LOT 175 PORTAGE ROAD

NIAGARA FALLS, ON

WIND DRIVEN MIST ASSESSMENT

PROJECT #2203060

AUGUST 3, 2022

SUBMITTED TO

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1. INTRODUCTION

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to assess the potential wind impact that may be caused by the proposed Lot 175 Portage Road development on the misting conditions of Horseshoe Falls in the City of Niagara Falls, Ontario.

The development site is located on the west side of Portage Road, less than a kilometer to the south of the Horseshoe Falls (Image 1).

The proposed development includes 35-storey Tower A on the south and 25-storey Tower B on the north. The two towers are atop a large shared podium with outdoor amenity areas on different levels of the podium structure (Image 2).

The area that is often wetted by mist from Horseshoe Falls is around Table Rock Centre along Niagara Parkway on the Canadian side of the Falls (Image 1).

Image 1: Aerial view of the existing site and surroundings
Credit: Google Maps

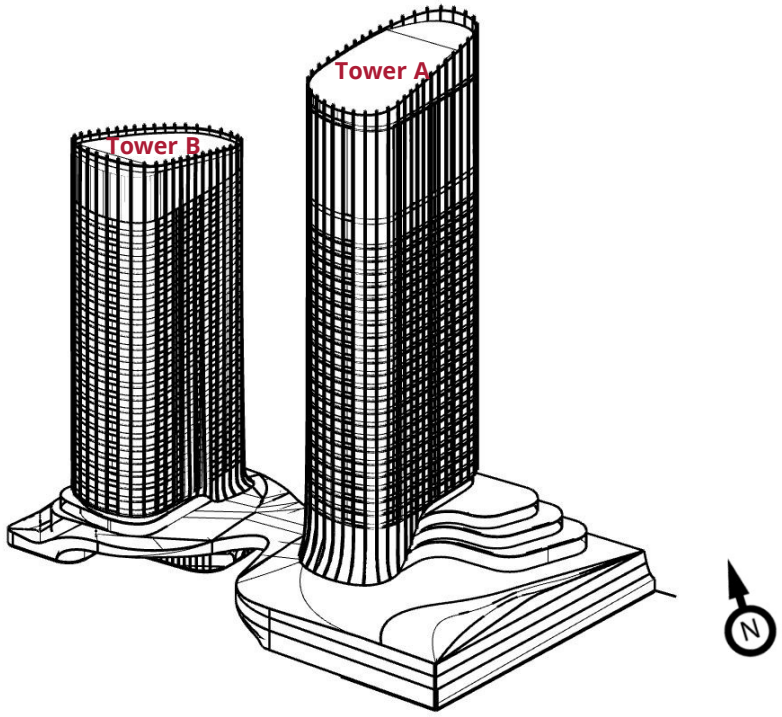


Image 2: Southwest view of the proposed development

2. METHODOLOGY

2.1 Objective

The objective of this assessment is to provide a qualitative evaluation of the potential wind impact of the proposed development on misting conditions around the Falls. Our assessment is based on the following:

- A review of the regional meteorological data from St. Catharines Niagara District Airport;
- Drawings of the proposed development received by RWDI on May 10, 2022;
- The use of Orbital Stack, an in-house computational fluid dynamics (CFD) tool, to aid in the assessment of wind flows around buildings;
- RWDI's previous wind and misting studies in Niagara Falls; and,
- Our engineering judgment, experience and expert knowledge of wind flows around buildings.

2.2 CFD for Wind Simulation

CFD is a numerical modelling technique for simulating wind flows in complex environments. For urban wind modelling, CFD techniques are used to generate a virtual wind tunnel where flows around the site, surroundings and the study building are simulated at full scale. The computational domain that covers the site and surroundings are divided into millions of small cells where calculations are performed, which allows for the "mapping" of wind conditions across the entire study domain. CFD excels as a tool for urban wind modelling for providing early design advice, resolving complex flow physics, and helping diagnose problematic wind conditions. It is useful for the assessment of complex buildings and contexts and provides a good representation of general wind conditions which makes it easy to judge or compare designs and site scenarios.

To simulate the turbulence nature of wind flows around the existing and proposed buildings, the escarpment and the Falls, an advanced CFD technique, Large Eddy Simulation (LES), was used for the current development.

2. METHODOLOGY

2.3 Simulation Model

Wind flows were simulated using Orbital Stack for the existing and proposed site scenarios with the existing surroundings. The computer models are shown in Image 3. For the purposes of this computational study, the 3D models were simplified to include only the necessary building and terrain details that would affect the local wind flows in the area around the site. Landscaping and other smaller architectural and accessory features were not included in the computer model as is the norm for this level of assessment. In addition, misting and water were not included in the simulation.

The simulation was conducted for only one wind direction: the south-southwest or 193°, which connects the project to the Falls. The approaching winds are modelled with typical suburban mean speed and turbulence profiles. Results of wind speeds and directions are presented side by side for the existing and proposed scenarios to illustrate the potential changes in wind speeds and directions that may be caused by the proposed development.

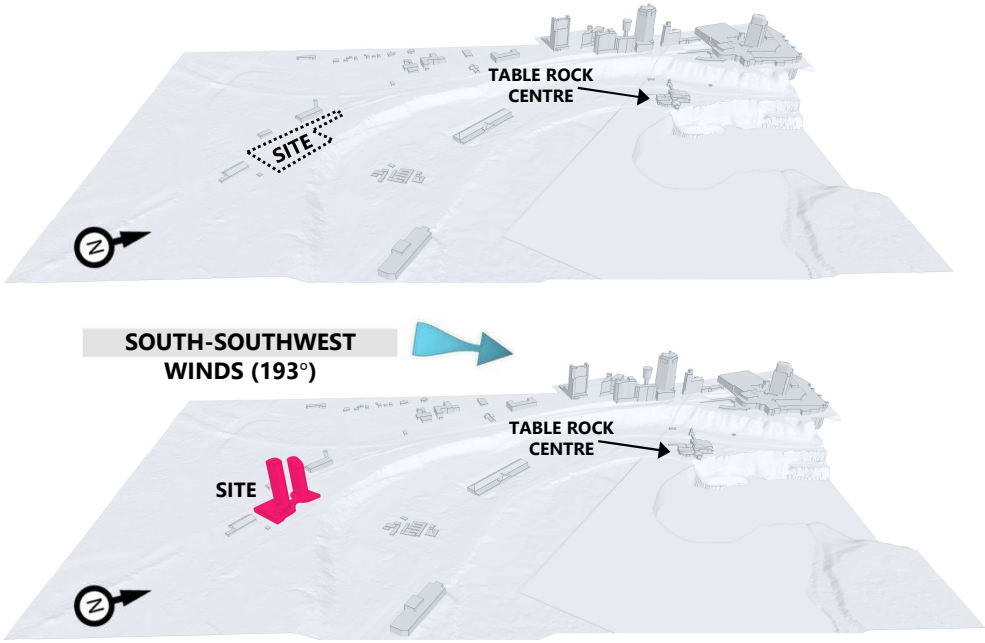


Image 3: Computer models of the existing (top) and proposed (bottom) site scenarios with existing surroundings (west view)

2. METHODOLOGY

2.4 Meteorological Data

Meteorological data from St. Catharines Niagara District Airport for the period from 2012 to 2020 were used as a reference for wind directionality in the area as this is the nearest station to the site with long-term, hourly wind data. The distribution of wind frequency and directionality is shown in the wind rose in Image 4.

Due to the location of the site relative to the Horseshoe Falls, the proposed development can have direct impact on the misting condition only through the less-frequent south-southwesterly winds (Image 3). The Falls and Table Rock are in the wake of proposed development when winds approach from this direction. Due to the relative location of and the distance between the project and Falls, no impact on misting is expected for winds from other directions.

Therefore, winds from the south-southwest direction or 193° are selected for the CFD simulations and this is considered to be worst case scenario for the potential impact on misting.

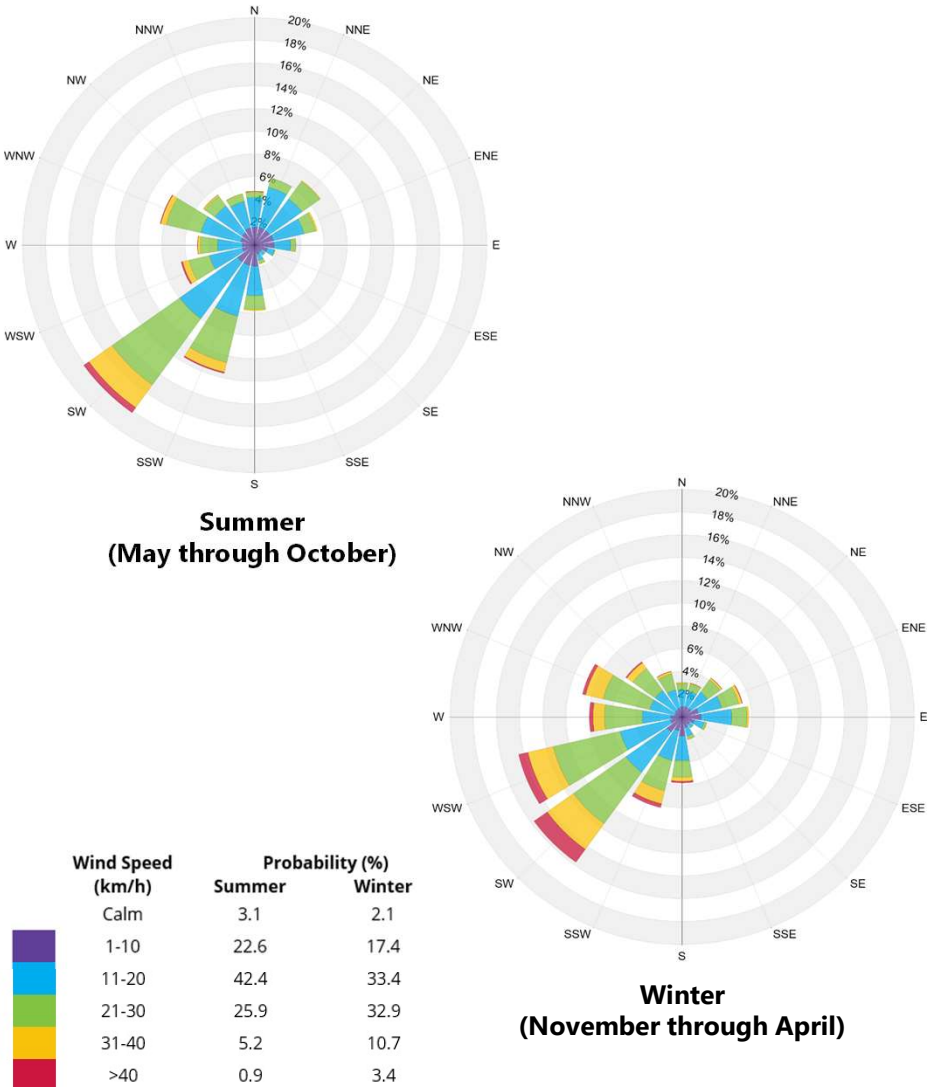


Image 4: Directional distribution of winds approaching St. Catharines Niagara District Airport (2012-2020)

3. WIND CRITERIA

3.1 Background

As water cascades over Horseshoe Falls and into the gorge below, an air plume rises, carrying a large amount of mist. The mist would fall back to the river below under no wind conditions. Typically, the mist would be carried in the same direction as the wind. For instance, the east and northeast winds would push the mist westward onto the Canadian side, but this will not be influenced by the proposed development, which is located to the south of the Falls. On the other hand, the prevailing southwest winds should push the mist eastward to the US side, but it is believed that tall buildings on the top of the escarpment in the Fallsview area may have created a reversed flow that pulls the mist plume back to the Canadian side (Image 5). The size of the wake behind the proposed project is critical for the direction of mist movement. The current CFD simulation is intended to compare the recirculation flows behind the existing buildings with and without the proposed development in place, for the infrequent south-southwest winds.

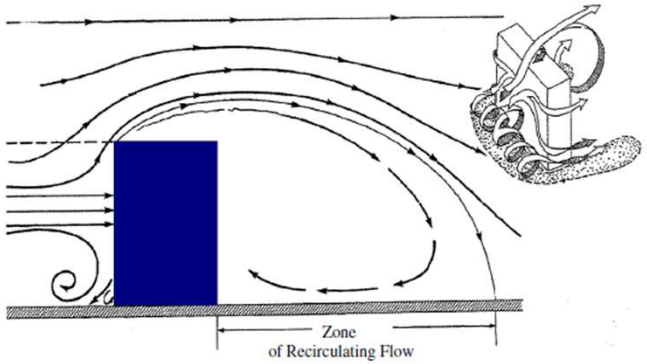


Image 5: Recirculation of wind flow behind buildings

3.2 Simulation Results

Wind flows around buildings are 3D in nature. To illustrate the 3D wind patterns, wind speeds and directions are presented on one vertical and five horizontal presentation planes, as shown in Image 6. The vertical plane is aligned with the south-southwesterly direction that cuts through the proposed development and the center of the Horseshoe Falls (Image 7), while the five horizontal planes are 5, 10, 20, 50 and 100 m above Table Rock (Images 8a through 8e). Qualitative variation of wind speeds at each presentation plane are presented using a low-medium-high scale as shown below, while black arrows in the images are indications of local wind directions.

For comparison purposes, Images 7 and 8 show the wind results for the existing and proposed scenarios side by side. Brief comments are provided beside the images in Section 3.3 for the wind flow patterns and their potential impact on misting. This is followed by further discussions in Section 3.4. Our conclusions are provided in Section 4 based on the findings of the current assessment.

Wind flow animations from LES simulations on the vertical presentation plane can be provided as video files, if needed.

3. RESULTS AND DISCUSSION

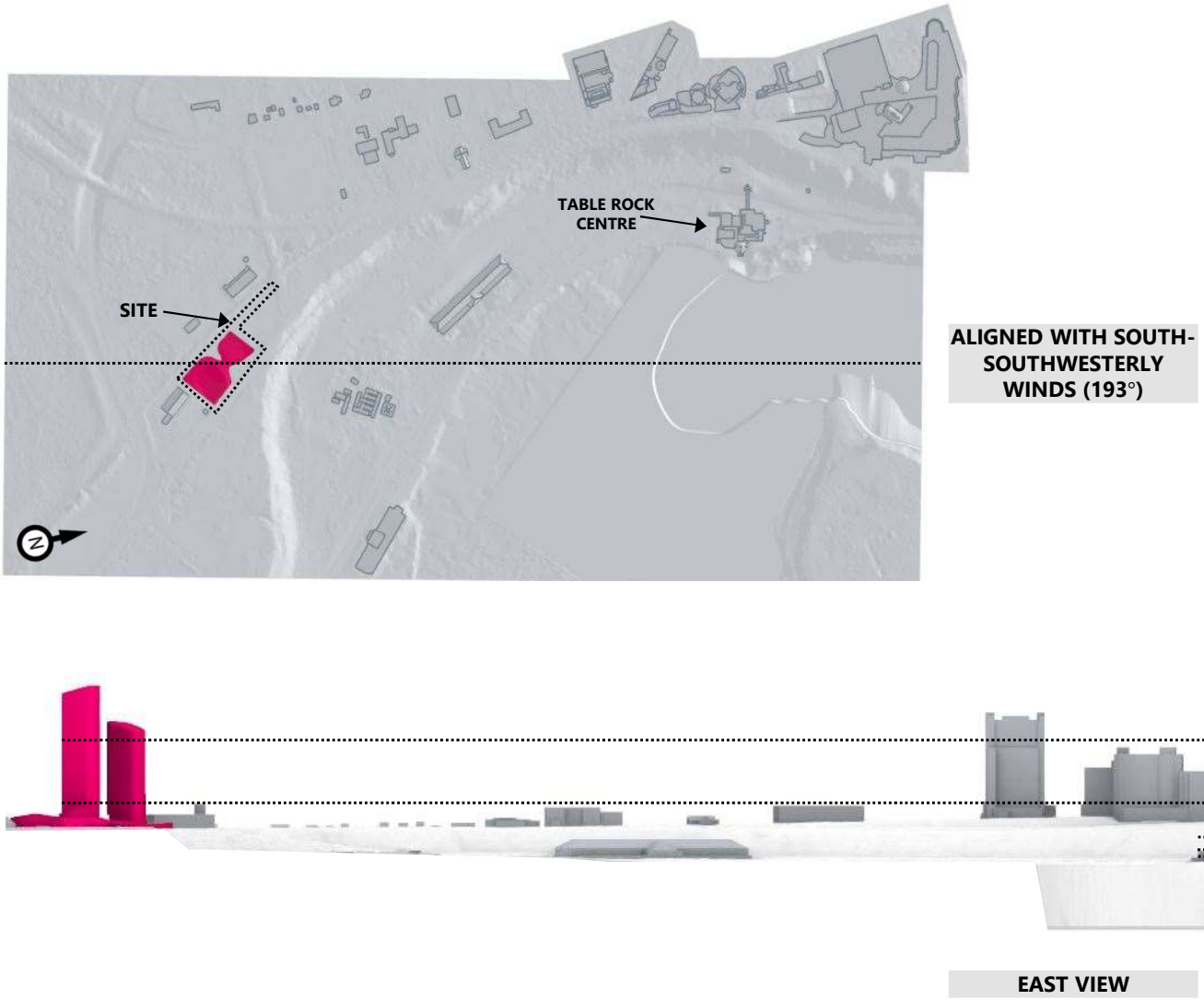
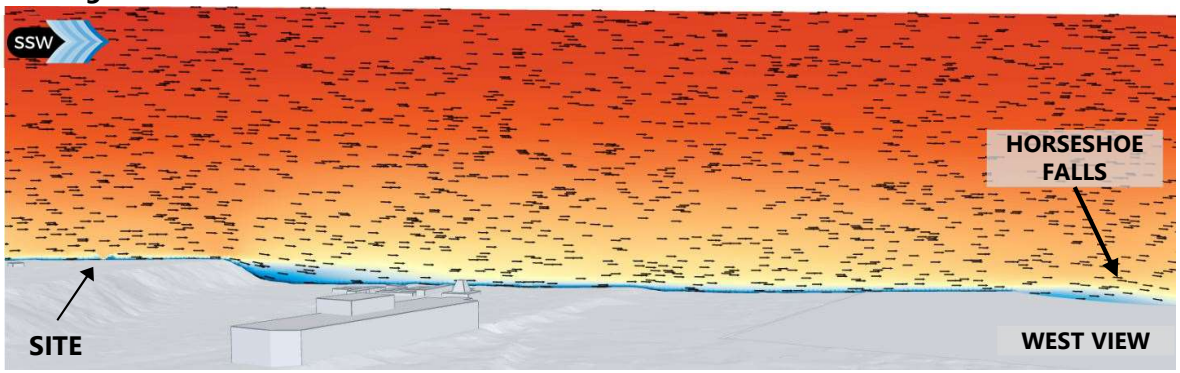


Image 6: One vertical and five horizontal presentation planes

3. RESULTS AND DISCUSSION

Existing Scenario



Proposed Scenario

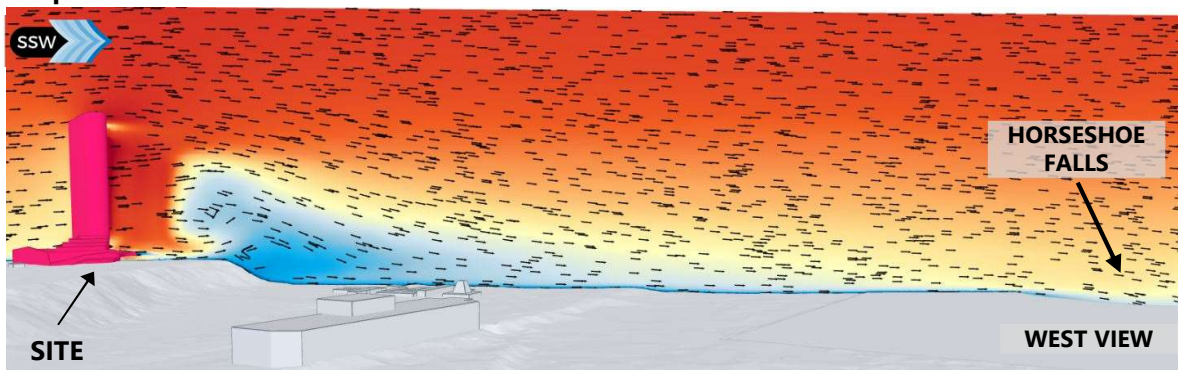


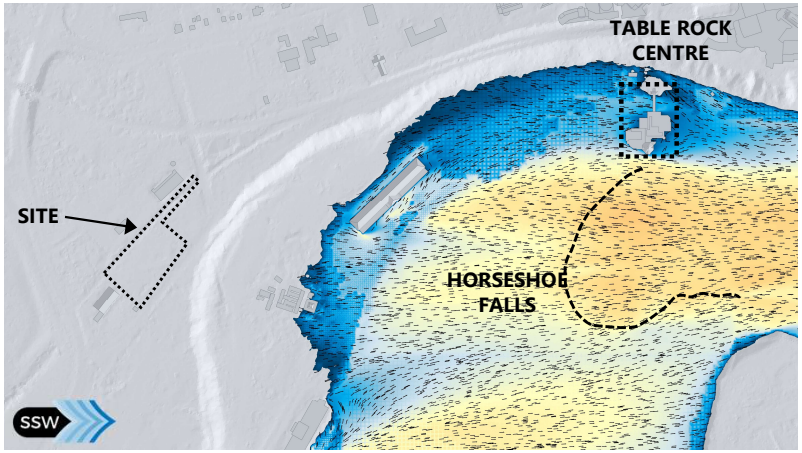
Image 7: Wind flow pattern on vertical presentation plane – through the proposed development and center of the Horseshoe Falls (Table Rock Center is on the west side of the vertical plane)
RWDI Project # 2203060
August 3, 2022

Notes on Proposed Scenario in Images 7 and 8a through 8e

- Wind flow accelerates between Tower A and Tower B.
- Reduced wind speeds and reversed wind flows are evident behind the proposed development.
- The flow pattern near the Horseshoe Fall and the Table Rock Center remains similar between the Existing and Proposed scenarios. No reversed wind flows are observed for either scenarios.

3. RESULTS AND DISCUSSION

Existing Scenario



Proposed Scenario

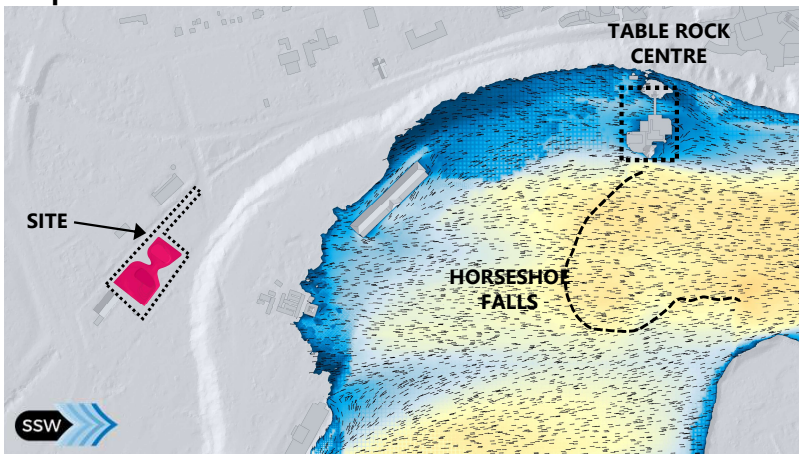
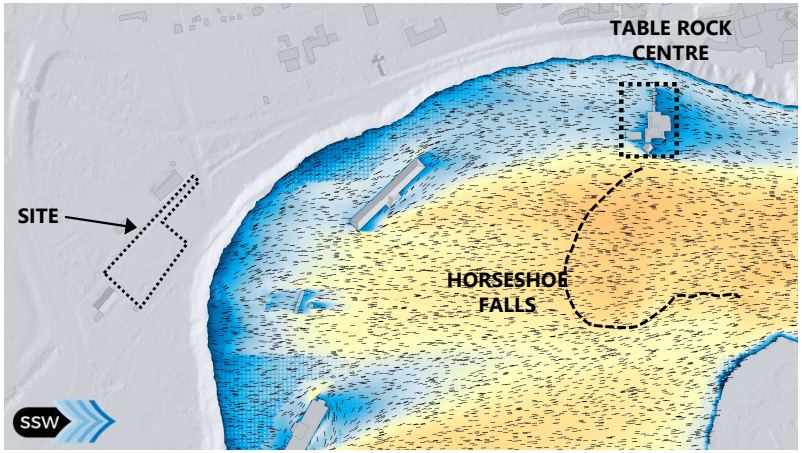


Image 8a: Wind flow pattern on horizontal presentation plane – 5 m above the Table Rock

3. RESULTS AND DISCUSSION

Existing Scenario



Proposed Scenario

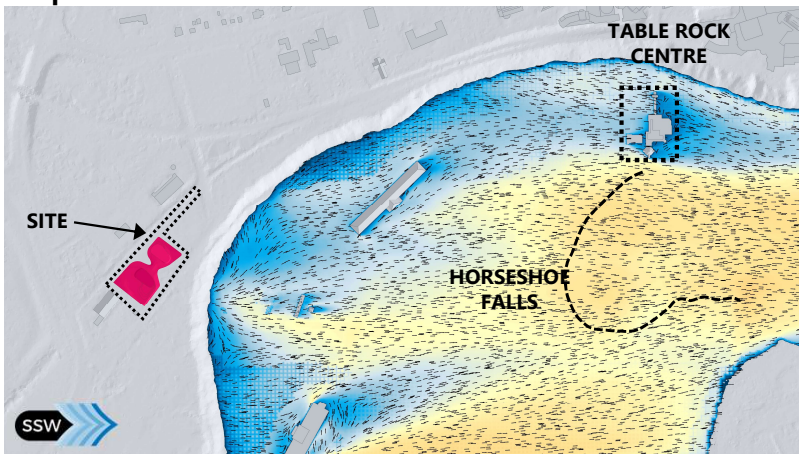
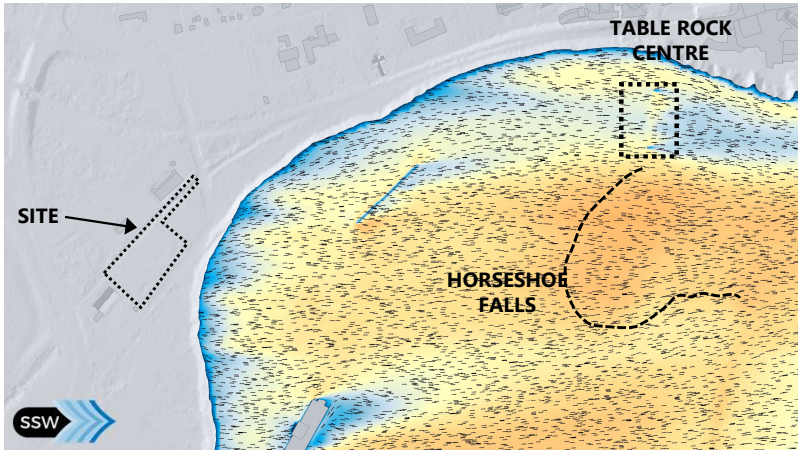


Image 8b: Wind flow pattern on horizontal presentation plane – 10 m above the Table Rock

Existing Scenario



Proposed Scenario

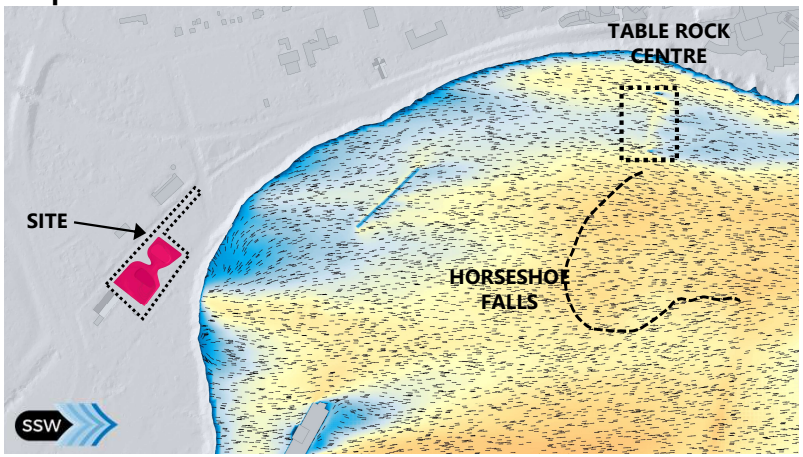
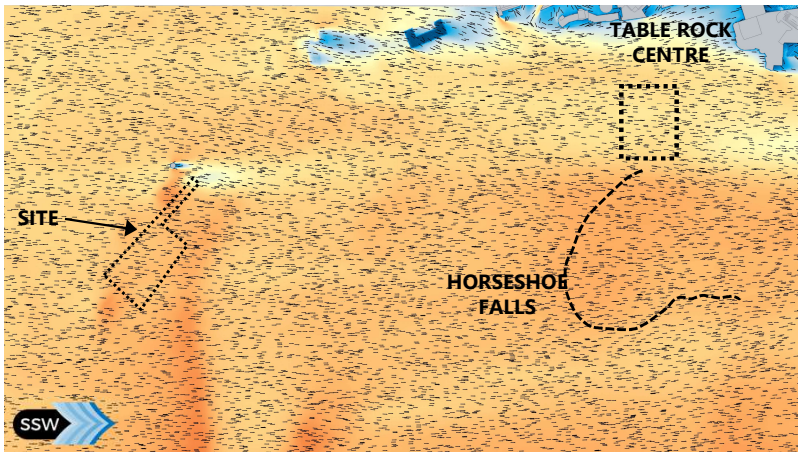


Image 8c: Wind flow pattern on horizontal presentation plane – 20 m above the Table Rock

3. RESULTS AND DISCUSSION

Existing Scenario



Proposed Scenario

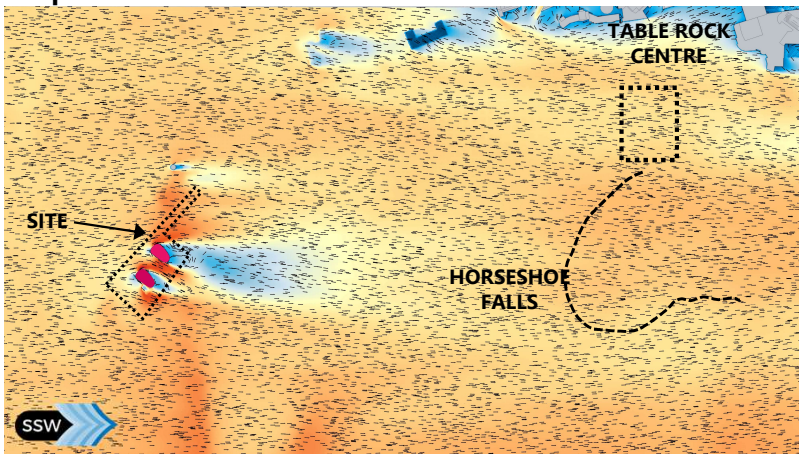
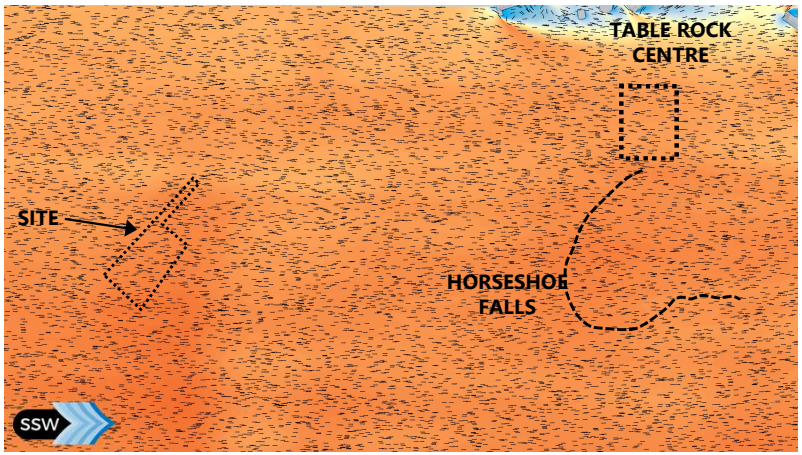


Image 8d: Wind flow pattern on horizontal presentation plane – 50 m above the Table Rock

3. RESULTS AND DISCUSSION

Existing Scenario



Proposed Scenario

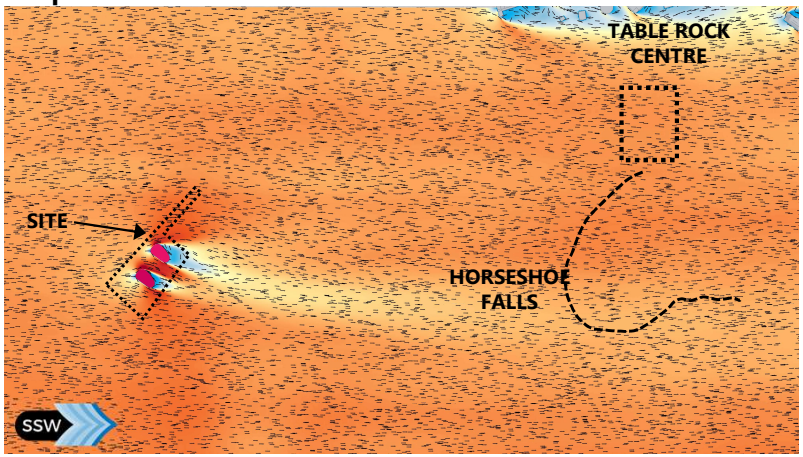


Image 8e: Wind flow pattern on horizontal presentation plane – 100 m above the Table Rock

3.3 Summary of Flow Patterns

The reversed wind flows are evident behind the proposed towers, as shown by the arrows in Images 7, 8d and 8e. Fortunately, due to the large distance between the proposed development and the Falls (approximately 800 m), the wake area with the reversed wind flows is not expected to reach the Horseshoe Falls and Table Rock Centre at any height, i.e., no additional mist from the Falls will be pulled back to the Canadian side when the winds are from the south-southwest. Given the location of the development with respect to the Falls, this wind direction is the only one that would impact the mist conditions on the Canadian side.

Based on the CFD simulation for the south-southwesterly winds, the local history of the wind patterns and our understanding of mist dispersion, it is our opinion that the proposed development will not have any significant impact on the existing misting conditions in the Table Rock Centre area.

3.4 Further Discussions

Records from the Niagara Parks Commission indicated there was a considerable increase in misting events after the construction of high-rise hotel towers in the Fallsview area. It is believed that, during the west and southwest winds, the reversed air flows behind these buildings pull the mist plume from the Falls back onto the Canadian side. This can be explained by (1) the tall hotel towers constructed in the recent years form a "solid wall" along the escarpment, creating a large wake area with reversed air flows; and (2) these buildings are in a short distance from the Falls (300 m), as demonstrated by Image 9 below.

In contrast, the currently proposed project is located away from this "wall" and further away to the south of the Falls. Therefore, it will not have any impact on the existing misting conditions.

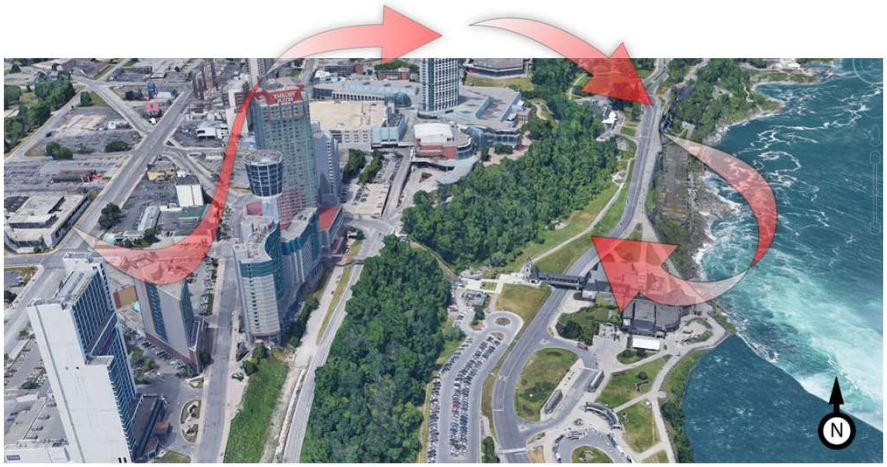


Image 9: A wall of tall buildings on the top of the escarpment (Source: Google Earth)

5. SUMMARY

Rowan Williams Davies & Irwin Inc. (RWDI) was retained to assess the potential wind impact that may be caused by the proposed Lot 175 Portage Road development on the misting conditions of Horseshoe Falls in the City of Niagara Falls, Ontario. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, and computational modelling and simulation of wind flows around buildings using the LES technique.

Our findings are summarized as follows:

- The project is located to the distant south of the Falls and winds that could potentially impact the mist conditions (south-southwesterly winds) are infrequent in the area.

- For the south-southwest winds, the reversed wind flows in the wake are evident behind the proposed towers, but they are not expected to reach the Table Rock Centre area.

- The increase in misting events in recent year is likely caused by the wall of the tall hotel towers along the escarpment, in a short distance from the Falls.

- Given the large distance of the proposed development site from the Falls and from the existing wall of tall buildings in the Fallsview area, and the local history of the wind directionality, the proposed project will not have any significant impact on the existing misting conditions in the Table Rock Centre area, as demonstrated by the flow patterns in Images 7 and 8.

5. STATEMENT OF LIMITATIONS

Design Assumptions

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in May 2022 (listed in table below). Should the details of the proposed fit out design and/or building geometry change significantly, results may vary.

File Name	File Type	Date Received (mm/dd/yyyy)
22-05-10_Portage_Massing Model	3D model	05/10/2022

Changes to the Design or Environment

It should be noted that wind flows are subjective and can be sensitive to changes in building design and operation that are possible during the life of a building. In the event of any such changes in the future, RWDI could provide an assessment of their impact on the discussions included in this report. It is the responsibility of Others to contact RWDI to initiate this process.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for Horn Design & Consulting Inc. The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein and authorized scope. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared.

Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendation.