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Delineating and monitoring bluff toe positions from boat-based lidar to quantify morphology change at Edgewater Beach, WA

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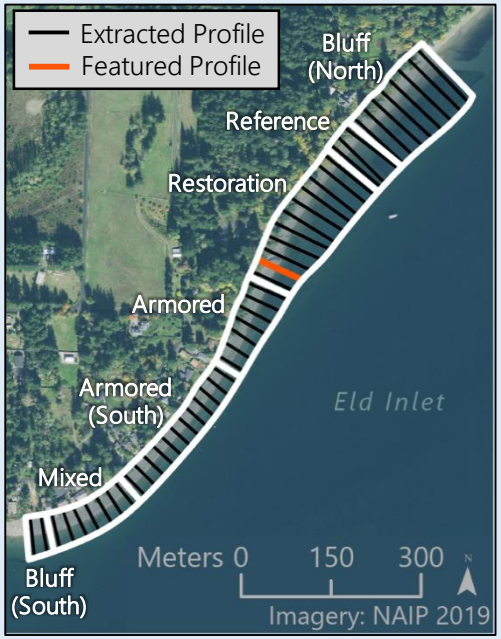
INTRODUCTION

The Washington State Department of Ecology has performed a total of four boat-based lidar surveys of a shoreline restoration project at Edgewater Beach in South Puget Sound where approximately 800 feet of shoreline armor was removed in 2016 from the base of a historic feeder bluff. Detailed topographic cross-shore profiles at the project site were compared between surveys, and beach width and slope were extracted to quantify changes to the beach and bluff. Surveys were conducted in 2015, 2017, 2019, and 2021 with results from 2015 through 2019 displayed on this poster.

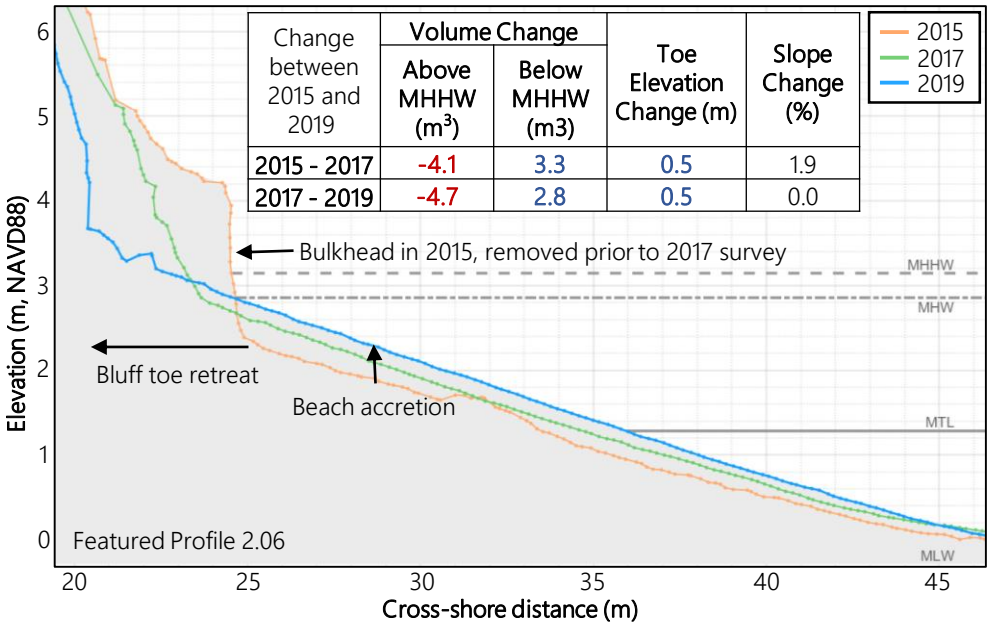
STUDY SITE

The study area included 50 cross-shore extracted profiles with 20-meter spacing and divided into seven sub-regions for analysis.

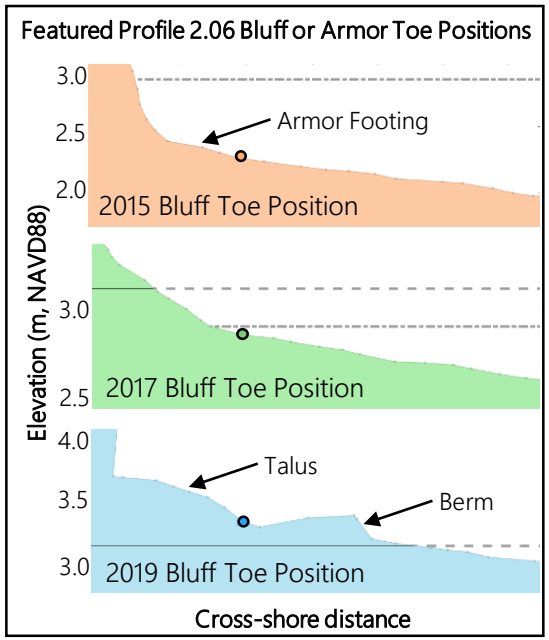


Profiles extracted from the lidar point cloud were used to quantify volume and beach metric changes between each survey. Below is an example profile from the restoration site and the toe position selections.

Change between 2015 and 2019	Volume Change: Above MHHW (m^3)	Volume Change: Below MHHW (m3)	Toe Elevation Change (m)	Slope Change (%)
2015 - 2017	-4.1	3.3	0.5	1.9
2017 - 2019	-4.7	2.8	0.5	0.0



The bluff or armor toe was considered the landward-most location where sediment had been worked by beach processes, which was generally the location where the beach slope became greater than the average upper beach slope. Automated selections were reviewed and adjusted as needed to include berms as the upper beach and exclude features that would result in overestimates of beach width and slope such as talus deposits, the bluff face, or armor footing. This rigorous selection process is important for ensuring comparable results through space and time, particularly in the ecologically important backshore zone.



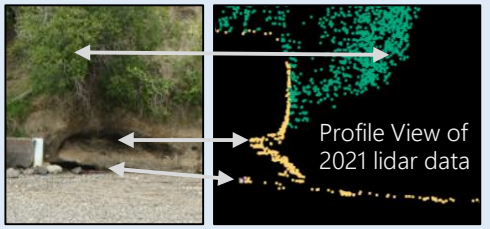
SUMMARY OF RESULTS

A comparison of the 2015 pre-restoration survey, 2017 post-restoration survey, and 2019 follow-up survey showed:

- The bluff toe along the previously armored shoreline translated landward and upward to **create a backshore zone**.
- The **beach width** at the restoration site and in the down drift direction (north) **increased** by approximately 5 meters at the restoration site, 2 meters at the reference site, and 3 meters at the northern bluff site, compared to minimal change in the up drift direction (south).
- The difference between the toe elevation and MHHW, or **relative encroachment**, at the restoration site decreased from 0.7 meters in 2015 at the armor toe to 0.3 meters in 2017 after armor removal. In 2019, there was no relative encroachment.

BOAT-BASED LIDAR

Boat-based lidar is an optimal tool for collecting upper beach features at Edgewater Beach because the horizontal look angle has an unobstructed view of the bluff face even if overhanging vegetation or undercutting is present, unlike traditional airborne lidar. Locations along the bluffs near Edgewater Beach have undercutting up to 3 meters, and vegetation overhanging as far as 8 meters.



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