KERR WOOD LEIDAL
associates limited
CONSULTING ENGINEERS
201 - 3045 Douglas Street
Victoria, B.C.
V8T 4N2
250-595-4223 P
250-595-4224 F
www.kwl.ca

Technical Memorandum

DATE: June 3, 2011

TO: Jody Watson, Capital Regional District

CC: Scott Murdoch

FROM: Craig Sutherland, P.Eng.
Dave Murray, P.Eng.

RE: **CAPITAL REGIONAL DISTRICT**
Bowker Creek at Oak Bay High School – Stream Rehabilitation Concept Design
Our File : 283.329

INTRODUCTION

The Capital Regional District (CRD) with support from the Municipality of Oak Bay and the Greater Victoria School District No. 61 (SD No. 61) has started planning and seeking funding to implement a restoration project on the section of Bowker Creek adjacent to Oak Bay High School as part of the re-development of the high school property. This conceptual design memorandum outlines the objectives, design criteria, major design elements, concept level cost estimate, and implementation for the proposed rehabilitation project.

Background

The Bowker Creek watershed, which lies within the Municipalities of Saanich, Victoria and Oak Bay, is a 1,028 hectare urban watershed which has been impacted by development and historical drainage improvement projects. However, despite the changes in the watershed, Bowker Creek is still used by people and wildlife; and maintains some of it's natural characteristics. In 2003, the Bowker Creek Watershed Management Plan was initiated by several parties including the municipalities and the local stewardship group, the Bowker Creek Imitative (BCI). Though the planning process the vision for the Bowker Creek Watershed is:

> *The varied human uses and natural areas in the Bowker watershed are managed to minimize runoff and pollution, making Bowker Creek a healthy stream that supports habitat for native vegetation*

and wildlife, and provides community greenway to connect neighbourhoods.

Throughout the planning process, a set of four watershed goals were developed. One goal is to improve and expand public areas, natural areas and biodiversity in the watershed. This is to be achieved through protecting and enhancing existing natural area (or areas with restoration potential) in the watershed, and by creating a multi-use corridor from the headwaters to the ocean as part of a regional greenway system.

One of the specific projects identified in the plan was to restore the section of Bowker Creek that runs adjacent to Oak Bay High School. The primary objectives of this proposed restoration are too:

1. Improve both stream and riparian habitat along that section of the creek;
2. Improve the existing trail along the creek to connect with a proposed Bowker Creek greenway system;
3. Improve drainage by improving flood flow capacity; and
4. Provide stream health education opportunities for both the high school students and the public.

Based on these objectives, a conceptual design has been developed.

Scope of the Study

Kerr Wood Leidal Associates Ltd. (KWL) has been retained by CRD to complete a conceptual design and cost-estimate for the proposed creek rehabilitation works. The scope of the work included:

1. Site visit to review site conditions and discuss design objectives with CRD Staff;
2. Collection of background information and plans relating to the creek;
3. Preparation of a draft concept plan for review;
4. Design review meeting with CRD Staff, Oak Bay High School Design Team, and Municipality of Oak Bay Staff; and
5. Preparation of concept plan and design memorandum.

KWL partnered with Murdoch de Greeff Inc., who provided landscape architecture and riparian habitat input to the plan.

Location

The proposed rehabilitation project is located on Bowker Creek, adjacent to the Oak Bay High School Property. The project runs downstream from the existing arch culvert which passes under the Oak Bay Recreation Centre Tennis Courts (Tennis Bubble) to the upstream end of

Bowker Creek Park (see Figure 1). This reach of the creek is identified as Reach 4 in the Bowker Creek Master Drainage Plan and the Bowker Creek Blue Print. Along this reach the creek generally runs from west to east, with the Oak Bay High School property to the south and a running track to the south.

From the outlet of the arch culvert at the upstream end of the project site, the creek passes through a relatively short concrete channel section before passing through two short box culvert sections which form a foot bridge over the creek (see Photo 1 in Appendix A). Downstream of this foot bridge, the creek channel makes a very sharp turn to the left, when looking downstream, before flowing into a 3.5 m to 4 m deep gully or ravine. The ravine is bounded on the right bank, or south side, by a 3.5 m to 4.0 m high concrete retaining wall which runs adjacent to the running track (see Photos 2 and 3). The north bank of the creek is formed by a steep slope covered with yellow willow, young cotton wood and Himalayan blackberry.

Some precast concrete lock blocks have been placed on the left bank near the downstream end of the project area. We understand from conversation with municipality of Oak Bay staff that these lock blocks were placed to protect the slope from erosion that was occurring along that section.

Except for the sharp bend immediately downstream of the foot bridge, the creek channel runs in a straight alignment along the foot of the concrete retaining wall. The channel is quite flat with a slope of about 0.4%. Downstream of the study area, the creek flows into an open channel flume lined by grouted rock walls (see Photo 4).

Existing utilities in the area include an inverted egg shaped trunk sanitary sewer which crosses the creek alignment under the creek near the upstream end of the site and connects to a manhole located in the centre of the running track field to the south of the creek. Downstream of this manhole the sanitary sewer turns north-east and passes under the creek again near the downstream end of the project site. From available record drawings provided by CRD, the top of the sewer is expected to be about 1.0 m below the current invert of the creek. In addition to the sewer, two existing watermains cross the creek to fire hydrants located on the north side of the creek in the Oak Bay high school property. The size and depth of these lines is unknown. The approximate location of the existing utilities is shown in Figure 1 but would need confirmation prior to construction.

DESIGN CONCEPT

Design Criteria

Based on these objectives outlined in Bowker Creek plan outlined above, a series of design criteria have been developed which provided guidance to in development of the conceptual plan. These include:

Improve both stream and riparian habitat along this reach of the creek

- improve channel complexity using a meandering channel alignment, a low flow channel with upper flood benches and in-stream complexing;
- remove invasive species in the riparian area and replant channel banks with native species;
- reduce the slope of the ravine banks to reduce potential of erosion and enhance creek access; and
- increase the width of the riparian zone within the overall limits of the high school redevelopment plan (approximately 20 m wide).

Improve existing trail along the creek to connect with the proposed Bowker Creek greenway system

- include a multi-use trail to align with plans for a regional greenway adjacent to the creek;
- include viewing opportunities to see the creek from the multi-use trail; and
- incorporate items which will reduce on-going maintenance requirements.

Improve drainage by improving flood flow capacity

- provide sufficient flood flow capacity for future flows in accordance with the Bowker Creek Master Drainage Plan (25-year return period, 15 minute peak instantaneous flow); and
- provide appropriate erosion protection to protect existing utilities and infrastructure from erosion.

Provide public opportunities for stream health education

- provide formal universal access within channel ravine for student and public access to the creek (not too be flooded during 25-year flood event);
- protect the enhanced riparian area from informal access;
- provide an opportunity for safe access creek channel during low flow periods; and
- install public information boards and public art promoting stream health.

In general the proposed project objectives meet those outlined in the Bowker Creek Blueprint report for Reach 4, with the exception of removal of the footbridge and concrete lined channel downstream of the arch culvert under the tennis bubble. These structures provide strong erosion protection for the high flow velocities in this area during large flow events. In addition, the concrete wall on the left bank (north side) protects the existing manhole which provides access to the truck sanitary sewer below.

Hydraulic Assessment

Based on a review of the Bowker Creek Master Drainage Plan, a series of hydraulic design parameters were developed for the conceptual design. These are outlined in Table 1.

Table 1: Hydraulic Design Criteria

	Preliminary Value
Hydraulic Criteria	
25-year return period, 15 min. peak flow (Trent Street)[1,2]	32.5 m^3/s
Design Flow Depth (excluding freeboard)	2.0-2.5 m
Design Velocity	2.0-2.5 m/s
Channel Design Criteria	
Low flow channel	2.5 m wide, 0.5 m deep
Left bank side slope	2.0 to 2.5 H to 1 V
Right bank planting bench	2.5 m wide
Channel gradient (maintain existing grade and elevation)	0.4%
Meander wave length	about 35.0 m

Notes:
1. Bowker Creek MDP Table 4-25, Scenario 6, future land use, daylighted stream.
2. Note that 25-year is the design standard adopted by the core municipalities for the MDP and should be reviewed at detailed design stage.

These parameters are considered sufficient information for conceptual design. However, it is recommended that further detailed hydraulic analysis be carried out as part of the detailed design phase to calculate appropriate design parameters for detailed design of channel and riparian features.

Proposed Design Concept

The proposed design concept is shown in Figures 2 and 3. The major components of the design include:

1. A meandering 2-2.5 m wide stream channel designed to carry low flows;
2. Channel ravine with 4 m wide bottom designed to handle larger flood flows;
3. Erosion protection provided using bioengineering treatments, channel toe rock, and cobble rock bench areas;
4. Low rock weirs providing energy dissipation, grade control and channel complexing;
5. Left bank slope of 2.5:1 (H:V) with a 2 m wide terrace;
6. Universal access path along the left bank slope to a 15 m x 6 m viewing/educational terrace;
7. Stairs from a viewing/educational area to the top of slope to provide circular traffic flow pattern; and

8. An upper viewing area adjacent to the multi-use trail to provide viewing opportunity to the stream from the upper trail which would include a handrail fitted with public education boards focused on watershed health.

The existing concrete retaining wall is required for the running track and can not be removed. However, it is proposed to construct planted floodplain benches along the toe of the wall to allow vegetation to grow. There is a concrete footing which extends approximately 2 m from the toe of the wall into the existing channel. This footing will have to remain in place to protect the structural integrity of the wall. It is proposed that the benches will cover this concrete toe and allow for planting of riparian vegetation along both sides of the channel.

Planting along the creek banks and upslope area would consist of native riparian and upland vegetation including species such as: bigleaf maple (*Acer macrophyllum*), red alder, (*Alnus rubra*), Pacific crab apple (*Malus fusca*), Garry oak (Quercus garryana), bitter cherry (*Prunus emerginata*), Douglas-fir (*Pseudotsuga menziesii*), western redcedar (*Thuja plicata*), vine maple (*Acer circinatum*), Douglas maple (*Acer glabrum*), saskatoon (*Amelanchier alnifolia*), red-osier dogwood (*Cornus stolonifera*), oceanspray (*Holodiscus discolor*), black twinberry (*Lonicera involucrata*), Indian plum (*Oemleria cerasiformis*), Pacific water-parsley (*Oenanthe sarmentosa*), mock orange (Coastal) (*Philadelphus lewisii 'Gordianus'*), Pacific ninebark (*Physocarpus capitatus*), cascara (*Rhamnus purshiana*), red flowering currant (*Ribes sanguineum*), nootka rose (*Rosa nutkana*), clustered wild rose (*Rosa pisocarpa*), Hooker's willow (*Salix hookeriana*), Scouler's willow (*Salix scouleriana*), Sitka willow (*Salix sitchensis*), red elderberry (*Sambucus racemosa*), hardhack (*Spirea douglasii*), common snowberry (*Symphoricarpos alba*), deer fern (*Blechnum spicant*), sword fern (*Polystichum munitum*), coastal strawberry (*Fragaria chiloensis*), beaked sedge (*Carex rostrata*), Sitka sedge (*Carex sitchensis*), sawbeak sedge (*Carex stipata*), common rush (*Juncus effusus*), dagger-leaf rush (*Juncus ensifolius*), cattail (*Typha latifolia*)

The primary focus of the planting design will be to provide riparian habitat and stream cover. However, in certain locations planting will be limited to low growing species to allow for viewing opportunities from the multi-use trail running along the top of the . One of these viewing areas will coincide with the lower education/viewing terrace. This will also improve public safety and security of the viewing area by improving site lines into the ravine.

COST ESTIMATE

Table 2 summarizes the concept design (Level-C) cost estimate for the project. The costs have been developed using standard unit costs, MDP unit costs and past project experience. The cost estimate should be considered preliminary and should be refined during the final design phase once more detailed information is available (geotechnical soil conditions, utility locations, etc.). A typical contingency of 20% has been added to the cost estimate to account for unforeseen items that may be identified as part of the detailed design phase.

Table 2: Conceptual (Level-C) Cost Estimate

Task	Cost
Mobilization/Demobilization/ Sediment & Water Control	$66,000
Channel/Ravine Construction	$187,200
Planting	$99,400
Park/Public Infrastructure	$57,500
Total Construction	**$410,100**
Detailed Engineering and Landscape Design/Environmental Monitoring	$123,000
Contingency (20%)	$82,000
TOTAL (rounded to nearest $1,000)	**$615,000**

RECOMMENDATIONS

The following items will need to be addressed prior to implementing the concept design:

1. Confirm the organization responsible for on-going maintenance of the site. The party responsible for on-going maintenance should be provided the opportunity to comment on final design details to ensure on-going maintenance items are addressed and annual maintenance costs and responsibilities area identified;

2. Obtain regulatory approvals including Water Act Section 9 "Works In and About a Stream Approval" from the Ministry of Environment. This typically requires at least 12 weeks notification prior to construction. Approval from the jurisdiction responsible for flood protection and drainage (typically the local authority which would be the District of Oak Bay); and possibly Canadian Environmental Assessment Act (CEAA) screening depending if project funding provided from a Federal source;

3. Conduct further detailed site investigations including geotechnical assessment, contaminated soils assessment, and archeological assessment to be carried out prior to completion of detailed design;

4. Review the location of the educational viewing area to ensure that the best viewing area is chosen and review the final alignment of the creek channel to allow for maximum planting along the exiting concrete retaining wall to screen it from the creek;

5. Complete detailed design including landscape design, hydraulic model update, erosion protection/bioengineering treatment details, path and viewing area construction details, detailed planting list and other final requirements; and

6. Consider not removing the existing footbridge and concrete lined channel downstream of the arch culvert under the tennis bubble at this time (Bowker Blueprint recommendation). It is possible that they would be removed as part of possible future works associated with removal of the arch culvert, when the opportunity arises. The future channel and riparian area could be easily tied into the proposed channel and riparian area.

CLOSING

If you have any questions or would like to discuss future development of the project, please contact the undersigned at (250) 595-4223.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by:

Craig Sutherland, P.Eng.
Water Resources Engineer

Reviewed by:

Dave Murray, P.Eng.
Manager, Water Resources Sector

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