Evolugen

Evolugen South March BESS Owner's Engineering Services

Ottawa, ON

Diversion watercourse design

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1. Introduction

Fitzroy BESS Inc., a subsidiary of Evolugen by Brookfield Renewable (Brookfield) in partnership with the Algonquins of Pikwàkanagàn, is proposing to develop the South March Battery Energy Storage System (BESS) Project (the Project). The Project will be in the West Carleton-March Ward in the City of Ottawa, Ontario. The Project is located on two leased parcels of land at 2555 and 2625 Marchurst Road, Ottawa, Ontario, and situated south of Thomas A. Dolan Parkway, west of Marchurst Road, and north of John Aselford Drive. The Project has a Development Area of approximately 9.0 hectares on approximately 84.5 hectares of property. The leased rural lots currently include two residential buildings with an access lane, naturalized areas with woodland and wetland, as well as limited non-commercial pasture use.

The Project is a 250-megawatt (MW) energy storage facility that uses lithium ion (lithium iron phosphate) technology and is designed to store up to 1,000 megawatt hours of energy, providing four hours of continuous discharge at full capacity.

The Project will consist of 256 BESS containers at the start of commercial operations and will progressively increase to 307 BESS containers over the duration of the IESO Offtake Agreement. The additional BESS containers will be added through the augmentation process to maintain the required 250 MW capacity. This process is further detailed within the Augmentation Process Memo.

This report considers the full Augmentation Process (a total of 307 BESS containers). Its findings and conclusions are not affected by any stage of augmentation, from 256 to 307 BESS containers.

2. Objective

The purpose of this document is to present the complete analysis and design process for the South March Creek diversion watercourse, including the hydraulic and channel design completed by BBA and the supporting fluvial geomorphological analysis prepared by Hatch. This report provides a comprehensive assessment of the diversion watercourse design and documents how Natural Channel Design principles were incorporated to achieve a stable and functional channel configuration.

3. Fluvial geomorphology analysis

As part of the fluvial geomorphological assessment, one-dimensional hydraulic modelling using HEC-RAS was completed to support the evaluation of erosion potential and geomorphic hazard limits along South March Creek. While geomorphological assessments are primarily based on field observations, historical analysis, and channel form interpretation, hydraulic modelling provides quantitative characterization of flow depths, velocities, energy gradients, and water surface elevations during higher-flow events. These parameters are directly related to erosion processes and are particularly important in low-gradient, weakly confined channel systems where backwater effects and overbank inundation can influence channel stability.

Peak flows for the 2-year and 100-year storm events were generated using PCSWMM provided by BBA, consistent with City of Ottawa Sewer Design Guidelines, and were applied in the HEC-RAS model to simulate existing and proposed hydraulic conditions. The HEC-RAS results were used to assess floodplain extents, flow regimes (including subcritical and localized critical conditions), and spatial patterns of hydraulic energy along the channel, which informed the erosion hazard assessment and setback delineation. Hydraulic modelling was therefore used as a supporting analytical tool, complementing field-based geomorphic observations rather than replacing them, and provides a defensible, integrated basis for evaluating potential changes to erosion risk under post-development condition.

4. Civil engineering of the diversion watercourse

The channel design was developed to control flow energy and minimize erosion risk by carefully selecting the longitudinal slope, cross-section geometry, and surface stabilization measures. The longitudinal slope was selected to remain gentle and consistent with existing site topography to keep flow velocities low, thereby reducing erosive forces acting on the channel bed and banks under both frequent and extreme flow conditions.

The channel cross-section consists of a trapezoidal profile with 3H:1V side slopes, which provides a stable geometry suitable for the anticipated hydraulic conditions and surrounding land use. The bottom width and channel depth vary along the alignment to provide sufficient hydraulic capacity while accommodating existing terrain and minimizing unnecessary excavation. This variable geometry supports efficient conveyance of runoff while maintaining shallow flow depths to limit shear stress and promote long-term channel stability.

Flow velocities within the channel were a key design consideration. The design was developed to ensure that velocities remain below 1.5 m/s, which is a commonly accepted threshold for erosion resistance in grass-lined channels under municipal drainage guidelines. Maintaining velocities below this limit reduces the likelihood of channel degradation and supports the use of vegetated stabilization approaches rather than hard structural measures.

Hydroseeding was selected as the primary erosion control and stabilization measure for the channel bed and banks. This approach provides immediate surface protection following construction, reduces erosion during the establishment period, and promotes vegetation growth. Once established, vegetative cover enhances soil cohesion, improves water retention at the ground surface, and contributes to long-term channel stability.

The selected velocity criteria are consistent with commonly referenced municipal guidance, including standards used in the Ottawa region, which identify approximately 1.5 m/s as the maximum permissible velocity for grass-lined channels. The design therefore aligns with accepted local practice while maintaining compatibility with naturalized drainage and erosion control principles.

The references drawings and memo that include the diversion watercourse are as follows:

7154023-100000-41-D20-0005	Road and finished grade
7154023-100000-41-D20-0006	Site grading, Profiles
7154023-100000-41-D52-0001	Road and ditches, key plan
7154023-100000-41-D52-0002	Road and ditches profiles
7154023-100000-41-D52-0003	Road and ditches profiles
7154023-100000-41-ELI-0001	Addendum to the stormwater management (Section 4, table 2)

5. Conformance with Natural Channel design principles

The proposed channel design has been developed in accordance with recognized Natural Channel Design (NCD) principles, with the objective of maintaining long-term hydraulic stability, minimizing erosion potential, and preserving natural geomorphic processes while accommodating site-specific land use constraints.

The channel geometry, including slope, width, and depth, follows existing topography and valley controls. Longitudinal slopes do not exceed 0.012 m/m, thereby limiting flow energy and reducing the risk of bed degradation or channel incision. Channel depths were intentionally kept to a minimum to avoid over-entrenchment and to maintain a stable, low-energy system under frequent flow conditions. This approach is consistent with NCD guidance, which emphasizes alignment with natural slope controls and discourages excessive deepening that may lead to instability and floodplain disconnection.

Channel widths were locally adjusted, varying between approximately 2 m and 3 m, to ensure extreme flow events are contained within the channel corridor and do not impact adjacent properties. These width adjustments were implemented without increasing channel slope or depth, allowing additional conveyance capacity to be achieved while maintaining low shear stresses and geomorphic integrity. Variable channel width reflects natural channel morphology and supports hydraulic and geomorphic resilience.

Hydrologic analyses confirm that pre- and post-development flows are comparable, thereby maintaining the existing hydrologic regime and reducing the potential for post-construction channel adjustment. Watershed connectivity has been preserved such that contributing drainage continues to flow freely into and through the channel without obstruction or redirection.

Hydraulic performance was evaluated under both frequent and extreme storm events. Under the 2-year return period event, maximum flow velocities do not exceed approximately 0.2 m/s, indicating low erosive potential during channel-forming and dominant discharge conditions. Under the 100-year return period event, maximum velocities remain below approximately 1.39 m/s at the last segment of the diversion watercourse, but below 1.2 m/s along most of the diversion watercourse, demonstrating that erosive forces are controlled even during infrequent, high-magnitude flows. The 100-year event was used as a bounding condition to confirm stability and property protection, while channel geometry remains governed by more frequent flow conditions.

Initial bank and bed stabilization are provided through hydroseeding to mitigate short-term erosion during establishment. Given the low design velocities, shallow channel depths, and agricultural land use context, this approach is appropriate and allows for progressive vegetation establishment over time. Setbacks from proposed development were verified through the fluvial geomorphic assessment, which confirmed that no regulatory floodplain or flood hazard limits encroach upon the development area, and that channel adjustments during extreme events will not affect adjacent backfills or structures.

The project is located within an agricultural setting with minimal physical constraints, allowing the channel to function as a stable, self-adjusting system driven by hydraulic and geomorphic processes rather than rigid structural control. Although fish habitat enhancement is not a project objective, the design maintains continuous low-flow conveyance and avoids features that would impede future ecological function, consistent with a process-based NCD approach.

Overall, the proposed design satisfies the key objectives of Natural Channel Design by prioritizing hydrologic consistency, controlled energy conditions, geomorphic stability, and compatibility with surrounding land use. The channel is expected to perform as a resilient, naturally functioning drainage system with low long-term maintenance requirements and minimal risk of erosion or off-site impacts.

6. Conclusion

The proposed channel design provides a stable, low-energy system that aligns with Natural Channel Design principles by prioritizing gentle longitudinal slopes, shallow channel depths, and controlled flow velocities. Channel geometry follows existing site topography and incorporates variable widths and a trapezoidal cross-section to safely convey extreme flows while minimizing erosion potential and avoiding over-entrenchment.

Hydrologic analyses confirm that pre- and post-development flow conditions are comparable, preserving watershed continuity and reducing the likelihood of long-term channel adjustment. Velocity controls under both frequent and extreme events limit erosive forces, supporting the use of vegetative stabilization measures and reducing reliance on structural protection. Setbacks from proposed development were verified through fluvial assessment to ensure that floodplain conditions and channel behaviour do not adversely affect adjacent lands.

Overall, the design balances hydraulic performance, erosion control, and geomorphic stability, resulting in a resilient and self-adjusting channel expected to function effectively over the long term with minimal maintenance requirements.