



To: **Bowker Creek Initiative c/o Capital Regional District** Date: **March 31, 2020**
Attention: **Jody Watson** Project No.: **32297**
Cc:
Reference: **Potential Stormwater Management Facilities on Bowker Creek**
From: **Ian McKinnon, P.Eng.**

1.0 Introduction

As an extension to the Bowker Creek Daylighting Feasibility Study, ISL Engineering and Land Services (ISL) was retained to conduct an overview assessment of two potential stormwater management facilities (SWMFs) along Bowker Creek. This included hydraulic modeling to determine the flood mitigation benefits of the potential SWMF and preparing schematics to illustrate the possible integration of stormwater storage within the existing sites.

The two sites that were explored were:

- Richmond School, a site owned by the Greater Victoria School District (SD61), also located in the District of Saanich; and
- 2661 Richmond Road, a largely undeveloped site that the District of Saanich recently purchased from BC Hydro.

This assessment was carried out for the Bowker Creek Urban Watershed Renewal Initiative (BCI) c/o the Capital Regional District (CRD). The BCI is a joint initiative of the CRD, the City of Victoria, the District of Saanich, the District of Oak Bay, and local community groups. The primary purpose of developing SWMFs would be to mitigate existing downstream flooding risks and to mitigate the impacts of climate change. Where feasible, the SWMFs would also provide improved biodiversity and water quality along and in Bowker Creek, as well as improved amenity value for residents.

2.0 Background

A Bowker Creek Master Drainage Plan (MDP) was completed in 2007 on behalf of the BCI. The Bowker Creek MDP investigated: the flooding risks under several scenarios (including existing and future land use), hydraulic upgrades to increase conveyance capacities, daylighting of piped reaches of Bowker Creek, development of SWMFs, and the potential effects of future climate change. The MDP proposed SWMF at multiple locations, including Richmond School and 2661 Richmond Road (referred to at the time as BC Hydro Lands).

The historic flooding areas along Bowker Creek are located downstream of the two potential SWMF sites, with the largest flooding area being between Haultain Street and Foul Bay Road. Urban redevelopment generally results in an increase in impervious area, which increases the runoff peak flows and volumes. Climate change is expected to increase the rainfall intensity during extreme rainfall events, which will further increase peak flows and exacerbate flooding risks.



3.0 SWMF Concepts

3.1 Richmond School

Richmond School has not been used as a full time community school for several years; currently, it is used as a temporary school while other nearby schools are undergoing renovations. The SD61 has not committed to a long-term use for the school, but it is expected to remain in use based on current enrollment.

The site is currently divided by Bowker Creek (open channel) which runs northwest to southeast. The creek is fenced off from the school for safety reasons. The triangular parcel southwest of the existing creek was suggested as a SWMF in the MDP but was considered too small to be effective in mitigating downstream flood risks (area is a 100m x 100m triangle). At the south boundary of the property, the creek enters a storm sewer at Spirit Garden, a City of Victoria owned property that has a high potential for daylighting and active transportation connectivity.

The southwest section of the site is generally flat, the northeast is approximately 1-2m higher (includes school buildings) than the southwest part. Both the southwest and northeast sections each have a soccer field and baseball backstop. The two sections are connected by an existing pedestrian bridge.

A sanitary trunk sewer runs parallel to the creek (northwest to southeast direction) which will have to be considered in the design.

The proposed concept for developing a SWMF within the existing school site is summarized below.

- The creek would be re-aligned to the southwest to increase the green space available for school playing fields.
- The creek would be naturalized with a slight meander, boulders, woody debris, and native plant species. Flow velocities would be reduced to limit erosion potential.
- The lower portion of the SWMF would be low lying along the creek and would be inundated during frequent storm events (~2 year). This area would be fenced from the school and naturalized with suitable riparian plants.
- The green space between the re-aligned creek and the school buildings would be developed as a dual-use dry pond; it would have a net increase in green space available for playing fields; the playing fields would flood during infrequent storm events (~25 year).
- The existing bridge crossing could be maintained via a new pedestrian bridge or open bottom culvert.
- A granular walking path and multi-use path (MUP) could be constructed alongside the creek; to maintain or improve active transportation connectivity between Townley Street and Newton Street.

Schematics for this site are shown in Exhibits 3.1 and 3.3. Illustrations of stormwater dry ponds in Edmonton are shown below.



Dual use dry ponds on school sites in Edmonton, AB

3.2 2661 Richmond Road

This site was recently acquired by the District of Saanich from BC Hydro. The District does not have official plans for the site but may select to develop part or all of the site into a park. There is strong public support for designated park use, including a community group (Kings Road Community Nature Green Space). At this time, the District has not started any park planning activities.

The site generally falls from the north to south and drops about 3 to 4 m over 200 m length. Bowker Creek is open channel running along the southwest edge of the parcel flowing in southeasterly direction. The creek is straight and runs parallel and close to the private property boundary to the southwest. The creek has steep banks that are susceptible to erosion.

The site is bordered by Kings Road to the north and Haultain Street to the south; both are dedicated as City of Victoria People Priority Greenways (west of Richmond Street). It is understood that improvements to the Haultain Street bicycle facilities are being coordinated between the City of Victoria and the District of Saanich.

The proposed concept for constructing a SWMF as part of a future park development is summarized below.

- The existing parcel would be divided into thirds:
 - the bottom (southern) third would be a low lying naturalized area along the creek that would be inundated during frequent storm events (~2 year);
 - the middle third would be turf grass for casual park use but would be inundated during infrequent storm events (~25 year); and
 - the northern third would be park space that is not part of the SWMF.
- The creek would be re-aligned at the south to provide a more natural setting; naturalize the south end with boulders and woody debris; riparian plants in lower area would be suitable for frequent inundation.
- A granular trail would be developed along the creek to connect Haultain Street to the south (connecting to informal path to Royal Jubilee Hospital) with Richmond Road to the west (with connection to Spirit Garden via existing sidewalks).
- A MUP could be constructed to improve active transportation connectivity between Haultain Street to the south and Kings Street to the north.



- Pedestrian bridges and/ or open bottom culverts may be considered to integrate the existing and proposed pathways.
- To maximize the available storage volume, it will be necessary to construct a south berm approximately 1m above the existing ground elevation. It is anticipated that some of the material excavated to create the SWMF could be reused for the berm.

Schematics for this site are shown in Exhibits 3.2 and 3.4.

4.0 Hydraulic Modeling Analysis

4.1 Model Set Up

The hydraulic model from the MDP was obtained for the Bowker Creek Daylighting Feasibility Study and was used to assess the two potential SWMF sites. The 2-year, 25-year and 100-year storm events (24 hour duration) were simulated. A total of four scenarios were simulated:

- Scenario 1: Existing conditions;
- Scenario 2: Richmond School SWMF only;
- Scenario 3: 2661 Richmond Road SWMF only; and
- Scenario 4: Both SWMFs operating together.

The SWMF concepts shown in Exhibits 3.1 to 3.4 were modeled. In both cases the SWMF includes a lower section that will be utilized for stormwater storage more frequently, with the higher section inundated less frequently. The Richmond School and 2661 Richmond Road SWMF have an estimated storage capacity of 36,000 m³ and 16,000 m³, respectively. The proposed high water level (HWL) elevation was based on being below the lowest adjacent ground elevation.

As these SWMF are “in-stream” facilities, they were modeled without a control structure that would typically be used for an off-line SWMF. The downstream hydraulics will determine how much stormwater is stored in the SWMF, and how much is discharged downstream. In the event that the hydraulic capacity is increased downstream (by daylighting or upsizing of storm sewers), the effectiveness of the SWMF flood mitigation could be maintained through the addition of control structures. As previously noted, it will be necessary to raise some of the low lying lands at the south end of 2661 Richmond Road site by about 1m.

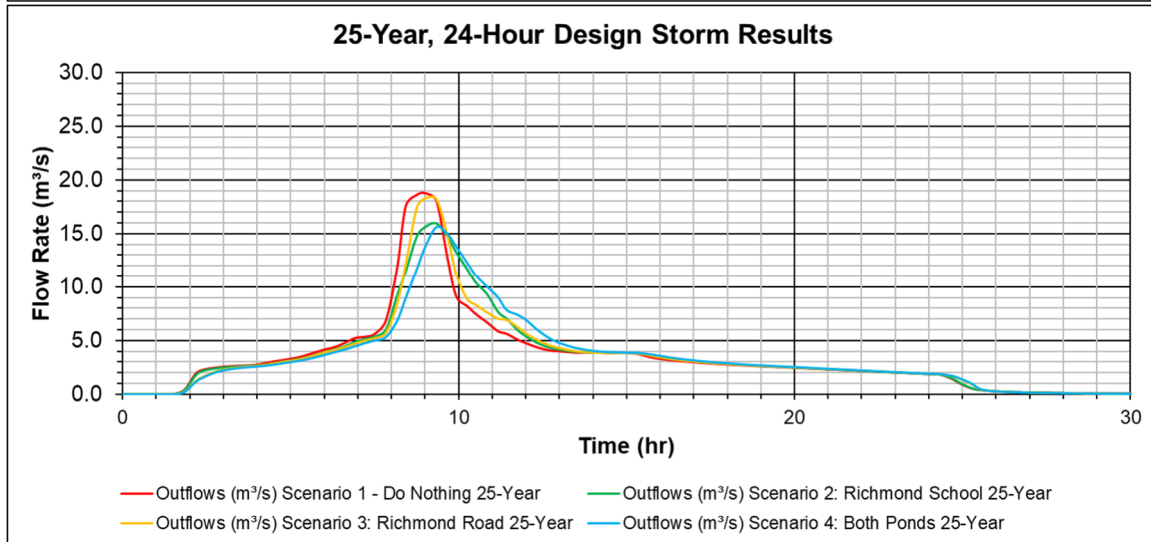
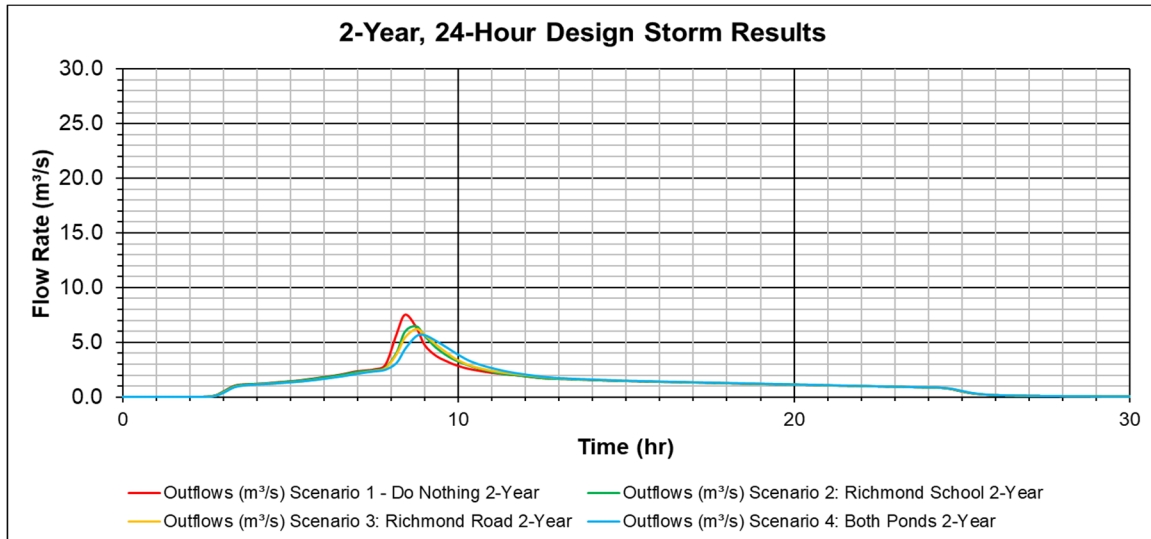
4.2 Modeling Results

The hydraulic modeling results are shown in Table 4.1 to 4.3 and Figure 4.1 below. The downstream impact of the two SWMFs is shown at Haultain Street in Table 4.1 and Figure 4.1. The impact of the Richmond School SWMF is clear with a reduction in the downstream peak flow of about 15% for all storm events, while the 2661 Richmond Road SWMF is only effective during the 2-year event. The 2661 Richmond Road SWMF also provides little or no benefit when combined with the Richmond School SWMF during infrequent storm events (25-year and 100-year).



Table 4.1 Peak Discharge Rate at Haultain Street

	Peak Discharge at Haultain Street (m ³ /s)		
	2-Year	25-Year	100-Year
Scenario 1: Do-Nothing	7.49	18.77	23.89
Scenario 2: Richmond School SWMF	6.46	15.97	20.29
Scenario 3: 2661 Richmond Road SWMF	6.21	18.30	23.68
Scenario 4: Both SWMF	5.62	15.60	20.97



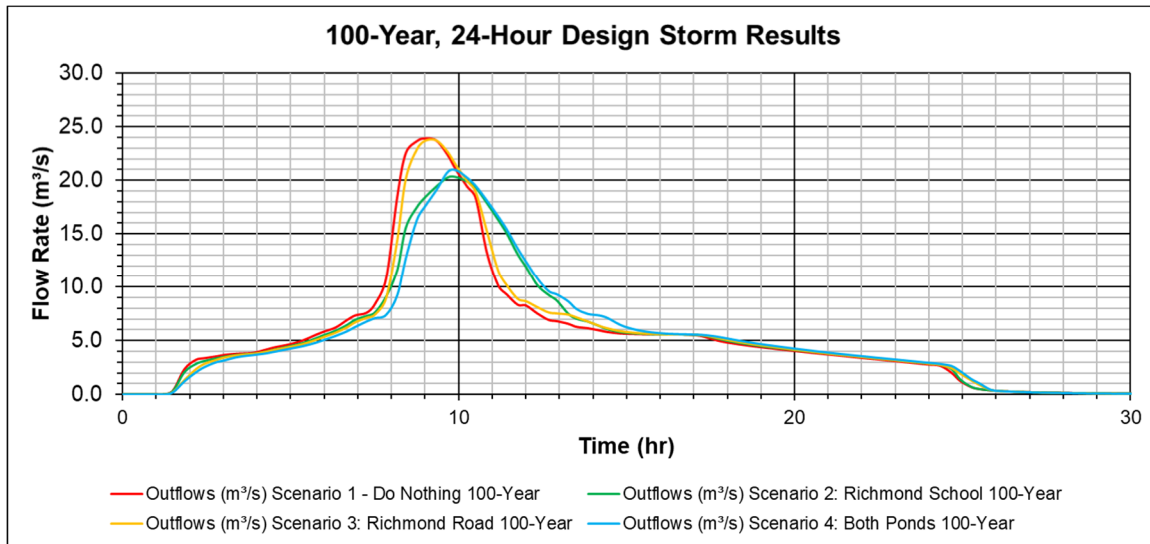


Figure 4.1 Discharge at Haultain Street

Similar results are shown for the downstream system at Trent Street, refer to Table 4.2. Trent Street has the highest risk of flooding as Bowker Creek enters a storm trunk immediately downstream of this location. The MDP noted extensive flooding in this area.

Table 4.2 Peak Discharge Rate at Trent Street

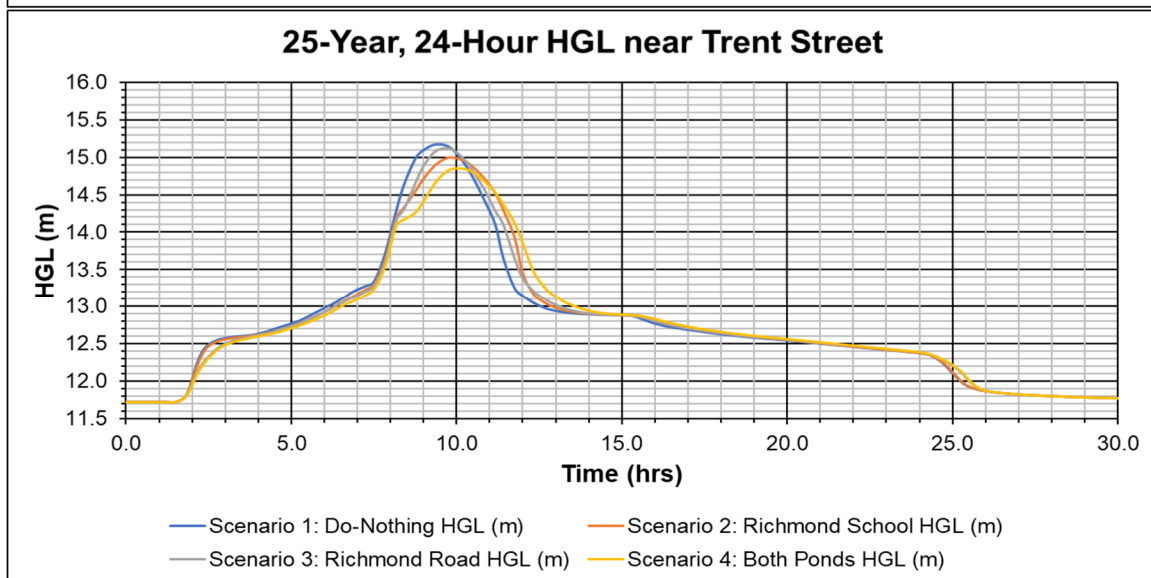
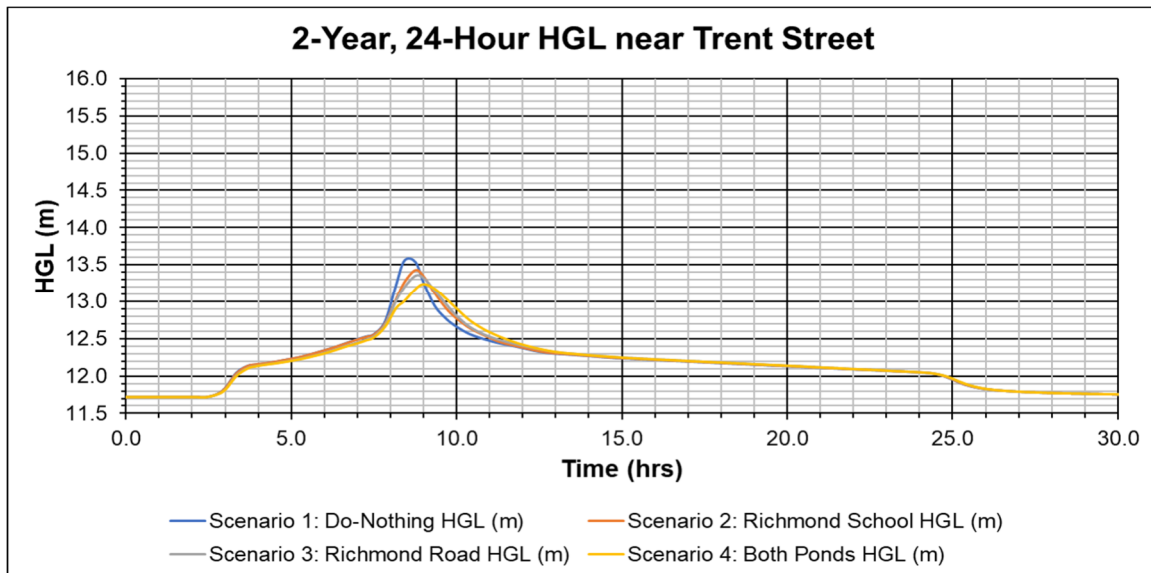
	Peak Discharge at Trent Street (m ³ /s)		
	2-Year	25-Year	100-Year
Scenario 1: Existing Conditions	7.41	16.86	24.00
Scenario 2: Richmond School SWMF	6.81	14.20	20.60
Scenario 3: Richmond Road SWMF	6.41	15.73	23.67
Scenario 4: Both SWMFs	5.88	13.67	20.77

Table 4.3 and Figure 4.2 show the maximum simulated hydraulic grade line (HGL), or high water level, at Trent Street. While the high water level only drops about 0.3m due to the SWMF, it can still represent a significant reduction in the surface area flooded. As noted in the MDP, there is limited benefit provided by the SWMFs during a 100-Year event. To fully address the downstream flooding risk, downstream trunk upgrading and/or daylighting may be required along with additional upstream storage (e.g. UVic, Lansdowne School).



Table 4.3 Maximum Hydraulic Grade Line at Trent Street

	Maximum HGL (m) at Trent Street		
	2-Year	25-Year	100-Year
Scenario 1: Existing Conditions	13.56	15.17	15.37
Scenario 2: Richmond School SWMF	13.42	14.99	15.28
Scenario 3: Richmond Road SWMF	13.35	15.12	15.35
Scenario 4: Both SWMFs	13.24	14.85	15.28



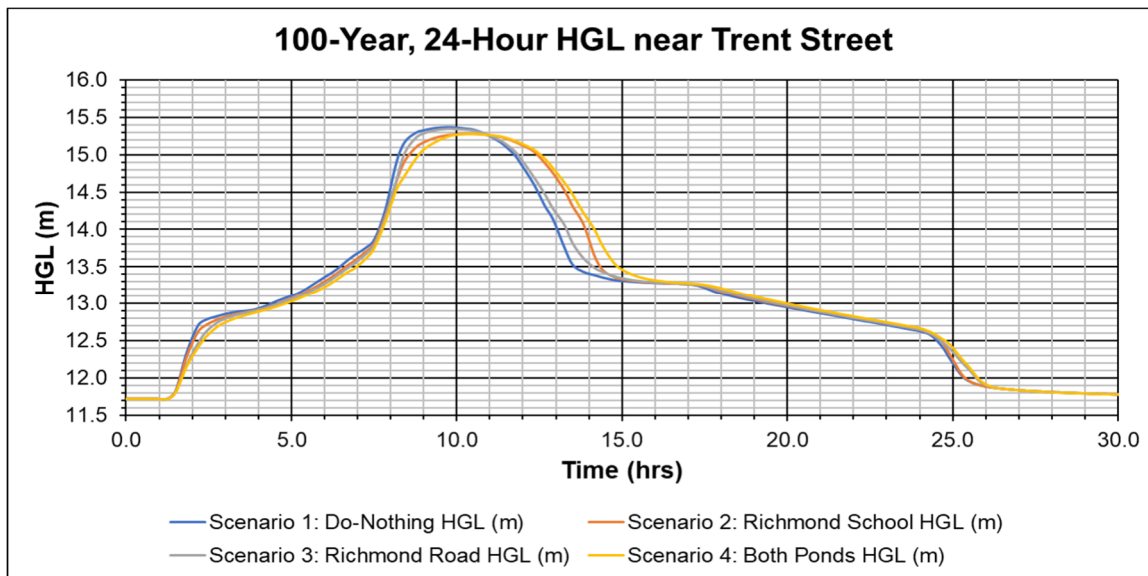


Figure 4.2 Simulated Water Level at Trent Street

Based on these results, the SWMFs appear to be useful at reducing the flooding impacts during moderately infrequent storm events (2-year and 25-year) but not particularly useful during very infrequent events (100-year). This is consistent with the finding of the previous MDP analysis. As noted in the Bowker Creek Daylighting Feasibility Study, it will be necessary to develop upstream SWMFs to mitigate the impact of very high flows during a 100-year event. However, the benefits provided during moderately infrequent events should be recognized and may justify the investment on an annualized flood damage basis.

4.3 Impact to Richmond School Playing Fields

The use of dual-use SWMF on school sites in new to greater Victoria and concerns were expressed during the project workshops about the impact of these facilities on the community’s use of the playing fields. The depth and duration of flooding was simulated using the hydraulic model. The results of the analysis are shown in Figure 4.3. The playing fields are at an elevation of about 16.4m, and thus would only be impacted during infrequent storm events (less than about once every two years). During infrequent storm events (25-year and 100-year), the field would be flooded for less than 24 hours. Similar results were found for the 2661 Richmond Road site. The impact of climate change (refer to Section 4.4 below) on the depth and duration of flooding is also shown in Figure 4.3.

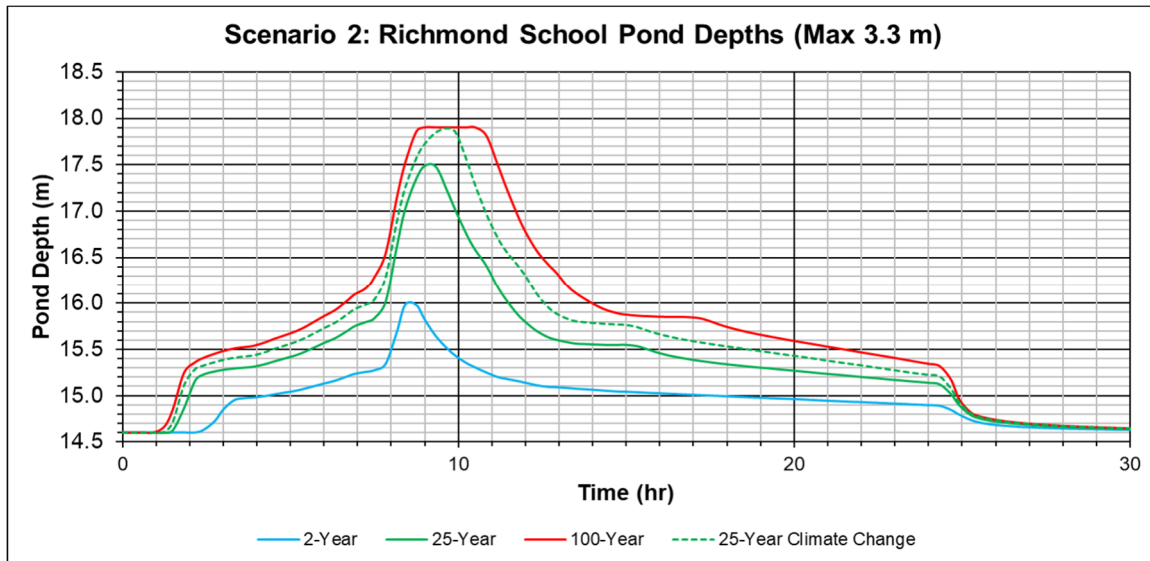


Figure 4.3 Simulated Water Level at Richmond School SWMF

4.4 Climate Change Consideration

Climate change is expected to increase rainfall intensity in the future, which will negatively impact existing the risk of flooding within existing stormwater drainage systems. The potential SWMF could offset the impacts of climate change through reducing the downstream discharge rates and water levels.

To assess the potential effectiveness of the SWMF of mitigating the impacts of climate change, hydraulic modeling was carried out for the Richmond School SWMF considering both existing rainfall patterns and future climate change conditions. The future climate change rainfall conditions was based on the 2100 climate change model using historical rainfall data from the Gonzalez rain gauge.

Four scenarios were considered in this analysis:

- Scenario 1: Do-Nothing (existing system hydraulics) with existing rainfall
- Scenario 1B: Do-Nothing with 2100 Climate Change
- Scenario 2: Richmond School SWMF with current rainfall
- Scenario 2B: Richmond School SWMF with 2100 Climate Change

The results are shown in Table 4.4 and Figure 4.4.

Table 4.4 Climate Change Analysis for Richmond School SWMF

	25-Year Peak Discharge at Haultain St
Scenario 1: Do-Nothing	18.77
Scenario 1B: Do-Nothing Climate Change	21.20
Scenario 2: Richmond School SWMF	15.97
Scenario 2B: Richmond School SWMF with Climate Change	17.94

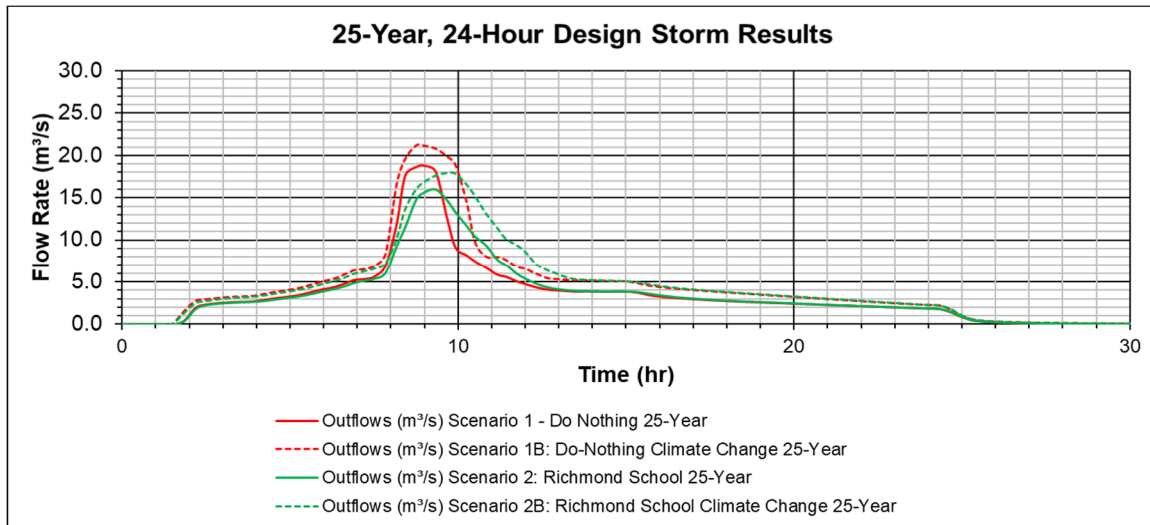


Figure 4.4 Climate Change Analysis for Richmond School SWMF – Peak Flows at Haultain Street

The hydraulic analysis illustrates that the potential Richmond School SWMF provides excellent climate change adaptation through reducing the 25-year 2100 climate change peak flow to below the current 25-year peak flows.

5.0 Cost Estimates

The estimated costs to design and construct the SWMFs, based on the concepts provided, are shown in Table 5.1.

Table 5.1 Estimated Costs of the Potential SWMFs

No.	Description	Richmond School SWMF (\$)	2661 Richmond Road SWMF (\$)
1	Environmental Protection (ESC and Bypassing)	125,000	125,000
2	Excavation	1,000,000	600,000
3	Naturalization (Gravel, Boulders, LWD)	200,000	200,000
4	Pathway – Gravel	25,000	29,750
5	Pathway – Asphalt	108,000	127,500
6	Trees, Shrubs, and Plants	250,000	225,000
7	Sodding	350,000	150,000
8	Fencing	75,000	0
9	Pedestrian Bridge	25,000	25,000
10	Site Furniture (Benches and Signs)	25,000	50,000
11	Sports Fields/ Field Drainage	150,000	0
	Subtotal	2,333,000	1,532,250
	Contingency (50% of Subtotal)	1,166,500	766,125
	Engineering/ Environmental (10% of Subtotal)	233,300	153,225
	Total	3,732,800	2,451,600



6.0 Discussion and Next Steps

There appears to be very good synergy between the two SWMF sites in reducing flooding risks and improving the environmental and recreational value. These projects align well with the goals and objectives of the Bowker Creek Urban Watershed Renewal Initiative. Specific benefits include:

- Reduction in peak flows conveyed downstream during infrequent storm events (2-year and 25-year);
- Reduction in high water levels in critical downstream flooding areas;
- Increased riparian areas along Bowker Creek, increasing biodiversity;
- Improved water quality in Bowker Creek;
- Enhanced recreational amenities along Bowker Creek for residents and trail users;
- Development of park space at 2661 Richmond Road as promoted by the District of Saanich and a local community group; and
- Enhancement of the Richmond School site with a net increase in playing field areas.

The potential next steps for this initiative may include:

- Obtain approval in principle from BCI stakeholders, and in particular, the CRD, District of Saanich and SD61;
- Seek funding opportunities from various levels of government; and
- Carry out conceptual design to refine estimated construction costs.

7.0 Closure

Thank you for the opportunity to conduct this assessment on behalf of the BCI and its partners. Please contact me if you have any questions regarding the findings.

Sincerely,

ISL Engineering and Land Services Ltd.



Ian McKinnon, P.Eng.
Project Manager

Attachments:

Exhibit 3.1 Potential SWMF at Richmond School – Plan View

Exhibit 3.2 Potential SWMF at 2661 Richmond Road – Plan View

Exhibits 3.3/ 3.4 Potential SWMFs at Richmond School and 2661 Richmond Road – Section View



LEGEND	
SYMBOL	DESCRIPTION
	REALIGNED BOWKER CREEK
	GRANULAR PATH
	MUP
	PEDESTRIAN BRIDGE
	FENCE

BOWKER CREEK DAYLIGHTING FEASIBILITY STUDY
POTENTIAL STORMWATER MANAGEMENT FACILITY AT RICHMOND SCHOOL

PLAN VIEW
2020-02-14





LEGEND	
SYMBOL	DESCRIPTION
	REALIGNED BOWKER CREEK
	GRANULAR PATH
	MUP
	PEDESTRIAN BRIDGE



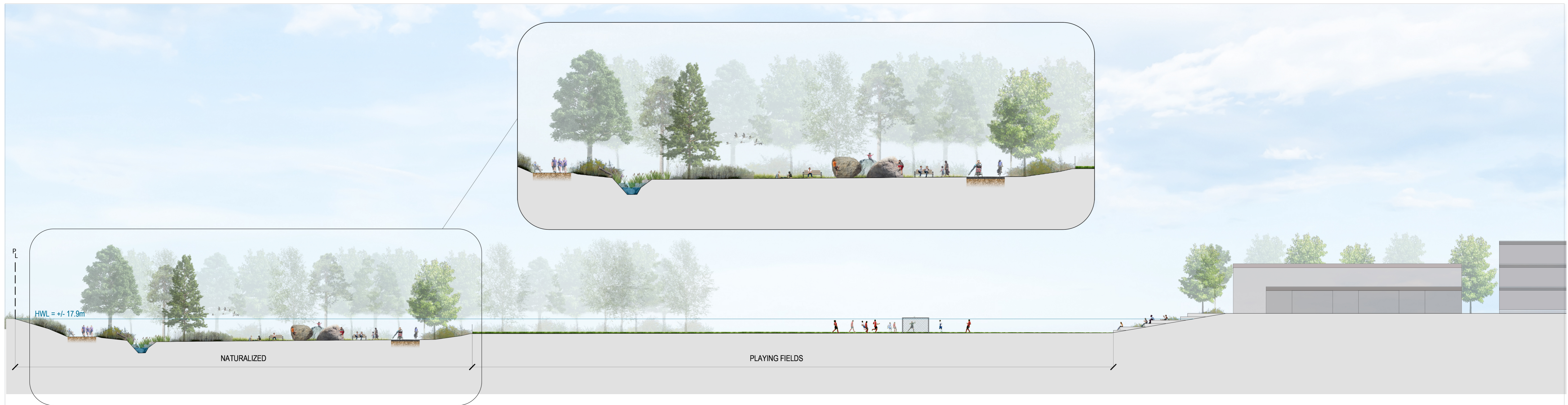


EXHIBIT 3.3 - RICHMOND SCHOOL

Scale 1:500
 0 5 25m

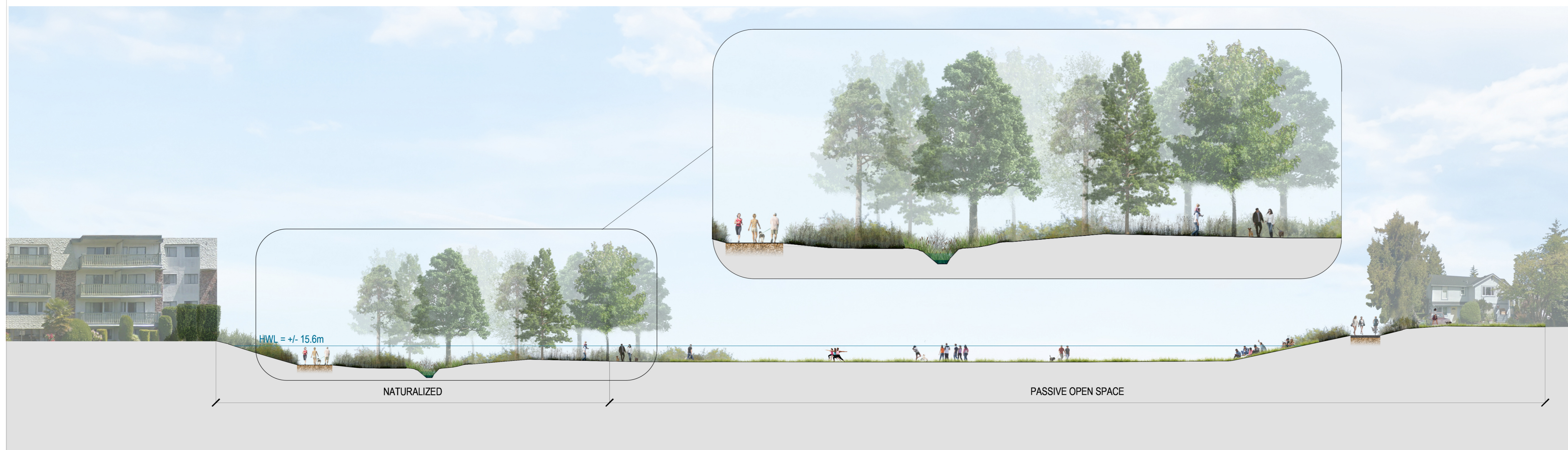


EXHIBIT 3.4 - 2661 RICHMOND ROAD

Scale 1:500
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