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Guichon Creek Daylighting: How an Emergency Response Became Creek Restoration

Caroline Charbonneau, MASc, Peng

March 26, 2025

Objective & Outline

- Objective:
  - Share a B.C. success story of urban creek daylighting as a preferred alternative to traditional infrastructure renewal (i.e., culvert repair)
  - Describe how an emergency response to a culvert failure became a precedent-setting creek daylighting project.

- Presentation is in two parts:
  - The first summarizes the extensive background work that was completed and the years of planning completed by the institution.
  - The second part explores a unique emergency response to major infrastructure – highlighting the construction and implementation of an innovative solution.

Introduction

Caroline Charbonneau, P.Eng., M.A.Sc.
STORMWATER ENGINEER

KERR WOOD LEIDAL

LEADER IN WESTERN CANADA IN STORMWATER, LOW IMPACT DEVELOPMENT, DRAINAGE MASTER PLANNING, AND ENGINEERING SERVICES

CREEK RESTORATION, REHABILITATION & DAYLIGHTING

GREEN INFRASTRUCTURE DESIGN

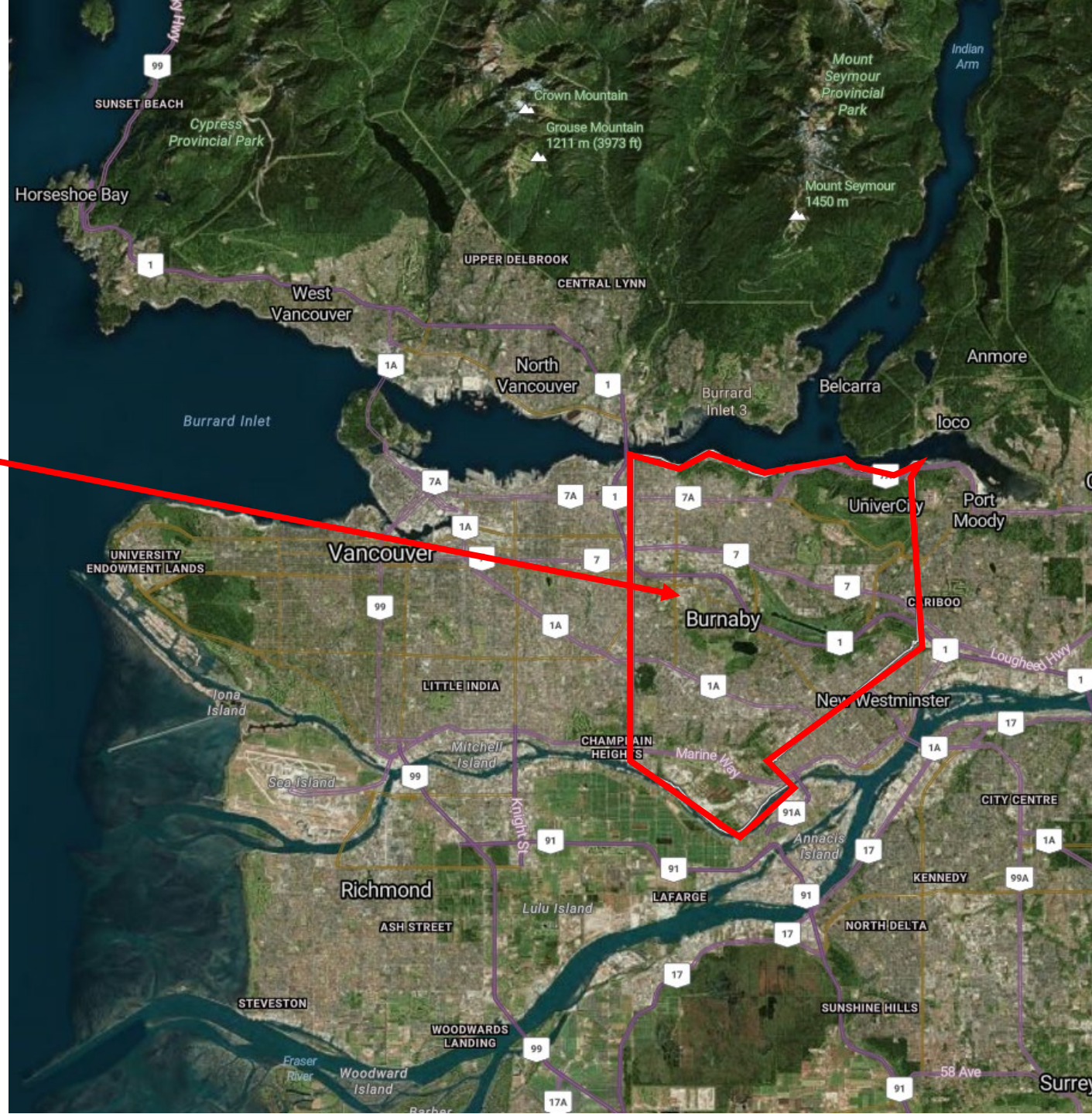
ASSET MANAGEMENT

ENVIRONMENTAL SERVICES

CONTEXT

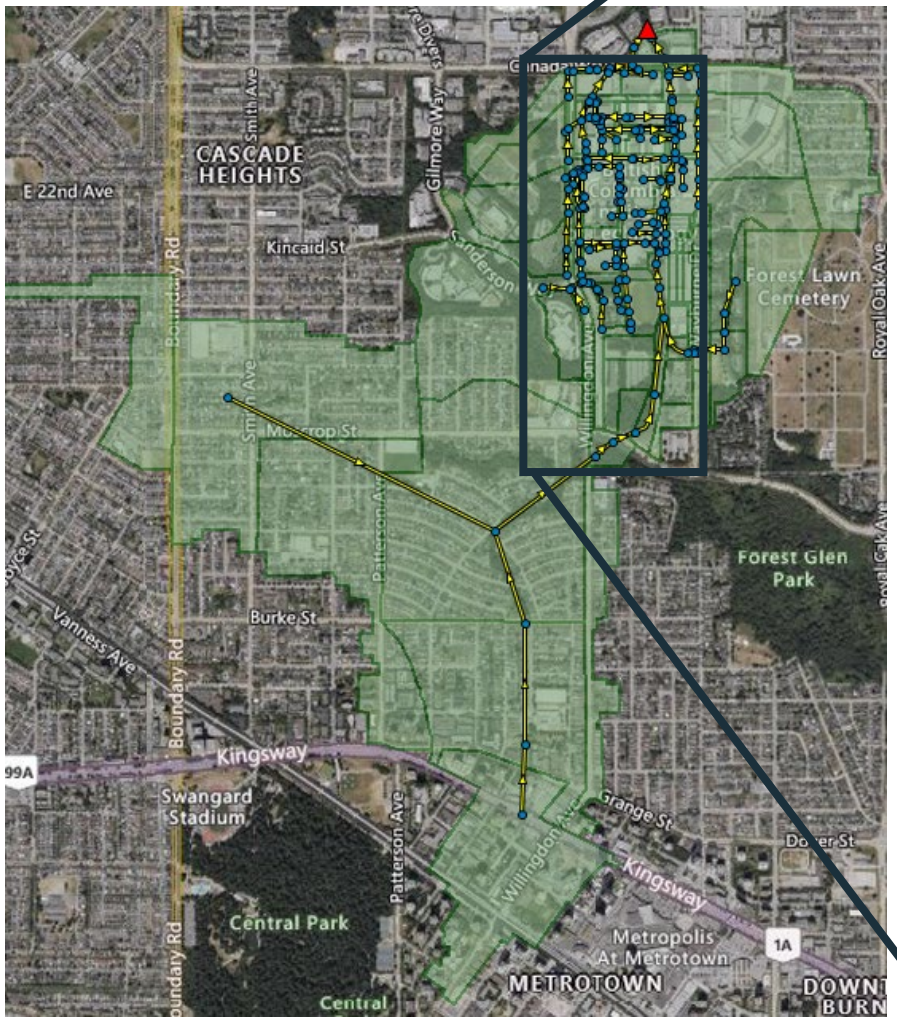
British Columbia Institute of Technology (BCIT)

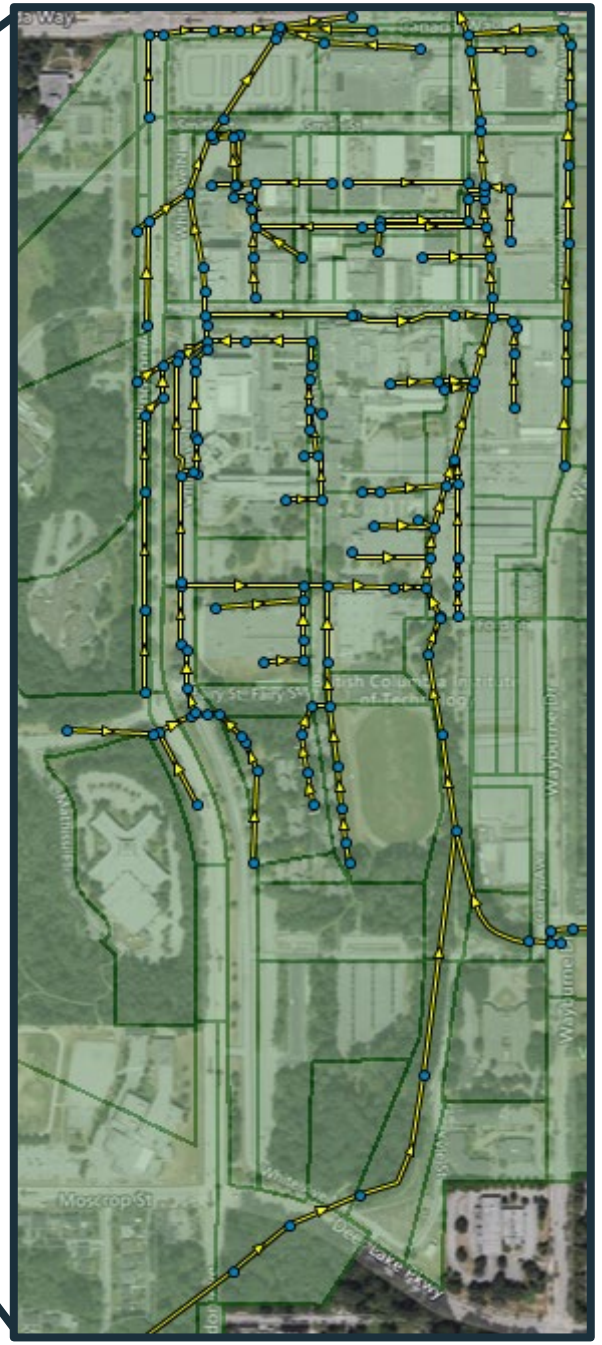
- Located in Burnaby, British Columbia
- Urban campus
- Single City parcel, surrounded by City ROWs
- Forested in the south
- Heavily developed in the north
- ~80% Impervious
- Guichon Creek flows through the campus



Guichon Creek Watershed

- Guichon Creek is an urban waterway and discharges to Still Creek → Burnaby Lake → Brunette River → Fraser River
- Campus is 55 ha of the ~310ha drainage area
- Campus drains via storm sewers to the Guichon Creek system
- Guichon Creek is conveyed through campus via open channel in the south portion and a series of culverts in the north end
- Historically culverted to support development of the campus





Guichon Creek Through BCIT

- Open channel in the southern half, transitioning via a large weir to culverted channel in the north
- BCIT has +/- 650 meters of old undersized culvert system
- Long term campus planning to daylight the entire culverted portion of the creek through campus

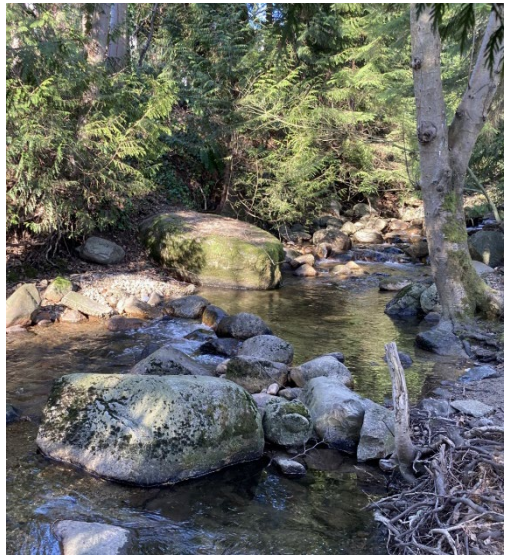


Photo: Patkau, 2023

Photo: NHC, 2021

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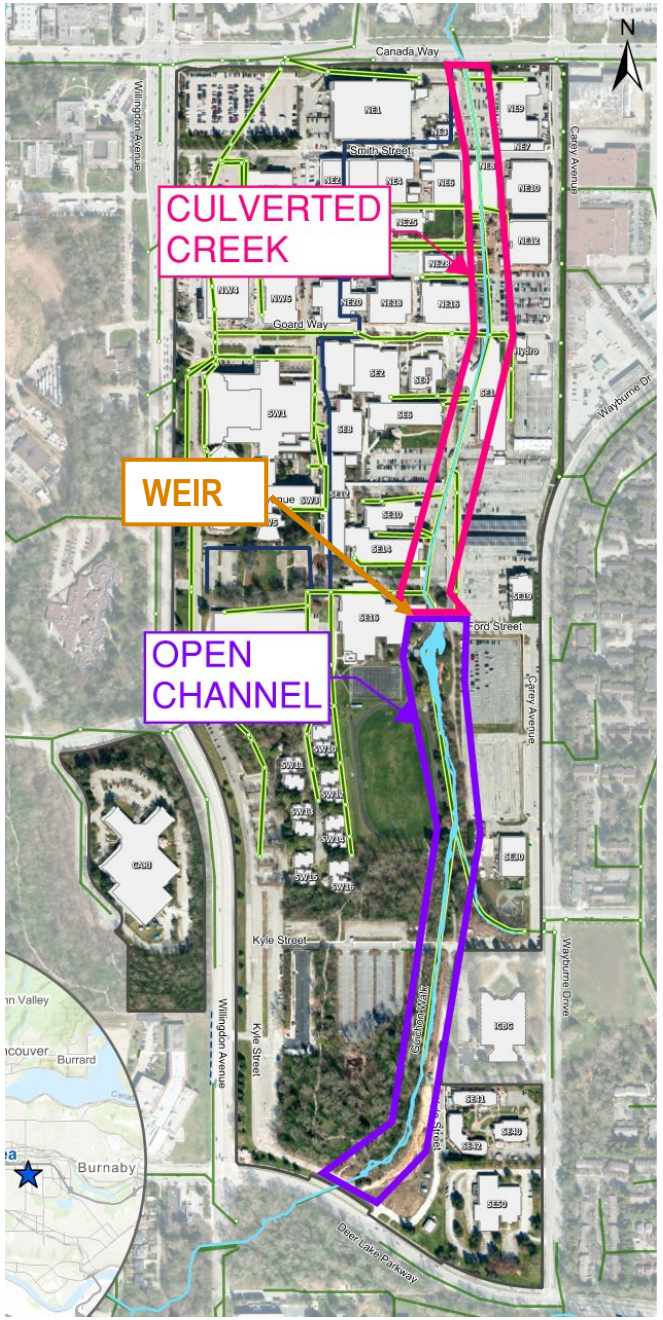


Campus Development Plan & Design Guidelines

- Campus Development Plan provides a conceptual development framework to guide future capital project proposals.
- Reimagines building layout to support a new alignment of Guichon Creek corridor through the campus
- Sets the stage for other studies on campus to support future development planning

Stormwater Strategy (KWL, 2023)

- KWL completed the stormwater design strategy which was developed to support the campus design guidelines and development plan
- **Highlight Guichon Creek as the Campus backbone**
- Develop an understanding of campus hydrology, hydraulics and stormwater response (PCSWMM Model)

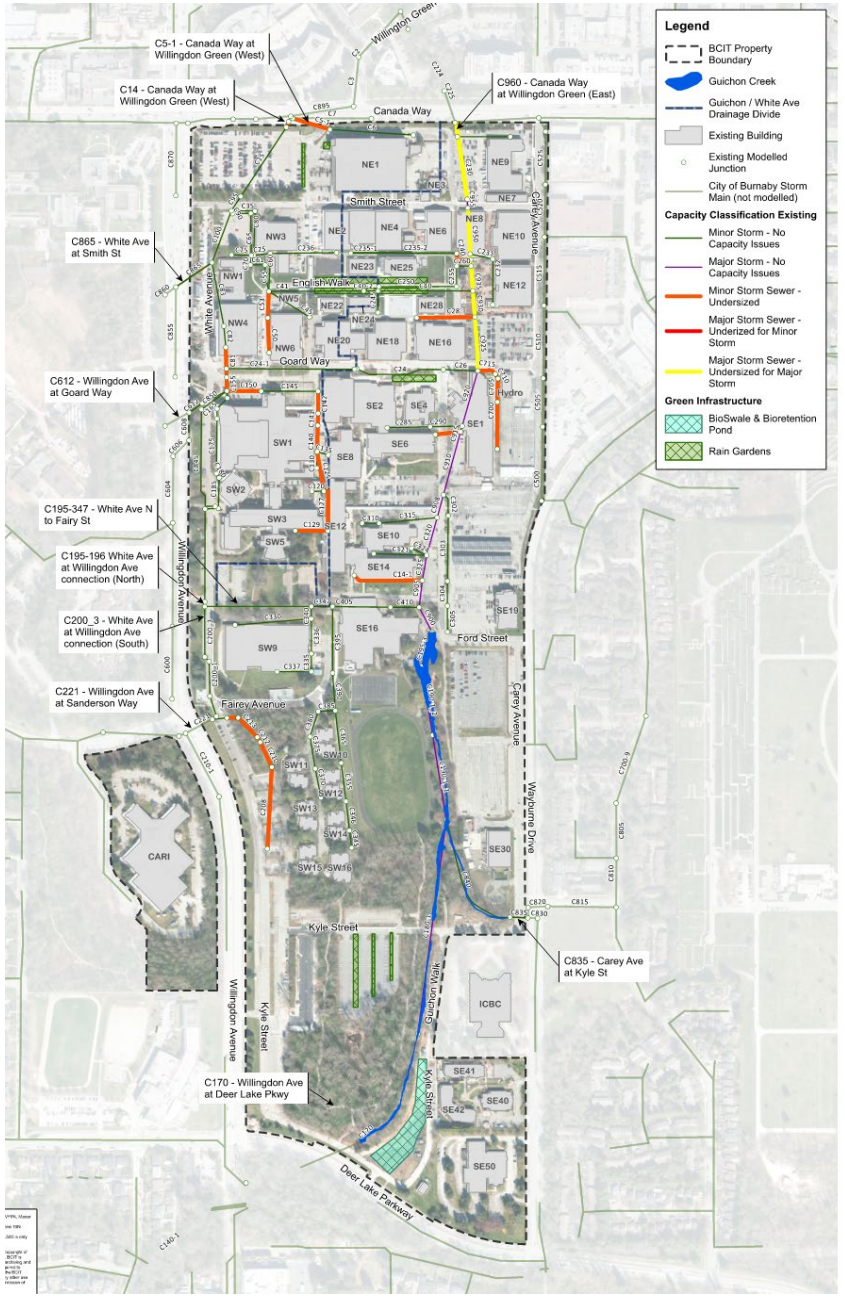
Improve stormwater quality and restore natural and urban ecosystems

Increase climate resilience

Enhance the exterior public realm

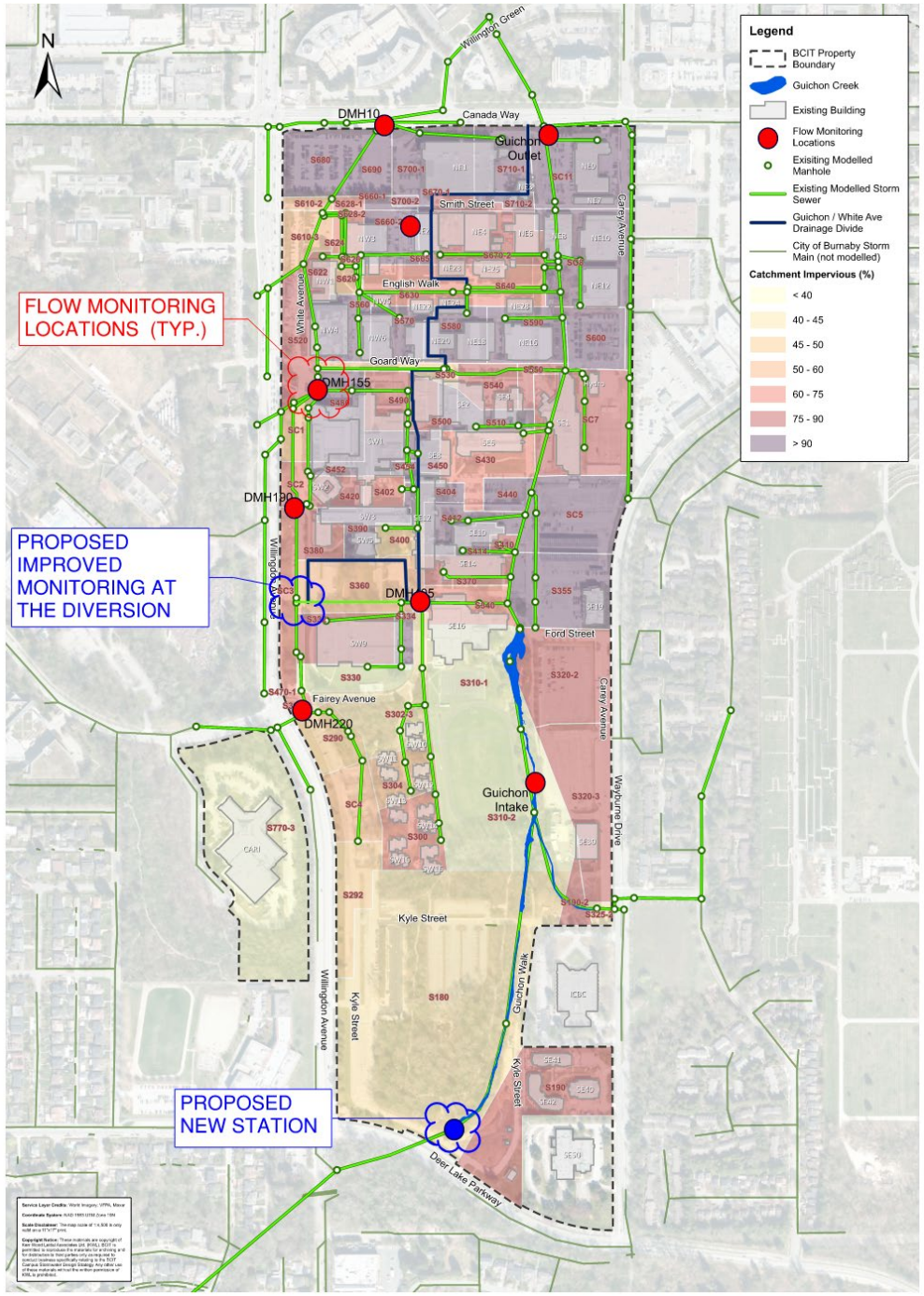
Embrace Stormwater as a campus resource

Provide enhanced riparian area, ecological habitat, and increased flood protection



Flow Monitoring

- BCIT had hydrometric monitoring undertaken across the Burnaby campus
- Monitoring occurred in 2021 / 2022 and resumed Fall 2024 with new locations and monitoring equipment to better support the campus's long-term goals
- Measured parameters include flow, temperature, level, and velocity
- Data collected is used to inform design studies on campus
- Ongoing monitoring completed by KWL

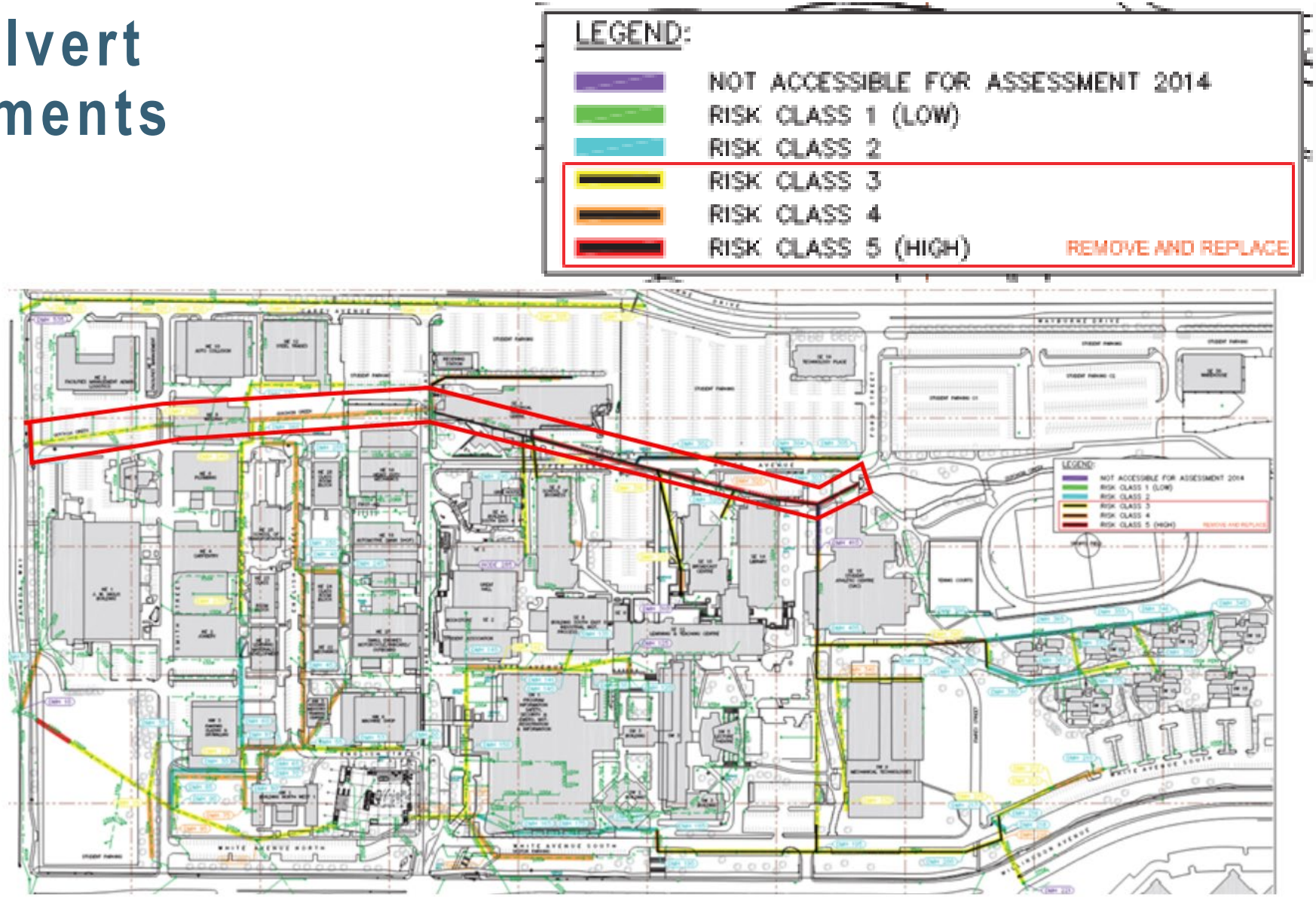


BCIT & Guichon Creek Daylighting Goals

- BCIT is a leader in sustainability education and training
- Aspirational goals have been set for the campus including the voluntary daylighting
- Faced with significant assets at end-of-life, BCIT is embracing a **holistic, innovative, naturalized** design approach
- Improve BCIT stormwater quality and restore natural and urban ecosystems (including habitat and fish access)
- Increase climate resilience by **improving flood conveyance** and replacing undersized culvert systems

Guichon Creek Culvert Condition Assessments

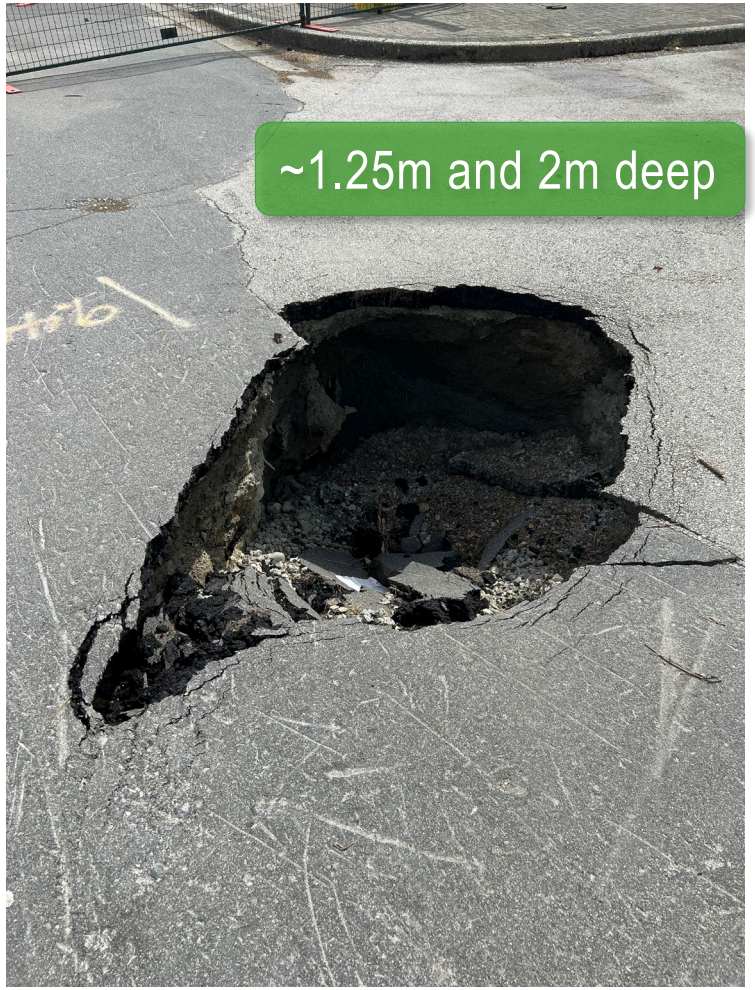
- Condition assessments have been completed including CCTV, locates, potholing, to determine condition of culvert through campus
- Degrading culvert likely contributing to nuisance flooding
- Sinkholes on campus from failing infrastructure
- Infrastructure (culvert) at end of life that needs replacing

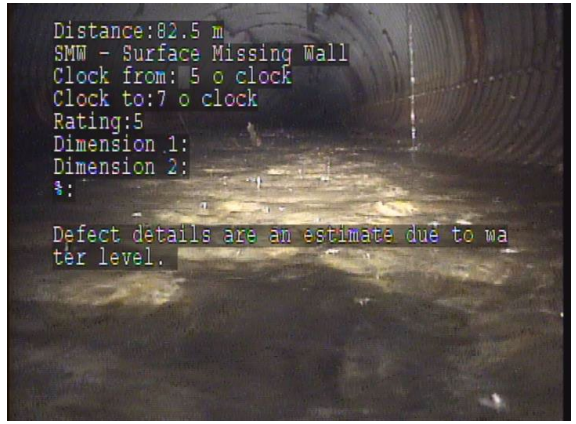


THE SINKHOLE

Sinkhole & Emergency Status

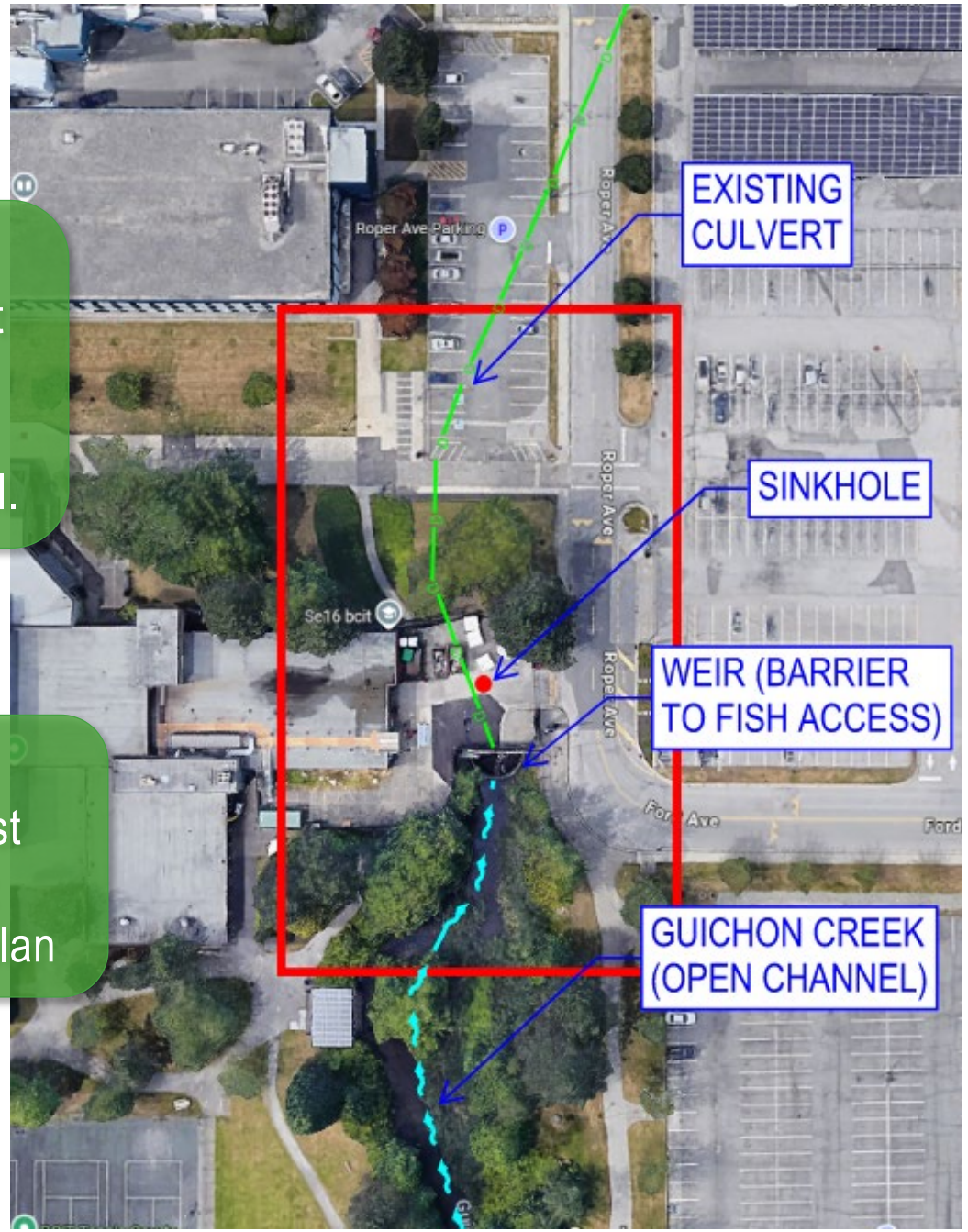
- February / March 2023
  - A pavement depression observed along existing culvert alignment
  - Depression widened and pavement revealed a large sinkhole
  - Civil consultants were engaged to begin investigations
  - Contractor was engaged for site safety/control as well as constructability input
  - CCTV footage of the storm culvert
- CCTV reports showed 13 different failures in the stormwater pipe over 15 linear meters - project was given “emergency status”

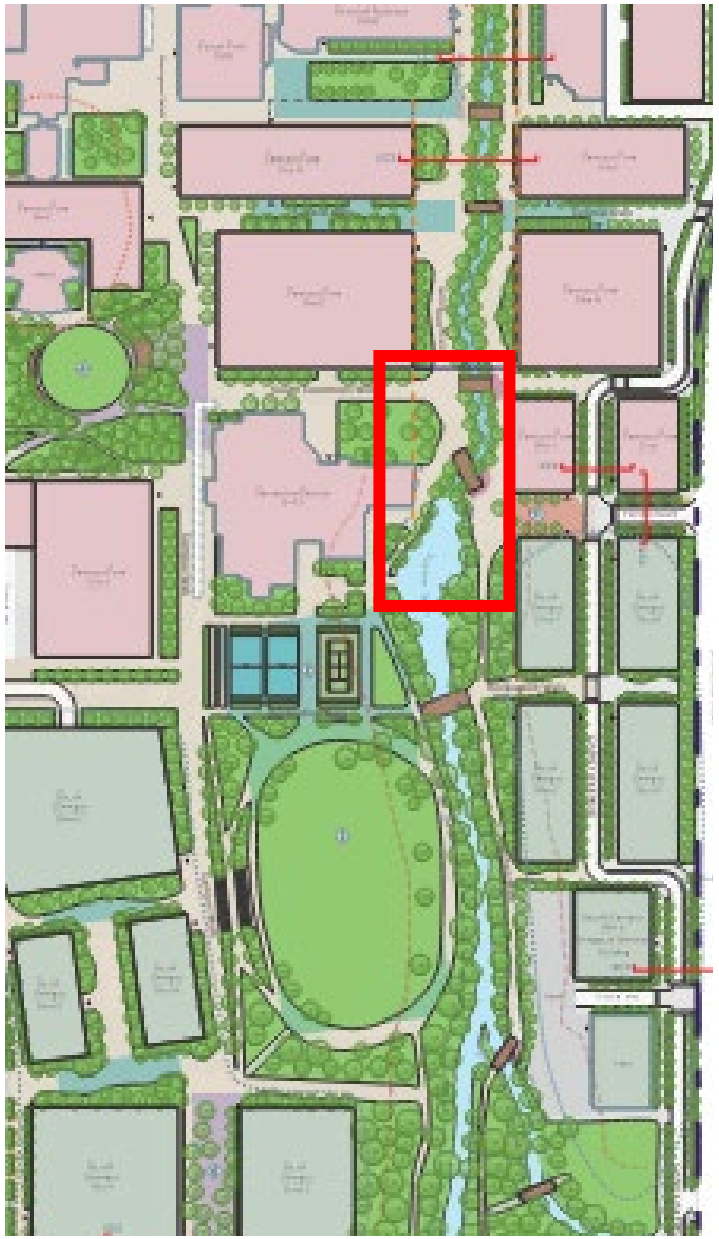




The sinkhole occurred along the existing culvert alignment and directly aligned with the location of the daylighted channel.

Creek daylighting option provided less risk and best value, and it is consistent with the campus master plan





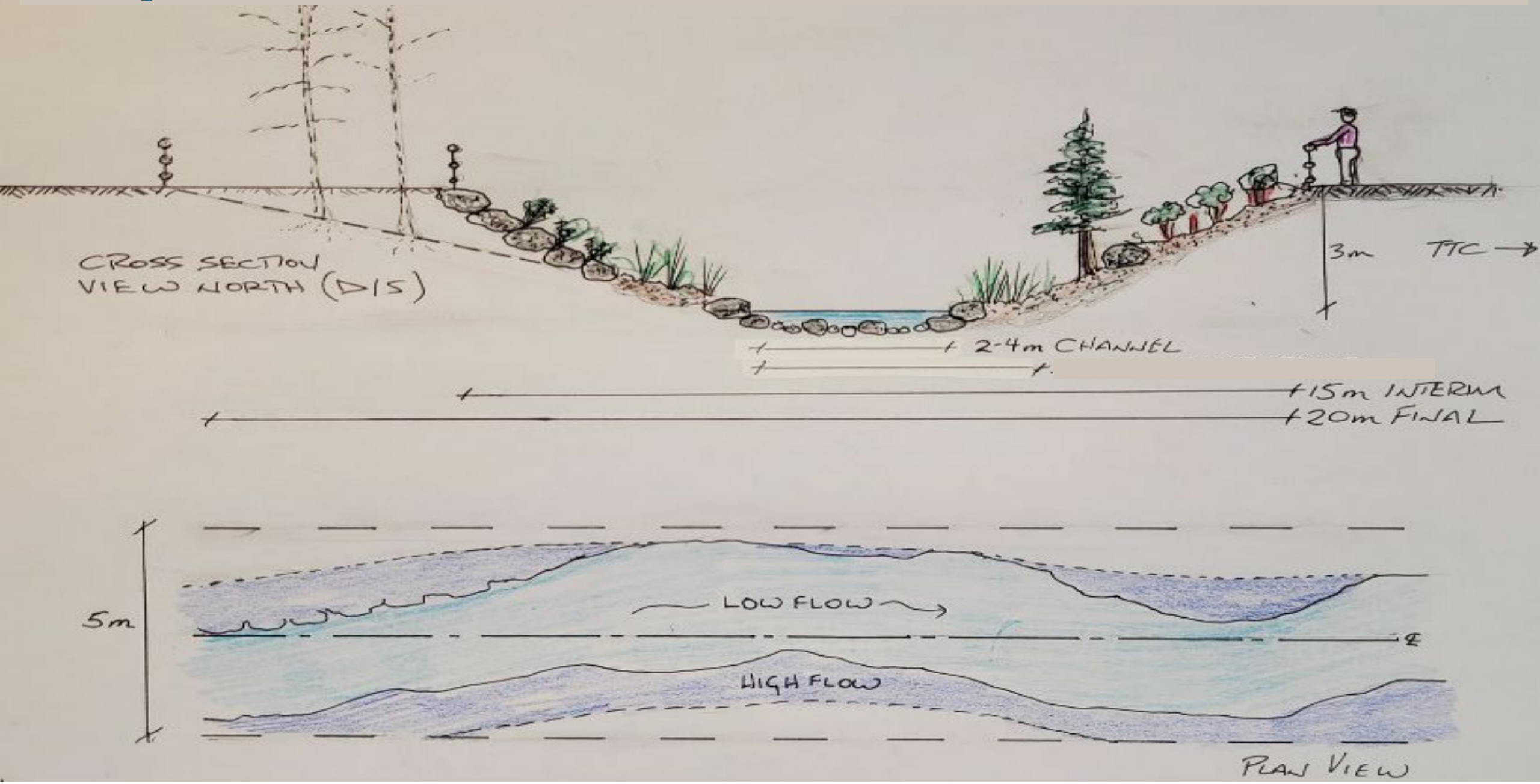
Daylighting Design Goals

- Daylight channel to increase flow capacity
- Retrofit / remove fish barrier at weir
- Minimize campus disturbance
- Complete construction in the least risk window for fish (Aug 1 – Sept 15) and have new channel functional before fall / winter rainy season

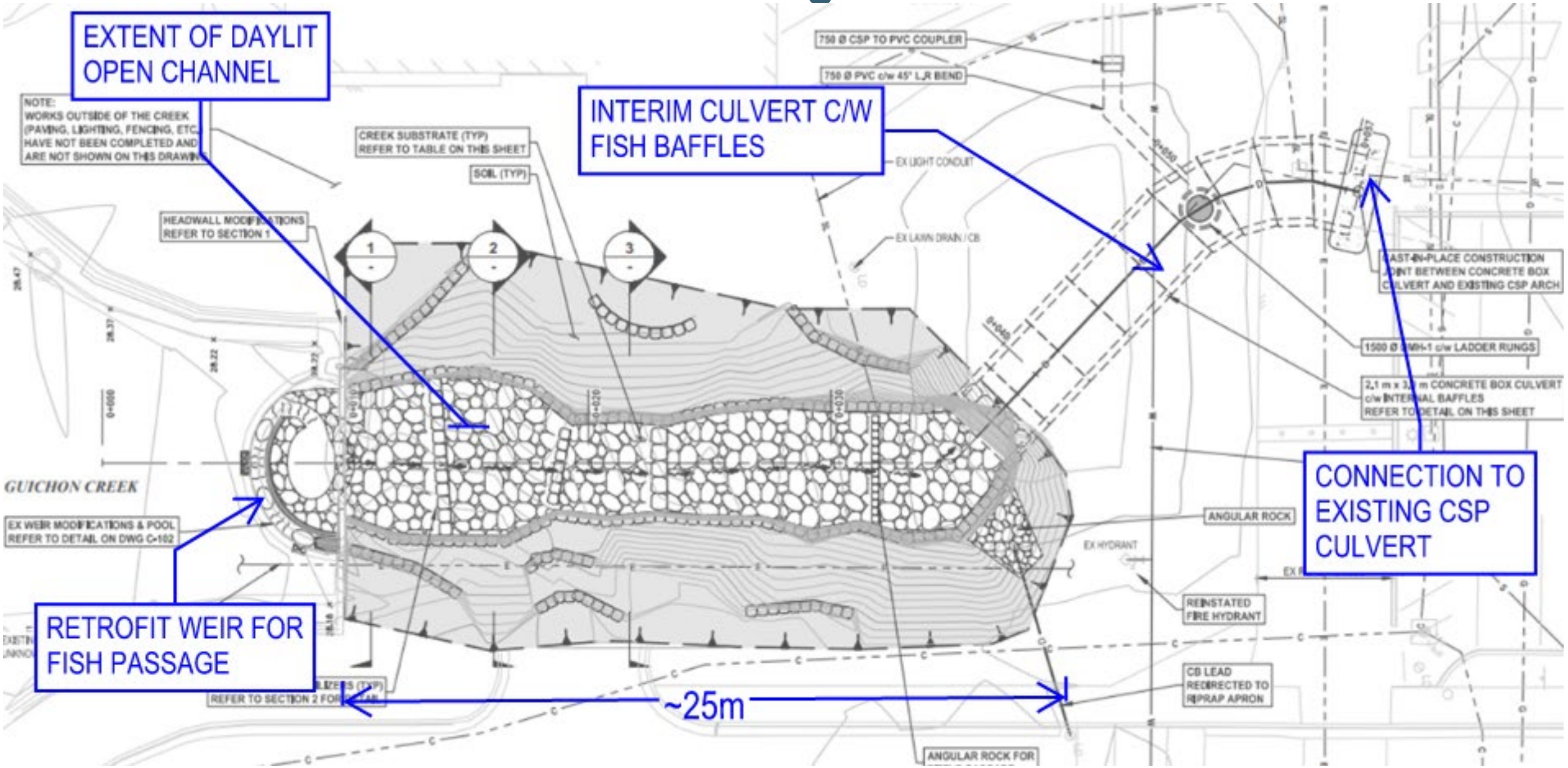
High level planning had been completed for the campus which set the stage to launch into detailed design without missing a beat.

DAYLIGHTING VISION

Design Vision

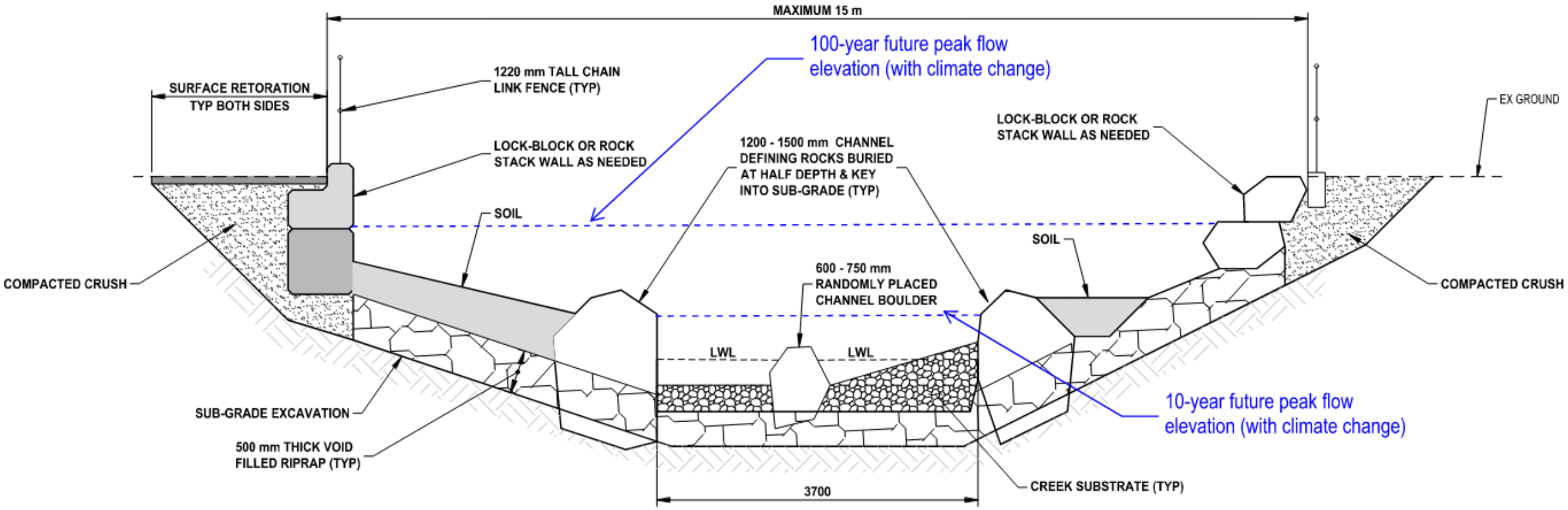


Detailed Design



Channel Cross Section

- Designed to convey the 100-year future conditions (including climate change) peak flow with minimum 0.3 m freeboard
- 100-year existing peak flow = 15.6 m³/s
- 100-year future (with climate change) peak flow = 31.2 m³/s



Fish Passage & Culvert Baffles

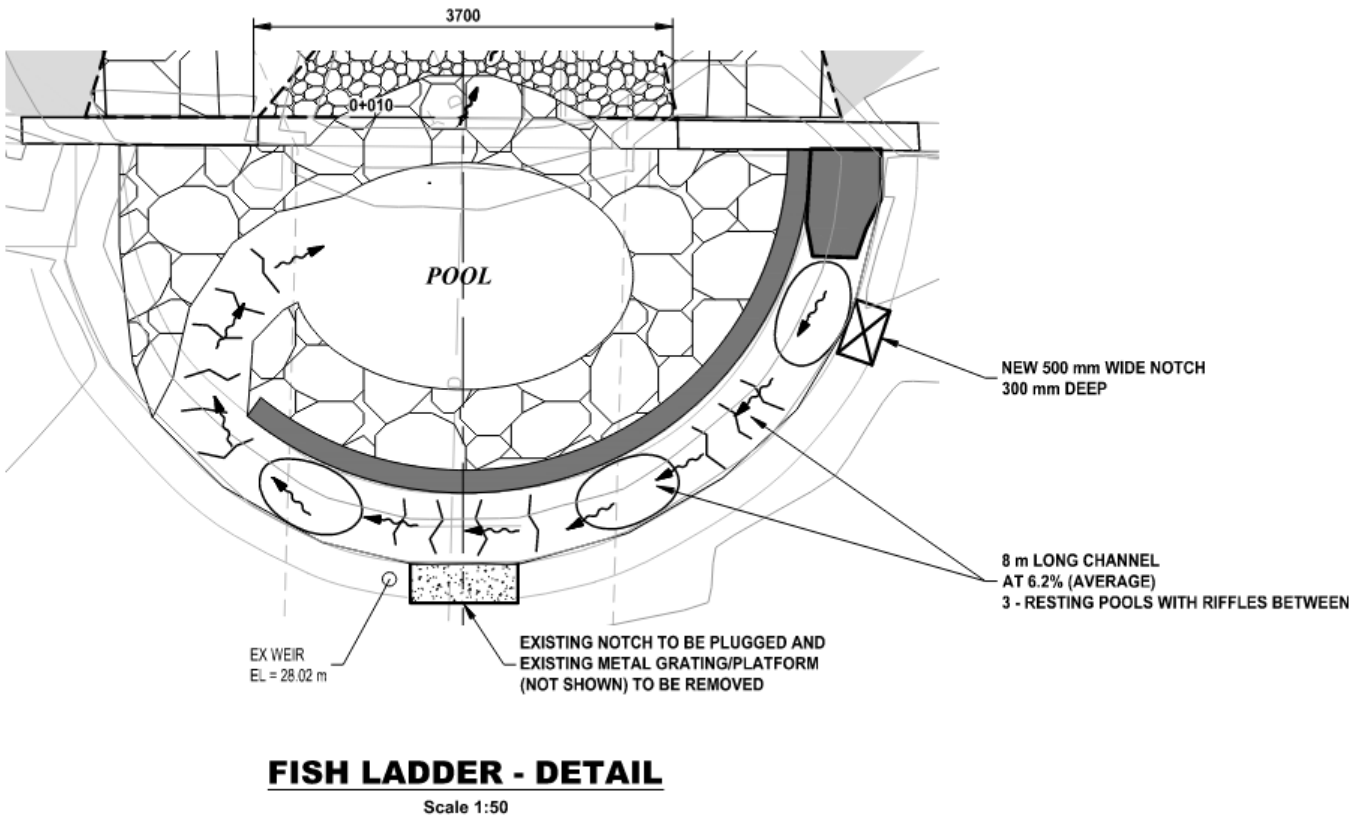
- Guichon Creek is home to Salmonids and juveniles are released into the creek each year
- Spawners have been observed in the culvert and as far up as the old weir
- Steepness (13%) of the new culvert required thoughtful design of the baffles
- Darkness of fully enclosed storm infrastructure is not a deterrent
- Custom pre-cast concrete box culverts

Weir / Fish Ladder Existing Condition

Barrier to fish passage and access to habitat in the upstream naturalized reaches

Weir / Fish Ladder Retrofit

Retrofit Concept



FISH LADDER - DETAIL

Scale 1:50

CONSTRUCTION & IMPLEMENTATION

How Did a Culvert Repair Turn Into a Creek Daylighting Design?

2015 – Condition Assessment

The culvert was flagged as Class 4 and Class 5 for replacement

May 2018 – Campus Development Plan

BCIT created a Campus Plan that reimagined the building layout to support a new alignment of Guichon Creek

Mid-2018 – Campus Design Guidelines

KWL started to work with BCIT to support their design guidelines (with PFS) specific to the campus

2021-2022 – Flow Monitoring

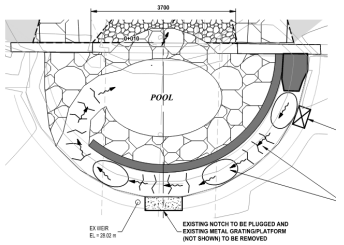
BCIT started flow monitoring to support the design guidelines and the stormwater strategy

2023 – Stormwater Strategy

KWL Completed the Stormwater Strategy for the Campus highlighting Guichon Creek as the Campus backbone

Feb 2023 – Sinkhole Appeared

Apr 2023 – Design Team Engaged



Design team was brought on, which included KWL, McElhaney, to support response

Jul 2023 – Design Completed

IFC Drawings Complete, Contractor Hired, Permits Obtained, Custom Culvert Ordered (8 weeks lead time)

Sep 2023 – Jan 2024 – Construction

Construction occurred outside of the least risk work fish window due to public risk

2024 – Completion

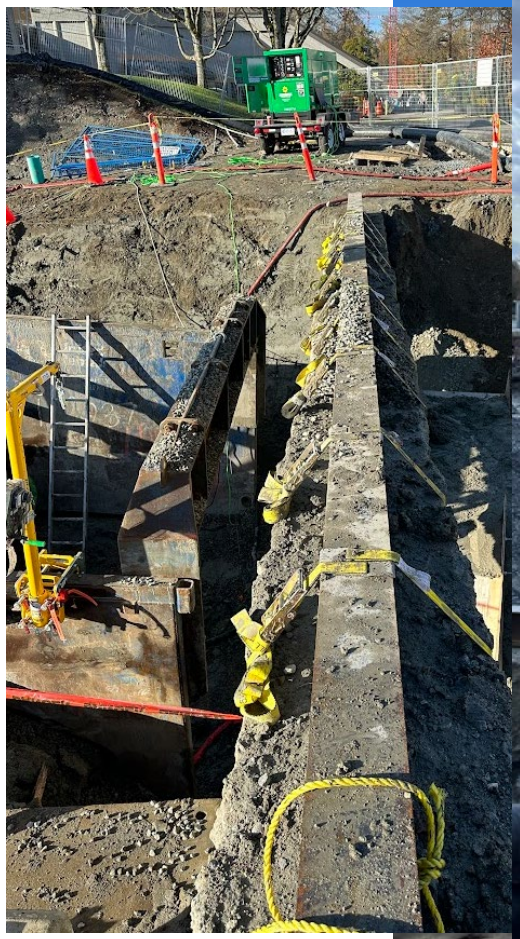
Work Completed by Others

Work Completed by BCIT

Work Completed by KWL

Sinkhole to Fishway Implementation Challenges

- Maintaining Fire Access
- Accommodating concrete encased duct bank
- Watermain and hydrant removed and restored
- Code Blue (campus safety systems)
- Guichon Creek – Winter Construction and flow bypass (10-year = 10m³/s)

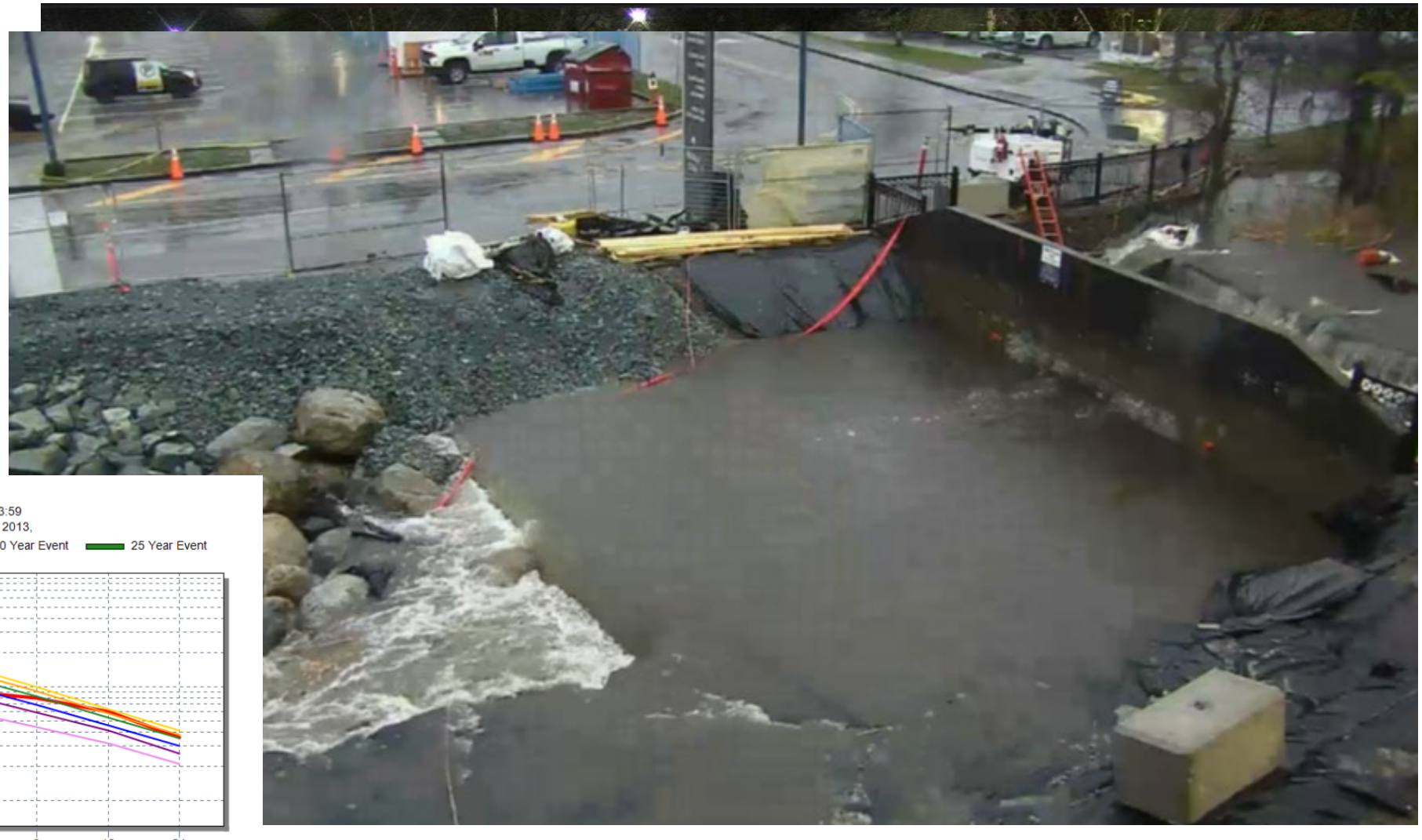


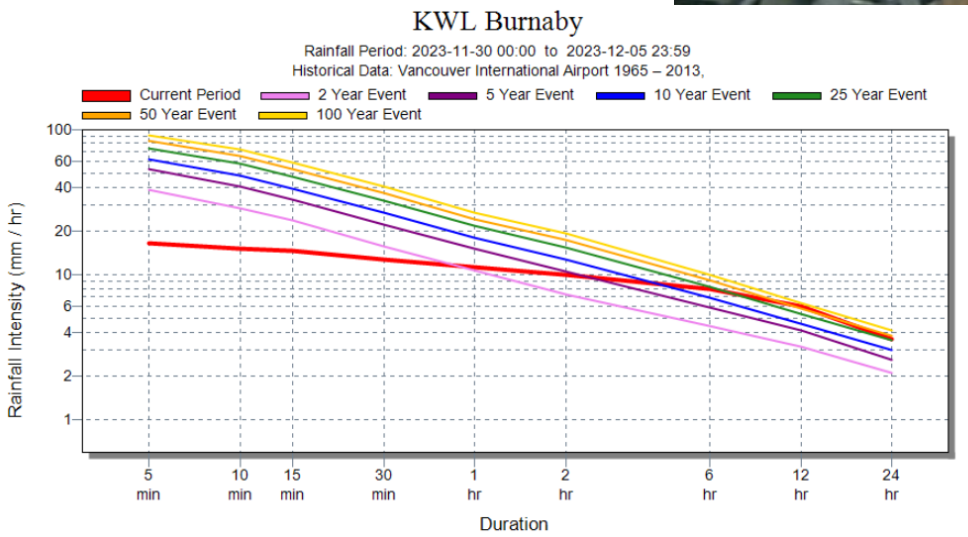
Creek Bypass – Winter Construction

- Creek was constructed in Nov/Dec due to emergency response
- Expected bypass flow rates of 10 m^3/s (10-yr) and greater
- Team worked collaboratively to implement a bypass channel connecting the active creek to the downstream culvert:
  - Coffer dam to divert the creek into the bypass channel upstream of active site
  - Five (5) electric pumps in the creek with capacity of ~1cms
- Design for engineered failure

Bypass Performance

- December 4, 2023 (during active construction) Burnaby experienced a 50-yr design storm event (90mm in 12hours)
- The bypass was able to convey the creek flow with minimal impacts to the site





Creek Construction

Weir / Fish Ladder Construction

Sinkhole Today

- **Improved flood capacity, climate resilience**
- Reinstated fish access (salmon are coming up to the weir)
- Increased riparian area
- Improved public realm and provided educational opportunities (living labs) for the campus

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An Innovative Success Story

- The extensive planning work allowed for the emergency response to be executed effectively
- Continue to leverage opportunities to daylight the creek in stages through campus as a part of campus planning and redevelopment
- Guichon Creek daylighting shows that creek restoration in urban areas is possible
- The daylit creek is a piece of stormwater infrastructure that serves as a precedent for next steps for campus daylighting and improvements

Thanks to the Project Team!

KERR WOOD LEIDAL

Consultant – Design Lead

MCELHANNEY

Project Managers
Environmental Services

PCL CONSTRUCTION

Construction Managers

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