

# An Integrated Modelling Framework for Environmental Impact Assessment of Large-Scale Arrays

M.C. Easton \*, D.K. Woolf \*, S. Pans \*\*

Work streams: 3. Wave and Tidal Effect; 4. Arrays Wakes and Near Field Effects

## Introduction

Tidal current energy is acknowledged as a key component of the United Kingdom's future energy mix. With developers now moving swiftly onto deployment of pre-commercial devices it is now important that we consider how deployment of large scale tidal energy arrays will interact with the host marine environment. The objective of this project is to construct a blueprint for environmental impact assessment by developing an extensive model for a key tidal energy site, the Pentland Firth.

## The Pentland Firth

Separating the North Coast of Great Britain and the Orkney archipelago, the Pentland Firth is recognised as one of the best tidal energy development sites in the World. Mean spring tidal current velocities here are in excess of 2.5 m/s. The Firth is complicated by the presence of tidal races, turbulent eddies, and various islands, and as a result exhibits sizeable areas of organised and random activity. A model of the existing system is therefore a prerequisite to modelling changes associated with future tidal energy development. Deadline

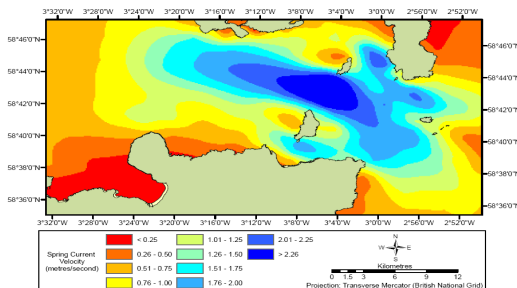


Fig 1. Mean Spring Current Velocities in the Pentland Firth, after Dillon and Woolf (2008)<sup>1</sup>

## Environmental Impacts of Tidal Energy

What might the environmental impacts of tidal current energy extraction be?

### • Increase Drag

Installations will introduce new drag elements into the flow, thereby altering the tidal currents that the devices intend to harness.

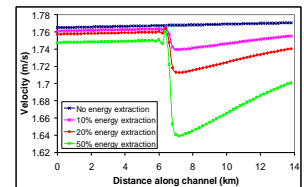


Fig. 2 Artificial drag element in channel - free surface. Fig. 3. Sample velocity reduction along channel in wake of tidal energy device. After Bryden et al. (2006)<sup>2</sup>.

### • Sedimentation Patterns

Changes in the currents and turbulence in the wake of tidal energy devices will also alter sedimentation dynamics. The characteristics of the currents and sedimentation influence the ecology of the Pentland Firth, and changes will therefore affect the whole ecosystem.

### Key Questions

What is the effect of increasing drag in the Pentland Firth?

What is the limit on how much drag we can add?

Will the environmental impacts of tidal energy extraction be at a local or regional scale?

## Initial Strategy

It is intended to construct a working model of the Pentland Firth based on the application of the DHI MIKE-21 hydrodynamic modelling software. Detailed in-situ data measurements from the firth will be used to ensure that this model can adequately simulate its true dynamics. The model will be integrated with a GIS package to simulate idealised tidal projects in the Pentland firth. Further modules, such as sedimentation transportation, can be added to build-up a complex model of the marine environment. This model will be used as a tool for constructing a blueprint for the environmental impact assessment of tidal energy arrays.

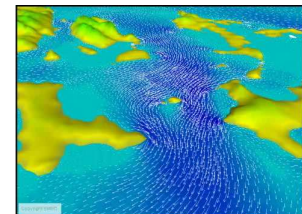


Fig 4. DHI 'Mike' modelling for European Marine Energy Centre (EMEC)<sup>3</sup>

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## References

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