

Reach 3 – Oshawa Harbour to St. Mary's



Local Conditions

- Reach Length = approximately 11 km.
- The Port of Oshawa and St. Mary's loading facility represent the boundaries of a sublittoral cell.
- The McLaughlin Bay Wildlife Reserve, Second Marsh Wildlife Area, and Darlington Provincial Park represent a significant natural heritage corridor in Reach 3.
- The three natural areas feature extensive coastal wetlands.
- The Darlington Nuclear Generating Station is also a significant development and covers approximately two kilometres of shoreline in Reach 3.
- There is no residential development along the shoreline in Reach 3 and a small amount of agricultural land.

Natural Beach & Embryo Dunes at Darlington Prov. Park.

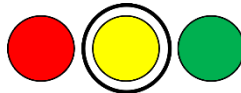


Shore Protection fronting Darlington Nuclear Power Plant

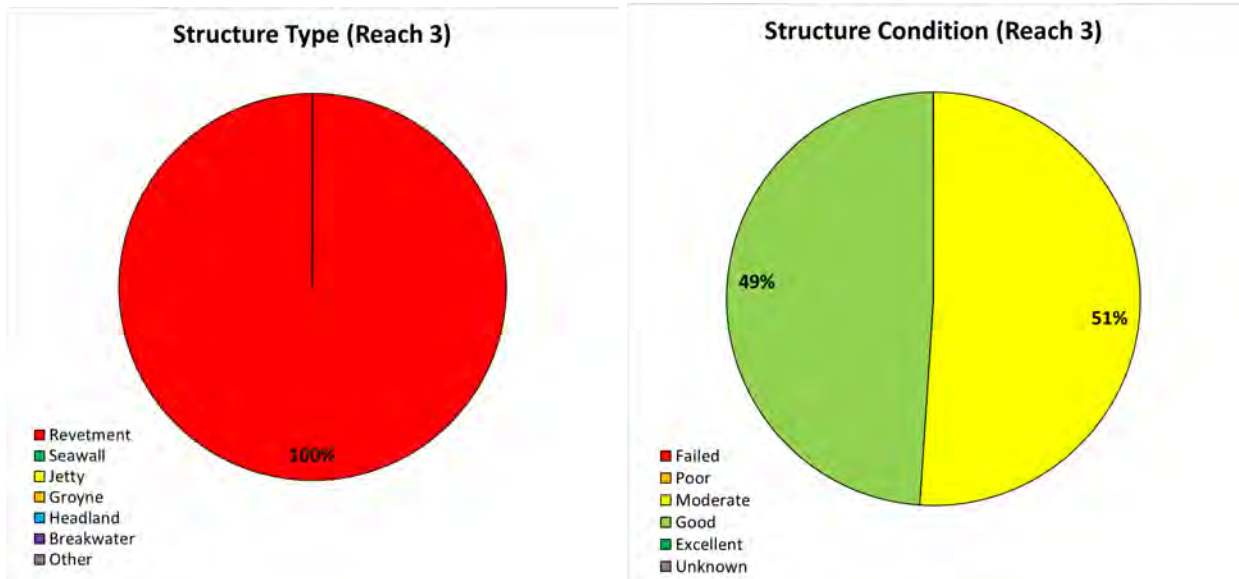


Shoreline Structures

- Reach 3 is 28% armoured, 72% natural.
- Armoured portions of shoreline are limited to shoreline immediately east of Oshawa Harbour, and the shoreline fronting Darlington Nuclear Power Plant and St. Mary's Cement Plant.
- Shoreline protection throughout the reach is generally well engineered armour stone revetments in moderate to good condition.
- Shoreline protection fronting St. Mary's is ad-hoc in places and should be monitored and maintained as required.
- Tolerance for additional shoreline armouring (low/**medium**/high):



- Sample statistics (for armoured portion of shoreline):



Sediment Supply and Longshore Sediment Transport

- Longshore sediment transport potential is very low (0 to 5,000 m³/year) west of Darlington Provincial Park, with nearly equal eastward and westward components.
- Longshore sediment transport potential east of Darlington Provincial Park is very high, with the net transport potential being upwards of 100,000 m³/year from west to east. Actual transport is however likely less than 10% of the potential due to the limited sediment supply, which is predominantly from eroding bluffs between the Provincial Park and Nuclear Power Plant.
- A significant shoal offshore of Darlington Provincial Park likely creates a depositional area in its lee (i.e. Darlington Beach).
- The Nuclear Power Plant and St. Mary's Cement Plant both present partial obstructions to longshore transport, however this effect is likely secondary to the small amount of

actual sediment availability and transport through the reach, as is evident by the lack of significant fillet beaches on the west side of these landmarks.



Summary of Natural Hazards

- 100-year Erosion Rate (Stable Slope not included):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year)	Bluff Crest or Waterline
43.8649, -78.8209	43.8686, -78.8185	0.25	Bluff Crest
43.8691, -78.7793	43.87, -78.7376	0.25	Bluff Crest
43.8672, -78.7169	43.8738, -78.7	0.25	Bluff Crest
43.8749, -78.6951	43.8725, -78.6863	0.25	Bluff Crest

- 100-year Flood Level and Flood Hazard Limit (including wave uprush):

Start (lat, long)	End (lat, long)	100-year Flood Level (m IGLD85')	Flood Hazard (m IGLD85')
43.8648, -78.8209	43.8684, -78.8187	+76.01	+77.88
43.8684, -78.8187	43.8684, -78.7762	+76.01	+77.64
43.8684, -78.7762	43.8749, -78.6952	+76.01	+77.74
43.8749, -78.6952	43.8782, -78.6843	+76.01	+77.83

- Dynamic Beach(es):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year) or Stable	Dynamic Beach Name
43.8686, -78.8185	43.8696, -78.8131	0.25	Oshawa East Beach
43.8696, -78.8131	43.869, -78.8038	0.73	McLaughlin Bay Barrier Beach A
43.869, -78.8038	43.868, -78.7999	0.25	McLaughlin Bay Beach
43.868, -78.7999	43.8693, -78.7867	0.73	McLaughlin Bay Barrier Beach B
43.8693, -78.7867	43.8691, -78.7793	0.25	Port Darlington PP Beach
43.87, -78.7376	43.8694, -78.7318	0.25	Port Darlington Power Plant Fillet Beach
43.8738, -78.7	43.8749, -78.6951	Stable	St. Mary's West Fillet Beach

- Wave climate ~1 km offshore (output location W3):

ARI (years)	Depth (m)	Hs (m)	DIR (deg)	Tp (s)
5	12.4	4.55	213	9.0
10	12.4	4.85	211	9.5
25	12.4	5.03	211	9.5
50	12.4	5.20	209	10.0
100	12.4	5.27	209	10.0

Infrastructure and Ecosystem Threats

- Barrier beach in Provincial Park (McLaughlin Bay) is actively migrating inland.
- Nuclear Plant: unprotected shoreline at east end of the plant will require shore protection.

Shoreline Management Recommendations

- Maintain natural bluff environments and buffers.
- Monitor existing shoreline protection at the Nuclear Plant.
- Monitor shore protection at St. Mary's Plant.

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Reach 4 – St. Mary’s to Bowmanville Harbour



Local Conditions

- Reach Length = approximately 2.5 km.
- St. Mary’s to Bowmanville Harbour is a small littoral sub-cell in the Central Lake Ontario Conservation Authority jurisdiction.
- The Cedar Crest Beach Road community in the western half of the Reach features lakefront properties constructed on the sand spit that separated the lake from the marsh. The buildings are close to the lake and vulnerable to coastal flooding.
- The St. Mary’s quarry is located inland of Cedar Crest Beach. St. Mary’s Pier is located at the west end of the sub-cell and features land reclamation and pier infrastructure protruding approximately 600 m into Lake Ontario from the historical shoreline location.
- The eastern half of the reach features Port Darlington West Barrier Beach, with Bowmanville Marsh in lee. The homes along the beach are setback approximately 50 m from the lake and less vulnerable to coastal hazards than the western half of the reach. The east end of the beach is public, accessible by boardwalks which were constructed to protect the native dune grasses and beach material.
- Two armour stone jetties stabilize the navigation channel for the outlet of Bowmanville Creek and have been trapping sand on the west side since at least the early 1950s.

Cedar Crest Beach Blvd. during Record High Water Levels (May 2019)

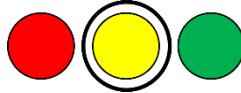


Fillet Beach and Jetties at Port Darlington (November 2018)

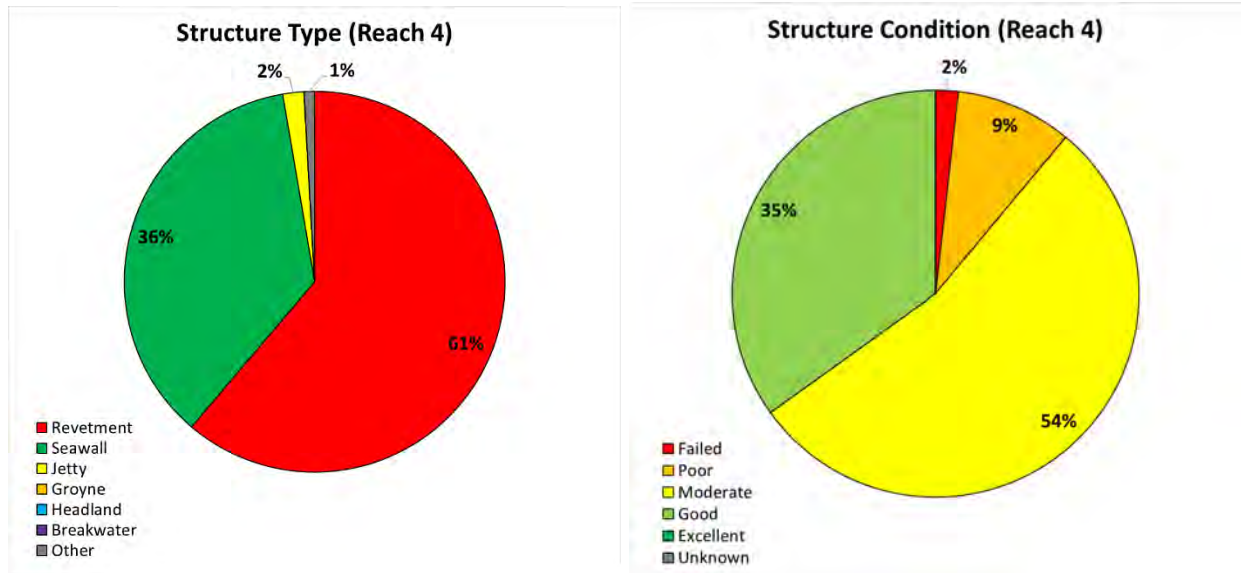


Shoreline Structures

- Reach 4 is 57% armoured, 43% natural.
- The east facing shoreline of St. Mary’s land is armoured with an ad-hoc rubble revetment. This protection may require upgrades to prevent erosion and should be monitored.
- The shoreline fronting Cedar Crest Beach Road is almost entirely armoured and features a wide variety of structure types, levels of design and condition. All structures have a very low crest due to the low land elevation and suffer from settlement during periods of high lake levels due to ongoing vertical erosion of the lakebed.
- The west jetty at Bowmanville Creek is in extremely poor condition and requires significant repairs and/or upgrades. The structure has limited ability to trap sand or to dissipate wave energy due to its porosity and low crest. The structure roundhead which features a navigation light is in good condition.
- Tolerance for additional shoreline armouring (low/**medium**/high):



- Sample statistics (for armoured portion of shoreline):



Sediment Supply and Longshore Sediment Transport

- Longshore sediment transport potential is generally very low in Reach 4 with sediment moving in both directions depending on wave conditions, away from the centre of the reach.
- Deposition occurs at the west end of the reach against the St. Mary’s lands, and at the east end of the reach in the form of a fillet beach against the Bowmanville Creek west jetty.

- The majority of the reach is a barrier beach complex that protects a marsh in its lee. The natural migration of the barrier has been altered through residential development and shore protection.



Summary of Natural Hazards

- 100-year Erosion Rate (Stable Slope not included):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year)	Bluff Crest or Waterline
43.8725, -78.6863	43.8781, -78.6843	0.25	Bluff Crest
43.8793, -78.6826	43.8805, -78.681	0.33	Bluff Crest

- 100-year Flood Level and Flood Hazard Limit (including wave uprush):

Start (lat, long)	End (lat, long)	100-year Flood Level (m IGLD85')	Flood Hazard (m IGLD85')
43.8782, -78.6843	43.8857, -78.6750	+76.01	+77.74
43.8857, -78.6750	43.8878, -78.6648	+76.01	+77.64

- Dynamic Beach(es):

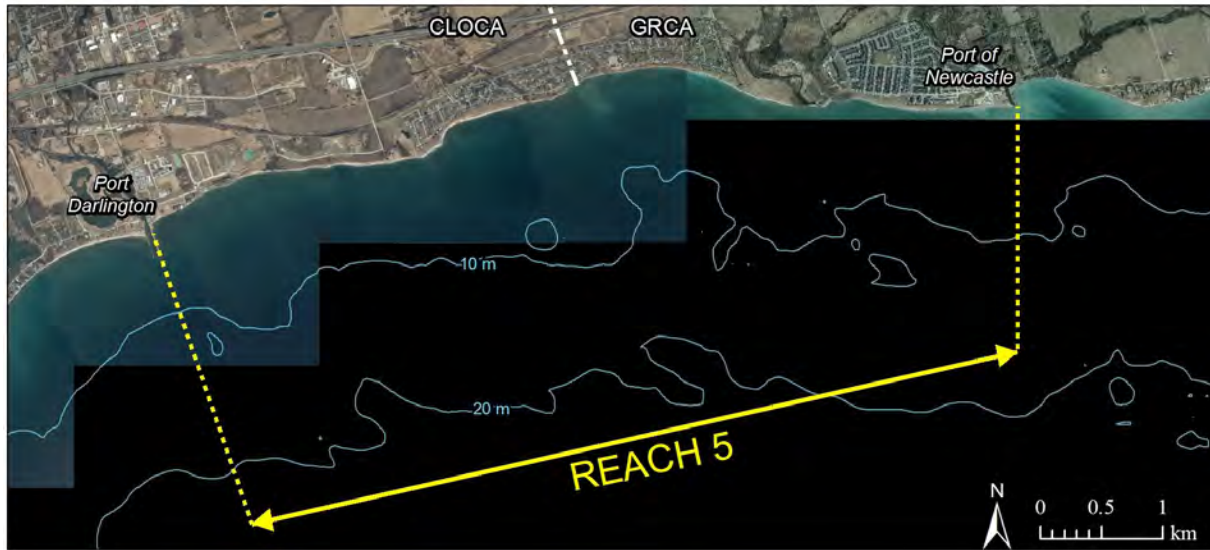
Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year) or Stable	Dynamic Beach Name
43.8781, -78.6843	43.8793, -78.6826	Stable	St. Mary's East Fillet Beach
43.8805, -78.681	43.8857, -78.6748	0.22	Cedar Crest Beach Rd.
43.8857, -78.6748	43.8873, -78.67	0.22	Cove Road
43.8873, -78.67	43.8877, -78.6648	Stable	Port Darlington West Fillet Beach

- Wave climate ~1 km offshore (output location W4):

ARI (years)	Depth (m)	Hs (m)	DIR (deg)	Tp (s)
5	14.1	3.01	206	9.0
10	14.1	3.28	204	9.5
25	14.1	3.51	203	9.5
50	14.1	3.84	201	10.0
100	14.1	4.06	201	10.0

Infrastructure and Ecosystem Threats
<ul style="list-style-type: none"> • Flooding and erosion threats for existing development along Cedar Crest Beach Road. • West jetty at Bowmanville Creek requires a significant structural upgrade.
Shoreline Management Recommendations
<p>Cedar Crest Beach Road and West Beach Road:</p> <ul style="list-style-type: none"> • Long-term incremental voluntary land disposition program required for the lands subject to acute risks due to lack of safe access during the 100-year flood and the location of development on a low-lying eroding dynamic barrier beach. • Short- and medium-term management options include continuing to facilitate private shore protection works by individual or, preferably, community scale beach nourishment and shore protection; road reprofiling. • West Jetty at Bowmanville Creek: structure requires upgrade to eliminate wave and sediment transmission into the navigation channel. Dune restoration to eliminate aeolian transport into the channel from the west fillet beach. • Sediment dredged from the navigation channel and fillet beach could be hydraulically bypassed to nourish the Port Darlington East Beach Park.
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Reach 5 – Port Darlington to Port of Newcastle



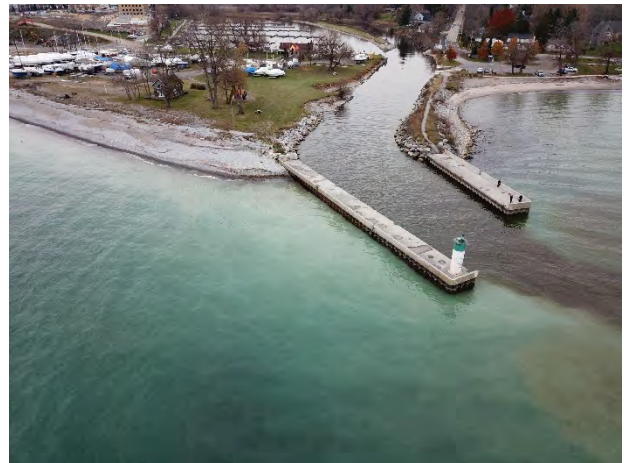
Local Conditions

- Reach Length = approximately 7.1 km.
- The jettied entrances to Port Darlington the Port of Newcastle define a littoral sub-cell along the north shore of Lake Ontario.
- The boundary between the Central Lake Ontario Conservation Authority and the Ganaraska Region Conservation Authority is in the centre of Reach 5.
- Significant sedimentation is ongoing in the navigation channel in Port Darlington.
- Two new residential developments are under construction along the eroding bluff shoreline east and west of Lambs Road.
- The Wilmont Creek Community stretches along almost 3 km of the eroding bluffs.
- The Port of Newcastle community is located west of the jettied rivermouth.

*Eroding Bluffs and Failed Shore Protection
East of Port Darlington*

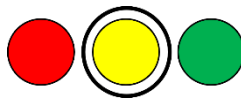


*Cobble Fillet Beach and Jetties at Port of
Newcastle*

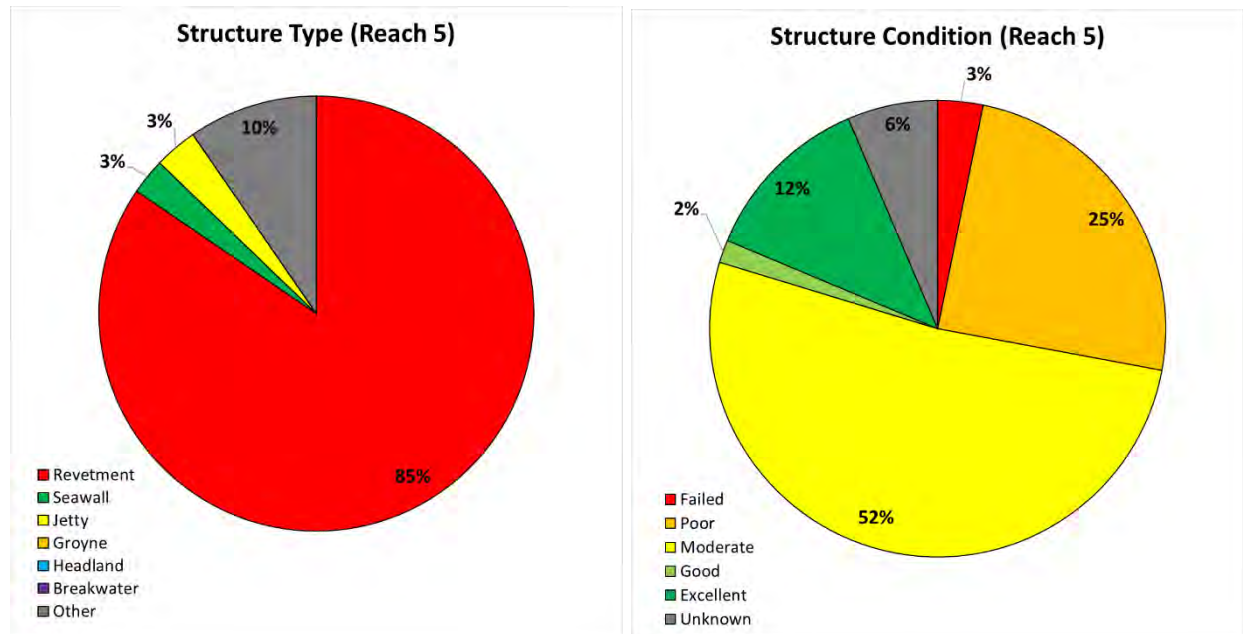


Shoreline Structures

- Reach 5 is 25% armoured, 75% natural.
- The west end of the reach features well engineered and recently constructed shore protection fronting Port Darlington East Beach. This structure is robust and in excellent condition.
- Immediately east of Port Darlington East Beach there are a number of properties sitting atop a high, rapidly eroding bluff. Some properties feature shore protection of varying quality and condition, while others are unprotected and continue to erode. These properties are at high risk due to their proximity to the bluff crust.
- The majority of shore protection within the reach is found in along the shores of Wilmot Creek, a retirement community that spans the border between the Central Lake Ontario Conservation Authority and the Ganaraska Region Conservation Authority. This structure has been engineered and implemented in the last decade, however it is only an interim, porous structure comprised of an armour stone berm resting directly on the beach at the toe of the bluff. Some vertical beach erosion and horizontal recession of the bluff is expected to continue behind the structure during periods of extreme lake levels.
- The jetties at Graham Creek (Port of Newcastle) are composite gravity structures and are both in moderate condition. The root of both structures is comprised of native fill material with a thin layer of minimal rock protection. These areas have suffered significant damage during the high-water periods in 2017 and 2019 and have nearly breached, particularly on the east side at Bond Head Parkette. These structures should be repaired and upgraded to prevent the propagation of waves and sediment into Graham Creek.
- Tolerance for additional shoreline armouring (low/**medium**/high):

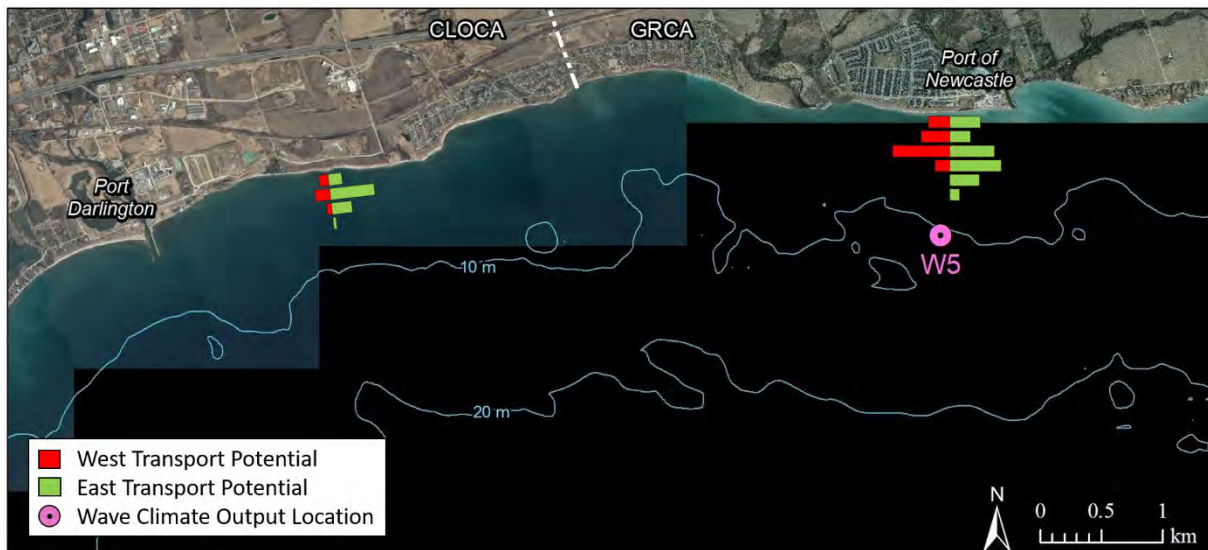


- Sample statistics (for armoured portion of shoreline):



Sediment Supply and Longshore Sediment Transport

- Net longshore sediment transport potential is from west to east through reach 5 with a potential volume of 80,000 to 100,000 m³/year. The actual transport is likely less than 10,000 m³/year as the supply of sediment is predominantly limited to local bluff erosion within the reach.
- Deposition occurs primarily in the fillet beach to the west of the Graham Creek jetties, as is evident by the significant offset in shoreline position from the west side to the east (~140 m).
- Some deposition occurs at the west end of the cell at Port Darlington East Beach during periods of wave action from the southeast quadrant.
- The significant amount of hardened shoreline fronting the Wilmot Creek Retirement Community reduces the sediment supply to the reach, however the structure is reasonably low crested and porous and therefore does not completely mitigate the bluff erosion that contributes sediment to the region.



Summary of Natural Hazards

- 100-year Erosion Rate (Stable Slope not included):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year)	Bluff Crest or Waterline
43.8891, -78.663	43.8976, -78.6203	0.24	Bluff Crest
43.8976, -78.6203	43.8959, -78.5975	0.24	Bluff Crest
43.8962, -78.5947	43.8953, -78.5815	0.24	Bluff Crest

- 100-year Flood Level and Flood Hazard Limit (including wave uprush):

Start (lat, long)	End (lat, long)	100-year Flood Level (m IGLD85')	Flood Hazard (m IGLD85')
43.8885, -78.6624	43.8895, -78.6617	+76.01	+77.64
43.8895, -78.6617	43.8967, -78.6257	+76.01	+77.77
43.8967, -78.6257	43.8956, -78.5767	+76.01	+77.77

- Dynamic Beach(es):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year) or Stable	Dynamic Beach Name
43.8885, -78.6641	43.8891, -78.663	Stable	Port Darlington East Park
43.8959, -78.5975	43.8962, -78.5947	0.11	Wilmot Creek Barrier Beach
43.8953, -78.5815	43.8955, -78.5764	Stable	Newcastle Beach

- Wave climate ~1 km offshore (output location W5):

ARI (years)	Depth (m)	Hs (m)	DIR (deg)	Tp (s)
5	13.1	4.72	211	9.5
10	13.1	4.82	211	9.5
25	13.1	5.02	208	10.0
50	13.1	5.08	208	10.0
100	13.1	5.13	208	10.0

Infrastructure and Ecosystem Threats

- West jetty at Bowmanville Creek requires a significant structural upgrade to mitigate wave and sediment transmission into the navigation channel (reported in Reach 4).
- Port Darlington East Beach suffers from a sediment deficit.
- Residences atop bluff east of Port Darlington East Beach are threatened by erosion.
- Wilmot Creek: interim shore protection that only provides partial erosion mitigation.
- Jetties at Graham Creek require significant repairs/upgrades to their roots to mitigate wave and sediment transmission into Graham Creek.
- Jetties at the Graham Creek trap longshore sediment transport and starve the downdrift shoreline to the east (Bond Head).

Shoreline Management Recommendations

- Impacts of additional shoreline armouring: moderate impacts within Reach 5 but significant negative impacts to Reach 6 to the east.
- West jetty at Bowmanville Creek requires significant structural upgrade to mitigate wave and sediment transmission into the navigation channel.
- Implement a sediment bypassing program from the Port Darlington west fillet beach to nourish Port Darlington East Beach Park.
- A long-term community scale solution is required for Port Darlington East Beach community to reduce erosion and flood hazards, such as protection or retreat. For example, a long-term voluntary land acquisition program for lands subject to acute hazards could be implemented to return the shore lands to public open space.
- Maintain naturally eroding bluff environments.
- Wilmot Creek Development: monitor shore protection and upgrade structures as required to provide the necessary protection.
- Monitor trail location at Newcastle and relocate inland when threatened by erosion.
- No further development in the floodplain west of Graham Creek (Port of Newcastle).
- Root of jetties at Graham Creek require significant repairs/upgrades.
- Implement a sediment bypassing program for the west fillet beach at Port of Newcastle to nourish the eroding east beach (Bond Head Parkette, Boulton Street).

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Reach 6 – Bond Head to Port Hope West Beach



Local Conditions

- Reach Length = approximately 23.4 km.
- This long reach stretches from the Port of Newcastle to Port Hope West Beach.
- East of the Port of Newcastle, the Bond Head bluffs and gullies dominate the shoreline.
- The central portion of the reach features large tracks of agricultural land and small shoreline communities, such as Port Granby and Port Britain.
- The Ontario Power Generation Wesleyville Storage is located 8 km west of Port Hope.
- Port Hope west beach is a large deposition sink for the sand and gravel transported west to each in this reach.
- Immediately west of West Beach, the railway into Port Hope runs right along the bluff crest and will soon require shoreline protection to stabilize the slope.

Eroding Bluffs at Bond Head

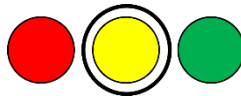


Port Hope West Beach and Jetties

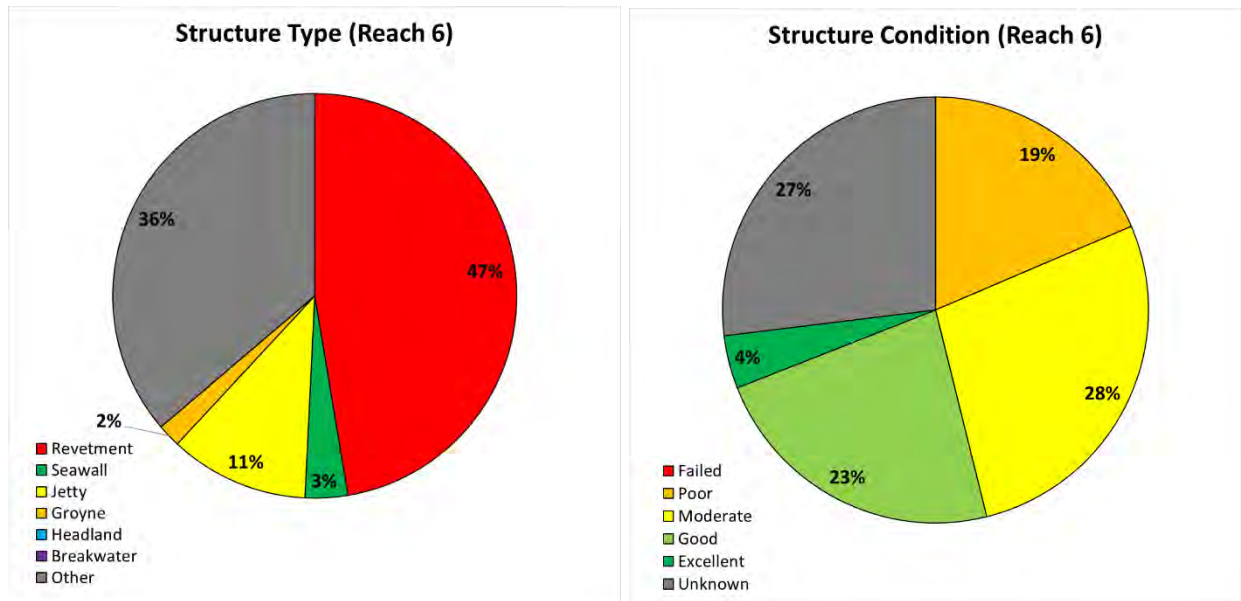


Shoreline Structures

- Reach 6 is 7% armoured, 93% natural.
- The jetties at Graham Creek at the west end of the reach are in poor condition at their root, where the structures were close to breaching during record high lake levels in 2019.
- There is a significant offset in shoreline position from the west side of Graham Creek (Reach 5) to the east side, where the Bond Head Parkette and properties along Boulton street have suffered significant erosion due to a lack of sediment supply. The Parkette and neighbouring properties have all been hardened to some degree to mitigate ongoing erosion. These structures are mostly well engineered and in good condition, with a few exceptions.
- Lakeshore Road is protected by an engineered armour stone revetment and is in generally good condition.
- The high bluff shoreline from Bond Head to Port Britain, a distance of over 17 km, is entirely natural and unprotected.
- Many private properties at Port Britain feature mostly ad-hoc shore protection. This protection is generally in poor to moderate condition and may require upgrades.
- Tolerance for additional shoreline armouring (low/medium/high):



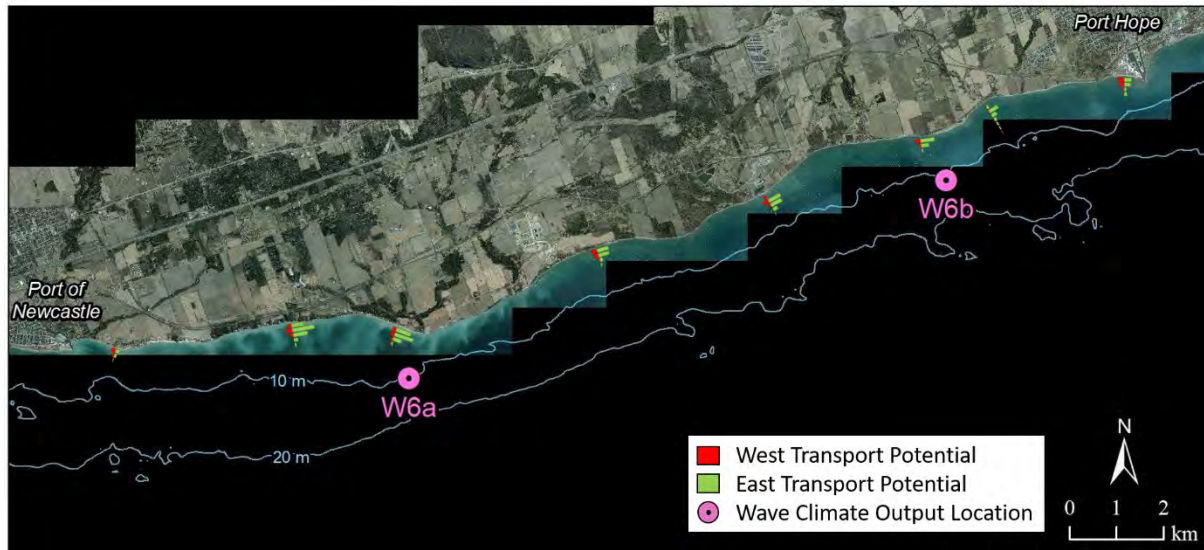
- Sample statistics (for armoured portion of shoreline):



Sediment Supply and Longshore Sediment Transport

- Longshore sediment transport potential is very low in the embayment at the west end of the reach (Boulton Street), with very little sediment entering this region from either direction.

- Net longshore sediment transport potential from Bond Head to Port Hope is from west to east with net potential transport volumes in excess of 100,000 m³/year at several locations.
- A significant percentage of this transport potential is likely realized, perhaps up to 50% and particularly during high lake levels, due to the significant length of unprotected eroding bluff that contributes sediment to the reach and the nearshore lakebed which is comprised primarily of sand and cobble.
- Deposition occurs primarily at the Port Hope west fillet beach to the west of Port Hope Harbour jetties, as is evident by the significant offset in shoreline position from the west side of the harbour to the east (over 300 m).



Summary of Natural Hazards

- 100-year Erosion Rate (Stable Slope not included):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year)	Bluff Crest or Waterline
43.8956, -78.5759	43.8965, -78.4836	0.59	Bluff Crest
43.8965, -78.4836	43.9033, -78.4591	0.17	Bluff Crest
43.9033, -78.4591	43.9134, -78.4132	0.41	Bluff Crest
43.9134, -78.4132	43.9166, -78.408	0.29	Waterline
43.9202, -78.3955	43.9229, -78.3889	0.29	Waterline
43.9229, -78.3889	43.9282, -78.3803	0.2	Bluff Crest
43.9308, -78.3605	43.936, -78.3355	0.2	Bluff Crest
43.936, -78.3355	43.9372, -78.3337	0.29	Waterline
43.9384, -78.3286	43.9409, -78.3019	0.2	Bluff Crest

- 100-year Flood Level and Flood Hazard Limit (including wave uprush):

Start (lat, long)	End (lat, long)	100-year Flood Level (m IGLD85')	Flood Hazard (m IGLD85')
43.8965, -78.5766	43.8973, -78.5718	+76.01	+77.67
43.8973, -78.5718	43.8958, -78.5656	+76.01	+77.77
43.8958, -78.5656	43.8961, -78.5567	+76.01	+77.85
43.8961, -78.5567	43.9045, -78.4563	+76.01	+77.77
43.9045, -78.4563	43.9335, -78.3393	+76.01	+77.77

43.9335, -78.3393	43.9406, -78.3032	+76.01	+77.86
43.9406, -78.3032	43.9408, -78.2913	+76.01	+77.77

- Dynamic Beach(es):

Start (lat, long)	End (lat, long)	100-year Erosion Rate (m/year) or Stable	Dynamic Beach Name
43.9166, -78.408	43.918, -78.4046	0.2	Wesleyville Beach
43.918, -78.4046	43.9191, -78.4003	0.29	Wesleyville Beach
43.9191, -78.4003	43.9195, -78.3975	0.2	Wesleyville Beach
43.9195, -78.3975	43.9202, -78.3955	0.29	Wesleyville Beach
43.9282, -78.3803	43.9299, -78.3731	0.2	Willow Beach
43.9299, -78.3731	43.9302, -78.3681	0.29	Willow Beach
43.9302, -78.3681	43.9308, -78.3605	0.2	Port Britain Road
43.9372, -78.3337	43.9384, -78.3286	0.2	Unknown
43.9409, -78.3019	43.9409, -78.2926	Stable	Port Hope West Beach

- Wave climate ~1 km offshore, west portion (output location W6a):

ARI (years)	Depth (m)	Hs (m)	DIR (deg)	Tp (s)
5	12.5	4.03	207	9.5
10	12.5	4.20	207	9.5
25	12.5	4.59	205	10.0
50	12.5	4.77	205	10.0
100	12.5	4.94	205	10.0

- Wave climate ~1 km offshore, east portion (output location W6b):

ARI (years)	Depth (m)	Hs (m)	DIR (deg)	Tp (s)
5	12.2	4.34	210	9.5
10	12.2	4.51	210	9.5
25	12.2	4.90	208	10.0
50	12.2	5.06	208	10.0
100	12.2	5.22	208	10.0

Infrastructure and Ecosystem Threats

- Jetties at Graham Creek are at risk of breaching at their structure roots (north of composite sections).
- Boulton Street and Bond Head Parkette threatened by erosion due to sediment deficit.
- Bond Head Bluffs: high erosion rates and large gullies threaten homes close to the bluff edge.
- West rail line (CN and CP) entering Port Hope is at the crest of an eroding bluff.

Shoreline Management Recommendations

- Sediment bypassing from west fillet beach at Graham Creek to sediment starved shoreline fronting Bond Head Parkette and Boulton Street.
- Bond Head Bluffs: Avoid further development on hazardous lands. Monitor proximity of bluff crest to existing development and slope stability. Relocate homes at risk.
- Conservation Authority should regularly update hazard mapping at Bond Head to account for latest toe of slope, slope stability, and erosion. The 2020 hazard mapping must be updated frequently.

- Maintain naturally eroding bluff environments. Avoid rezoning agricultural land for residential development along gully dominated shoreline.
- Relocated buildings along high bluff environments susceptible to erosion and slope stability hazards.
- Implement floodproofing measures for development on low lying lands adjacent to the lake (Port Granby, Port Britain).
- Monitor rail line west of Port Hope and upgrade shore protection as required.
- West Beach at Port Hope would benefit from dune and vegetation restoration to stabilize the back beach and enhance local habitat.
- Mechanical bypassing of sediment from Port Hope West Beach to East Beach to avoid sedimentation in the navigation channel.

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