KERR WOOD LEIDAL
consulting engineers

Vancouver Island
201 - 3045 Douglas Street
Victoria, BC V8T 4N2
T 250 595 4223
F 250 595 4224

Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan

Volume 2 of 2 – Appendices

Final Report
March 2019
KWL Project No. 2212.071

Prepared for:
Cowichan Valley Regional District and Cowichan Tribes

Funding Partners:
Public Safety and Emergency Preparedness Canada and Emergency Management BC

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Appendix A

Detailed Drainage Inventory Mapping

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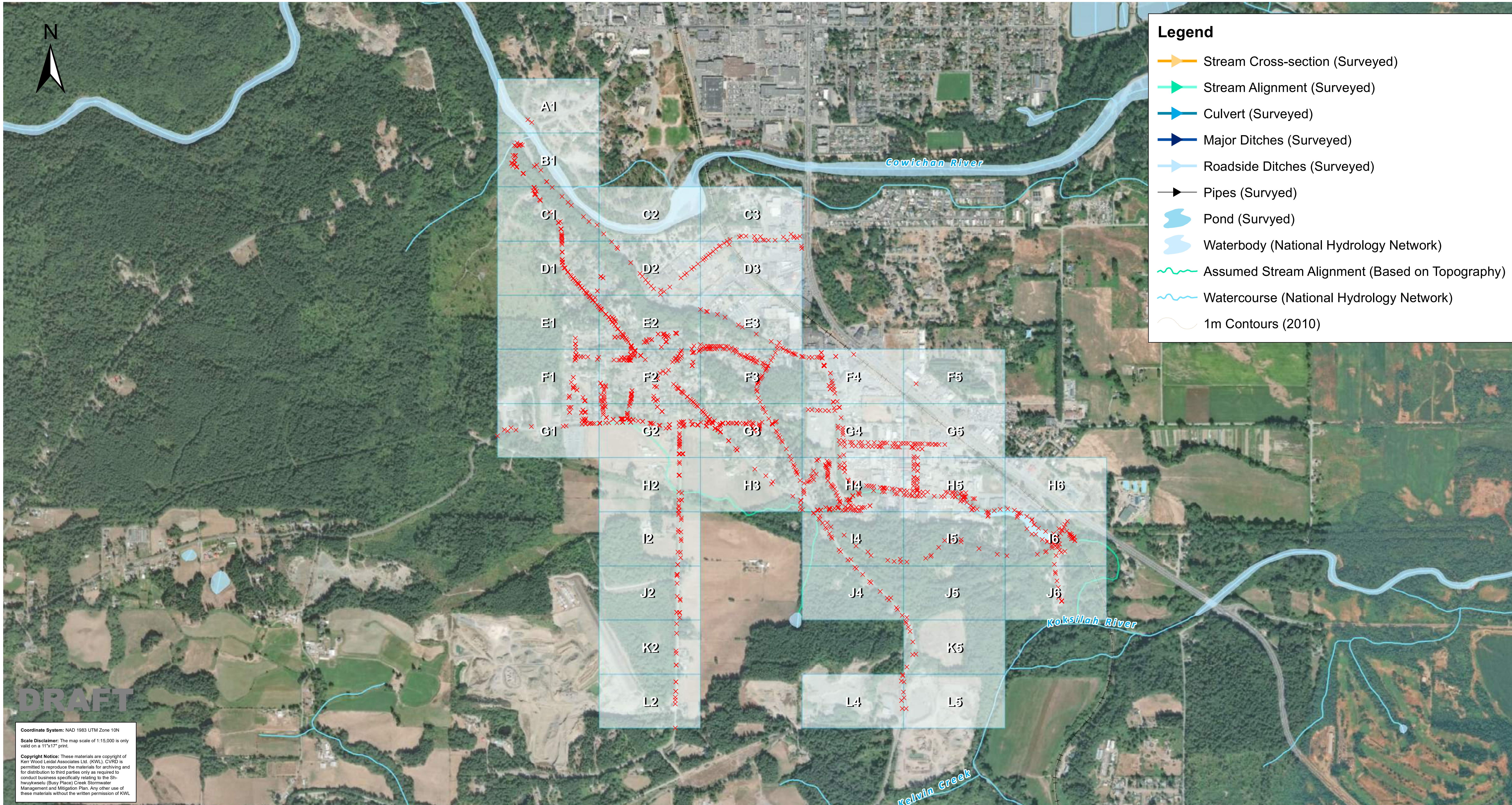
Cowichan Valley Regional District

Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan

KERR WOOD LEIDAL
consulting engineers



Project No. 2212-071

Date April 2019

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Survey Index

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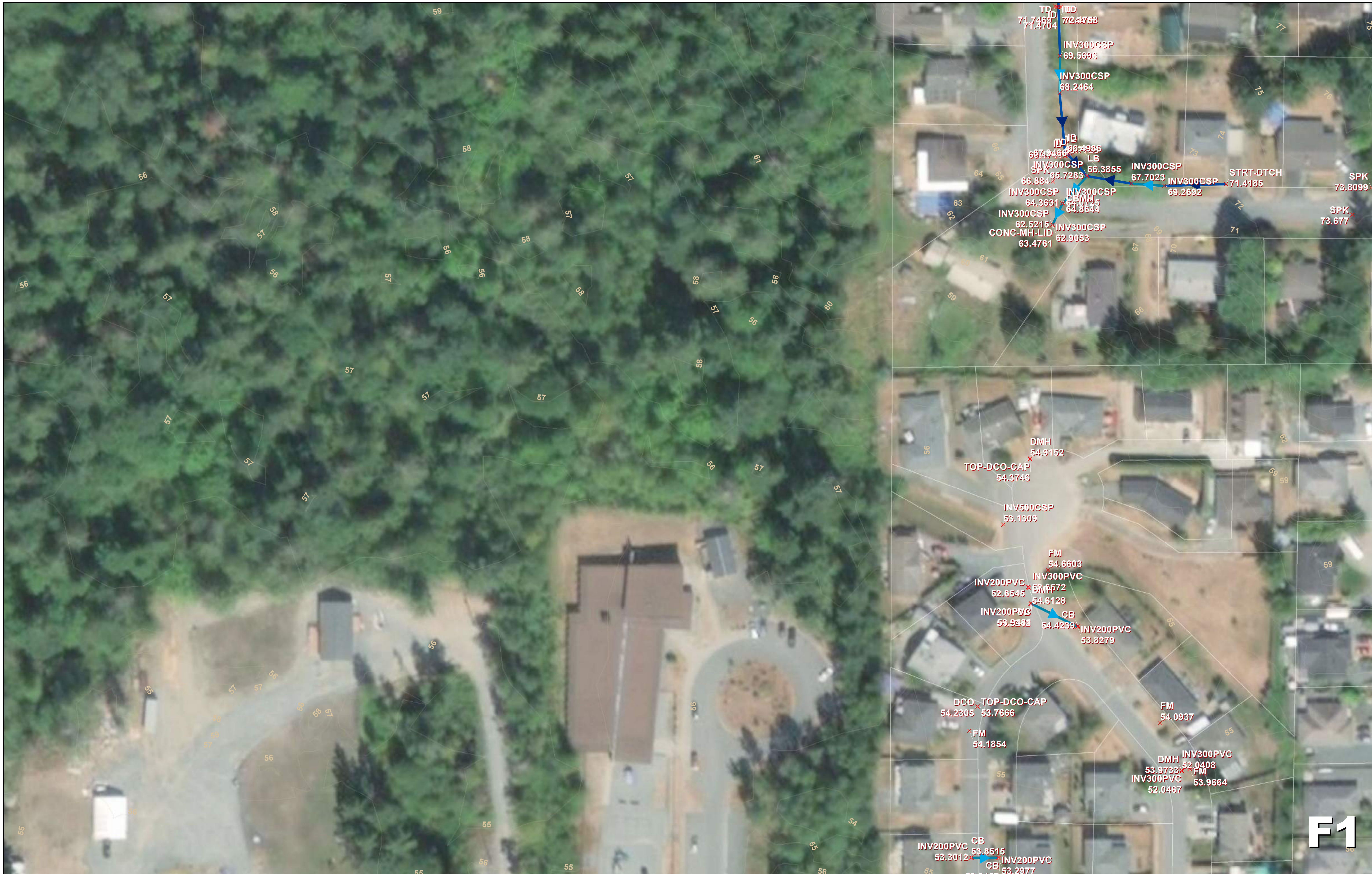
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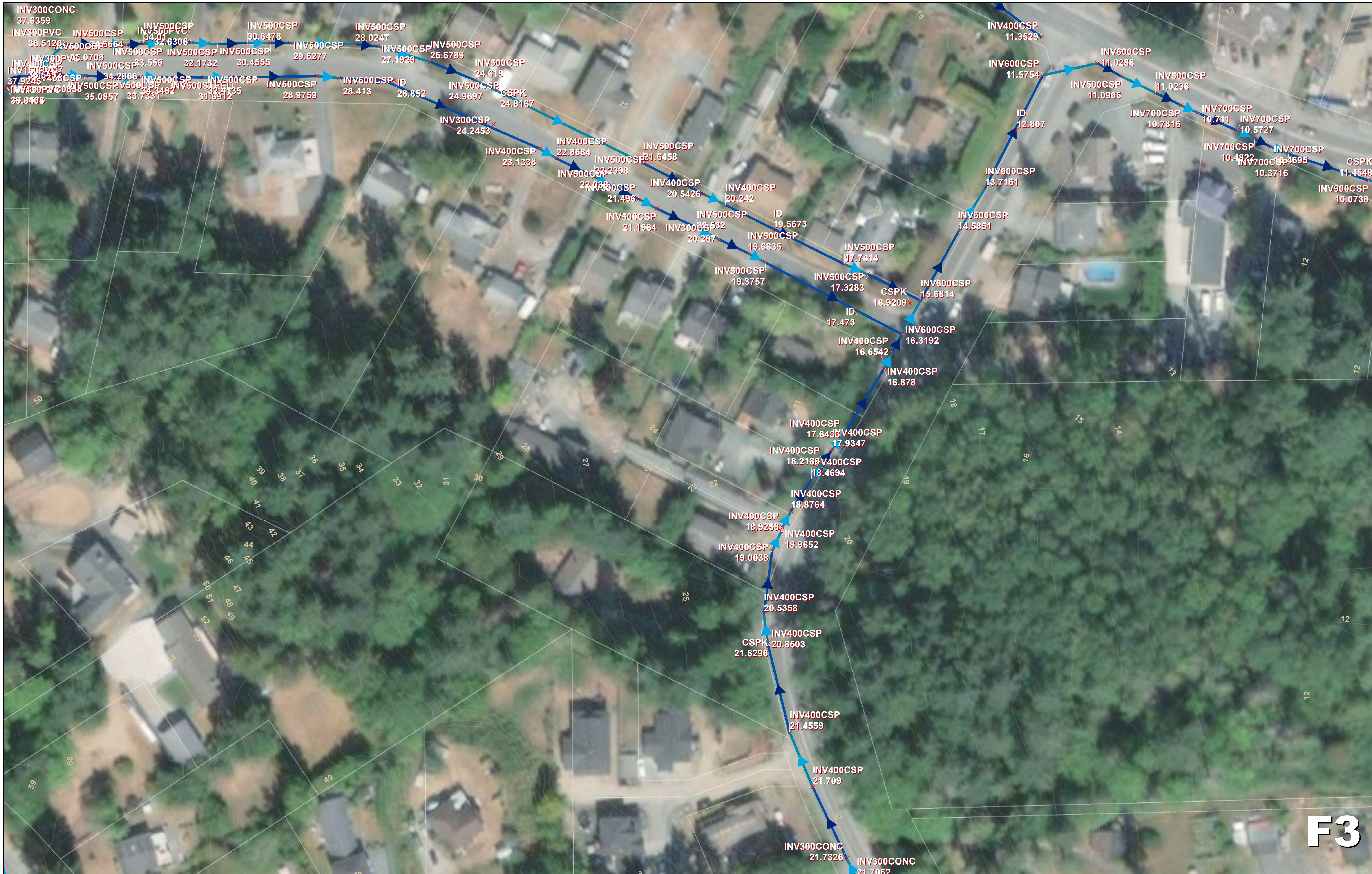
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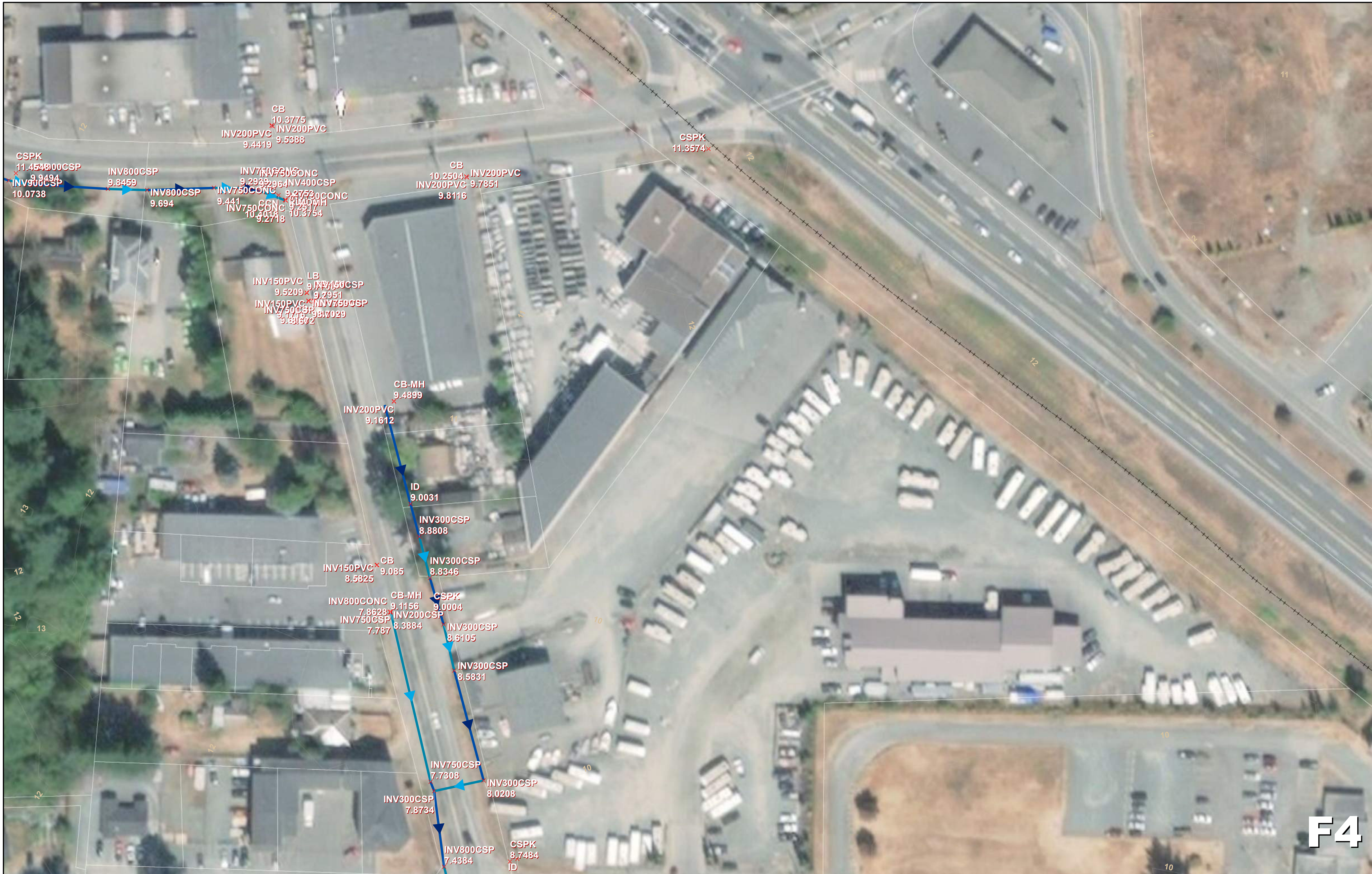

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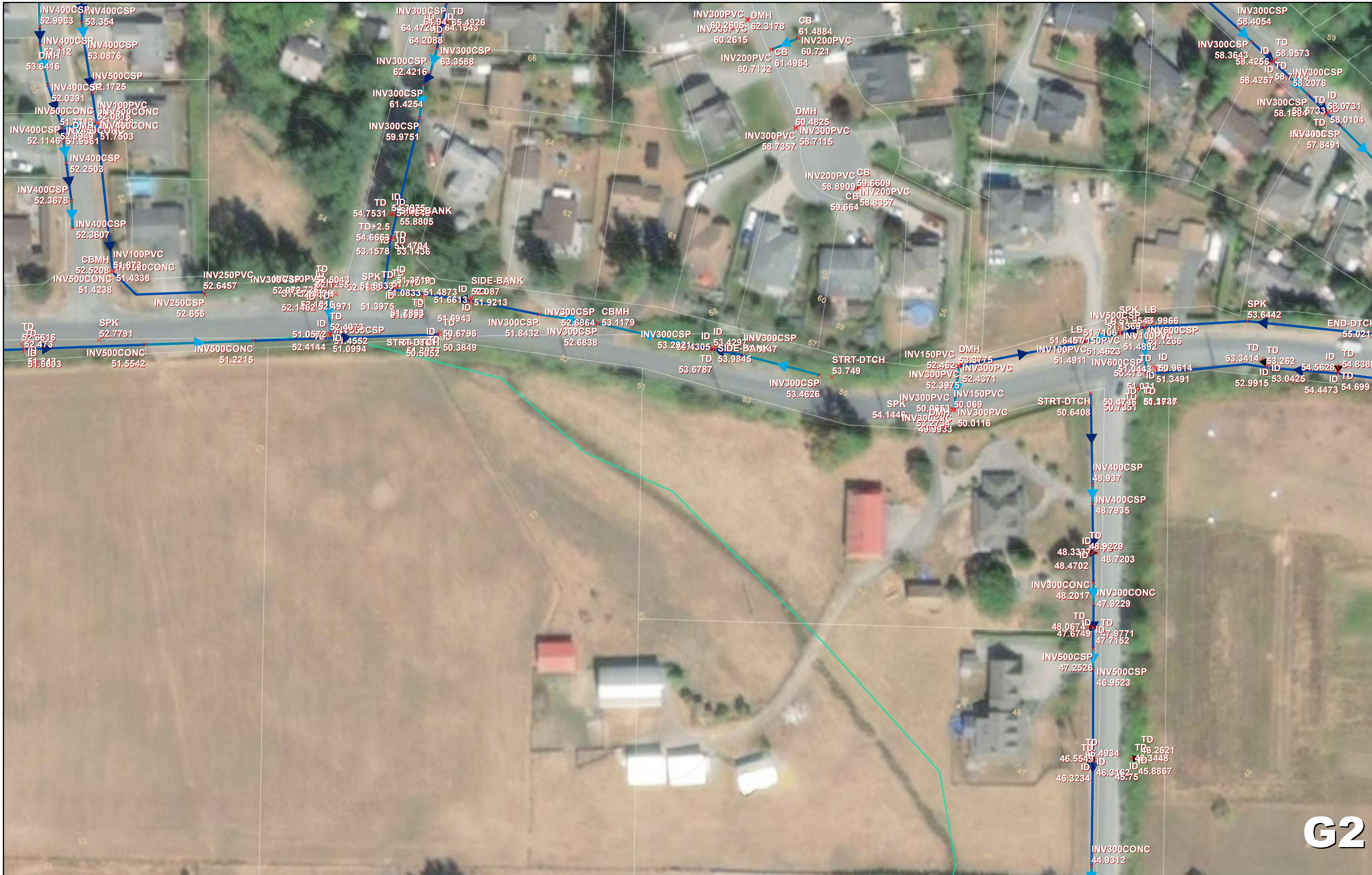

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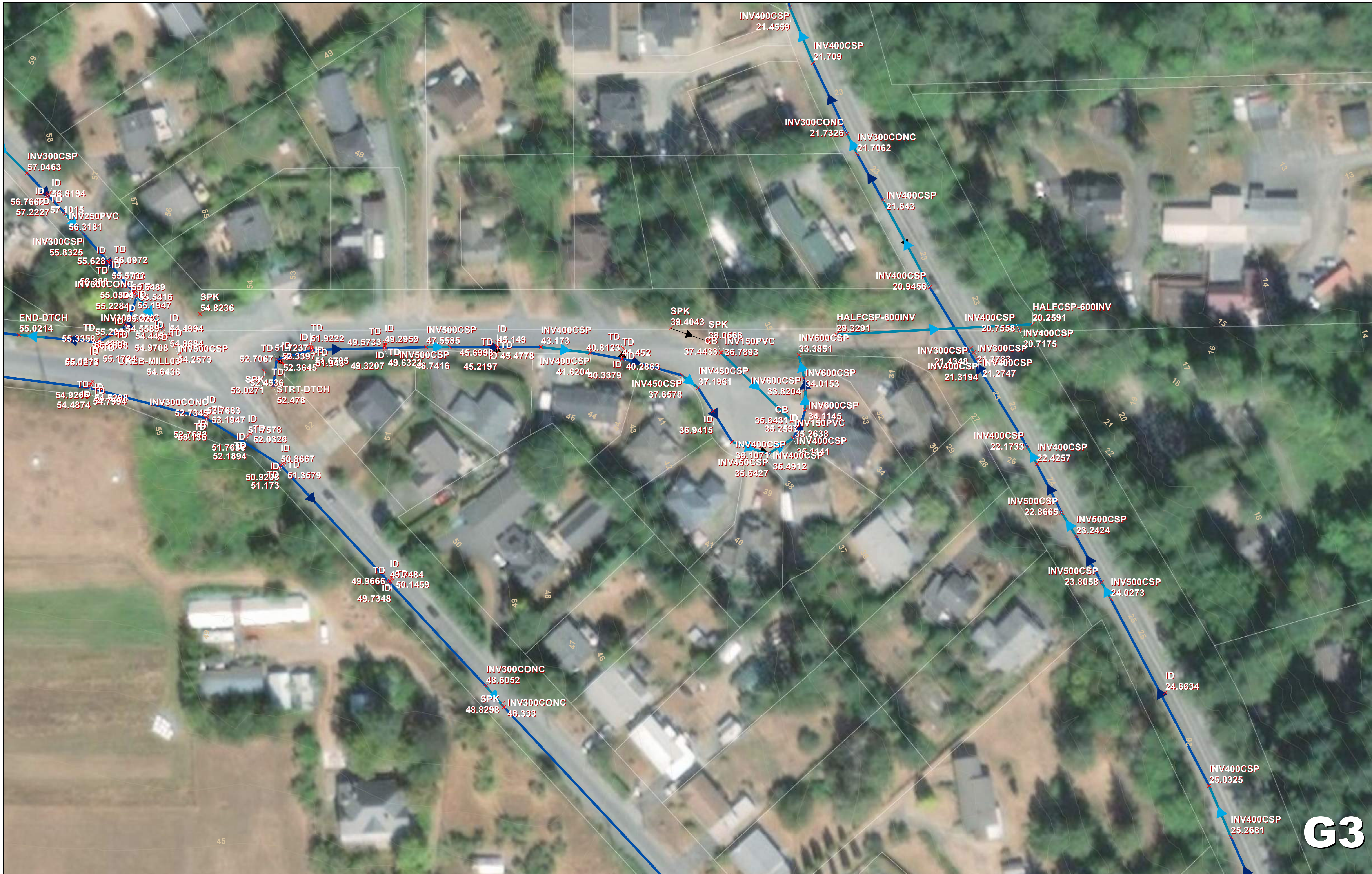
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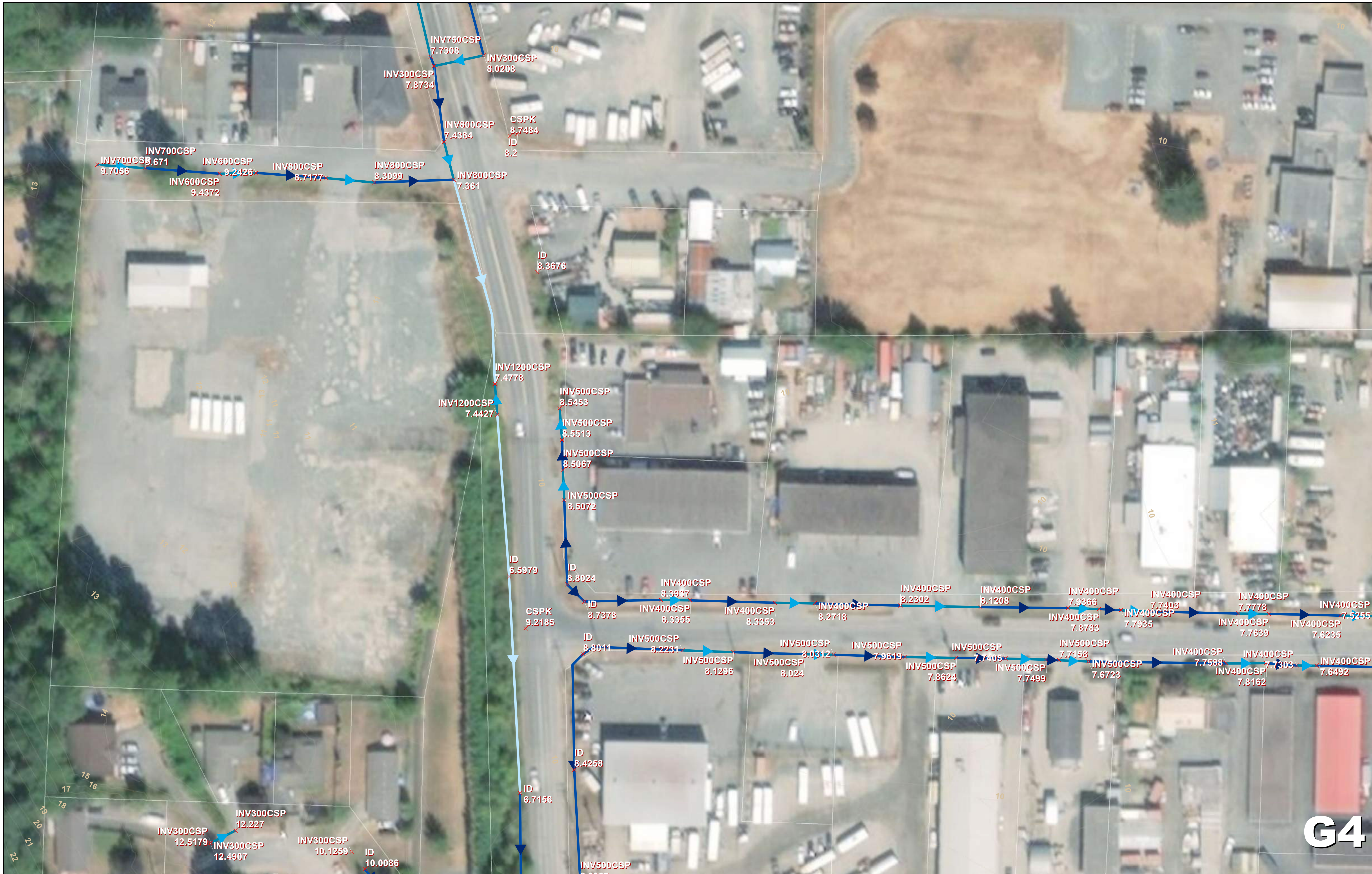
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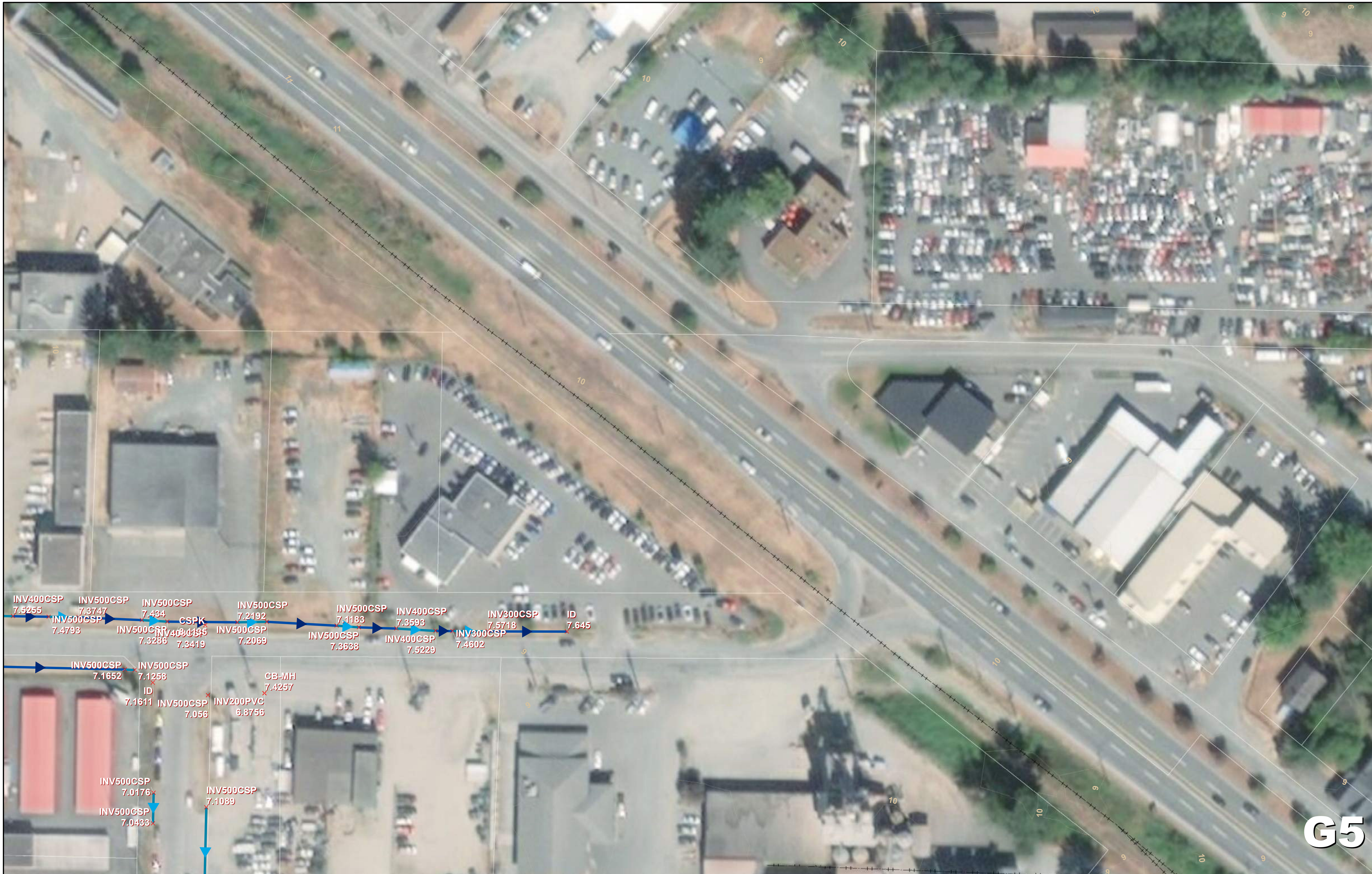
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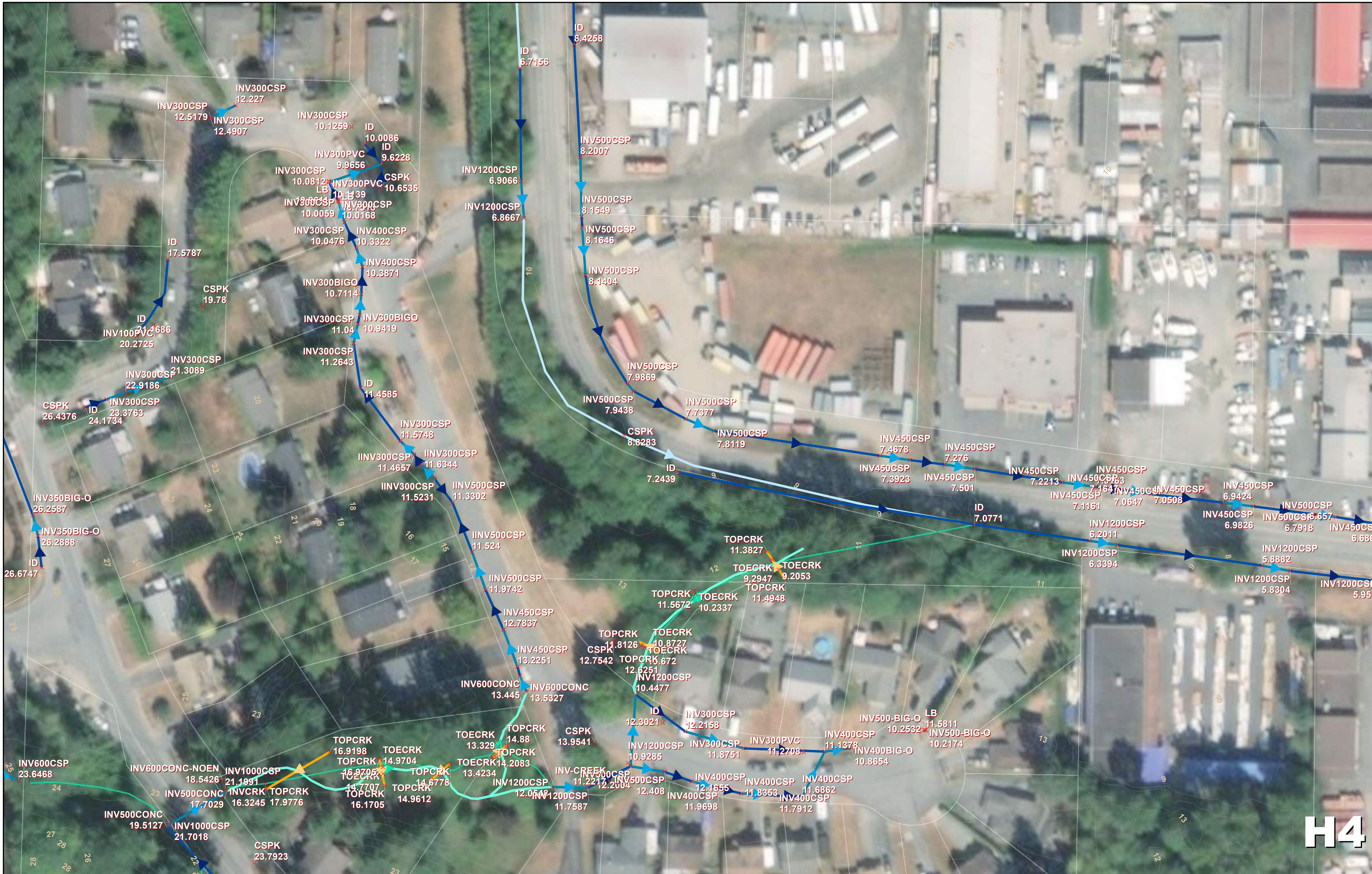

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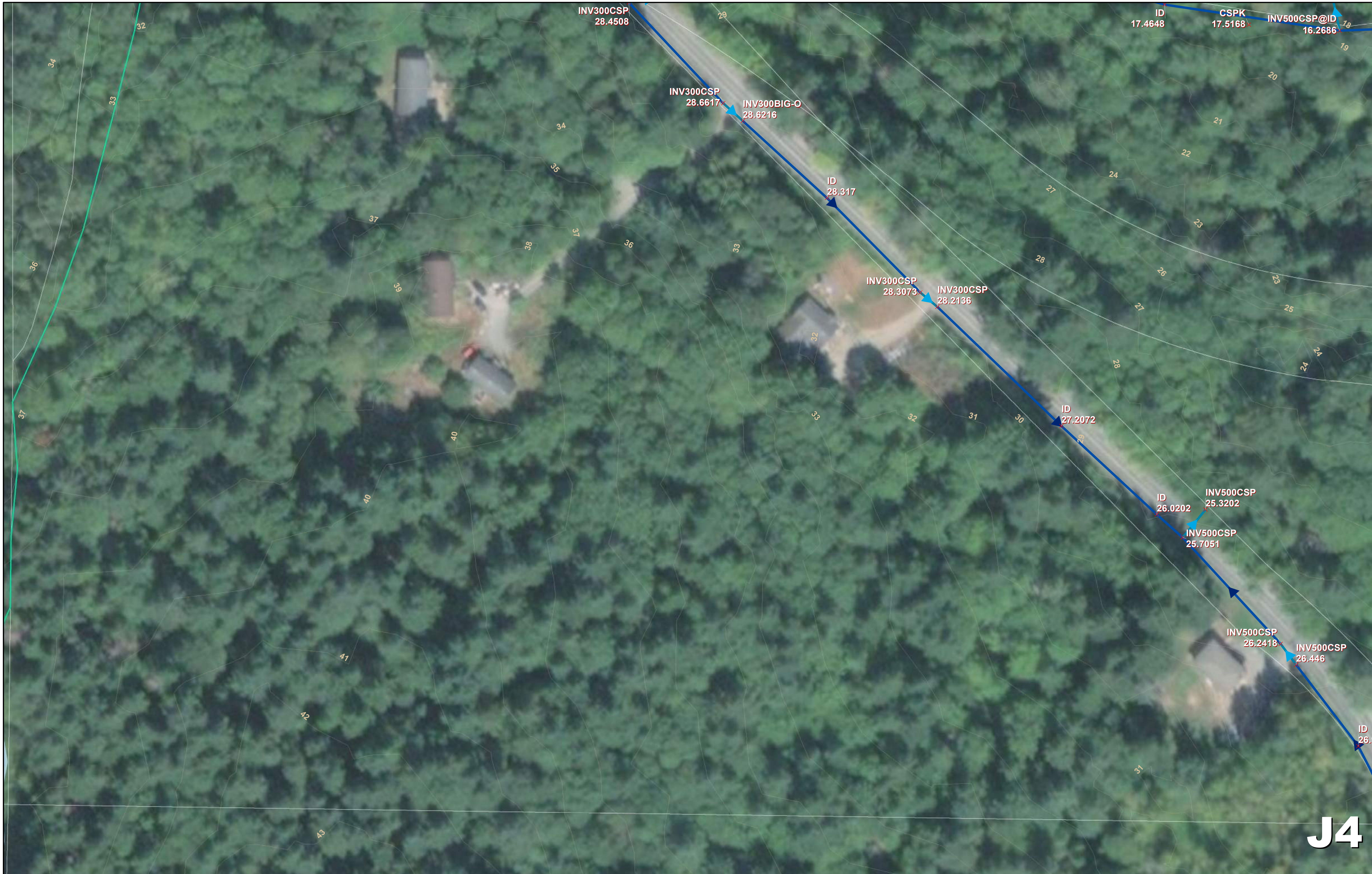

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KERR WOOD LEIDAL
consulting engineers

Appendix B

Community Engagement Plan

CVRD

APRIL 2018 – DRAFT

Shu-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

PUBLIC CONSULTATION PLAN

Cowichan Valley Regional District

LANARC

Table of Contents

Version Control

Version	Date Issued	Distribution by:	Method of Delivery	Comments
Draft	2018.03.15	Reid	Email	Internal DRAFT to KWL
Draft R1	2018.04.05	Reid	Email	Revised DRAFT to KWL

1.0 Overview

1.1 About the Project

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is undertaking a technical drainage study to develop a Stormwater Management & Mitigation Plan for Shu-hwuykwselu (Busyplace) in the Cowichan Valley Regional District. The resulting Stormwater Management and Mitigation Plan will guide prioritized infrastructure improvements for implementation for the CVRD to mitigate risk attributed by current and projected high and base flows.

Key to this process is understanding the current policy issues for environmental, land use, development, and construction as well as the key issues, priorities, and goals within the community. To help understand Cowichan Tribe, other participants, and public perspectives on the Cowichan/Koksilah floodplain, an public engagement and consultation process will complement the technical drainage study to help community members understand stormwater management, work through policy development, and build support for implementing stormwater best practices within the community.

This Public Consultation Plan outlines an approach to integrating public and stakeholder consultation activities throughout the planning process. It is anticipated that this Public Consultation Plan will be a working document that is refined and updated as the Project progresses.

1.2 Engagement Objectives

Public input will help develop a long-term Stormwater Management and Mitigation Plan that can be effectively implemented through policy development and community support. The consultation process aims to:

- Introduce the Project to the Technical Advisory Group, Cowichan Tribes, and Other Interested Stakeholders including the process, anticipated outcomes, and what has been achieved in terms of stormwater management and mitigation efforts in the CVRD to date;
- Gather input to understand current conditions, future plans, key related issues, and potential opportunities related to the public safety, environmental, economic, land use, or climate change aspects of the Project;
- Gather feedback related to stormwater management and mitigation issues and identify how these issues can be translated into opportunities to enhance stormwater management in the CVRD through policy development as related to environmental management;
- Confirm assumptions of hydrological and hydraulic modelling based on “on the ground” observations;
- Build public support for implementing stormwater best practices within the community through understanding of the issues through effective communication of technical information; and
- Facilitate a dialogue amongst community members to find an acceptable balance among often-competing values and priorities.

1.3 Key Messages (to be refined)

Key messages are targeted messages that we want audiences to understand and remember. The messages are designed to communicate the most relevant information about the plan development including the "why" and the "how". Initial key messages for the development of the CVRD Stormwater Management and Mitigation Plan include:

- The Cowichan Valley Regional District, in partnership with Cowichan Tribes, is developing a Stormwater Management and Mitigation Plan to guide efforts for future infrastructure improvements that mitigate impacts of current and projected high flows and base flows.
- The land use, environmental design, social, economic, and climate change aspects are key considerations in terms of developing a long-term Stormwater Management and Mitigation Plan that need to be addressed through a balancing of priorities and determining solutions that are "multiple benefit".
- The resulting Stormwater Management and Mitigation Plan aims to position the CVRD and Cowichan Tribes as leaders in addressing stormwater management issues in the community and adapting to climate change-related impacts.
- Input from Project partners and Key Project Participants, including government agencies, community members in the Study area, and other stakeholders is an integral part of developing the Stormwater Management and Mitigation Plan as it will lay the foundation for a long-term strategy, through valuable input, that complements the technical input, towards developing policies that will be publicly supported and implemented within the community.
- The planning process will align with the technical study. There will be opportunities for the public and stakeholders to provide input into plan development by participating in the Technical Advisory Committee, through Cowichan Tribes, and as a Key Project Participant or Other Interested Stakeholders in consultation meetings at key points in the process.
- Information about the process will be available by visiting the Project webpage on the CVRD website which outlines the project background, process, schedule, and anticipated outcomes and by subscribing to the CVRD's email distribution list to obtain project update communications as the process unfolds.

2.0 Audiences

Early and ongoing involvement is anticipated from several key groups so that participants can provide input as the plan develops. The following table summarizes the audience groups anticipated to be involved in the process.

Table I: Audience Groups

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<tr><th>Members</th><th>Communications Focus</th><th>Communication Tools / Formats</th></tr>
<tr><td colspan="3">PROJECT TEAM</td></tr>
<tr><td>▪ CVRD Project Lead
▪ CVRD Key Project Staff
▪ Consulting Team (KWL, Lanarc)</td><td>▪ Maintain ongoing communication and coordination
▪ Project development and input
▪ Project oversight / Reviews</td><td>▪ Project team meetings
▪ Coordination calls / emails
▪ Ongoing communications
▪ Initial site visit
▪ Attend stakeholder meetings</td></tr>
<tr><td colspan="3">COWICHAN VALLEY REGIONAL DISTRICT LEADERSHIP</td></tr>
<tr><td>▪ Board Chair
▪ Board of Directors
▪ Administration</td><td>▪ Reviews
▪ Final approvals as required
▪ Share outcomes</td><td>▪ Staff reports
▪ Input as required</td></tr>
<tr><td colspan="3">TECHNICAL ADVISORY COMMITTEE (TAG)</td></tr>
<tr><td>▪ CVRD Project team representatives from:
→ Land Use Services
→ Community Services
→ Engineering Services
→ Communications
→ Bylaw Enforcement
→ Communications
▪ Cowichan Tribes technical staff
▪ Ministry of Transportation and Infrastructure
▪ Fisheries and Oceans Canada
▪ Ministry of Agriculture
▪ Cowichan Watershed Board
▪ Indigenous Services Canada
▪ Provincial representatives (BC Parks, Crown Land)
▪ Vancouver Island Health Authority
▪ Adjacent municipalities</td><td>▪ Participation in consultation meetings
▪ Reviews
▪ Input / feedback to the process as required including roles and responsibilities, implementation, policy development
▪ Share outcomes</td><td>▪ Invitation to TAG stakeholder consultation meetings: Background presentation, review of proposed recommendations
▪ Calls / email exchanges
▪ Project updates via web or email communication
▪ Final Plan presentation</td></tr>
</table>

Members	Communications Focus	Communication Tools / Formats
COWICHAN TRIBES		
▪ Tribe Governance ▪ Tribes Administration ▪ Internal Committees	▪ Input / feedback to the process including roles and responsibilities, implementation, policy development ▪ Support partnership outreach efforts ▪ Share outcomes	▪ Invitation to consultation meeting ▪ Input as required ▪ Calls / email exchanges ▪ Project updates via web or email communication
OTHER INTERESTED STAKEHOLDERS		
▪ Busyplace Creek Streamkeepers Group ▪ Other environmental groups ▪ Local community associations or neighbourhood associations ▪ Property owners ▪ Businesses and business organizations in the study area ▪ Specialists (e.g. educational institute leads) ▪ BC Water and Waste Association ▪ Water Bucket Initiative representatives ▪ Builder or developer associations ▪ Other members of interested public	▪ Input on current conditions, future plans, key related issues, and potential opportunities related to the social, environmental, economic, land use, or climate change aspects of the Project ▪ Support stakeholder outreach efforts ▪ Stakeholder meeting participation ▪ Share outcomes	▪ Initial outreach ▪ Invitation to participate in consultation meeting ▪ Calls / email exchanges ▪ Project updates via web or email communication ▪ Input as required

2.1 Key Project Contacts

Key Project contacts are contained in the table below.

Table II: Key Project Contacts

Organization	Name	Phone	Email Address
COWICHAN VALLEY REGIONAL DISTRICT			
▪ Project Sponsor	▪ Kate Miller	▪ 250-746-2509	▪ kmiller@cvrd.bc.ca
▪ Project Manager	▪ Keith Lawrence	▪ 250-746-2643	▪ klawrence@cvrd.bc.ca
COWICHAN TRIBES			
▪ Tech. Rep.	▪ Fred Bosma	▪ 778- 422-2259	▪ Fred.Bosma@cowichantribes.com
▪ Engagement Rep.	▪ Tracy Fleming	▪ 250-748-3196	▪ Tracy.fleming@cowichantribes.com
CONSULTING TEAM			
Kerr Wood Leidal			
▪ Project Manager	▪ Craig Sutherland	▪ 250-889-2155	▪ csutherland@kwl.ca
▪ Utility Management / First Nations Engagement	▪ Catherine Simpson	▪ 604-293-3126	▪ csimpson@kwl.ca
▪ Planner	▪ Robin Hawker	▪ 604-293-3107	▪ rhawker@kwl.ca
Lanarc 2015 Consultants Ltd.			
▪ Project Director	▪ David Reid	▪ 250 739 3625	▪ david.reid@lanarcconsultants.ca
▪ Engagement Planner	▪ Kristen Falconer	▪ 778-762-4800 ext. 007	▪ kristen@lanarcconsultants.ca

3.0 Engagement Process Overview

The Project workplan outlines a three-phase process for the development of the Stormwater Management and Mitigation Plan for the CVRD/Cowichan Tribes. Consultation during this process will be woven together with the technical analysis. The process moves from broader to more specific engagement, starting off with understanding the issues and opportunities and confirming technical information, then advancing to generating draft recommendations, and finally, developing the Stormwater Management and Mitigation Plan that outlines actions, best practices, organizational roles and responsibilities, and implementation. The following points describe anticipated components for each phase of work. Section 4.0 provides further detail on each phase.

▶ Phase 1: Understanding Issues and Opportunities (April 2018 – June 2018)

The first phase will focus on gathering and analyzing data and perspectives about the Study area's current situation in terms of stormwater management and mitigation efforts to-date. This phase will introduce the project to TAG members, Cowichan Tribes, and Other Interested Stakeholders by providing background information early in the process. The focus will be on listening to stakeholders about their experiences, concerns, and ideas as well as an opportunity to confirm assumptions of the hydrological model and hydraulic model with TAG stakeholders following field review and base mapping. Input from the first phase of engagement will be used to define the criteria, assumptions and alternatives for the technical drainage analysis which is to be carried out in July and August 2018.

Key consultation components for this phase:

- Raise awareness about the Stormwater Management and Mitigation Plan process and outline what it means for the community
- Develop a consultation strategy to parallel the technical process and to reach a broad cross-section of community members who may be impacted by policy changes
- Provide initial outreach to connect with a variety of groups that may have an interest in stormwater management and mitigation in the CVRD and encourage participation in the process
- Understand current conditions, key issues, plans, growth scenarios, opportunities, priorities, and assumptions to inform draft recommendations development through stakeholder consultation
- Develop communications to stakeholder consultation to encourage participation and provide project background information and anticipated outcomes and information to solicit feedback

▶ Phase 2: Draft Plan Recommendations (September 2018 – October 2018)

Phase 2 will focus on developing, reviewing, and refining draft plan recommendations for the Stormwater Management and Mitigation Plan by welcoming input from stakeholders. Feedback will inform the draft recommendations as well as an exploration of potential policy and project development, potential roles and responsibilities, potential short-to-medium-to long-term phasing, and funding as part of implementation as a secondary step. Consultation during the second round is also anticipated to provide the TAG with an opportunity to review model results and confirm drainage improvement options and design flows as input into the Draft Plan development. Input from engagement during the second phase refine draft plan recommendations for the Stormwater Management and Mitigation Plan.

Key consultation components for this phase:

- Communicate input heard from Phase 1 and how it was translated into the development of draft recommendations as part of the Stormwater Management and Mitigation Plan
- Develop communications materials to provide project updates and information to solicit feedback and encourage stakeholder participation, including development of a final plan presentation for the TAG

4.0 Consultation Steps

The following outlines preliminary methods to engage stakeholder audiences, the timing of consultation, and roles / resources required to implement the consultation strategy.

4.1 Phase 1: Understanding Issues and Opportunities *(April – June 2018)*

Activity	Description	Target Date*	Responsibilities
COWICHAN VALLEY REGIONAL DISTRICT STAFF / COWICHAN TRIBES CONSULTATION			
Key Site Visit and Field Survey	▪ On site visit and discussions with key staff and Cowichan Tribes leadership to: → Take photo and video of representative land use types, corridors, and key watercourse, wetland, and open space assets through a field survey → Gather relevant planning documents and regulations → Gather information on Cowichan Tribes processes, housing strategy, and land code, → Review draft consultation plan, discuss refinements, and coordinate on the implementation of identified stakeholder meetings → Discuss preliminary issues and opportunities, current conditions, and information	March 27	▪ **Lanarc:** Prepare agenda / key questions and draft engagement plan ▪ **CVRD:** Coordinate participation of CVRD Staff and site visit logistics

Activity	Description	Target Date*	Responsibilities
ROUND 1 STAKEHOLDER OUTREACH			
CVRD Project Website (Main Page Link, Public Engagement Page, and Community Planning Page) *(potentially social media depending on CVRD input and capacity).*	▪ Project overview ▪ Key messages ▪ Process ▪ Participation and input opportunities ▪ Project contacts ▪ Background information ▪ Project Updates	Mid April 2018	▪ Lanarc: Develop content for CVRD review and refinement ▪ CVRD: Review content and post to Project website through communications department
Stakeholder Lists	▪ List of key contacts for: → TAG members (start-up meeting minutes from KWL) → Cowichan Tribe members (Tracy Fleming) ▪ Other Interested Stakeholders (i.e. people subscribed to CVRD distribution mailing list)	Mid April 2018	▪ Lanarc: Source and maintain stakeholder contact list ▪ CVRD Review/refine list prior to communications and distribute emails
Cowichan Tribes Website Announcement *(and potentially Cowichan Tribes Public Facebook Page depending on Cowichan Tribes input)*	▪ Project overview ▪ Key messages ▪ Participation and input opportunities ▪ Project contacts	Mid-April 2018	▪ Lanarc: Develop content for CVRD review and refinement ▪ Cowichan Tribes: Review content and post to Project website through communications department
Stakeholder Notification Email (Invites)	▪ Emailed notification to the following to invite participation in the process, encourage outreach to memberships and others interested in the topic, and provide background information: → TAG members → Cowichan Tribe members → Other Interested Stakeholders (i.e. people subscribed to CVRD distribution mailing list)	Mid-April 2018	▪ Lanarc: Draft initial outreach letter for CVRD review and refinement, follow up by phone with stakeholders to confirm meeting participation ▪ CVRD: Distribute to distribution mailing list and other stakeholder lists

Activity	Description	Target Date*	Responsibilities
1-2 Pg. Project Overview/Backgrounder with Maps	▪ 1-2 pg. Graphic Project Backgrounder outlining general Project information, process, anticipated outcomes, why plan development is important, and input required as well as maps of key areas	Mid-April 2018	▪ **Lanarc:** Draft backgrounder for CVRD review and refinement ▪ **CVRD:** Review and provide comments; distribute to distribution mailing list and other stakeholder lists with stakeholder notification email (invite)
Postcard (or Letter) Direct Mail/Delivery♦	▪ Mailed to residents within impacted property areas	Mid-April 2018	▪ **Lanarc:** Develop and organize printing of postcards (if letter develop letter content) ▪ **CVRD:** Review postcards prior to printing and delivery

♦ *TBD depending on potential quantities in Study area.*

Activity	Description	Target Date*	Responsibilities
ROUND 1 ENGAGEMENT AND CONSULTATION: UNDERSTANDING ISSUES & OPPORTUNITIES			
Discussion Guide	▪ Key questions in the form of a worksheet to facilitate group discussion and record discussion points or complete ▪ Available in hard copy at stakeholder meetings	Early May 2018	▪ **Lanarc:** Develop discussion guide with key questions/ worksheet ▪ **CVRD:** Collect/input hard copies from stakeholder meetings
PowerPoint Presentation	▪ PowerPoint presentation to introduce process, outline objectives, and anticipated outcomes	Early May 2018	▪ **Lanarc:** Develop and refine presentation ▪ **CVRD:** Review presentation prior to meetings
Area Mapping Exercise → TAG → Cowichan Tribes → Other Interested Stakeholders	▪ Develop large-format mapping to support stakeholder meetings to understand key areas of issues and opportunities	Mid-May 2018	▪ **Lanarc:** Develop draft and final materials ▪ **CVRD:** Review materials with consolidate edits and approve upon revision
Stakeholder Meetings: → TAG → Cowichan Tribes → Other Interested Stakeholders	▪ (3) individual meetings ▪ ~2 to 3 hours each ▪ At CVRD offices ▪ **TAG:** Achieve consensus on the assumptions used in the modelling, key issues and opportunities ▪ **Cowichan Tribes:** May align with another community event or walking tour ▪ **Other Interested Stakeholders:** Focus on issue & opportunities	Mid to Late May 2018	▪ **Lanarc:** Organize logistics and coordination with CVRD, prepare agenda; facilitate meetings, and document meeting minutes ▪ **CVRD:** Schedule meetings, organize venues and refreshments; distribute discussion guide by email 1-week in advance; facilitation
Round 1 Consultation Summary	▪ Summary of Round 1 public consultation	June 2018	▪ **Lanarc:** Draft input summary for input into the development of the Draft Plan. ▪ **CVRD:** Review summary

** Initial dates set based on the communications with CVRD. Dates subject to updates based on overall project schedule/progress.*

4.2 Phase 2: Draft Plan Recommendations *(September – October 2018)*

Activity	Description	Target Date *	Responsibilities
CONSULTATION PLAN UPDATE			
The consultation plan will be reviewed based on the outcomes of Round 1 and amendments will be suggested to be incorporated into Round 2. This update will invite observations from the Project team and CVRD staff in the early September timeframe.			
ROUND 2 OUTREACH			
Phase 1 outreach, materials, and distribution channels will be updated for Phase 2 public and stakeholder outreach in the early to mid-September timeframe.			
Stakeholder Notification Email (Invites)	▪ Emailed notification to TAG members to provide project update and objectives of Round 2 consultation	Early September 2018	▪ **Lanarc:** Draft initial outreach letter for CVRD review and refinement as well as follow up by phone with stakeholder to confirm participation in meetings ▪ CVRD: Distribute to distribution mailing list and other stakeholder lists
ROUND 2 MATERIALS			
Discussion Guide	▪ Discussion Guide on proposed recommendations for policies, potential roles/responsibilities, and potential short-to-medium-to long-term phasing and funding for implementation in the form of a worksheet to facilitate group discussion and record discussion points Available in hard copy at stakeholder meetings	Mid-September 2018	▪ **Lanarc:** Develop discussion guide with key questions/ worksheet ▪ **CVRD:** Collect/input hard copies from stakeholder meetings
PowerPoint Presentation	PowerPoint presentation to outline draft recommendations, key topics for implementation, and policy framework	Mid-September 2018	▪ **Lanarc:** Develop and refine presentation ▪ CVRD: Review presentation prior to meetings
COWICHAN VALLEY REGIONAL DISTRICT STAFF CONSULTATION			
CVRD Staff Meeting	▪ Presentation of Phase 1 input summary ▪ Review consultation plan updates and discuss coordination on Round 2 activities	Mid-September 2018	▪ **Lanarc:** Prepare agenda, consultation plan updates, and facilitation ▪ **CVRD:** Coordinate participation of CVRD staff

Activity	Description	Target Date *	Responsibilities
ROUND 2 PUBLIC CONSULTATION: DRAFT PLAN RECOMMENDATIONS			
Stakeholder Meetings: → TAG	▪ (1) individual meeting ▪ ~2 to 3 hours each ▪ At CVRD offices ▪ **TAG:** Review Round 1 engagement and how information was incorporated into the draft recommendations. Discuss proposed recommendations for policies, potential roles/responsibilities, and potential short-to-medium-to long-term phasing and funding for implementation. Policy development will also be a topic of discussion.	Late September 2018	▪ **Lanarc:** Organize logistics and coordination with CVRD, prepare agenda; facilitate meeting, and document meeting minutes ▪ **CVRD:** Schedule meeting, organize venue and refreshments; distribute discussion guide by email 1-week in advance; facilitation
Round 2 Summary	▪ Summary of consultation process including Round 2 input ▪ Post to website, email link to email distribution list	Early October 2018	▪ **Lanarc:** Draft input summary for review and refinement ▪ **CVRD:** Review and post to CVRD website and email link to list

** Initial dates set based on the communications with CVRD. Dates subject to updates based on overall project schedule/progress.*

4.3 Stormwater Management & Mitigation Plan *(September – October 2018)*

Activity	Description	Target Date *	Responsibilities
PUBLIC AND STAKEHOLDER OUTREACH			
Project updates will be posted on the CVRD website and notifications will be distributed to participants who have been involved the process.			
COWICHAN VALLEY REGIONAL DISTRICT STAFF CONSULTATION			
Lanarc will coordinate with CVRD and Cowichan Tribes leadership to develop a policy framework and to integrate land use and environmental design policy into the stormwater management plan.			
FINAL PLAN PRESENTATION			
Project webpage update	▪ Update to Project webpage about process to date, key outcomes, and thank you to participants to report back and encourage continued support	Mid-October 2018	▪ Lanarc: Update content for review and refinement ▪ CVRD: Review and post content online link online
Stakeholder Referrals	▪ Coordinate referrals to all stakeholders of the draft plan	Mid-October 2018	▪ Lanarc: Prepare summary and draft email referral for review and refinement ▪ CVRD: Distribute emails
Final Plan Presentation → TAG	▪ Present Final Plan to TAG summarizing the process and findings of the plan	Mid-October 2018	▪ Lanarc: Develop presentation and lead presentation to TAG, document meeting minutes ▪ CVRD: Prepare staff report, coordinate meeting room and refreshments, Prepare staff report

** Initial dates set based on the communications with CVRD. Dates subject to updates based on overall project schedule/progress.*

5.0 Round 1: Understanding Issues and Opportunities

This section provides a preliminary planning outline for the proposed **Round 1 Consultation: Understanding Issues & Opportunities.**

5.1 Purpose

- Introduce the Stormwater Management and Mitigation Plan project, planning process, and anticipated outcomes to stakeholder to build awareness and support;
- Engage a broad audience to share their knowledge about current conditions, key issues, opportunities, and ideas for effective stormwater management and mitigation in the CVRD;
- Provide background, technical information, mapping, and analysis about stormwater management issues and impacts in the CVRD and encourage sharing of experiences;
- Communicate what stormwater management and mitigation efforts have taken place to date as well as precedents and success stories in other regions that face similar issues; and
- Encourage dialogue amongst participants to share experiences and ideas on how to develop and implement a plan in the community that will be publicly supported.

5.2 Round 1 Logistics

Individual Meeting:	Technical Advisory Committee Meeting (~2-3 hours)
Date	May 11, 2018 – TBD (alternate date May 9, 2018) - TBD
Time	Daytime
Format	Individual Stakeholder Group Meeting (1 of 3)
Location	CVRD Offices – (CVRD to coordinate venue)
Anticipated Attendance	~20 per meeting
Individual Meeting:	**Cowichan Tribes Meeting (~2-3 hours)**
Format	May 10, 2018 - TBD
Time	Late Afternoon/Early Evening
Format	Individual Stakeholder Group Meeting (2 of 3) potentially aligned with community event
Location	Cowichan Tribes to confirm location; CVRD to coordinate venue
Anticipated Attendance	~30 per meeting
Individual Meeting:	**Other Interested Stakeholders (~2-3 hours)**
Format	Late-May 2018 – TBD (Two potential meetings)
Time	Mid-Afternoon Meeting & Late Afternoon/Evening Meeting (2)
Format	Individual Stakeholder Group Meeting (3 of 3)
Location	CVRD to coordinate venue
Anticipated Attendance	~50 per meeting

5.3 Outline

The three stakeholder meetings would be an invitation only event to allow targeted participants to provide key input on stormwater plan development. Possible activities include:

ROUND 1	Individual Stakeholder Meetings (2-3 hours each)
Outreach	▪ Stakeholder Contact list ▪ Email invitation to three stakeholder groups: TAG, Cowichan Tribes, and Other Interested Stakeholders with 1-2-page overview/backgrounder with maps ▪ Project website content (CVRD, potentially Cowichan Tribes website announcement) ▪ Potentially social media (Cowichan Tribes Facebook depending on Cowichan Tribes input and CVRD depending on input and capacity) ▪ Postcard / Letter Direct Mail / Delivery ⬧ ▪ Phone follow-up to confirm stakeholder attendance (TAG)
Materials	▪ Agenda ▪ Large-format community mapping exercise ▪ Discussion Guides / Response Form (questions) ▪ Background information (CVRD plans and existing policies) ▪ Large-format flip charts ▪ Directional signage
Summary	▪ Large-format flip charts to capture meeting minutes ▪ Summary feedback as input into Round 1 Consultation Summary

⬧ TBD depending on potential quantities in Study area.

5.4 Initial Materials List

Individual Stakeholder Meetings (for each meeting depending on meeting)

Materials	Qty	Responsibility (TBC)
Venue	1 for each of the 3 meetings	CVRD with input from CVRD and Cowichan Tribes for Cowichan Tribes meeting
Tables	3-4	CVRD
Chairs	20 – 25*	CVRD
Directional Signage	4 ea.	Lanarc
Materials – Community Mapping Exercise	2 ea.	Lanarc
Materials - Agenda	20-30	Lanarc
Materials – PowerPoint Presentation	1 ea.	Lanarc
Laptop / Cables	1 ea.	Lanarc
Background information (existing plans and policies)	As needed	CVRD
Workshop Materials – sticky notes, pens, dots, tape, flip charts, stands, etc.	As needed	Lanarc

Materials	Qty	Responsibility (TBC)
Printed Discussion Guides	30 – 50*	CVRD
Sign-in Sheets	2 ea.	Lanarc
Flip Chart to Record Discussion	2 ea.	Lanarc
Refreshments	As needed	CVRD

*Depending on meeting (TAG approx. 20 attendees; Cowichan Tribes approx. 30 attendees, and Interested Stakeholders approx. 30-50 attendees)

6.0 Anticipated Challenges

During consultation processes, challenges can arise and advance consideration of responses can help manage these challenges. The following potential consultation challenges have been developed based on previous similar work.

Table 3: Potential Consultation Challenges and Proposed Response Plan

Potential Consultation	**Proposed Response Plan**
Engaging people on a wide concept of a Stormwater Management Plan	▪ Highlight the key points of how a Stormwater Management Plan works and why it is important to develop and implement. ▪ Highlight how stormwater management fits within the wider context of the community. ▪ Design meetings and materials to allow participants to provide input based on the topics that are most relevant to them. ▪ Manage confusion by clearly educating and explaining technical terms and by reviewing existing information.
Maximizing participation from a broad range of community members and stakeholders	▪ Establish a range of outreach methods, in both print and digital. ▪ Use traditional outreach methods (e.g. postcards) for those who may have an interest and be impacted by events ▪ Use digital engagement to bolster communication through project webpage, email updates, etc. ▪ Follow-up by phone to confirm stakeholders can attend events. ▪ Develop materials that are brief, easy to read, and can be accessed easily. ▪ Focus communications on graphics to the extent possible and use plain language where text is needed, especially for technical concepts.
Participants with conflicting opinions about priorities and implementation	▪ Listen first – search out underlying concerns and values and local knowledge and ensure that it is recorded and shared back to other stakeholders. ▪ Emphasize the multi-interest nature of planning and identify early that compromises and prioritization will be required. ▪ Undertake collaborative events that bring stakeholders together to discuss options that affect multiple parties. ▪ Structure meetings that include the attendance of key individuals that can address technical and/or policy questions.

Potential Consultation	Proposed Response Plan
Engaging with Cowichan Tribes (First Nations)	▪ Engage early so that issues can be managed early in the process and to promote good business practice and help build local capacity. ▪ Maintain open lines of communication throughout the process. To ensure that members are regularly informed at key junctures. ▪ Develop activities that are not only effective but encourage participation through interactive process, such as a waking tour or community mapping exercise ▪ Arrange meetings with Cowichan Tribes leadership. ▪ Undertake clear and effective information sharing policies. ▪ Follow community protocols or best practices where they exist. ▪ Recognize and accommodate First Nations cultural activities. ▪ Coordinate meetings and consultation activities to coincide around other community events such as a barbeque or local event.
Limitations to engagement resources / expenses	▪ Confirm early what consultation resources (e.g., staff) may be available. ▪ Communicate effectively and regularly ▪ Adhere to scheduling ▪ Capitalize on other ongoing activities to encourage strong participation from stakeholder and create an effective outreach program.

KERR WOOD LEIDAL
consulting engineers

Appendix C

Community Engagement Feedback

PUBLIC CONSULTATION SUMMARY REPORT – ROUND 1

Stormwater Management & Mitigation Plan

PART I: OVERVIEW

INTRODUCTION

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is undertaking a technical drainage study for the Sh-hwuykwselu (Busyplace) Watershed, a subwatershed of the Cowichan and Koksilah Rivers in the Cowichan Valley Regional District. The purpose of the Study is to develop a Stormwater Management and Mitigation Plan (the Plan) to guide prioritized infrastructure improvements and development policies to mitigate flooding and erosion risk from high flows, to improve water quality of stormwater runoff, and to sustain summer/fall base flows.

A key part of the planning process is to understand the current policy issues for environmental, land use, development, and construction as well as the key issues, priorities, and goals within the community that will complement the technical study. Engagement events are being held with key stakeholders including a Technical Advisory Group, Cowichan Tribes members, and members of the public.

This report provides a summary of the **Round 1** Engagement and Communications process that was carried out between April 2018 and June 2018 to understand key issues and opportunities in the Sh-hwuykwselu Watershed, as well as to achieve consensus on the assumptions used in the modelling including land use and watershed boundaries. Information during this phase of engagement will be considered by CVRD and consultants, along with technical information, to develop the Plan. **Round 2** of the engagement process will focus on reviewing the draft plan recommendations, policy issues and how to address these issues, potential implementation process, roles and responsibilities.

KEY OBJECTIVES

- Introducing the Project to the Technical Advisory Group, Cowichan Tribes, and community members including the process, anticipated outcomes, and what has been achieved in terms of stormwater management and mitigation efforts in the CVRD to date;
- Helping Technical Advisory Group, Cowichan Tribes members, and community members understand stormwater management issues in the Sh-hwuykwselu Watershed as input to plan and policy development;
- Gathering input to understand current conditions, future plans, key related issues, and potential opportunities related to the public safety, environmental, economic, land use, or climate change aspects of the Project;
- Gathering feedback related to stormwater management and mitigation issues and identify how these issues can be translated into opportunities to enhance stormwater management in the CVRD through policy development;
- Confirming assumptions of hydrological and hydraulic modelling based on “on the ground” observations;
- Building public support for implementing stormwater best practices within the community through understanding of the issues through effective communication of technical information; and
- Facilitating a dialogue amongst community members to find an acceptable balance among often-competing values and priorities.

PART II: ENGAGEMENT PROCESS

APPROACH AND METHOD – UNDERSTANDING ISSUES & OPPORTUNITIES

The engagement process was developed based on an engagement and communications plan that outlined the overall approach, key messaging and communications protocols, engagement steps, anticipated schedule. The Engagement Plan identifies the Technical Advisory Committee, Cowichan Tribes members, and community members to be invited to the process.

Round 1 of the engagement and communications process included logistical coordination and facilitation of three key events: Technical Advisory Group workshop, Cowichan Tribes workshop, and Public workshop. Public outreach and the development of communications materials supported the workshops.

TECHNICAL ADVISORY GROUP WORKSHOP (ENGAGEMENT MEETING #1)

Format: The event format was a technically-focused meeting to provide a background of the project to a Technical Advisory Group and to encourage representatives to share their knowledge and experience about stormwater and rain water management issues and opportunities in the watershed, highlighting any nuances. The event was also an opportunity to obtain feedback on impacted areas, watershed boundaries, environmental considerations, and land use or development goals within the community and achieve consensus on assumptions used in the technical study to help shape plan development. Finally, the meeting discussed how best to engage Cowichan Tribes members for subsequent meetings.

Technical Advisory Group Meeting

May 9, 2018
10:00 – 2:00 pm

Boardroom, Cowichan Valley Regional District, Duncan, BC

Number of Participants: 19 (including 6 facilitators)

COWICHAN TRIBES DINNER & DISCUSSION (ENGAGEMENT MEETING #2)

Format: The event format was an informal dinner to encourage conversation and dialogue about the issues and opportunities in the Sh-hwuykwselu Watershed among the broader Cowichan Tribes membership. The CVRD and Cowichan Tribes provided a brief welcome, opening and closing prayer. The introduction included a video that explained some of the background issues and solutions in stormwater management. Participants were invited to share their stories about flooding and erosion in the community, participate in a community mapping activity to highlight key features, historical issues, and current challenges in the watershed using large-format maps for reference; and discuss ways to move forward. The meeting also provided the Cowichan Tribes members the opportunity to ask questions about the Project.

Cowichan Tribes Dinner & Discussion

June 4, 2018
6:00 – 8:00 pm (doors 5:30 pm)

Si'em Lelum Gymnasium Kitchen,
5574 River Road, Duncan, BC

CVRD cooperated with Cowichan Tribes for outreach and communications, as well as for organizing a community cook (Bev Antione) to coordinate the dinner. Elders and members of all ages contributed to the event.

Number of Participants: 20 (including 5 facilitators).

COMMUNITY EVENT FOR INTERESTED STAKEHOLDERS (TWO SESSIONS) (ENGAGEMENT MEETING #3)

Format: The event format involved two sessions:

- Session 1 (afternoon) was intended for the local business community in the study area as well as members of the public and
- Session 2 (evening) was for all members of the public including local landowners who have experienced flooding, environmental groups, and interested citizens.

Community Event for Interested Public

June 7, 2018
Session 1: 3:00-5:30 pm
Session 2: 7:00 – 8:30 pm

Eagles Hall,
2965 Boys Road, Duncan, BC

Each session included a background presentation and introductory video. The event also included a community mapping exercise using large-format maps for participants to identify issues and opportunities in the watershed. A discussion on ways to move forward was also scheduled although one-to-one conversations worked best to obtain input due to the number of participants. The event also provided participants the opportunity to ask questions about the Project.

Number of Participants: 19 (including 3 facilitators)

OUTREACH AND NOTIFICATION

The CVRD provided public outreach to notify the public about the upcoming events as an opportunity to learn about flooding and erosion issues in the watershed and provide input by the following outreach materials:

- **CVRD Website:** Project webpage communication on main page (link to Project webpage); Project webpage: https://cvrd.bc.ca/3064/Busyplace-Stormwater-Management; link from Environment page; link from Watersheds page *(Note: CVRD chose not to utilize PlaceSpeak as it was a focused Study area as opposed to a regional initiative).* Key content included:
  - **Overview:** General Project summary. *"Stay Connected"*. Key Contacts for CVRD and Cowichan Tribes for Project questions.
  - **Sh-hwuykwselu Watershed:** What is a Watershed? Where is the Sh-hwuykwselu Watershed (including overview map)?
  - **About the Project:** About Rainfall and Snowfall. What is a Stormwater Management Plan? What Are Ways to Manage Stormwater?
  - **Planning Process**: Diagram illustrating the technical planning process and anticipated stages of engagement, which began in April 2018 and is anticipated to be complete in October 2018.
  - **Upcoming Events:** Summary of upcoming events: Do You Live or Work in the Sh-hwuykwselu Watershed? We want to hear from you! Event information, key objectives of the events, and link to response form.
  - **Resources and Information** – Background documents including base map and project process diagram with information to be updated as the project progresses.
  - **Public Questionnaire Update**: Action call to share knowledge, participate in survey, and duration of survey.

- **Cowichan Tribes Facebook Page**: Four (4) posts on https://www.facebook.com/cowichan.tribes from May 24, 2018 to June 4, 2018.

- **Cowichan Tribes Website Announcement:** Posting on the announcements page on http://www.cowichantribes.com/ (poster) that was posted two weeks prior to event.

- **Postcard Mailout / Hand Delivered Postcards:** Quantity of 800 postcards were distributed to participants in the Study area only, which included mailed out postcards to residents and businesses as well hand-delivered postcards by Cowichan Tribes representatives to select residents and businesses only within the Study area as determined by Cowichan Tribes representatives.

- **Email Communication: Invitation and Follow-Up:** Email communication to Technical Advisory Committee members, Cowichan Tribes members, and interested public (stakeholders) (CVRD's email distribution list) with invitation to events and to request circulation among membership. A thank you for participating / next steps email was also distributed to participants.

- **Community Poster:** Graphic 8.5 x 11 poster displayed in key locations including where appropriate: the event venue, community locations such as community centres, libraries, CVRD offices, local grocery stores, etc.

Examples of outreach materials used are contained in **Appendix A.**

COMMUNICATIONS MATERIALS:

The following table outlines logistics and communications materials (see **Appendix B**) used for each of the three events:

Communications Materials	TAC	Cowichan Tribes	Interested Public
Event Outline (event logistics including facilitator roles, health & safety, and equipment checklist)	✓	✓	✓
Speaking Points (outlining key messages)	✓	✓	✓
Event Agenda	✓	✓	✓
PowerPoint Presentation (to provide Project background, process, existing policy and program framework, climate change consideration, and existing precedents)	✓		✓
Discussion Guide (overview, study area map, and strategic discussion questions to facilitate discussion and a worksheet to record discussion points)	✓		
Community Mapping Activity (using large-format maps of watershed area)	✓	✓	✓

Two-Page Handout (to provide background overview of Project)		✓	✓
Directional Signage (to provide location of meeting on outside of building and from parking areas to direct participants to each event)	✓	✓	✓
Sign-in Sheet (to track participants that attended each meeting)	✓	✓	✓
Best Management Practice Toolkit Summary (an overview of tools used for low impact development to manage stormwater)		✓	✓
Video (to provide background on stormwater management and best management practices)		✓	✓
Koksilah Business Park Survey (to support the Technical Advisory Committee discussion)	✓		
Proposed Stormwater Management Design Criteria and Modelling Assumptions (assumptions used during the Technical Advisory Committee discussion)	✓		
Technical Information (i.e. relevant background information, municipal or Cowichan Tribes info, or maps for reference)	✓	✓	✓
Public Questionnaire (Hardcopy and Online) using third-party vendor Simple Survey® for online version and available in hard copy at each event and CVRD offices		✓	✓
Event Materials (facilitator name tags, flip-charts, stationery, etc.)	✓	✓	✓

PART 3: SUMMARY OF INPUT

The following summary outlines key themes in the input received from Round 1 of the engagement process.

Input was received through:

Discussion Notes (from each of the three events). Please refer to **Appendix C** for complete discussion notes.

Public Questionnaire Responses (for Cowichan Tribes and the Interested Public both hard copy and online versions*)*. **Appendix D** contains a public questionnaire responses summary and other feedback received from meetings.

KEY THEMES

- **Vision and Values:** Community growth and enhancement, future-focused, connectivity, building resilience in the face of climate change, action-oriented initiatives to address roots of the issues
- **Environmental:** Natural capital, environmental assets, low impact development, fish and habitat enhancement, watershed health, environmental protection
- **Partnership/Collaboration:** Cooperation, efficiency, integrated approach, clear roles and responsibilities, Cowichan Tribes complexities and considerations, Ministry of Transportation involvement, equitable funding.
- **Planning**: Incremental, achievable, aligned with other long-term processes, coordination with other divisions, land use considerations, development guidelines, bylaws, standards, permits, zoning, setbacks, land use, natural area designation, retrofitting.
- **Tools**: Agricultural water demand model (Province of BC) and water balance model (rates based on soils)
- **Management:** Regulation, funding opportunities, alleviate flooding and erosion, effective maintenance program, administration, unified understanding, leadership, watershed boundaries, key issues (gravel, logs)
- **Public Engagement:** Aspirational goals, quality of life, infrastructure as benefits (vs. tax), rainwater as asset, awareness, education, best practices, watershed health.
- **Technology:** Low impact development, green infrastructure, drainage design, sediment control, infiltration, hydrological/hydraulic considerations, distribution, identification of pervious/impervious areas, watershed processes, modelling, detention/retention, daylighting, culvert enhancement, natural features, monitoring, dike enhancement.

ISSUES AND OPPORTUNITIES

The table on the following page summarizes the key issues and opportunities heard during Round 1 of the engagement process. While some comments concerned wider watershed concerns (e.g. flooding, log jams, and sediment deposition in the Koksilah River), the scope of the Study focuses on the Sh-hwuykwselu (Busyplace) Watershed.

ISSUES	OPPORTUNITIES
▪ Flooding and erosion in watershed areas including residential, industrial, roads, wetlands, particularly after heavy rain ▪ Water backflows/reversal from high water levels resulting in high water and drainage issues ▪ Lack of efficient, coordinated approach to address key issues in region ▪ Issues aggravated by climate change impacts ▪ Development pressures ▪ Land use complexity, decisions, and priorities (industrial activities etc.) ▪ Limited funding, housing constraints on limited land area, limited resources (Cowichan Tribes) ▪ Current infrastructure issues (dikes, bridges, etc.) ▪ Lack of regulation and authority for watershed, development, etc. ▪ Lack of data and information on diverse watershed environments (complicated), pervious/impervious areas, monitoring ▪ Water quality issues caused by pollution, surface water contamination (point-source issues), groundwater quality ▪ Lack of management and maintenance on drainage designs, sediment control. ▪ Key issues with logs jams and sediment (and to ensure that the plan looks beyond the Study boundaries, where possible, to consider the impacts of external issues on flooding in the Sh-hwuykwselu (Busyplace) Watershed ▪ Gravel deposition issues ▪ Issues with other ongoing activities (e.g. highway development, community growth, industrial) ▪ Public perception of tax, low impact development, funding, issues of flooding ▪ Environmental impacts on fish habitat, habitats ▪ Ministry of Transportation and Infrastructure work (bridges and roads) impact flooding	▪ Coordinated, integrated, efficient partnership with leadership and with defined roles and responsibilities ▪ Modelling, monitoring, shared data and processes on watershed health, best practices, pervious/impervious areas identification ▪ Understanding processes (hydrology, soils, etc.) as well as local knowledge ▪ Public engagement to educate / reframe issue towards positive future and infrastructure as asset, environmental values, natural capital ▪ Involvement of community through business champions/awards for flood protection ▪ Promotion of environment values for long-term community sustainability and quality of life ▪ Environmental restoration ▪ Land use management ▪ Incremental change with opportunities for aligning with other processes, divisions, and initiatives including new regulation and bylaws and setbacks ▪ Funding attained based on collaboration ▪ Addressing key issues through low impact technology, infrastructure planning, storage ▪ Maintenance, upgrades planning ▪ Development of key infrastructure including dikes, culverts, channel construction to control backup and removal of sediment and log jams ▪ Partnership with Cowichan Tribes to address specific issues (housing, resources) ▪ Cooperation with Ministry of Transportation and Infrastructure for bridges and roads upgrades ▪ Grants and funding (provincial or federal) for staff/resources/programs/local groups

NEXT STEPS

Round 2 of the Engagement and Communications process will focus on reviewing elements of the Draft Plan. A second workshop with the Technical Advisory Committee (Engagement Meeting #4) will be held in fall 2018 to provide an update on the process and share feedback heard from Round 1. The potential policy framework will be the focus of the discussion to achieve consensus on the options for the Draft Plan, specifically:

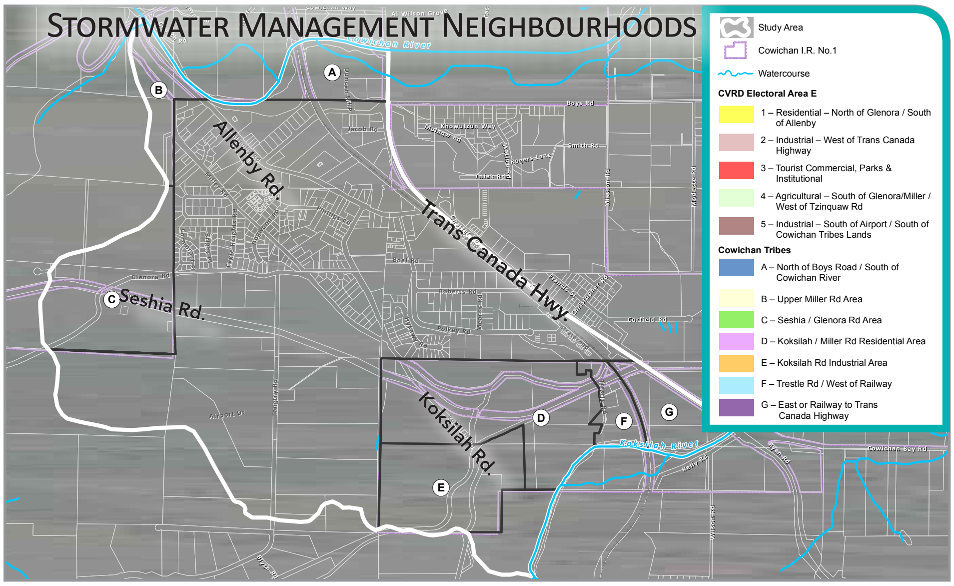
- Draft action plan options;
- Policy issues and how to address these issues;
- Potential implementation process;
- Roles and responsibilities; and
- Costing, operations, and maintenance.

APPENDIX A: OUTREACH MATERIALS

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

Do You Live or Work in the Sh-hwuykwselu Watershed?

Cowichan Tribes, in partnership with the Cowichan Valley Regional District (CVRD), is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) Watershed. We'd like to invite you to share your knowledge about the watershed, your experiences with flooding and erosion, and to talk about ways to move forward.



INTERESTED PUBLIC:

Community Workshop

Monday, June 4, 2018

3:00- 5:30 pm & 7:00- 8:30 pm

Eagles Hall, 2965 Boys Road, Duncan

COWICHAN TRIBES MEMBERS:

Dinner & Discussion

Thursday, June 7, 2018

6:00- 8:00 pm (Doors 5:30)

Si'em Lelum Gym Dining Area, 5574 River Rd., Duncan

What is Stormwater?

- Surface water resulting from rain, snow, or storms that does not soak into the ground

What is a Stormwater Management Plan?

- A plan that considers a range of approaches to help guide future infrastructure improvements & priorities to mitigate flooding, erosion, and water quality impacts from stormwater

Why Do We Need a Management Plan?

- To protect property and the public
- To mitigate flooding & erosion risk
- To improve the quality of stormwater runoff

CVRD

Need More Information?

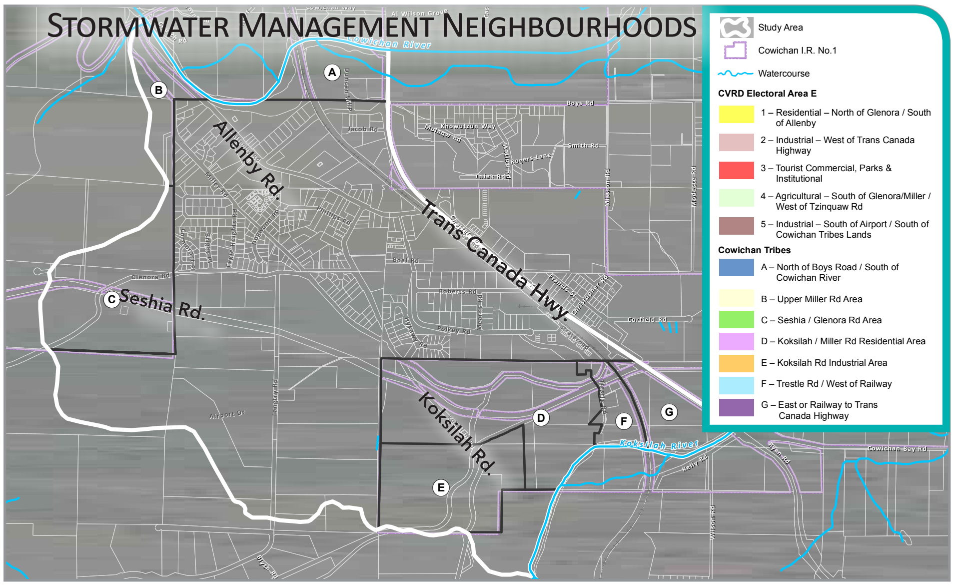
www.cvrd.bc.ca/busyplace

www.cowichantribes.com/announcements

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

Do You Live or Work in the Sh-hwuykwselu Watershed?

Cowichan Tribes, in partnership with the Cowichan Valley Regional District (CVRD), is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) Watershed. We'd like to invite you to share your knowledge about the watershed, your experiences with flooding and erosion, and to talk about ways to move forward.



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CVRD

Need More Information?

www.cvrd.bc.ca/busyplace

www.cowichantribes.com/announcements

Kristen Falconer

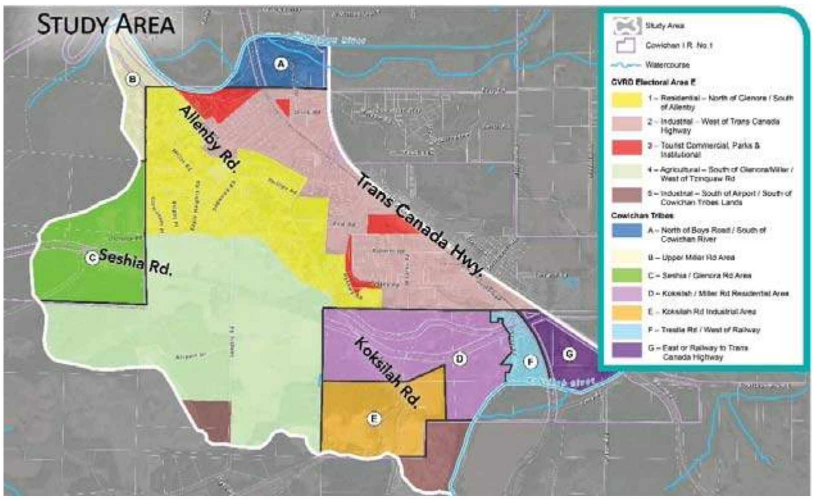
Subject: 1: You're Invited! Community Workshop for Sh-hwuykwselu (Busyplace) Stormwater Management Plan

Dear Community Member,

The **Cowichan Valley Regional District (CVRD),** in partnership with **Cowichan Tribes**, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed in the Cowichan/Koksilah floodplain. The plan will help protect our homes and communities from flooding and erosion as well as improve the quality of stormwater runoff.

Upcoming Event

If you live, work, or manage land in the Sh-hwuykwselu (Busyplace) watershed (please see map below), we'd like to invite community members to join us to share your knowledge about the watershed and your experiences with flooding and erosion at our upcoming community event, and to talk about ways to move forward.



INTERESTED PUBLIC:

Community Workshop

Thursday, June 7, 2018

3:00- 5:30 pm & 7:00- 8:30 pm

Eagles Hall, 2965 Boys Rd., Duncan

Your input will help develop the draft **Stormwater Management & Mitigation Plan** to help manage rain and flood waters affecting communities in the watershed.

Do you know someone who might be interested in this event? Please help spread the word by sharing this invitation.

Questions?

- Check out the Project Webpage at www.cvrd.bc.ca/busyplace
- Contact Keith Lawrence, Senior Environmental Analyst, Cowichan Valley Regional District at klawrence@cvrd.bc.ca or Tracy Fleming, *Lulumexun* Lands Department, Cowichan Tribes at tracy.fleming@cowichantribes.com

We look forward to hearing your experiences, knowledge, and thoughts on managing rain and flood waters in the Sh-hwuykwselu (Busyplace) watershed.

Kristen Falconer

Subject: 2: Community Events: Sh-hwuykwselu (Busyplace) Stormwater Management Plan

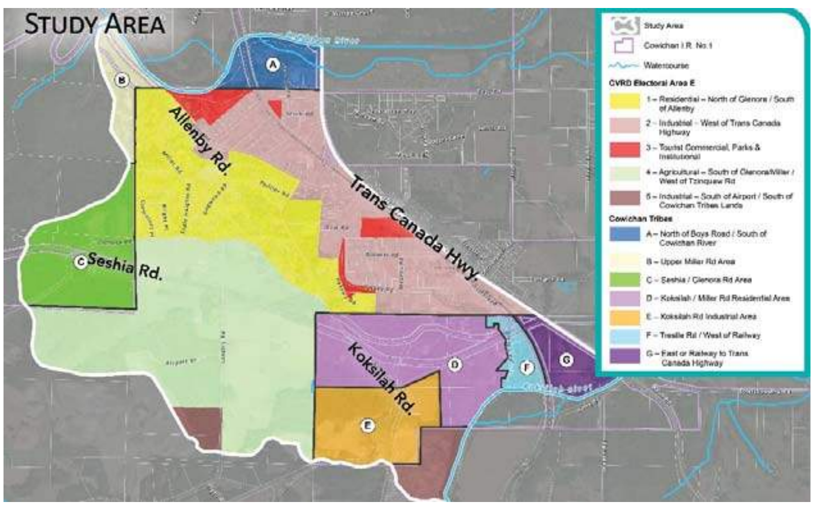
Dear Technical Advisory Group member,

As you are aware, the **Cowichan Valley Regional District (CVRD),** in partnership with **Cowichan Tribes**, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed in the Cowichan/Koksilah floodplain. The plan will help protect homes and communities from flooding and erosion as well as improve the quality of stormwater runoff.

Upcoming Events

As valued partners in this process, we would like to share that we are inviting members of the public who either live, work, or manage land in the Study area to join us to share their knowledge about the watershed and experiences with flooding and erosion, and talk about ways to move forward. Input will help shape the draft Stormwater Management & Mitigation Plan to help manage rain and flood waters affecting communities in the watershed.

If you know of community members in the Study area who would be interested in attending these events, please help spread the word.



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Si'em Lelum Gym Dining Area, 5574 River Rd., Duncan

Questions?

- Check out the Project Webpage at www.cvrd.bc.ca/busyplace

- Contact Keith Lawrence, Senior Environmental Analyst, Cowichan Valley Regional District at klawrence@cvrd.bc.ca or Tracy Fleming, *Lulumexun* Lands Department, Cowichan Tribes at tracy.fleming@cowichantribes.com

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CVRD

Sh-hwuykwselu (Busyplace)
Stormwater Management & Mitigation Plan

Kristen Falconer

Subject: 3: Community Events: Sh-hwuykwselu (Busyplace) Stormwater Management Plan

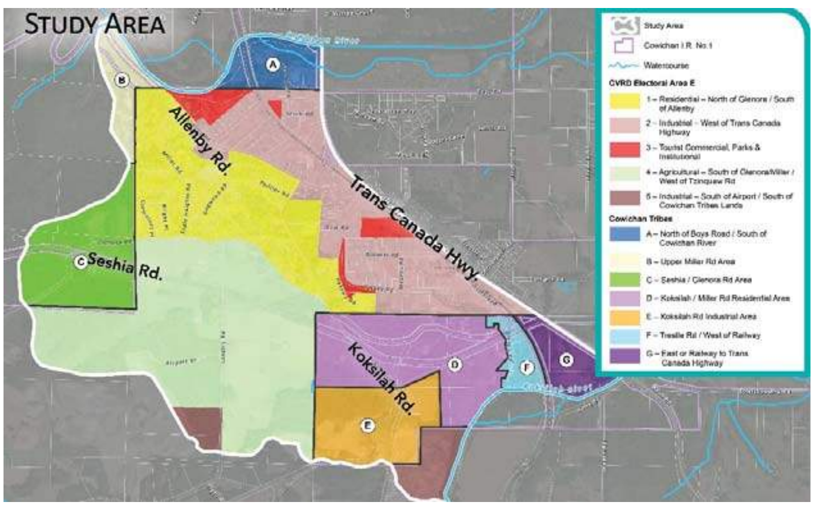
Dear Committee member,

The **Cowichan Valley Regional District (CVRD),** in partnership with **Cowichan Tribes**, is developing a plan to help manage rain and flood waters affecting communities in the
Sh-hwuykwselu (Busyplace) watershed in the Cowichan/Koksilah floodplain. The plan will help protect homes and communities from flooding and erosion as well as improve the quality of stormwater runoff.

Upcoming Events

We would like to share with you that we are we are inviting members of the public who either live, work, or manage land in the Study area to join us to share their knowledge about the watershed and experiences with flooding and erosion, and to talk about ways to move forward at two upcoming events. Input will help develop the draft **Stormwater Management & Mitigation Plan** to help manage rain and flood waters affecting communities in the watershed.

If you know of community members in the Study area who would be interested in attending these events, please help spread the word.



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- Contact Keith Lawrence, Senior Environmental Analyst, Cowichan Valley Regional District at klawrence@cvrd.bc.ca or Tracy Fleming, *Lulumexun* Lands Department, Cowichan Tribes at tracy.fleming@cowichantribes.com

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CVRD

Sh-hwuykwselu (Busyplace)
Stormwater Management & Mitigation Plan

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Notes:

1. Content to be posted on https://cvrd.bc.ca/busyplace as a **Project Webpage** (CVRD to determine appropriate placement).
2. Please add links from the following pages to the Project Webpage:
   a. Environment (https://www.cvrd.bc.ca/1691/Environment)
   b. Events (https://cvrd.bc.ca/calendar.aspx);
3. High resolution graphics will be provided separately. Where possible, smaller graphics (e.g., the process diagram) should be clickable to open a larger graphic for viewing.
4. Photos may be substituted if the CVRD has preferred images.
5. <link to …> indicates a link to be added when the pages are developed.
6. Page content will be updated following Draft Stormwater Management & Mitigation Plan and prior to Final Plan Development (~September 2018).

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

Overview

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed. The plan will help ensure that our homes and communities remain safe from flooding and erosion.

Cowichan River

From now until October 2018, we will be working to gather detailed information, including feedback from the public, about rain water and flood management issues and opportunities in the Sh-hwuykwselu (Busyplace) watershed. This information will be used to consider priority actions that will be outlined in the Stormwater Management & Mitigation Plan.

We'd like to invite interested community members to share knowledge and experiences with flooding and erosion in the Sh-hwuykwselu (Busyplace) watershed, and to talk about ways to move forward.

Stay Connected

- Subscribe to CVRD's Public Notifications List
- Check this Project webpage and the Event Calendar Tab for upcoming events
- Watch for announcements in your community

Questions?

Keith Lawrence, Senior Environmental Analyst
Cowichan Valley Regional District
Email: klawrence@cvrd.bc.ca
Tel: 250-746-2643

Tracy Fleming or Melissa Tokarek
Lulumexun Lands Department
Cowichan Tribes
Email: tracy.fleming@cowichantribes.com or melissa.tokarek@cowichantribes.com
Tel: 250-748-3196

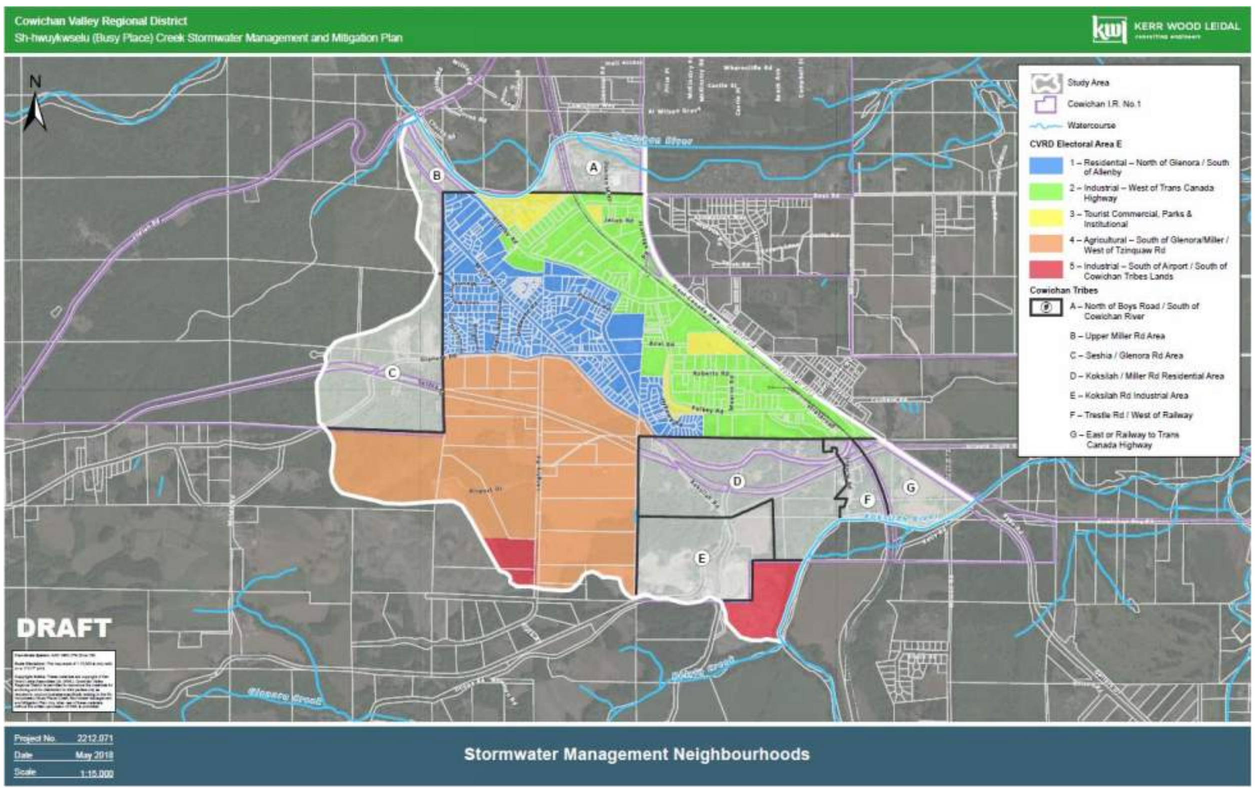
Sh-hwuykwselu Watershed

What is a watershed?

A ***watershed*** is an area of land where all water that falls or drains into it moves toward a common outlet, such as a river, basin, or ocean.

Where is the Sh-hwuykwselu Watershed?

The Study area includes areas of Cowichan Tribes & CVRD Electoral Area "E" lands west of the TransCanada Highway, between the Kosilah and Cowichan Rivers, and up to the watershed boundary west of Quw'tsum Smuneem Elementary School. The Study area comprises several "stormwater management neighbourhoods" as illustrated below.



About the Project

About Rainfall and Stormwater

- ***Stormwater*** is heavy rainfall that runs off from surfaces and does not soak into the ground.
- Stream flows and wetlands are fed largely by shallow groundwater, receiving surface runoff only during large storms.
- Traditionally, stormwater was managed through the construction of pipes and channels to carry away rainfall as quickly as possible to protect homes and the public.
- The traditional approach, combined with the removal of natural forest cover, ponds, and wetlands has led to increased volumes of rapid runoff.
- Rapid runoff can increase the risk of flooding, erosion, and degradation of stream habitat.

Did you know that in a **natural forest**, about 90% of the average annual rainfall evaporates or soaks into the ground? When land is developed with more roads, roofs, and pavement, water cannot soak into the ground and rapid runoff increases.

What is a Stormwater Management Plan?

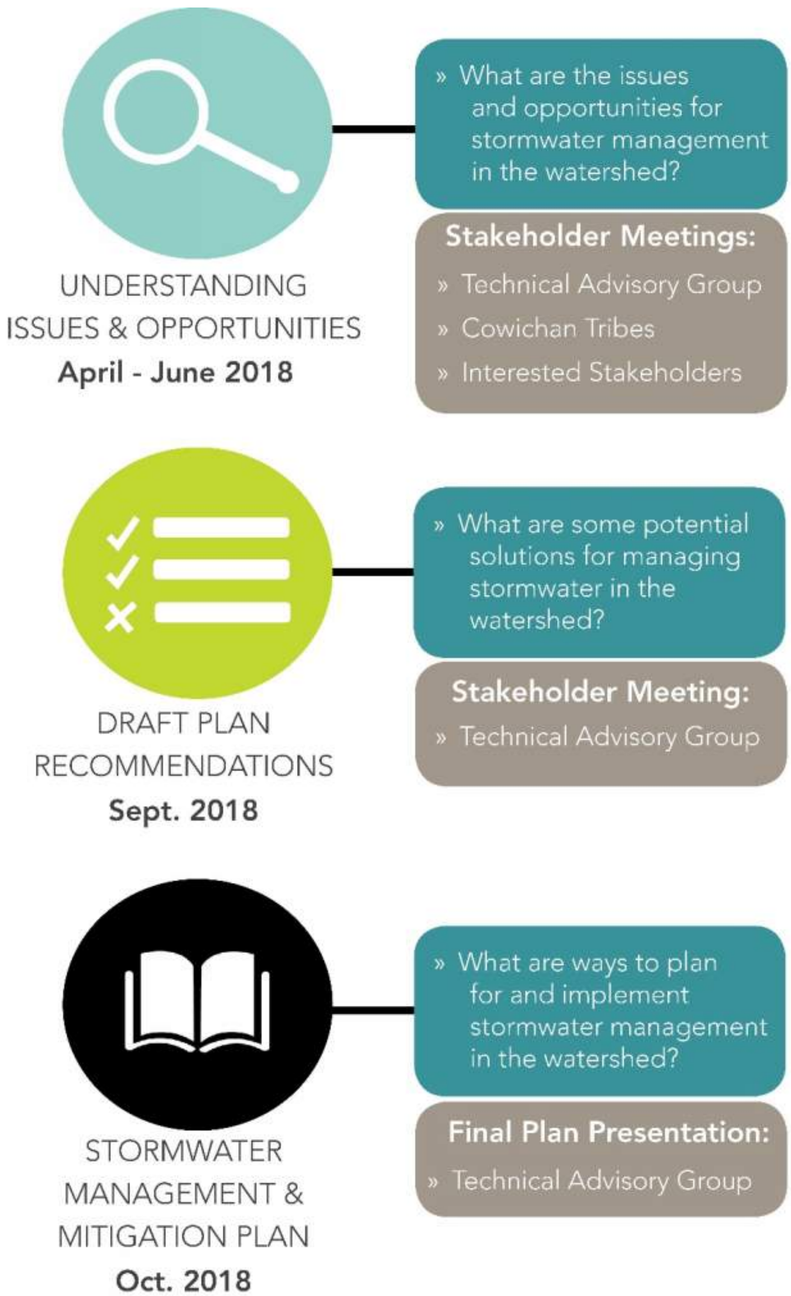
Stormwater management aims to control surface runoff by using various strategies to manage water quantity and improve water quality caused by surface pollutants. A ***stormwater management plan*** considers a range of approaches to help protect property and the public, but it also reduces channel erosion and improves water quality and stream habitat.

What are Ways to Manage Stormwater?

- Wetland, ponds, or underground reservoirs that store and delay runoff
- Green infrastructure such as porous paving, raingardens, and landscaped features that capture stormwater
- Ditches, culverts, pipes, and repaired stream corridors that safely convey stormwater
- Guidelines for development and building design
- Dike construction to reduce the risk of flooding

Process

The planning process began in April 2018 and is anticipated to be complete in October 2018. The diagram below shows the anticipated stages of the engagement process and identifies opportunities for you to be involved. The engagement process will run parallel to a technical process. The process and timeline may be updated as the project progresses.



Upcoming Event

Community Workshop:

Understanding Rain Water and Flooding Issues & Opportunities in the Sh-hwuykwselu Watershed

We'd like to invite interested community members to join us to share your knowledge and experience with flooding and erosion, and to talk about ways to move forward.

Please join us at an upcoming presentation and discussion on current challenges and goals for addressing rain water and flooding issues in the Sh-hwuykwselu (Busyplace) watershed. Your input will help develop the draft Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan.

Join us to:

- Learn more about rainwater, flooding, and stormwater management in the Sh-hwuykwselu (Busyplace) watershed and what it means for you
- Hear about the plan, its process, and anticipated outcomes
- Complete a <Response Form> *(link to Response Form)* to provide your input on rainwater and flooding challenges and potential solutions
- Share your thoughts with representatives from CVRD and Cowichan Tribes, technical consultants, and others in your community
- Help develop a plan for managing rainwater and flooding in the Sh-hwuykwselu (Busyplace) watershed for the future

Not able to attend? CVRD staff and Cowichan Tribes representatives welcome your questions and comments about stormwater management throughout the process. You can still complete a <response form> *(link to Response Form)* or drop us a line at klawrence@cvrd.bc.ca. We welcome your feedback.

Resources & Information

Documents and information developed during the Sh-hwuykwselu (Busyplace) Stormwater Management and Mitigation Plan process will be posted here. Please check back for new postings.

Background Information

- <Base Map: Sh-hwuykwselu (Busyplace) Watershed> *(link to base map of watershed)*

Issues & Opportunities

- <Understanding Issues & Opportunities – Presentation> *(link to PDF of Presentation)*
- <Understanding Issues & Opportunities – Response Form> *(link to Response Form)*
- <Understanding Issues & Opportunities - Engagement Summary> *(link to Engagement Summary Report)*

Draft Plan Recommendations

- <Draft Stormwater Management Plan> *(link to Draft Plan)*

Final Plan

- <Final Stormwater Management & Mitigation Plan> *(link to Final Plan)*

Upcoming Events

Do You Live in the Sh-hwukwselu Watershed? We want to hear from you!

If you live in the Sh-hwuykwselu (Busyplace) Watershed, we'd like to invite you to share your knowledge about the watershed, your experiences with flooding and erosion, and to talk about ways to move forward. Your input will help develop the draft Stormwater Management & Mitigation Plan the Cowichan Valley Regional District (CVRD), in partnership with <Cowichan Tribes>, is developing to help manage rain and flood waters affecting communities in the watershed.

INTERESTED PUBLIC:

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Thursday, June 7, 2018
3:00- 5:30 pm & 7:00- 8:30 pm
Eagles Hall, 2965 Boys Rd., Duncan

COWICHAN TRIBES MEMBERS:

Dinner & Discussion
Monday, June 4, 2018
6:00 - 8:00 pm (Doors 5:30 pm)
Si'em Lelum Gym Dining Area, 5574 River Rd., Duncan

Please join us to:

- Learn more about flooding, erosion, and stormwater management, and what it means for the Sh-hwuykwselu (Busyplace) watershed and you
- Hear about the Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan, its process, and anticipated outcomes
- Share your experiences with flooding and erosion and your thoughts on challenges and potential solutions
- Discuss issues and opportunities with representatives from CVRD, Cowichan Tribes, technical consultants, and others in your community
- Help develop a healthy future for our community by helping to develop a plan to manage flooding & erosion

Not able to attend? CVRD staff welcome your questions and comments about flooding and erosion in the Sh-hwuykwselu (Busyplace) watershed throughout the process. You can still complete a response form online (please check back for details) or drop us a line at klawrence@cvrd.bc.ca or tracy.fleming@cowichantribes.com.

PUBLIC QUESTIONNAIRE: June 4, 2018 – June 22, 2018

Share Your Knowledge about Sh-hwuykwselu (Busyplace) Watershed!
Have you experienced flooding and erosion on your property or the property you manage? Do you have knowledge about the Sh-hwuykwselu watershed? Share them by participating in our public questionnaire. We want to hear from you.

Click here to complete your public questionnaire online now!

Your input will be used to help develop the Sh-hwuykwselu Stormwater Management & Mitigation Plan.

Would you Rather Complete a Hard Copy Questionnaire?

You can pick up a questionnaire from:
Cowichan Valley Regional District office: 175 Ingram Street, Duncan, BC.
Cowichan Tribes Lands Office: 222 Cowichan Way, Duncan, BC

- Or <click here> to download a PDF and print it at home

If you complete a hard copy questionnaire, please return it by **Friday, June 22, 2018**. You can:

- **Drop it off to the CVRD Office**: 175 Ingram Street, Duncan, BC, Attn: Keith Lawrence
- **Drop it off to Cowichan Tribes Lands Dept.:** 222 Cowichan Way, Duncan, BC, Attn: Tracy Fleming
- **Mail it to:** Cowichan Valley Regional District, 175 Ingram Street, Duncan, BC, V9L 1N8
- **Scan and Email it to**: klawrence@cvrd.bc.ca or tracy.fleming@cowichantribes.com

You can submit your questionnaire any time between **Monday**, **June 4, 2018** and **Friday, June 22, 2018.**

We look forward to hearing from you!

Commented [KF1]: This section would replace the Overview section (with overview content now to follow the Public Questionnaire content and before "Stay Connected").

Commented [KF2]: Active link is:

https://form.simplesurvey.com/f/s.aspx?s=c67ff030-28d1-41fa-86d5-6be249c1c898

Commented [KF3]: Add link to PDF of questionnaire

Sh-hwuykwselu Stormwater Management & Mitigation Plan

UPCOMING COMMUNITY EVENTS

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed.

The plan will help protect our homes and communities from flooding and erosion and will improve the quality of stormwater runoff. We'd like to invite community members to join us to share your knowledge about the watershed, your experiences with flooding and erosion at our upcoming community events, and to talk about ways to move forward.

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Si'em Lelum Gym Dining Area,
5574 River Rd., Duncan

CVRD

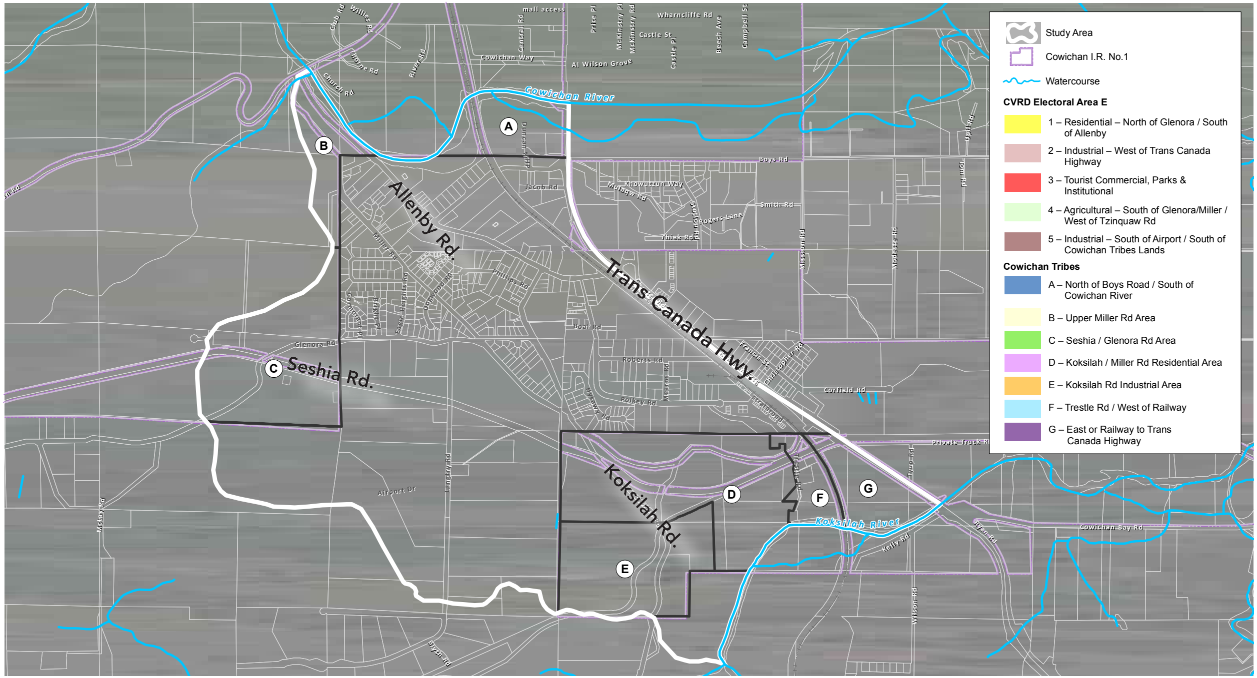
KWAMUTSUN QWUM'YIQUN' XWULQW'SELU S'AMUNU LHUMLHUMULUTS' XINUPSUM TL'ULPALUS

FOR MORE INFORMATION

klawrence@cvrd.bc.ca or tracy.fleming@cowichantribes.com

www.cvrd.bc.ca/busyplace

Do You Live or Work in the Sh-hwuykwselu Watershed?



Help develop a healthy future for our community by managing flooding & erosion.

Sh-hwuykwselu Stormwater Management & Mitigation Plan

UPCOMING COMMUNITY EVENTS

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed.

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FOR MORE INFORMATION

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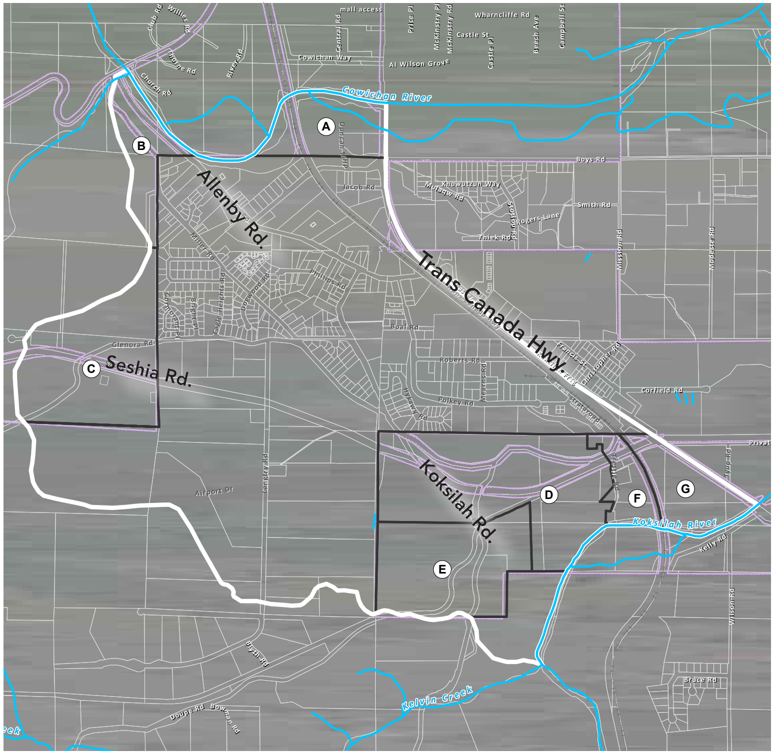
www.cvrd.bc.ca/busyplace

Do You Live or Work in the Sh-hwuykwselu Watershed?



PLACE
STAMP
HERE

APPENDIX B: LOGISTICS AND COMMUNICATIONS MATERIALS

TECHNICAL ADVISORY GROUP MEETING

MAY 9, 2018

From: Keith Lawrence
To: Keith Lawrence
Cc: "Craig Sutherland"; Kristen Falconer; David Reid
Subject: FW: Busyplace Stormwater Management Plan: Technical Advisory Group Invitation - May 9th
Date: Thursday, April 26, 2018 4:37:46 PM
Attachments: image009.png
image010.png
image007.png

From: Keith Lawrence
Sent: April-26-18 4:35 PM
To: Mike Tippett <mtippett@cvrd.bc.ca>; Bev Suderman <bsuderman@cvrd.bc.ca>; Brian Farquhar <bfarquhar@cvrd.bc.ca>; Graham Gidden <ggidden@cvrd.bc.ca>; Sybille Sanderson <ssanderson@cvrd.bc.ca>; Hamid Hatami <HHatami@cvrd.bc.ca>; Kate Miller <kmiller@cvrd.bc.ca>; Brian Dennison <bdennison@cvrd.bc.ca>; Jeff Moore <JMoore@cvrd.bc.ca>; Rob Conway <rconway@cvrd.bc.ca>; 'Tracy Fleming' <Tracy.Fleming@cowichantribes.com>; Melissa Tokarek <Melissa.Tokarek@cowichantribes.com>; 'Andrew.Newall@gov.bc.ca' <Andrew.Newall@gov.bc.ca>; 'sean.wong@gov.bc.ca' <sean.wong@gov.bc.ca>; 'Melissa.Nottingham@dfo-mpo.gc.ca' <Melissa.Nottingham@dfo-mpo.gc.ca>; 'Tom Rutherford' <tom.cowichan@gmail.com>; 'Sowa, Stacey' <Stacey.Sowa@viha.ca>; 'emmet@duncan.ca' <emmet@duncan.ca>; 'kyle.young@northcowichan.ca' <kyle.young@northcowichan.ca>; 'Mike.Boissonneault@gov.bc.ca' <Mike.Boissonneault@gov.bc.ca>
Subject: Busyplace Stormwater Management Plan: Technical Advisory Group Invitation - May 9th

Dear Technical Advisory Group members,

The **Cowichan Valley Regional District (CVRD),** in partnership with Cowichan Tribes, is developing a **Stormwater Management and Mitigation Plan** for the Shu-hwuykwselu (Busyplace) watershed in the Cowichan/Koksilah floodplain to guide future infrastructure improvements and priorities to mitigate flooding and erosion risk.

As a valued partner in this process, we would like to invite you to participate in a group meeting to share your knowledge and experience about stormwater and rain water management issues and opportunities in the watershed. Specifically, we welcome your feedback on impacted areas, watershed boundaries, environmental considerations, and land use or development goals within the community. Your input will be used to confirm assumptions to be used in the technical study and to help us shape plan development as we move forward in the process.

What: **Technical Advisory Group Meeting**
Understanding Issues & Opportunities in the Shu-hwuykwselu (Busyplace) Watershed

When: **Wednesday, May 9, 2018**
10:00 am to 12:00 pm

Where: **Boardroom**
Cowichan Valley Regional District
175 Ingram Street, Duncan, BC

Please **RSVP** (by May 7): Keith Lawrence, Senior Environmental Analyst, CVRD
klawrence@cvrd.bc.ca | 250.746.2643

Please accept this meeting invitation to participate in the Technical Advisory Group Meeting. We will be contacting you by phone to confirm your attendance. A detailed meeting agenda will be forwarded prior to the meeting including background details and a process overview. Please stay tuned for more information in the coming days.

In the meantime, if you have any questions, please contact Keith Lawrence, Senior Environmental Analyst, Cowichan Valley Regional District at 250-746-2643 or klawrence@cvrd.bc.ca or Tracy Fleming, *Lulumexun* Lands Department, Cowichan Tribes at tracy.fleming@cowichantribes.com or 250-748-3196.

We look forward to this upcoming discussion to help address stormwater management challenges in the watershed.

CVRD

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Understanding Issues & Opportunities

Sh-hwuykwselu (Busyplace) Watershed

TECHNICAL ADVISORY GROUP MEETING #1 | May 9, 2018 from 10:00 am – 12:00 pm

Today's Agenda

Agenda Item	Approx. Time
Welcome & Introductions	10:00 – 10:10
Project Background	10:10 – 10:30
Group Discussion:	
Issues & Opportunities for Sh-hwuykwselu Watershed	10:30 – 11:15
Confirmation of modelling assumptions / inputs	11:15 – 11:45
Next Steps	11:45 – 12:00

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Introductions

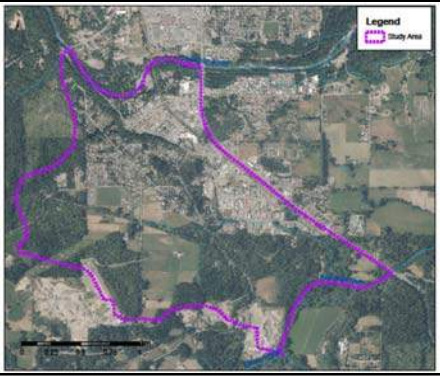
Project
Partners

Project
Overview

Project
Background

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Study Area



Project Context

OPPORTUNITIES

- Two funding programs approved including:
  1. Drainage master plan development
  2. Works to improve drainage and reduce flooding impacts
- Connectivity within the system – no "orphan structures"
- Must be complete by March 31, 2019

CHALLENGES

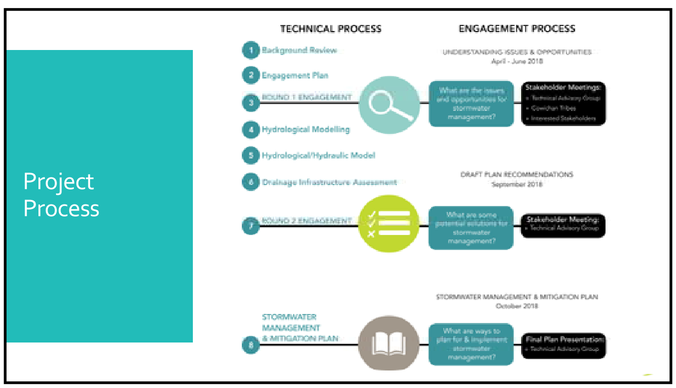
- Multiple agencies
- No designated drainage lands
- No long-term "service" to maintain works
- Multiple land use objectives in a changing environment
- Multiple governance and regulatory frameworks

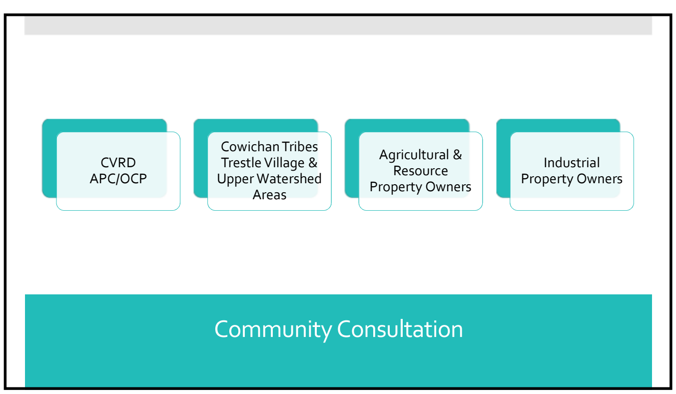
SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Project Objectives

Understand	Understand drainage and flooding issues
Identify	Identify areas of improvement (green or gray)
Protect	Protect community assets and infrastructure
Reduce	Reduce impacts on or improve the quality of the environment
Build	Build partnerships and capacity to address issues over the longer term
Determine	Determine needs or feasibility of a watershed-based function
Inform	Inform future DPA policies and guidelines, proactive land use policies, and proposed works (green or gray)


Why is a Stormwater Management Plan Needed?
ROAD FLOODED


Project Process
TECHNICAL PROCESS
ENGAGEMENT PROCESS
1 Background Review
2 Engagement Plan
3 ROUND 1 ENGAGEMENT
4 Hydrological Modelling
5 Hydrological/Hydraulic Model
6 Drainage Infrastructure Assessment
7 ROUND 2 ENGAGEMENT
8 STORMWATER MANAGEMENT & MITIGATION PLAN
UNDERSTANDING ISSUES & OPPORTUNITIES
April - June 2018
What are the issues and opportunities for stormwater management?
Stakeholder Meetings:
• Technical Advisory Group
• Cowichan Tribes
• Interested Stakeholders
DRAFT PLAN RECOMMENDATIONS
September 2018
What are some potential solutions for stormwater management?
Stakeholder Meeting:
• Technical Advisory Group
STORMWATER MANAGEMENT & MITIGATION PLAN
October 2018
What are ways to plan for & implement stormwater management?
Final Plan Presentation:
• Technical Advisory Group

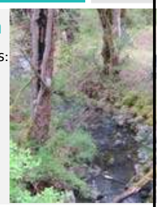

CVRD APC/OCP
Cowichan Tribes Trestle Village & Upper Watershed Areas
Agricultural & Resource Property Owners
Industrial Property Owners
Community Consultation

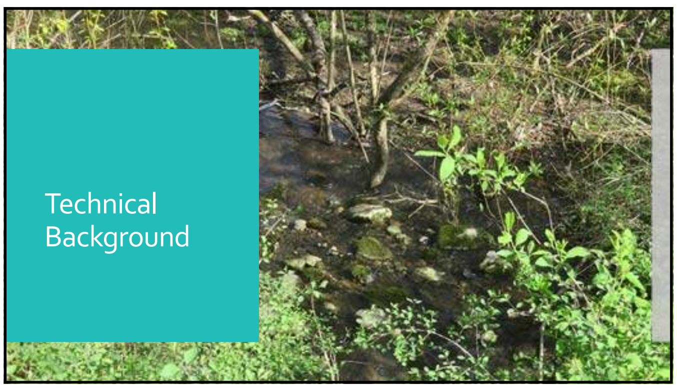
Project Deliverable

Stormwater Management & Mitigation Plan

Recommendations to mitigate impacts of base and high flows:

- Policy development including environmental, land use, development, infrastructure, and construction
- Drainage infrastructure improvements
- Naturalize streams, wetlands and ponds
- Build community





Technical Background

Current Conditions

Information Review (GIS mapping, hydrometric and climate data, stormwater system records and reports, areas of concern

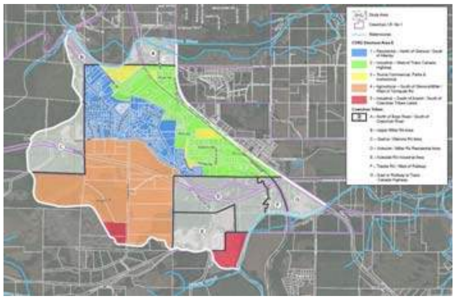
Site Visit of Watershed including key features, stormwater infrastructure, flooding and erosion areas

Base Mapping (topography, watershed boundaries, drainage network, land use (current and future for CVRD and CT)

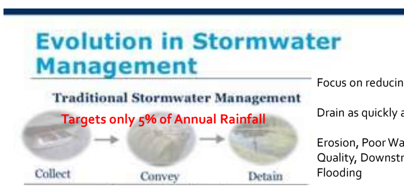
SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Stormwater Management Neighbourhoods

- Focus on reducing flooding
- Drain as quickly as possible



Stormwater Management Approach



Focus on reducing flooding

Drain as quickly as possible

Erosion, Poor Water Quality, Downstream Flooding

What about remaining 95% of rainfall?

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Stormwater Management Performance Targets

Range of Rainfall Intensities

- Frequent Small Events (75% of Annual Rainfall)
  - Protect Water Quality
  - Rainfall Capture
- Infrequent Large Storms (20% of Annual Rainfall)
  - Protect Streams from Erosion
  - Runoff Control
- Rare Extreme Storms (5% of Annual Rainfall)
  - Protect Property from Flooding
  - Flood Risk Management

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Stormwater Management Performance Targets

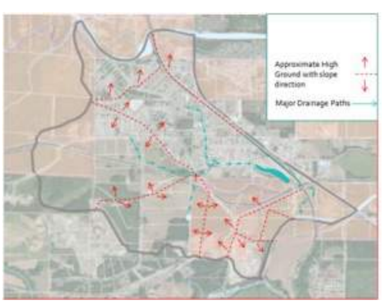
Range of Rainfall Intensities

- **Rare Extreme Storms** (5% annual Rainfall)
  - Protect Property from Flooding
  - Flood Risk Management
- **Infrequent Large Storms** (20% of annual rainfall)
  - Protect streams from Erosion
  - Runoff Control
- **Frequent Small Events** (75% of annual rainfall)
  - Protect Water Quality
  - Rainfall Capture

Stormwater Management Design Criteria

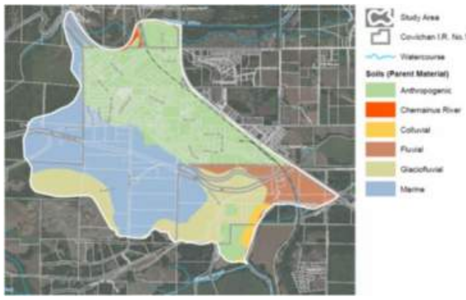
Rare Extreme Storms (5% of Annual Rainfall)	Infrequent Large Storms (20% of Annual Rainfall)	Frequent Small Events (75% of Annual Rainfall)
Flood Management Design Criteria	Stormwater Management Design Criteria	Habitat Protection Design Criteria
200-year return period floodplain	Reduce Peak flow to pre-development levels	Capture and retain
100-year return period for culverts/bridges and overland flow paths	6-month and 2-year return period	6-month return period (72% of 2-year return period 24-hr storm)
10-year return period for storm drains, roadside ditches, etc.		Establish Riparian Setbacks

Characterizing Watershed



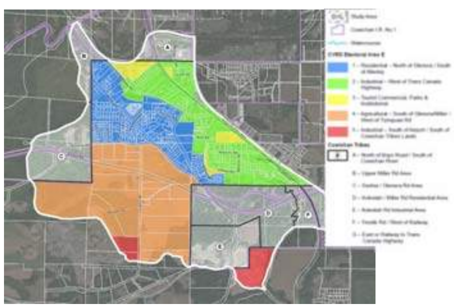
Watershed Boundary/ Drainage

Characterizing Watershed



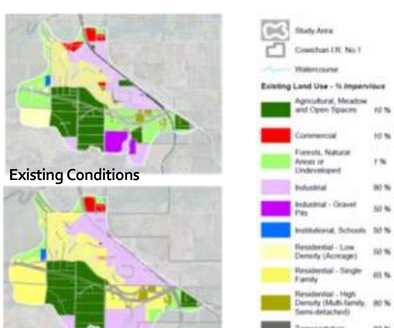
Soils

Characterizing Watershed



Neighbourhoods

Characterizing Watershed



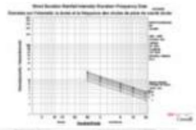
Existing Conditions

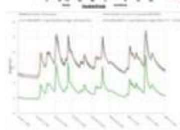
Future Conditions (Full Build-Out)

Characterizing Watershed

Rainfall and Water Levels

- No recent data recorded within watershed
- Use rainfall data from North Cowichan Climate Station
- Use Water Level Data recorded on Koksilah River at Highway 1 Bridge to develop downstream boundary conditions





Characterizing Watershed

Model Validation

- No water level or discharge data within the watershed.
- January 9, 2018 flood is roughly "bank full" confirmed by photograph.
- Compare model results to photos.

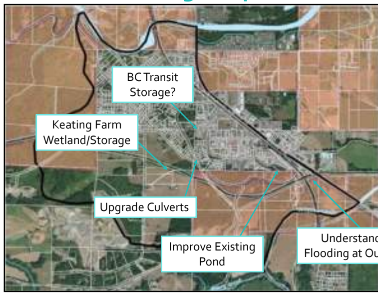
Characterizing Watershed

Proposed Model Runs

Model Scenarios	Land Use Type	Climate Data	Design Rainfall
Validation Run	Existing Land Use	Current climate data	Jan. 2018 storm event
Existing Conditions	Existing Land Use	Current climate data	Synthetic design storms with 1-hour to 24-hour duration
		Year 2050 climate data projection with RCP=8.5	
Future Conditions	Full Build-out according to the existing 1994 Electoral Area "E" Official Community Plan and Cowichan Tribes Draft Land Use Framework	Year 2050 climate data projection with RCP=8.5	
	Additional Scenario selected with input from the TAG and community		

Characterizing Watershed

Potential Drainage Improvements



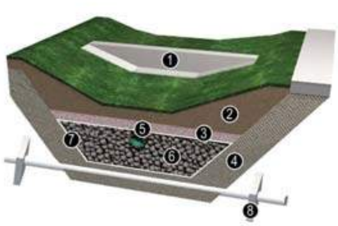
SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Best Management Practices Toolkit

- Infiltration swales
- Absorbent landscape
- Raingardens/bulges
- Pervious paving
- Green roof
- Tree well structures
- Rainwater harvesting
- Infiltration trenches
- Water quality structure
- Detention tank
- Constructed streams/wetlands

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

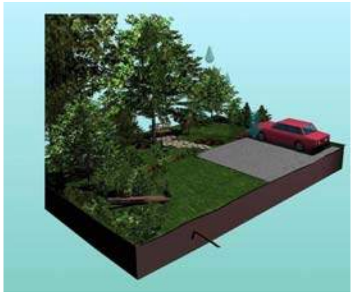
Infiltration Swales (for low infiltration rates)



Partial infiltration swale with reservoir and subdrain

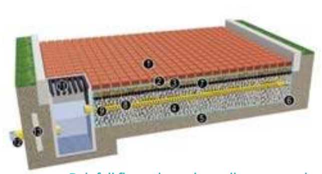
SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Absorbent Landscape



Keeping the 12 stormwater variables in balance is the key to successful stormwater source control using absorbent landscape.

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

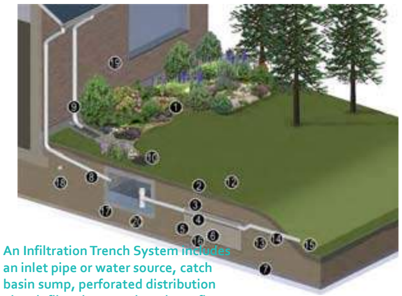


Rainfall flows through small aggregate in the cracks into drain rock and infiltrates into underlying soils.

Pervious Paving

Infiltration Bulges

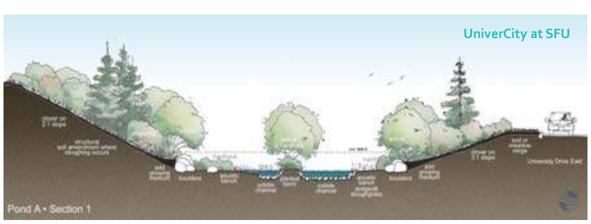
Infiltration Trench



An Infiltration Trench System includes an inlet pipe or water source, catch basin sump, perforated distribution pipe, infiltration trench and overflow to the storm drainage system.

Rainwater Harvesting

Rainwater Tank Capture System



Constructed Wetlands

Putting it All Together…

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Group Discussion

Vision & Values

Sh-hwuykwselu (Busyplace) Watershed

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Issues & Opportunities

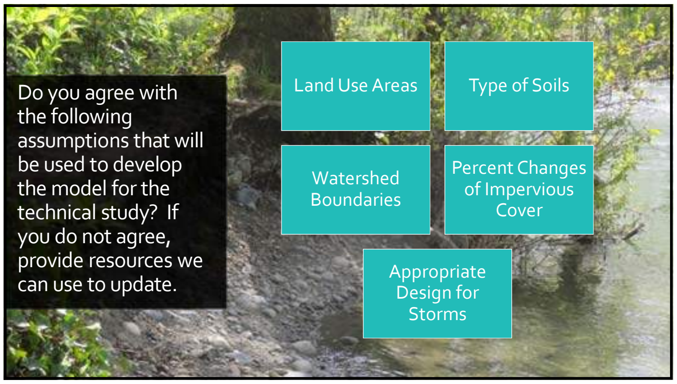
Sh-hwuykwselu (Busyplace) Watershed

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Modelling Assumptions

Land Use, Impervious Cover Changes, & Appropriate Design Storms

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN


Do you agree with the following assumptions that will be used to develop the model for the technical study? If you do not agree, provide resources we can use to update.
Land Use Areas
Type of Soils
Watershed Boundaries
Percent Changes of Impervious Cover
Appropriate Design for Storms


Based on the review of assumptions to be used for the development of the model, what are some potential solutions (e.g. storage, culvert upgrades, etc.)?


Next Steps

Immediate Next Steps

TECHNICAL
- Hydrological Modelling
- Hydrologic / Hydraulic Model
- Drainage Infrastructure Assessment

ENGAGEMENT
- Cowichan Tribes & Interested Community Members Meetings

Questions?

Please remember to submit your discussion guide.

Thank You

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

Technical Advisory Group

Meeting Details:

MEETING:	Technical Advisory Group Meeting
DATE / TIME:	Wednesday, May 9, 2018 10:00 am to 12:00 pm (2 hours)
LOCATION:	Boardroom - Cowichan Valley Regional District Offices 175 Ingram Street, Duncan, BC *Remote attendees please dial: 1-877-234-4610 (Code 5792846)*

Purpose:

The Cowichan Valley Regional District (CVRD) in cooperation with Cowichan Tribes, is developing a Stormwater Management and Mitigation Plan for the Sh-hwuykwselu (Busyplace) watershed. The purpose of this meeting is to understand key issues and opportunities in the watershed, to confirm assumptions for model development, and to consider infrastructure planning strategies and best management practices to manage stormwater.

Meeting Objectives:

- Provide an overview of the Project, anticipated outcomes, and how it fits into broader strategies
- Understand key issues and opportunities in the Sh-hwuykwselu (Busyplace) watershed
- Confirm assumptions to be used in model development including land use, impervious cover changes, and appropriate design storms
- Review and discuss potential solutions with initial model

Agenda:

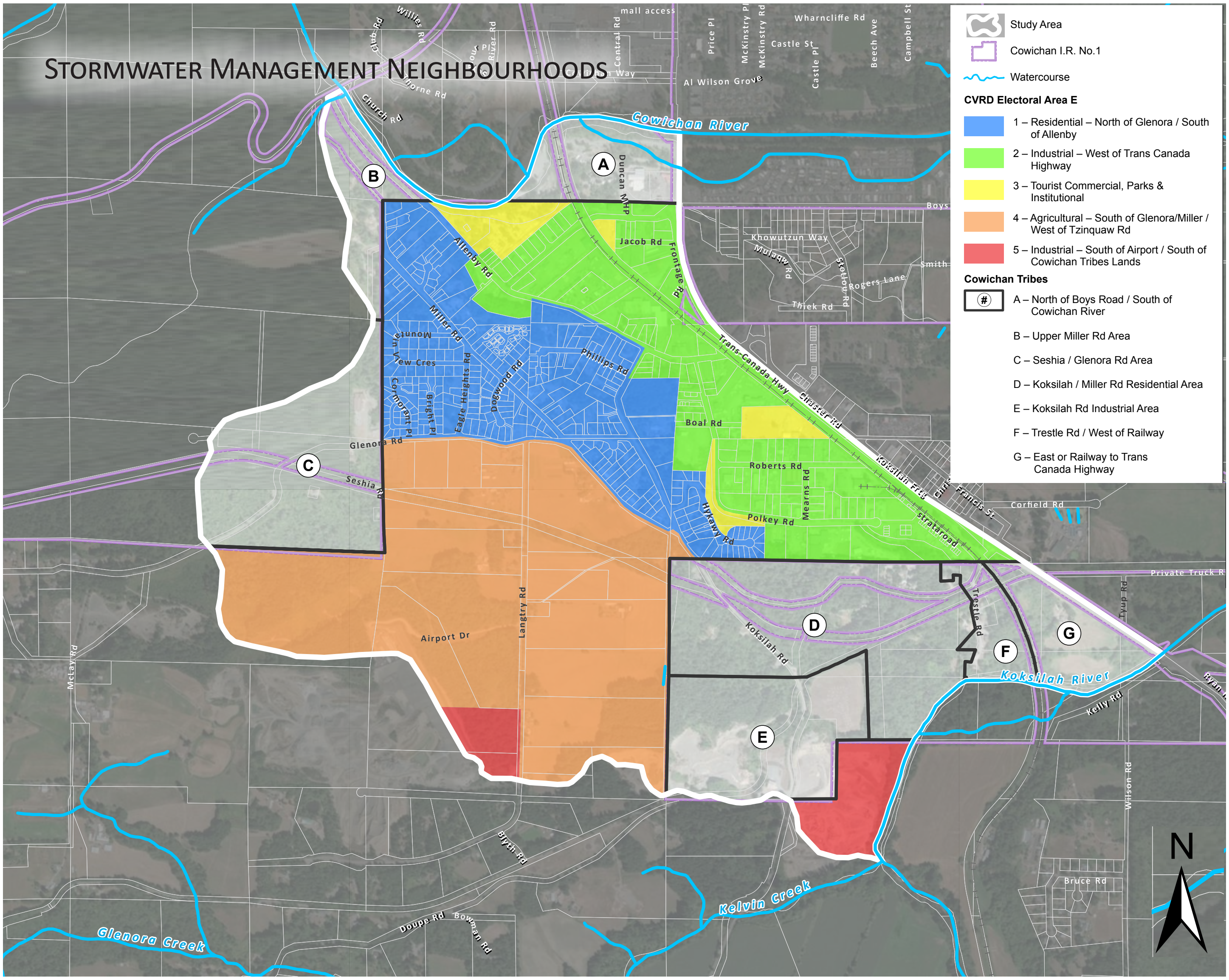
#	Agenda Item	Approx. Time
1	**Welcome, Introductions & Project Background**	**10:00 - 10:30**
2	**Group Discussion:** » Issues and Opportunities for the Sh-hwuykwselu Watershed » Confirmation of modelling assumptions/inputs for technical study	**10:30 - 11:45**
3	**Next Steps**	**11:45 - 12:00**

Please review the following information prior to the meeting.

CVRD

Study Area Context:

The Sh-hwuykwselu watershed comprises several stormwater management neighbourhoods. The Study Area includes areas of **Cowichan Tribes & Electoral Area "E"** lands west of the Trans Canada Highway, between the Kosilah and Cowichan Rivers, up to the watershed boundary west of Quw'tsum Smuneem Elementary School.



Stormwater Management Neighbourhoods

Please refer to the attached Technical Memo #1:
Key Stormwater Management Design Criteria & Modelling Assumptions

Discussion Questions:

Understanding the perspectives of the stakeholders, Cowichan Tribes, and the community on current and future stormwater management for the Sh-hwuykwselu (Busyplace) watershed is an integral part of developing the **Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan.** The following discussion questions are provided for review and consideration prior to the meeting. Please come prepared to share ideas. Before or during the meeting, please record your responses in the spaces provided. We will collect the discussion question pages at the end of the meeting. If you need more space for your comments, please use a blank sheet and include it with your response.

VISION & VALUES

1. **What would the future of successful stormwater management in the Sh-hwuykwselu (Busyplace) watershed look like?**

2. **Do you think the planning horizon of 2050 is appropriate for the Study?**

ISSUES & OPPORTUNITIES

3. **What would you say are the key issues concerning stormwater management in the Sh-hwuykwselu (Busyplace) watershed?**

4. **What would you say are opportunities for stormwater management in the Sh-hwuykwselu (Busyplace) watershed?**

ASSUMPTIONS

5. In terms of the assumptions that will be used to develop the model for the technical study, please provide any comments about the following:

   a. Do you agree with the assumptions about land use areas as defined in the Study area?

   b. Do you agree with the information about types of soils assumed for the Study area?

   c. Do you agree with the watershed boundaries assumed for the Study area?

   d. Do you agree with the percentage changes of impervious cover indicated for the study area?

   e. Are the design for storms for the Study area appropriate?

6. Based on the review of assumptions to be used for the development of the model, what are some potential solutions (e.g. storage, culvert upgrades, etc.)?

7. If you do not agree with the assumptions, please provide other potential resources (e.g. studies, maps, guidelines, etc.) that we can use to improve or update our assumptions.

ADDITIONAL COMMENTS?

8. Do you have any other comments you would like to share at this time?

Project Contacts:

Keith Lawrence, Environmental Analyst, CVRD | 250.746.2643 | klawrence@cvrd.bc.ca

Tracy Fleming, Lulumexun Lands Dept., Cowichan Tribes | 250.748.3196 | tracy.fleming@cowichantribes.com

Project Process:

The following diagram illustrates the overall process for the Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan with the engagement process running parallel to the technical process.

TECHNICAL PROCESS

1. Background Review
2. Engagement Plan
3. ROUND 1 ENGAGEMENT
4. Hydrological Modelling
5. Hydrological/Hydraulic Model
6. Drainage Infrastructure Assessment
7. ROUND 2 ENGAGEMENT
8. STORMWATER MANAGEMENT & MITIGATION PLAN

ENGAGEMENT PROCESS

UNDERSTANDING ISSUES & OPPORTUNITIES
April - June 2018

What are the issues and opportunities for stormwater management?

Stakeholder Meetings:

» Technical Advisory Group
» Cowichan Tribes
» Interested Stakeholders

DRAFT PLAN RECOMMENDATIONS
September 2018

What are some potential solutions for stormwater management?

Stakeholder Meeting:

» Technical Advisory Group

STORMWATER MANAGEMENT & MITIGATION PLAN
October 2018

What are ways to plan for & implement stormwater management?

Final Plan Presentation:

» Technical Advisory Group

What is Stormwater?

- Surface water resulting from rain, snow or storms that does not soak into the ground

What is a Stormwater Management Plan?

- A plan that considers a range of approaches to guide future infrastructure improvements & priorities to mitigate flooding, erosion, and water quality impacts.

Why Do We Need a Plan?

- To protect property and the public
- To mitigate flooding & erosion risk
- To improve water quality & flows for salmon and stream habitat

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

TECHNICAL ADVISORY GROUP MEETING #1

Name:	Organization:	Please Sign in:
CRAIG SUTHERLAND	KWL	[signature]
Jae Miller	CVRD	[signature]
CAM WILLIAMS	COW - Surveyor	[signature]
Louise Knodel-Joy	CVRD - Water Management	[signature]
CORALIE BREEN	CVRD - PLANNING	[signature]
Jeff Moore	CVRD - Env. Services	[signature]
Bev Suderman	CVRD - Planning	[signature]
GRAHAM GIDDEN	CVRD - PARKS + TRAILS	[signature]
Sybille Sanderson	CVRD - Emergency Program Coord.	[signature]
Tom Rutherford	Cowichan Watershed Board	[signature]
Rob Conway	CVRD - Inspections + Enforcement	[signature]

Thank you for your participation. Your input will be used to inform the development of the Stormwater Management & Mitigation Plan for Sh-hwuykwselu (Busyplace) Watershed.

CVRD

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

TECHNICAL ADVISORY GROUP MEETING #1

Name:	Organization:	Please Sign in:
AMY MELMOCK	ECONOMIC DEV. COWICHAN (CVRD)	
Mike Boissonneault	Ministry of Transportation	
Eyvette Elliott	Cowichan Tribes / Lands	
Tracy Fleming	Cowichan Tribes, Lands Dept.	
David Reid	Lorane	
Keith ~~Re~~ Lawrence	CVRD	
+ Hamid? - GM Engineering, CVRD		

Thank you for your participation. Your input will be used to inform the development of the Stormwater Management & Mitigation Plan for Sh-hwuykwselu (Busyplace) Watershed.

CVRD

Technical Advisory Group Meeting#1

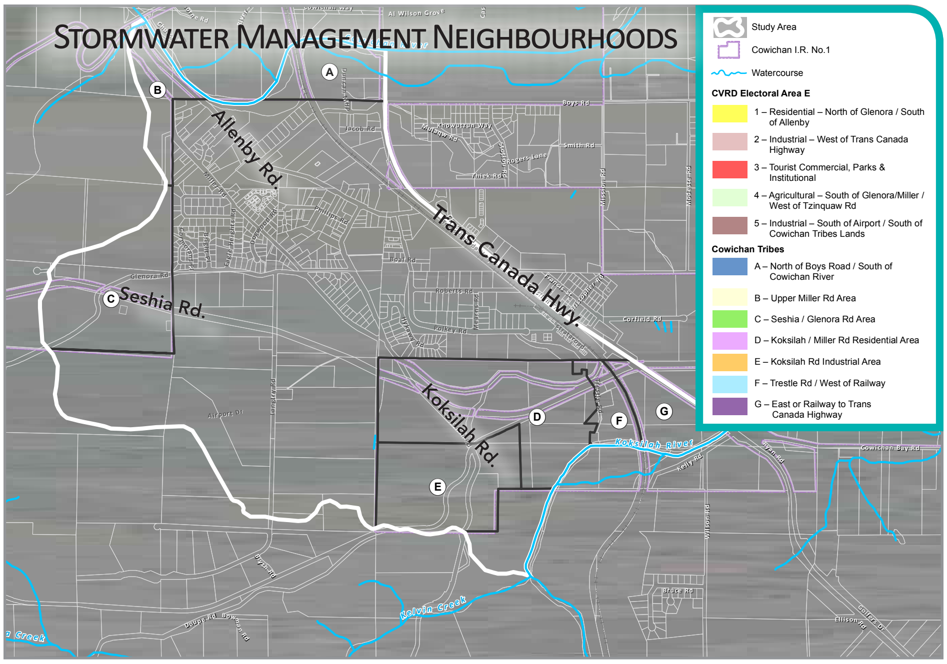
COWICHAN TRIBES MEETING
JUNE 4, 2018

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Understanding Issues & Opportunities in the Watershed

Background:

The Cowichan Valley Regional District (CVRD) in cooperation with Cowichan Tribes, is developing a plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed. The plan will help ensure that our communities remain safe from flooding and erosion as well as improve the quality of stormwater runoff.



What is Stormwater?

- Surface water resulting from rain, snow, or storms that does not soak into the ground

What is a Stormwater Management Plan?

- A plan that considers a range of approaches to help guide future infrastructure improvements & priorities to mitigate flooding, erosion, and water quality impacts from stormwater

Why Do We Need a Management Plan?

- To protect property and the public
- To mitigate flooding & erosion risk
- To improve the quality of stormwater runoff

Dinner & Discussion:

- Dinner & A Bit of Background
- Share Your Stories: Flooding, Erosion, & Water Quality in the Watershed
- Mapping Your Community: What are Issues & Opportunities in the Watershed?
- How Can We Move Forward?

CVRD

Project Contacts:
Keith Lawrence, CVRD, klawrence@cvrd.bc.ca
Tracy Fleming, Cowichan Tribes, tracy.fleming@cowichantribes.com

Process:

The following process diagram illustrates the overall engagement process and key activities for the Sh-hwuykwselu (Busyplace) Stormwater Management and Mitigation Plan.

UNDERSTANDING ISSUES & OPPORTUNITIES
April - June 2018

What are the issues and opportunities for stormwater management in the watershed?

Stakeholder Meetings:
- Technical Advisory Group
- Cowichan Tribes
- Interested Stakeholders

DRAFT PLAN RECOMMENDATIONS
Sept. 2018

What are some potential solutions for managing stormwater in the watershed?

Stakeholder Meeting:
- Technical Advisory Group

STORMWATER MANAGEMENT & MITIGATION PLAN
Oct. 2018

What are some ways to plan for an implement stormwater management practices in the watershed?

Final Plan Presentation:
- Technical Advisory Group

We Need Your Input!

Please submit a questionnaire at this event. If you prefer, you can also submit an **online questionnaire** - please refer to the link at the bottom of this page.

ONLINE FEEDBACK FORM

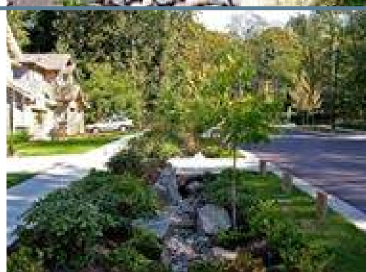
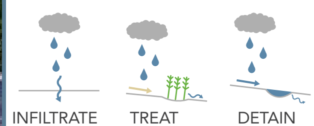
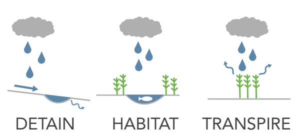
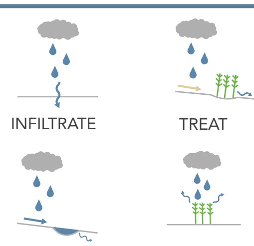
Know someone else who may be interested in stormwater management for our watershed? Please let them know about the online questionnaire and how they can provide input. Feedback will be used to help shape a stormwater management plan for the watershed.

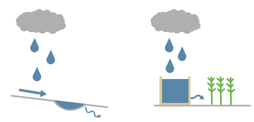
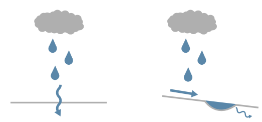
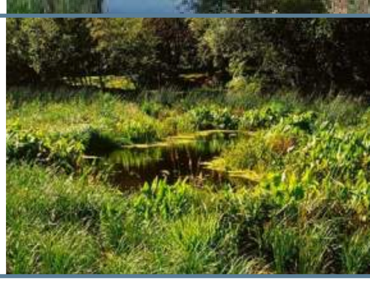
The deadline for all input is Friday, June 22, 2018.

Thank You for Your Involvement!

For more information, Project updates, or to view materials online, please visit: www.cvrd.bc.ca/busyplace

Best Management Practice Toolkit Summary Table

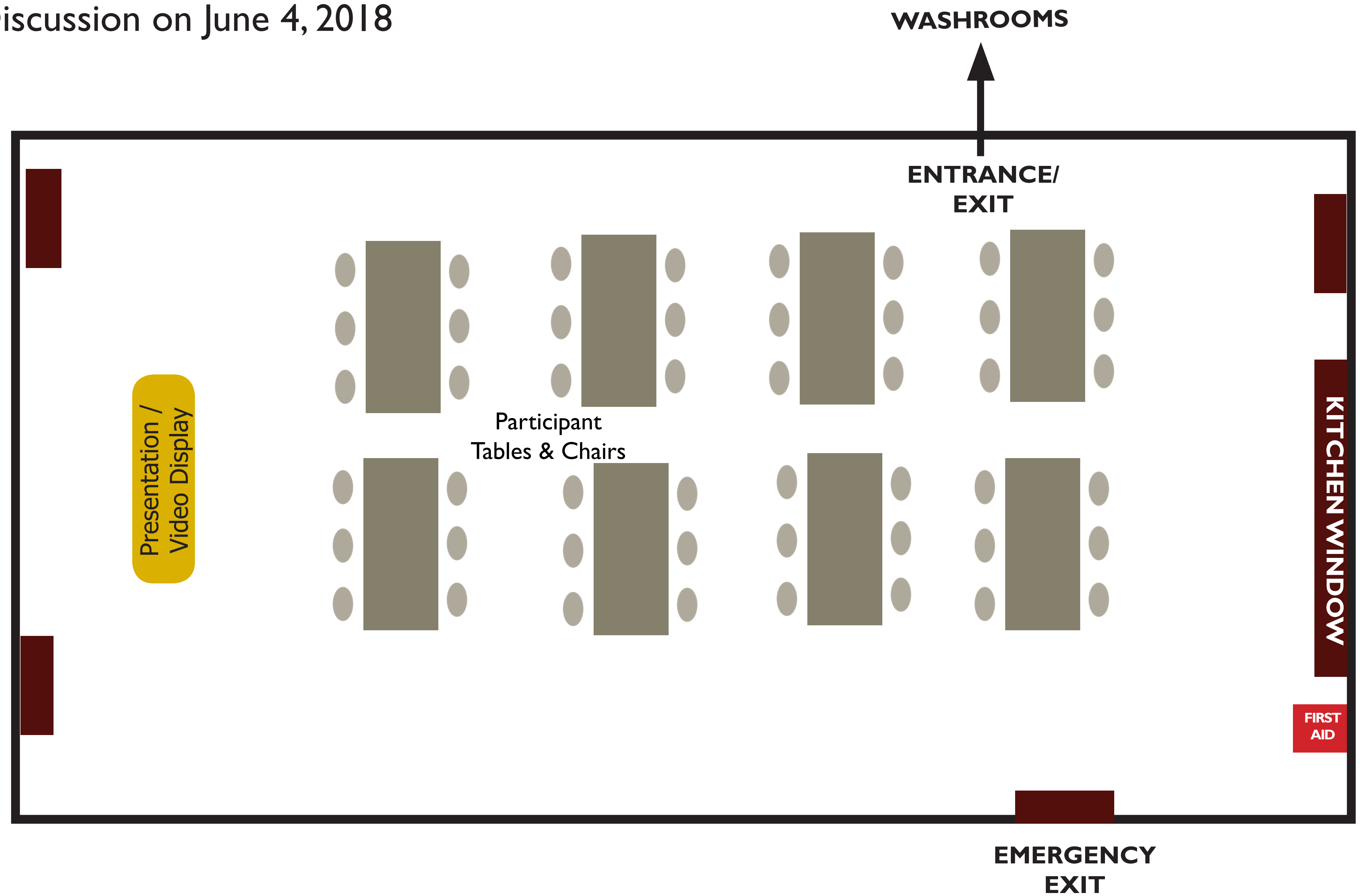
TOOL		IMPACTS ON WATER	BENEFITS
Absorbent Landscapes			• intercept and clean rainwater through soil pores, allowing gradual infiltration into subsoils to recharge groundwater
Infiltration Swales			• reduce runoff volume and increase water quality by capturing, detaining, treating, and conveying stormwater
Rain Gardens & Infiltration Bulges			• reduce runoff volume and improve water quality by infiltrating, capturing, and filtering stormwater • an overflow conveys extreme rainfall volumes
Pervious Paving			• reduce runoff volume and improve water quality by infiltrating and treating stormwater while still providing a hard, drivable surface
Green Roofs			• reduce stormwater peak flows and volume, depending on depth of growing medium • benefit buildings by providing insulation and by reducing the heat island effect • provide urban habitat
Tree Well Structures			• adequate soil volume will retain excess stormwater and help to remove pollutants from stormwater runoff • support a healthy tree canopy which intercepts rainfall

TOOL		IMPACTS ON WATER	BENEFITS
Stormwater Harvesting		 DETAIN; CAPTURE & REUSE	• runoff from roof surfaces can be captured, stored and used for non-potable uses like landscape irrigation, laundry, and toilets
Infiltration Trenches		 INFILTRATE; DETAIN	• reduce the volume and rate of runoff by holding and infiltrating water into subsurface soils • water quality pre-treatment is advisable
Water Quality Structures		 TREAT	• capture hydrocarbons, coarse grit and coarse sedminent • provide some water quality benefits except for soluble nutrients and pollutants
Detention Tanks		 DETAIN	• reduce flooding and in-stream erosion by collecting and storing stormwater runoff during a storm event, and releasing it at controlled rates to the downstream drainage system
Daylighted Streams & Channel Improvements		 DETAIN; HABITAT; TREAT	• may provide in-stream detention, water quality improvements, and essential habitat for aquatic life • contribute to the liveability of an area and establish a sense of place if properly designed
Constructed Wetlands		 DETAIN; HABITAT; TREAT	• provide detention, storage, habitat, and treat stormwater runoff through natural processes prior to discharging it into the downstream drainage system

CVRD / Cowichan Tribes - Sh-hwuykwselu (Busyplace) Project
FLOOR PLAN for Dinner & Discussion on June 4, 2018

JUNE 4TH SCHEDULE

- Cook Arrives: 2:00 pm
- YTT Set-Up: 2:30 - 4:00 pm
- Facilitator Set-Up: 4:00 - 5:00
- Doors: 5:30 pm
- Dinner & Discussion: 6:00 - 8:00 pm
- Take-Down: 8:00 - 9:00 pm



Si'em Lelum Gymnasium Kitchen/Dining Area
5574 River Rd., Duncan, BC

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

TECHNICAL ADVISORY GROUP MEETING #1

Name:	Organization:	Please Sign in:

Thank you for your participation. Your input will be used to inform the development of the Stormwater Management & Mitigation Plan for Sh-hwuykwselu (Busyplace) Watershed.

CVRD

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

COWICHAN TRIBES - JUNE 4, 2018

Name:	Email*:	Please Sign in:
Tracy Fleming	tracy.fleming@cowichantribes.com	
Keith Lawrence	keith.e.lawrence@gmail.com	
Zachary Elliott	zacheg@hotmail.com	
Simon Kulchyski		
Nola Kulchyski		
Tim Kulchyski	Tim.kulchyski@cowichantribes.com	
Kate Miller	kmiller@cvrd.bc.ca	
CRAIG SUTHERLAND	csutherland@kwl.ca	
TERRY DANIELS	tdaniels@sd79.bc.ca	
Mary Wilson	marygeorgewilson@gmail.com	
Deanna George	geofam91@outlook.com	
Eyvette Elliott	e.hannah@live.ca	
LEMO SMITH		
CINDY DANIELS	cindy.daniels@hotmail.com	
RON DANIELS	rdaniels404@gmail.com	
E. Lisa Daniels	~~ldaniels~~ ldaniels699@icloud.com	
Peter Williams		
Philomena Williams	philomena.williams@shaw.ca	
Luschiim		

* If you would like to be updated about Project developments, please provide your email too (it will be used solely for Project updates.)

CVRD

Thank you for your participation. Your input will be used to help develop a plan to manage rain and flood waters in the Sh-hwuykwselu (Busyplace) Watershed.

WELCOME

Cowichan Tribes
Dinner & Discussion

Cowichan Tribes Dinner & Discussion

QUESTIONNAIRES

Please submit your completed questionnaire forms here.

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

QUESTIONNAIRES

Please submit your completed questionnaire forms here.

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

COMMUNITY EVENT FOR INTERESTED PUBLIC

JUNE 7, 2018

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

Understanding Issues & Opportunities in the Watershed

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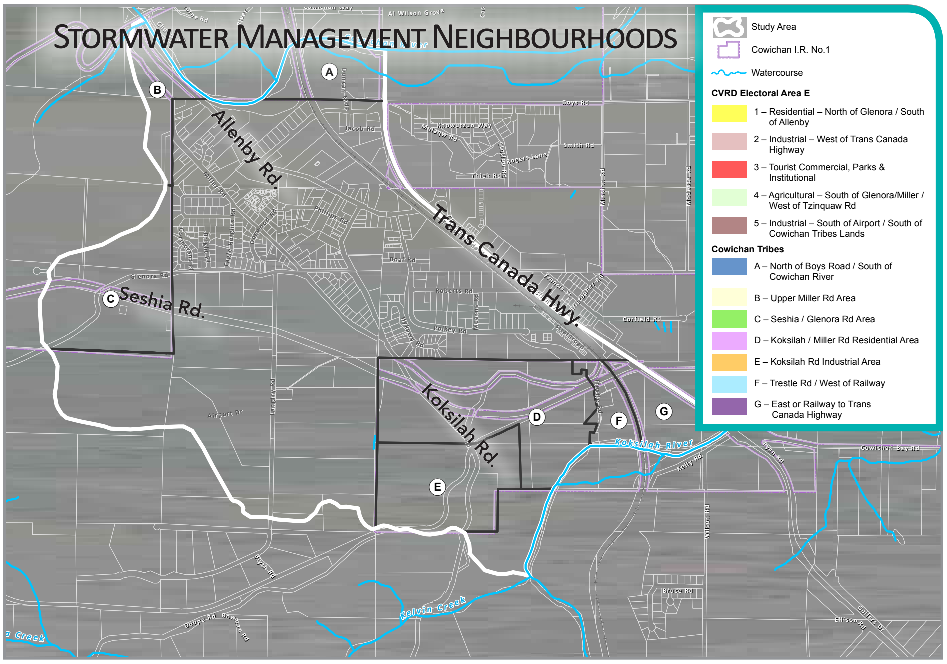

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- To protect property and the public
- To mitigate flooding & erosion risk
- To improve the quality of stormwater runoff

Community Event:

- Background Presentation
- Mapping Your Community: What are Issues & Opportunities in the Watershed?
- Discussion: How Can We Move Forward?
- Public Questionnaire
- Questions & Comments

CVRD

Project Contacts:

Keith Lawrence, CVRD, klawrence@cvrd.bc.ca
Tracy Fleming, Cowichan Tribes, tracy.fleming@cowichantribes.com

Process:

The following process diagram illustrates the overall engagement process and key activities for the Sh-hwuykwselu (Busyplace) Stormwater Management and Mitigation Plan.

UNDERSTANDING ISSUES & OPPORTUNITIES
April - June 2018

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DRAFT PLAN RECOMMENDATIONS
Sept. 2018

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Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

PUBLIC QUESTIONNAIRE

The Cowichan Valley Regional District, in partnership with Cowichan Tribes, is developing the **Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan** - plan to help manage rain and flood waters affecting communities in the Sh-hwuykwselu (Busyplace) watershed. The plan will help ensure that our homes and communities remain safe from flooding and erosion.

The Project began in April 2018, and will continue over the coming months, to be completed in October 2018. Understanding the perspectives of the key stakeholders, Cowichan Tribes, and the community on stormwater management for the watershed is an integral part of developing the plan.

We'd like to invite interested community members to share knowledge and experiences with flooding and erosion in the Sh-hwuykwselu (Busyplace) watershed, and to talk about ways to move forward. Please share your knowledge, experiences, and ideas!

Your input is important!

The questionnaire will take about 12 Minutes to complete.
Please submit your form no later than:

Friday, June 22, 2018

Would you prefer to complete the questionnaire online?
Please visit the link below.

Your feedback will inform the development of the Stormwater Management & Mitigation Plan for Sh-hwuykwselu watershed.

What is Stormwater?

- Surface water resulting from rain, snow, or storms that does not soak into the ground

What is a Stormwater Management Plan?

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Why Do We Need a Management Plan?

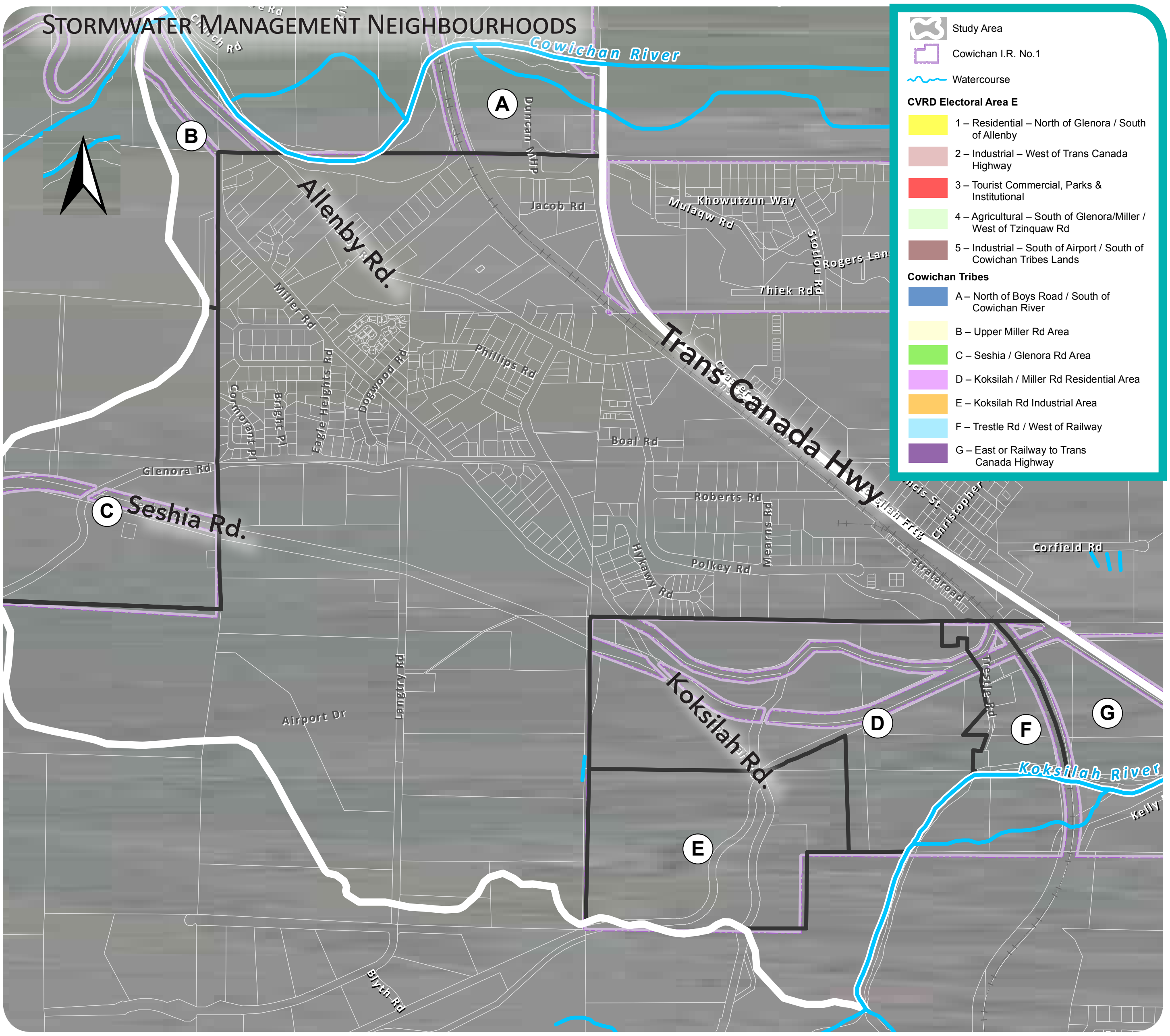
- To protect property and the public
- To mitigate flooding & erosion risk
- To improve water quality & flows for salmon and stream habitat

CVRD

For information, Project updates, or to view materials online, please visit www.cvrd.bc.ca/busyplace.

Study Area Context:

The Sh-hwuykwselu watershed comprises several stormwater management neighbourhoods. The Study Area includes areas of **Cowichan Tribes & Electoral Area E** lands west of the Trans Canada Highway, between the Kosilah and Cowichan Rivers, up to the watershed boundary west of Quw'tsum Smuneem Elementary School.



SECTION 1: Watershed Land

Please refer to the study area map on the previous page illustrating the Sh-hwuykwselu (Busyplace) watershed 'Stormwater Management Neighbourhoods' in both the Cowichan Tribes Area and Electoral Area "E".

QUESTION 1:

Please indicate which stormwater management neighbourhood in the study area that you either live in or manage land. If you live in or manage land in more than one area, please provide an additional response form for each area of land you live in or manage.

If you live in the Cowichan Tribes area, what best describes where you live?

☐ A - North of Boys Road / South of Cowichan River
☐ B - Upper Miller Road Area
☐ C - Seshia / Glenora Road Area
☐ D - Koksilah / Miller Road Residential Area
☐ E - Koksilah Road Industrial Area
☐ F - Trestle Road / West of Railway
☐ G - East of Railway to TransCanada Highway
☐ Other in the study area (please describe) ______________________________

If you live in Electoral Area "E", what best describes where you live?

☐ 1 - North of Glenora / South of Allenby (Residential)
☐ 2 - West of TransCanada Highway (Industrial)
☐ 3 - Tourist, Commercial, Parks & Institutional Land
☐ 4 - South of Glenora / Miller and West of Tzinquaw Road (Agricultural)
☐ 5 - South of Airport / South of Cowichan Tribes Lands (Industrial)
☐ Other in the study area (please describe) ______________________________

QUESTION 2:

If you selected that you live or manage land in the study area, what is the address (street address or legal parcel description)? *Please note that lot-specific information will be held confidential, with only neighbourhood-scale information released.*

____

If you don't live or manage land in the Sh-hwuykwselu (Busyplace) watershed, please skip to Question 11 and 12 to provide general comments or questions.

SECTION 2: Stormwater Management Issues

QUESTION 5:

Have you experienced any of the following flooding issues on your property or the land you manage? If so, please describe how the problems have affected your property and use. For each answer, please describe the maximum depth, room type, or outdoor use affected in the space beside.

- ☐ Flooding of main dwelling (s) ________________________________
- ☐ Flooding of out-building e.g. garage, shed __________________________
- ☐ Flooding of commercial or industrial building ________________________
- ☐ Flooding of outdoor driveway or parking/storage area ____________________
- ☐ Flooding of outdoor lawn or garden area ___________________________
- ☐ Flooding of farm or agricultural area ____________________________
- ☐ Flooding of undeveloped or wooded area ___________________________

QUESTION 6:

Have you experienced erosion issues on your property of the land you manage? Please check all that apply and describe how erosion impacts you. Please describe the impact in the space beside your answer(s).

- ☐ A. Land slide of steep slopes ________________________________
- ☐ B. General erosion and gullying of gentle slopes ______________________
- ☐ C. Erosion of stream banks or channels ___________________________
- ☐ D. Other (please describe) _________________________________

QUESTION 4:

How concerned are you about flooding and erosion impacting your land or the land you manage?

- ☐ I am not concerned at all
- ☐ I am somewhat concerned
- ☐ I am not sure
- ☐ I am concerned
- ☐ I am very concerned

QUESTION 7:

Are there any actions you have take, or plan to take, to reduce flooding and erosion (gradual movement of soil by rain, groundwater, or stormwater) on your land or the land you manage (e.g. elevate site or building, capture rainwater in rain gardens or soakaway pits, increase ditching or piping)? Please specify.

- ☐ Yes ____
- ☐ No ____

SECTION 3: Planning for the Future

QUESTION 8:

We would like to get an understanding of the amount of *impervious surfaces* (surfaces where water does not soak through) and *pervious surfaces* (surfaces where water can be easily absorbed) on your land or the land you manage both today and in the future.

A. Please give a general percentage range of each of the following surfaces below (e.g. roof, lawn, woods) TODAY (i.e. in April 2018). Provide your best estimate – percentages don't have to be measured or exact.

Surfaces	<5%	5-10%	10-15%	5-20%	20-25%	Other (specify)
Roof						
Asphalt or Concrete Pavement						
Gravel Drive or Gravel Yard						
Lawn or Garden						
Field						
Woods						
Other (please specify)						

B. Please give a general percentage range of each of the following surfaces below (e.g. roof, lawn, woods) in the FUTURE (i.e. existing plus anticipated over the next 25 years). Provide your best estimate – percentages don't have to be measured or exact.

Surfaces	<5%	5-10%	10-15%	5-20%	20-25%	Other (specify)
Roof						
Asphalt or Concrete Pavement						
Gravel Drive or Gravel Yard						
Lawn or Garden						
Field						
Woods						
Other (please specify)						

SECTION 3: Planning for the Future Cont.

QUESTION 9:

If you anticipate much change on your land or the land you manage, how fast do you expect to reach the total anticipated change of use? Please check one below.

- ☐ Within 1 year
- ☐ Within 5 years
- ☐ Within 10 years
- ☐ Within 15 years
- ☐ Within 20 years
- ☐ Within 25 years
- ☐ Beyond 25 years
- ☐ Other (specify) ______________________________

QUESTION 10:

Please indicate your level of support for implementing low-impact stormwater management techniques on your land or the land you manage. Some examples include raingardens, rainwater capture from rooftops, infiltration swales, or porous paving).

- ☐ I do not support
- ☐ I have a low level of support
- ☐ I am neutral
- ☐ I support
- ☐ I have a high level of support

What are Low-Impact Stormwater Management Techniques?


Pervious Paving


Absorbent Landscape


Infiltration Swale


Rain Garden

SECTION 4: General Comments

QUESTION 11:

Please tell us how flooding and erosion have impacted how you visit, use, or enjoy the Sh-hwuykwselu (Busyplace) watershed (i.e. outside of the land you may have or manage in the study area or if you live outside the study area)?

____

____

QUESTION 12:

Please use this space to tell as any other important information you would like us to know about stormwater impacts, stormwater management in the study area, or how stormwater impacts you.

____

____

____

____

____

____

Thank you for your input!

Project Contacts:

Keith Lawrence,
Environmental Analyst
Cowichan Valley
Regional District
T: 250.746.2643
E: klawrence@cvrd.bc.ca

Tracy Fleming
Lulumexun Lands Dept.
Cowichan Tribes
T: 250.748.3196
E: tracy.fleming@
cowichantribes.com

Please remember to submit your form by Friday, June 22, 2018.

All your answers are anonymous, and the information collected will only be used for study purposes to inform the development of the Sh-hwuykwselu (Busyplace) Stormwater Management and Mitigation Plan.

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Understanding Issues & Opportunities

Sh-hwuykwselu (Busyplace) Watershed

BUSINESS & COMMUNITY MEETINGS | June 7, 2018

Today's Agenda

Agenda Item	Approx. Time
Welcome & Introductions	5 min
Project Background & Video	20 min
Community Mapping and Group Discussion:	
Issues & Opportunities for Sh-hwuykwselu Watershed	45
Reporting Back	15
Q&A and Next Steps	5

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead: Dave

Presentation Lead: Cowichan Valley Regional District (Keith Lawrence) – recognize CT and MOTI etc. if present

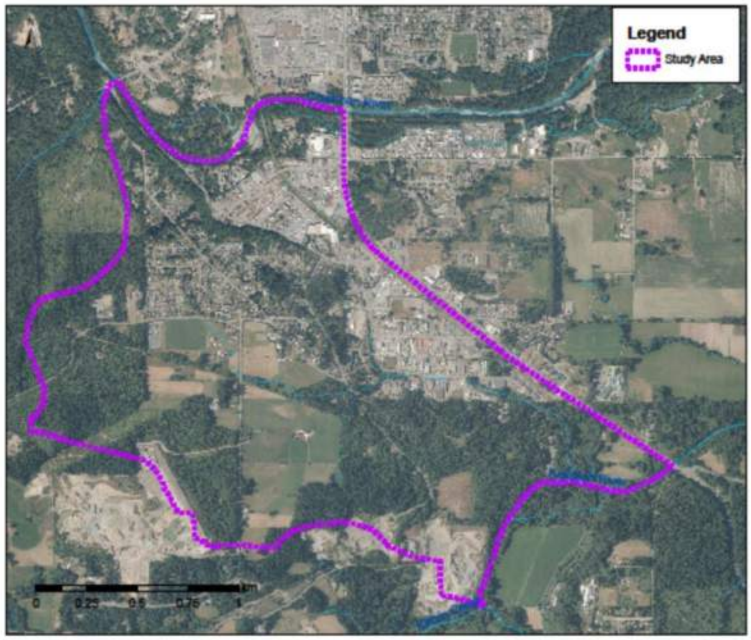
Presentation Lead: Cowichan Valley Regional District (Keith Lawrence)

The program has multiple partners currently that are key to its success and are members of the technical team:

- Cowichan Tribes,
- Ministry of Transportation and Infrastructure
- Public Safety Canada
- Emergency Management BC

Presentation Lead: Cowichan Valley Regional District (Keith Lawrence)

Study Area



Presentation Lead: Cowichan Valley Regional District (Keith Lawrence)

- Study Area is 389 hectares
- The area is bounded by TransCanada highway to the East, Koksilah River to the South, Sh-hwuykwselu Creek to the Southwest and West and Cowichan River to the North.
- The upper watershed areas are mostly agricultural and residential lands.
- The lower watershed areas are mostly industrial and residential lands located in the 200-year Cowichan/Koksilah Floodplain.
- Several organizations have jurisdiction over land use in the project area including the CVRD, Cowichan Tribes and MoTI and MAG

Presentation Lead: Cowichan Valley Regional District (Keith Lawrence)

1. Lower area impacted by flooding from upland as well as Koksilah River
2. Growing residential development
3. Potential for contamination of Surface and groundwater
4. Historic development patterns and

land uses increase risk of flooding impacts

5. No specific water balance targets
6. No single entity has sole responsibility
7. Transition to a new economic base is hindered by flooding potential
8. Importance of planning before investments

- **Historic development patterns and land uses did not take into consideration the impact of stormwater discharge.**

- **Key drinking water source for the City of Duncan, Eagle Heights and communities in the municipality of North Cowichan and the CVRD.**

Video Introduction to Stormwater Management

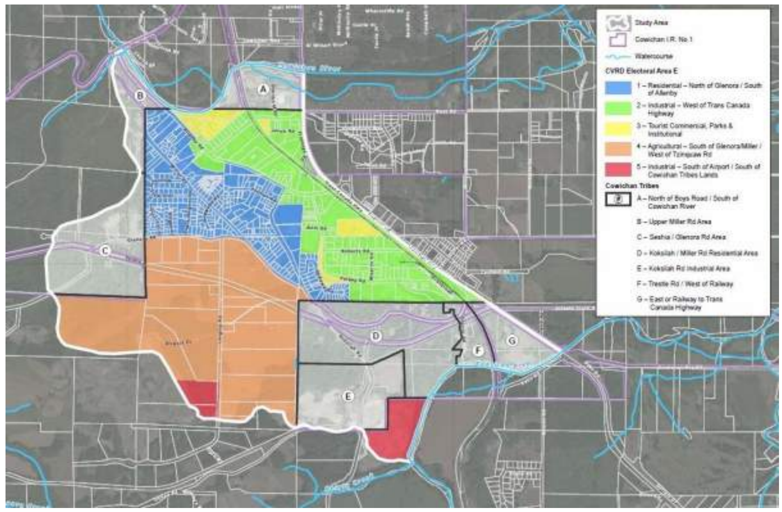
SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead: Dave

Presentation Lead: KWL (Craig Sutherland)

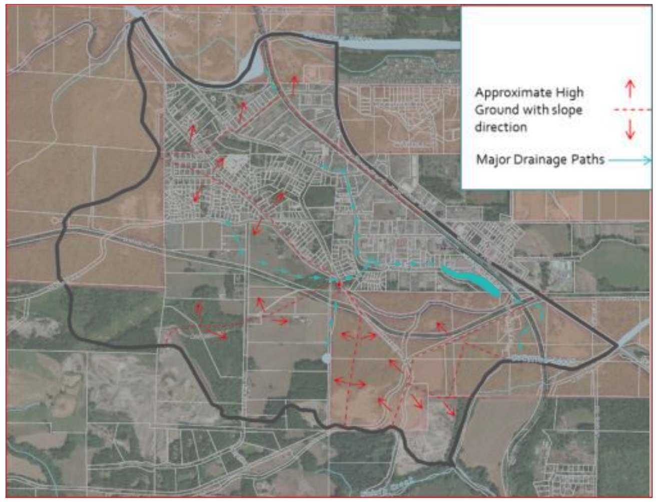
Stormwater Management Neighbourhoods

- Focus on reducing flooding
- Drain as quickly as possible



Presentation Lead: KWL (Craig Sutherland)

Characterizing Watershed

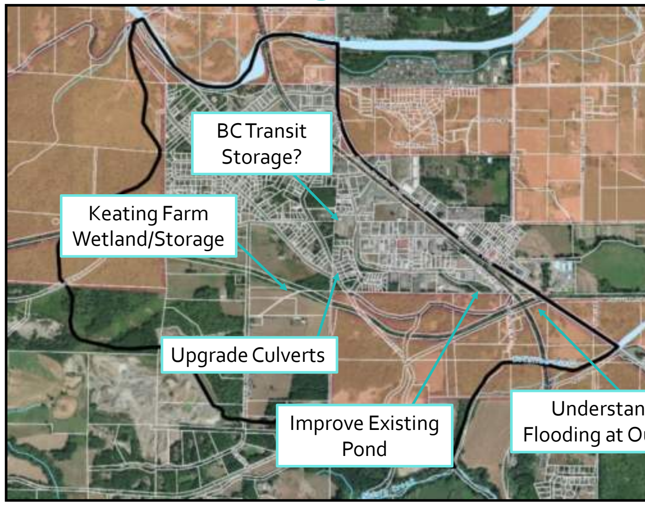


Watershed Boundary/ Drainage

Presentation Lead: KWL (Craig Sutherland)

Potential Drainage Improvements

Characterizing Watershed



SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

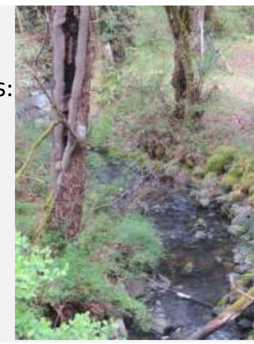
Presentation Lead: KWL (Craig Sutherland)

Project Deliverable

Stormwater Management & Mitigation Plan

Recommendations to mitigate impacts of base and high flows:

- Policy development including environmental, land use, development, infrastructure, and construction
- Drainage infrastructure improvements
- Naturalize streams, wetlands and ponds
- Build community



Presentation Lead: KWL (Craig Sutherland)

- Key drainage infrastructure upgrade plans and cost estimates.

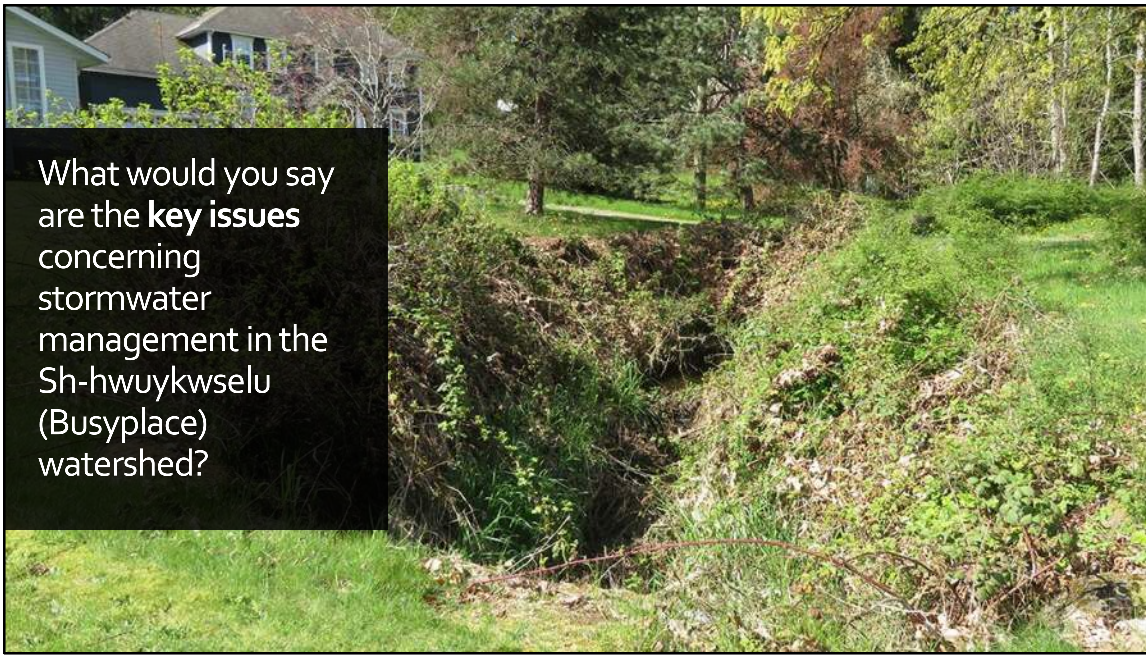
- Solutions in the Stormwater Management Plan should enable:
  - Quantity control
  - Quality control

Questionnaire & Issues & Opportunities

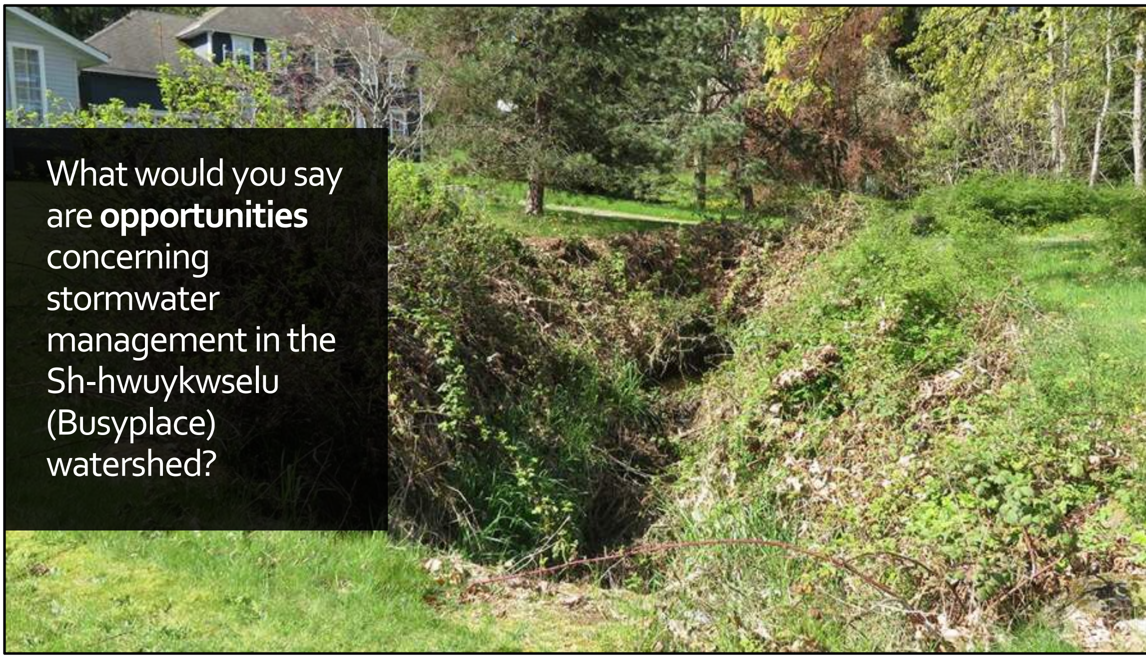
Sh-hwuykwselu (Busyplace) Watershed

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead – Dave

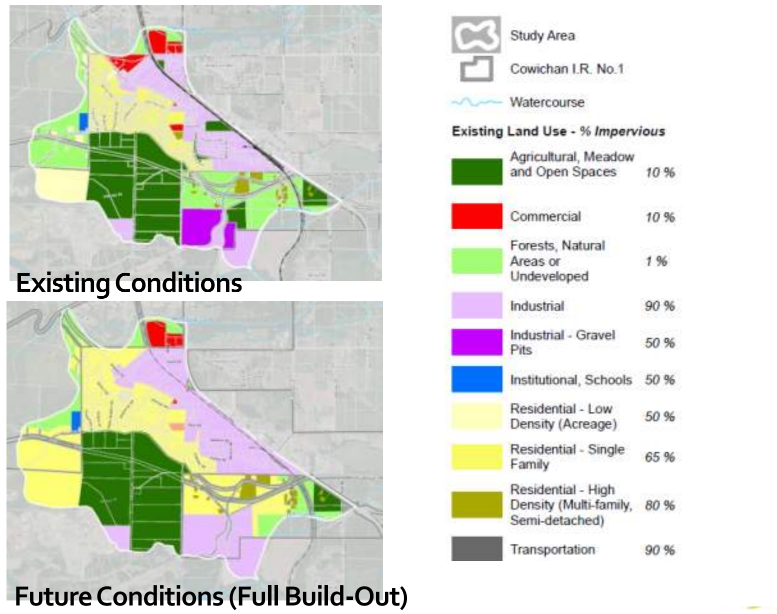


Presentation Lead – Dave



Presentation Lead – Dave

What Impervious Area Needs to be Modelled?



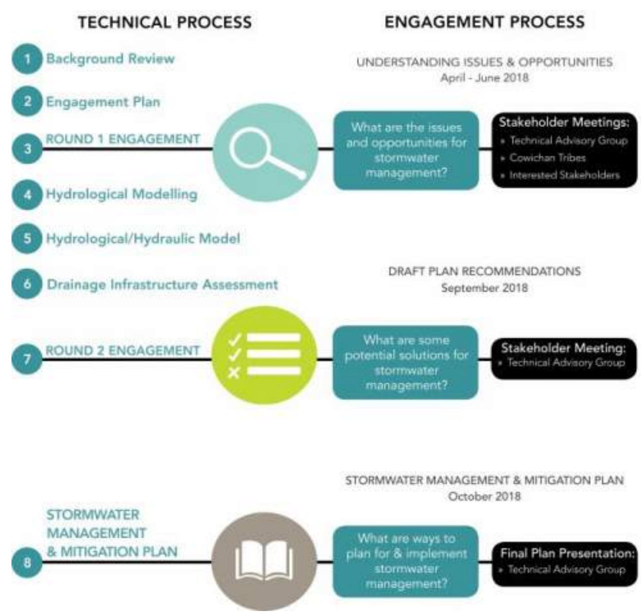
Presentation Lead: Dave

Presentation Lead – Dave

Might be small group, or in plenary depending on attendance

Presentation Lead – Dave

Process and Next Steps



Presentation Lead: Dave

Questions?

Please remember to submit your discussion guide.

Presentation Lead – Dave


Thank You
SH-HWUYKWSELU
BUSY PLACE
CREEK
TROUT AND SALMON
HABITAT
PLEASE PROTECT
OUR HERITAGE

Current Conditions

Information Review (GIS mapping, hydrometric and climate data, stormwater system records and reports, areas of concern

Site Visit of Watershed including key features, stormwater infrastructure, flooding and erosion areas

Base Mapping (topography, watershed boundaries, drainage network, land use (current and future for CVRD and CT)

Presentation Lead: KWL (Craig Sutherland)

Stormwater Management Approach

Evolution in Stormwater Management

Traditional Stormwater Management

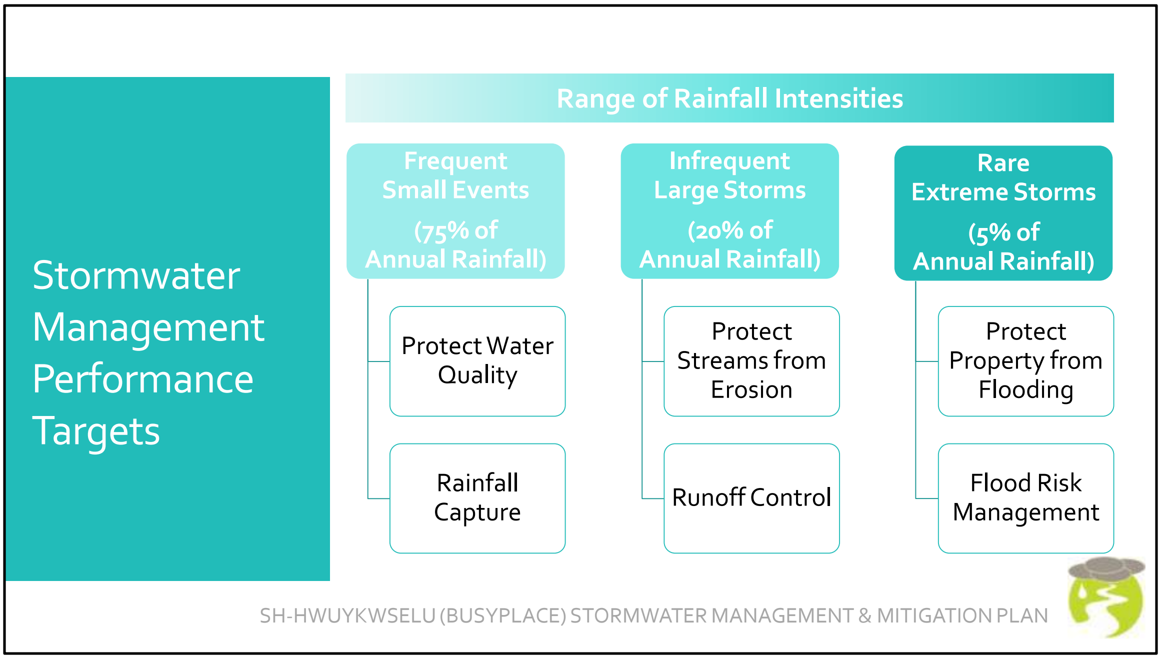
Targets only 5% of Annual Rainfall

Focus on reducing flooding

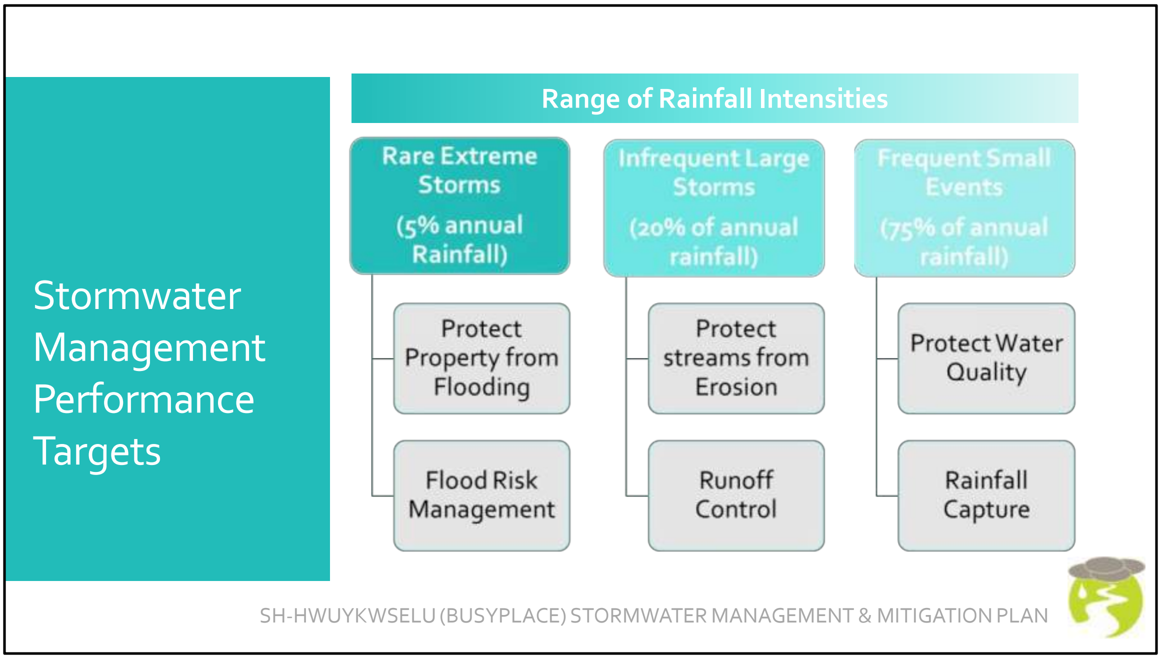
Drain as quickly as possible

Erosion, Poor Water Quality, Downstream Flooding

What about remaining 95% of rainfall?



Presentation Lead: KWL (Craig Sutherland)



Presentation Lead: KWL (Craig Sutherland)

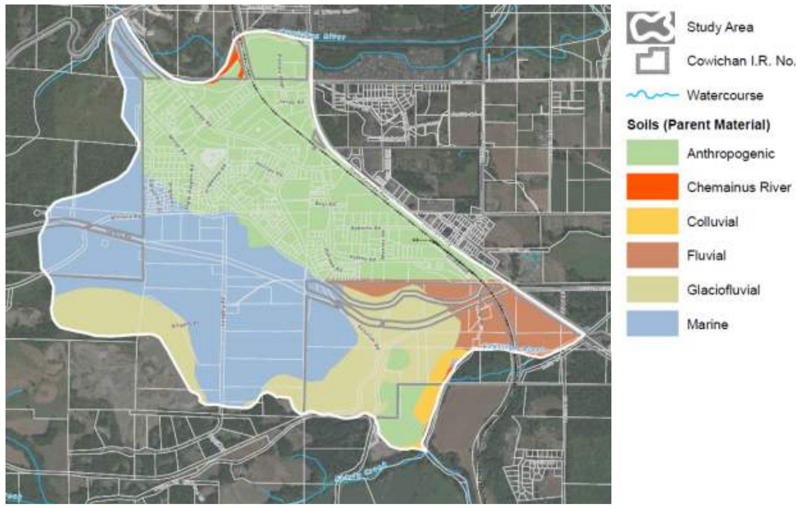
Stormwater Management Design Criteria

Rare Extreme Storms (5% of Annual Rainfall)	Infrequent Large Storms (20% of Annual Rainfall)	Frequent Small Events (75% of Annual Rainfall)
Flood Management Design Criteria	**Stormwater Management Design Criteria**	**Habitat Protection Design Criteria**
200-year return period floodplain	Reduce Peak flow to pre-development levels	Capture and retain
100-year return period for culverts/bridges and overland flow paths	6-month and 2-year return period	6-month return period (72% of 2-year return period 24-hr storm)
10-year return period for storm drains, roadside ditches, etc.		Establish Riparian Setbacks

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead: KWL (Craig Sutherland)

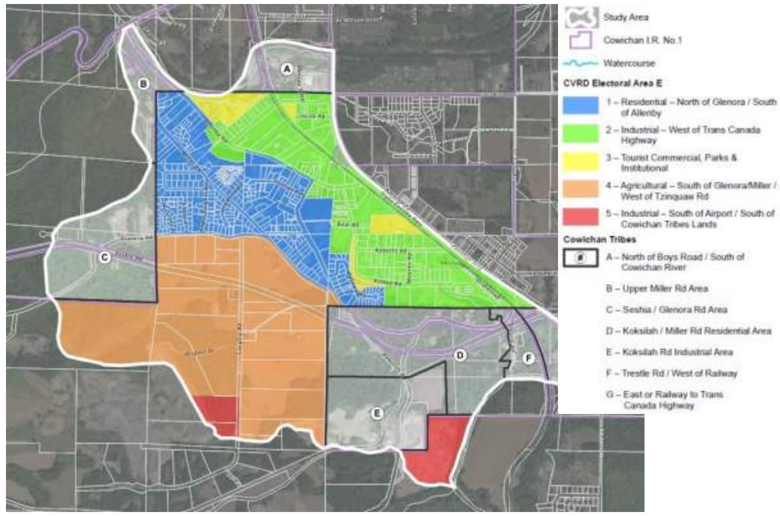
Characterizing Watershed



Soils

Presentation Lead: KWL (Craig Sutherland)

Characterizing Watershed

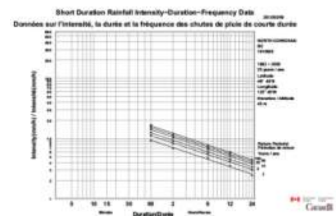


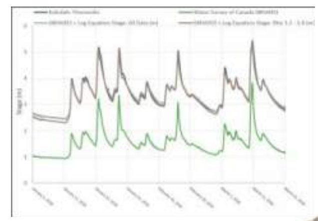
Neighbourhoods

Presentation Lead: KWL (Craig Sutherland)

Rainfall and Water Levels

- No recent data recorded within watershed
- Use rainfall data from North Cowichan Climate Station
- Use Water Level Data recorded on Koksilah River at Highway 1 Bridge to develop downstream boundary conditions





Characterizing Watershed

Presentation Lead: KWL (Craig Sutherland)

Characterizing Watershed

Model Validation

- No water level or discharge data within the watershed.
- January 9, 2018 flood is roughly “bank full” confirmed by photograph.
- Compare model results to photos.

Presentation Lead: KWL (Craig Sutherland)

Characterizing Watershed

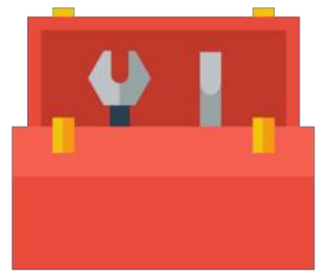
Proposed Model Runs

Model Scenarios	Land Use Type	Climate Data	Design Rainfall
Validation Run	Existing Land Use	Current climate data	Jan. 2018 storm event
Existing Conditions	Existing Land Use	Current climate data	Synthetic design storms with 1-hour to 24-hour duration
		Year 2050 climate data projection with RCP=8.5	
Future Conditions	Full Build-out according to the existing 1994 Electoral Area "E" Official Community Plan and Cowichan Tribes Draft Land Use Framework	Year 2050 climate data projection with RCP=8.5	
	Additional Scenario selected with input from the TAG and community		

Presentation Lead: KWL (Craig Sutherland)

Best Management Practices Toolkit

- Infiltration swales
- Absorbent landscape
- Raingardens/bulges
- Pervious paving
- Green roof
- Tree well structures
- Rainwater harvesting
- Infiltration trenches
- Water quality structure
- Detention tank
- Constructed streams/wetlands



SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead – Lanarc (David Reid)

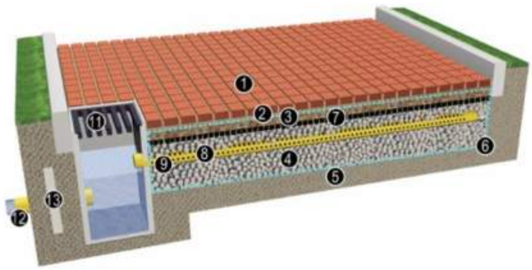
Presentation Lead – Lanarc (David Reid)

Absorbent Landscape

Keeping the 12 stormwater variables in balance is the key to successful stormwater source control using absorbent landscape.

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

Presentation Lead – Lanarc (David Reid)

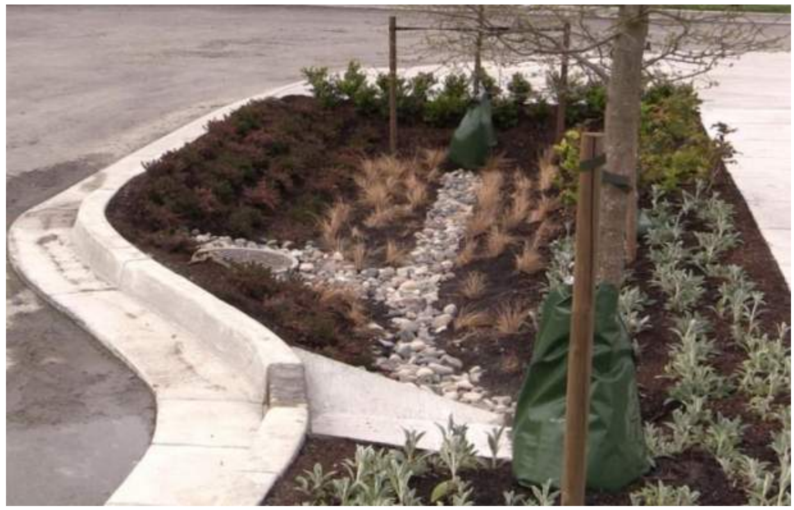


Rainfall flows through small aggregate in the cracks into drain rock and infiltrates into underlying soils.

Pervious Paving

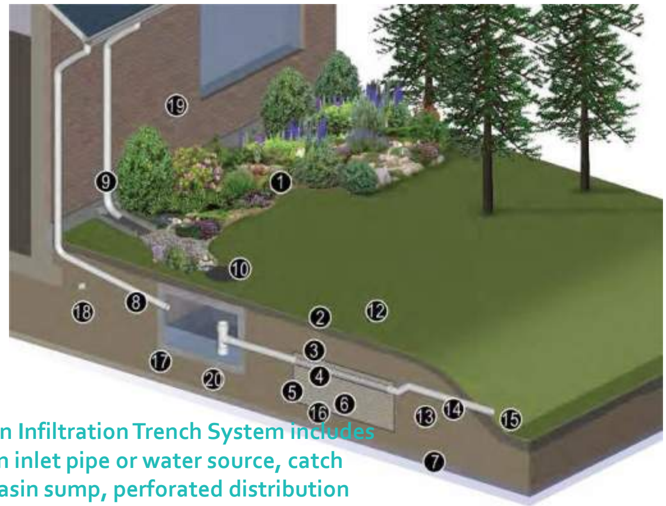
Presentation Lead – Lanarc (David Reid)

Infiltration Bulges



Presentation Lead – Lanarc (David Reid)

Infiltration Trench



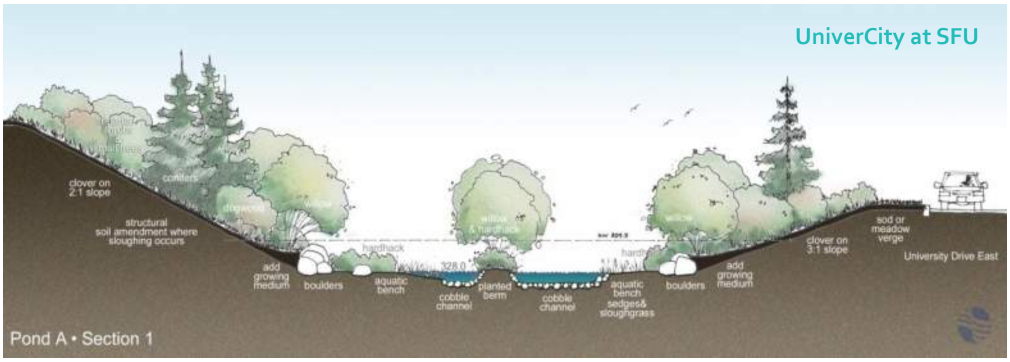
An Infiltration Trench System includes an inlet pipe or water source, catch basin sump, perforated distribution pipe, infiltration trench and overflow to the storm drainage system.

Presentation Lead – Lanarc (David Reid)

Rainwater Harvesting

Rainwater Tank Capture System

Presentation Lead – Lanarc (David Reid)



Constructed Wetlands

Presentation Lead – Lanarc (David Reid)

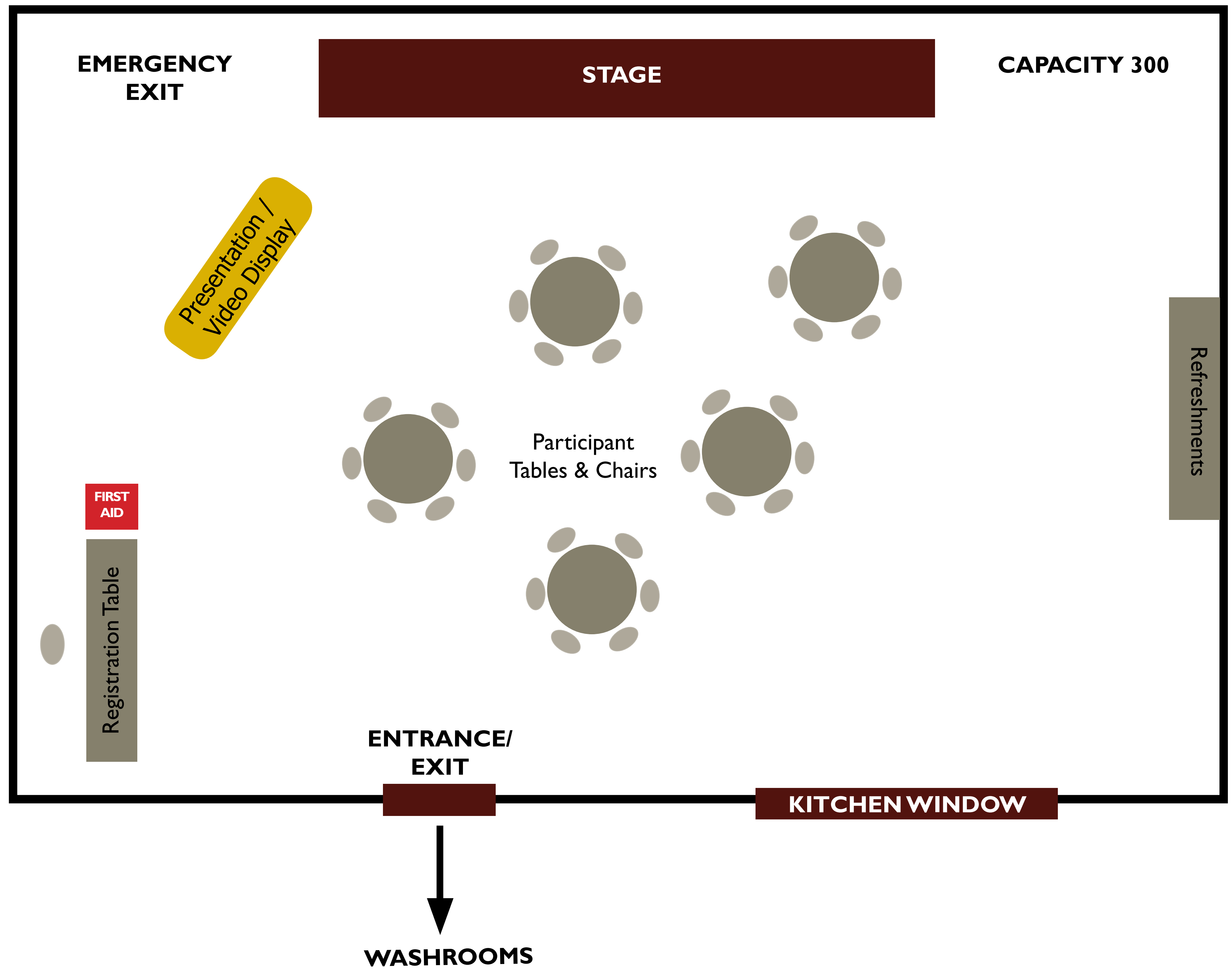
Putting it All Together…

Presentation Lead – Lanarc (David Reid)

CVRD / Cowichan Tribes - Sh-hwuykwselu (Busyplace) Project
FLOOR PLAN for Community Event on June 7, 2018

JUNE 7TH SCHEDULE

- Set-Up: 2:00-3:00 pm
- Session I: 3:00 - 5:30 pm
- Facilitator Break: 5:30 - 7:00 pm
- Session II: 7:00 - 8:30 pm
- Take-Down: 8:30 - 9:30 pm



EAGLES HALL
2965 Boys Rd., Duncan, BC

WELCOME

Community Event

Community Event

QUESTIONNAIRES

Please submit your completed questionnaire forms here.

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

QUESTIONNAIRES

Please submit your completed questionnaire forms here.

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

SH-HWUYKWSELU (BUSYPLACE) STORMWATER MANAGEMENT & MITIGATION PLAN

COMMUNITY EVENT - JUNE 7, 2018

Name:	Email*:	Please Sign in:
Alison Nicholson	anicholson@cvrd.bc.ca	
STEVE ALLEN	ALLEN595@TELUS.NET	[illegible]
DAVE TURNER - Dalven Holdings	DALVEN@SHAW.CA	Dave Turner
Tom Rutherford	tom.cowichan@gmail.com	[illegible]
Tracy Fleming	tracy.fleming@cowichantribes.com	
Shannon Waters	shannon.waters@viha.ca	[illegible]
Teresa Emery	mclayhouse@gmail.com	[illegible]
Andrew Newall	MoTI	
Amy Melmock	CVRD Economic Development	
DAVE REID	LANARC	[illegible]
CRAIG SUTHERLAND	KWL	[illegible]
Susan Doughty	doughtysd2@~~shaw~~ gmail.com	
JILL HEARD	heard@shaw.ca	J Heard
Lynn Woodgate	rwoodgate@shaw.ca	[illegible]
Kathy O'Donnell	jorkodonnell@shaw.ca	Kathy O'Donnell
SUSAN Kaufmann	slkaufmann@shaw.ca	[illegible]
Tom Paterson	firgrove@telus.net	[illegible]
[illegible]	CVRD	

* If you would like to be updated about Project developments, please provide your email too (it will be used solely for Project updates.)

CVRD

Thank you for your participation. Your input will be used to help develop a plan to manage rain and flood waters in the Sh-hwuykwselu (Busyplace) Watershed.

APPENDIX C: DISCUSSION NOTES

APPENDIX C: DISCUSSION NOTES

TECHNICAL ADVISORY COMMITTEE MEMBERS – MAY 9

The Technical Advisory Group meeting was facilitated with a discussion guide which included the following key questions:

VISION & VALUES

What would the future of successful stormwater management in the Sh-hwuykwselu (Busyplace) watershed look like?

- **Goals:** Addressing flooding concerns, aligning overarching values, interactive strategy (how to apply in jurisdiction), environmental asset lens, economic development lens to improve community growth, efficiency in process
- **Management:** Decentralized approach, integrated approach, industry-effective towards partnerships, for agriculture use Water Demand Model for Cowichan Valley (Province of BC, 2013), Regional District structure is challenging as process led by service area and electoral areas differ (in terms of management and funding) so is often site-by-site basis working with developer, more collaboration with Cowichan Tribes jurisdiction, roles and responsibilities unclear
- **Perception/Education:** See rainwater as an asset, rather than a liability; Reframe conversation to focus on positive, focus on aspirational goals/hopes for the future and how we can improve quality of life in watershed (e.g. recreation), collaboration and partnership, infrastructure as a benefit as opposed to tax impediment
- **Planning/Process:** Achievable, incremental improvement, opportunities for bundling services, roles and responsibilities within (who has responsibility for drainage), regulation through development permits (opportunities for innovation), commonalities for funding, new service function, attainable funding, integrated approach
- **Environment**: Low environmental impact, expand naturalization of open ditching along roads, greening, drainage, no environmental damage, focus on natural capital, improved environmental values
- **Technology**: Low technology, stormwater management system integrated into landscaping.
- **Specific Measures**: Expand detention upstream of Polkey Rd., better and diverse flow past Miller Rd., Bunker Creek.

Do you think the planning horizon of 2050 is appropriate for the Study?

- **Yes** – Lines up with OCP planning horizon / other planning processes, use Water Demand Model (Province of BC) but identify that CVRD planning model may change.
- **No** – Opinion that 30 years from now, the annual flooding will have become a greater issue causing damage to property and infrastructure. The fish population and habitat will be further degraded.

ISSUES & OPPORTUNITIES

What would you say are the key issues concerning stormwater management in the Sh-hwuykwselu (Busyplace) watershed?

- **Environment:** Health of watershed to measure, small waterhed area with complex flooding and erosion issues, flooding, contamination, riparian restoration, point-source issues with sediment and volume, CVRD needs to manage stormwater and drainage designs and sediment controls, diversity of environments and ecosystems within the defined drainage areas, resilience.
- **Maintenance:** Culvert sizes and replacements and maintenance function, maintenance of ongoing maintenance of

infrastructure, components of infrastructure, infrastructure maintenance / upgrade, upstream stormwater controls.

- **Specific Measures:** Lengthen the span highway bridge over the Koksilah River.
- **Technology:** Understand flooding and hydrological / hydraulic issues surrounding Trestle Rd., infiltration, distribution of source rather than centralized.
- **Cowichan Tribes**: Identify areas for housing as limited non-flooding areas on reserve, areas on reserve to be kept in natural condition, identify areas of pervious surfaces to help with rainfall management, archaeological evidence (all new projects require Archaeological Impact Assessment), reserve areas most impacted by rainwater and least resources, complexity of large organization with lack of inter-departmental coordination, lack infrastructure, lack of in-house knowledge (e.g. green infrastructure), limited funding, not an option to "retreat" from flood areas due to constrained land
- **Management:** Administrative issues, partnership approach – address flooding and environmental values, efficiency and economic, fractional management of drainage, integrated into existing jurisdiction, Cowichan Tribes – large organization and integration of, funding challenges, varying degrees of understanding, lack of context on path forward, lack of control, no direct authority
- **Perception/Education:** Buy-in from community for a function to pay for management, value rainwater as attribute.
- **Planning/Process:** Development permits are guidelines only in absence of specific information, funding mechanisms in CVRD, other partners; Agricultural demand model, OCP (over 20 years) to recognize more community uses in land areas, provide green infrastructure standards, development permits, zoning setbacks, buffering incompatible uses etc., definition of success – how to measure it?
- **External Factors**: Community growth, climate change.

What would you say are opportunities for stormwater management in the Sh-hwuykwselu (Busyplace) watershed?

- **Perception/Education:** Awareness, best practices, reports, focus on rainwater as an asset, flip opportunities to needs, address watershed health through community engagement strategies
- **Environment:** Identify key areas to remain natural and or developed with greatest percentage of pervious surfaces, key point to recognize water doesn't want to move in a linear fashion – by its nature, it is sinuous; efficient use of resources, riparian area setbacks, streamline protection setbacks, watershed health indicators
- **Planning/Process:** Integrating storm drainage considerations into a diversity of planning processes, structure that supports public distribution system, focus annuity in place of revitalization, partnerships that all parties bring different tools to the table including local experience, model for action-oriented initiatives, use of long-range planning to determine predictions (e.g. climate)
- **Land Use and Development:** Relocate industry, provide nuanced land use, move dangerous industrial areas, strategies for Koksilah Business Park, development guidelines, limit areas/housing for Cowichan, parks/Maplewood park (low lying toe of drainage so much stormwater), transit and storage solutions, "retreat" from flood areas, more mixed use in business park or use a more nuanced approach or more input in terms of how it is developed (i.e. middle-of-the-road scenario), practical solutions for bigger picture yet understand complexities (e.g. water and sewer, development), designate neighbourhood drainage area to protect ultimate receiving environment based on watershed itself
- **Technology**: Retention (e.g. in parkland), develop a model project that could be applied elsewhere, infrastructure upgrades that contribute to stream health, bylaw for drainage designs (LID), sediment control during design,

agricultural water balance model to determine rates based on soils as a potential tool as well as water demand model (2013) to determine amount of water needed for property (for expansion purposes)

ASSUMPTIONS

In terms of the assumptions that will be used to develop the model for the technical study, please provide any comments about the following:

Do you agree with the assumptions about land use areas as defined in the Study area?

- Generally, yes; however, Cowichan Tribes will need to confirm with lands administration to confirm natural areas designations around Glenora Road.

Do you agree with the information about types of soils assumed for the Study area?

- Generally, yes.

Do you agree with the watershed boundaries assumed for the Study area?

- Generally, yes.
- Cowichan Tribes accepts study area boundaries recognizing the area of influence of this small watershed is large – it includes lands east of the TransCanada Highway.

Do you agree with the percentage changes of impervious cover indicated for the study area?

- Generally, yes.

Do you agree with the percentage change of impervious cover for the Study area?

- Opinion that there will be a greater than 1% decrease in natural areas / impervious cover.

Is the design for storms for the Study area appropriate?

- Generally, yes and to support using common tools.

Based on the review of assumptions to be used for the development of the model, what are some potential solutions (e.g. storage, culvert upgrades, etc.)?

- Detention and retention of water (i.e. in industrial park or other places for release in dry summer months).
- Stream daylighting.
- Regulation for development and permitting.
- Parks management (for features of park)
- Adding roughness to culverts or increasing culvert size.
- Maintain on natural features (for ditches and culverts).
- Replace culvert under miller road (near Trestle) with larger one.
- Implement green infrastructure options and support for green roof systems (where appropriate) in industrial areas.

If you do not agree with the assumptions, please provide other potential resources (e.g. studies, maps, guidelines, etc.) that we can use to improve or update our assumptions.

- Cowichan Tribes needs to implement green infrastructure in future (where possible).
- Important that residential areas at high elevations in the Study retrofit their infrastructure etc. to improve percentage of permeable / pervious surfaces.

ADDITIONAL COMMENTS

Do you have any other comments you would like to share at this time?

- Disagreement with regulations on impervious surfaces as a good tool in this context – other techniques and engineered solutions should be allowed.
- Acknowledgement of CVRD and Cowichan Tribes leadership to control flooding and erosion in watershed.
- Flood control and environmental values are not mutually exclusive.

KEY DISCUSSION NOTES

Key themes from the discussion included:

HISTORICAL

- Several channels used to connect two rivers Cowichan and Kosilah which are now blocked off. Settlement used to focus on the junction areas where food was abundant.

ISSUES

- Issues are development pressures and complexity of various land use
- Changing, dynamic rivers
- Flooding in key areas (e.g. residential areas, on Trestle Road)
- Current Trestle Village dike does not allow water to drain and is aggravated by storm surge
- 2008 flood crossed highway and impacted rail and bridge
- Funding constraints
- Various agencies involved (“patchwork”) and no direct function
- Threat of groundwater and surface water contamination
- Future flooding can hinder economic base
- Traditional approach to convey water away quickly resulted in poor quality / contamination
- Climate change – define intensity

OPPORTUNITIES

- Support for forward-thinking approach to gain support within community
- Incorporation of natural systems in solutions – natural capital approach (value in terms of overall community i.e. value of stream vs. value of replacing pipe) to assign value to river as an asset
- Green infrastructure
- Opportunity to enhance watershed (in terms of quality control / quantity control)
- Solution for whole watershed and connectivity through system (not in isolation)
- Alignment with Official Community Plan (OCP) land use changes over time
- Sustainable infrastructure - opportunities to prioritize investment over time when and where needed most
- Determine complete build-out vis-à-vis watershed
- Engage community in terms of watershed health
- Flood risk management (beyond protection) to quickly recover from flooding
- Protect environmental habitat
- Monitoring devices
- Identification of pervious areas
- Storage opportunities for drainage improvements include: BC Transit facility, wetland – irrigation, Miller Road culvert upgrades, pond, better ends for flood outlets
- Fish management (water quality)
- Low impact development to allow slower soak-in rates

HISTORICAL INFORMATION (SH-HWUYKWSELU WATERSHED)

- Prior to contact, Cowichan River Side channel was at Trestle Village/ Sh-hwuykwselu - part of the Sh-hwuykwselu Creek was the Koksilah River pre-contact.
- At early contact, Sh-hwuykwselu was a slough.
- Sheshia Rd. in Glenora wetlands historically fishing area.
- Polkey Road area used to have fish and even up to the "hanging" culverts on Koksilah Rd.
- Historically, salmon reached Quw'utsun Smuneem school and the headwaters at that location.
- Old school (corner of Boys Road and Mission Road) experienced flooding issues in past (1930s).

ISSUES (RELATING TO HIGH WATER ON KOKSILAH RIVER / SH-HWUYKWSELU CREEK)

- While the following issues are outside the Study boundary, they could have a potential impact on flood levels within the Study area; therefore, are summarized for consideration in the planning process:
  - Bridges/Roads crossing the Cowichan and Koksilah Rivers are too narrow and restricting flow.
  - Gravel deposition / accumulation in Koksilah River near the Railway Bridge: about 100,000 m3 of gravel removed per year over three-year period (unclear if Cowichan or Koksilah or both); however, the first year all gravel was back after three days and after the third year of gravel removal, some of the pools were starting to form again. If the river bed rises, dikes would need to rise.
  - Log jam removal needed downstream in the Koksilah River.
- Trestle Village is the highest value that land can be used for - needs managed to avoid flooding.
- Second smaller railway bridge on the tributary needs to be cleared.
- Highway bridge over the Koksilah River is too narrow.
- Large gravel bar at railway bridge.
- Need for ongoing sediment management.
- Concerns about flooding at Trestle Village and water backing up from Koksilah River into Sh-hwuykwselu Creek. Key Observations:
  - Water flows down from upper slopes of the watershed, but flood waters also come from the Koksilah River.
  - As the Koksilah River rises, the flow in Sh-hwuykwselu Creek reverses and flows towards Miller Road. Flow has been observed traveling along the channel between the railway embankment and the dike flowing north. This backflow results in high water on the downstream side of the Miller Road culvert, which then means the pond and upstream channels cannot drain properly.
  - During high flows in the Koksilah River, there is a noticeable water level drop from upstream to downstream at the Highway Bridge and most notably at the railway bridge. This astute observation is similar to what the model developed for the Integrated Flood Management Plan is showing: about 0.5 m water level drop at each bridge.

- Observed flows over Miller Road.
- Is a pump station needed at Trestle village if the water levels in the Koksilah River/ Sh-hwuykwselu Creek can be lowered? What about significant groundwater flows (observed during construction of the new housing in Trestle Village).

- Sh-hwuykwselu Creek flows are not as great as an issue as backups on the Koksilah River.
- Cowichan Community has most significant flooding issues in Cowichan/Koksilah with least resources.
- Inequitable spending on flood protection along Cowichan as opposed to the Koksilah River?
- Resident concerns about overflows on property as a result of increase rainfall: pond on the north side of Miller/Trestle intersection.
- Resident concerns about overflows on wetland: Sheshia Rd. in Glenora.
- Comment from resident during Community Input Session on June 4, 2018: concern that the dyke has not been functional since 1986, causing flooding (potentially due to pond construction) between the multi-family development on Trestle Road (flows onto road because drains get plugged on Trestle near Miller). Concern that since the pond was built, the road seems to be flooding more.
- Opinion that previous work may have increase size of creek.
- Issues caused by 2008 flood.
- Influence of the Koksilah flooding on the east side of the highway (outside of the Study area).
- Concerns about increased development at the junction of Koksilah and Miller Roads above Hykaway which will worsen the issue.
- Concerns about climate change impacts on property.
- Concerns that at Tzouhalem and Cowichan Bay road bridges are smaller each time they are replaced or upgraded.
- Concerns about local environment creating ideal conditions for flooding (warm wind blowing on shore, lots of snow, lots of rain, high or king tide, increased sediment build up).
- Concern about roles and responsibilities for highway flooding as a result of increased development (i.e. highway in the Daniels area built up)
- Slope stability issues on Miller Road reserve just above/upslope the white bridge on Allenby (potentially ground and surface water drainage issues).
- Concern that land beside the Quw'utsun Smuneem elementary school in Glenora may face possible damage to the creek headwaters (improvements and driveway building along the upper reaches of the creek by the school have been made).
- Lack of guidance by Cowichan Tribes without land code and bylaws.

OPPORTUNITIES

- Replace culvert near corner of Trestle and Miller with larger culvert (but use caution to ensure infrastructure will alleviate issue and not worsen).

- Support for resolving issue as opposed to “band-aid” solution.
- Support for building dikes.
- Support for solution that allows water to drain out and into the Koksilah River.
- Support for widening bridges at Tzouhalem and Cowichan Bay roads, which act as big dams or dikes.
- Constructed pond potentially coho habitat (observations of coho)
- Polkey Road ditch / culvert at Drillwell potentially coho habitat (observations of coho spawners) – current drainage at the Koksilah Business Park supports coho rearing.
- Chum, Coho, Steelhead, Spring (Chinook) and oolichan are present and were more numerous in this system.
- Support for working together as a single community
- Opportunities to collaborate on funding (e.g. First Nations Adapt Program through INAC for flooding area of influence on east side of highway.
- Opportunities for collaboration (e.g. Lands Office) to discuss what is feasible to address drainage/flooding issues in area.
- Support for continued provincial EMBC funding spent on Cowichan Reserve for a more detailed investigation of the Koksilah River flooding.
- Long-standing need for improvements at ClemClem (in progress).
- Opportunities to review ground and surface water drainage (to address slope stability issues above Allenby).
- Opportunities for projects to address key issues as a result of Project.

INTERESTED PUBLIC – JUNE 7

ISSUES:

- Remove log jams.
- Remove gravel and manage gravel removal to alleviate issues.
- Dikes have been raised three time; however, the river is getting higher.
- Road and bridge work carried out by the Ministry of Transportation and Infrastructure has an influence on flooding.
- Fish habitats are evident in certain areas.
- Specific measures required to address flooding at Polkey Road at the bottom terminus, drainage at the transit facility, flooding east side of highway meeting the Farmer's Market (due to hatchery burn), graphic summary (**Appendix D**).

OPPORTUNITIES

- Environmental protection
- Community involvement: Recognizing of business champions / award, opportunities to collaborate with Cowichan Tribes: Lalamachan means "guardians of the land".
- Land use management (upstream solutions and land management)
- Support for developing a stormwater management and mitigation plan to address issues.

APPENDIX D: QUESTIONNAIRE RESULTS, DISCUSSION QUESTION RESPONSES, AND OTHER PUBLIC INPUT

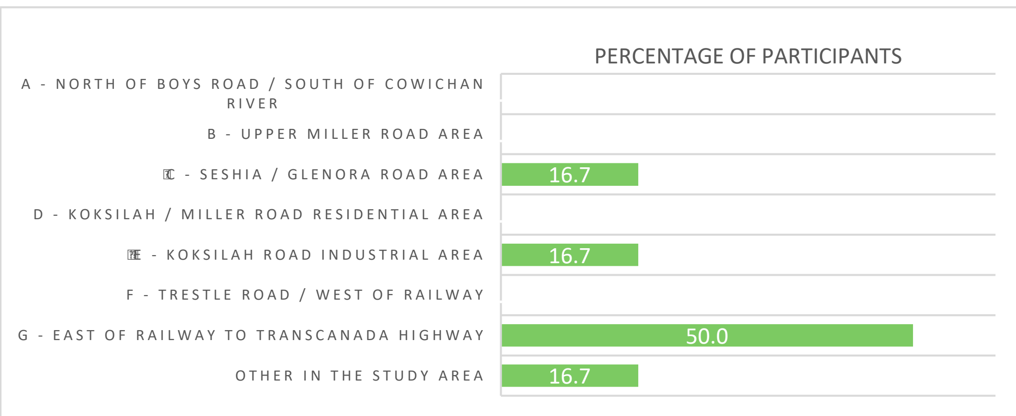
APPENDIX D: QUESTIONNAIRE RESULTS

The Response Form for Round 1 of the engagement process focused on gathering input on the following to identify issue and opportunities in the watershed. A total of 8 participants completed response forms.

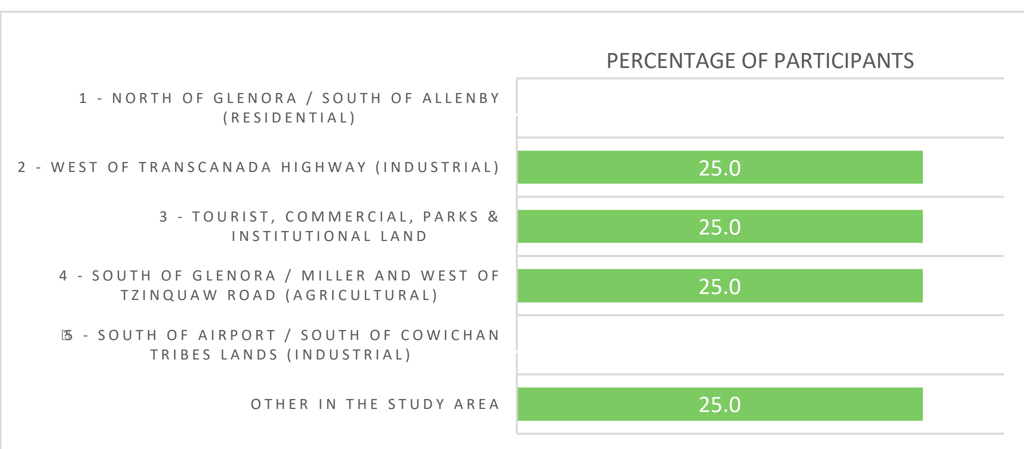
- **Watershed Land:** Best description of area where resident lives, street address or parcel description
- **Stormwater Management Issues:** Flooding or erosion issues on property or land managed and extent of issue, level of concern about flooding and erosion issues, actions taken to reduce flooding and erosion issues.
- **Planning for the Future:** General percentage of pervious and impervious surfaces today and estimated for the future, anticipated change on land owned or land managed within near future, level of support for implementing low-impact stormwater management techniques on land owned or land managed.
- **General Comments:** Impact flooding or erosion has had on other sites in the Sh-hwuykwselu Watershed, other general comments.

WATERSHED LAND

QUESTION 1: AREA OF RESIDENCE IN THE COWICHAN TRIBES AREA



QUESTION 2: AREA OF RESIDENCE IN 'ELECTORAL AREA E'



QUESTION 3: STREET ADDRESS OF LEGAL PARCEL

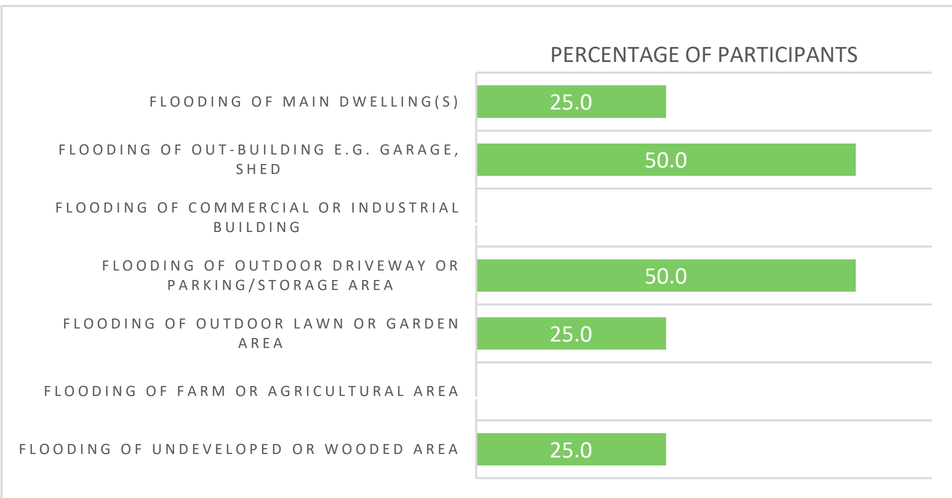
- Address information is being used for technical input only and is kept confidential for the purpose of this report.

QUESTION 4: LIVE OR MANAGE LAND

- Of the respondents, 75% live or manage land in the Study area.

STORMWATER MANAGEMENT ISSUES

QUESTION 5: FLOODING ISSUES ON PROPERTY OR LAND MANAGED



QUESTION 6: EROSION ISSUES ON PROPERTY OR LAND MANAGED

One response indicated other issues.

QUESTION 7: LEVEL OF CONCERN ABOUT FLOODING AND EROSION

Of the participants in the survey, 60% are concerned and 40% are very concerned.

QUESTION 8: ACTIONS TAKEN OR PLAN TO TAKE TO REDUCE FLOODING AND EROSION

80% have taken actions including developing house site above highway level, bringing in fill, and cleaning ditches in front of property twice per year.

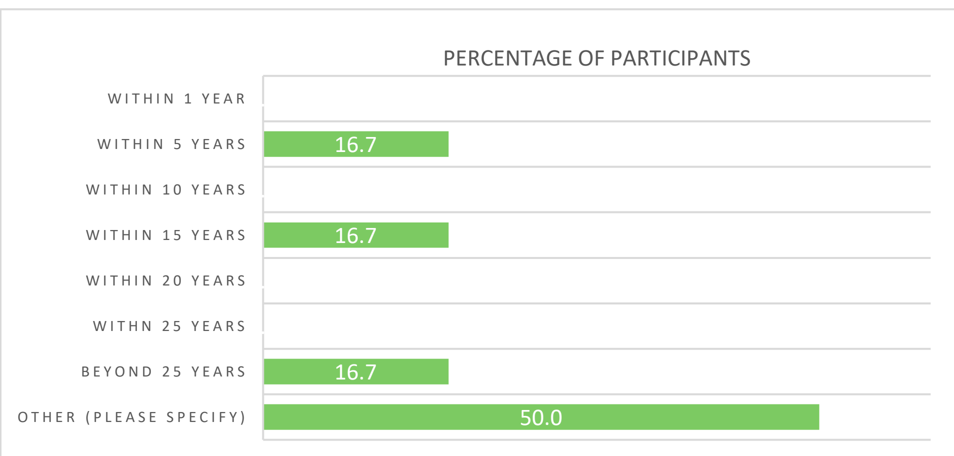
QUESTION 9: PERCENTAGE RANGE OF SURFACES – TODAY (ESTIMATE)

- **Roof:** 35% (1 participant)
- **Asphalt or concrete pavement:** Ranged from <5% up to 55% (3 participants)
- **Gravel drive or gravel yard:** Ranged from <5% up to 20-25% (5 participants)
- **Lawn or garden:** Ranged from <5% up to 20-25% (2 participants)
- **Field:** Ranged from 10-15% up to 50% (3 participants)
- **Woods:** Ranged from 10-15% up to 20-25% (2 participants)
- **Other**: n/a

QUESTION 10: PERCENTAGE RANGE OF SURFACES – FUTURE (ESTIMATE)

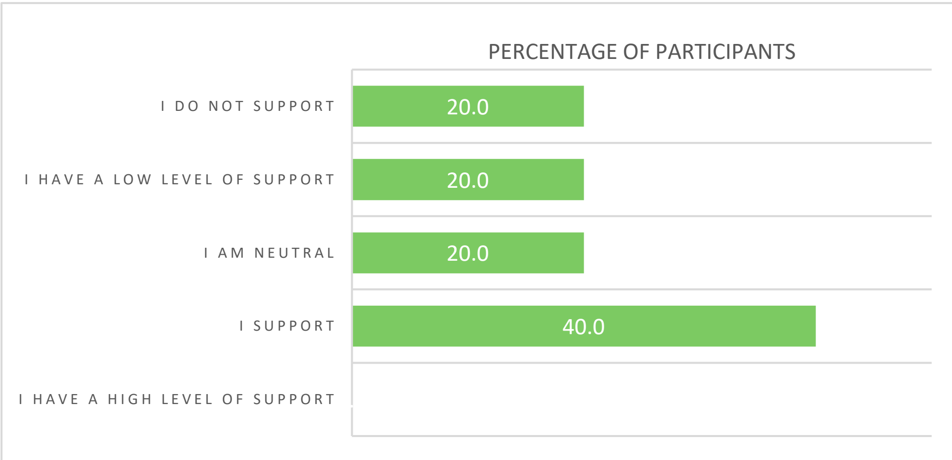
- **Roof:** 20-25% (1 participant)
- **Asphalt or concrete pavement:** 20-25% (1 participant)
- **Gravel drive or gravel yard:** 20-25% (1 participant)
- **Lawn or garden:** 20-25% (1 participant)
- **Field:** 20-25% (1 participant)
- **Woods:** 20-25% (1 participant)
- **Other**: n/a

QUESTION 11: ANTICIPATED CHANGE ON PROPERTY OR LAND MANAGED



Note: Other – no change anticipated at this time.

QUESTION 12: LEVEL OF SUPPORT FOR LOW IMPACT STORMWATER MANAGEMENT TECHNIQUES ON PROPERTY



GENERAL COMMENTS

QUESTION 13: FLOODING AND EROSION IMPACTS OUTSIDE OF THE SH-HWUYKWSELU WATERSHED

- Flooding experienced after rain for duration of three or four days.

QUESTION 14: GENERAL COMMENTS

- Potential solution to install "ponding" solutions at the top of Miller Road to lower water coming down to low lying land or find a way to redirect it.
- Desire to do a petition for community to construct a dike at the Koksilah River to control flooding issues and reduce creek flows that impact homes in the neighbourhood.
- Hope that the ditch on Polkey Rd will be kept at the level that was approved for the design of Industrial Park (being the height of the bottom of culverts).

Sh-hwuykwselu (Busyplace)
Stormwater Management & Mitigation Plan

TECHNICAL ADVISORY GROUP WORKSHOP #2 - SUMMARY

Stormwater Management & Mitigation Plan

OPTION EVALUATION CRITERIA & REVIEW

INTRODUCTION

The Cowichan Valley Regional District (CVRD), in partnership with Cowichan Tribes, is undertaking a technical drainage study for the Sh-hwuykwselu (Busyplace) Watershed, a subwatershed of the Cowichan and Koksilah Rivers in the Cowichan Valley Regional District. The purpose of the Study is to develop a Stormwater Management and Mitigation Plan (the Plan) to guide prioritized infrastructure improvements and development policies to mitigate flooding and erosion risk from high flows, to improve water quality of stormwater runoff, and to sustain summer/fall base flows.

A key part of the planning process is to understand the current policy issues for environmental, land use, development, and construction as well as the key issues, priorities, and goals within the community that will complement the technical study. The purpose of **Round 2** of the Stakeholder Engagement and Communications process, which focused on Technical Advisory Group Workshop (TAG) #2 (Engagement Meeting #4), was to:

- Provide an update on the technical process for developing the draft Stormwater Management and Mitigation Plan;
- Share feedback heard from Round 1 of the Stakeholder Engagement and Communications process;
- Discuss potential multiple account evaluation criteria that might be used to rank and prioritize preliminary options for managing rainwater, flooding, and erosion issues affecting communities in the watershed; and
- Review preliminary approaches for addressing these issues.

This document provides a summary of comments heard during Round 2 of the engagement process which focused on the TAG #2 workshop. Input will be used to refine the multiple account evaluation criteria to evaluate the preliminary options, and move toward a draft recommended option will form the basis of the draft Plan.

Input was received through:

- **Discussion Guide Responses** (hard copy version only). **Appendix A** contains a summary of the responses received.
- **Discussion Notes** (from TAG #2 workshop). Please refer to **Appendix B** for complete discussion notes.

GENERAL KEY THEMES

OPTION EVALUATION CRITERIA

Participants were asked to review the draft Multiple Account Evaluation (MAE) accounts and criteria (both qualitative and quantitative) that would be used to evaluate preliminary options and consider if the accounts and criteria are appropriate to compare options and understand the range of implications.

Financial Account:

- Criterion such as cost and implementation are key criterion.
- Consider the definition and range of "cost" criterion such as installation cost, opportunity cost, base case scenario (the cost of no action),operating and maintenance costs, cost/benefit, capital costs, life cycle costs, land value, long-term financial stability, and equity.
- Transferable and reflective of Cowichan Tribes member concerns for financial equity.
- Addition of a system operation (e.g. tax or maintenance) perspective for each of the three options.

Environmental Account:

- Transferable and reflective of Cowichan Tribes member concerns for environmental values.
- Differentiate between other criteria to be added (e.g. drinking water quality and recreational water quality).
- Inclusive of criteria for reduction of stormwater contaminants that reduce water quality.
- Consider land development and effects on natural water balance.
- Reflective of natural capital, habitat protection, and conversation principles.

Regulatory / Political Account:

- Consider if preliminary options to address rain and flood waters align with current best practices and are reflective of key strategic priorities of the partners (i.e. OCP, climate change resiliency).
- Consider likelihood of approval and implementation.
- Omit criteria concerning development approval and permitting.

Socio-Community Account:

- Transferable and reflective of and Cowichan Tribes member interests and concerns for cultural values and activities (e.g. food gathering, fishing).
- Include water quality impacts for recreation.
- Include agricultural and industry considerations and impacts.
- Include considerations in the lens of public health and safety.
- Consider likelihood of public acceptability/support and opportunities for public education.

Constraints/Risks:

- Consider how physical constraints (e.g. hydrological) will apply to options and constructability.
- Include considerations regarding private property impacts including retaining features, maintenance.

General:

- Consider combining some criteria together to avoid redundancy.
- Provide further explanation on some criterion and how it will be used in the evaluation.
- Potentially some weighted categories (e.g. cost, community impact) and may be based on various stakeholder interests; however, consider the ranking for MAE across stakeholders.

PRELIMINARY MITIGATION OPTIONS:

Participants were asked to provide input on the preliminary approaches for mitigating rain and flood waters in the watershed.

General comments included:

- Possible competing interests in study area with respect to boundaries.
- Ensure potential communications strategy for communicating benefits of options to public.
- Option that potentially has the greatest long-term return on investment or social impacts likely the preferred option.
- Include involvement of industrial stakeholders for implementation.
- Further evaluation and discussion with MoTI on options that involve MoTI (before recommending).
- In general, for any drainage improvement option that results in the construction of a pump station and any other accessory building it may be worth implementing green infrastructure (e.g. roofs).

Comments on the options specifically included:

Option 1:

- Consider if wetland at Keating Farm is a natural wetland in terms of converting it to a detention pond as that may contravene the Canada Fisheries Act and/or BC Water Act based on Ministry of Environment's Develop with Care 2014: Environmental Guidelines for Urban and Rural Development in British Columbia.
- Consider incorporating silt and pollutant reduction (from entering into streams and groundwater) features into the environment design.

Option 2:

- Consider incorporating silt and pollutant reduction (from entering into streams and groundwater) features into the environment design.

Option 3:

- Consider incorporating silt and pollutant reduction (from entering into streams and groundwater) features into the environment design.

Option 4:

- Consider reducing Polkey Road and naturalizing the floodplain to reduce the impervious area, which can allow onsite rain water infiltration.

Option 5:

- Consider naturalizing the Miller Road ditches to reduce the impervious area, which can allow onsite rain water infiltration.

Option 6:

- Consider incorporating vegetated swales, infiltration basins, absorbent vegetation, or engineered wetlands etc. as peak flows are diverted from the upstream side of Miller Road along Highway 1 to the downstream side of the Koksilah Road Bridge.

Option 7:

- Consider upgrading the floodbox infrastructure that is already in place.

Option 8:

- Consider diverting to a detention pond to allow for slow infiltration.

Option 9:

- Consider where diverted water will be directed and its impacts as there may not be sufficient storage to store water in the Trestle Village area during periods of high water in the Koksilah River.
- Consider diverting to a detention pond to allow for slow infiltration.
- Identify where Trestle Village flow could be diverted to and recommend natural practices that help to slowly infiltrate stormwater.

Option 10:

- Support that the Lower Sh-hwuykselu Creek Channel Realignment should not be further reviewed if there are concerns for flooding or erosion of land adjacent to realignment as flooding and/or erosion of land may contribute to contaminants flowing into other water bodies.

General Assumptions:

- Important to consider that residential areas at high elevations in the Study area may be able to retrofit their infrastructure to improve the percentage of permeable / pervious surfaces.
- Support for other techniques and engineered solutions beyond regulations on impervious surfaces as a tool that may be more effective and/or publicly supported.

DRAFT MULTIPLE ACCOUNT EVALUATION CRITERIA

Participants were asked to:

1. Review the draft Multiple Account Evaluation (MAE) criteria (both qualitative and quantitative) as part of the option evaluation framework that will be used to evaluate option by understanding the range of implications by each account: Financial, Environmental, Socio-Community, Regulatory/Political, or Constraints/Risks.
2. Consider if criteria are appropriate, need refinement, or if other criteria should be added.
3. Rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).

RESPONSES

FINANCIAL ACCOUNT

Add: Installation cost, cost of "do nothing" (i.e. relative to a base case scenario or status quo)

Reconsider: One criterion for capital cost, operating and maintenance costs, life cycle costs and long-term financial stability; equity definition,

Omit: n/a

Capital Cost

- May have more opportunity in a capital project setting.
- Capital cost will be a key consideration for how well the plan is received and adopted.
- Capital cost, operating and maintenance costs, life cycle costs and long-term financial stability are variations on the same thing.
- A cost/benefit study is needed on this project.

Operating and Maintenance Costs

- A major factor if savings can be made.
- Infrastructure that has a low maintenance or passive operational cost should be considered.

Life Cycle Costs

- This is a standard consideration that doesn't warrant key consideration.
- Owners of lands will better support projects with a longer lifespan.
- Possibly redundant - already captured as capital cost, operating cost, and maintenance cost.
- Is installation cost captured?
- This would include capital and operating and maintenance costs.

Equity

- If it is possible to build local government or private equity, it should be considered.
- Not a consideration for right-of-way.
- Not sure what this in the context? Asset value? Or, does this criterion apply when it is a Public Private Partnership (PPP)?
- Explanation needed. Is this equitability or equity?
- Who pays? Is it fair?
- Criterion unclear.

Long-term Financial Stability

- Expectation of developer/residents.

Other

- What is the cost of not doing anything?

ENVIRONMENTAL ACCOUNT

Add: Recreational water quality.

Reconsider: Aquatic, terrestrial impacts as one criterion, water quality and reduction of stormwater contaminants as one criterion, include species as well as habitat impacts in evaluation.

Omit: n/a

Aquatic / Riparian Impacts

- Aquatic / riparian impacts, terrestrial impacts, reduction of stormwater contaminants, and water quality impacts are variations on the same thing
- These would look at species as well as habitat impacts?
- Protection of riparian areas should be a key consideration.

Terrestrial Impacts

- These would look at species as well as habitat impacts?

Water Quantity Impacts

- These would look at species as well as habitat impacts?

Water Quality Impacts

Reduction of Stormwater Contaminants / Sediment

- Don't know how this criterion differs from water quality impacts.
- Redundant with water quality.
- This will support cost efficiency in the long run.
- Same as water quality impacts.

Climate Change Adaptability

- Aligns with key CRD strategic priorities.
- Climate change adaptation is important, but the point is to make the stream system more resilient, which in itself achieves the goal of adaptation for climate change.

Other

- Recreational water quality.

REGULATORY/POLITICAL ACCOUNT

Add: Likelihood of approval/ implementation, stormwater management best practices, broader application of option.

Reconsider: Land use/OCP consistency, local/provincial government noting to include Cowichan Tribes, sustainability to resiliency or have as climate change adaptability.

Omit: Development approval / permitting.

Development Approval / Permitting

- This does not seem to be "criteria".
- DPs are unsuitable tools for this.

Land Use / OCP Consistency

- Land use/OCP policies don't provide much guidance.

Sustainability / Resiliency

- Dislike the word "sustainability"; resiliency is preferred.
- Redundant with climate change adaptability.
- This criterion is too vague/abstract to be of much value.

Local / Provincial Government Support

- Local / provincial government support is very similar to public acceptability/support.
- Cowichan Tribes as a local government.
- Does not belong in this – it is the realm of decision-makers.

Other

- There should be a measure for “likelihood of approval/ implementation”.
- There should be a criterion for the possible broader application of the option.
- Stormwater management best practices.

SOCIO-COMMUNITY ACCOUNT

Add: Industry considerations.

Reconsider: Health and safety in terms of flooding, combining public acceptability support with local/provincial government support. Clarify reduction of flood risk in terms of property improvements.

Omit: n/a

Public Acceptability / Support

- I put this last, although if a special requisition is needed, it will be a very high priority. However, it seems to me that if the property impacts are addressed, as well as community activities and economic activities, that should address the need for public support/acceptability.
- Similar to local / provincial government support .

Health and Safety

- Important from flooding.

Cultural / Archaeological Values

- Don’t obliterate stuff.

Community Activity Impacts (e.g. fishing, recreation)

Local Economic Impacts (e.g. agricultural)

Opportunities for Education / Awareness

- Both for residents and government staff.

Property Improvements (e.g. reduction of flooding)

- How will property improvements be evaluated?
- Is the criterion “reduction of flooding”? Or reduction of flood risk?

Other

- Industry needs to be invested in the positive impacts of the study.

CONSTRAINTS / RISKS ACCOUNT

Add: Private property ownership changes, retaining features/maintenance.

Reconsider: How physical constraints will apply to evaluation. Define constructability and what it means for evaluation.

Omit: n/a

Physical Constraints (e.g. topography, hydrological)

- It informs cost so why test again?
- Given the current state of drainage system.
- More clarification of this criteria is needed and how it will be used.
- Chosen option needs to be achievable and practical.

Constructability

- Anything is constructible if you throw enough money at it.
- No idea what this means.

Other

- Private property ownership changes- ongoing participation.
- How to secure and retain features/maintenance.

DISCUSSION QUESTIONS

Do you have any comments on the draft accounts and multiple account evaluation criteria?

General

- Redundant criteria should be removed.
- Further explanation on what the criteria mean and how they will be used is needed. For example, equity, topographical constraints.
- I think these MAE may not be so transferable to Cowichan member concerns and interests. I think it is important for another Cowichan Tribes community meeting to be held to talk about the final actions proposed for further funding. These "actions" will include those applicable to the lower end of Sh-hwuykwselu creek where flooding is driven by the Koksilah River; i.e. actions that will influence residents who live on reserve, and possibly some of the businesses in the industrial park.
- A higher weighting could be given to areas that are linked to community engagement and financial cost.
- Seems to be comprehensive. The one factor that might be missing (not sure how relevant it is) is the idea of a "System Operation" account i.e. what is involved from a tax or maintenance perspective of the three options.

- Environmental Account:
  - It may be worth differentiating between drinking water quality and recreational water quality impacts as separate criteria.*
  - Island Health supports rain and floodwater management options that help to reduce storm water contaminants / sediment as these elements can result in degradation of both drinking water and recreational water quality. Impacts to the underlying aquifer(s) and potentially the Cowichan River may affect the City of Duncan and Municipality of North Cowichan's well fields. Furthermore, water from the Busyplace watershed can drain into the Koksilah River, which flows into Cowichan Bay both of which contain public and private recreational water areas.
  - Rain and flood management options should take into consideration land development and its effects on natural water balance. Solutions should encourage managing rainwater onsite as much as possible.
  - Furthermore, prioritizing integrated rainwater management approaches that store and slowly release rainwater into the ground will support the replenishing of aquifers and streams, which consequently protects water quantity for the municipal water systems as well as aquatic and riparian environments.
- Regulatory Account
  - An additional criterion to consider including is "Current Storm Water Management Best Practices" – as in, do the preliminary options to address rain and flood waters align with current best practices?
  - Implementation of management approaches should align with the OCP vision for the area and take into consideration the surrounding land uses. Consideration should be taken into how these options meet the principles of a healthy built environment, a framework that is often used to update/amend OCPs and land use bylaws. For example, rain gardens, engineered wetlands, green roofs and detention ponds are all elements that support the natural environment principle under the Healthy Built Environment Framework (as outlined in the BCCDC Healthy Built Environment Linkages Toolkit). In addition, where possible, permeable surfacing and ground cover helps to address storm water on site, thereby reducing overland flow, which can contribute to contaminants making their way into neighbouring water bodies (integral to both drinking water and water quality, and overall healthy built environment).
  - Island Health also supports "the implementation of storm water management policies and bylaws to improve water quality and ecological function of the watershed" as highlighted in the report. While storm water management solutions should be evaluated in consideration of what is permitted under current legislation and local bylaws and policies, proposed options can also present opportunities for re-evaluating or developing the approving/permitting frameworks to promote integrated storm water management. For example, developing local bylaws and making land use decisions that encourage and support integrated storm water management approaches.
- Socio-Community Account
  - As Island Health's mandate is to promote and ensure health and care for everyone, everywhere, every time, storm water management solutions that align with public health and safety are highly encouraged.
- Constraints/Risk Account
  - Storm water management options should take into consideration the physical constraints (e.g. hydrological) that may impact the underlying aquifer and neighbouring water bodies (integral to drinking water and recreational water quality).

Do you think that MAE should be weighted as part of the evaluation, and if so, how?

- I believe that the environmental account and the financial account are the most salient points, although the social and community account is also important.
- Does this framework adequately reflect the concerns of the Cowichan Tribes? And associated cultural values, including traditional food gathering ideas? In reviewing the above, I have been making the assumption that improvements in the stream system would support those, but I may be wrong.
- It may be worth assigning criteria with a certain weight as part of the evaluation process. The weighted value can be based on the various stakeholder's interests – consider the ranking for the MAE across stakeholders.

Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?

- The ability to generate land-value capture funding might be a criterion (from the BC Rapid Transit MAE evaluation) that could be adapted to this context. With the investment, will land values increase?
- Do the preliminary options to address rain and flood waters align with current best practices?
- Add drinking water quality and recreational water quality impacts as separate criteria.

PRELIMINARY APPROACHES

Participants were asked to provide feedback on the preliminary options are being developed to address the existing and future issues identified in the Study prior to the option evaluation process.

DISCUSSION QUESTIONS

Do you see any issues or challenges with either preliminary option?

- Competing interests in the study area. Water/flooding issues adjacent to the study area boundaries.
- Please see technical memo comments below which relate to how the options may be understood and evaluated.
- A detailed communications strategy will be needed for communicating with residents and industrial park users about the benefits of some of the approaches being considered, particularly the proposed development of a Polkey Road Channel/Constructed Wetland.
- Option 1: There may be an issue with the Keating Farm option if the wetland is a natural wetland and there are considerations to convert it to a detention pond. According to Ministry of Environment's Develop with Care 2014: Environmental Guidelines for Urban and Rural Development in British Columbia, conversion of natural wetlands to detention ponds may contravene the Canada Fisheries Act and/or BC Water Act.
- Option 9: Where will the diverted water be directed? The report highlighted that there is unlikely sufficient storage to store water in the Trestle Village area during period of high water in the Koksilah River
- Option 10: We agree (Island Health) that the Lower Sh-hwuykselu Creek Channel Realignment should not be further reviewed if there are concerns for flooding or erosion of land adjacent to realignment. Flooding and/or erosion of land may contribute to contaminants making their way into water bodies.

What would you say are opportunities for each preliminary option?

- I do not have comments on each preliminary option. The technical aspects of the options appear to be sound, but additional consideration may want to be given to prioritizing the options according to which activity would produce the greatest long-term return on financial investment, or rating the options in terms of their intended positive social impact on communities.
- Options 1-3: Opportunities to reduce silt & pollutants from entering into streams and groundwater; can incorporate these features into a healthy built environment design.
- Option 4: Reducing Polkey Road and naturalizing the floodplain reduces the impervious area, allowing for onsite rain water infiltration.
- Option 5: Opportunity to naturalize the Miller Road ditches (similar to note above).
- Option 7: As the floodbox infrastructure is already in place, it is worth upgrading it.
- Option 8-9: Opportunity to divert to a detention pond to allow for slow infiltration.

What changes, if any, would you recommend for each preliminary option?

- I would include an option that includes bringing strategically-located industrial park users onside for playing a leadership role in creating pervious beautification projects and landscaping and drainage improvements that lead to more effective flood management activity at the Koksilah Industrial Park.
- Option 6: Is it possible to incorporate vegetated swales, infiltration basins, absorbent vegetation, or engineered wetlands etc. as peak flows are diverted from the upstream side of Miller Road along Highway 1 to the downstream side of the Koksilah Road Bridge?
- Option 9: Identify where Trestle Village flow could be diverted to and recommend natural practices that help to slowly infiltrate storm water.
- In general, for any drainage improvement option that results in the construction of a pump station and any other accessory building it may be worth implementing green roofs.

Do you believe either of the options warrant further consideration through the Option Evaluation process?

- I think the BC Transit Property/storage option should be researched further with Ministry of Transportation and Infrastructure before it listed as an option.

Do you have any additional comments?

- In Technical Memo #2:
  - Please clarify the justification for the use of the 24-hour storm vs another storm duration such as the 12-hour storm.
  - In the hydrological analysis maps that show the flood depths, can you please include the locations of the existing drainage culverts.

NEXT STEPS

The next stage of the process will use input received from both Round 1 and Round 2 of the Engagement and Communications process to develop the Draft Plan Recommendations and Final Plan Presentation which will outline:

- Draft action plan options;
- Policy issues and how to address these issues;
- Potential implementation process;
- Roles and responsibilities; and
- Costing, operations, and maintenance.

APPENDIX A:
DISCUSSION GUIDE COMMENTS & SUMMARIZED RESULTS

Questionnaire

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

October 16, 2018

Please provide your written responses by email to Keith Lawrence, CVRD at klawrence@cvrd.bc.ca or Tracy Fleming, Cowichan Tribes at tracy.fleming@cowichantribes.com by end of business day on Friday, Oct. 26, 2018.

Understanding the perspectives of the stakeholders, Cowichan Tribes, and the community is an integral part of developing the Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan. Feedback will be used to inform the development of the Plan. Thank you!

DRAFT OPTION EVALUATION CRITERIA

Multiple Account Evaluation (MAE) is a decision-making framework that helps evaluate options for a project by understanding the range of implications by account. Key accounts may include Financial, Environmental, Socio-Community, Regulatory/Political, or Constraints/Risks and may be measured qualitatively or quantitatively. An MAE process will be used to evaluate preliminary options for managing rain and flood waters in the watershed.

1. *Please review draft evaluation criteria and consider if criteria are appropriate, and if other criteria should be added. Please explain in the comments.*
2. *Please rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).*
3. *Please add any additional comments that might help describe or clarify criteria.*

Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost	4	May have more opportunity In a capital project setting	$
Operating and maintenance costs	4	Major factor if savings can be made.	$
Life cycle costs	4	Owners of lands will support better with longer lifespan	$
Equity	1	Not a consideration for ROW	$
Long-term financial stability	4	Expectation of developer/residents	$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	3		#/Qual.
Terrestrial impacts	3		#/Qual.
Water quantity impacts	3		#

Water quality impacts	3		#
Reduction of stormwater contaminants / sediment	3		#
Climate change adaptability	3		Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting	4		Qualitative
Land use / OCP Consistency	4		Qualitative
Sustainability / resiliency	4		Qualitative
Local / provincial government support	5		Qualitative
Other (please note):			
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support	4		Qualitative
Health and safety	4		Qualitative
Cultural / archaeological values	4		Qualitative
Community activity impacts (e.g. fishing, recreation)	3		#/Qual.
Local economic impacts (e.g. agricultural)	3		#/Qual.
Opportunities for education / awareness	3		Qualitative
Property improvements (e.g. reduction of flooding)	4		#
Other (please note):			
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)	3	Given the current state of drainage system.	#
Constructability	3		#
Other (please note): Private property ownership changes- ongoing participation	4	How to secure and retain features/maintenance	

1. **Do you have any comments on the draft accounts and MAE criteria? No**

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how? No**

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration? Not at this time. Unknown**

PRELIMINARY APPROACHES

Preliminary options for managing rain and flood waters in the watershed are being developed to address the existing and future issues identified in the Study. A primary focus of the engagement process is for participants to review these preliminary options and provide feedback prior to options being evaluated during the Option Evaluation process (using finalized MAE criteria).

4. **Do you see any issues or challenges with any of the preliminary options?**

Competing interests in the study area. Water/flooding issues adjacent to the study area boundaries.

5. **What would you say are opportunities for each preliminary option?**

6. **What changes, if any, would you recommend for each preliminary option?**

None

7. **Do you believe any of the options warrant further consideration through the Option Evaluation process?**

8. **Do you have any additional comments?**

No

Questionnaire

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

October 16, 2018

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DRAFT OPTION EVALUATION CRITERIA

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1. *Please review draft evaluation criteria and consider if criteria are appropriate, and if other criteria should be added. Please explain in the comments.*
2. *Please rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).*
3. *Please add any additional comments that might help describe or clarify criteria.*

Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost			$
Operating and maintenance costs			$
Life cycle costs		Possibly redundant. Already captured as capital cost, operating cost and maintenance cost. Is installation cost captured?	$
Equity		Explanation needed. Is this equitability, or	$
Long-term financial stability			$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	3		#/Qual.
Terrestrial impacts	3		#/Qual.

Water quantity impacts	5		#
Water quality impacts	5		#
Reduction of stormwater contaminants / sediment		Redundant with water quality	#
Climate change adaptability			Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting			Qualitative
Land use / OCP Consistency			Qualitative
Sustainability / resiliency		Redundant with climate change adaptability	Qualitative
Local / provincial government support			Qualitative
Other (please note):			
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support			Qualitative
Health and safety			Qualitative
Cultural / archaeological values			Qualitative
Community activity impacts (e.g. fishing, recreation)			#/Qual.
Local economic impacts (e.g. agricultural)			#/Qual.
Opportunities for education / awareness			Qualitative
Property improvements (e.g. reduction of flooding)		How will property improvements be evaluated?	#
Other (please note):			
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)		More clarification of this criteria is needed and how it will be used.	#
Constructability			#
Other (please note):			

1. **Do you have any comments on the draft accounts and MAE criteria?**

Redundant criteria should be removed. Further explanation on what the cirteria mean and how they will be used is needed. For example equity, topographical constraints,.

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how?**

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?**

PRELIMINARY APPROACHES

Preliminary options for managing rain and flood waters in the watershed are being developed to address the existing and future issues identified in the Study. A primary focus of the engagement process is for participants to review these preliminary options and provide feedback prior to options being evaluated during the Option Evaluation process (using finalized MAE criteria).

4. **Do you see any issues or challenges with any of the preliminary options?**

   Please see technical memo comments below which relate to how the options may be understood and evaluated.

5. **What would you say are opportunities for each preliminary option?**

6. **What changes, if any, would you recommend for each preliminary option?**

7. **Do you believe any of the options warrant further consideration through the Option Evaluation process?**

8. **Do you have any additional comments?**

In technical memo #2:

- please clarify the justification for the use of the 24 hour storm vs another storm duration such as the 12 hour storm.
- In the hydrological analysis maps that show the flood depths, can you please include the locations of the existing drainage culverts

Questionnaire

Sh-hwuykwselu (Busyplace) Stormwater Management & Mitigation Plan

October 16, 2018

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Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost	5		$
Operating and maintenance costs	5		$
Life cycle costs	5		$
Equity	2		$
Long-term financial stability	5		$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	5		#/Qual.
Terrestrial impacts	2		#/Qual.
Water quantity impacts	4		#
Water quality impacts	4		#
Reduction of stormwater contaminants / sediment	4	Same as water quality impacts	#

Climate change adaptability	3		Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting	?	This does not seem to be a "criteria"	Qualitative
Land use / OCP Consistency	1	Land use/OCP policies don't provide much guidance	Qualitative
Sustainability / resiliency	1	This criteria is too vague/abstract to be of much value	Qualitative
Local / provincial government support	4		Qualitative
Other (please note):	5	There should be a measure for "likelihood of approval/ implementation" There should be a criteria for the possible broader application of the option	
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support	3		Qualitative
Health and safety	2		Qualitative
Cultural / archaeological values	2		Qualitative
Community activity impacts (e.g. fishing, recreation)	2		#/Qual.
Local economic impacts (e.g. agricultural)	3		#/Qual.
Opportunities for education / awareness	3		Qualitative
Property improvements (e.g. reduction of flooding)	3		#
Other (please note):			
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)	5	Chosen option needs to be achievable and practical	#
Constructability	5		#
Other (please note):			

1. **Do you have any comments on the draft accounts and MAE criteria?**

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how?**

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?**

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Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost			$
Operating and maintenance costs			$
Life cycle costs			$
Equity	1	Who pays? Is it fair?	$
Long-term financial stability			$
Other (please note): green infrastructure	2	What is the cost of not doing anything?	
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	4		#/Qual.
Terrestrial impacts	3		#/Qual.
Water quantity impacts	2		#
Water quality impacts	5		#
Reduction of stormwater contaminants / sediment	5		#

Climate change adaptability	1		Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting			Qualitative
Land use / OCP Consistency			Qualitative
Sustainability / resiliency	1		Qualitative
Local / provincial government support	2	Cowichan Tribes as a local government.	Qualitative
Other (please note):			
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support			Qualitative
Health and safety	2		Qualitative
Cultural / archaeological values	3		Qualitative
Community activity impacts (e.g. fishing, recreation)	5		#/Qual.
Local economic impacts (e.g. agricultural)			#/Qual.
Opportunities for education / awareness	4	Both for residents and government staff.	Qualitative
Property improvements (e.g. reduction of flooding)	1		#
Other (please note):			
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)	1		#
Constructability	2		#
Other (please note):			

1. **Do you have any comments on the draft accounts and MAE criteria?**

I think these MAE may not be so transferable to Cowichan member concerns and interests. I think it is important for another CT community meeting to be held to talk about the final actions proposed for further funding. These "actions" will include those applicable to the lower end of Sh-hwuykwselu creek where flooding is driven by the Koksilah River; i.e. actions that will influence residents who live on reserve, and possibly some of the businesses in the industrial park.

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how?**

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?**

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2. *Please rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).*
3. *Please add any additional comments that might help describe or clarify criteria.*

Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost	5	Capital cost will be a key consideration for how well the plan is received and adopted.	$
Operating and maintenance costs	5	Infrastructure that has a low maintenance or passive operational cost should be considered	$
Life cycle costs	3	This is a standard consideration that doesn't warrant key consideration.	$
Equity	4	If it is possible to build local government or private equity it should be considered	$
Long-term financial stability	5		$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	5	Protection of riparian areas should be a key consideration	#/Qual.

Terrestrial impacts	4		#/Qual.
Water quantity impacts	5		#
Water quality impacts	5		#
Reduction of stormwater contaminants / sediment	4	This will support cost efficiency in the long run.	#
Climate change adaptability	5	Aligns with key CRD strategic priorities.	Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting	4		Qualitative
Land use / OCP Consistency	5		Qualitative
Sustainability / resiliency	3		Qualitative
Local / provincial government support	5		Qualitative
Other (please note):			
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support	5		Qualitative
Health and safety	3		Qualitative
Cultural / archaeological values	4		Qualitative
Community activity impacts (e.g. fishing, recreation)	5		#/Qual.
Local economic impacts (e.g. agricultural)	5		#/Qual.
Opportunities for education / awareness	5		Qualitative
Property improvements (e.g. reduction of flooding)	5		#
Other (please note): Opportunities for Industry leadership	5	Industry needs to be invested in the positive impacts of the study,	
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)	5		#
Constructability	4		#
Other (please note):			

1. **Do you have any comments on the draft accounts and MAE criteria?**

All criteria are important, but the criteria surrounding the financial cost, social impacts, and the regulatory environment deserve highest consideration.

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how?**

   A higher weighting could be given to areas that are linked to community engagement and financial cost.

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?**

PRELIMINARY APPROACHES

Preliminary options for managing rain and flood waters in the watershed are being developed to address the existing and future issues identified in the Study. A primary focus of the engagement process is for participants to review these preliminary options and provide feedback prior to options being evaluated during the Option Evaluation process (using finalized MAE criteria).

4. **Do you see any issues or challenges with any of the preliminary options?**

A detailed communications strategy will be needed for communicating with residents and industrial park users about the benefits of some of the approaches being considered, particularly the proposed development of a Polkey Road Channel/Constructed Wetland.

5. **What would you say are opportunities for each preliminary option?** I do not have comments on each preliminary option. The technical aspects of the options appear to be sound, but additional consideration may want to be given to prioritizing the options according to which activity would produce the greatest long-term return on financial investment, or rating the options in terms of their intended positive social impact on communities.

6. **What changes, if any, would you recommend for each preliminary option?** I would include an option that includes bringing strategically located industrial park users onside for playing a leadership role in creating pervious beautification projects and landscaping and drainage improvements that lead to more effective flood management activity at the Koksilah Industrial Park.

7. **Do you believe any of the options warrant further consideration through the Option Evaluation process?**

I think the BC Transit Property/storage option should be researched further with MOT before it listed as an option.

8. **Do you have any additional comments? No.**

Questionnaire

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2. *Please rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).*
3. *Please add any additional comments that might help describe or clarify criteria.*

Draft Option Evaluation Criteria	Rank 1-5	Comments?	Measure
FINANCIAL ACCOUNT			
Capital cost	4		$
Operating and maintenance costs	5		$
Life cycle costs	1	This would include capital and O&M costs	$
Equity	3	Not sure what this in the context? Asset value? Or does this criteria apply when it is a PPP?	$
Long-term financial stability	2		$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	1	These would look at species as well as habitat impacts?	#/Qual.
Terrestrial impacts	4	Ditto	#/Qual.
Water quantity impacts	3		#
Water quality impacts	2	Ditto	#

Reduction of stormwater contaminants / sediment	5	Don't know how this criteria differs from water quality impacts	#
Climate change adaptability	4	Climate change adaptation is important, but the point is to make the stream system more resilient, which in itself achieves the goal of adaptation for climate change	Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting	4		Qualitative
Land use / OCP Consistency	3		Qualitative
Sustainability / resiliency	1		Qualitative
Local / provincial government support	2		Qualitative
Other (please note):			
SOCI-COMMUNITY ACCOUNT			
Public acceptability / support	7	I put this last, although if a special requisition is needed, it will be a very high priority. However, it seems to me that if the property impacts are addressed, as well as community activities and economic activities, that should address the need for public support/acceptability	Qualitative
Health and safety	1		Qualitative
Cultural / archaeological values	3		Qualitative
Community activity impacts (e.g. fishing, recreation)	4		#/Qual.
Local economic impacts (e.g. agricultural)	5		#/Qual.
Opportunities for education / awareness	6		Qualitative
Property improvements (e.g. reduction of flooding)	2	Is the criteria "reduction of flooding"? Or reduction of flood risk?	#
Other (please note):			
CONSTRAINTS / RISKS ACCOUNT			
Physical constraints (e.g. topography, hydrological)	1		#
Constructability	2	Anything is constructable if you throw enough money at it.	#
Other (please note):			

1. **Do you have any comments on the draft accounts and MAE criteria?**

Seems to be comprehensive. The one factor that might be missing (not sure how relevant it is) is the idea of a "System Operation" account … i.e. what is involved from a tax or maintenance perspective of the 3 options.

2. **Do you think that MAE should be weighted as part of the evaluation, and if so, how?**

I believe that the environmental account and the financial account are the most salient points, although the social and community account is also important.

Does this framework adequately reflect the concerns of the Cowichan Tribes? And associated cultural values, including traditional food gathering ideas? – In reviewing the above, I have been making the assumption that improvements in the stream system would support those, but I may be wrong.

3. **Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?**
    - The ability to generate land-value capture funding might be a criteria (from the BC Rapid Transit MAE evaluation) that could be adapted to this context. With the investment, will land values increase?
    -

PRELIMINARY APPROACHES

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4. **Do you see any issues or challenges with any of the preliminary options?**

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6. **What changes, if any, would you recommend for each preliminary option?**

7. **Do you believe any of the options warrant further consideration through the Option Evaluation process?**

8. **Do you have any additional comments?**

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Draft MAE Criteria

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DRAFT OPTION EVALUATION CRITERIA *(Note: Account weighting, if required, to be determined based on your input.)*

Draft Criteria Description	Rank?	Comment?	Measure
FINANCIAL ACCOUNT			
Capital cost	2		$
Operating and maintenance costs	3		$
Life cycle costs	4		$
Equity	5		$
Long-term financial stability	1		$
Other (please note):			
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts	6		#/Qual.
Terrestrial impacts	4		#/Qual.
Water quantity impacts	3		#
DW Water quality impacts	1		#
Reduction of stormwater contaminants / sediment	2		#
Climate change adaptability	7		Qualitative
Other (please note): Rec Water Quality	5		
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting	3		Qualitative
Land use / OCP Consistency	2		Qualitative
Sustainability / resiliency	4		Qualitative
Local / provincial government support	5		Qualitative
Other (please note): Storm Water Management Best Practices (1)			
SOCIO-COMMUNITY ACCOUNT			
Public acceptability / support	7		Qualitative
Health and safety	1		Qualitative
Cultural / archaeological values	5		Qualitative
Community activity impacts (e.g. fishing, recreation)	3		#/Qual.
Local economic impacts (e.g. agricultural)	4		#/Qual.
Opportunities for education / awareness	6		Qualitative
Property improvements (e.g. reduction of flooding)	2		#
Other (please note):			
CONTRAINTS / RISK ACCOUNT			
Physical constraints (e.g. topography, hydrological)	1		#
Constructibility	2		#
Other (please note):			

Mike T

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DRAFT OPTION EVALUATION CRITERIA *(Note: Account weighting, if required, to be determined based on your input.)*

Draft Criteria Description	Rank?	Comment?	Measure
FINANCIAL ACCOUNT			
1 Capital cost	5	1, 2, 4, 5 are variations on the	$
2 Operating and maintenance costs		same thing	$
3 Life cycle costs			$
4 Equity – unclear			$
5 Long-term financial stability			$
Other (please note):		on this, a cost/benefit study is needed	
ENVIRONMENTAL ACCOUNT			
Aquatic / riparian impacts 1	4	1, 3, 4, 5 are the same,	#/Qual.
Terrestrial impacts 2			#/Qual.
Water quantity impacts 3			#
Water quality impacts 4			#
Reduction of stormwater contaminants / sediment 5			#
Climate change adaptability 6	5		Qualitative
Other (please note):			
REGULATORY / POLITICAL ACCOUNT			
Development approval / permitting		DP's are unsuitable tools for this	Qualitative
Land use / OCP Consistency		not sure what is meant here	Qualitative
~~Sustainability~~ / resiliency	5		Qualitative
Local / provincial government support		does not belong in this it is the realm of decision-makers.	Qualitative
Other (please note):			
SOCIO-COMMUNITY ACCOUNT			
Public acceptability / support			Qualitative
Health and safety	5	(from flooding)	Qualitative
Cultural / archaeological values	5	– don't obliterate stuff!	Qualitative
Community activity impacts (e.g. fishing, recreation)	1		#/Qual.
Local economic impacts (e.g. agricultural)	4		#/Qual.
Opportunities for education / awareness	5		Qualitative
Property improvements (e.g. reduction of flooding)	5		#
Other (please note):			
CONTRAINTS / RISK ACCOUNT			
Physical constraints (e.g. topography, hydrological)		it informs cost so why list again?	#
Constructibility		no idea what this means.	#
Other (please note):			

again super redundant!

is like this word

very similar

same?

<u>Island Health Feedback on Discussion Questions</u>

Option Evaluation Criteria

1. Do you have any comments on the draft accounts and MAE criteria?

- Financial Account
    - No additional comment

- Environmental Account
    - It may be worth differentiating between drinking water quality and recreational water quality impacts as separate criteria.*
    - Island Health supports rain and floodwater management options that help to reduce storm water contaminants / sediment as these elements can result in degradation of both drinking water and recreational water quality. Impacts to the underlying aquifer(s) and potentially the Cowichan River may affect the City of Duncan and Municipality of North Cowichan's well fields. Furthermore, water from the Busy place watershed can drain into the Koksilah River, which flows into Cowichan Bay both of which contain public and private recreational water areas.
    - Rain and flood management options should take into consideration land development and its effects on natural water balance. Solutions should encourage managing rainwater onsite as much as possible.
    - Furthermore, prioritizing integrated rainwater management approaches that store and slowly release rainwater into the ground will support the replenishing of aquifers and streams, which consequently protects water quantity for the municipal water systems as well as aquatic and riparian environments.

- Regulatory
    - An additional criterion to consider including is "Current Storm Water Management Best Practices" – as in, do the preliminary options to address rain and flood waters align with current best practices? *
    - Implementation of management approaches should align with the OCP vision for the area and take into consideration the surrounding land uses. Consideration should be taken into how these options meet the principles of a healthy built environment, a framework that is often used to update/amend OCPs and land use bylaws. For example, rain gardens, engineered wetlands, green roofs and detention ponds are all elements that support the natural environment principle under the Healthy Built Environment Framework (as outlined in the BCCDC *Healthy Built Environment Linkages Toolkit*). In addition, where possible, permeable surfacing and ground cover helps to address storm water on site, thereby reducing overland flow, which can contribute to contaminants making their way into neighbouring water bodies (integral to both drinking water and water quality, and overall healthy built environment).
    - Island Health also supports "the implementation of storm water management policies and bylaws to improve water quality and ecological function of the watershed" as highlighted in the report. While storm water management solutions should be evaluated in consideration of what is permitted under current legislation and local bylaws and policies, proposed options can also present opportunities for re-evaluating or developing the approving/permitting frameworks to promote integrated storm water management. For example, developing local bylaws and making land use decisions that encourage and support integrated storm water management approaches.

- Socio-community
    - As Island Health's mandate is to promote and ensure health and care for everyone, everywhere, every time, storm water management solutions that align with public health and safety are highly encouraged.

- Constraints/Risk Account
    - Storm water management options should take into consideration the physical constraints (e.g. hydrological) that may impact the underlying aquifer and neighbouring water bodies (integral to drinking water and recreational water quality).

2. Do you think that MAE should be weighted as part of the evaluation and if so, how?
    - It may be worth assigning criteria with a certain weight as part of the evaluation process. The weighted value can be based on the various stakeholder's interests – consider the ranking for the MAE across stakeholders.

3. Are there any other draft MAE criteria (qualitative or quantitative) that warrant consideration?
    - Please see the points with asterisk under question #1.

Preliminary Approaches

4. Do you see any issues or challenges with any of the preliminary options?
    - Option 1: There may be an issue with the Keating Farm option if the wetland is a natural wetland and there are considerations to convert it to a detention pond. According to Ministry of Environment's *Develop with Care 2014: Environmental Guidelines for Urban and Rural Development in British Columbia*, conversion of natural wetlands to detention ponds may contravene the Canada *Fisheries Act* and/or BC *Water Act*.
    - Option 9: Where will the diverted water be directed? The report highlighted that there is unlikely sufficient storage to store water in the Trestle Village area during period of high water in the Koksilah River
    - Option 10: We agree that the Lower Sh-hwuykselu Creek Channel Realignment should not be further reviewed if there are concerns for flooding or erosion of land adjacent to realignment. Flooding and/or erosion of land may contribute to contaminants making their way into water bodies.

5. What would you say are opportunities for each preliminary option?
    - Options 1-3: Opportunities to reduce silt & pollutants from entering into streams and groundwater; can incorporate these features into a healthy built environment design.
    - Option 4: Reducing Polkey Road and naturalizing the floodplain reduces the impervious area, allowing for onsite rain water infiltration.
    - Option 5: Opportunity to naturalize the Miller Road ditches (similar to note above)
    - Option 7: As the floodbox infrastructure is already in place, it is worth upgrading it.
    - Option 8-9: Opportunity to divert to a detention pond to allow for slow infiltration

6. What changes, if any would you recommend for each preliminary option?
    - Option 6: Is it possible to incorporate vegetated swales, infiltration basins, absorbent vegetation, or engineered wetlands etc. as peak flows are diverted from the upstream side of Miller Road along Highway 1 to the downstream side of the Koksilah Road Bridge?
    - Option 9: Identify where Trestle Village flow could be diverted to and recommend natural practices that help to slowly infiltrate storm water.

- In general, for any drainage improvement option that results in the construction of a pump station and any other accessory building it may be worth implementing green roofs.

APPENDIX B: TAG #2 MEETING NOTES

Meeting Details:

Meeting:	**Technical Advisory Group Meeting #2**
Meeting Topic:	Preliminary Options and Evaluation Criteria
Date:	Tuesday, October 16, 2018
Time:	9:15 am to 12:05 pm
Location:	Boardroom, Cowichan Valley Regional District, 175 Ingram Street, Duncan, BC
Attendees:	**Key Stakeholders** ▶ Candice Campbell, Resident/Farmer ▶ Emmet McCusker, City of Duncan ▶ Andy Newall, Ministry of Transportation & Infrastructure (MoTI) ▶ Melissa Nottingham, Department of Fisheries & Oceans (DFO) ▶ Doug Pepper, Ministry of Agriculture (AGRI) ▶ Tom Rutherford, Cowichan Water Board (CWB) **Cowichan Tribes** ▶ Fred Bosma, Cowichan Tribes ▶ Lisa Daniels, Cowichan Tribes/Resident ▶ Tracy Fleming, Cowichan Tribes **Cowichan Valley Regional District (CVRD)** ▶ Rob Conway, CVRD ▶ Graham Gidden, CVRD ▶ Steven Godfrey, CVRD ▶ Keith Lawrence, CVRD ▶ Amy Melmock, CVRD ▶ Kate Miller, CVRD ▶ Alison Nicholson, CVRD ▶ Rachelle Randeau, CVRD ▶ Sybille Sanderson, CVRD ▶ Mike Tippett, CVRD ▶ Sybille Sanderson, CVRD **Consultants** ▶ Craig Sutherland, Kerr Wood Leidel (KWL) ▶ David Reid, Lanarc Consultants ▶ Kristen Falconer, Lanarc Consultants

Action Items:

#	Description	Responsibility
1	▶ Investigate the road right-of-way to determine potential solution between Polkey Rd., stream channel, and drainage ditch.	**KWL (CS)**
2	▶ Provide CVRD the discussion guide in Word format by morning of Oct. 17.	**Lanarc (KF)**
3	▶ Distribute Word version of discussion guide by email to participants by Oct. 17.	**CVRD (KL)**

Discussion Summary:

#	Description
1	**Welcome and Introductions** ▶ KL welcomed participants explaining there is no one jurisdiction that has full responsibility for watershed management – all have a role to play. ▶ KL said the initiative is based on the government funding program for National Disaster Mitigation with limited funding available for Phase 2 (physical works). ▶ KL said that the watershed is core to the community in terms of livability, employment, agriculture, environment, fish habitat, drinking water supply, etc. ▶ KL said the watershed also holds great importance to Cowichan Tribes. ▶ TF said CVRD approached Cowichan Tribes to partner to develop solutions for seasonal flooding issues that impact both CVRD and Cowichan Tribes as watershed boundaries are shared. ▶ CS said that KWL and Lanarc have been retained to work with CVRD, Cowichan Tribes, and the Technical Advisory Group (TAG) to develop tools to manage risks, identify physical works, and develop policy improvements to mitigate flooding in lowland areas, as well as improve water quality.
2	**Project Overview - Recap** **Project Background** ▶ CS provided a recap on the Study background noting that the Project is a small case study that explores land use and development in terms of appropriate policies, infrastructure, implementation, phasing, and if a new approach can be considered vs. traditional stormwater management strategies. ▶ CS said new strategies may consider rebuilding in terms of natural assets / naturalizing to decrease costs over the long-term, and to adapt to the realities of climate change impacts. ▶ CS said the Study area features a wide variety of land uses including agriculture, industry, and residential as well as low- and high-density areas. ▶ CS said the objective is to develop a prioritized list of upgrades that can be implemented over time. ▶ CS defined the Study area being the area between the height of land at Eagle Heights, to the west from Cowichan River to the north, and Koksilah River to the south. The natural watershed is truncated at the Trans-Canada Highway (TCH) to the east. ▶ CS noted that lowland areas within the watershed have been heavily modified. Historically, one of the channels of the Cowichan River used to flow through the land where the Koksilah Business Park is now located, and joined the Koksilah River at Trestle Village, where Sh-hwukselu Creek now joins the Koksliah River. ▶ FB noted there are tributaries along the highway that operate on the edge of the watershed on Cowichan Tribes lands and there are some gravel quarries to the south of the Study area.

#	Description
	Process to Date ▶ DR explained the engagement process to date noting Technical Advisory Group meeting #1 focused on understanding issues and opportunities in the watershed and #2 is to review preliminary options and develop potential evaluation criteria to evaluate preliminary options to move toward recommended options that will form the basis of the key deliverable: Stormwater Management & Mitigation Plan.
3	**What We Heard** ▶ DR provided a summary of input heard during Round 1 of the engagement process noting that the team engaged with partners, key stakeholders, and private and business property owners. ▶ DR said objectives of Round 1 were to gather input on issues and opportunities, achieve consensus on modelling assumptions used for land use and watershed boundaries, and to facilitate a dialogue to develop a path forward. ▶ DR said three events were held: Technical Advisory Group #1, Cowichan Tribes Event – Dinner & Discussion, and Community Event for Interested Stakeholders. ▶ DR explained key comments heard during the process noting that key themes included: ▪ Partnership / Cooperation ▪ Environmental Considerations ▪ Planning and Management ▪ Technological Considerations / Innovations ▪ Community Impacts / Effects ▶ CS said KWL's role is to assess the watershed to quantify observations and traditional knowledge from community members so a sense of magnitude of the issues is known. ▪ CS said some results were expected while others were surprising.
4	**Technical Overview** ▶ CS explained the key objectives of the Study are to compile a list of ideas for evaluation. **Stormwater Management Performance Targets** ▶ CS explained the range of rainfall intensities noting three categories: rare/extreme storms (5% of annual rainfall, infrequent large storms (20%), and frequent small events (75%). ▶ CS said it is important to manage the rare/extreme storms (i.e. 100-200-year return period design) but also the day-to-day rainfall that can also have impacts in terms of cumulative erosion in the stream channels slopes, and related deposition in flatter areas. **Drainage Design Criteria** ▶ CS explained drainage design criteria for flood protection and stormwater management noting two key areas: Koksilah backup to Village Rd. area from high flows onto Cowichan Tribes lands and industrial area flows. ▪ "Busyplace" refers to the Old Cowichan River channel intersection to the Koksilah River. ▪ Criteria for flood management for stream drainage requires 10-year return period design but if these are overwhelmed, roads become the flood path so necessary to ensure these are managed. ▪ Stormwater management targets focus on volume reduction and water quality, rate control, and riparian and more frequent events create more erosion over time. **Model Scenarios**

#	Description
	▸ CS explained model scenarios for existing and future conditions by land use type, climate data, and Koksilah/Cowichan water levels. ▸ CS explained existing climate and land use for rare/extreme flood events and future climate and land use for infrequent large floods. ▸ CS noted that on the maps, dark blue areas indicate shallow depths (0.5 m) and red areas indicate deep depths, with downstream controlled by Koksilah River flows backing up. ▸ CS said the analysis will determine if flooded areas are representative of land use, as well as percentage of cover (i.e. pervious/impervious areas). **Drainage Assessment** ▸ CS noted modelling indicates that peak flood levels upstream of Miller Road near Trestle Village are generally governed by peak flows coming down from the upper watershed, while downstream of Miller Road, the backwater effect from water levels in the Koksilah River is the primary driver of peak water levels in Sh-hwuykselu Creek. ▸ CS noted that model results are similar to observations discussed with the Project team by Luchiim, Cowichan Elder. ▸ CS noted the downstream section of the creek flows underneath the railroad through two sets of undersized culverts. These culverts restrict backwatering of flow upstream towards Miller Road so if the culvert was upgraded, this could actually increase peak water levels slightly. ▸ CS noted peak water at Trestle Village acts like a “bathtub” due to the dike around the village, so with existing conditions, there is potentially enough storage but could present risks in future conditions. ▸ CS said eliminating bridge flow restrictions at TCH bridge and E&N railroad bridge could result in peak water levels in Koksilah River decreasing +/- 0.5m at each crossing, so it may be an option to increase conveyance near Trestle Rd., although that is beyond the Project scope. ▸ CS said the modelling indicates that the backwatering effect from the Koksilah River does not result in significant risk of flooding of properties within the Koksilah Business Park (along Polkey Road) as the ground levels are high enough in this area. However, the greater risk of flooding in this area is from overtopping/breaching of the Cowichan River dikes.
5	**Preliminary Options Review** **Drainage Improvement Options** ▸ CS explained the range of drainage improvement options for the Study area: ▪ Opportunity to renew the old irrigation pond at the old Keating Farm property as a base for storage to mitigate downstream flooding, potentially with a riparian restoration area or wetland. ▪ BC Transit Facility under development so potential storage opportunities. ▪ Potential diversion through Hykawy Park . ▪ Potential culvert replacements at Tzinquaw Road, Hykawy Road, and Miller Road. ▪ Redevelop Polkey Road to one-lane and use the other half as a riparian buffer. ▪ Potential flow diversion trough stormdrain along east side of TCH. ▪ Improve drainage to Trestle Village with two culverts (low and high) through the existing dike. **Low Impact Best Management Practices** ▸ DR explained low impact best management practices (BMPs) that might be incorporated into planning for new developments.

#	Description
	▶ DR indicated which BMPs, in terms of flood management, might apply to the Study area to (a) help to mitigate a significant storm event versus those BMPs that don't contribute significantly to large flood mitigation and (b) improve water quality and base flows for habitat. **DISCUSSION – PRELIMINARY OPTIONS** **Best Management Practices – Property Owners** ▶ Comment about how the individual, as a landowner, can alleviate flood management risk – half the property is hay and the other half pasture and outbuildings. Is rain soaking into the ground towards the drainage ditches a good thing or not? ▪ DR said that soil is helpful for watershed management as it slows flows of water from rainfall and reduces pollutants. Vegetated cover (i.e. pasture) is pervious and would keep flows slow. ▶ Comment about runoff from the outbuildings – what measures can be undertaken? ▪ CS said that it is important to deal with the route of the runoff to ensure that it soaks into the ground and avoids being directed into pipes and drainage ditches (what we are trying to avoid). ▶ Comment asking about collecting well water for livestock. ▪ CS said water collection is good and there can be other techniques such as rain gardens that divert water flows away from the perimeter of buildings. The preferred way is to disconnect rainwater to reduce effects of impervious areas. ▪ KM provided an example of the Keating Farm area – if there are many outbuildings, it could be an option to analyze the system to build water infiltration capacity. ▪ DR said a key goal of the Study is to work with industrial partners to develop such best practices. ▶ Comment that storage might be a preferred option instead of infiltration due to increasing drought risk in summer, need for irrigation, and livestock purposes. Agriculture is a priority for the community. **Mitigation Measures for Road Right-of-Way** ▶ CS pointed out the Polkey Road channel where drainage ditches impact the road due to flows. ▶ Comment that the right-of-way beside the creek could be an opportunity to keep a double-lane on the road (as opposed to previous suggestion to develop into a one-lane road) but to work with the MoTI to develop a solution. ▪ CS said it is possible although it is already a tight space especially if there is potentially a roadside drainage channel between the road and the private property. ▶ Comment that there may be some resistance from local landowners to a one-way road although potentially opinions may shift. ▪ CS said that the technical team can investigate the right-of-way for that location. ▶ **ACTION: KWL to investigate the road right-of-way to determine potential solution between Polkey Road, stream channel, and drainage ditch.** **Riparian Areas** ▶ Comment if agricultural lands have a procedure if lands are adjacent to a natural riparian area. If there is storage for water capacity gains, there are opportunities to naturalize. ▪ CS said it depends on extreme events vs. day-to-day events, as well as potential water quality impacts from contaminants, although riparian areas are more beneficial for habitat benefits than flood control benefits. ▪ DR noted that water temperature plays a key role in habitat values.

#	Description
	Trestle Road Dike ▶ Comment regarding the Trestle Rd. dike: floods are significant in that area and a pump station was mentioned. Are there opportunities to prevent flooding on private properties in that area. ▪ CS said the dike slows flows; water is driven by the Koksilah River flows and backs up due to a "bathtub" effect from the dike; however, a pump station can pump out the water over to the Koksilah River side. It first must be determined if there is a way not to pump (i.e. to avoid energy and operational cost). ▪ CS said potentially, there could be two pipes (one high and one low). Options are still under investigation but it is noted that this is an area of concern. ▶ Comment about pump station moving water to the other side of the tracks and potential flooding impacts. ▪ CS said the water levels on the opposite side of the tracks are controlled by the Koksilah River as well as water levels by the bridges although the bridges are outside the Study scope. ▪ CS noted that log jams and gravel removal do not address specific reduction of flooding but they do help avoid flood levels from getting worse. ▶ Comment about potential changes to the railroad bridges that may help improve conveyance. ▪ CS said the technical team can look at improvements to conveyance that can lower water levels by 0.5m. or more in concept; however, this could impact downstream. A larger (separate) study of that idea is needed. ▶ Comment suggesting a different strategy for the two areas in the watershed: high areas and low areas (two streams of work). Potentially, there could be an "old school" or grey infrastructure approach for the low area that requires retrofitting. Soft engineering could address impacts for habitat both in low and high areas. There can be upstream support from CVRD Planning for measures for newer developments. ▪ CS aid improving the culvert through the Trestle Road dike may be an option and could include an automated or manual floodgate. ▪ CS said upland drainage towards Trestle Village could also be reduced by a cut-off ditch higher on the hill so water is diverted to Miller Rd. or to the Koksilah River; however, this would not improve groundwater flows. **Vegetation** ▶ Comment noting that the current dike at Trestle Road is older with a bolted gate and trees and old vegetation may be jeopardizing flows. Does it need upgrading? Or can trees be maintained? ▪ CS said his understanding is that maintenance for vegetation is a concern. ▶ Comment that overgrown vegetation on both sides of Trestle Road exacerbates water management. Could Cowichan Tribes remove or maintain to improve detention? ▪ CS said it would not improve conveyance but there is a need for balance and protection of vegetation for fish habitat on the creek side of Trestle dike. ▶ Comment asking if pond improvements upstream of Trestle dike would help flood water management? ▪ CS said pond improvements would help moderately but for not for extreme events as there is not enough storage space. There are limits to storage based on the groundwater table so storage cannot be too deep.

#	Description
6	**Option Evaluation Criteria** **Option Evaluation Framework** ▶ DR explained provided a brief overview about each of the accounts as part of the multiple account evaluation framework. **ACTIVITY: Multiple Account Evaluation (MAE) Criteria Ranking** ▶ DR introduced the discussion guide and list of preliminary evaluation criteria asking participants to rank from 1 to 5 (with 1 being lowest priority and 5 being highest priority) the evaluation criteria, add others for consideration, or revise wording to clarify preliminary evaluation criteria. **DISCUSSION: Option Evaluation Criteria** ▶ DR led a discussion about preliminary option evaluation criteria to consider refinements. **Financial** ▶ KL asked to include equity to acknowledge the financial differences and available resources between CVRD and Cowichan Tribes. ▶ KL suggested to include long-term financial stability (i.e. in terms of asset management – can we afford to maintain program or will borrowing be required)? ▶ Comment that some criteria are redundant e.g. life cycle vs. long-term operating costs. ▪ KM noted to add the cost of not doing anything (e.g. relative to a base case or status quo scenario), which may ultimately be a higher cost. ▶ Comment suggesting that life cycle cost and capital cost be combined. ▪ KM said operating and maintenance costs are also connected as well as long-term financial stability – it is about acknowledging regulatory factors at play. ▶ Comment suggesting a cost-benefit analysis should be included i.e. how to account for the impacts to private property? Presently the analysis is a one-sided equation that fails to quantify benefits of homes. ▶ Comment responding that it is a fair comment; ideally, there would be cost-benefit analysis except that that criterion all relates to all other accounts as well. ▪ TF said that as a financial project, a cost-benefit would be helpful although acknowledged that it is challenging to look at multiple financial components vis a vis what we are trying to do in terms of investment. The analysis cannot just look at valuation of property (e.g. employment numbers may also be important). Further information would be required. ▪ KM agreed there is much information that is unknown (e.g. cost of contaminated drinking water). **Environmental** ▶ KM said climate change impacts are anticipated. ▶ TF said Cowichan Tribes lives in the flood plain which is what is driving the Study, although climate change is not discussed despite newest reports from Intergovernmental Panel on Climate Change (IPP). ▶ KM said if there is major flooding there will be major impacts. ▶ Comment that climate change will affect all accounts – why is it included in the environmental account? ▪ KM said change is the continuum. ▶ DR asked if risk management should be a higher consideration? **Regulatory / Political**

#	Description
	▶ Comment that the regulatory/political account is an opportunity to look at changes in land use. ▪ DR said additional factors may influence regulatory and political criteria such as highway regulations and property impacts. ▶ FB said development permitting as an implementation tool is questionable as in BC, it is a weak tool that is not enforceable and provides just a snap shot in time. It only works if there is compliance or better legislation. For Cowichan Tribes, permits are challenging due to backlogs and limited resources. ▪ Comment that potentially the industrial park could be a pilot to investigate regulatory approaches for regulations for impervious and pervious surfaces – industrial stakeholders can play a leadership role and could showcase low impact development or other beautification for water management. There would be aptitude if approached the right way and eventually embedded in the culture. ▶ Comment that development permitting is not a useful criterion in terms of evaluation. ▪ DR said by example, are there regulations to implement or compliance with guidelines as a second step? ▶ Comment that there could be demonstration projects for development applications in the watershed. ▪ DR said the idea of education is a precursor to regulation although one issue is that it is a guideline that is not enforceable and better information is required as to how we can legislate. ▶ DR said potentially low impact development could be built into development permits for fish habitat, roads, and other CVRD and Cowichan Tribes information for new developments. ▪ KM said the critical aspect to regulation is fairness. ▪ KM said regulations such as Riparian Area Regulation (RAR) are triggered only when there is a request for development (*Note: Development Permit Areas, Zoning Bylaw provisions, Watercourse or environmental bylaws, or municipal policies*). Could a system-wide approach be reviewed? ▪ KM said the RAR process is expensive and results are typically ad hoc. The CVRD estimates targets and the time required to undertake the works and if it meets feasible guidelines. It is a tool that is specific to outcomes CVRD is looking for (e.g. drainage, flood, bylaw). ▪ DR said there may be opportunities to update the engineering standards that may be combined with development permit and building standards and triggered at redevelopment. ▪ DR said RAR is a provincial framework that controls works around fish-bearing streams but it is also about stormwater and erosion (although that aspect is complex). ▪ DR said it is important to ask what the objective of the policy is. ▶ Comment asking what the framework is for stormwater management? ▪ KM said it is performance-based framework where natural areas are positive, energy efficient, etc. ▶ Comment stating that it is appreciated what we want to achieve through permitting but a long-term approach is that governance is an important piece and it is necessary to have a level of authority. **Socio-Economic** ▶ Comment that health and safety should be under risks. **Constraints** ▶ Comment asking if criteria are not weighted, is it necessary to have categories or accounts? ▪ DR agreed the accounts are not as relevant; it is just a way of categorizing. Potentially the rank is not critical; rather, a tool to report back is what is important. ▶ Comment asking who will undertake the ranking?

#	Description
	▪ DR said the technical team will complete the option evaluation and draft report. ▶ FB asked how the evaluation can reconcile Cowichan Tribes values and others' values? That is important in terms of directive government decisions in the event of two options – how do we determine what option is the more preferred option? ▪ DR said the multiple account evaluation process will provide that summary as it evaluates both quantitatively and qualitatively as opposed to "best guess", and at least if there is no agreement, there is transparency to encourage discussion on values behind the choice and other factors. ▪ DR said there is appreciation of different values and that land use factors may matter more to those living in the Cowichan Tribes flood plain so some sensitivity is needed while working to accommodate residential development. ▶ Comment asking if there should be a program to encourage roof leader disconnection and could it potentially be included in the evaluation criteria? ▶ Comment that not all options are equal and there should be clarity on how well options perform as part of the evaluation criteria. ▪ DR said a question could be: is it solving the flooding problem? ▪ KM reminded participants that the Stormwater Management and Mitigation Plan is a case study about developing a watershed strategy and presenting high-level options to mitigate issues. The Study will help determine other components part of an overall strategy and will open doors for other items.
7	**Next Steps** ▶ DR explained the immediate next steps in the process noting that input will be used to confirm evaluation criteria used to evaluate the preliminary options to move toward recommended actions for the Stormwater Management and Mitigation Plan. ▶ DR asked participants to complete discussion guides and submit to Keith Lawrence or Tracy Fleming. ▶ KL will email the discussion guide in Word format to allow participants to complete electronically. ▶ **ACTION: Lanarc (KF) to provide CVRD the discussion guide in Word format by morning of Oct. 17.** ▶ **ACTION: CVRD (KL) to distribute Word version of discussion guide by email to participants by Oct. 17.**

KERR WOOD LEIDAL
consulting engineers

Appendix D

Technical Memorandum #1

Hydrological/Hydraulic Modelling Assumptions Summary

KERR WOOD LEIDAL
consulting engineers

Greater Vancouver
200 - 4185A Still Creek Drive
Burnaby, BC V5C 6G9
T 604 294 2088
F 604 294 2090

Technical Memorandum #1

DATE: July 19, 2018

TO: Keith Lawrence, Senior Environmental Analyst
Cowichan Valley Regional District
175 Ingram Street
Duncan, BC V9L 1N8

FROM: Eva Li, M.A.Sc., P.Eng.

RE: **SH-HWUYKWSELU (BUSYPLACE) CREEK STORMWATER MANAGEMENT & MITIGATION PLAN**
Proposed Stormwater Management Design Criteria and Modelling Assumptions
Our File 2212.071-300

1. Overview

The following memorandum outlines the stormwater management design criteria and the assumptions used for hydrological and hydraulic modelling. The sections of this memo include the following.

1. Overview
2. Introduction
3. Approach
4, Background Review
5. Site Visit
6. Bylaws, Guidelines Review and Design Criteria
7. Modelling Assumptions

2. Introduction

The Cowichan Valley Regional District (CVRD) retained Kerr Wood Leidal Associates Ltd. (KWL) to prepare a stormwater management and mitigation plan for the Sh-hwuykwselu (Busy Place) Creek. As part of the hydrological and hydraulic modelling work, model assumptions have been proposed in this technical memorandum for review and approval of CVRD and other stakeholders, including TAG, Cowichan Tribes and stakeholders. This technical memorandum also summarizes the information collected from the background review, site visit, and policy review.

3. Approach

- Background Review: to review historical studies, collect hydrometric and climate data, and compile existing data of the stormwater drainage system;

- Site Visit: to familiarize the project team with the watershed, review current conditions within the watershed, better understand future land use plans, visually inspect the erosion sites and to collect local knowledge relative to drainage and flooding concerns;
- Bylaw and Guidelines Review: review relevant bylaws and guidelines from Ministry of Transportation, MMCD and City of Duncan to establish the assessment criteria for the Busy Place Creek drainage system; and
- Model Assumptions: provide assumptions on design storm, climate change, land use, boundary condition, and modelling scenarios for client review and approval.

4. Background Review

4.1 GIS mapping

The following GIS mapping has been provided by CVRD and incorporated into a GIS database for the purpose of base mapping and GIS analysis:

- base mapping,
- aerial photography,
- topography,
- land use, and
- soils and vegetation.

Figure 1 shows the study area and major drainage features in the watershed.

4.2 Hydrometric and Climate Data

Hydrometric Stations

Nearby hydrometric station data was gathered for the purposes of model calibration and validation, and to establish downstream boundary conditions for the hydraulic model. Data was used from two gauges nearby; a Water Survey of Canada (WSC) gauge (08HA003) on the Koksilah just upstream of Koksilah Road and a FlowWorks gauge on the Koksilah at Island Highway. The WSC gauge is currently active and has 71 years of recorded discharge and water level data. The FlowWorks gauge was installed in February 2011 with concurrent water level data to 2016, the gauge stopped recording for a period of time and became active again in April 2018.

North Cowichan Climate Station

A review of regional weather stations was carried out to identify a station that is representative of the precipitation conditions at Busy Place watershed and provides a full year of precipitation records. The review led to the selection of the Environment Canada North Cowichan Climate Station (1015630), with 38 years of recorded data between 1981 and 2018. An Intensity-Duration-Frequency (IDF) rainfall curve was developed for this station using 22 years of rainfall data (1982-2005), see Figure 2 attached. The IDF curve, developed by Environment Canada, was used to develop design storms for the hydrological model. Hourly rainfall data from the North Cowichan Climate Station were obtained from the Municipality of North Cowichan. The hourly data will be used for model validation for the January 2018 rainfall event.

4.3 Existing Stormwater Drainage System Data

A topographic survey of ditches, culverts and stormdrains has been carried out within the watershed by CDW Survey and Design Services Ltd. (CDW). This data will be used to compile a basemap of the existing stormwater drainage system. Where possible, existing record drawings and information will be used to supplement the survey. The survey will identify characteristics of the stream segments and their sensitivity. Locations that require additional investigation will be recommended to determine sizes or routes of underground stormwater infrastructure that could not be identified in the initial survey.

4.4 Previous Reports

The following reports were reviewed to provide background context for the study:

- Culvert Sizing and Watershed Drainage Review, Cowichan Valley, Stantec, 2009
- Trestle Road Triplex Stormwater Study, by Chatwin Engineering, November 2017
- Cowichan Tribes Draft Land Use Framework and Atlas, Draft, 2014
- Archaeological Impact Assessment for Trestle Road/Wilson Road Water System, Madrone Environmental Services, 2014
- Lower Cowichan/Koksilah River Integrated Flood Management Plan, NHC, 2009
- Busyplace Creek in the Cowichan Valley - A Pilot for a Water-Centric Approach to Land Use Planning, 2008. waterbucket.ca
- Updated Electoral Area E OCP Land Use Designations, OCP Bylaw No. 1690, 2016.
- Climate Projects for the Cowichan Valley Regional District, CVRD. https://www.cvrd.bc.ca/DocumentCenter/View/81884/Climate-Projections-Report?bidId=

Relevant information on flooding history, floodplain mapping, drainage characteristics, and flood control structures, etc., will be extracted from the previous report and utilized in this study.

4.5 Known Drainage Issues

The key drainage issues known to the stakeholders include:

1. January 8, 2018 flooding. Twin culverts were flowing full at the Miller Road/Koksilah Road and Tzinquaw Road crossing. High energy flow resulted erosion hazard to the upstream side of the culverts and potential flood hazard to the downstream properties;
2. Trestle Road flooding. Flood overtopped the road and caused flooding hazard to the residential area. There is no outlet from the diked area of Trestle Road to discharge water during the rainy season;
3. Flooding at the confluence of Busy Place Creek and Polkey Road by ICBC due to gravel deposition; and
4. Loss of headwater storage. Historical failure of pond in the upland agriculture area downstream of Langtry Road. Loss of storage pond in the area upstream of Langtry Road.

5. Site Visit

A site visit was conducted by Craig Sutherland and Eva Li from KWL and David Reid from Lanarc on April 19, 2018. The visit was accompanied by Keith Lawrence (CVRD), Andrew Newall (MoTI), Tracy Flemming and Eyvette Elliot from the Cowichan Tribes Land Office, and Luschiim (Arvid Charlie) Ph.D. (Honorary, VIU) and Cowichan Elder from the Cowichan Tribes.

The purpose of the site visit was to familiarize the project team with the watershed, review current conditions within the watershed, better understand future land use plans, visually inspect the erosion sites and to collect local knowledge relative to drainage and flooding concerns. Photos taken during the site visit are provided in Appendix A.

The following locations were visited:

- Quw'utsun Smuneem Elementary School – wetland and stormwater pond;
- Glenora Road past Keating Farm Property: drainage direction and potential location for stormwater detention storage/wetland);
- Tzinquaw Road and Miller Road/Koksilah Road: twin culverts and active bank erosion;
- Trestle Village and E&N Railway Embankment – discuss flooding/drainage concerns within Trestle village; and
- ICBC office via Miller Road, and Koksilah Road, Polkey Road - discuss drainage issues in this confluence location.

6. Bylaws, Guidelines Review and Design Criteria

6.1 Bylaw and Guidelines Review

Relevant bylaws and guidelines were reviewed to establish the assessment criteria for the Busy Place Creek drainage system.

Ministry and Transportation and Infrastructure (MoTI), 2007. BC Supplement to TAC Geometric Design Guide

Develop design storms for 2-year, 10-year, 50-year and 100-year return periods using available IDF curves and design storm rainfall temporal distributions. The recommended design return period of road drainage structures is provided in Table 1. Road classification for the roads and Highway within the study area were provided by MoTI and listed in Appendix B.

Table 1: Design Return Periods for Hydraulic Structures (Years)

Road Classification Hydraulic Structures	Low Volume	Local	Collector	Arterial	Freeway
Storm Sewers	-	10-25	10-25	10-25	10-25
Highway Ditches	10-25	10-25	10-25	10-25	10-25
Culverts <3 m Span	50-100	50-100	100	100	100
Bridges	100	200	200	200	200
River Training and Channel Control Works	100	200	200	200	200

Requirement for Drainage Designs

- The minor or piped system consists primarily of the storm sewer system comprised of inlets, conduits, manholes and other appurtenances designed to collect and discharge into a major system for frequently occurring storms (e.g. less than 5 to 10-year return period).
- The major or overland system will come into operation once the minor system's capacity is exceeded. Thus, in developments where the major system has been planned, the streets and ditches may act as open channels directing the excess stormwater to nearby watercourses without endangering the public, damaging property or causing excessive erosion. The major system shall be designed to convey a 100-year return period peak discharge.
- Water Quality: Design considerations include using catch basins to direct pavement run-off overland instead of direct discharge to streams, topsoil and sod lined ditches, filtration ditch blocks, and/or water quality ponds at ditch outlets to streams. A Registered Professional Biologist shall be involved with these designs.

Discharge Rates for Land Development

- All drainage systems must include run-off controls to limit post-development peak discharge rates to the predevelopment rates for 5-year return period storms.
- The BC Supplement to TAC Geometric Design Guide refers to MMCD Design Guideline Manual (2005) for storm drainage design.
- The BC Supplement to TAC Geometric Design Guide refers to Stormwater Planning: A Guidebook for British Columbia (2002) for Stormwater Management.

MMCD, 2014 Stormwater Drainage Design

The MMCD guideline is listed as follows:

- The minor system consists of pipes, gutters, catch basins, driveway culverts, open channels, watercourse, and stormwater management BMPs designed to capture, convey, treat or modify flows up to a set return frequency (e.g., 5-year or 10-year), as directed by the local authority.
- The major system consists of surface flood paths, roadways, roadway culverts, watercourses and stormwater management facilities designed to capture, convey, treat, or modify larger flows up to a set return frequency (e.g., 100-year or possibly 200-year).

City of Duncan, Works and Services Bylaw, No. 3158, 2017

The Works and Services Bylaw, No. 3158, for the City of Duncan was also reviewed as a reference.

The following return frequencies shall be used for design:

- Minor system: 10-year return period for conventional design (i.e. conveyance),
- Minor system: 5-year return period for stormwater management, and
- Major system: 100-year return period.

6.2 Design Criteria

The following design criteria was proposed based on BC Supplement to TAC Geometric Design Guide (2007), and MMCD Stormwater Drainage Design (2014). Input was also received from MoTI staff on the road classification and recommended design criteria.

The drainage system in the study area composed of the minor drainage system (storm sewers, roadside ditches, and ditch connecting culverts) and the major drainage system (natural watercourses, stream crossing culverts, and overland flow routes). These networks collect both stormwater from impervious surfaces such as roads and roofs and some stormwater that infiltrates into the ground. All storm sewer pipes (>300 mm), creeks, and ditches contained in the storm sewer database will be included within the model. The drainage assessment criteria are listed in Table 2.

The stormwater management criteria (including water quality, volume and rate control) was proposed based on the Stormwater Planning Guide Book (BC Government, 2002 and 2007). It is a standard practice to plan for stormwater management measures for many municipalities in BC.

Table 2: Proposed Drainage Assessment Criteria

Application		Criteria/Methodology
Flood Protection	Storm sewers, roadside ditches and culverts connecting ditches	• 10-year return period design event (minor system)[1]
	Stream crossing culverts	• 100-year return period design event (major system)[2]
	Natural watercourses	• 100-year return period design event[2]
	Bridges and culvert > 3 m diameter	• 100-year return period design event (low volume) [2] • 200-year return period design event (local, collector, artery, freeway)[2]
	River training and channel control works	• 200-year return period design event
Stormwater Management	Volume Reduction & Water Quality (source controls)	• On-site rainfall captures 90% of the average annual runoff and remove 80% total suspended solid (72% of the 2-year 24-hour storm)[3]
	Rate Control (Detention/Diversion)	• Control post-development flows to pre-development levels for 6-month, 2-year 24-hour events.[3]
	Riparian	• Establish and protect riparian setbacks.[4]

1. MMCD, 2014. Stormwater Drainage Design.
2. BC Ministry of Transportation Supplement to Transportation Assoc. of Canada Geometric Design Guide, 2007.
3. Stormwater Planning: A Guidebook for British Columbia, 2002; Beyond the Guidebook - June 2007
4. British Columbia *Riparian Areas Regulation*, 2006.
5. All design flood events are to be based on future land use conditions and future projected climate conditions for Year 2050s.

7. Modelling Assumptions

7.1 Modelling Software

PCSWMM 2D software package will be used to perform hydrologic and hydraulic modelling. Using inputs from the CVRD's existing GIS-database supplemented with additional field survey data, the PCSWMM model can model both the hydrological response of watersheds considering watershed size, topography, land use, soils, and impermeable surfaces as well as model the hydraulics of the drainage system.

7.2 Catchment Delineation

For natural areas, catchment delineation will be conducted using the contour data. For areas with municipal stormwater drainage system (i.e., storm sewers, culverts, ditches, etc.) the catchment delineation will be based on site survey that is underway. Where routes of underground storm sewers cannot be determined with available information and observations from the surface, the routes will be assumed to provide conservative modelled flows.

7.3 Soil Parameters

The groundwater portion of PCSWMM will be used to better estimate the groundwater and interflow portions of the runoff hydrograph. Infiltration rates, soil depths, and soil hydraulic conductivity were all input based on previously used and typical values. Figure 3 shows the soil map from BC Ministry of Agriculture (AGRI) and BC Ministry of Environment (MoE) that will be used to determine soil parameters. A summary of soil parameters for each soil type are included in Appendix A.

7.4 Design Storms

Synthetic design storms will be used in the hydraulic model to assess the capacity of the stormwater drainage system. Table 3 provides the design rainfall amount based on North Cowichan IDF curve to present the existing condition.

1. A Chicago storm distribution will be used to generate short duration design storms (1-hour to 12-hour) for the purposes of generating peak discharge estimates for sizing of conveyance structures. To replicate antecedent wet conditions, the timing of the storm peak will be adjusted from 50% (conventional Chicago distribution) to 30 per cent of the 24-hour time frame. The modified curves will be scaled to match the peak rainfall intensity for a specific duration.
2. SCS Type 1A distribution will be selected to generate long-duration design storms (24-hour) for conservative sizing of the detention facilities, as recommended in the MoTI Design Guide (2007). The SCS Type 1A curve will be used to provide distribution of rainfall over 24-hour duration.

Table 3: Total Precipitation Amounts for Design Storms (Existing Condition)

Duration	Total Rainfall (mm) Return Period				
	2-Year	10-Year	50-Year	100-Year	200-Year[2]
1-hour	9.2	12.5	15.4	16.7	18.1
2-hour	13.7	18.2	22.1	23.8	25.7
6-hour	28.4	35.9	42.4	45.1	48.3
12-hour	42.0	55.0	66.4	71.2	76.7
24-hour	57.8	79.4	98.4	106.5	115.6

1. Design rainfall based on North Cowichan IDF Curve.
2. 200-year return period by extrapolation.

7.5 Climate Change

To account for climate change in future modelling scenarios and subsequently in design, climate change factors for the design storms were determined using IDF-CC climate change estimation tool[1]. The tool was developed by Western University and has nine built-in climate models. The Western Canada Climate Model (namely CanESM2) was recommended by the Pacific Climate Institute Consortium (PCIC) and was chosen to calculate the climate change factors under year 2050 condition. The highest greenhouse gas emission scenario, RCP 8.5, was selected as a conservative approach.

The estimated climate change factors range from 12 per cent to 26 per cent for all duration and return period design storms from the North Cowichan Climate Station. For the 20-year 24-hour return period storm, the IDF-CC tool predicted a climate change factor of 17 per cent, as oppose to 23 per cent from the CVRD Climate Projections Study (Phase 1, 2017). For consistency, climate change factors from the IDF-CC tool were scaled up by 6 per cent for all duration and return period storms to match with the estimates from the CVRD Climate Projections Study. The scaled climate change factors under 2050 climate change conditions are provided in Table 4. The total precipitation amounts under 2050 climate change conditions are provided in Table 5.

Table 4: Climate Change Factors for Design Storms (Year 2050 Climate Change Conditions)

Duration	Climate Change Factor						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year[1]
1-hour	1.18	1.18	1.19	1.22	1.22	1.26	1.30
2-hour	1.18	1.18	1.20	1.23	1.24	1.27	1.31
6-hour	1.18	1.19	1.21	1.23	1.23	1.25	1.28
12-hour	1.18	1.19	1.21	1.22	1.23	1.24	1.25
24-hour	1.18	1.19	1.21	1.23	1.24	1.26	1.28

1. 200-year rainfall volume uses the 100-year climate change factor.
2. All climate change factors are positive (Increase in volume) by 18% to 30% for various return period and durations.

[1] Western University, 2018. IDF_CC Tool 3.0., http://www.idf-cc-uwo.ca/home.

Table 5: Total Precipitation Amounts for Design Storms (Year 2050 Climate Change Conditions)

Duration	Total Rainfall (mm) Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	200-Year[1]
1-hour	10.86	13.19	14.87	17.36	19.33	21.65	23.45
2-hour	16.12	19.38	21.85	25.23	28.11	31.22	33.96
6-hour	33.44	39.12	43.32	48.86	53.20	57.56	62.47
12-hour	49.41	59.28	66.33	75.46	82.42	89.32	97.60
24-hour	67.99	84.24	95.97	111.62	123.73	136.18	150.05

1. 200-year rainfall volume uses the 100-year climate change factor.
2. All climate change factors are positive (Increase in volume) by 18% to 30% for various return period and durations.

7.6 Design Storm Hyetograph

The 1- to 12-hour design storms were distributed using Chicago distribution and the 24-hour design storms were distributed using the SCS Type1A distribution. The 12-hour and 24-hour design storm hyetrographs are shown in Figures 4 and 5.

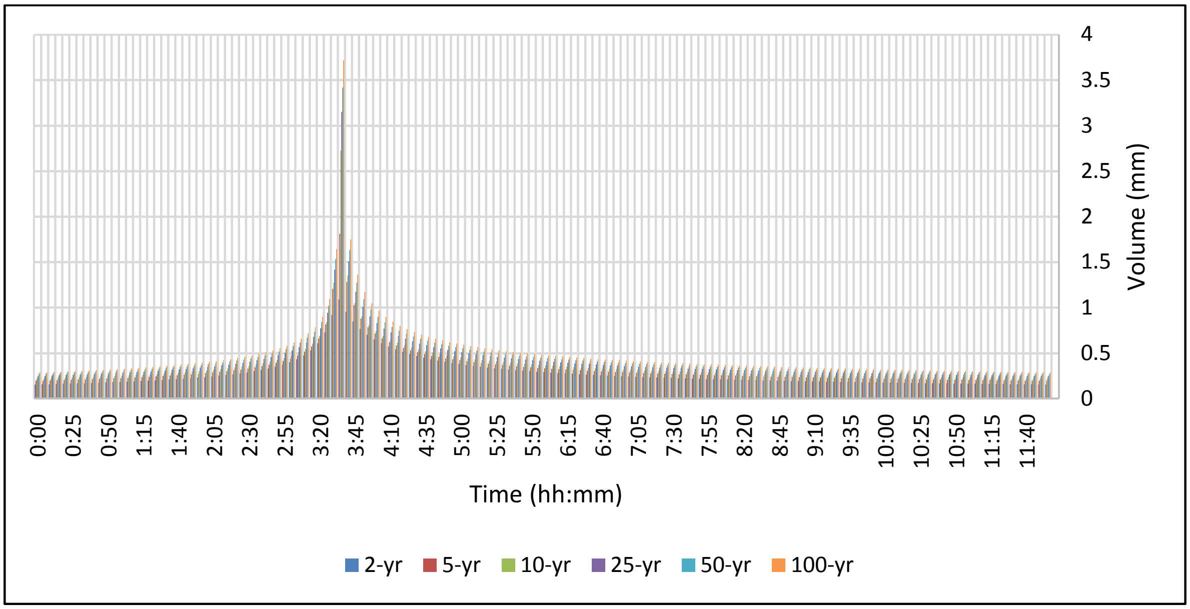

Figure 4: Chicago Design Storms for 12-hour Durations

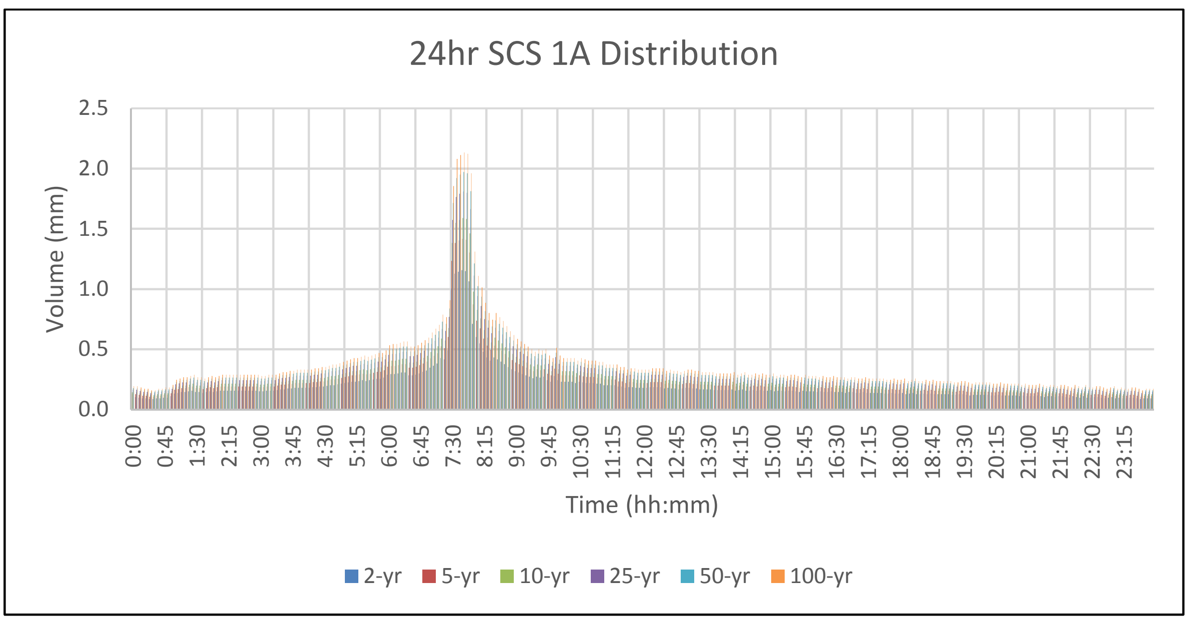

Figure 5: SCS Type 1A Design Storms for 24-hour Duration

7.7 Land Use Plan and Percentage Impervious

Three land use plans will be modelled in this study to reflect the current and future land use conditions:

1. Current land use conditions – air photo and zoning;
2. Full Build-out according to the existing 1994 Electoral area E Official Community Plan and Cowichan Tribes Draft Land Use Framework; and
3. Full build-out according to Electoral Area E Official Plan Update and input from Technical Advisory Committee. It is assumed that this scenario will be carried out at a later stage based on the outcome of the first two scenarios and based on further discussion with the Cowichan Trib.

Land use types were obtained from the OCP and the Cowichan Tribes Draft Land Use Framework. The proposed percentage imperviousness was proposed based on professional judgement using GIS orthophoto analysis and similar project experiences and listed in Table 6. Gravel pit areas were separated from the rest of the industrial areas based on its high permeability.

Table 6: Percentage Imperviousness for Typical Land Use Types

Land Use Type	Sub-Categories	% Impervious
Commercial		60%
Industrial		90%
Gravel Pit		10%
Comprehensive Development		90%
Residential	Urban Low Density (Acreage Residential and half acreage)	10%
	Urban Single Family (urban detached)	50%
	Urban Medium Density (medium density multi-dwelling)	70%
Agricultural Land		10%
Airport		75%
Parks/Playground/Cemeteries		10%
School/Institutional/Church		50%
Forests, Natural Areas or Undeveloped		5%
Open Space		10%
Camp Ground/Recreational		20%
Transportation		90%

Once the catchment delineation is completed, the percentage imperviousness will be applied to each sub-catchment using area weighted method. Figures 6 and 7 show the percentage impervious proposed for the existing land use and the future land use within the study area.

7.8 Floodplain Roughness

Surface resistance for the purposed of overland flow in PCSWMM model is defined using Manning's n empirical roughness value. Spatially-varied values will be assigned to represent the complex roughness characteristics of the Busy Place Creek watershed. Characteristic roughness values were selected based on project experiences and KWL's database from calibrated models. Following land use classification, roughness values will be assigned to polygons simulating sub-catchments across the study area. The proposed floodplain roughness values are listed in Table 7.

Table 7: Floodplain Roughness Values

Land Use	Manning's n Roughness		Considerations
	Range	Selected	
Urban / Suburban Residential	0.05 - 0.07	0.06	fences and obstacles in backyards
Rural / Large Lot Residential	0.035 - 0.06	0.045	pasture and woodland areas
Commercial	0.013 - 0.06	0.035	areas outside buildings i.e., parking lots, vehicle jams
Industrial	0.013 - 0.05	0.035	obstacles from storage/operations and some free lawn
Institutional	0.013 - 0.05	0.03	areas with short grass / lawn or free landscape
Parks / Open Spaces	0.03 - 0.06	0.035	more natural / landscape areas than institutional
Undeveloped / Forested Areas	0.08 - 0.12	0.1	consider some trees down, flood stage below branches
Roads	0.013 - 0.03	0.02	include roads, railway and highway transportation corridors; assume no blockages

7.9 Model Validation

No water level or discharge records are available within the watershed for the purposes of model validation. Instead, model validation is proposed using photo and video records taken during the January 28, 2018 storm event when the storm resulted in bankfull conditions within the lower reaches of the creek. This information will be used to validate model results by checking if the model is simulating bankfull conditions using precipitation records from the January 2018 flood event.

Due to the complexity of the Busyplace Creek downstream drainage system at the E&N railway embankment, a dynamic modelling approach will be used in the model validation process to best match the timing of the peak rainfall and the flood wave in the Koksilah River. The initial offset of the peak rainfall and the Koksilah River peak discharge will be determined by reviewing historical storm events and refined in a dynamic model.

7.10 Downstream Water Level Boundary Condition

Busy Place Creek drains into the Koksilah River. Water level in the Koksilah River serves as the downstream boundary condition in the hydraulic model. There are two water level gauges in the Koksilah River. Station 08HA003 is an active hydrometric station operated by Water Survey of Canada (WSC) for the period of 1914 to present. It is located approximately 4.5 km upstream of the Busy Place Creek confluence. Another gauge is operated by FlowWorks for the period of 2011 to present. The gauge provides water level data via a radar sensor. It is located at the Island Highway Bridge approximately 550 m downstream of the confluence. However, this gauge has a large data gap between November 2016 and March 2018.

For the model validation event (January 2018), the water levels at the FlowWorks gauge was missing. To establish a downstream boundary condition at the confluence of Busy Place Creek and the Koksilah River, a correlation was developed using the latest overlapping period of water level record (January 1, 2016 to March 21, 2016) from the FlowWorks gauge (Blue line in Figure 8) and the WSC gauge (Green Line in Figure 8). Logarithmic trendline was fit to water levels between 1.2 to 1.8 metre, which is the range of water level during the January 2018 storm event. The two gauges had a 99 per cent correlation on a scatter plot. The logarithmic equation will be applied to the water levels at the WSC water level to estimate the corresponding water level at the FlowWorks gauge during the January 2018 validation event. The estimated water level at the FlowWorks gauge will be used to represent the downstream water level boundary condition in the Koksilah River for the model validation run.

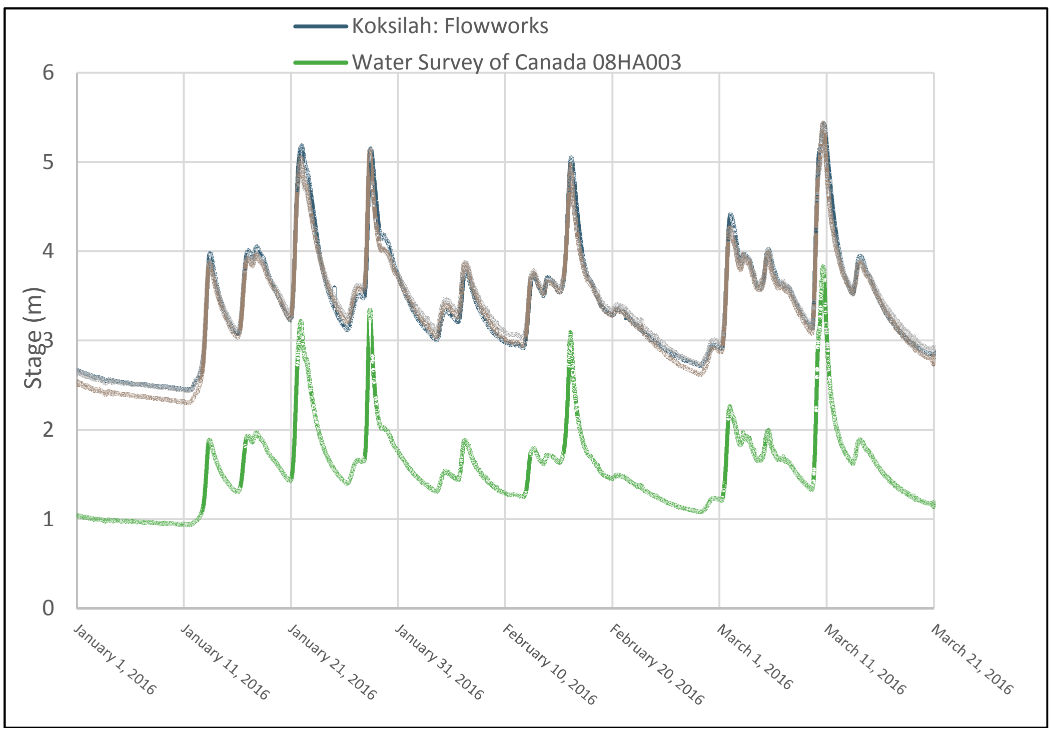

Figure 8: Environment Canada & Koksilah FlowWorks Stage Comparison

The design peak water levels used for the 10-year return period, 100-year return period and 200-year return period are shown in Table 8.

For the model design runs, design water levels in the Koksilah River will be obtained from the MIKE-FLOOD hydraulic model that was used in the Lower Cowichan/Koksilah River Integrated Flood Management Plan (NHC, 2009).

Table 8: Peak Design Water Levels

Location	Peak Water Level		
	20-Year	100-Year	200-Year
Koksilah River Locations			
34 m upstream of E&N Bridge	7.22	7.65	7.84
Upstream side of E&N Bridge	6.9	7.42	7.64
Downstream side of E&N Bridge	6.83	7.29	7.38
66 m Upstream of Highway 1 Bridge	6.5	6.8	6.87
Upstream Side of Highway 1 Bridge	6.23	6.48	6.53
Downstream Side of Highway 1 Bridge	6.08	6.28	6.31
Cowichan River Locations			
130 m Downstream of Allenby Road Bridge	15.27	15.48	15.57
320 m Downstream of Allenby Road Bridge	14.74	14.92	15.01
Upstream Side of Highway 1 Bridge	13.03	13.32	13.44

1. Peak design water levels extracted from MIKE 11 model developed for Cowichan-Koksilah River Integrated Flood Management Plan provided by Northwest Hydraulic Consultants.
2. Elevations shown in meters above NGVD 1928 datum

For future conditions, the model results from the Cowichan-Koksilah River Integrated Flood Management Plan have also been used. The model results indicate that water levels increase by about 0.25 m.

7.11 Model Scenarios

Up to five model runs will be performed to assess the Busy Place Creek drainage system under combinations of land use and climate conditions, see Table 9.

Table 9: Model Scenarios

Model Scenarios	Land Use Type	Climate Data	Design Rainfall
Existing Conditions	Existing Land Use	Current climate data	Synthetic design storms with 1-hour to 24-hour duration
		Year 2050 climate data projection with RCP=8.5	
Future Conditions	Full Build-out according to the existing 1994 Electoral area E Official Community Plan and Cowichan Tribes Draft Land Use Framework	Year 2050 climate data projection with RCP=8.5	
	Full build-out according to Electoral Area E Official Plan Update		
	Additional Scenario selected with input from the TAG and community		

Closure

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by: Reviewed by:

Eva Li, M.A.Sc., P.Eng.
Project Engineer

Craig Sutherland, P.Eng.
Project Manager

Encl.: Figure 1: Drainage Review
Figure 2: Rainfall Intensity Duration Frequency (IDF) Curve at North Cowichan Station
Figure 3: Soil Map
Figure 4: Percentage Imperviousness for the Existing Land Use
Figure 5: Percentage Imperviousness for the 1994 Electoral Area E OCP and Cowichan Tribes Draft Land Use Framework
Appendix A: Site Visit Photographs
Appendix B: Road Classifications
Appendix C: Soil Parameters

Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
0	July 29, 2018	Final	Issued for client review	EL

OQM CERTIFIED

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Cowichan Valley Regional District

Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan

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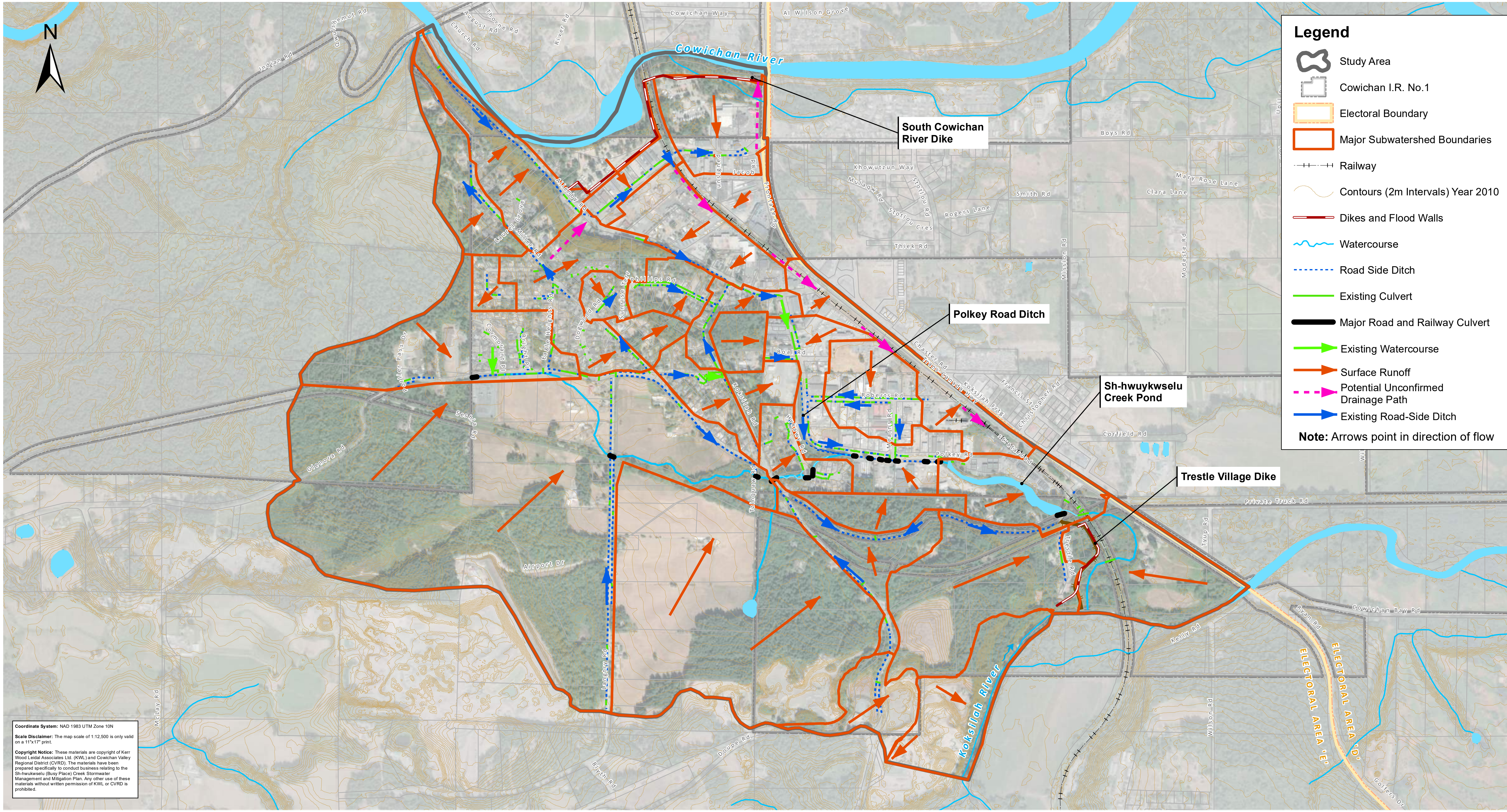

Project No. 2212.071

Date March 2019

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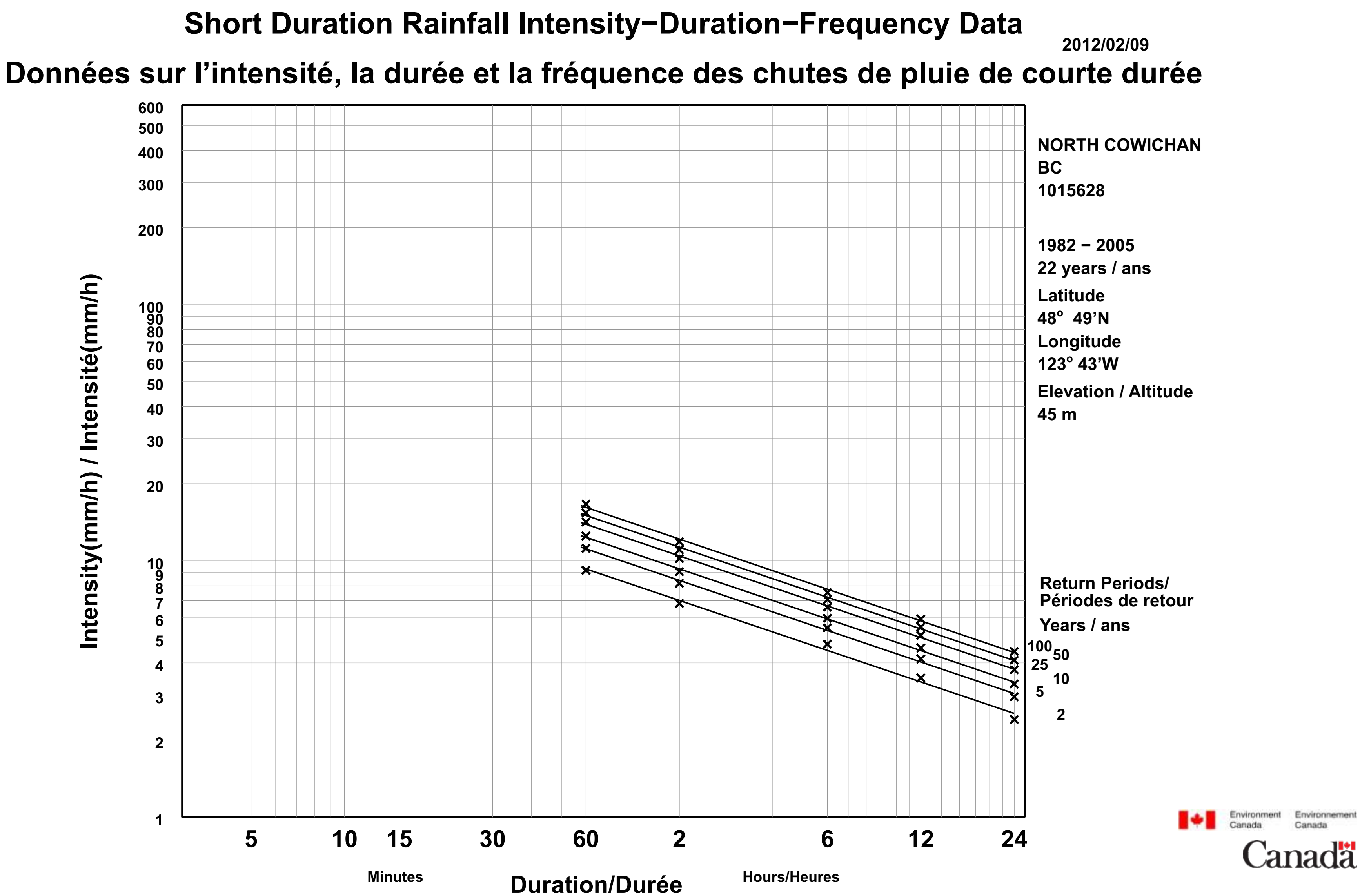
Drainage Overview

Figure 1



Rainfall Intensity-Duration-Frequency (IDF) Curve at North Cowichan Station

Figure 2

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Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan

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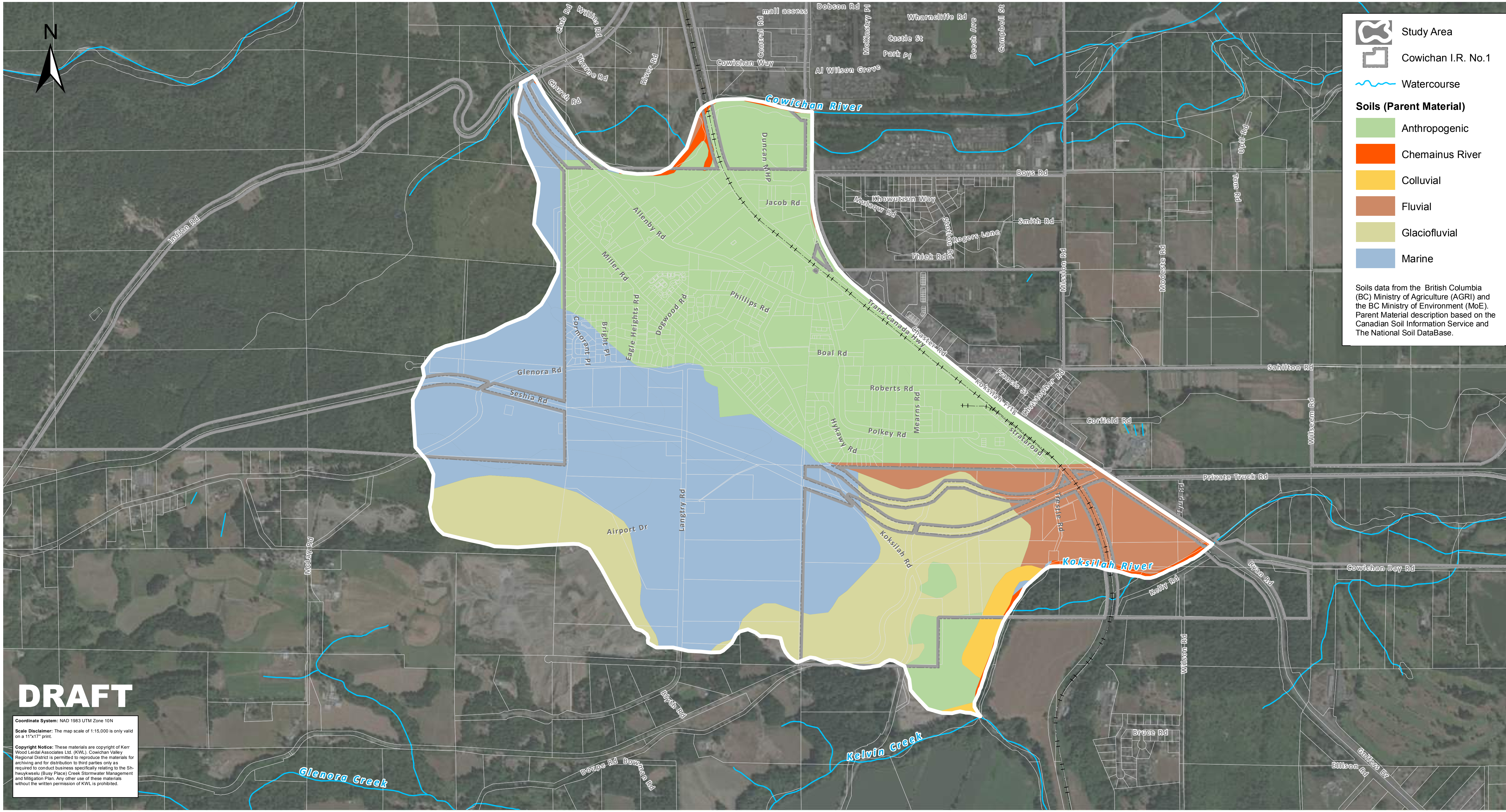

DRAFT

Coordinate System: NAD 1983 UTM Zone 10N

Scale Disclaimer: The map scale of 1:15,000 is only valid on a 11"x17" print.

Project No. 2212.071

Date May 2018

Scale 1:15,000

Soil Map

Figure 3

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Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan

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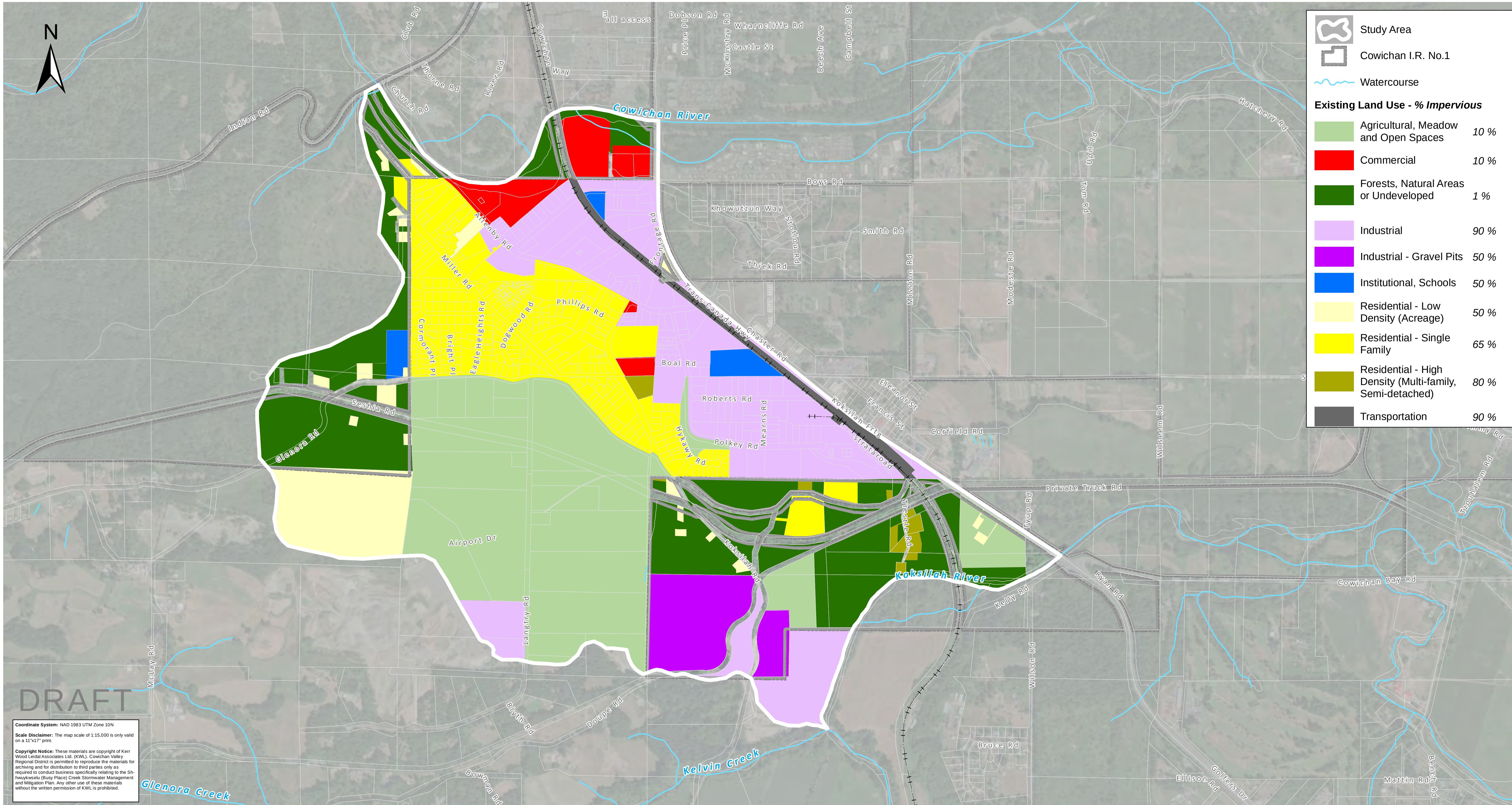

Project No. 2212.071

Date May 2018

Scale 1:15,000

Percentage Imperviousness for the Existing Land Use

Figure 4

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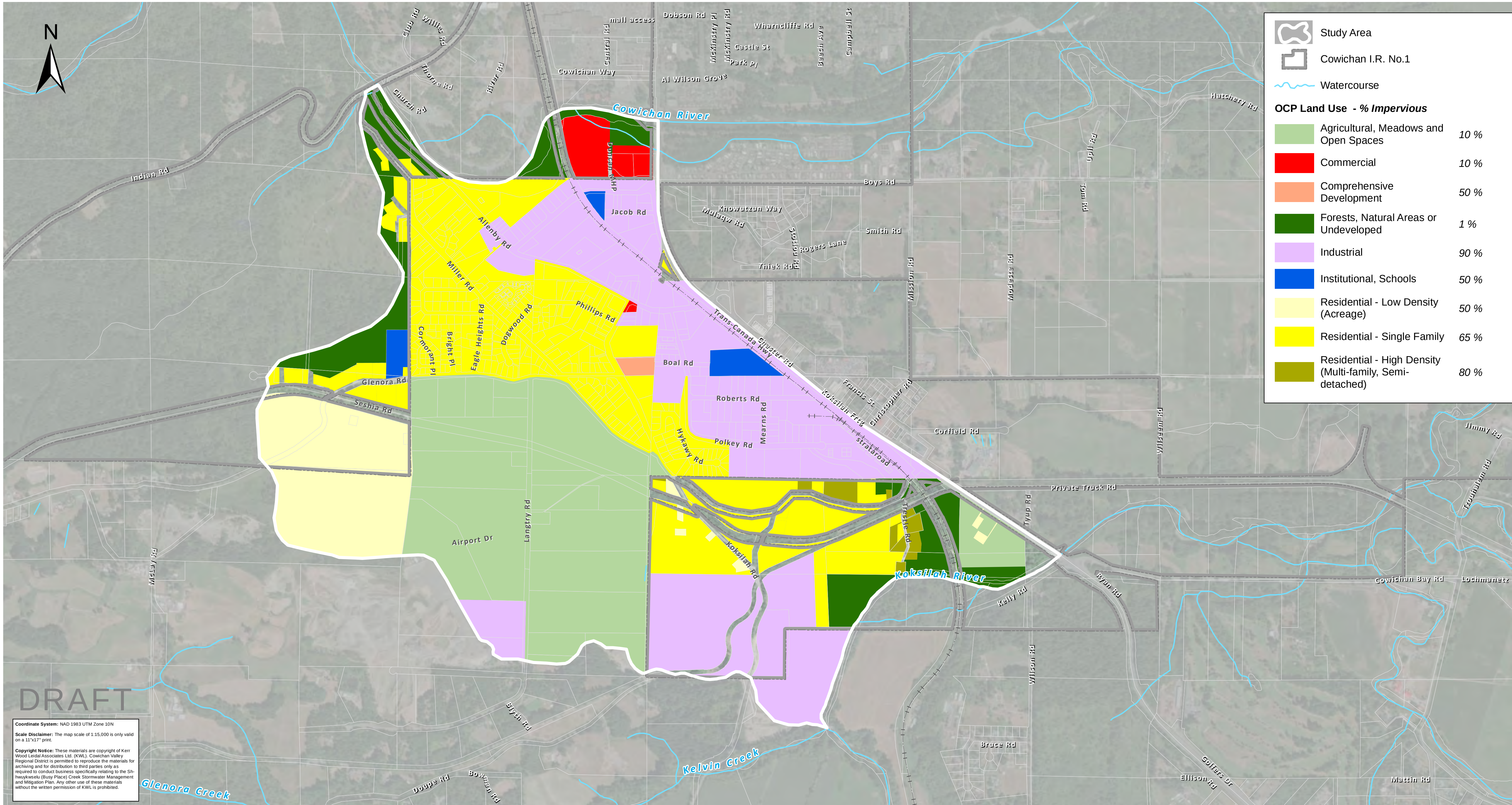

Coordinate System: NAD 1983 UTM Zone 10N

Scale Disclaimer: The map scale of 1:15,000 is only valid on a 11"x17" print.

Project No.	2212.071
Date	May 2018
Scale	1:15,000

Percentage Imperviousness for the 1994 Electoral Area E OCP and Cowichan Tribes Draft Land Use Framework

Figure 5

Appendix A - Photographs

Photo 1: Stormwater Pond at Quw'utsun Smuneem Elementary

Appendix A - Photographs

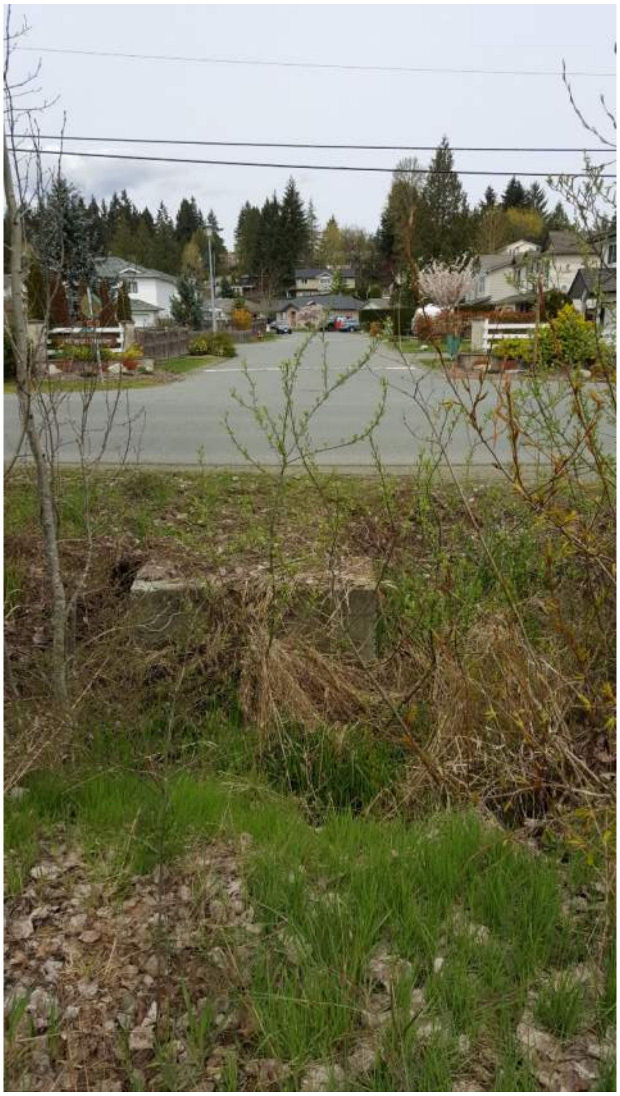

Photo 2: Inflow from North into the Glenora Road Ditch

Photo 3: Glenora Road Ditch (south of the road)

Appendix A - Photographs

Photo 4: Inlet of Tzinqua Road Twin Culvert (lower culver blocked)

Photo 5: Bank Erosion at Miller/Koksilah Road Culvert Crossing (upstream side)

Appendix A - Photographs

Photo 6: Miller/Koksilah Road Culvert Inlet

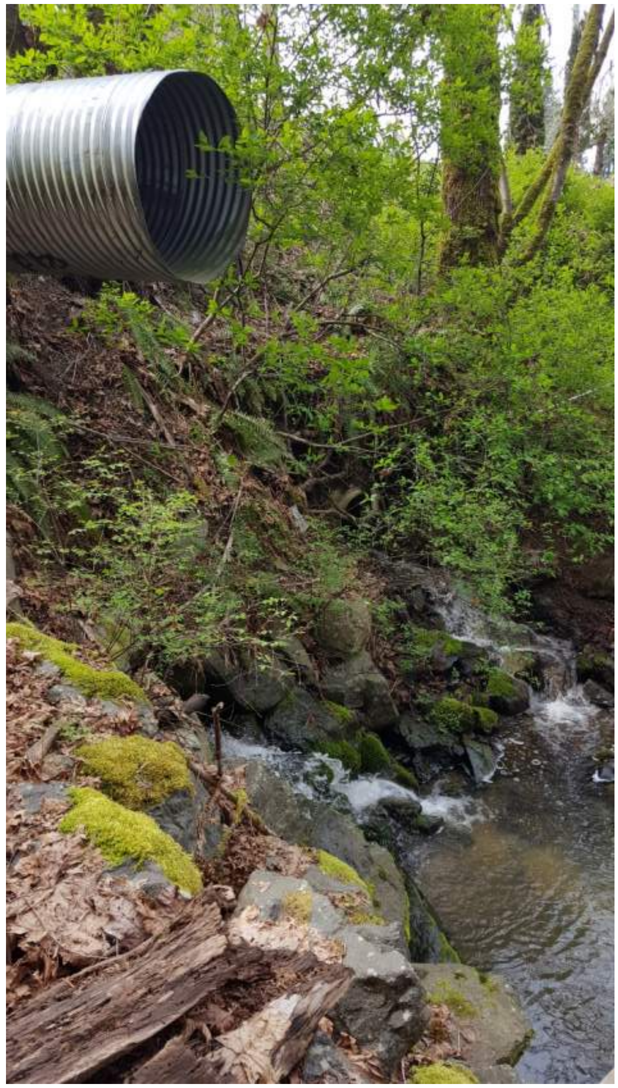

Photo 7: Miller/Koksilah Road Culvert Outlet

Appendix A - Photographs

Photo 8: Busyplace Creek Confluence at Polkey Road by ICBC

Appendix A - Photographs

Photo 9: Busyplace Creek Fish Habitat Signage

Appendix B – Road Classification

Road	Classification
Allenby Road (between Indian Road/Miller Road and Highway 1)	2 - Arterial
Boal Road (west side of old school)	6 - Local
Boal Road (east side of old school)	5 - Local
Boys Road (between Allenby Road and Highway 1)	3 - Collector
Bright Place	6 - Local
Cormorant Place	0- Local Private Road/Strata
Dogwood Road	6 – Local
Eagle Heights Road	6 - Local
Glenora Road (between Miller Road and Seshia Road)	4/5 split - Collector
Hykway Road	6 - Local
Koksilah Road (between Doupe Road and Allenby Road)	3 - Collector
Laurel Grove (?)	0 - Strata road Not Provincial - Local
Langtry Road	5 - Local
Mearns Road	6 - Local
Miller Road (between Highway 1 and Allenby Road)	3 - Collector
Mountain View Crescent	6 -Local
Phillips Road	6 – Local
Polkey Road	3 - Collector
Roberts Road	3 - Local
**Tzinquaw Road	7 - Low Volume Road
Reference: Information provided by Mr. Andrew Newall of MOTI.	

Appendix C: Soil Parameters

Soil Type	Soil Depth (m)	Soil Hydraulic Conductivity (mm/hr)	Initial Soil Moisture (fraction)
Sandy Loam	2	50.3	0.12
Silty Loam	2	10.8	0.31

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Appendix E

Class 5 (Order of Magnitude) Cost Estimate Basis

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consulting engineers

Vancouver Island
201 - 3045 Douglas Street
Victoria, BC V8T 4N2
T 250 595 4223
F 250 595 4224

Class 5 Cost Estimate Basis

DATE: February 13, 2019

TO: Keith Lawrence, CVRD

FROM: Craig Sutherland, M.Sc., P.Eng

RE: **Class 5 (Order of Magnitude/Concept Screening) Cost Estimate Basis**
Sh-hwuykwselu (Busy Place) Creek
Stormwater Management and Mitigation Plan
Our File 2212.071

1. Cost Estimate Basis

This memorandum summarizes and provides a basis for the Class 5 (Order of Magnitude/Concept Screening) Cost Estimate produced for the conceptual capital stormwater management projects identified in the Sh-hwukswselu (Busy Place) Creek Stormwater Management and Mitigation Plan.

1.1 Classification, Purpose, and Use of Estimate

In accordance with the American Association of Cost Engineers (AACE) International Recommended Practice for Cost Estimating (56R-08), a Class 5 (Order of Magnitude/Cost Estimate is defined as an estimate produced with:

- 0% to 2% project definition in terms of % complete; and
- Expected accuracy range of -30% to +50%.

The purpose of this estimate is to provide an opinion of probable cost to:

- Develop an order of magnitude life-cycle costs (25-years) for the conceptual stormwater management projects for long term budget planning.
- Provide cost comparison between conceptual stormwater management projects.

1.2 Estimate Scope

1.2.1 General Description

The conceptual cost estimates for stormwater management projects are based on project descriptions outlined in the drainage project descriptions in the Sh-hwukswselu (Busy Place) Creek Stormwater Management and Mitigation Plan. The locations of the projects for the entire watershed and a detail of the projected located within Trestle Village is shown in Figure 1 and Figure 2, respectively. A copy of a table defining the projects is attached to this technical memo for reference (see Table 1).

1.2.2 Work Included

The estimates for the projects include costs for the following key items including:

1. An allowance for project planning including Engineering Design, Environmental Permitting, Engineering Inspection and Environmental Monitoring estimated using typical percentages (20% to 30%) of total construction cost selected based on anticipated complexity of design and environmental permitting;
2. Mobilization/Demobilization costs assumed to be typical 10% o total construction costs (as outlined in Section 1.4.3 below);
3. Capital costs for major components of the work;
4. Annual on-going maintenance costs for 25-year (not including CVRD or other management/staff costs); and
5. Contingency Allowance (assumed to be 50% as outlined in Section 1.5 below).

1.2.3 Work Excluded

The estimate excludes the following:

1. Costs for extraordinary site conditions such as environmental remediation, archeology, geotechnical stabilization, etc.
2. CVRD's staff/management costs for planning, construction and on-going management.

1.3 Currency

The estimate is developed in December 2018 in Canadian dollars. No allowance for currency effects, escalation, or inflation is included.

1.4 Estimating Methodology

The estimated costs were determined from:

- Estimated quantities of materials measured from available mapping (Google Earth, CVRD GIS, etc) and project concepts;
- Unit rates for materials based on pricing from similar past projects; and
- First principal estimates where work is itemized and cost in sub-components, then summed together and averaged over a suitable unit to produce a viable unit cost.

No recent quotations from contractors have been used in the development of costs.

1.4.1 Insurance and Bonding

Insurance or bonding costs are NOT included.

1.4.2 Consulting Budget

Engineering and Project Planning is included at between 10% to 20% of the total construction cost depending on the complexity of the project.

Construction Services including Engineering Inspection, Contract Management and Environmental Monitoring is included at 10% of the total construction cost.

1.4.3 Mobilization/Demobilization

Contractor Mobilization and demobilization is included at 10% of the total.

1.5 Contingency

1.5.1 Contingency

Contingency, as used in this estimate, is similar to that used in the AACEi Recommended Practice No. 10S-90, Cost Engineering Terminology:

> *Contingency is an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows would likely result, in aggregate, in additional costs.*

In other words, <u>contingency is expected to be spent</u> and should be considered separately from risk items.

Contingency items include, but are not limited to, the following:

- Planning and estimating errors and omissions;
- Minor price fluctuations (other than general escalation);
- Design and scope changes; and
- Variations in the market and environmental conditions.

Contingency excludes the following:

- Major scope changes;
- Extraordinary events such as strikes and natural disasters;
- Management reserves; and
- Escalation and currency effects.

A 50% overall project contingency is applied to the construction cost subtotal.

1.6 Estimate Accuracy

Based on the engineer’s judgement, this estimate should be considered accurate within -30% and +50% which is suitable for the purposes of comparison of options.

2. Summary of Costs

A breakdown of costs for each of the projects is included in the attached tables.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:	Reviewed by:
Original Signed and Sealed	Original Signed
Craig Sutherland, P.Eng Project Engineer	David Zabil, P.Eng Technical Review

CS/

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Revision History

Revision #	Date	Status	Revision Description	Author
0	February 13, 2019	FINAL	Issued for the final report	CS

OQM | Organizational Quality Management Program

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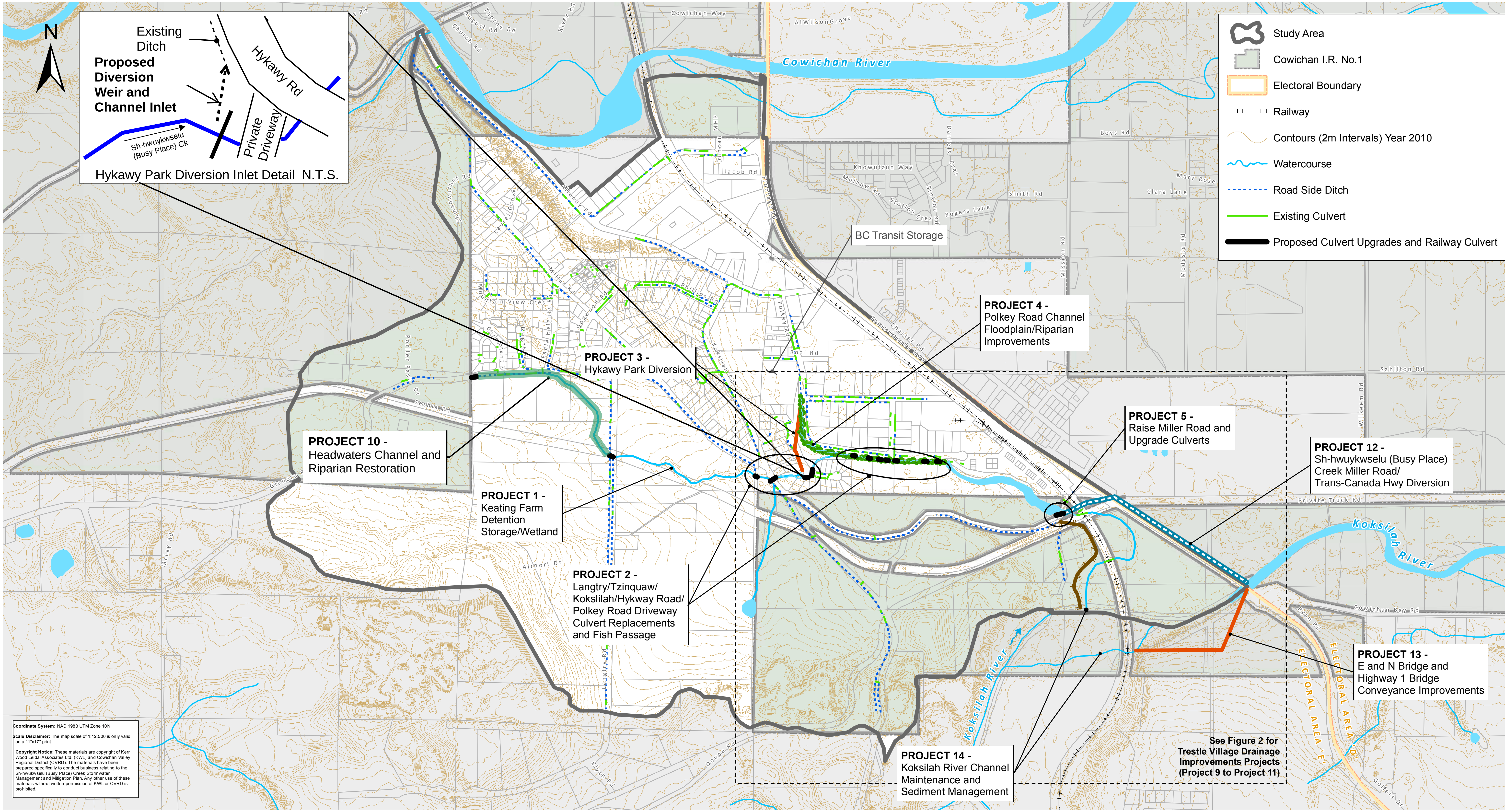
Cowichan Valley Regional District

Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan - Class 5 Cost Estimate Basis

KERR WOOD LEIDAL consulting engineers



Project No. 2212.071

Date February 2019

Scale 1:12,500

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Location of Potential Stormwater Management Projects

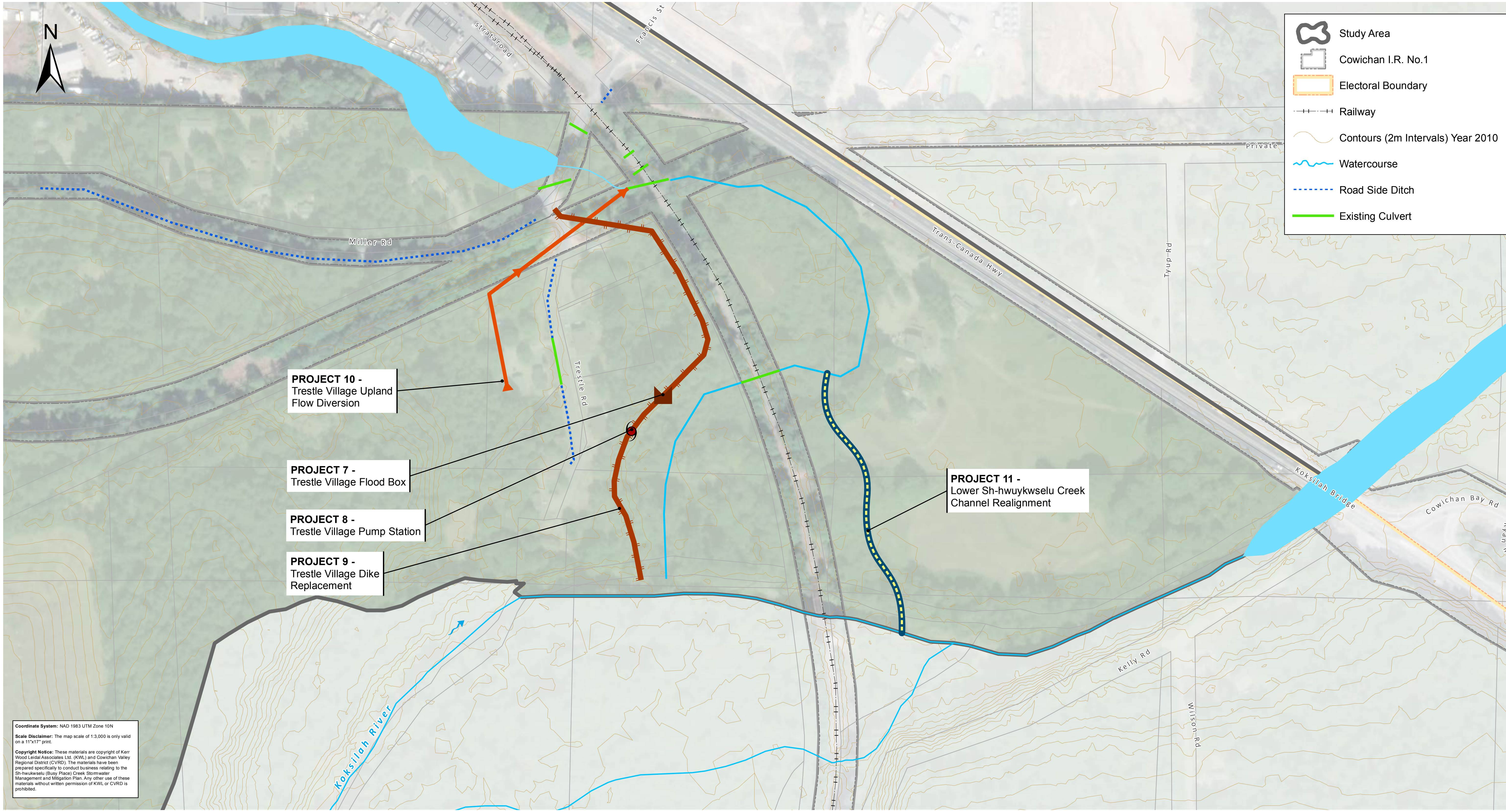
Figure 1

Path: Q:\2200-2299\2212-071\430-GIS\MXD-Rp\Report_Figure\2212071_Fig6-8B_WatershedManagement-DrainageOptions.mxd Date Saved: 1/10/2019 4:03:44 PM | Author: jlau

Cowichan Valley Regional District

Sh-hwuykwselu (Busy Place) Creek Stormwater Management and Mitigation Plan - Class 5 Cost Estimate Basis

KERR WOOD LEIDAL consulting engineers



Coordinate System: NAD 1983 UTM Zone 10N

Scale Disclaimer: The map scale of 1:3,000 is only valid on a 11"x17" print.

Project No. 2212.071

Date February 2019

Scale 1:3,000

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Polykey Road/Trestle Village Area Potential Drainage Projects (Project 9 to Project 11)

Figure 2

Table 1: Summary of Potential Drainage Improvement Projects

Drainage Improvement Project	Intent	Drainage Analysis	On-going Maintenance Considerations
1. Keating Farm Detention Pond/Wetland	Provide upland storage to reduce peak flows from the upper watershed and provide water quality improvement opportunity	Requires approximately 20,000 m^3 of storage to reduce peak flows to 1.7 m^3/s (capacity of culverts at Tzinquaw Road)	As the pond would be considered a dam, formal dam safety inspections, dam maintenance and other dam safety regulatory requirements will be required. The pond may also require infrequent (~5 to 10 years) removal of sediment accumulation to maintain function.
2. Langtry/Tzinquaw/Kokslilah/Hykway Road/Polkey Road Driveway Culvert Replacements and Fish Passage	Replace major road crossing of main creek channel and driveway culvert crossings along Polkey Road to provide sufficient capacity to safely pass the 200-year return period flood	Drainage analysis results showing recommended minimum culvert sizes for hydraulic capacity are shown in Table 6-3 in the report. Culverts will need to be further sized to provide fish passage by designing culverts such that peak flow velocities are maintained below maximum recommended for fish species and low flow water depths are maintained above minimum recommendations with preference for culverts with natural channel substrate (ie: arch culverts, open bottom culverts or box culverts with fish baffles) .	Annual clearing of debris from the culverts and culvert condition inspection every 10 years

Drainage Improvement Project	Intent	Drainage Analysis	On-going Maintenance Considerations
3. Hykawy Park Diversion	Provide diversion flow from Sh-hwuykwselu (Busy Place) Creek along the diversion channel through the park to the detention area.	Requires a diversion channel and culverts for the road crossing to carry approximately 2.0 m^3/s. This is equivalent to a trapezoidal channel with 2:1 side slope and a 1 m bottom width having a depth of flow of 0.5 m (assuming channel slope of 2%)	Maintenance of the channel and riparian vegetation through the park.
4. Polkey Road Channel Floodplain/ Riparian Improvements	Reduce Polkey Road to one lane/ one-way road and use space to naturalize floodplain area. Polkey Road could also be raised to reduce the potential for overland flooding,	Results baseline 200-year return period conditions indicate minimum overtopping of Polkey Road at the peak 200-year Return Period flood. Therefore, Polkey Road would only be required to be raised.	Riparian maintenance
5. Raise Miller Road and Upgrade Existing Culverts	Raise Miller Road and upgrade existing culverts.	Results indicate that Miller Road would have to be raised by about 0.5 m with existing culverts upgraded to minimum 1.2 m x 2.5 m box culvert (or equivalent). A different culvert geometry may be required to meet fish passage peak velocity and minimum depth requirements, which will be determined during detailed design.	Riparian maintenance
6. Trestle Village Floodbox	Upgrade the Trestle Village flood box to replace the existing culvert. The flood box would include two pipes (a lower and upper-level pipe to assist with drainage of the Trestle Village Area) and proper functioning flap gates to prevent backflow. No additional improvements to the dike are proposed with this project (see project 8.).	Initial results during the 200-year flood event indicate that peak water levels in the Trestle Village Area are approximately equal to the peak water levels in the Koksilah River. This indicates that there is insufficient area to store water in the Trestle Village area during periods of high water in the Koksilah River when the flap gate would be closed.	Annual clearing of debris from the floodbox, 5 to 10-yer flushing and inspections. Should also be included as part of annual dike inspections.

Drainage Improvement Project	Intent	Drainage Analysis	On-going Maintenance Considerations
7. Trestle Village Pump Station	Includes a pump station to transfer water from the Trestle Village drainage system into the Koksilah River during periods of high water. The pump station will consist of a portable pump which can be brought to the site and run when required. Can be stored and maintained off-site when not required.	Should the flood box alone not be sufficient to maintain water levels below habitable floor levels in Trestle Village during periods of high water in Koksilah River.	The pump station would require annual regular maintenance/testing, upgrading of controls/electrical every 10-years, likely replacement of pumps at the 25-year mark.
8. Trestle Village Dike Replacement	Replace existing Trestle Village Dike. This would entail removal of the existing dike and full reconstruction of the Trestle Village Dike to standards. This could be combined with the flood box (Project 7) and a pump station (Project 8)	Dike crest would be raised to 200-year return period flood construction level (based on future climate conditions).	Dike would require periodic maintenance/removal of vegetation. Annual dike inspections.
9. Trestle Village Upland flow diversion	Another potential option for management of flood risk at Trestle Village may be to collect and divert runoff from the upland area to the west of Trestle Village and divert around the Trestle Village dike.	This option would reduce the volume of water flowing into the Trestle Village area and thus eliminate the need for a pump station.	Limited channel clearing/vegetation clearing
10. Headwaters Channel and Riparian Restoration	Rehabilitate natural function of mainstem of Sh-hwuykwselu (Busy Place) Creek near the headwaters of the watershed. This will help improve water quality for downstream and will also provide opportunity for additional fish habitat in the system after restoration of fish access.	Drainage analysis not required for this option. Channel design to be carried out at detailed design to carry and be stable at design flows. Restoration will involve rehabilitation of channel, placement of instream habitat structures, riparian planting and fencing within the agricultural lands to protect stream and riparian zone from livestock and other farming activities.	Initial riparian vegetation maintenance and riparian fence maintenance.

Drainage Improvement Project	Intent	Drainage Analysis	On-going Maintenance Considerations
11. Sh-hwuykwselu (Busy Place) Creek Miller Road/Trans-Canada Highway Diversion	Divert peak flows from the upper Sh-hwuykwselu (Busy Place) Creek watershed around the lower reaches of the creek channel by constructing a large diameter diversion pipe from the upstream side of Miller Road along Highway 1 to the downstream side of the Koksilah Road Bridge	Initial modelling results indicate an insignificant change in peak water levels downstream of Miller Road for the rare extreme flood events (100-year and 200-year return periods) as the water levels in Koksilah River control water levels downstream of Miller Road at these flood levels. PROJECT NOT CARRIED FORWARD FOR COSTING.	Storm drain flushing and inspection every 5 to 10 years
12. Lower Sh-hwuykwselu Creek Channel Realignment	Currently, the lower reaches of the creek channel cross from the west to east of the E&N railway embankment and then back from east to west through two separate sets of culverts. The proposed channel diversion would carry water directly to the Koksilah River along the east side of the E&N railway embankment to discharge on the downstream side of the E&N Railway bridge.	As the water levels on the downstream side of the E&N railway are about 0.5 m lower than the water levels at the confluence of the Koksilah River and Sh-hwuykwselu Creek. This option will not be reviewed further due to concerns of the landholder of potential for flooding or erosion of land adjacent to realignment. PROJECT NOT CARRIED FORWARD FOR COSTING.	May require periodic channel and vegetation clearing.

Drainage Improvement Project	Intent	Drainage Analysis	On-going Maintenance Considerations
13. E&N Railway and Highway 1 Bridge Conveyance Improvements	The previous modelling carried out for the Cowichan-Koksilah Integrated Flood Management Plan indicates approximately 0.5 m drops in water level from upstream to downstream of each of the bridges (a total of 1.0 m from downstream of the Highway Bridge to Upstream of the E&N Highway Bridge)	Upgrades of the E&N and Cowichan-Koksilah Bridges could be carried out to improve conveyance of flood discharges in the Koksilah River and lower peak flood levels by up to 1 m on the upstream side of the E&N railway. Detailed analysis of these options is beyond the scope of this study but will be recommended as part of future Koksilah River flood management strategy,	Depending on the solution, this option may require periodic clearing of gravel and debris at bridge crossings to maintain capacity.
14. Gravel Management, Logjam Removal and side channel maintenance on Koksilah River	Development of gravel management and logjam removal plan for the Koksilah River should be carried out. In addition, this plan could address maintenance of the conveyance within the existing side channel to the south of the Koksilah River. Any proposed works within the Koksilah River is outside the boundary and beyond the scope of the current study but will be recommended to be investigated as part of future Koksilah River flood management plans.	Gravel removal and logjam removal will help to maintain channel conveyance and reduce the risk of increased flood levels during large flood events. Gravel management is an on-going maintenance function and as such will require a comprehensive plan to identify appropriate gravel removal sites, provide best management practices to reduce potential impacts to fish and riparian habitat and to identify partners and funding structure to provide long-term and on-going maintenance.	Channel maintenance may be required every one to two years initially reducing 4 to 6 years. Logjam removal may be required every 5 to 10 years.

Drainage Project 1a Class 5 (Order of Magnitude) Cost Estimate: Keating Farm Detention Pond

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$24,446	10% of total
					Dam	
2.1	Water Control	1	LS	$5,235	$5,235	Water control only required for construction of pond berm
2.2	Clearing and Grubbing	180	m²	$13	$2,284	
2.3	Stripping and stockpiling topsoil	180	m²	$25	$4,567	Assume local stockpile of topsoil material (asssume 300 mm thick layer)
2.4	Finishing Grading and Seeding	180	m²	$3	$571	
2.5	Dam	1,440	m^3	$95	$136,800	4m high by 30m Long
2.6	Outlet Structure with Spillway	1	LS	$20,000	$20,000	
2.7	Riparian planting	3000	m²	$25	$75,000	Approximately 3000 m2 of plantings (includes first year maintenance)
				Contingency (50%)	$134,451	
				Total Estimated Construction Cost	$403,354	
				Engineering Design (20%)	$80,671	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$40,335	
				Total Estimated Project Cost (exclusive of taxes)	$524,360	
				Annual Maintenance Cost	$30,000	
				25-Year Total Project Cost	$1,274,360.29	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 1b Class 5 (Order of Magnitude) Cost Estimate: Keating Farm Wetland

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$14,186	10% of total
					Dam	
2.1	Water Control	1	LS	$5,235	$5,235	Water control only required for construction of pond berm
2.2	Clearing and Grubbing	180	m²	$13	$2,284	
2.3	Stripping and stockpiling topsoil	180	m²	$25	$4,567	Assume local stockpile of topsoil material (asssume 300 mm thick layer)
2.4	Finishing Grading and Seeding	180	m²	$3	$571	
2.5	Dam	360	m^3	$95	$34,200	1m high by 30m Long
2.6	Outlet Structure with Spillway	1	LS	$20,000	$20,000	
2.7	Riparian planting	3000	m²	$25	$75,000	Approximately 3000 m2 of plantings (includes first year maintenance)
				Contingency (50%)	$78,021	
				Total Estimated Construction Cost	$234,064	
				Engineering Design (20%)	$46,813	
				Engineering Inspection, Permitting and Environmental Monitoring (15%)	$35,110	
				Total Estimated Project Cost (exclusive of taxes)	$315,986	
				Annual Maintenance Cost	$10,000	
				25-Year Total Project Cost	$565,986.50	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 2 Class 5 (Order of Magnitude) Cost Estimate: Langtry/Tzinquaw/Kokslilah/Hykway Road/Polkey Road Driveway Culvert Replacements

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$73,179	10% of total
					Culverts	
	Langtry Road					
2.1	Langtry Road Excavation/Backfill	473	m³	$90	$42,525	15m long x avg width 9 m by 3.5 m deep
2.2	1500mm Dia Culvert at Langtry Rd	1	ea	$30,750	$30,750	
2.3	Paving (subbase and ashphalt 2 lifts)	150	m²	$150	$22,500	15m long x 10 m wide
	Tzinquaw Road					
3.1	Tzinquaw Road Road Excavation and Backfill	600	m³	$90	$54,000	15m long road crossing, avg 10 m wide by 4 m deep
3.2	1500mm Dia Culvert at Tzinquaw Rd	1	ea	$30,750	$30,750	10 m long by 20 m wide crossing
3.3	Paving (subbase and ashphalt 2 lifts)	150	m²	$150	$22,500	10 m long by 15 m wide crossing
	Hykawy Road					
3.1	5169 Hykawy Road Driveway Excavation/Backfill	400	m³	$90	$36,000	10m long road crossing, avg 10 m wide by 4 m deep
3.2	1500mm Dia Culvert at 5169 Hykawy Road Drivewa	1	ea	$20,500	$20,500	
3.1	Tzinquaw Road Road Excavation and Backfill	800	m³	$90	$72,000	20m long road crossing, avg 10 m wide by 4 m deep
3.2	1500mm Dia Culvert at Tzinquaw Rd	1	ea	$41,000	$41,000	10 m long by 20 m wide crossing
3.3	Paving (subbase and ashphalt 2 lifts)	150	m²	$150	$22,500	10 m wide x 15 m long
	Polkey Road Driveway Culverts					
2.1	Driveway Culvert Excavation and Backfill	675	m³	$42	$28,269	9x 10m long road crossing, 3m wide, 2.5 m deep
2.2	1800 mm dia culvert	4	ea	30000	$120,000	5146 Polkey Road (2 culverts), 5136 Polkey Road, 5130 Polkey Road
2.3	2000 mm dia culvert	3	ea	$38,000	$114,000	5120 Polkey Road (2 culverts), 4994 Polkey Road
2.4	Paving (subbase and ashphalt 2 lifts)	360	m²	$150	$54,000	9x 10m long road crossing, 3m wide
2.9	1600mm Dia Culvert at Koksilah Rd	1	LS	$20,500	$20,500	1600 mm Dia Culverts at each road
	Contingency (50%)				$402,487	
	Total Estimated Construction Cost				$1,207,460	
	Engineering Design (15%)				$181,119	
	Engineering Inspection, Permitting and Environmental Monitoring (10%)				$120,746	
	Total Estimated Project Cost (exclusive of taxes)				$1,509,325	
	Annual Maintenance Cost				$10,000	
	25-Year Total Project Cost				$1,759,324.62	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 3 Class 5 (Order of Magnitude) Cost Estimate: Hykawy Park Diversion

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$19,995	10% of total
				Tributary Channel		
3.1	Clearing and Grubbing	560	m²	$13	$7,105	Assume 2.8 m wide channel 200m long
3.2	Stripping and stockpiling topsoil	560	m²	$25	$14,210	Assume 2.8 m wide channel 200m long
3.3	Excavation (Tributary Channel)	279.5	m³	$42	$11,705	Manning calculation used to calculate size required to convey 2.03 cms to be 1.5 m wide channel (1:1 side slopes, top width 2.8m) and 0.65m deep with 1% slope (n=0.035)
3.4	Tributary Channel Inlet Structure	1	LS	$8,500	$8,500	
3.5	Tributary Channel Finishing	200	m	$500	$100,000	
				Culverts		
4.1	Excavation (Road Crossing for Culverts)	180	m³	$42	$7,538	2x 10m road crossing 3 m wide and 3m deep
4.2	Subbase	60	m²	$32	$1,903	2x 10m road crossing 3 m wide
4.3	Base	60	m²	$19	$1,142	2x 10m road crossing 3 m wide
4.4	Asphalt, 2 lifts	60	m²	$114	$6,851	2x 10m road crossing 3 m wide
4.5	1500mm Dia Culvert at Hykway Road	1	LS	$20,500	$20,500	
4.6	1500mm Dia Culvert at Driveway Culvert	1	LS	$20,500	$20,500	
				Contingency (50%)	$109,975	
				Total Estimated Construction Cost	$329,925	
				Engineering Design (20%)	$65,985	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$32,992	
				Total Estimated Project Cost (exclusive of taxes)	$428,902	
				Annual Maintenance Cost	$10,000	
				25-Year Total Project Cost	$678,902	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 4 Class 5 (Order of Magnitude) Cost Estimate: Polkey Road Channel and Riparian Improvements

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$229,744	10% of total
				Moving road and Storm Drains		
2.1	Excavation (Road Area)	3,600	m³	$42	$150,767	600 m long road excavation assume 3m wide, 2 m deep
2.2	Subbase	1,800	m²	$32	$57,093	600 m long road excavation assume 3m wide
2.3	Base	1,800	m²	$19	$34,256	600 m long road excavation assume 3m wide
2.4	Asphalt, 2 lifts	1,800	m²	$114	$205,534	600 m long road excavation assume 3m wide
2.5	New Storm Drain	600	m	$1,142	$685,113	Assume 600 dia concrete pipe
				Drainage Channel		
3.1	Clearing and Grubbing	1,200	m²	$13	$15,225	Assume 2 m wide channel 450m long
3.2	Stripping and stockpiling topsoil	1,200	m²	$25	$30,449	Assume 2 m wide channel 450m long
3.3	Excavation (New Drainage Channel)	1,200	m³	$42	$50,256	Assume 2 m wide channel 450m long and 0.5m deep
3.4	Drainage Channel Finishing	600	m	$1,500	$900,000	
				Riparian Improvements		
4.1	Riparian planting	6750	m²	$25	$168,750	Approx 6750 sq m of ripirian plannting area
				Contingency (50%)	$1,263,593	
				Total Estimated Construction Cost	$3,790,779	
				Engineering Design (10%)	$379,078	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$379,078	
				Total Estimated Project Cost (exclusive of taxes)	$4,548,935	
				Annual Maintenance Cost	$20,000	
				25-Year Total Project Cost	$5,048,935	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 5 Class 5 (Order of Magnitude) Cost Estimate: Raise Miller Road and Upgrade Culverts

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$31,369	10% of total
					Replace Miller Road Culvert	
2.1	Excavtion and backfill of culvert	473	m³	$90	$42,525	10m wide, 5 m avg width, 3 m deep
2.2	Replace Existing Culverts with new box culvert	1	LS	$50,000	$50,000	Assume 2.5 m x 1.2 m box culvert x 20 m long
					Raise Miller Road	
2.1	Excavation (Removal of existing road pavement)	375	m³	$15	$5,625	125m long road excavation assume 10m wide, 0.3 m deep
2.2	Fill	625	m³	$15	$9,375	125m long road excavation assume 10m wide, 0.5 m deep
2.3	Subbase	1,250	m²	$32	$39,648	125m long road excavation assume 10 m wide
2.4	Base	1,250	m²	$19	$23,789	125m long road excavation assume 10 m wide
2.5	Asphalt, 2 lifts	1,250	m²	$114	$142,732	125m long road excavation assume 10 m wide
	Contingency (50%)				$172,531	
	Total Estimated Construction Cost				$517,594	
	Engineering Design and Project Planning (15%)				$77,639	
	Engineering Inspection, Permitting and Environmental Monitoring (15%)				$77,639	
	Total Estimated Project Cost (exclusive of taxes)				$672,872	
	Annual Maintenance Cost				$10,000	
	25-Year Total Project Cost				$922,872	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 6 Class 5 (Order of Magnitude) Cost Estimate: Trestle Village Floodbox

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$19,764	10% of total
	Culverts with Flap Gates					
2.1	Excavation (to remove eixting culvert)	975	m³	$42	$40,833	15 m long 3 m wide at base, 2:1 side slopes, 5 m deep
2.2	Compacted dike fill	975	m²	$75	$73,125	15 m long 3 m wide at base, 2:1 side slopes, 5 m deep
2.5	Flap gates	2	LS	$6,344	$12,687	
2.8	Headwalls	4	LS	$7,500	$30,000	
3.1	1500 mm Dia Culvert	2	LS	$20,500	$41,000	
	Contingency (50%)				$54,352	
	Total Estimated Construction Cost				$271,762	
	Engineering Design (20%)				$54,352	
	Engineering Inspection, Permitting and Environmental Monitoring (10%)				$27,176	
	Total Estimated Project Cost (exclusive of taxes)				$353,290	
	Annual Maintenance Cost				$10,000	
	25-Year Total Project Cost				$603,290.30	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 7 Class 5 (Order of Magnitude) Cost Estimate: Trestle Village Pump Station

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$80,697	10% of total
					Pump Station	
2.1	Excavation (Wet well)	300	m³	$42	$12,564	
2.2	Civil concrete works	1	LS	$50,000	$50,000	
2.3	Clearing and Grubbing	100	m²	$13	$1,269	
2.4	Stripping and stockpiling topsoil	100	m²	$25	$2,537	
2.5	New storm drain	25	m	$1,142	$28,546	Assume 600mm dia concrete pipe
2.6	New storm forcemain	25	m	$482	$12,053	Assume 300mm dia PVC pipe
2.7	Portable Diesel Pump	1	LS	$700,000	$700,000	Based on typical costs to supply portable pump and genset
				Contingency (50%)	$443,833	
				Total Estimated Construction Cost	$1,331,499	
				Engineering Design (10%)	$133,150	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$133,150	
				Total Estimated Project Cost (exclusive of taxes)	$1,597,799	
				Annual Maintenance Cost	$50,000	
				25-Year Total Project Cost	$2,847,799	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 8 Class 5 (Order of Magnitude) Cost Estimate: Trestle Village Dike Replacement

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$164,544	10% of total
					Dike	
2.2	Clearing and rubbing	2,500	m²	$13	$31,718	Assume 5m wide for 500 m of dike
2.3	Removal of existing dike	22,000	m²	$35	$770,000	Assume 500 m long x 3 m wide crest x 4 m high with 1.5:1 side slopes
2.4	Finishing Grading and Seeding	2,500	m²	$3	$7,930	
2.5	Dike	500	lin m	$1,672	$835,796	
				Contingency (50%)	$361,998	
				Total Estimated Construction Cost	$2,171,986	
				Engineering Design (15%)	$325,798	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$217,199	
				Total Estimated Project Cost (exclusive of taxes)	$2,714,982	
				Annual Maintenance Cost	$10,000	
				25-Year Total Project Cost	$2,964,982	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction. Costs do not include any geotechnical ground improvements for earthquake guidelines. The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 9 Class 5 (Order of Magnitude) Cost Estimate: Trestle Village Upland Flow Diversion

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$17,029	10% of total
	Diversion Channel					
2.1	Clearing and Grubbing	800	m²	$13	$10,150	Assume 4 m wide clearing x 200m long
2.2	Stripping and stockpiling topsoil	200	m²	$25	$5,075	Assume 1 m wide channel 200m long
2.3	Excavation (Diversion Channel)	100	m³	$42	$4,188	Assume 1 m wide channel 200m long and 0.5m deep
	Storm Drain for Trestle Road and Miller Road					
3.1	Excavation (Stormdrain installation)	675	m³	$42	$28,269	3 m wide and 3m deep x 75 m
3.2	Subbase	225	m²	$32	$7,137	3 m wide x 75 m long
3.3	Base	225	m²	$19	$4,282	3 m wide x 75 m long
3.4	Asphalt, 2 lifts	225	m²	$114	$25,692	3 m wide x 75 m long
3.5	600 mm dia storm drain	75	lin m	$1,140	$85,500	
	Contingency (50%)				$93,660	
	Total Estimated Construction Cost				$280,981	
	Engineering Design (10%)				$28,098	
	Engineering Inspection, Permitting and Environmental Monitoring (10%)				$28,098	
	Total Estimated Project Cost (exclusive of taxes)				$337,178	
	Annual Maintenance Cost				$10,000	
	25-Year Total Project Cost				$587,178	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction.
The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

Drainage Project 10 Class 5 (Order of Magnitude) Cost Estimate: Headwaters Channel and Riparian Restoration

Item	Description	QTY	Unit	Rate	Total	Comment
1.1	Mobilization and Demobilization				$28,685	10% of total
					Dam	
2.1	Clearing and Grubbing	180	m²	$13	$2,284	Aprox 400 m lin m
2.2	Channel Excavation	300	m³	$42	$12,564	1.5 m wide by 0.5 m deep
2.3	Tributary Channel Finishing	400	m	$200	$80,000	Includes channel gravel, riffles, habitat structures, etc.
2.4	Riparian planting	12,000	m²	$15	$180,000	400 m lin m by 30 m wide
2.5	Fencing	800	lin m	$15	$12,000	Assume page wire fencing
				Contingency (50%)	$157,766	
				Total Estimated Construction Cost	$473,299	
				Engineering Design (10%)	$47,330	
				Engineering Inspection, Permitting and Environmental Monitoring (10%)	$47,330	
				Total Estimated Project Cost (exclusive of taxes)	$567,958	
				Annual Maintenance Cost	$5,000	
				25-Year Total Project Cost	$692,958.25	

Note: Cost estimate provided is based on limited field data and rough quantities with unit rates based on previous experience with similar projects. The cost estimate is considered preliminary and is suitable for project planning and budgeting purposes. Actual costs may vary as a result of market conditions at the time of construction.
The Cost Estimate Basis Memorandum prepaed February 11, 2019 provides key assumptions and limitations of the Class 5 Cost Estimate.

KERR WOOD LEIDAL
consulting engineers

Appendix F

At-Source Stormwater Management Control Examples

BEST MANAGEMENT PRACTICE TOOLKIT

The BMP Toolkit provides an introduction to a range of common best practices to improve rainwater management. These tools are in common use in other jurisdictions on Vancouver Island, the Pacific Northwest, and in developed areas around the world.

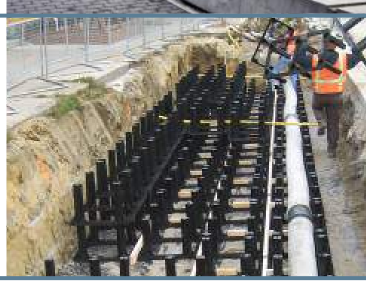
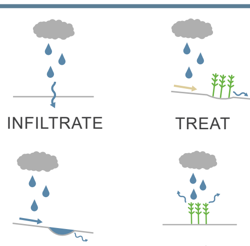
The Toolkit BMPs are:

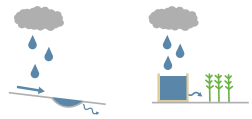
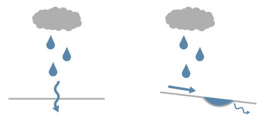
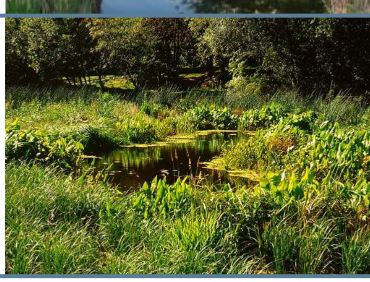
- Absorbent Landscapes
- Infiltration Swales
- Rain Gardens & Infiltration Bulges
- Pervious Paving
- Green Roof
- Tree Well Structure
- Rainwater Harvesting
- Infiltration Trench
- Water Quality Structures
- Detention Tanks
- Daylighted Streams
- Constructed Wetlands

Table II - 1 summarizes the Toolkit BMPs. The Toolkit includes key description of purpose, graphics and diagrams to show scope and application, key design principles, limitations and sizing variables, and maintenance and operations considerations.

The Toolkit is introductory. Links to examples and manufacturer information is provided in the 'For More Information' Section. Readers should use the Toolkit in conjunction with more detailed technical guidance, which can be found in documents such as the 2012 Metro Vancouver Stormwater Source Control Guidelines.

Table 1: BMP Toolkit Summary Table

TOOL		IMPACTS ON WATER	BENEFITS
Absorbent Landscapes		 INFILTRATE	• intercept and clean rainwater through soil pores, allowing gradual infiltration into subsoils to recharge groundwater
Infiltration Swales		 INFILTRATE TREAT DETAIN	• reduce runoff volume and increase water quality by capturing, detaining, treating, and conveying stormwater
Rain Gardens & Infiltration Bulges		 INFILTRATE TREAT DETAIN	• reduce runoff volume and improve water quality by infiltrating, capturing, and filtering stormwater • an overflow conveys extreme rainfall volumes
Pervious Paving		 INFILTRATE	• reduce runoff volume and improve water quality by infiltrating and treating stormwater while still providing a hard, drivable surface
Green Roofs		 DETAIN HABITAT TRANSPIRE	• reduce stormwater peak flows and volume, depending on depth of growing medium • benefit buildings by providing insulation and by reducing the heat island effect • provide urban habitat
Tree Well Structures		 INFILTRATE TREAT DETAIN TRANSPIRE	• adequate soil volume will retain excess stormwater and help to remove pollutants from stormwater runoff • support a healthy tree canopy which intercepts rainfall

TOOL	IMPACTS ON WATER	BENEFITS
Rainwater Harvesting 	 DETAIN CAPTURE & REUSE	• runoff from roof surfaces can be captured, stored and used for non-potable uses like landscape irrigation, laundry, and toilets
Infiltration Trenches 	 INFILTRATE DETAIN	• reduce the volume and rate of runoff by holding and infiltrating water into subsurface soils • water quality pre-treatment is advisable if water is not from roof areas
Water Quality Structures 	 TREAT	• capture hydrocarbons, coarse grit and coarse sediment • provide some water quality benefits except for soluble nutrients and pollutants
Detention Tanks 	 DETAIN	• reduce flooding and in-stream erosion by collecting and storing stormwater runoff during a storm event, and releasing it at controlled rates to the downstream drainage system
Daylighted Streams & Channel Improvements 	 DETAIN HABITAT TREAT	• may provide in-stream detention, water quality improvements, and essential habitat for aquatic life • contribute to the liveability of an area and establish a sense of place if properly designed
Constructed Wetlands 	 DETAIN HABITAT TREAT	• provide detention, storage, habitat, and treat stormwater runoff through natural processes prior to discharging it into the downstream drainage system

Absorbent Landscapes

In most natural wooded conditions 90% of rainfall volume never becomes runoff, but instead is either soaked into the soils or evaporates/ transpirates. Trees, shrubs, grasses, surface organic matter, and soils all play a role.

Primary Purpose

- To reduce runoff from impermeable surfaces by creating more absorbent landscapes that intercept and retain rainwater.

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment
- Aesthetic Benefits
- Biodiversity Benefits

Good

- Volume Control
- Public Education, Culture and Health Values

COST CRITERIA

Best

- Land Cost
- Property Value
- Longevity

Good

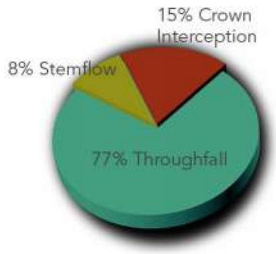
- Material and Construction Cost

Limited Benefit

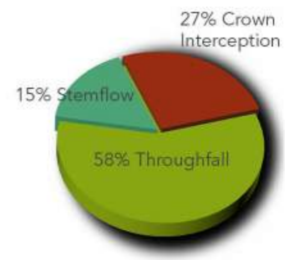
- Maintenance Cost

This tool is suitable for:

- Low Density
- Medium/High Density
- Commercial Mixed Use
- Industrial
- Institutional
- Parks & Greenspace
- Local Streets

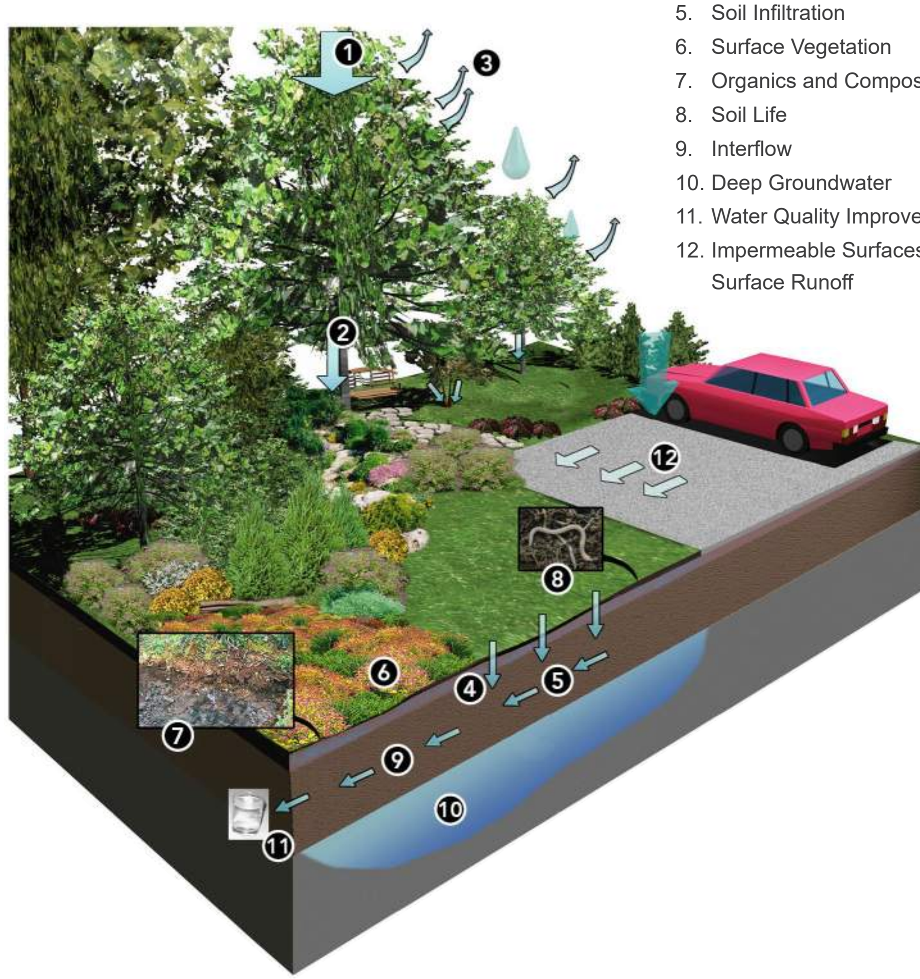


Pear Tree



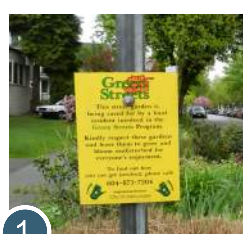
Evergreen Oak Tree

Winter tree canopies intercept 15% to 27% of rainfall

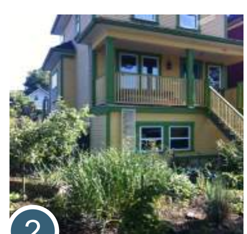


1. Crown Interception
2. Throughfall and Stemflow
3. Evapotranspiration
4. Soil Water Storage
5. Soil Infiltration
6. Surface Vegetation
7. Organics and Compost
8. Soil Life
9. Interflow
10. Deep Groundwater
11. Water Quality Improvement
12. Impermeable Surfaces and Surface Runoff

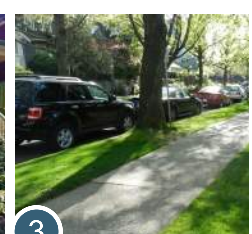
Absorbent Landscape Examples



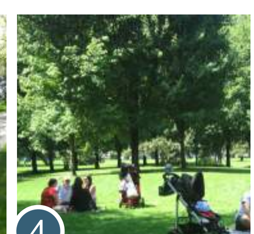
1 Vancouver's Green Street Program



2 Private residential yard



3 Residential Street



4 Parks & Open Space

Design Principles, Limitations and Sizing Variables

- Maximize the area of absorbent landscape—either existing or constructed—on the site. Conserve as much existing vegetation and undisturbed soil as possible.
- Minimize impervious area by using multi-storey buildings, narrower roads, minimum parking, larger landscape areas, green roof, and pervious paving.
- Disconnect impervious areas from the storm sewer system, having them drain to absorbent landscape.
- Design absorbent landscape areas as dished areas that temporarily store stormwater and allow it to soak in, with overflow for large rain events to the storm drain system.
- Maximize the vegetation canopy cover over the site. Multi-layered evergreens are ideal, but deciduous cover is also beneficial for stormwater management.
- Ensure adequate growing medium depth for both horticultural and stormwater needs—a minimum depth of 300 mm for lawn is required to store 60 mm of rainfall.
- Cultivate compost into surface soils to create minimum 8% organic matter for lawns, and 15% for planting beds.
- To avoid surface crusting and maintain surface permeability, install vegetative (grass, groundcovers, shrubs, trees) or organic cover (mulch, straw, wood fibre) as early as possible in the construction process, and prior to winter storms.
- Provide effective erosion control during construction, including erosion control on upstream sites that may flow into absorbent landscape.

Optimizing Performance

DESIGN & CONSTRUCTION

- Ensure scarification of subgrade.
- Enforce quality control of topsoil to be free of weed seeds, and to meet specs for texture and hydraulic properties. If suitable reuse existing topsoil.
- Include compost to increase percolation and reduce need for water and fertilizer inputs.
- Greater growing medium depth equals greater storage and treatment of rainfall.
- Include an organic mulch layer to surface.

MAINTENANCE

- In planting beds, aerate or till surface 25 mm deep between plants each spring to reduce crusting.
- In lawns, core-aerate areas of surface compaction each spring.
- Ensure regular spring weeding to avoid weeds going to seed.
- Remove and replace surface mulch in ponding areas once every three years

Did you know?

- Impermeable surfaces create 8 –10 times more runoff than absorbent landscapes.
- Organic matter and soil micro-organisms are vital to maintaining soil infiltration rates.
- Rainfall storage in soil is 7% to 18% of soil volume.

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/StormwaterSourceControlDesignGuidelines2012.pdf

Infiltration Swales

An Infiltration Swale is a shallow grassed or vegetated channel designed to capture, detain and treat stormwater and convey larger flows. It takes surface flows from adjacent paved surfaces, holds the water behind weirs, and allows it to infiltrate through a soil bed into underlying soils. The swale and weir structures provide conveyance for larger storm events to the storm drain system. Variations on designs include an underlying drain rock reservoir, with or without a perforated underdrain.

Primary Purpose

- Water quality treatment, reduction of runoff

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment

Good

- Volume Control
- Public Education, Culture and Health Values
- Aesthetic Benefits
- Biodiversity Benefits

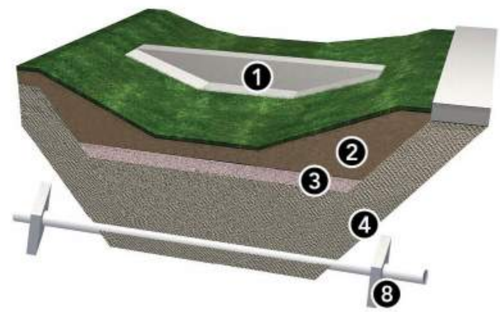
COST CRITERIA

Best

- Property Value

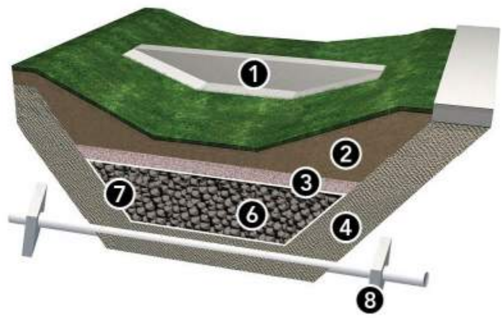
Good

- Longevity
- Land Cost
- Material and Construction Cost
- Maintenance Cost



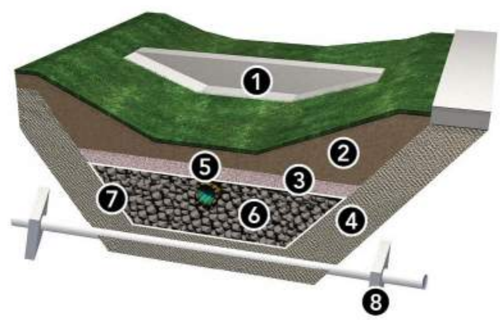
FULL INFILTRATION

Where water entering the swale is filtered through a grass or groundcover layer, and then passes through sandy growing medium and a sand layer into underlying scarified subgrade. Suitable for sites with small catchments and subsoil permeability > 30 mm/hr.



FULL INFILTRATION WITH RESERVOIR

Designed to reduce surface ponding by providing underground storage in a drain rock reservoir. Suitable for sites with small catchments and subsoil permeability > 15 mm/hr.



PARTIAL INFILTRATION WITH RESERVOIR & SUBDRAIN

Where a perforated drain pipe is installed at the top of the reservoir, providing an underground overflow that removes excess water before it backs up to the surface of the swale. Suitable for sites with larger catchments and low infiltration rates into subsoil permeability < 15 mm/hr. Provides water quality treatment even if infiltration into subsoils is limited.

1. Weir Keyed into Swale Side Slope
2. Growing Medium (300 mm Min.)
3. Sand
4. Existing Scarified Subsoil
5. Perforated Underdrain (150 mm Dia. Min.)
6. Drain Rock Reservoir (300mm Min.)
7. Geotextile Along All Sides of Reservoir
8. Trench Dams at All Utility Crossing

This tool is suitable for:

- Medium/High Density
- Commercial Mixed Use
- Industrial
- Institutional
- Parks & Greenspace
- Local Streets
- Collector/ Arterial Streets

Precedent examples

1

Bioswale - Olympic Village

2

Infiltration Swale - Nanaimo Regional General Hospital

Design Principles, Limitations and Sizing Variables

- Literature suggests swale areas of about 10–20% of upstream impervious area. Higher sediment load land uses require lower ratios of impervious area to swale area.
- Flow to the swale should be distributed sheet flow, travelling through a grassy filter area at the swale verges. Provide pre-treatment and erosion control to avoid sedimentation in the swale.
- Provide a 50 mm drop at the edge of paving to the swale soil surface, to allow for positive drainage and buildup of road sanding/organic materials at this edge.
- Swale planting is typically sodded lawn. Low volume swales can be finished with a combination of grasses, shrub, groundcover and tree planting.
- Swale bottom - flat cross section, 600 to 2400 mm width, 1–2% longitudinal slope or dished between weirs.
- Swale side slopes—3(horizontal):1(vertical) maximum, 4:1 or less preferred for maintenance.
- Weirs to have level top to spread flows and avoid channelization, keyed in 100 mm minimum.
- Maximum ponding level - 150 mm. Drawdown time for the maximum surface ponded volume - 24 hours.
- Treatment soil depth—300 mm desirable, minimum 150 mm if design professional calculates adequate pollutant removal.
- Design stormwater conveyance using Manning's formula or weir equations whichever governs with attention to channel stability during maximum flows.
- Drain rock reservoir and underdrain may be avoided where infiltration tests by a qualified professional, taken at the depth of the proposed infiltration, show an infiltration rate that exceeds the inflow rate.

Optimizing Performance

DESIGN & CONSTRUCTION

- Undertake site-specific infiltration testing and, based on results, design the system infiltration area, surface and underground storage volume, and overflow subdrain. Be careful to not exceed impervious / pervious (I/P) guidelines in design, exercising great caution if exceeding a 5:1 I/P ratio.
- Provide a minimum 50 mm drop in gutter profiles and further 50 mm drop into the infiltration surface to avoid runoff bypassing the facility.
- Enforce quality control of topsoil to be free of weed seeds, and to meet specs for texture and hydraulic properties. Use of non-angular sand (e.g. Fraser River pump sand) is encouraged for the sand component. Native topsoil will rarely be suitable, having too low an infiltration rate.
- Include compost to increase percolation and reduce need for water and fertilizer inputs. Greater growing medium depth equals greater storage and treatment of rainfall. Include an organic mulch layer to surface.

MAINTENANCE

- Inspect and clean the inlet twice per year minimum (spring and fall).
- In lawns, core-aerate areas of surface compaction each spring.
- In planting beds, cultivate surface 25 mm deep between plants each spring to reduce crusting. Ensure regular spring weeding to avoid weeds going to seed.
- Remove and replace surface mulch between plants in ponding areas once every three years.

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/04StormwaterSourceControlDesignGuidelinesInfiltrationSwales.pdf

Rain Gardens & Infiltration Bulges

An Infiltration Rain Garden is a form of bioretention facility designed to have aesthetic appeal as well as a stormwater function. Rain gardens are commonly a concave landscaped area where runoff from roofs or paving infiltrates into deep constructed soils and subsoils below. On subsoils with low infiltration rates, Rain Gardens often have a drain rock reservoir and perforated drain system to convey away excess water.

Primary Purpose

- Capture and filter runoff from adjacent impervious surfaces such as roads, roofs, parking lots and driveways.

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment
- Aesthetic Benefits
- Biodiversity Benefits

Good

- Volume Control
- Public Education, Culture and Health Values

COST CRITERIA

Best

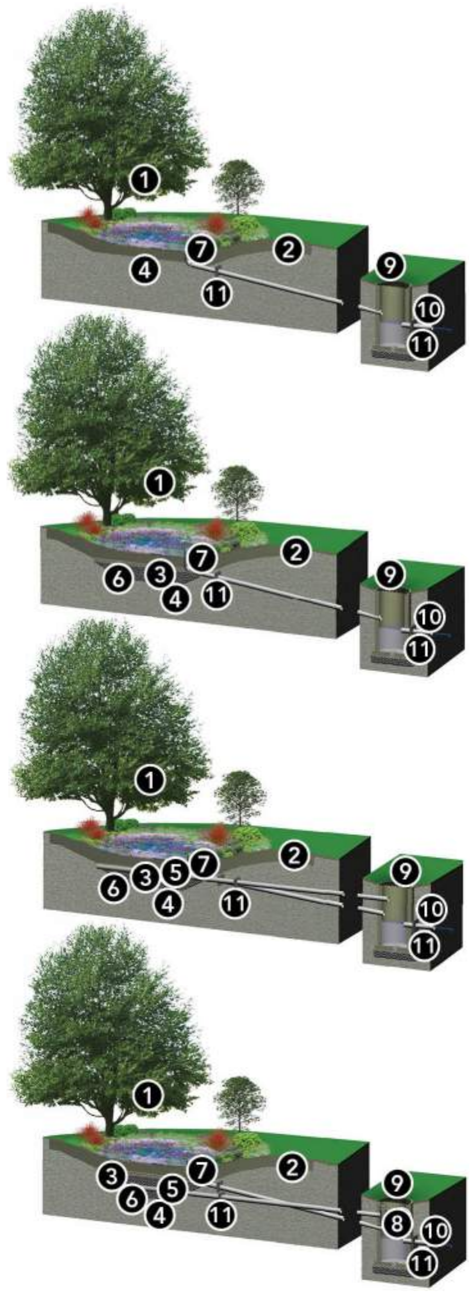
- Land Cost
- Property Value

Good

- Longevity
- Material and Construction Cost
- Maintenance Cost

This tool is suitable for:

- Low Density
- Medium/High Density
- Commercial Mixed Use
- Industrial
- Institutional
- Parks & Greenspace
- Local Streets



1. Tree, Shrub and Groundcover Plantings
2. Growing Medium Minimum 450 mm Depth
3. Drain Rock Reservoir
4. Flat Subsoil - scarified
5. Perforated Drain Pipe 150 mm Dia. Min.
6. Geotextile Along All Sides of Drain Rock Reservoir
7. Overflow (standpipe or swale)
8. Flow Restrictor Assembly
9. Secondary Overflow Inlet at Catch Basin
10. Outflow Pipe to Storm Drain or Swale System
11. Trench Dams at All Utility Crossings

FULL INFILTRATION

Where all inflow is intended to infiltrate into the underlying subsoil. Candidate in sites with subsoil permeability > 30 mm/hr. An overflow for large events is provided by pipe or swale to the storm drain system.

FULL INFILTRATION WITH RESERVOIR

Adding a drain rock reservoir so that surface water can move quickly through the installed growing medium and infiltrate slowly into subsoils from the reservoir below. Candidate in sites with subsoil permeability > 15 mm/hr.

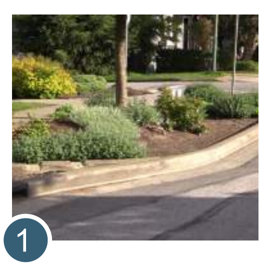
PARTIAL INFILTRATION

Designed so that most water may infiltrate into the underlying soil while the surplus overflow is drained by perforated pipes that are placed near the top of the drain rock reservoir. Suitable for sites with subsoil permeability > 1 and < 15 mm/hr.

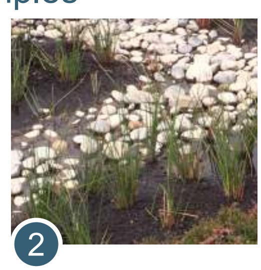
PARTIAL INFILTRATION WITH FLOW RESTRICTOR

For sites with subsoil permeability < 5 mm/hr, the addition of a flow restrictor assembly with a small orifice slowly decants the top portion of the reservoir and rain garden. Provides water quality treatment and some infiltration, while acting like a small detention facility.

Precedent examples



1 **Infiltration Bulge -** Ontario St.



2 **Rain garden infiltration area -** East Fraserlands

Design Principles, Limitations and Sizing Variables

- Literature suggests rain garden areas of about 10–20% of upstream impervious area. Higher sediment load land uses require lower ratios of impervious area to rain garden area.
- Smaller, distributed rain gardens are better than single large scale facilities.
- Locate rain gardens a minimum 30.5 m from wells, 3m downslope of building foundations, and only in areas where foundations have footing drains and are not above steep slopes.
- Provide pretreatment and erosion control i.e. grass filter strip to avoid introducing sediment into the garden.
- At point-source inlets, install non-erodable material, sediment cleanout basins, and weir flow spreaders.
- Bottom width - 600 mm (Min.) to 3000 mm and length-width ratio of 2:1 desirable.
- Side slopes – 2:1 maximum, 4:1 preferred for maintenance. Ponding depth - 150 – 300 mm.
- Draw-down time for maximum ponded volume - 72 hours.
- Treatment soil depth - 300 mm (Min.) to 1200 mm (desirable); use soils with minimum infiltration rate of 50 mm/hr.
- Surface planting should be primarily trees, shrubs, and groundcovers, with planting designs respecting the various soil moisture conditions in the garden. Plantings may include rushes, sedges and grasses as well as lawn areas for erosion control and multiple uses.
- Apply a 50–75 mm layer of organic mulch for both erosion control and to maintain infiltration capacity.
- Install a non-erodible outlet or spillway to discharge overflow.
- Avoid utility or other crossings of the rain garden. Where utility trenches must be constructed below the garden, install trench dams to avoid infiltration water following the utility trench.
- Drain rock reservoir and perforated drain pipe may be avoided where infiltration tests by a design professional show a subsoil infiltration rate that exceeds the inflow rate..

Optimizing Performance

DESIGN & CONSTRUCTION

- Undertake site-specific infiltration testing and, based on results, design the system infiltration area, surface and underground storage volume, and overflow subdrain. Be careful to not exceed impervious / pervious (I/P) guidelines in design, exercising great caution if exceeding a 5:1 I/P ratio.
- Provide a minimum 50 mm drop in gutter profiles and further 50 mm drop into the infiltration surface to avoid runoff bypassing the facility.
- Enforce quality control of topsoil to be free of weed seeds, and to meet specs for texture and hydraulic properties. Use of non-angular sand (e.g. Fraser River pump sand) is encouraged for the sand component. Native topsoil will rarely be suitable, having too low an infiltration rate.
- Include compost to increase percolation and reduce need for water and fertilizer inputs. Greater growing medium depth equals greater storage and treatment of rainfall. Include an organic mulch layer to surface.

MAINTENANCE

- Inspect and clean the inlet twice per year minimum (spring and fall).
- In planting beds, cultivate surface 25 mm deep between plants each spring to reduce crusting. Ensure regular spring weeding to avoid weeds going to seed.
- Remove and replace surface mulch between plants in ponding areas once every three years.

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/05StormwaterSourceControlDesignGuidelinesRainGarden.pdf

Pervious Paving

Pervious paving is a surface layer that allows rainfall to percolate into an underlying reservoir base where rainfall is either infiltrated to underlying soils or removed by a subsurface drain. The surface component of pervious paving can be:

- Porous asphalt or porous concrete.
- Concrete or plastic grid structures filled with unvegetated gravel or vegetated soil,
- Concrete modular pavers with gapped joints that allow water to percolate through.

Primary Purpose

- Infiltrate and treat stormwater while still providing a hard, drivable surface.

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment

Good

- Volume Control
- Public Education, Culture and Health Values

Limited Benefit

- Aesthetic Benefits
- Biodiversity Benefits

COST CRITERIA

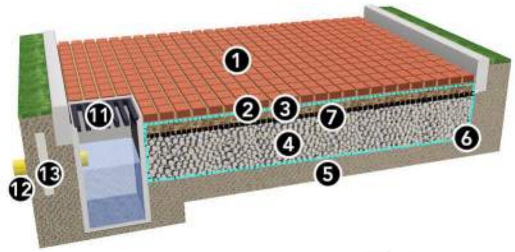
Best

- Land Cost

Good

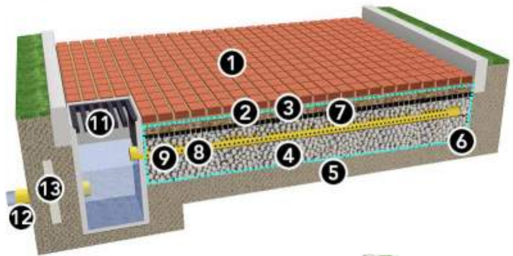
- Property Value
- Material and Construction Cost
- Maintenance Cost
- Longevity

PERVIOUS PAVEMENT DESIGNS MAY BE ONE OF THREE TYPES:



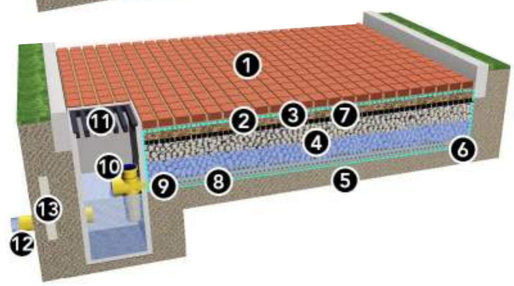
FULL INFILTRATION

Where rainfall is intended to infiltrate into the underlying subsoil. Candidate in sites with subsoil permeability > 15 mm/hr.



PARTIAL INFILTRATION

Designed so that most water may infiltrate into the underlying soil while the surplus overflow is drained by perforated pipes that are placed near the top of the drain rock reservoir. Suitable for subsoil permeability >1 and < 15 mm/hr.



PARTIAL INFILTRATION WITH FLOW RESTRICTOR

Where subsoil permeability is < 1 mm/hr, water is removed at a controlled rate through a bottom pipe system and flow restrictor assembly. Systems are essentially underground detention systems, used where the underlying soil has very low permeability or in areas with high water table. Also provides water quality benefits. However this should not be needed if I/P< 2.

1. Permeable Pavers (Min. 80 mm thickness)
2. Aggregate Bedding Course - not sand (50 mm depth)
3. Open Graded Base (depth varies by design application)
4. Open Graded Sub-base (depth varies by design application)
5. Subsoil - flat and scarified in infiltration designs
6. Geotextile on All Sides of Reservoir
7. Optional Reinforcing Grid for Heavy Loads
8. Perforated Drain Pipe 150 mm Dia. Min.
9. Geotextile Adhered to Drain at Opening
10. Flow Restrictor Assembly
11. Secondary Overflow Inlet at Catch Basin
12. Outlet Pipe to Storm Drain or Swale System. Locate Crown of Pipe Below Open Graded Base (no. 3) to Prevent Heaving During Freeze/Thaw Cycle
13. Trench Dams at All Utility Crossings

This tool is suitable for:

- Low Density
- Medium/High Density
- Commercial Mixed Use
- Institutional
- Parks & Greenspace
- Local Streets

Precedent examples

1 Olympic Village

2 Reid Residence, Nanaimo, BC

Design Principles, Limitations and Sizing Variables

- Pervious paving is most suitable for low traffic areas—driveways, parking areas(maximum 1–2 vehicles per day per parking space), walkways, recreational vehicle pads, service roads, fire lanes.
- The ratio of impermeable surface area draining onto pervious pavement area should be ratio 2:1 maximum.
- To avoid surface plugging, it is critical to protect pervious paving from sedimentation during and after construction.
- Identify pollutant sources, particularly in industrial/ commercial hotspots, that require pre-treatment or source control upstream.
- For designs which rely entirely on infiltration into underlying soils, the infiltration rate should be 15 mm/ hr minimum.
- Soil subgrade analysis should include soil texture class, moisture content, 96 hour soaked California Bearing Ratio (CBR) and on-site infiltration tests at the elevation of the base of the reservoir.
- Surface slope should be 1% minimum to avoid ponding and related sediment accumulation.
- Wrap paver bedding material with geotextile filter cloth on bottom and sides to maintain water quality performance and keep out intrusion of fines.
- Provide edge restraint to contain pavers, similar to standard unit paving.
- Design reservoir water levels using continuous flow modelling. Drawdown time—96 hrs max., 72 hrs desirable.
- Bottom of reservoir: flat in full infiltration designs, minimum 0.1% slope to drain in piped systems.
- Where utility trenches must be constructed below the reservoir, install trench dams at exits to avoid infiltration water following the utility trench.
- Pavers with wide joints should not be used for disabled persons parking or pedestrian ramps at street crossings.
- If being designed for heavy loads, optional reinforcing grids may be included in the pavement subbase.

Optimizing Performance

DESIGN & CONSTRUCTION

- Undertake site-specific infiltration testing and, based on results, design the system infiltration area, underground storage volume, and overflow subdrain. Be careful to not exceed impervious / pervious (I/P) guidelines in design, exercising great caution if exceeding a 2:1 I/P ratio.
- Isolate the pervious pavement from sources of sediment – consider a gutter to separate travelled lane drainage from pervious pavement parking area. Although this would reduce the I/P area efficiency, it also reduces the risk of surface plugging. Install pervious paving after adjacent construction is complete.
- Enforce quality control of materials, in particular bedding and crack aggregate sizing and fractured face qualities. These pavements have no sands, no fines.
- Greater reservoir depth equals greater storage and treatment of rainfall. Hydrocarbons soaking into the aggregate undergo aerobic digestion.

MAINTENANCE

- Provide vacuum sweeping at least twice/year, spring, and fall after leaf drop.
- Surface weeding may be similar to that required of standard interlocking pavers (some weed/ moss growth). Ensure regular spring weeding to avoid weeds going to seed.
- In interlocking pervious pavements, remove and replace top one-third of crack aggregate once every three years. Localized plugged areas, if found, may be repaired by lifting the pavers, replacing bedding aggregate and upper filter cloth, and returning the pavers—a shallow repair.

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/06StormwaterSourceControlDesignGuidelinesPerviousPaving.pdf

www.pavingstones.com/document/pdfviewer/printer-friendly-brochure/160/aquapave_web.pdf

Green Roof

A Green Roof is a roof with a veneer of drainage and growing media that supports living vegetation.

Green roofs provide a wide range of benefits—from reduction in peak flows and volumes to building heat gain reductions.

Primary Purpose

- To reduce peak flows and stormwater volume;
- To provide additional benefits to the building, such as insulation, air filtration and reduced heat island effect.

Performance Rating

FUNCTIONAL CRITERIA

Best

- Aesthetic Benefits
- Biodiversity Benefits

Good

- Public Education, Culture and Health Values
- Volume Control

Limited Benefit

- Water Quality Treatment

COST CRITERIA

Best

- Land Cost
- Property Value

Good

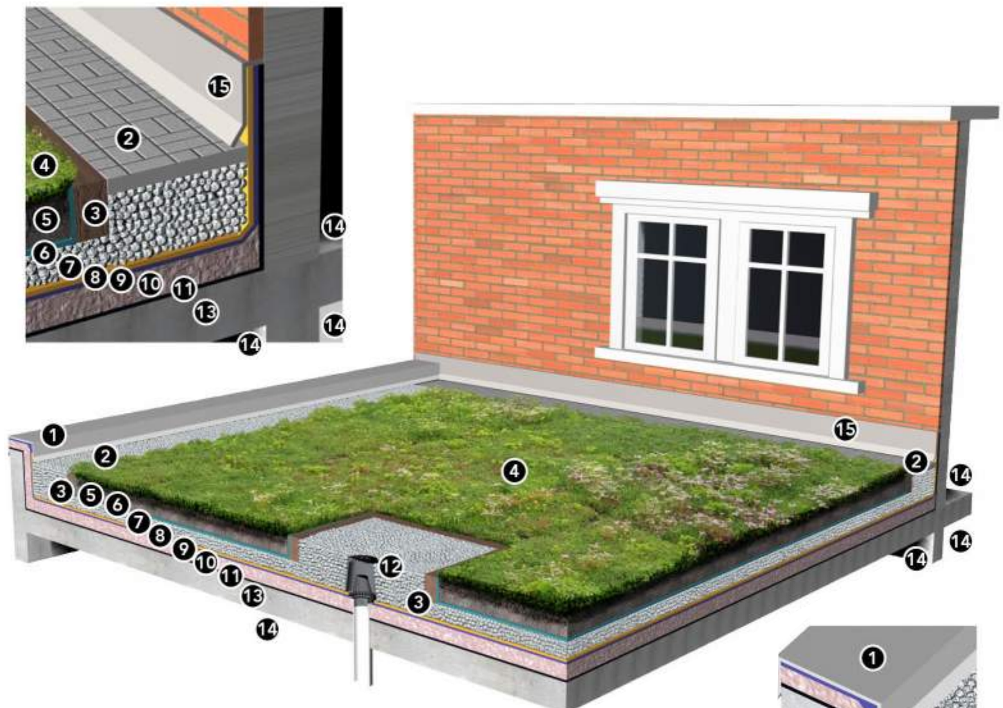
- Longevity

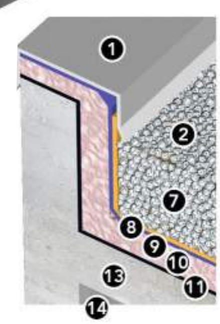
Limited Benefit

- Maintenance Cost
- Material and Construction Cost

This tool is suitable for:

- Commercial Mixed Use
- Institutional
- Parks & Greenspace





There are two basic types of Green Roofs:

Intensive – deeper growing medium to support larger plants and trees; designed for public use as well as stormwater and insulation functions.

Extensive - shallow, lightweight growing medium; designed for stormwater, insulation and environmental functions; vegetation is low and hardy; usually no public access.

Extensive Green Roof

1. Wall Cap Flashing, waterproof membrane extends to 100 mm above finished grade
2. Drain Rock, Paving Slab, or Other Buffer Equivalent
3. Wood, Steel or Concrete Curb/Edging (Optional)
4. Planting
5. Growing Medium
6. Filter Layer
7. Drainage Layer
8. Protection Layer and Root Barrier
9. Waterproof Membrane
10. Thermal Insulation
11. Vapour Barrier
12. Area Drain
13. Structural Slab
14. Building Interior
15. Wall Flashing, waterproof membrane extends to 150mm above finished grade

Precedent examples

1 Vancouver Convention Centre

2 Vancouver Central Library

3 Private Residence, Vancouver

4 Creekside Community Centre

Design Principles, Limitations and Sizing Variables

- Suitable for flat roofs and, with proper design, roofs of 20º (4:12 roof pitch) or less.
- Suitable for many rooftop situations—industrial, warehousing, commercial buildings, office complexes, hospitals, schools, institutional/ administrative buildings, residential and garages.
- Design a green roof at the same time as designing the building or retrofit, so that the structural load can be balanced with the design of the building.
- In calculating structural loads, always design for the saturated weight of each material.
- Provide construction and maintenance access to extensive green roofs. Access through a 'man door' is preferable to a roof hatch.
- Roofs with less than 2% slope require special drainage construction so that no part of the growing medium is continuously saturated.
- Avoid monocultures when planting a green roof; the success of establishing a self-maintaining plant community is increased when a mix of species is used.
- Provide intensive maintenance for the first 2 years after plant installation—irrigation in dry periods, weed removal, light fertilization with slow release complete fertilizers, and replacement of dead plants.
- To facilitate access and prevent moisture on exposed structural components, provide plant free zones along the perimeter, adjacent facades, expansion joints, and around each roof penetration.
- Fire breaks of non-combustible material, 50 cm wide, should be located every 40 m in all directions and at roof penetrations.
- Provide protection against root penetration of the waterproof membrane by either adding a root barrier or using a membrane that is itself resistant to root penetration.

Optimizing Performance

DESIGN & CONSTRUCTION

- Intensive green roofs (>100 depth) provides greater rainwater storage and stormwater benefits than an extensive green roofs (<100 depth)
- Growing medium mixes for extensive green roofs may be primarily fine aggregate with limited rainwater storage potential.
- Greater growing medium depth and higher fines/organic content of intensive green roofs equals greater storage and treatment of rainfall.

MAINTENANCE

- In planting beds, cultivate surface 25mm deep between plants each spring to reduce crusting.
- In extensive green roof lawns, core-aerate areas of surface compaction each spring.
- Ensure regular spring weeding to avoid weeds going to seed.

Green Roof Benefits

- Reduced peak flows & stormwater volume
- Mitigation of urban heat island effect
- Insulation against heat loss and gain
- Extended roof membrane life
- Sound insulation & air filtration
- Urban habitat & biodiversity
- Aesthetics

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/07StormwaterSourceControlDesignGuidelinesGreenRoof.pdf

Tree Well Structures

Trees play a vital role in reducing stormwater runoff in urban settings. Trees within tree wells are generally healthier and reach mature height faster, which leads to more water being intercepted by the tree canopy. Tree wells contain a large volume of soil which retains excess stormwater and helps to remove pollutants from stormwater runoff.

Primary Purpose

- To optimize tree growth and manage stormwater from adjacent hard surfaces.

Performance Rating

FUNCTIONAL CRITERIA

Good

- Water Quality Treatment
- Volume Control
- Aesthetic Benefits
- Public Education, Culture and Health Values

Limited Benefit

- Biodiversity Benefits

COST CRITERIA

Best

- Land Cost
- Longevity

Good

- Maintenance Cost
- Property Value

Limited Benefit

- Material and Construction Cost

This tool is suitable for:

- Medium/High Density
- Commercial Mixed Use
- Institutional
- Collector/Arterial Streets

Tree wells (also called soil cells) are rigid frame structures which are typically installed under a hard surface such as a sidewalk, parking lot or road. Tree wells allow a large amount of soil to be installed under hard surfaces without compromising surface loading.

Street tree in Silva Cell - 2009

Street tree in Silva Cell - 2013

Winter tree canopies intercept 15% to 27% of rainfall. The bigger the canopy, the more water it intercepts.

Perforated drain line is installed at the bottom of the 1st layer of Silva Cells and connected to the catch basin.

Did you know?

- Tree wells can be fed by curb grates, permeable pavement, natural surface infiltration and collected roof water.
- Tree wells can be used in a number of areas including streetscapes, plazas, and parking lots.

Tree Well Examples

1 **Installation of Strata Cell -** Rossland, BC

2 **Installation of Silva Cell -** Queensway, Toronto, ON

Design Principles, Limitations and Sizing Variables

- Verify location of all existing underground utilities and conditions prior to excavation.
- Excavate the trench according to the dimensions necessary to install the desired tree well system. Allow 12" (30 cm) additional space along all edges.
- Compact subgrade to 95% density or as recommended by the geotechnical engineer.
- Prepare the subbase as per product specifications.
- Do not install when subgrades or planting soils are wet, muddy or frozen.
- Review installation layout and procedures with the general contractor, landscape architect and product representative prior to installation.
- Refer to product supplier specifications for information on sizing, material type, preparation and system installation.
- Refer to product specifications for installation instructions.

Optimizing Performance

DESIGN & CONSTRUCTION

- If including infiltration in the design, undertake site-specific infiltration testing and, based on results, design the system infiltration area, surface and underground storage volume, and overflow subdrain. Be careful to not exceed impervious/pervious (I/P) guidelines in design, exercising great caution if exceeding a 5:1 I/P ratio. If using a 'flow-through' design, do not exceed the infiltration capacity of the design soil.
- Ensure the design provides root barriers and/or air gap to separate tree roots from paving. Note that root barriers must break to the air surface – roots will grow over buried root barriers.
- Enforce quality control of topsoil to be free of weed seeds, and to meet specs for texture and hydraulic properties. Use of non-angular sand (e.g. Fraser River pump sand) is encouraged for the sand component. Native topsoil will rarely be suitable, having too low an infiltration rate.
- Include compost to increase percolation and reduce need for water and fertilizer inputs. Greater growing medium depth equals greater storage and treatment of rainfall.
- Include an organic mulch layer to surface.

MAINTENANCE

- Inspect and clean the inlet twice per year minimum (spring and fall).
- Surface areas exposed to air/moisture will require weeding. Ensure regular spring weeding to avoid weeds going to seed.
- Adjust the tree well grate opening to allow for tree growth, and remove/replace organic mulch to exposed areas, as required but at least once every three years.

For more information:

www.deeproot.com/silvapdfs/resources/supporting/silva_cell_brochure.pdf
www.citygreen.com/products/structural-cells/stratacell/

Rainwater Harvesting

Rainwater harvesting involves collecting rainwater from roofs and storing it for non-potable uses.

Primary Purpose

- To reduce domestic water demands and runoff from impermeable surfaces.

Performance Rating

FUNCTIONAL CRITERIA

Good

- Volume Control
- Aesthetic Benefits
- Public Education, Culture and Health Values

Limited Benefit

- Water Quality Treatment
- Biodiversity Benefits

COST CRITERIA

Best

- Land Cost
- Property Value

Good

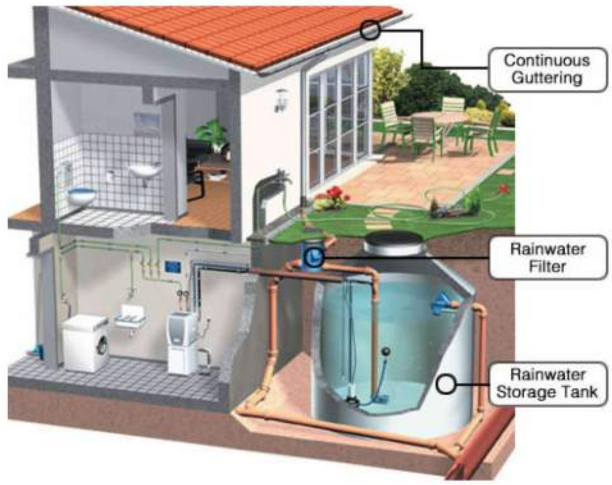
- Longevity

Limited Benefit

- Maintenance Cost
- Material and Construction Cost

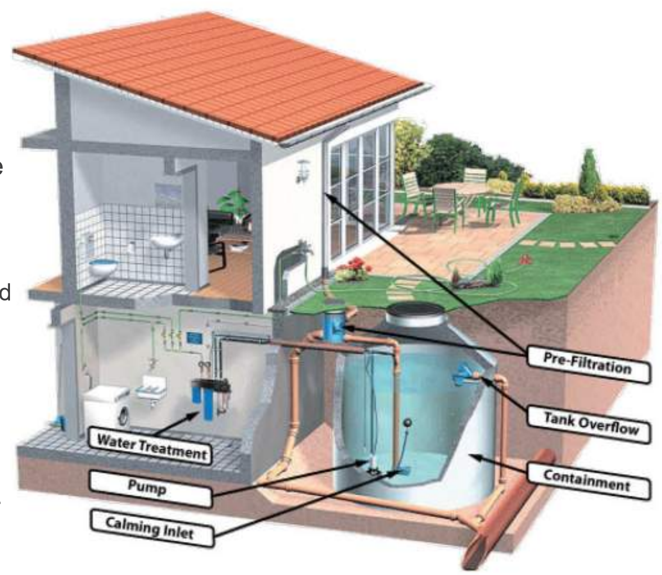
This tool is suitable for:

- Commercial Mixed Use
- Institutional



The primary components of a rainwater harvesting system for non-potable water applications include the following:

- Roofing materials;
- Gutters, gutter covers and downspouts;
- Leaf screens and roof washers;
- First-flush diverter;
- Storage Tank (Cistern);
- Pump and pressure tank.
- Filter; and
- Backflow preventer.



- The installed cost for an in-ground rainwater harvesting system capable of meeting two-thirds of residential water needs Is about $10,000
- Good practice involves diverting the initial portion of a rainfall event to prevent contaminants from entering the water storage

Rainwater Harvesting Example

1

Above Ground Rainwater Harvesting System (www.completeenergyuk.co.uk)

Design Principles, Limitations and Sizing Variables

- The amount of rainfall that can be potentially captured depends on the catchment area (area of the roof used to capture rainfall) and the precipitation.
- The average precipitation in Duncan is 1090 mm per year.
- The total amount of rainfall in litres that can be captured is calculated by multiplying the roof area (m^2) by a percent of average rainfall.
- In Duncan, a roof area of 100 m^2 would require 17 m^3 of storage to maximize the amount of captured water
- To avoid contaminating the rainwater, careful selection of building materials is required as well as incorporating screens and making provision for diverting the first 0.5 mm of each rainfall event.
- In-ground rainwater storage tanks are about twice as expensive as above-ground storage tanks.
- A pumping and pressure control system needs to meet minimum pressure requirements under conditions of maximum demand and system head-losses.
- Backflow prevention, either air gap or reduced pressure principle, is required to avoid direct connection between the rainwater system and the municipal potable water system.
- The cost of a rainwater harvesting system is approximately $10,000 for 15 m^3 (4,000 gallon) capacity below ground tank, and about half that for above ground storage, and could supply about 2/3 of the domestic water demands for an average family.
- By diverting roof runoff from the storm sewer, rainwater capture and reuse that includes toilet flushing to draw down the tank year round provides stormwater benefits.
- Combined with toilet flushing, summer outdoor water use from rainwater tank provides major water conservation benefits.

Optimizing Performance

DESIGN & CONSTRUCTION

- To maximize stormwater benefits, a regular, slow decanting of the tank is desired year round. Toilets (and laundry) provide this regular demand. If they are not connected, the tank needs to have a winter 'seep' facility to slowly decant to absorbent landscape or infiltration trench.
- Roof surfaces that are not under trees, and of relatively clean materials (metal or asphalt) are preferred. Green roof is not a desirable source of rainwater harvesting.
- Careful plumbing installation/inspection to avoid cross connection between rainwater and potable water is warranted.
- Minor rainwater treatment to reduce colouration of rainwater will increase user acceptance, in particular for indoor non-potable uses.

Key Eight Rainwater Harvesting System Design Considerations (Exall, K., and T.D. Vassos, 2012)

MAINTENANCE

- Inspect and clean gutters, first flush diverter regularly (spring and fall or more often).
- Maintain non-light conditions in tanks and pipes—this will reduce algae growth.
- Drain and clean tanks and fixtures at least once every three years.

For more information:

www.rdn.bc.ca/events/attachments/evID6235evattID1344.pdf

Infiltration Trench

An Infiltration Trench system is a sub-surface infiltration facility. These systems are often rock retention trenches or 'milk crate' type facilities that hold and infiltrate water into the subsurface soils. The system includes an inlet pipe or water source, catch basin sump, perforated distribution pipe, infiltration trench and overflow to the storm sewer.

Primary Purpose

- Volumetric Reduction and Rate Reduction

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment

Good

- Volume Control
- Aesthetic Benefits
- Public Education, Culture and Health Values

Limited Benefit

- Biodiversity Benefits

COST CRITERIA

Best

- Land Cost

Good

- Material and Construction Cost
- Maintenance Cost
- Property Value
- Longevity

This tool is suitable for:

- Commercial Mixed Use
- Industrial
- Institutional
- Local Streets

A properly designed retention trench differs from a rock pit in a number of ways. To prevent the retention trench from clogging over time, the trench is encapsulated in filter fabric to prevent entry of any fine material around and on top of the trench and the stormwater entering the trench via perforated pipes is first treated to remove fines in a sump or through grass filter strips. No pavement/walkway runoff, which may contain pollutants and grit, is allowed to flow directly into the trench. Instead it is also first filtered by a grass area, a filter strip, or a planted swale. The retention trench is sized based on measured infiltration rates of the native soils below the trench and the trench depth is limited to allow it to fully drain between storm events. The retention trench is only used where the seasonal high water table and/or bedrock is well below the bottom of the trench. An overflow pipe is incorporated into the retention trench design to prevent the lawn overtop of the trench from becoming saturated and unusable.

Infiltration Chamber Installation, MEC North Vancouver

Rock Trench Installation with Perforated Pipe, MEC North Vancouver

Precedent examples

1 Whistler Athletes Village Drywell

2 Rock Pit Installation, Squamish Thunderbird Subdivision

3 Atlantis Style Infiltration Chamber, Turtle Mountain

Design Principles, Limitations and Sizing Variables

- Sized to drain completely between storms.
- Rock Trench depth vary from 0.3 m to 2 m deep depending on infiltration capacity of native soils
- Trench must be located 5 m from any building, 1.5 m from property lines and 6 m from adjacent infiltration systems
- Suitable for clean runoff from surfaces such as roofs
- Does not provide water quality, dirty runoff (parking, roads) must be treated prior to being directed to infiltration trench.
- Can be placed under pervious or impervious surfaces (lawns or parking lots)
- Conduct on an on-site infiltration test at the proposed infiltration depth and design the trench based on the design flow and infiltration rate.
- Separation between base of drain rock reservoir and water table should be a minimum of 600 mm
- Trench bottom width is not restricted but is generally between 600 mm and 2400 mm
- Install infiltration trench over native ground and avoid over compaction of the trench sides and bottom to protect the infiltration capacity.
- Scarify infiltration trench base to a depth of 150 mm prior to installation of the rock reservoir.
- Infiltration trench shall include a sump with lid to allow for inspection and cleanout.
- Install infiltration trench with overflow to storm sewer to allow flows in excess of the design flow to pass.
- Avoid utilities and other crossings of the trench. Where utilities cross the trench install trench dams to avid infiltration water following the utility trench.
- More detailed design information can be found at www.metrovancouver.org/about/publications/Publications/01StormwaterSourceControlDesignGuidelinesCover-Intro.pdf

Optimizing Performance

DESIGN & CONSTRUCTION

- Infiltration trenches used for vehicle or pedestrian travelled areas require a water quality pre-treatment system installed ahead of the trench to remove sediment and gross pollutants.
- Preform site-specific infiltration testing and design infiltration basin based on the results of such.
- Site the infiltration trench at least 5 meters from any building footings or foundations

MAINTENANCE

- Sump should be inspected annually and cleaned as required. Sediment should be removed from the tank bottom and floatables removed from the water surface.

For more information:

www.metrovancouver.org/services/liquid-waste/LiquidWastePublications/08StormwaterSourceControlDesignGuidelinesInfiltrationTrenchSoakawayManhole.pdf

Infiltration Chambers

StormTrap: www.stormtrap.com

Brentwood Industries Storm Tank: www.BrentwoodProcess.com

Hancor LandMax system: www.hancor.com

Triton Stormwater: www.tritonsws.com

Stormtech: www.stormtech.com

Contech: www.conteches.com/products/applications/stormwater-infiltration.aspx

Water Quality Structures

Water quality structures are manufactured BMPs that treat for a variety of pollutants. There are several different kinds of water quality structures including: Oil separators, grit/sediment separators, and filter structures.

Primary Purpose

- Water Quality Treatment

Performance Rating

FUNCTIONAL CRITERIA

Good

- Water Quality Treatment
- Aesthetic Benefits
- Public Education, Culture and Health Values

Limited Benefit

- Volume Control
- Biodiversity Benefits

COST CRITERIA

Best

- Land Cost

Good

- Material and Construction Cost
- Property Value
- Longevity

Limited Benefit

- Maintenance Cost

This tool is suitable for:

- Local Streets
- Collector/Arterial Streets

Oil separators are typically precast tanks with buffer walls or coalescing plates to encourage oil to float to the top of the structure and become trapped behind the buffer or plate. The oil remains floating on the top of the tank until removed by routine maintenance. Oil separators may also collect floating trash.

Grit / sediment separators can take several forms including precast cylindrical tanks which replace manholes in pipe systems or precast tanks. Most separators rely on gravity separation or hydrodynamic separation and settlement of particles. Several of the hydrodynamic separators also collect oil and floating trash. Particles are settled and collect until removed by routine maintenance.

Filter structures can be used to remove the most challenging pollutants from stormwater including nutrients such as phosphorus. Similar to sediment separators, filter structures come in either a precast cylindrical tank or a more traditional shaped precast tank. The filter structures require filter media that must be maintained or replaced regularly.

Installation of a Oil Water Separator - Coast Mountain Bus Company

Copper Valley Oil Interceptor installation (Photo Credit: Langley Concrete)

Precedent examples

1 Oil & Grit Separator, ICBC Salvage Facility, New Westminster

2 MEC Head Office Interceptor, Vancouver

3 Deltaport Multiple Unit Stormceptor

Design Principles, Limitations and Sizing Variables

- They are available in a variety of sizes and are sized based on maximum treatment flow.
- Any flow above the designed treatment flow is bypassed either by an upstream bypass or an in structure bypass.
- Work with product manufacture to ensure product is properly sized and selected for site and runoff composition.

Optimizing Performance

DESIGN & CONSTRUCTION

- Ensure proper design flow and move unit off line if peak flows are expected to exceed desired treatment flow to prevent wash though and other problems

MAINTENANCE

- Inspect annually and clean as required. Sediment should be removed from the structure bottom and floatables removed from the water surface. Vacuum truck should be used to dispose of any oil/hydro carbons within the unit.
- Change any filter media / cartridges as needed or as recommended by manufacture

For more information:

Proceptor by Green Turtle: www.greenturtletech.com/introduction-to-proceptor.php

Imbrium: Stormceptor, Jellyfish, Sorbtive media: www.imbriumsystems.com/

Contech: Vortech, Vortsentry, Jellyfish, VortClarex: www.conteches.com/products/stormwater-management/treatment.aspx

Armtec: www.armtec.com/products/stormwater-management/

Detention Tanks

Detention tanks collect and store stormwater runoff during a storm event, then release it at controlled rates to the downstream drainage system, thereby attenuating peak discharge rates from the site. With such systems in place, a drainage system can cater for high intensity rainfall events. Detention tanks may be located above or below ground. Detention systems can address a number of stormwater related issues such as: flood protection, erosion and aquatic habitat.

Primary Purpose

- Reduce the risk of flooding and erosion downstream of the detention tanks for major storm events

Performance Rating

FUNCTIONAL CRITERIA

Good

- Aesthetic Benefits

Limited Benefit

- Volume Control
- Water Quality Treatment
- Biodiversity Benefits
- Public Education, Culture and Health Values

COST CRITERIA

Best

- Land Cost

Good

- Maintenance Cost
- Longevity

Limited Benefit

- Material and Construction Cost
- Property Value

Detention Tank Installation, MEC Head Office

This tool is suitable for:

- Commercial Mixed Use
- Industrial
- Institutional

Precedent examples

1 UBC Detention Tank Installation

2 StormTrap Detention Installation
(Photo credit: Sustainable Technologies Evaluation Program)

Design Principles, Limitations and Sizing Variables

- To determine if detention tank systems are required for a site by looking at municipal or LEED requirements.
- Determine the pre-development flow pattern and volume for the site.
- The tank should be designed based on the size of the development, degree of detention required and specific criteria for post development flows.
- Design tank to meet criteria for post-development flows.
- Typical Peak Discharge Criteria
  - » **Flood/Erosion Protection:** Control the post-development to pre-development levels for the 5-year return period.
  - » **Aquatic Habitat Protection (DFO) :** 6-MONTH Volume Reduction and Water Quality treatment and flow control 6-month, 2-year, and 5-year 24-hour post-development flows to pre-development levels.
- Detention requirements can be estimated by various methods including: the rational method, SCS (U.S. Soil Conservation Service) unit hydrograph and level pool routing as examples.
- The selection of the method of analysis depends on the size of the development and the intended application of the results.
- Most analysis should be done or reviewed by a Professional Engineer.
- Underground detention can be provided by tanks or pipes or culverts that are designed to be oversized.
- Discharge either by gravity or through pumping. In order to ensure that detention volume is available for the next storm event.
- A pre-treatment sump is required to remove sediments in the runoff.
- Provide an overflow to allow larger storms to overflow the tank.
- Tank should be designed to allow for access for maintenance or cleaning.
- All underground tanks should have an air space equal to 20% of the maximum depth, connected to the atmosphere by a vent.
- The maximum depth is a function of safety and convenience of users. A depth of over 2 meters is not recommended.
- Undertone tanks must have a minimum of 0.5 meters of cover and must be capable of handing the loads from the surface above.
- More detailed information can be found at: Metro Vancouver Best Management Practices Guide: www.metrovancouver.org/about/publications/Publications/BMPVol1a.pdf

Optimizing Performance

DESIGN & CONSTRUCTION

- To maximize stormwater benefits, detention to pre-development conditions is preferred.
- Many pre-cast concrete vaults exist that can be utilized for detention tanks.

MAINTENANCE

- Inspect manhole/tank annually and clean as required. Sediment should be removed from the tank bottom and floatables removed from the water surface.
- Maintain any sumps or upstream pre-treatment regularly to ensure proper operation.

For more information:

ZCL: www.zcl.com/products/water-products.html

Langley Concrete: www.langleyconcretegroup.com/

Barr: www.barrplastics.com

Armtech: www.armtec.com

StormTech: www.stormtech.com/

Cultech: www.cultec.com/stormwater-systems.html

Storm Chamber: https://www.layfieldgroup.com/Geosynthetics/Storm-Water-Control-Products/StormChamber-Arch-System.aspx

Contech: www.conteches.com

StormTrap: www.stormtrap.com

Hancor: www.hancor.com

Daylighted Streams

Daylighting of historical streams creates essential habitat for aquatic life, contributes to the liveability of a neighbourhood and provides a sense of place.

Primary Purpose

- To contribute to the liveability, sense of place, and environmental education of residents and providing needed habitat for birds, small mammals, amphibians and other wildlife within the urban environment

Performance Rating

FUNCTIONAL CRITERIA

Best

- Habitat Creation
- Biodiversity Benefits
- Increased Liveability

Good

- Flood Control

Limited Benefit

- Water Quality Treatment

Cost Criteria

Best

- Property Values
- Longevity

Good

- Material & Construction Costs

Limited Benefit

- Land Acquisition Cost
- Stream Maintenance

This tool is suitable for:

- Parks and Green Space
- Commercial Mixed Use
- Industrial
- Institutional

Daylighting of streams should be undertaken in areas where maximum benefit (i.e. maximized habitat creation) can be achieved.

Design Principles, Limitations and Sizing Variables

- Determine flow patterns.
- Design the channel to convey the 100 year event as well as maintaining adequate depths and flows for aquatic species during summer
- Create complexity within the channel (use large woody debris, boulder clusters, weirs and vegetation to mimic the natural environment)
- Provide a riparian margin planted with woody vegetation to provide shade to the stream as well as creating further habitat for birds and other wildlife
- Provide appropriate armouring at storm outfalls into the daylighted creek
- Have a geotechnical assessment done.
- Is there soil contaminant issues?
- Is stability an issue?
- Utilize catchment metrics to determine the suitability of daylighting
    - Total impervious area
    - Catchment flow characteristics
    - Available stream corridor width

Optimizing Performance

- Undertake public consultation to give a sense of ownership to the community and to understand what is driving the project
- Utilize landscape architecture and fish biology principles early. Determine the correct species to plant given design objectives, site conditions, and desired maintenance levels. Incorporate habitat features into the design and plantings
- Plan for follow-up and repair to stream features as the daylighted reach evolves throughout the first few seasons. Prepare an operation and maintenance manual to manage and maintain the stream and riparian buffers after construction.

For more information:

www.americanrivers.org/newsroom/resources/daylighting-streams-breathing-life-into-urban-streams-and-communities/

Constructed Wetlands

Engineered stormwater treatment wetlands are a series of shallow ponds connected by an engineered marsh system designed to treat contaminated stormwater through the biological processes associated with emergent aquatic plants and via sedimentation. Treatment wetlands typically are not designed to provide stormwater detention as the area required for both treatment and detention is usually in excess of what is available (approximately 3–5% of the catchment area).

Primary Purpose

- Treat stormwater runoff through natural processes prior to discharge into the receiving waters

Performance Rating

FUNCTIONAL CRITERIA

Best

- Water Quality Treatment
- Habitat Creation
- Biodiversity Benefits

Good

- Aesthetic Benefits
- Peak Flow Reduction for Frequent Events

Limited Benefit

- Volume Control

COST CRITERIA

Best

- Longevity

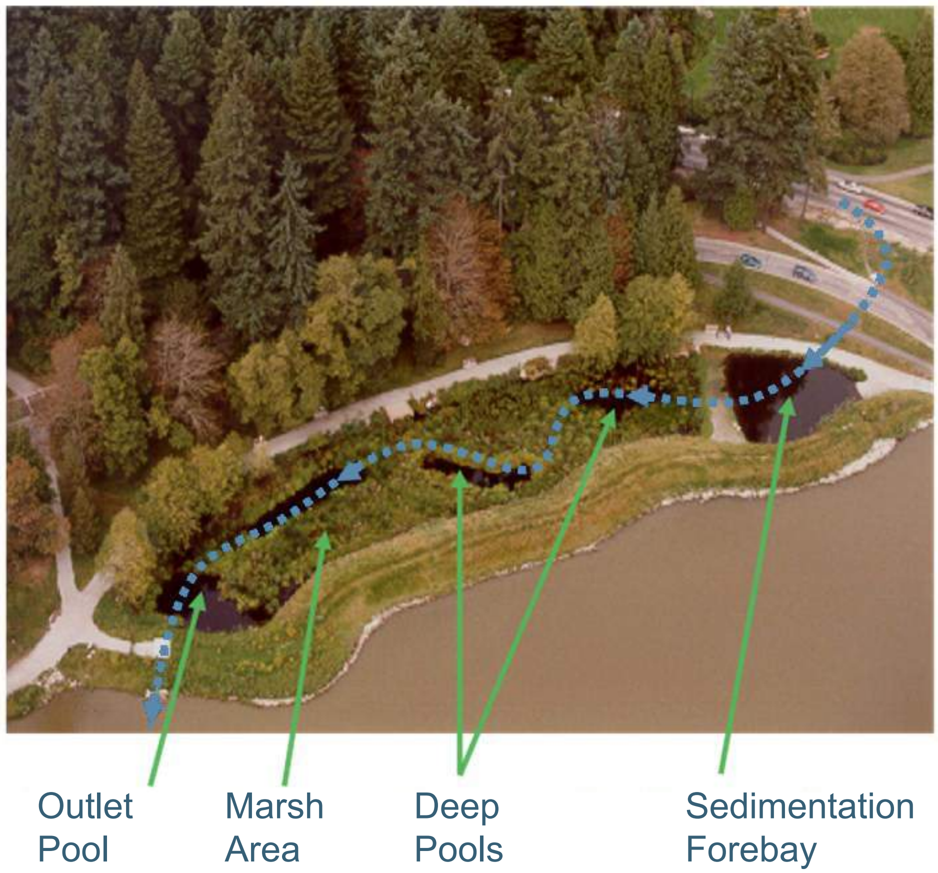
Good

- Construction Costs

Limited Benefit

- Land Cost
- Maintenance Cost

Wetlands collect, detain and treat stormwater runoff during storm events and release it into the receiving environment. Properly constructed wetland systems provide a high level of contaminant removal through sedimentation and biological uptake. Wetlands can also benefit issues such as flood protection, stream erosion, habitat creation and protection.



This tool is suitable for:

- Parks & Greenspace
- Industrial
- Institutional

Design Principles, Limitations and Sizing Variables

- The wetland location should be chosen to provide continual flow throughout the year so as not to allow stagnation.
- Typical Design Criteria
  - » Water Quality Treatment Size forebay to allow sediment to settle out (~80% TSS removal) Size wetland to hold 90% of average annual rainfall runoff
- Wetlands can be land intensive because they are shallow facilities
  - » Minimum 65% of the pond should be less than 450 mm deep allowing for vegetation growth and contaminant uptake
  - » Depths should vary (25% > 1.2 m deep, 65% < 450 mm deep, 35% < 150 mm deep)
- A sediment forebay of 10% of the total wetland area

- Length to width ratio of 3:1 to 5:1
- Recommended side slopes 5:1 (H:V) or flatter
- Permanently wetted area should be approximately 72% of the runoff from a 2-year 24-hour rainfall event
- Analysis should be done or reviewed by a professional engineer
- Select plant species for survival rather than contaminant uptake
- Use a professional to determine the correct plants for each of the zones (wet to dry)

Optimizing Performance

- Location should be chosen to ensure a large enough catchment for continual flow though the dry season (June – September)
- Design wetland to mimic natural systems (varying depths, islands, high marsh peninsulas)
- Minimize flow velocities to minimize sediment re-entrainment and erosion
- Intersperse open water with marsh
- Limit extended detention depth (live storage) to 1m or less to protect plants

For more information:

www.saskatoon.ca/sites/default/files/wetlands_design_guidelines.pdf

www.env.gov.bc.ca/wld/documents/bmp/wetlandways2009/Wetland%20Ways%20Ch%2010%20Development.pdf

www.env.gov.bc.ca/wld/documents/bmp/wetlandways2009/Wetland%20Ways%20Ch%2011%20Enhancement.pdf

KERR WOOD LEIDAL
consulting engineers

Appendix G

Multiple Accounts Evaluation (MAE) of Potential Stormwater Improvement Projects

Appendix G: Multiple Accounts Evaluation of Projects

Drainage Improvement Project	Intent	Impact in comparison to Status Quo		Project Approvals	Infrastructure (Traditional vs Natural)	Capital Cost[1]	Average Annual Maintenance Costs[2]	Estimated Total Life Cycle Cost (25-years)[3]
		People[1] (Flood Risk Reduction)	Environment[2]					
1A Keating Farm Detention Pond - (Large Flood Detention Facility)	Provide upland storage to reduce peak flows from the upper watershed to reduce 100-year return period flows such that undersized culverts downstream do not need to be upgraded.	Moderate (Reduces peak flows downstream such that 100-year flood can safely pass undersized culverts)	Moderate Deterioration (Large fluctuation in water levels in pond would make creation of wetland habitat difficult)	Requires Acquiring Property from Private Land Owner/Dam Safety Liability	Traditional	$525,000	$30,000	$1,280,000
1B. Keating Farm Detention Pond/Wetland	Provide upland storage to reduce peak flows for 2-year return period flood to reduce channel erosion, improve habitat function and provide water quality improvement opportunity.	Minor (Wetland only design to detain up to the 2-year return period flood)	Moderate Improvement (Provides Upland Wetland Storage for to reduce erosion potential along stream and provides additional aquatic habitat)	Normal approval process	Natural			
2. Langtry/ Tzinquaw/Koksilah/ Hykway Road/ Polkey Road Driveway Culvert Replacements and Fish Passage	Replace major road crossing of main creek channel and driveway culvert crossings along Polkey Road to provide sufficient capacity to safely pass the 200-year return period flood.	Significant (Improved flood conveyance, 200-year return period design, Koksilah Road provides detour option for Highway 1 during large flood)	Moderate Improvement (Improvement to fish passage)	Normal approval process	Traditional	$1,500,000	$10,000	$1,750,000
3. Hykawy Park Diversion	Provide diversion flow from Sh-hwuykwselu (Busy Place) Creek along the diversion channel through the park to the detention area.	Minor (Only Improves Flood Conveyance for Hykway Road Culvert)	Moderate Improvement (Additional aquatic habitat area and Improved Fish Passage and potential for additional riparian area)	Requires park land	Natural	$430,000	$10,000	$680,000
4. Polkey Road Channel Floodplain/ Riparian Improvements	Reduce Polkey Road to one lane/ one-way road and use space to naturalize floodplain area. Polkey Road could also be raised to reduce the potential for overland flooding.	Minor (Raising Polker Road provides limited improvement in flood conveyance and reduction in flood area)	Significant Improvement (Connects Ripraian Area from Sh-hwuykwselu (Busy Place) Creek Pond to Hykway Park)	Requires approval from MoTI for one-way road for Polkey Road	Natural	$4,600,000	$20,000	$5,100,000
5. Raise Miller Road and Upgrade Existing Culverts	Raise Miller Road and upgrade existing culverts.	Significant (Reduces potential of regular flooding	Moderate Improvement (Would include fish	Normal approval process	Traditional	$670,000	$10,000	$920,000

Drainage Improvement Project	Intent	Impact in comparison to Status Quo		Project Approvals	Infrastructure (Traditional vs Natural)	Capital Cost[1]	Average Annual Maintenance Costs[2]	Estimated Total Life Cycle Cost (25-years)[3]
		People[1] (Flood Risk Reduction)	Environment[2]					
		of Miller Road and improves reliability of access)	passage improvements across all flow regimes. However, currently the culvert is passable at certain flows)					
6. Trestle Village Floodbox	Upgrade the Trestle Village flood box to replace the existing culvert. The flood box would include two pipes (a lower and upper-level pipe to assist with drainage of the Trestle Village Area) and proper functioning flap gates to prevent backflow. No additional improvements to the dike are proposed with this project (see project 8).	Moderate (Modelling indicates that floodbox only improves peak water levels for lower return period events)	No Change	Normal approval process	Traditional	$350,000	$10,000	$600,000
7. Trestle Village Pump Station	Includes a pump station to transfer water from the Trestle Village drainage system into the Koksilah River during periods of high water. The pump station will consist of a portable pump which can be brought to the site and run when required. Can be stored and maintained off-site when not required.	Significant (Pump station sized to lower water levels in Trestle Village up to the 200-year return period event)	No Change	Normal approval process	Traditional	$1,600,000	$50,000	$2,900,000
8. Trestle Village Dike Replacement	Replace existing Trestle Village Dike. This would entail removal of the existing dike and full reconstruction of the Trestle Village Dike to standards. This could be combined with the flood box (Project 7) and a pump station (Project 8).	Significant (Reduce flood risk to trestle village up to the 200-year return period event)	No Change	Normal approval process	Traditional	$2,700,000	$10,000	$3,000,000
9. Trestle Village Upland flow diversion	Another potential option for management of flood risk at Trestle Village may be to collect and divert runoff from the upland area to the west of Trestle Village and divert around the Trestle Village dike.	Moderate (Could reduce peak water levels in Trestle Village but uncertain about effectiveness of diverting groundwater)	No Change	Will require right of way agreements	Traditional	$340,000	$10,000	$590,000
10. Headwaters Channel and Riparian Restoration	Rehabilitate natural function of mainstem of Sh-hwuykwselu (Busy Place) Creek near the headwaters of the watershed. This will help improve water quality for downstream and will also provide opportunity for additional fish habitat in the system after restoration of fish access.	Minor (Additional channel storage in headwaters channeld would provide only a minor reduction in peak flows for extreme events	Significant Improvement (Provides additional riparian area, shade to maintain lower baeflow water temperatures, provides food source for downstream and protects water quality)	Will require right of way agreements	Natural	$570,000	$5,000	$695,000
Note:								

Drainage Improvement Project	Intent	Impact in comparison to Status Quo		Project Approvals	Infrastructure (Traditional vs Natural)	Capital Cost[1]	Average Annual Maintenance Costs[2]	Estimated Total Life Cycle Cost (25-years)[3]
		People[1] (Flood Risk Reduction)	Environment[2]					

1 – Impacts to people have been compared qualitatively based on change in potential flooding impacts resulting proposed drainage improvements. This qualitative comparison considers the reduction in inundated area and in inundation depth resulting from improvement, the reduction in risk of failure of road crossing leading to closure of the road (this includes consideration of road classification/traffic volume, alternative detour routes available, ease of reconstruction of crossing if failure should occur, etc.), and the improved level of service (ie: what is the return period for which the drainage improvements are being designed to handle based on design criteria)

2 – Impact to the environment have been compared qualitatively based on change in natural function of the watershed and stream. Considerations used in the qualitative comparison include the amount of stream habitat area impacted or improved, the amount of riparian area impacted or improved, the location of the improvement in the watershed (upstream vs downstream), the improvement in accessibility and reconnection of habitat, etc.)

Evaluation Framework

Sh-hwuykwselu (Busyplace) Creek Stormwater Management and Mitigation Plan

	Baseline - No Adaptation	Option A Minimum Intervention / Minor Watershed Health Decline	Option B Extensive Intervention / Major Watershed Health Gain	Option C Balanced Intervention / No Net Loss Watershed Health
Values Criteria				
People Highest # protected	MODERATELY WORSE	SLIGHTLY BETTER	FAR BETTER	MODERATELY BETTER
Economy Sustained job and housing opportunities	MODERATELY WORSE	SLIGHTLY BETTER	FAR BETTER	MODERATELY BETTER
Environment Sustained/improved long term	MODERATELY WORSE	SLIGHTLY WORSE	FAR BETTER	NO CHANGE
Social Fairness/cost equity for land uses/partners	NO CHANGE	SLIGHTLY WORSE	FAR BETTER	MODERATELY BETTER
Infrastructure Road / emergency / utility function	MODERATELY WORSE	SLIGHTLY WORSE	FAR BETTER	MODERATELY BETTER
Impact and Risk of Failure				
Overall Risk	VERY HIGH	HIGH	LOW	MODERATE
Cost Criteria				
Joint Project Budget Initial		$	$	$
Joint Project Budget with Inflation		$	$	$
Joint Operation and Maintenance Effort		SLIGHTLY HIGHER	HIGHER	SLIGHTLY HIGHER
Cost/Inconvenience to Private Sector / FN Members		MODERATELY LOW	MODERATELY HIGH	MODERATE
Partnership Potential (co-fund)		LOW	MODERATE	HIGH
Future Long-term Climate Adaptation Cost		HIGH	LOW	MODERATE

DRAFT MULTIPLE ACCOUNT EVALUATION CRITERIA

Participants were asked to:

1. Review the draft Multiple Account Evaluation (MAE) criteria (both qualitative and quantitative) as part of the option evaluation framework that will be used to evaluate option by understanding the range of implications by each account: Financial, Environmental, Socio-Community, Regulatory/Political, or Constraints/Risks.
2. Consider if criteria are appropriate, need refinement, or if other criteria should be added.
3. Rank the draft criteria in terms of importance compared to other criteria by ranking from 1 to 5 (with 1 being the lowest importance and 5 being the highest importance).

RESPONSES

FINANCIAL ACCOUNT

Add: Installation cost, cost of "do nothing" (i.e. relative to a base case scenario or status quo)

Reconsider: One criterion for capital cost, operating and maintenance costs, life cycle costs and long-term financial stability; equity definition,

Omit: n/a

Capital Cost

- May have more opportunity in a capital project setting.
- Capital cost will be a key consideration for how well the plan is received and adopted.
- Capital cost, operating and maintenance costs, life cycle costs and long-term financial stability are variations on the same thing.
- A cost/benefit study is needed on this project.

Operating and Maintenance Costs

- A major factor if savings can be made.
- Infrastructure that has a low maintenance or passive operational cost should be considered.

Life Cycle Costs

- This is a standard consideration that doesn't warrant key consideration.
- Owners of lands will better support projects with a longer lifespan.
- Possibly redundant - already captured as capital cost, operating cost, and maintenance cost.
- Is installation cost captured?
- This would include capital and operating and maintenance costs.

Equity

- If it is possible to build local government or private equity, it should be considered.
- Not a consideration for right-of-way.
- Not sure what this in the context? Asset value? Or, does this criterion apply when it is a Public Private Partnership (PPP)?
- Explanation needed. Is this equitability or equity?
- Who pays? Is it fair?
- Criterion unclear.

Long-term Financial Stability

- Expectation of developer/residents.

Other

- What is the cost of not doing anything?

ENVIRONMENTAL ACCOUNT

Add: Recreational water quality.

Reconsider: Aquatic, terrestrial impacts as one criterion, water quality and reduction of stormwater contaminants as one criterion, include species as well as habitat impacts in evaluation.

Omit: n/a

Aquatic / Riparian Impacts

- Aquatic / riparian impacts, terrestrial impacts, reduction of stormwater contaminants, and water quality impacts are variations on the same thing
- These would look at species as well as habitat impacts?
- Protection of riparian areas should be a key consideration.

Terrestrial Impacts

- These would look at species as well as habitat impacts?

Water Quantity Impacts

- These would look at species as well as habitat impacts?

Water Quality Impacts

Reduction of Stormwater Contaminants / Sediment

- Don't know how this criterion differs from water quality impacts.
- Redundant with water quality.
- This will support cost efficiency in the long run.
- Same as water quality impacts.

Climate Change Adaptability

- Aligns with key CRD strategic priorities.
- Climate change adaptation is important, but the point is to make the stream system more resilient, which in itself achieves the goal of adaptation for climate change.

Other

- Recreational water quality.

REGULATORY/POLITICAL ACCOUNT

Add: Likelihood of approval/ implementation, stormwater management best practices, broader application of option.

Reconsider: Land use/OCP consistency, local/provincial government noting to include Cowichan Tribes, sustainability to resiliency or have as climate change adaptability.

Omit: Development approval / permitting.

Development Approval / Permitting

- This does not seem to be "criteria".
- DPs are unsuitable tools for this.

Land Use / OCP Consistency

- Land use/OCP policies don't provide much guidance.

Sustainability / Resiliency

- Dislike the word "sustainability"; resiliency is preferred.
- Redundant with climate change adaptability.
- This criterion is too vague/abstract to be of much value.

Local / Provincial Government Support

- Local / provincial government support is very similar to public acceptability/support.
- Cowichan Tribes as a local government.
- Does not belong in this – it is the realm of decision-makers.

Other

- There should be a measure for “likelihood of approval/ implementation”.
- There should be a criterion for the possible broader application of the option.
- Stormwater management best practices.

SOCIO-COMMUNITY ACCOUNT

Add: Industry considerations.

Reconsider: Health and safety in terms of flooding, combining public acceptability support with local/provincial government support. Clarify reduction of flood risk in terms of property improvements.

Omit: n/a

Public Acceptability / Support

- I put this last, although if a special requisition is needed, it will be a very high priority. However, it seems to me that if the property impacts are addressed, as well as community activities and economic activities, that should address the need for public support/acceptability.
- Similar to local / provincial government support .

Health and Safety

- Important from flooding.

Cultural / Archaeological Values

- Don’t obliterate stuff.

Community Activity Impacts (e.g. fishing, recreation)

Local Economic Impacts (e.g. agricultural)

Opportunities for Education / Awareness

- Both for residents and government staff.

Property Improvements (e.g. reduction of flooding)

- How will property improvements be evaluated?
- Is the criterion “reduction of flooding”? Or reduction of flood risk?

Other

- Industry needs to be invested in the positive impacts of the study.

CONSTRAINTS / RISKS ACCOUNT

Add: Private property ownership changes, retaining features/maintenance.

Reconsider: How physical constraints will apply to evaluation. Define constructability and what it means for evaluation.

Omit: n/a

Physical Constraints (e.g. topography, hydrological)

- It informs cost so why test again?
- Given the current state of drainage system.
- More clarification of this criteria is needed and how it will be used.
- Chosen option needs to be achievable and practical.

Constructability

- Anything is constructible if you throw enough money at it.
- No idea what this means.

Other

- Private property ownership changes- ongoing participation.
- How to secure and retain features/maintenance.

DISCUSSION QUESTIONS

Do you have any comments on the draft accounts and multiple account evaluation criteria?

General

- Redundant criteria should be removed.
- Further explanation on what the criteria mean and how they will be used is needed. For example, equity, topographical constraints.
- I think these MAE may not be so transferable to Cowichan member concerns and interests. I think it is important for another Cowichan Tribes community meeting to be held to talk about the final actions proposed for further funding. These "actions" will include those applicable to the lower end of Sh-hwuykwselu creek where flooding is driven by the Koksilah River; i.e. actions that will influence residents who live on reserve, and possibly some of the businesses in the industrial park.
- A higher weighting could be given to areas that are linked to community engagement and financial cost.
- Seems to be comprehensive. The one factor that might be missing (not sure how relevant it is) is the idea of a "System Operation" account i.e. what is involved from a tax or maintenance perspective of the three options.

- Environmental Account:
  - It may be worth differentiating between drinking water quality and recreational water quality impacts as separate criteria.*
  - Island Health supports rain and floodwater management options that help to reduce storm water contaminants / sediment as these elements can result in degradation of both drinking water and recreational water quality. Impacts to the underlying aquifer(s) and potentially the Cowichan River may affect the City of Duncan and Municipality of North Cowichan's well fields. Furthermore, water from the Busyplace watershed can drain into the Koksilah River, which flows into Cowichan Bay both of which contain public and private recreational water areas.
  - Rain and flood management options should take into consideration land development and its effects on natural water balance. Solutions should encourage managing rainwater onsite as much as possible.
  - Furthermore, prioritizing integrated rainwater management approaches that store and slowly release rainwater into the ground will support the replenishing of aquifers and streams, which consequently protects water quantity for the municipal water systems as well as aquatic and riparian environments.
- Regulatory Account
  - An additional criterion to consider including is "Current Storm Water Management Best Practices" – as in, do the preliminary options to address rain and flood waters align with current best practices?
  - Implementation of management approaches should align with the OCP vision for the area and take into consideration the surrounding land uses. Consideration should be taken into how these options meet the principles of a healthy built environment, a framework that is often used to update/amend OCPs and land use bylaws. For example, rain gardens, engineered wetlands, green roofs and detention ponds are all elements that support the natural environment principle under the Healthy Built Environment Framework (as outlined in the BCCDC Healthy Built Environment Linkages Toolkit). In addition, where possible, permeable surfacing and ground cover helps to address storm water on site, thereby reducing overland flow, which can contribute to contaminants making their way into neighbouring water bodies (integral to both drinking water and water quality, and overall healthy built environment).
  - Island Health also supports "the implementation of storm water management policies and bylaws to improve water quality and ecological function of the watershed" as highlighted in the report. While storm water management solutions should be evaluated in consideration of what is permitted under current legislation and local bylaws and policies, proposed options can also present opportunities for re-evaluating or developing the approving/permitting frameworks to promote integrated storm water management. For example, developing local bylaws and making land use decisions that encourage and support integrated storm water management approaches.
- Socio-Community Account
  - As Island Health's mandate is to promote and ensure health and care for everyone, everywhere, every time, storm water management solutions that align with public health and safety are highly encouraged.
- Constraints/Risk Account
  - Storm water management options should take into consideration the physical constraints (e.g. hydrological) that may impact the underlying aquifer and neighbouring water bodies (integral to drinking water and recreational water quality).