

Appendix “A” – Wave Buoy and Camera Data Collection Report

Awareness campaign/ communication

A research assistant from the University of Waterloo made a total of 8 trips to Port Elgin and Southampton beaches, between July 30th and August 31st, 2025. These trips occurred predominately on weekends when beach usage was at its maximum and when more people were visiting the beach from outside of the local area. The student spent approximately 4 hours on-site during each trip, for a total of 32 hours. A standard prompt was used to provide beach users background information on the project goals and the purpose of the survey. Those volunteering to complete the survey were then given a business card with a QR code, allowing them access to the on-line survey. The student reported an acceptance rate of approximately 30% and that groups tended to be more receptive to discussing the project and accepting the business cards, in comparison to lone individuals. While the acceptance of the business cards did not guarantee the completion of the survey, this effort contributed to the overall response total and increased the visibility and communication of the project to the public.

Wave Buoy Information and Data

The wave buoy, operated by the Real-Time Aquatic Ecosystem Observation Network (RAEON), was installed on June 9th, 2025, and is located 1.2 km offshore of Port Elgin Beach (Lon: -81.42°, Lat: 44.44°; Fig. 1). The buoy records weather, wave, currents, and water temperature every 20 minutes, including:

- Air Temperature (K)
- Significant Wave Height (m), Wave Period (s), and Wave Direction (°)
- Wind Speed (m/s), Wind Gusts (m/s), and Wind Direction (°)
- Current Speed (m/s) and Current Direction (°), at each m water depth (1-8 m)
- Lake Temperature (K), at each m water depth (1-8 m)

All data is reported in real time and is freely accessible to the public, through the seagull.glos.org website. This site also provides downloads of historical data that covers the entirety of each operating season (typically May through October).

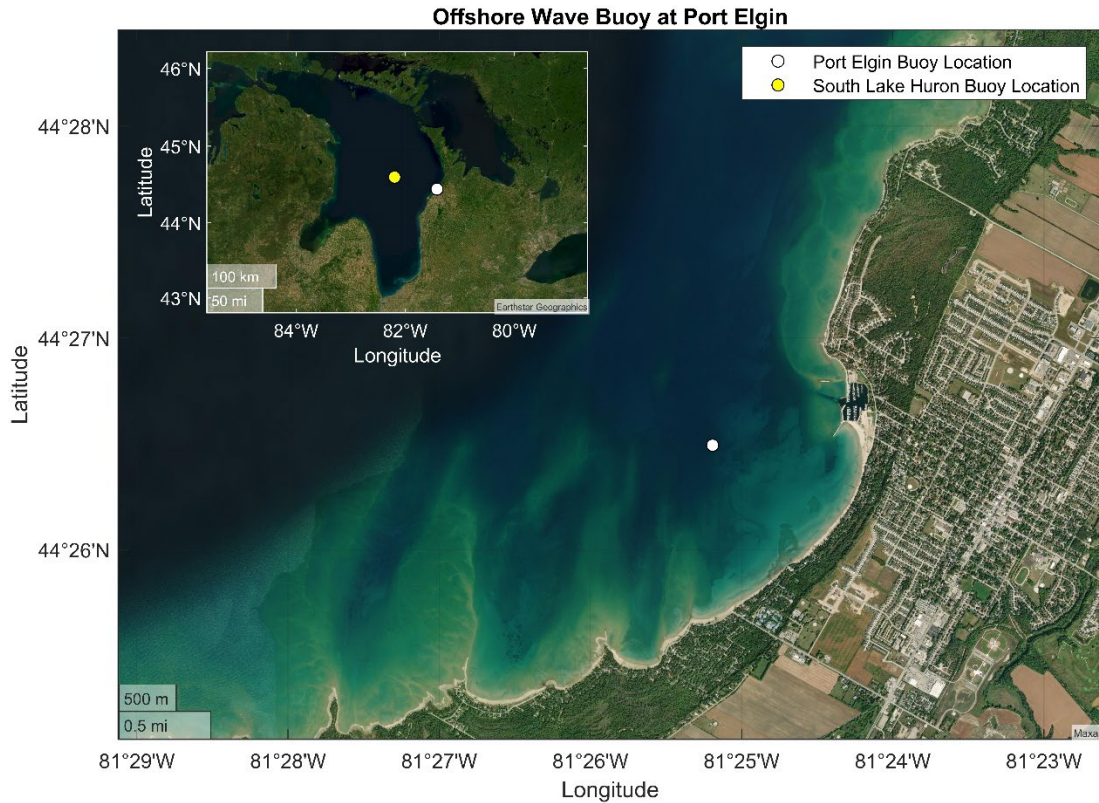


Figure 1: Locations of the Port Elgin and South Lake Huron wave buoys.

The buoy data will be used to create a locally calibrated random forest (RF) machine learning model to predict surf zone hazards that could increase the risk of drownings, including high waves, strong currents, and offshore winds that can move people on flotation devices away from the shoreline. Training data for the RF model will come from the South Lake Huron Buoy (Fig. 1), operated by the National Oceanic and Atmospheric Administration (NOAA), and tested on the data recorded from the local wave buoy offshore of Port Elgin. Due to the high operational costs of installing and maintaining the local buoy, the RF model represents a long-term solution to provide the Municipality free and highly accurate predictions of surf zone hazards that will be integrated into the publicly available beach safety application.

For example, during this past summer, wave conditions recorded at Port Elgin were generally calm with an average Significant Wave Height (H) of 0.27 m (Fig. 2). However, during strong westerly cyclones, the increased fetch over Lake Huron and strong winds can produce waves approaching the beach in excess of 1 m (Fig. 2), representing a significant hazard to beach users. The RF model will continuously update warnings every 20 minutes to indicate low, moderate, or high risks of entering the water. This dynamic warning system is critical because changes in weather and lake conditions can occur rapidly, and there is a need to provide the public real-time information on hazards to promote best beach safety practices.

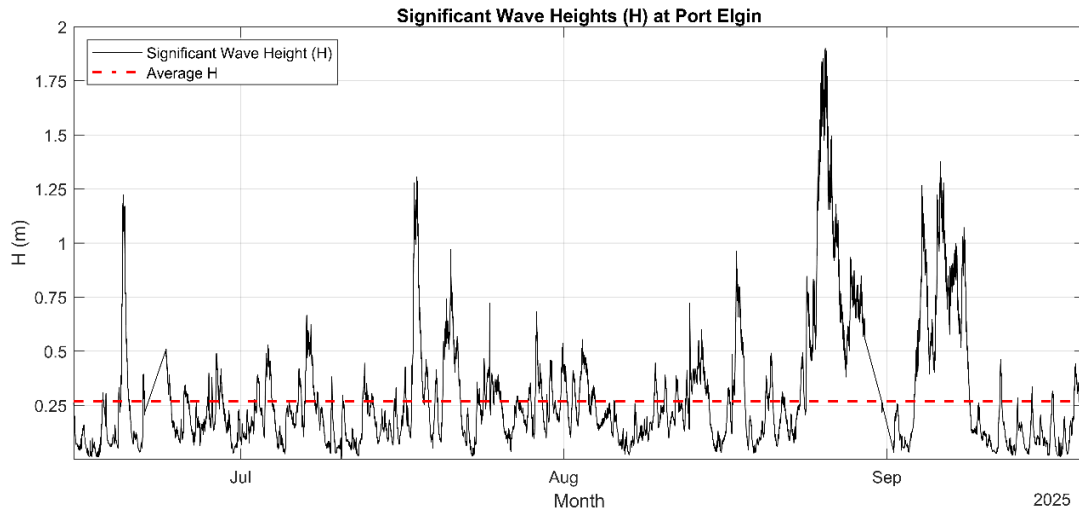


Figure 2: Significant wave heights (H) recorded from the Port Elgin wave buoy during the summer of 2025.

Camera Information and Data

A Reolink Duo 3 camera was installed at Port Elgin and began recording on August 7th, 2025. Images were taken every 20 minutes (at the same sampling frequency of the wave buoy) using the timelapse function during daylight hours, between 8 a.m. to 8 p.m. Each day, 37 images were taken and over 2,000 images have been collected to date. The camera has a 180° field of view, allowing for the seamless monitoring of beach usage along the entirety of Port Elgin beach (Fig. 3). This data will be used to train and test a computer vision model that counts the number of people that are on the beach and in the water. A similar model has been developed for an early phase of the Smart Beach project at Kincardine, with findings suggesting that an accurate count of beach users can be made utilizing this data.



Figure 3: Camera images taken during Labor Day weekend (A.) and during a week day in August (B.) when hazard levels were low and high, respectively.

Imagery allows for the monitoring of beach user behaviour in response to lake conditions being recorded by the wave buoy. This is particularly important because previous surveys conducted by Smart Beach found that the majority of people commuting from outside of the local area did not to check weather or lake conditions prior to traveling to the beach. In other words, there may be an influx of people on the beach when lake conditions are unsafe due to advanced travel plans. Initial results of imagery at Port Elgin reveal that beach usage tends to increase during good weather conditions, weekends, and extended bank holiday weekends (Fig. 3A.). Alternatively, cooler days with higher winds and surf tended to have the fewest people on the beach (Fig. 3B.). While these results are expected, further analysis is needed to determine if there are instances when beach user behaviour did not align with surf zone hazards and, in case, how to better communicate potential risks to the public. Over the next two years, imagery will also provide valuable field-based evidence on the efficacy of the beach warning application to alter behaviour and need for improvements.

Next Steps

- **Test and refine a locally calibrated surf zone model for Port Elgin**

A locally calibrated RF model, accounting for the unique morphology (e.g., shoreline orientation and curvature) of Port Elgin beach, will be developed during the Winter of 2025/2026. The model will utilize training data from the South Lake Huron Buoy (Fig. 1), to predict wave, current, and wind conditions recorded from the local wave buoy. Model

refinement, including modification of hyperparameters, will be conducted until a high level of accuracy is achieved. A similar process will be conducted at Southampton in Year 2 of the project to provide accurate and site-specific predictions of regional surf zone hazards.

- **Test and refine a beach user counting model for Port Elgin**

A computer vision model will be tested and refined during the Winter of 2025/2026 in order to accurately count the number of people in the water and on the beach. These counts will provide valuable information on when beach usage is highest, and when beach user behaviour does not align with hazards recorded from the local wave buoy. In combination, this information will provide insight on how to best communicate and engage with the public on beach safety.