SPERLING HANSEN ASSOCIATES

• Landfill Engineering
• Solid Waste Planning
• Environmental Monitoring
• Landfill Fire Risk Control

David Morel
Assistant Deputy Minister
Environmental Protection Division
Ministry of Environment and Climate Change Strategy
Office of the Minister
Parliament Buildings
Victoria BC V8V 1X4

cc. Tessa Graham, AJ Downie, ENV
Martin Block, Cobble Hill Holdings

Dear Mr. Morel,

Re: **Amendment to Cobble Hill Landfill Updated Final Closure Plan 2019**

Sperling Hansen Associates (SHA) is pleased to submit this amendment to the *Cobble Hill Landfill Updated Final Closure Plan 2019* for your review. The amendment has been prepared to provide information on additional monitoring wells that are being proposed downgradient of the landfill site to further increase our capacity to detect breaches in the cell encapsulation system, should those develop over time, and to respond to some of the review comments on the slope stability aspects of the plan by GHD.

Subsequent to the submission of the 2019 Closure Plan, based on a detailed review of available monitoring data in association with ENV staff, it has been established that the groundwater and surface water flow regime in the area of the Cobble Hill Landfill is comprised of three components: 1) near surface interflow within the fractured and blasted bedrock, 2) deeper groundwater flow within the bedrock and 3) surface water run-off within ephemeral creek that derives water from all three sources, interflow, groundwater and surface water run-off in differing quantities throughout the year.

It has been shown that shallow downgradient wells SHA SB-1 to SHA SB-3 are heavily influenced by factors such as the first fall flush, the winter rains and the summer drying period. As a result, the water quality data from these sampling locations is noisy, with indicator parameters fluctuating up and down with the seasons. Deeper groundwater wells are more stable.

To provide a more stable data set where any increase in concentration in leachate indicator parameters can be more easily noticed, it is proposed that two new shallow groundwater wells be drilled at downgradient locations SHA MW 19-01 and SHA MW 19-02, at the landfill toe, centrally located between seepage blanket wells SB-1, SB-2 and SB-3. The locations of the proposed monitoring wells are shown on Figure 10-1, attached. It is proposed that the wells be drilled to a depth of 10.0 m, below the expected depth of blast induced fractures. The wells are to be screened between 5 and 10 m to

provide a sufficiently wide interval for the drill to intercept one or more water bearing fractures. The wells will be developed with standard sched 40 PVC slotted screen with properly sized slots and silica sand pack around the screened interval. The upper 5 m of the borehole are to be properly sealed off with bentonite.

In response to concerns raised by members of the Shawnigan Lake Research Group that groundwater in the seepage blanket may be flowing to the east rather than to the north, as a further protective measure, SHA recommends installing a fourth shallow seepage well SB-4 on the east side of the Permanent Encapsulation Area. Because SB-4 will be in an area that will be receiving additional stabilizing fill, we propose that the well be established prior to fill placement, and the pipe be extended to surface as the fill material is placed at a 5H:1V slope. Again, the location of the well is shown on Figure 10-1.

Drilling will be conducted with a Sonic Drill Rig to secure a representative bedrock core of the subsurface. Particular attention will be paid to identify fractures that may be serving potential conduits for leachate to escape to the environment.

On April 10th, 2019 a teleconference meeting was held between ENV staff, review consultants from GHD and SHA. The purpose of the call was to discuss and clarify concerns raised by GHD in their review letters dated March 28th. During the call it became clear that the Closure Plan did not clearly articulate that at no point will the final closure cap be constructed at 2.5H:1V.

In their March 28th, 2019 Task 1 Letter, GHD commented that *"There is a risk of the wedge sliding off the smooth LLDPE at 2.5H:1V slope."* Because the sand friction layer and the gravel drainage layer will be deployed onto the 2.5H:1V slope in small increments concurrently with placement of the 5H:1V grading wedge in thin horizontal lifts, there will not be any opportunity for the granular drainage materials to slip on the 2.5H:1V slope because they will always be buttressed by the soil grading wedge which will be sloped at 5H:1V.

In the same letter, GHD also commented "*SHA has carried out stability analyses utilizing Rocscience's SLIDE 4.0© using the Bishop Simplified method, a limit equilibrium analysis method. The Bishop's Simplified method is an established method of stability analysis, however, it does not satisfy all equilibrium conditions, e.g., it does not satisfy horizontal force equilibrium and does not take into account interslice shear. These factors typically effect the computed factors of safety values to some degree, with Bishop's Simplified method sometimes providing slightly higher factors of safety compared to methods that satisfy all conditions of equilibrium such as Spencer and Morgenstern-Price. It is, therefore, recommended that the analyses should be verified by using either Spencer or Morgenstern-Price methods of limit equilibrium."*

In response to the concerns raised by GHD, SHA reanalyzed the subject slope with the Spencer method. The results for both static and seismic are attached in Figures 2 and 3 respectively. Of interest, the Spencer analysis (results attached) yielded very similar but slightly higher factors of safety for both static (2.636) and seismic (1.153) conditions than the FOS generated by the Bishop method presented in the Updated Closure Plan (2.615 for static and 1.119 for seismic).

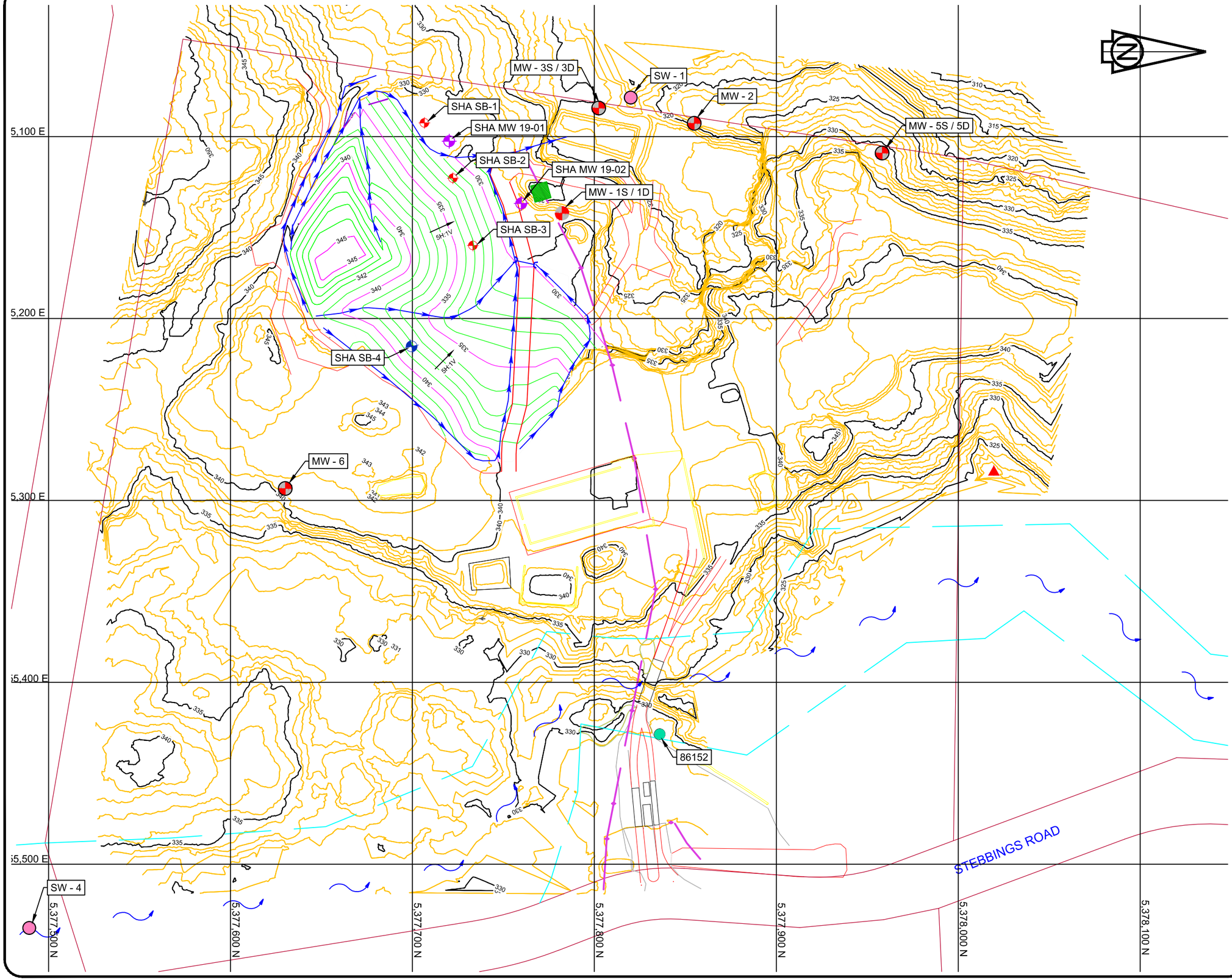
We hope this additional information provides ENV with the necessary data to fully evaluate the Updated Closure Plan 2019 and we look forward to supporting Cobble Hill Holdings and ENV in plan implementation. Please do not hesitate to call with any questions or concerns.

Yours truly,
SPERLING HANSEN ASSOCIATES

Dr. Tony Sperling, P.Eng.
President

PROFESSIONAL ENGINEER
A. SPERLING
PROVINCE OF BRITISH COLUMBIA

April 23rd, 2019



SPERLING HANSEN ASSOCIATES

Landfill Services Group

- Landfill Siting
- Design & Operations Plans
- Landfill Closure
- Environmental Monitoring

#8 - 1225 East Keith Road
North Vancouver, B.C. V7J 1J3

Phone: (604) 986-7723
Fax: (604) 986-7734

LEGEND:

- 5m EXISTING CONTOUR
- 1m EXISTING CONTOUR
- 5m DESIGN CONTOUR
- 1m DESIGN CONTOUR
- ROAD
- SURFACE WATER DITCH
- PROPERTY LINES
- PROPOSED CLOSURE AREA
- SEEPAGE BLANKET MONITORING WELL
- LEACHATE AND LEAK DETECTION STORAGE FACILITY
- PROPOSED POST CLOSURE MONITORING WELL
- SEEPAGE BLANKET MONITORING WELL TO BE CONSTRUCTED

CLIENT:

COBBLE HILL HOLDINGS LTD.

PROJECT:

COBBLE HILL LANDFILL
UPDATED FINAL CLOSURE PLAN
2019

TITLE:

POST CLOSURE MONITORING

SCALE:	DATE:	PROJECT NO:
1:2,000	2019/04/18 yyyy/mm/dd	PRJ 18074
DESIGNED	SG	DRAWING NO:
DRAWN	MG	**FIGURE 10-1**
CHECKED	TS	

Figure 2. Cobble Hill Permanent Encapsulation Area – Static Stability Analysis

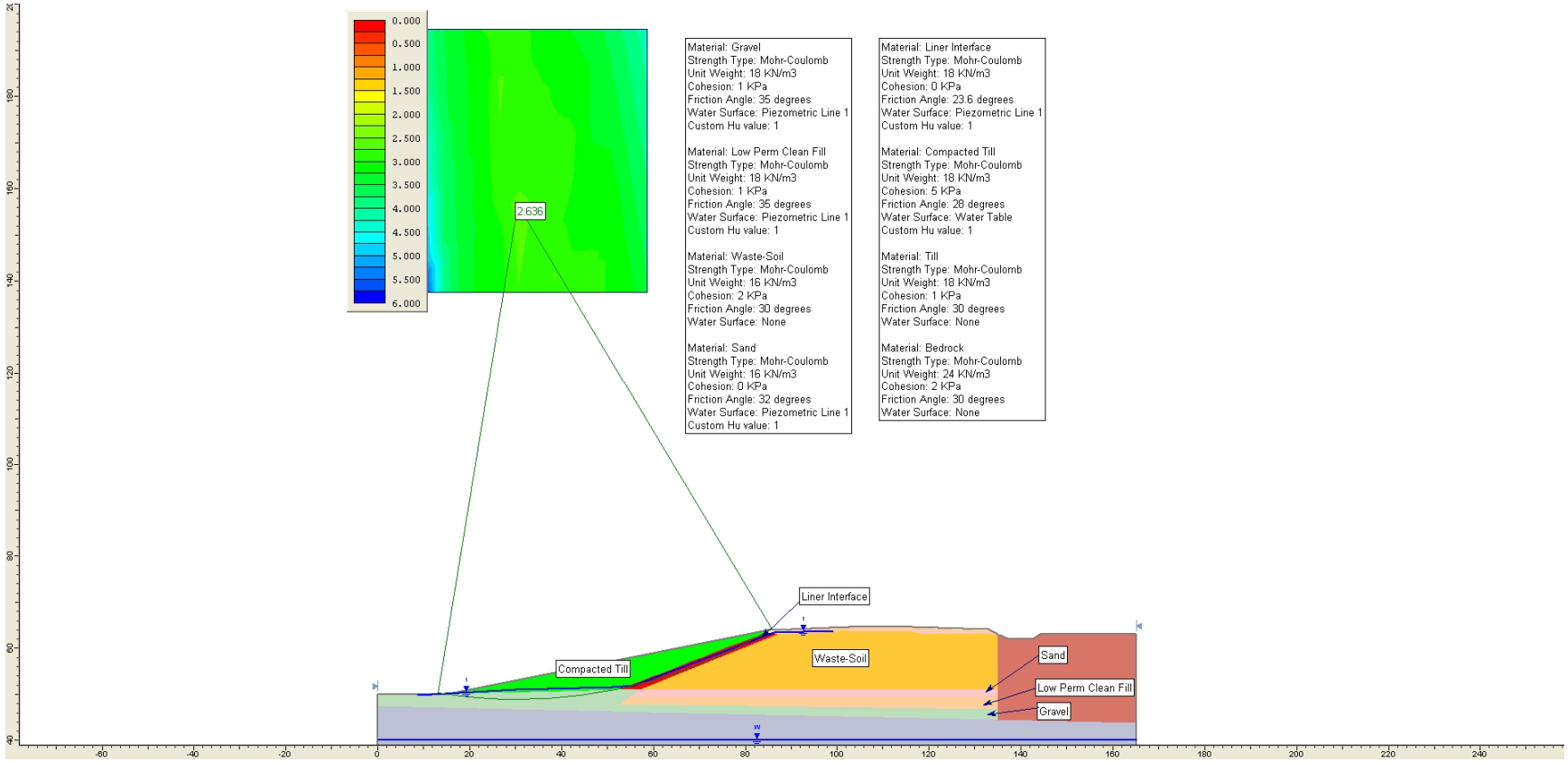


Figure 3. Cobble Hill Permanent Encapsulation Area – Seismic Analysis