Monkstown Marina Development, Monkstown, Co. Cork

Phase II Marina Development

Coastal Processes Report

Date: 16 *July 2009*
(Rev.1)

Job No: *C/285*

Client: *Monkstown Bay Marina Company Ltd.*

Cronin Millar
Consulting Engineers
Civil • Marine • Structural • Environmental

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Revision Control Table & Document History Record

Rev.	Date	Description & Reason for Issue	Orig.	Chkd.	App.
1	*16/07/09*	*For EIS/FI*	*SMC/AC*	*AC*	*AC*

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1.0 Introduction

1.1 Background to Study

A planning application was lodged with Cork County Council for the Monkstown Marina Phase II development. As part of the Request for Further Information issued by the planning authority, an EIS was requested. The EIS was to *"include information regarding the impact that the land reclamation and dredging will have on the coastal area in the vicinity of the site re: accretion and erosion of the shoreline."*

This report presents the findings of an examination of the impact of the development on the localised coastal processes, with particular emphasis on the potential changes to the erosion and accretion regime at and adjacent to the site.

1.2 Site Description

The proposed marina location is on the west shore of Monkstown, Cork Harbour (see figs. 1 & 2). The site is positioned on the right hand river bank adjacent to Monkstown Creek, which is an extensive mudflat area. The existing shoreline at the site includes a vertical seawall at the upper reaches of the foreshore. The intertidal area is overlain by coarse silts and sands which are underlain by dense sand and cobbles, with areas of loose clay and rock.

The location of the proposed development is an area where the river velocity decreases substantially due to the plan form of the river/estuary and the topography of the area. Monkstown creek is a natural deposition area for the river sediments due to this velocity decrease. The footprint of the proposed development is at the upstream edge of this depositional area.

1.3 Proposed Development

The proposed development involves the reclamation of foreshore for the purposes of providing a platform for the landside element of the project. The reclaimed platform boundary will be comprised of a rock armour revetment. This type of structure will have a rough surface finish. The finished platform level will be +3.5m OD Malin.

The development also includes the capital dredging of a basin to accommodate the floating marina infrastructure. The depth of dredging will vary throughout the site depending on the size/depth of vessel throughout the marina, in an attempt to minimize the amount of dredging required. The dredging will be carried out to between -3.73 CD to -5.93 CD. It is proposed to over dredge the basin by approximately 0.5m, to increase the period between maintenance dredging operations.

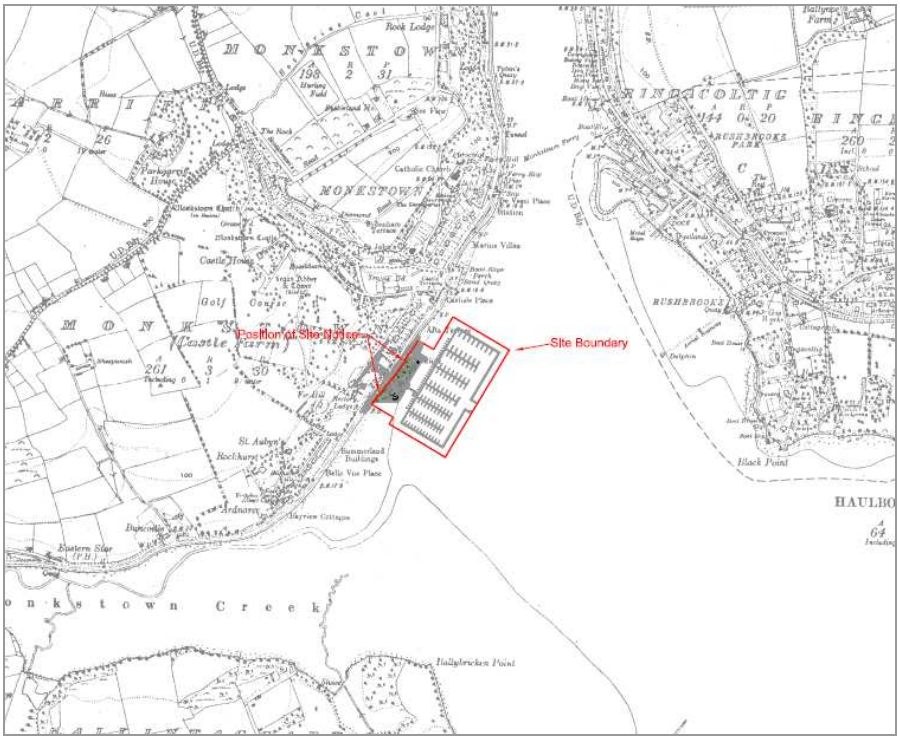


Fig. 1 – Location of Marina Development

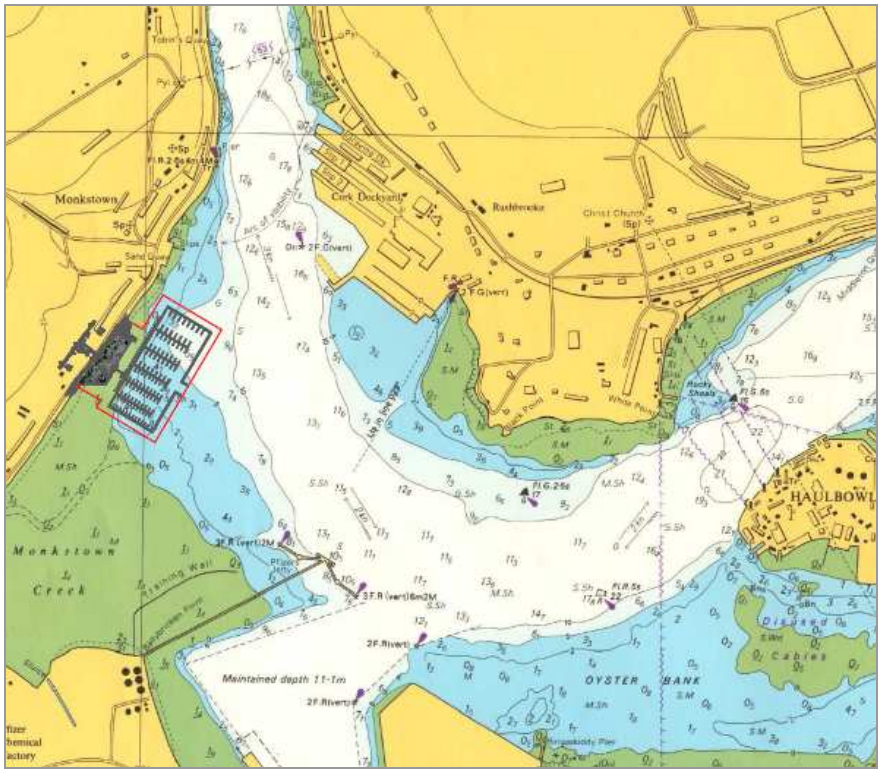


Fig. 2 – Admiralty Chart

2.0 Hydrodynamic Modelling

2.1 Software

The potential impacts of the proposed development on the tidal regime, sediment transport and coastal processes in the area surrounding the development were investigated using the DYNLET 1 Dimensional numerical hydrodynamic model.

DYNLET (DYNamic behavior of tidal flows at inLETs) is a powerful 1-D hydrodynamic model for riverine, estuarine and costal modeling, which was developed by the US Corp of Engineers. DYNLET predicts tide dominated velocities and water level fluctuations at inlets, estuaries and backwater systems. The model solves the full one-dimensional shallow water equations employing an implicit finite difference technique.

2.2 Methodology

The existing scenario was modeled to provide baseline bathymetric, velocity and flow patterns at the proposed site and in the surrounding area. The proposed development including the reclamation and dredging works were then input into the model and the changes in relevant parameters recorded.

Offshore waves propagating through the mouth of Cork Harbour have a negligible effect on the site. The area is relatively sheltered in all directions from local wind generated waves due to the layout and topography of the harbour. Shelter from the predominant south west to west sectors is provided by the shores of Monkstown and Ringaskiddy. The site is more exposed to the north and south east sectors.

The following scenarios were modelled:

- Springs tides (existing)
- Spring Tides (proposed development)
- Neap Tides (existing)
- Neap Tides (proposed development)

Wind factors were input for each scenario

Mannings Coefficient (roughness factor) was altered for each model run to examine the impact of the substrate roughness on the output results.

2.3 Data Sources

The topographic and bathymetric information was obtained from the British Admiralty Charts (no's. 1773 and 1777) and localised topographic and bathymetric survey results.

Wave data was obtained from the Cronin Millar Wave Climate Study report which was prepared for the Monkstown Marina Phase I development.

Tidal and river flow data was obtained from British Admiralty sources.

Wind data was obtained from BS6399-1:1996 (as recommended by HR Wallingford when site specific data is unavailable).

A summary of the tidal and wind data is included on the following pages.

2.3.1 Tidal Data

Tide level information for Cork Harbour (Cobh) is as follows:

Tide Datum	HAT	MHWS	MHWN	MLWN	MLWS	LAT
Tide Level (CD)	+4.5m	+4.1	+3.2	+1.3	+0.4	-0.1

Cork Harbour Tide Level Information (Adapted from Admiralty Tide Tables)

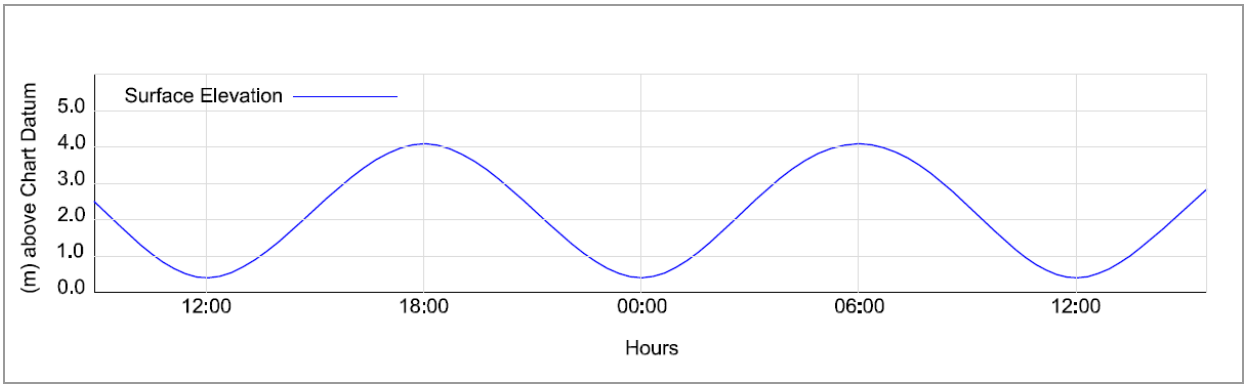


Fig. 3 – Spring Tidal Curve

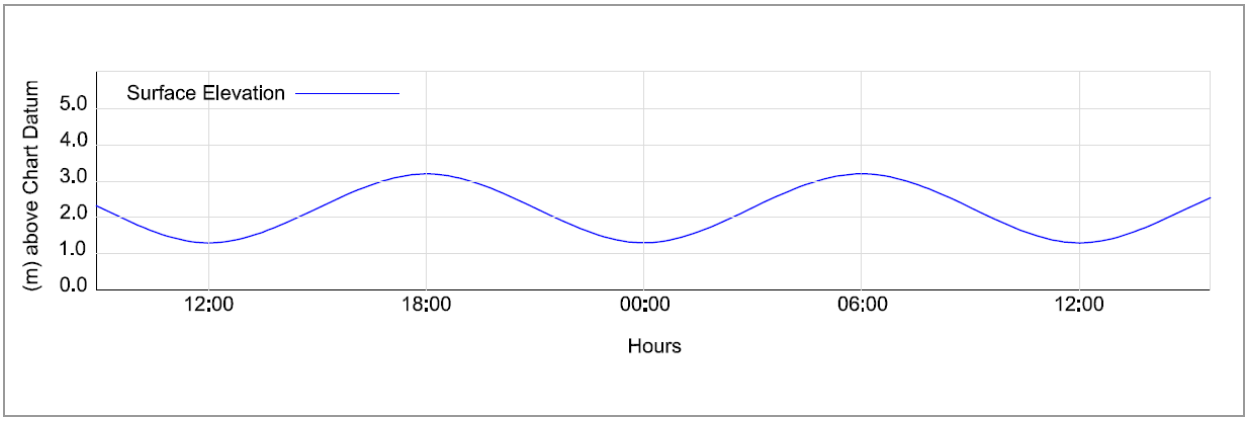


Fig. 4 – Neap Tidal Curve

2.3.2 Currents

The maximum charted current in the vicinity of the marina is 1.5m/s (3kt) for both the ebbing and flooding tide. This is charted for the centre of the navigation channel.

2.3.4 Wind Data

The following wind speed data was obtained for the Cork Harbour site for a maximum wind speed averaged over 15 minutes:

Return Period (years)	1	5	10	20	50	100
Wind Direction	**Wind Speed (m/s)**					
0^O North	13.28	16.45	17.44	18.43	19.82	20.81
30^O	12.43	15.39	16.32	17.25	18.55	19.48
60^O	12.43	15.39	16.32	17.25	18.55	19.48
90^O East	12.60	15.61	16.54	17.48	18.81	19.75
120^O	12.43	15.39	16.32	17.25	18.55	19.48
150^O	13.62	16.87	17.89	18.90	20.33	21.35
180^O South	14.48	17.93	16.96	20.08	21.60	22.68
210^O	15.83	19.61	20.79	21.98	23.63	24.81
240^O	17.02	21.09	22.36	23.63	25.41	26.68
270^O West	16.85	20.88	21.14	23.40	25.16	26.41
300^O	15.50	19.20	20.35	21.50	23.12	24.28
330^O	13.96	17.29	18.34	19.38	20.84	21.88

Fig. 5 - Design Wind Speeds (Adapted from BS6399-1:1996)

Adjusted Wind Speed					
Fetch No	**Fetch Distance (m)**	**Orientation (deg)**	**V (m/s)**	**Sw**	**U_a (m/s)**
1	3280	7	20.50	1.21	24.83
2	1720	103	19.35	1.14	22.06
3	2390	116	19.51	1.18	23.02
4	870	182	22.82	1.08	24.65
5	1470	232	26.18	1.12	29.32

Where *V =* *Design Wind Speed (from Table 2)*
Sw = *Over-water speed-up factor (from McConnell (1998))*
U_a = *Adjusted wind speed*

Fig. 6 - Adjusted Wind Speeds

2.3.5 Wave Data

Fetch No.	Fetch Length (m)	Hs (m)	Tp (sec)	Tm (sec)
1	3280	0.808	2.918	2.392
2	1720	0.527	2.306	1.891
3	2390	0.637	2.571	2.108
4	870	0.405	1.939	1.590
5	1470	0.641	2.454	2.012

Fig. 7 – Site Wave Characteristics (See Fetch Map page 11)

3.0 Existing Scenario

The conditions at the existing site were modelled using the DYNLET modelling software for both the spring and neap tidal cycles. The estuarine area around the site was modelled, based on cross section transects at and upstream and downstream of the site. Each transect records the water level (stage), velocity, and discharge at pre set nodes.

The outputs from all nodes and transects were examined, with particular emphasis on the area of the proposed development.

A chart showing the position of the transects and the corresponding cross section stations are depicted on the following pages.

The graphs showing the outputs for selected nodes and stations at and around the site are included in the appendix. A summary of the outputs for the existing scenario is as follows:

Node	Max & Min Velocity (m/sec.) (Spring Tides)	Velocity Average (m/sec.)	Max & Min Velocity (m/sec.) (Neap Tides)	Velocity Average (m/sec.)
4	0.65 Max 0.32 Min	0.45	0.65 Max 0.32 Min	0.45
5	0.82 Max 0.44 Min	0.63	0.82 Max 0.3 Min	0.55
6	0.77 Max 0.39 Min	0.57	0.77 Max 0.4 Min	0.57

Fig 8 – Summary of Velocity Outputs (Existing Scenario)

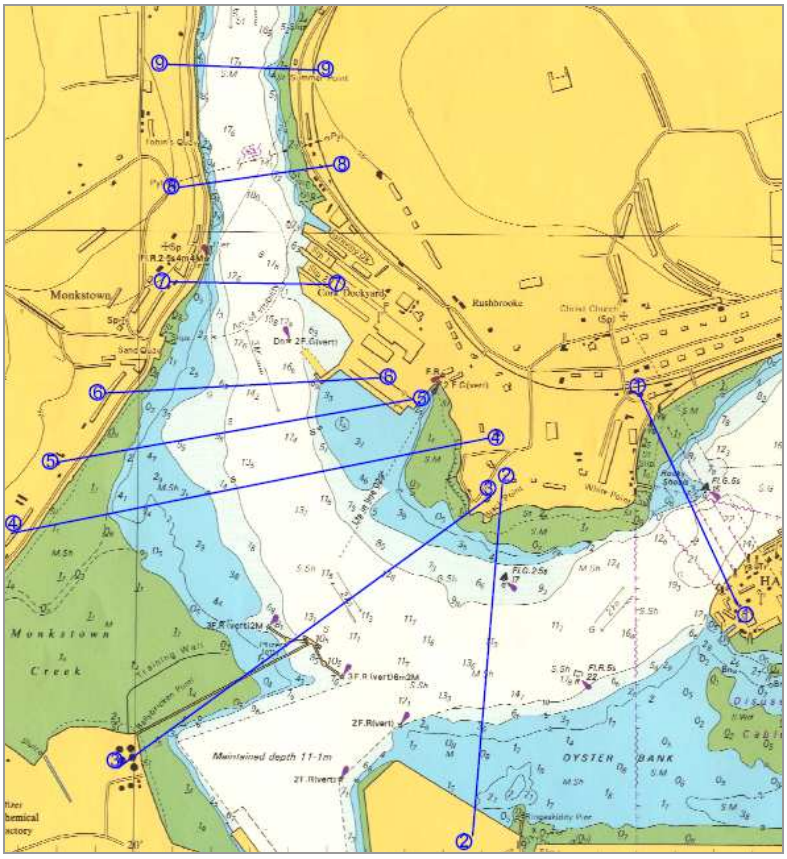


Fig. 9 – Model Transects (Existing)

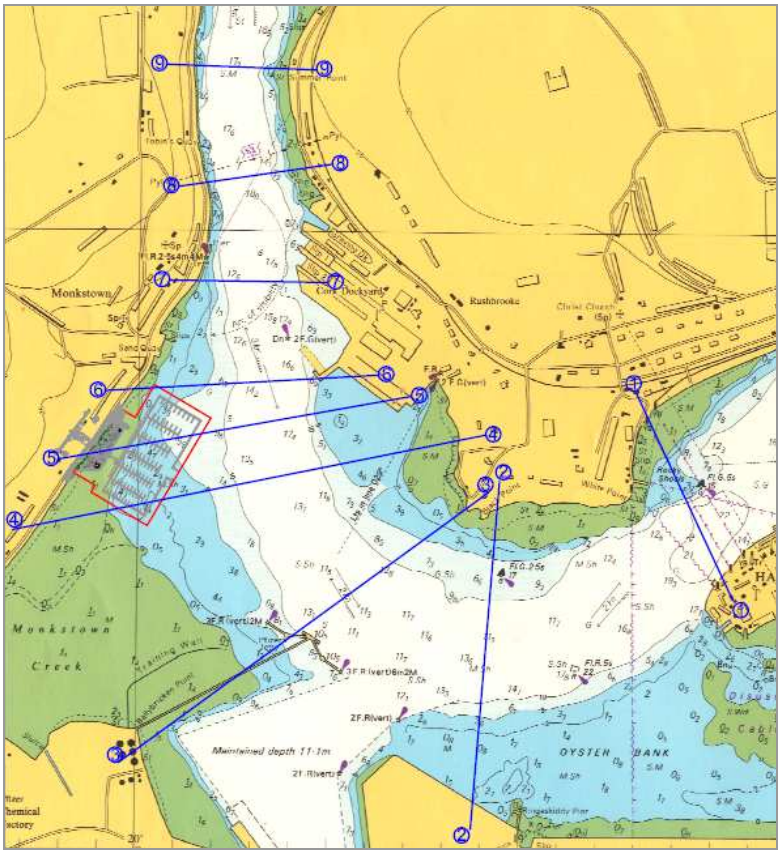
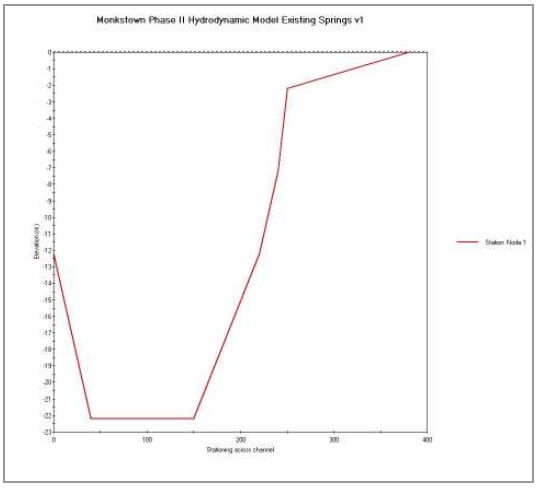
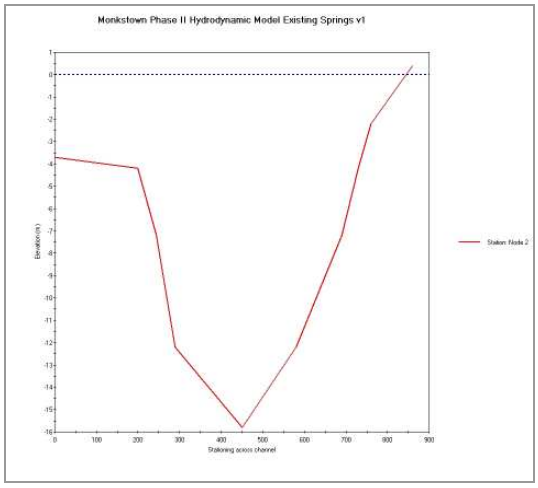


Fig. 10 – Model Transects (Proposed Development)



Node1 (Existing)



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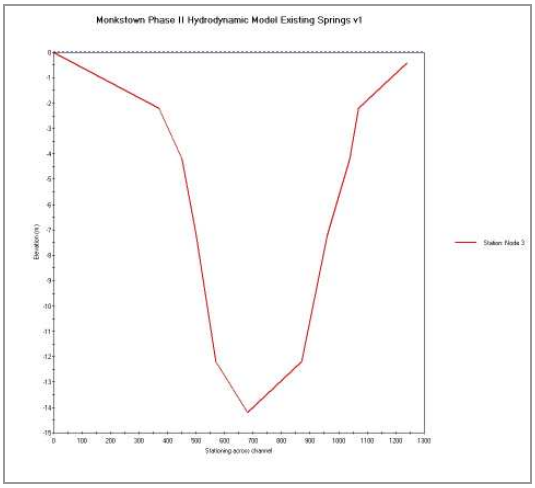
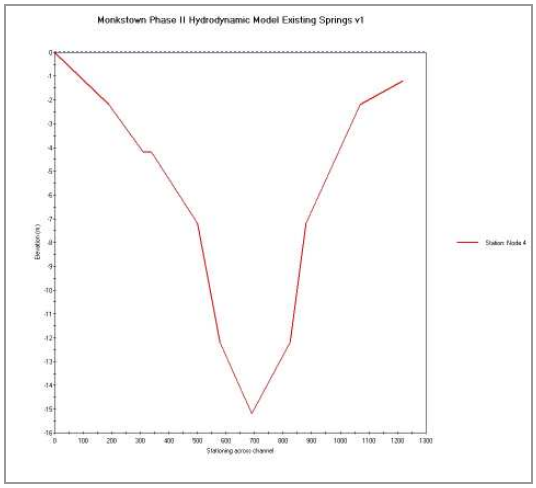
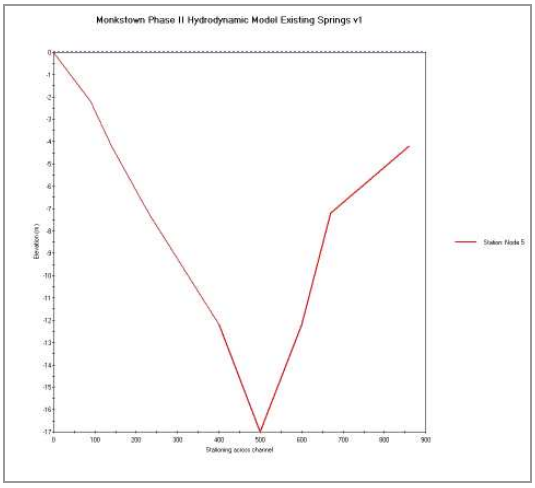


Node 3 (Existing)



Node 4 (Existing)



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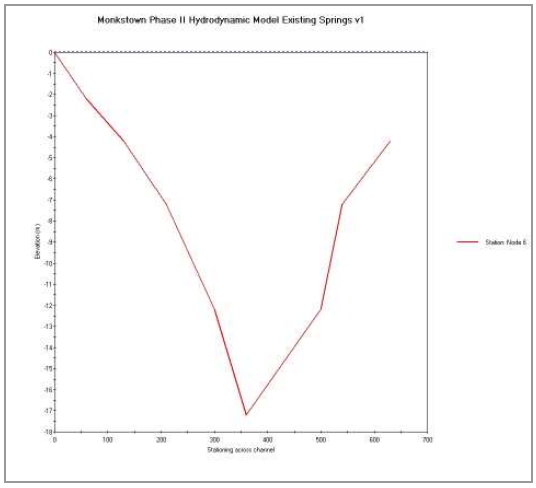
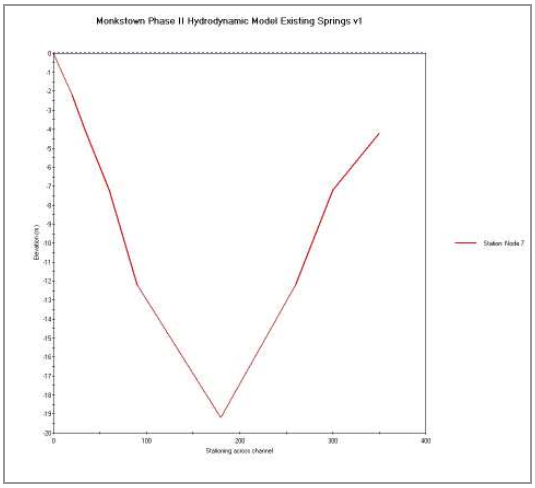


Node 6 (Existing)



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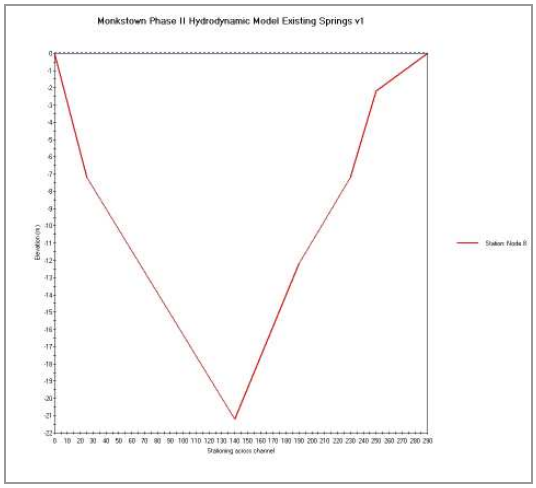
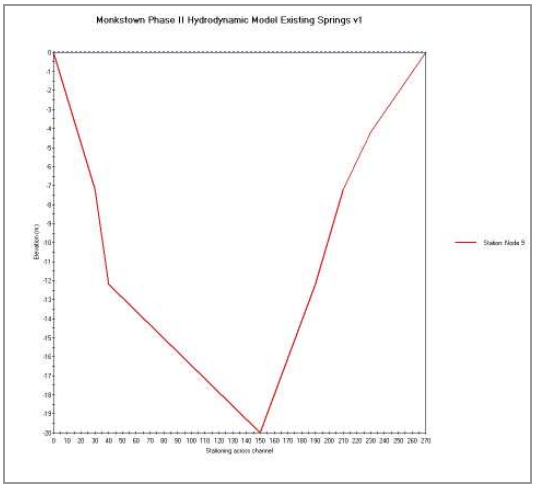
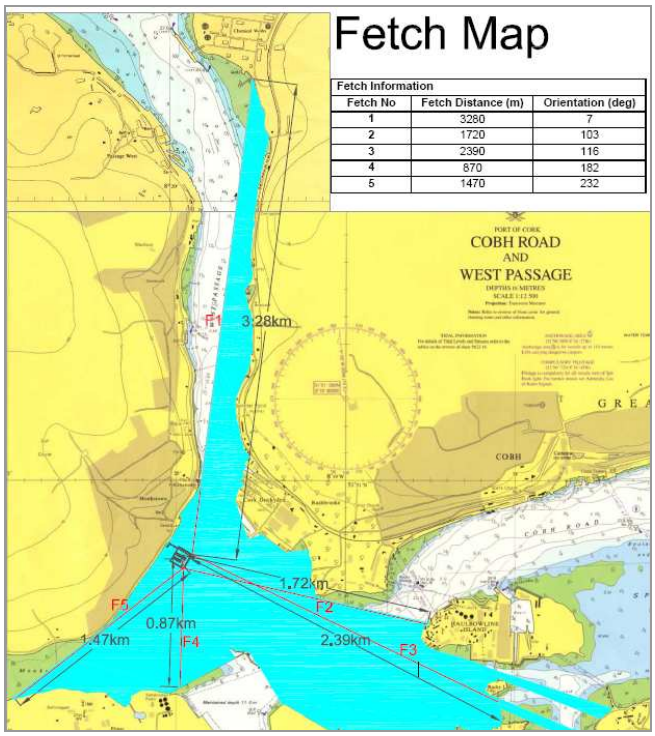


Node 8 (Existing)



Node 9 (Existing)



Fetch Map (Wind & Wave Data)

4.0 Proposed Development Scenario

The conditions at the site with the proposed development inputted were modelled using the DYNLET modelling software for both the spring and neap tidal cycles. The estuarine area around the site was modelled, based on cross section transects at and immediately upstream and downstream of the site. Each transect records the water level (stage), velocity, and discharge at pre set nodes.

The outputs from all nodes and transects were examined, with particular emphasis on the area of the proposed development.

A chart showing the position of the transects and the corresponding cross section stations is depicted on page 10.

The graphs showing the outputs for selected nodes and stations at and around the site are included in the appendix. A summary of the outputs for the proposed scenario is as follows:

Node	Max & Min Velocity (m/sec.) (Spring Tides)	Velocity Average (m/sec.)	Max & Min Velocity (m/sec.) (Neap Tides)	Velocity Average (m/sec.)
4	0.63 Max 0.36 Min	0.48	0.63 Max 0.36 Min	0.48
5	0.81 Max 0.29 Min	0.55	0.81 Max 0.28 Min	0.55
6	0.77 Max 0.42 Min	0.57	0.77 Max 0.42 Min	0.57

Fig 11 – Summary of Velocity Outputs (Proposed Scenario)

5.0 Comparison & Conclusion

.

5.1 Comparison of Results

Node	Max & Min Velocity (m/sec.) (Spring Tides)	Velocity Average (m/sec.)	Max & Min Velocity (m/sec.) (Neap Tides)	Velocity Average (m/sec.)
4	0.65 Max 0.32 Min	0.45	0.65 Max 0.32 Min	0.45
5	0.82 Max 0.31 Min	0.55	0.82 Max 0.3 Min	0.55
6	0.77 Max 0.39 Min	0.57	0.77 Max 0.4 Min	0.57

Existing

Node	Max & Min Velocity (m/sec.) (Spring Tides)	Velocity Average (m/sec.)	Max & Min Velocity (m/sec.) (Neap Tides)	Velocity Average (m/sec.)
4	0.63 Max 0.36 Min	0.48	0.63 Max 0.36 Min	0.48
5	0.81 Max 0.29 Min	0.55	0.81 Max 0.28 Min	0.55
6	0.77 Max 0.42 Min	0.57	0.77 Max 0.42 Min	0.57

Proposed Development

As can be seen from the above summary tables, the proposed development will have very little impact on the water velocities at and around the site of the proposed marina. Velocity graphs from all of the above outputs, in a combined format are included in the appendix.

The maximum deviations from the existing velocities will occur at the following points:

Node 4, Station 2 (Neaps)
This location is at the downstream end of the marina on the edge of the dredged basin area. The model has predicted that the velocity will increase from 0.32 m/sec. to 0.35 m/sec. An increase of 0.03 m/sec.

Node 6, Station 2 (Springs)
This location is at the upstream inner corner of the development, close to the seawall. The model has predicted that the velocity will increase from 0.38 m/sec. to 0.42 m/sec. An increase of 0.04 m/sec.

5.2 Summary & Conclusion

The potential impacts of the proposed development on the tidal regime, sediment transport and coastal processes in the area surrounding the development were investigated using the DYNLET 1 dimensional numerical hydrodynamic model.

The existing scenario was modeled to provide baseline bathymetric, velocity and flow patterns at the proposed site. The proposed development including the reclamation and dredging works were then input into the model and the changes in relevant parameters recorded.

The location of the proposed development is an area where the river velocity decreases substantially due to the plan form of the river/estuary and the topography of the area. Monkstown creek is a natural deposition area for the river sediments due to this velocity decrease. The footprint of the proposed development is at the upstream edge of this depositional area.

The existing seabed substrate is comprised of silt, sands and gravels at varying depths. The silts are cohesive in nature.

Reclamation

The proposed development involves the reclamation of foreshore for the purposes of providing a platform for the landside element of the project. The results of the hydrodynamic modeling showed that the construction of the reclaimed platform will have a very minimal impact on the current velocities in the area.

Dredged Basin

The proposed development includes the capital dredging of a basin to accommodate the floating marina infrastructure. The depth of dredging will vary throughout the site depending on the size/depth of vessel throughout the marina, in an attempt to minimize the amount of dredging required. The dredging will be carried out to between -3.73 CD to -5.93 CD. It is proposed to over dredge the basin by approximately 0.5m, to increase the period between maintenance dredging operations. The results of the hydrodynamic modeling showed that the capital dredging will have a very minimal impact on the current velocities in the area.

Impacts of Development

The proposed development will have only a negligible impact on the coastal processes in the area. The development will not have any impact on water levels. The maximum increase in current velocities, which will occur within or immediately adjacent to the development will be 0.04 m/sec.

Based on the composition of the seabed, it is unlikely that any additional erosion or accretion will occur as a result of the development.

It is however possible that localised deposition will occur at the upstream side of the proposed slipway and at the upstream end of the rock armour revetment face, due to the physical configuration of these structures. This will be very minor in nature and will not result in any negative impacts.

It is likely that re-siltation of the dredged basin will occur over a period of time. It is difficult to predict the time frame for re-siltation of the basin, but it is expected that maintenance dredging will be required approximately every ten to twelve years.

The dredging operations will result in the suspension of sediments into the water column. It is proposed to restrict dredging operations to the ebb cycle of the tide to ensure that any suspended sediment will be carried out into the main river channel.

The dredge arisings will be disposed of via two routes. Suitable material will be used as fill for the reclaimed platform, while the unsuitable silts will be dumped at sea at the licensed dredge site outside Cork Harbour. The dredging and dumping at sea operations will be subject to the granting of a foreshore licence and dumping at sea licence by the Department of Agriculture, Fisheries & Food.

Conclusion

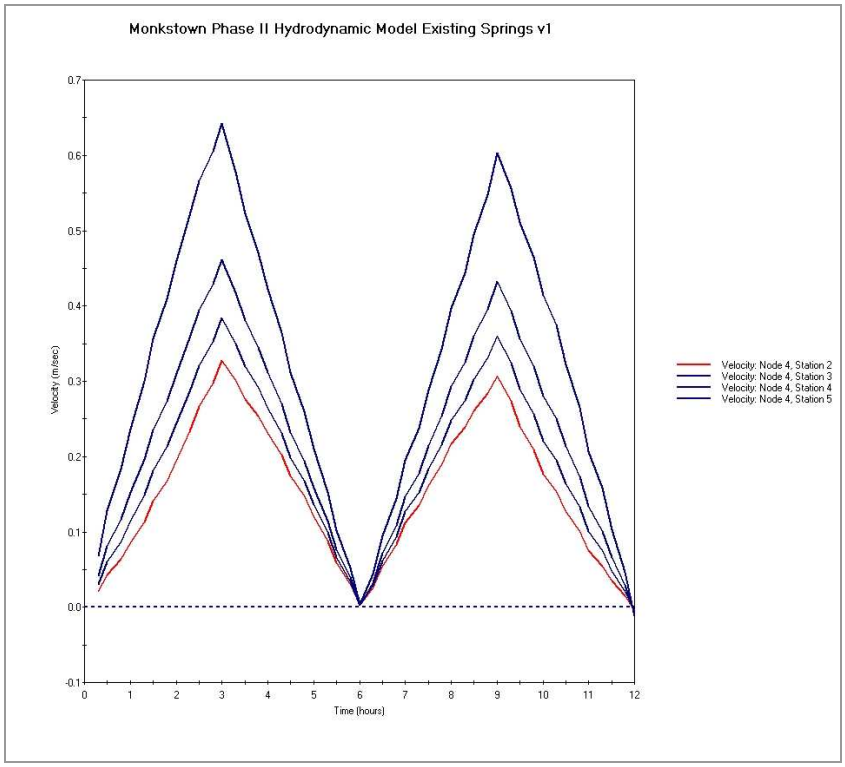
The proposed construction of a reclaimed platform and dredged marina basin will have a very limited impact on the surrounding seabed area and the coastal processes. The existing water velocities in the area are very low and the area is a natural deposition area for river sediment migrating downstream. Minor sedimentation may occur immediately upstream of the proposed slipway and at the upstream end of the rock armour revetment face.

Re-siltation of the dredged basin will occur in time, requiring ongoing maintenance dredging.

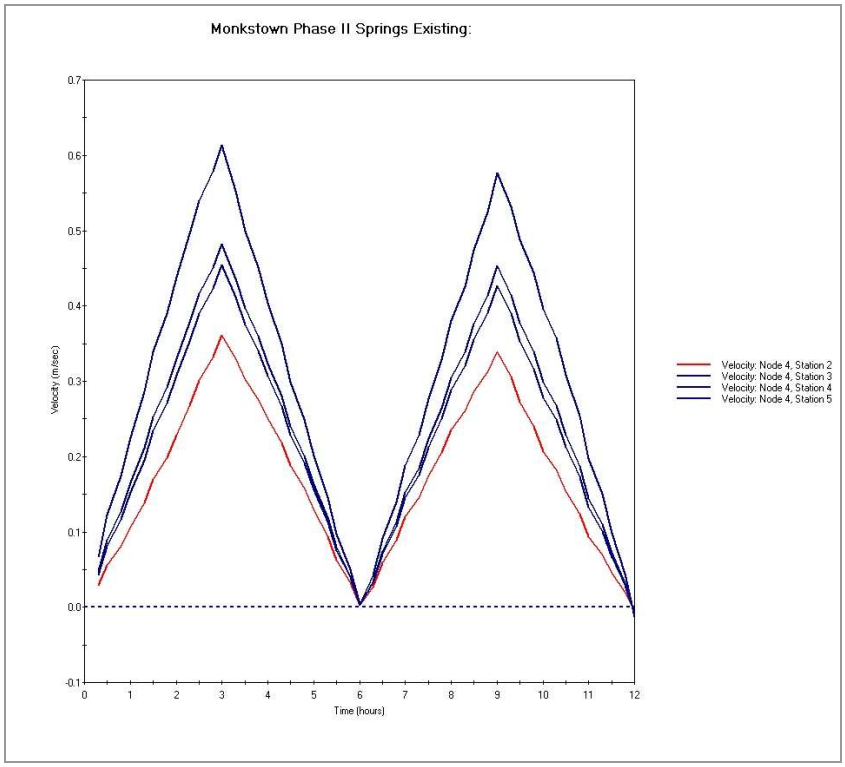
The dredging operations will result in suspension of sediments into the water column. Dredging activities will be restricted to the ebb flow of the tidal cycle to prevent ant settlement of the suspended sediments in the Monkstown Creek area.

Appendix

Node 4 Velocities – Proposed & Existing (Springs)

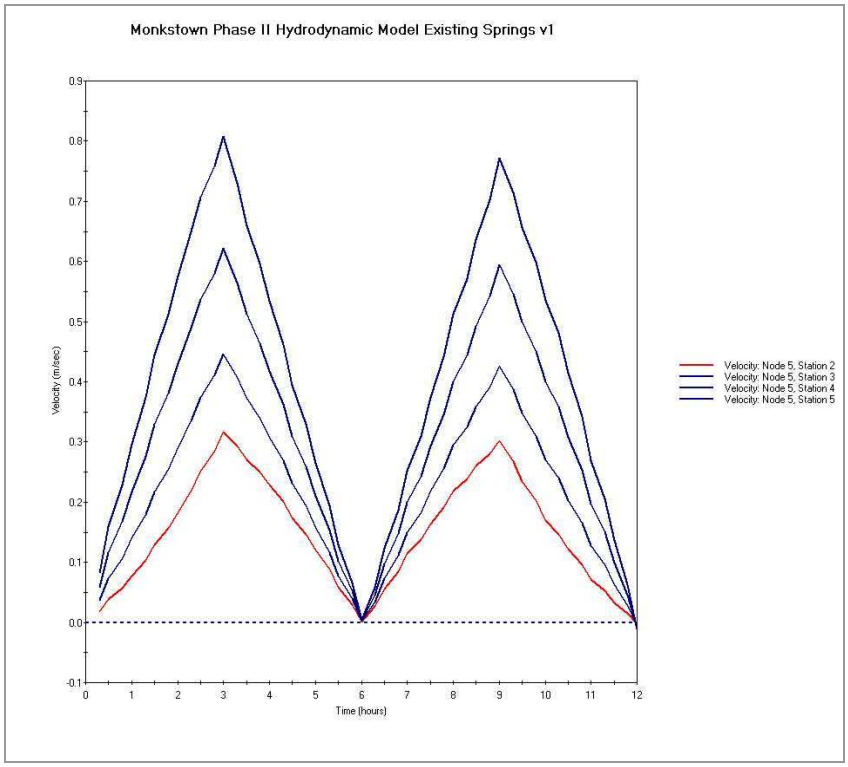


Node 4 (all stations) – Existing with Spring Tides

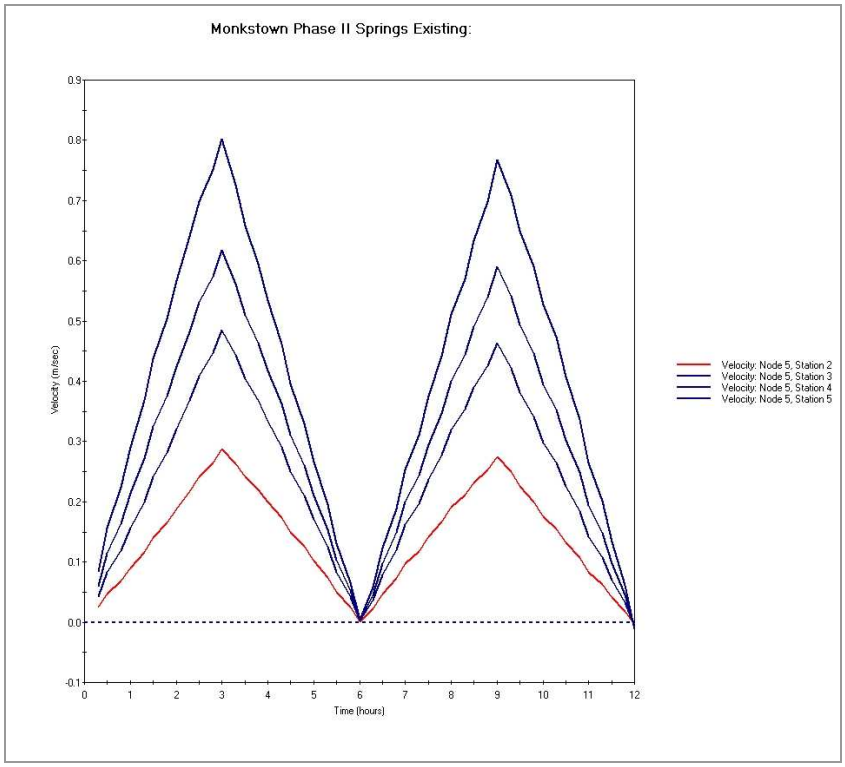


Node 4 (all stations) – Proposed with Spring Tides

Node 5 Velocities – Proposed & Existing (Springs)

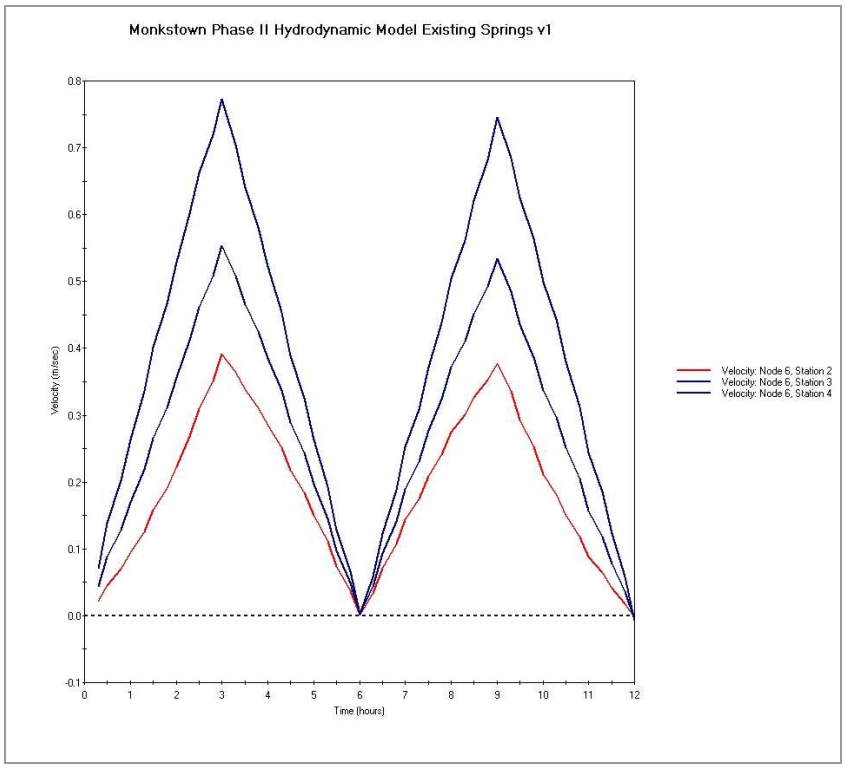


Node 5 (all stations) – Existing with Spring Tides

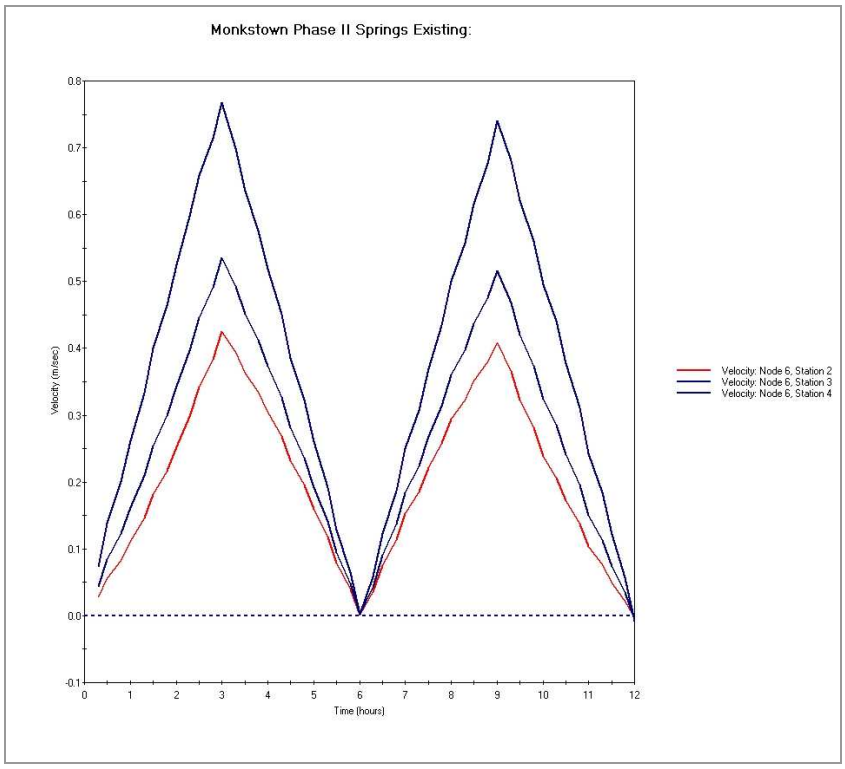


Node 5 (all stations) – Proposed with Spring Tides

Node 6 Velocities – Proposed & Existing (Springs)

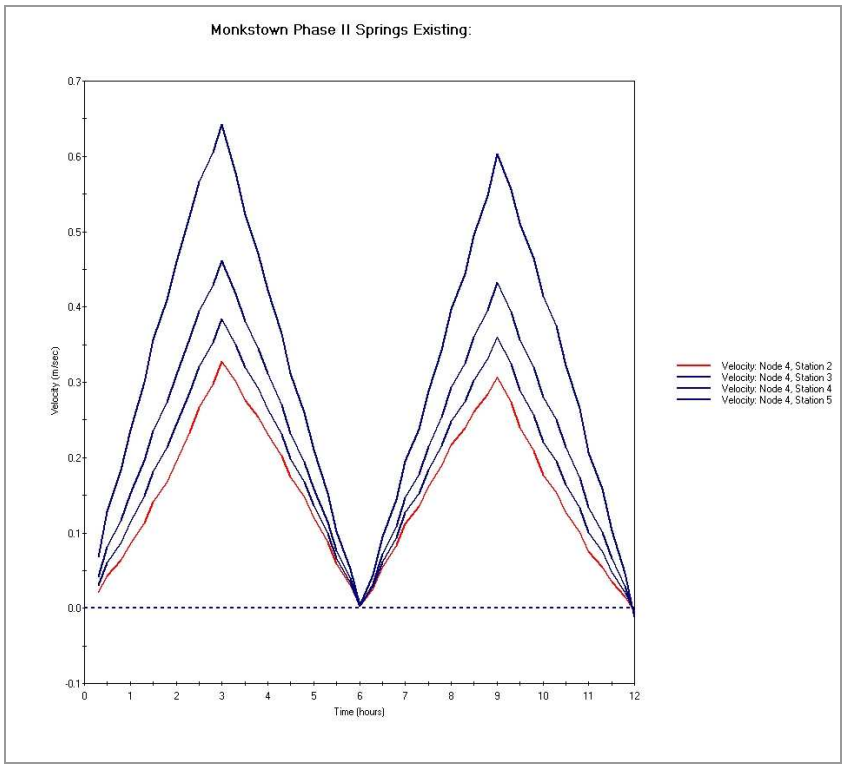


Node 6 (all stations) – Existing with Spring Tides

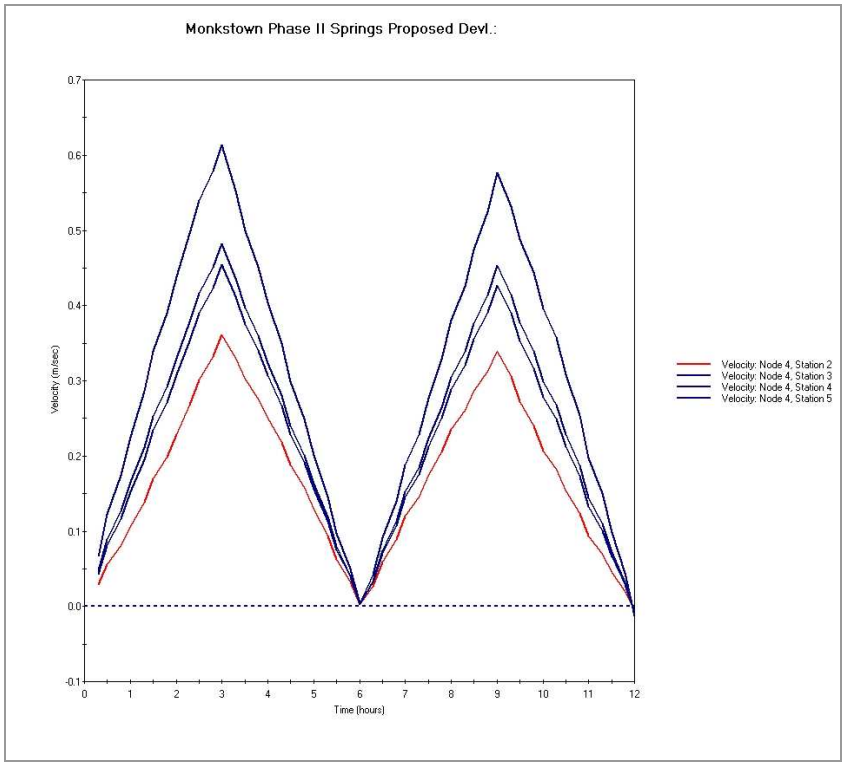


Node 6 (all stations) – Proposed with Spring Tides

Node 4 Velocities – Proposed & Existing (Neaps)

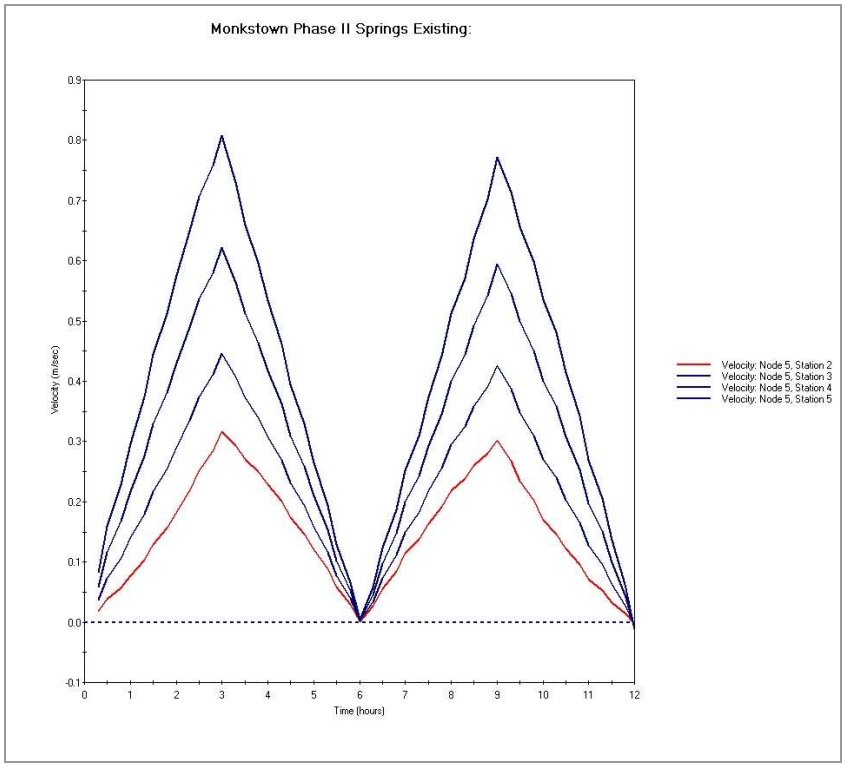


Node 4 (all stations) – Existing with Neap Tides

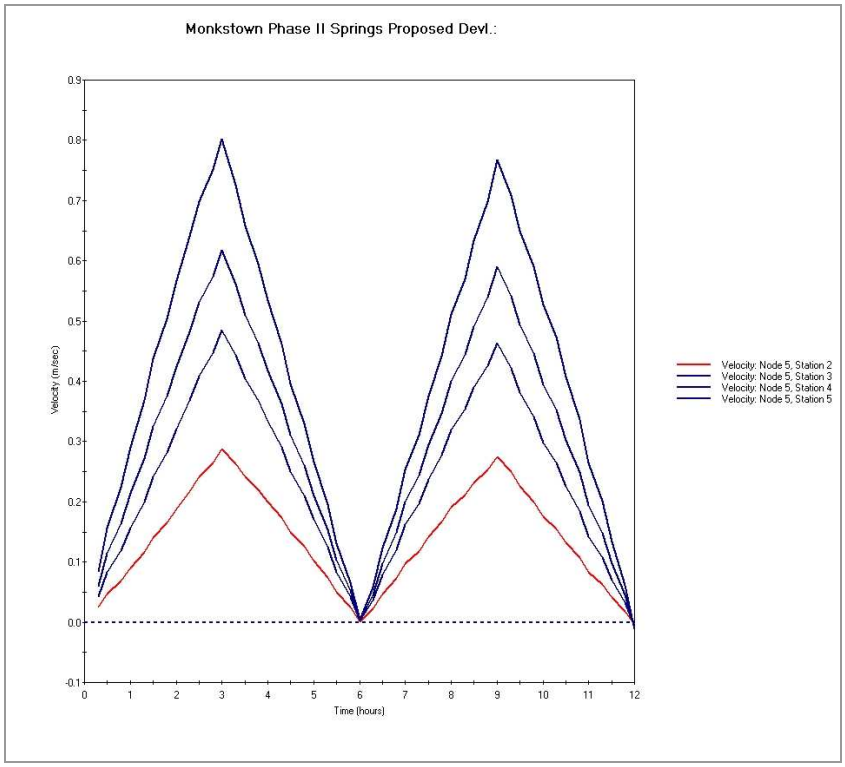


Node 4 (all stations) – Proposed with Neap Tides

Node 5 Velocities – Proposed & Existing (Neaps)

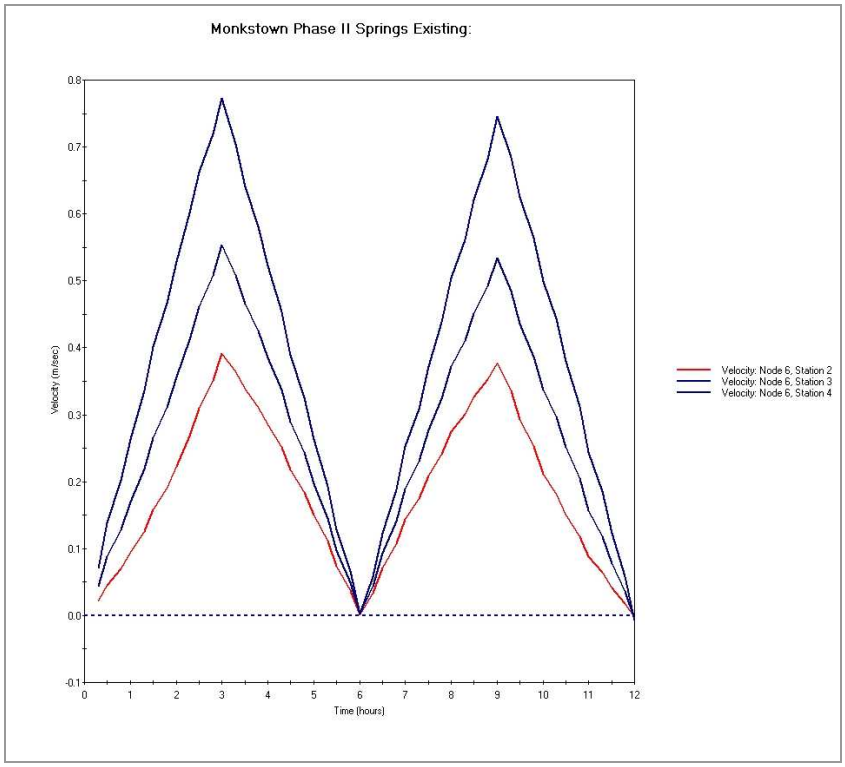


Node 5 (all stations Existing with Neap Tides

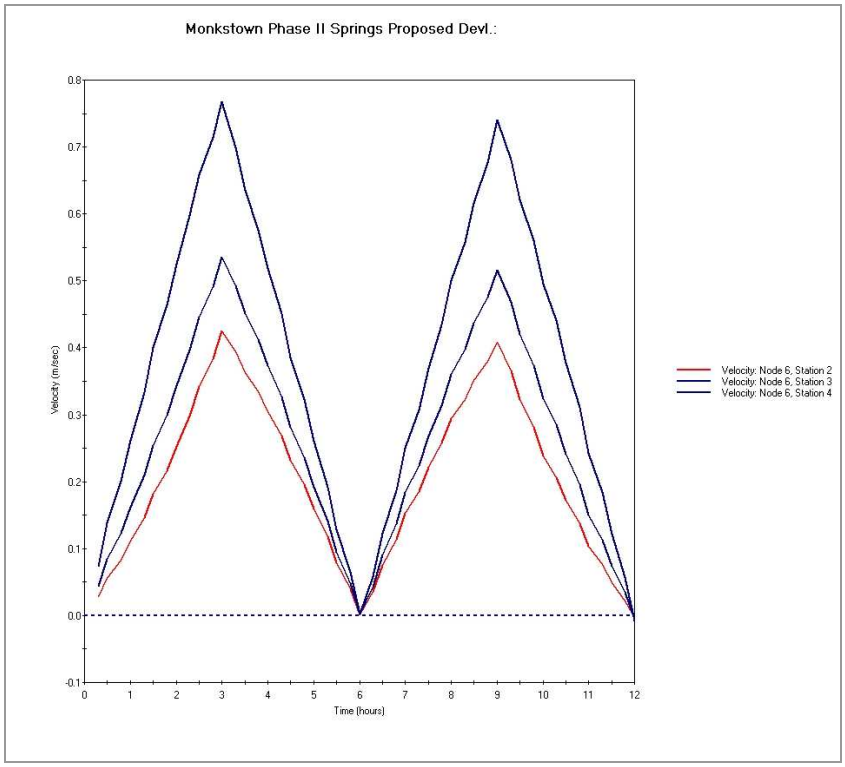


Node 4 (all stations) – Proposed with Neap Tides

Node 6 Velocities – Proposed & Existing (Neaps)



Node 6 (all stations) – Existing with Neap Tides



Node 6 (all stations) – Proposed with Neap Tides