



Environment
Agency



Dawlish Warren Beach Management System

Joshua Gibson, Atkins Ltd
Andrew Wareing, Atkins Ltd

Contents

- Strategic context
- Technical approach
- Finding a sustainable solution
- Scheme development
- Numerical Modelling



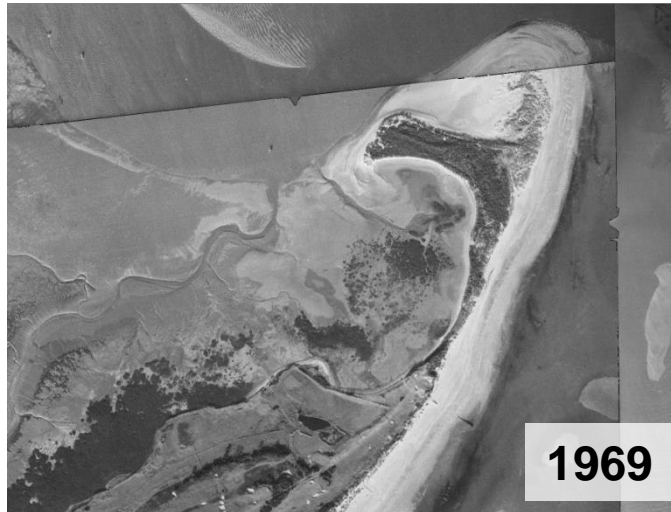
Strategic Context

- Long term management
 - Climate change
 - People and infrastructure
 - Designated environment
- Dawlish Warren sand spit
 - Storm sheltering function
 - Designated environment
 - Legacy of hard engineering

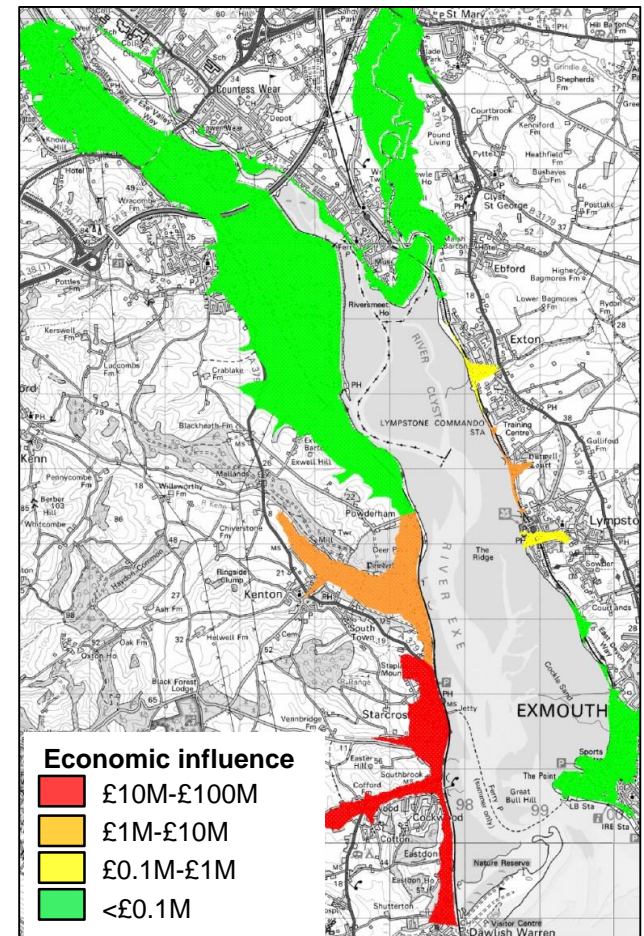
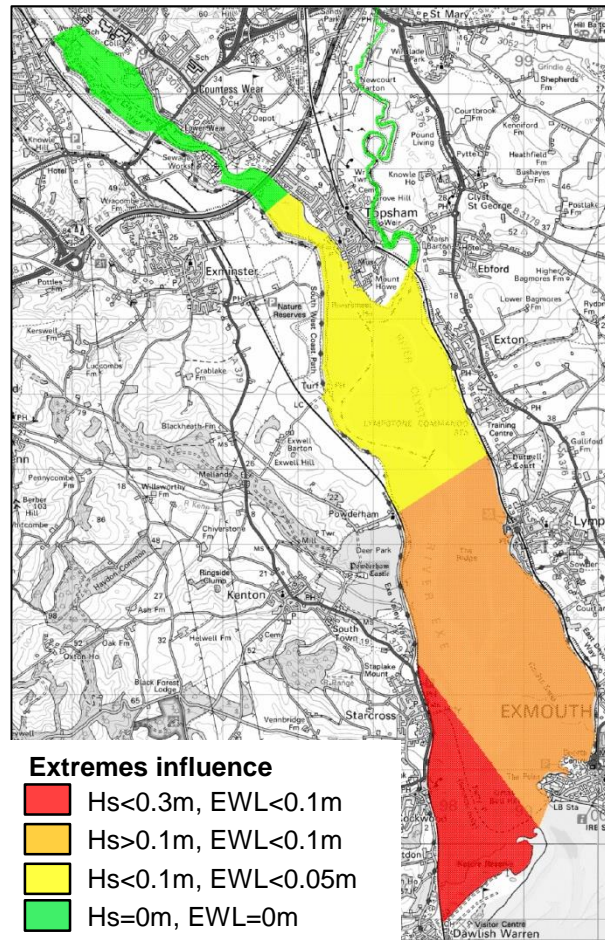
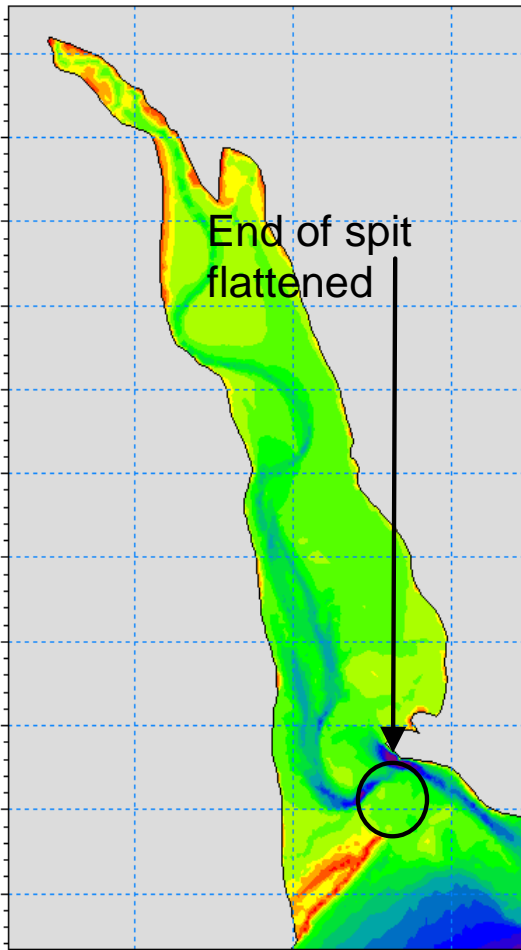


Strategic Approach: historic analysis

**Breach and flattening
of distal sand spit**



Technical Approach: economic drivers



Design development: Overview

Pole Sands

Dredging and recharge:
working with estuary scale
natural processes

Buried geotube at
the neck: improving
sheltering function

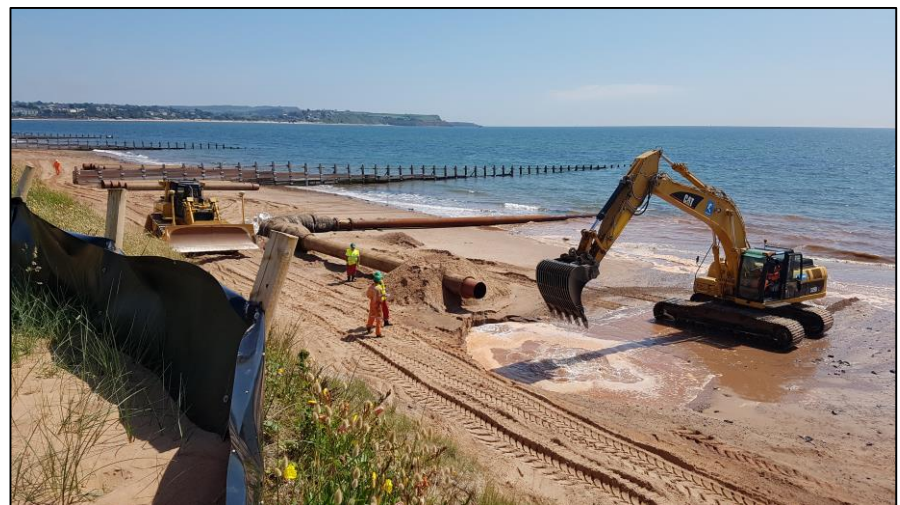
Groyne works:
improving beach
management

Gabion removal:
enhancing natural
environment

Flood wall: managing
local flood risk

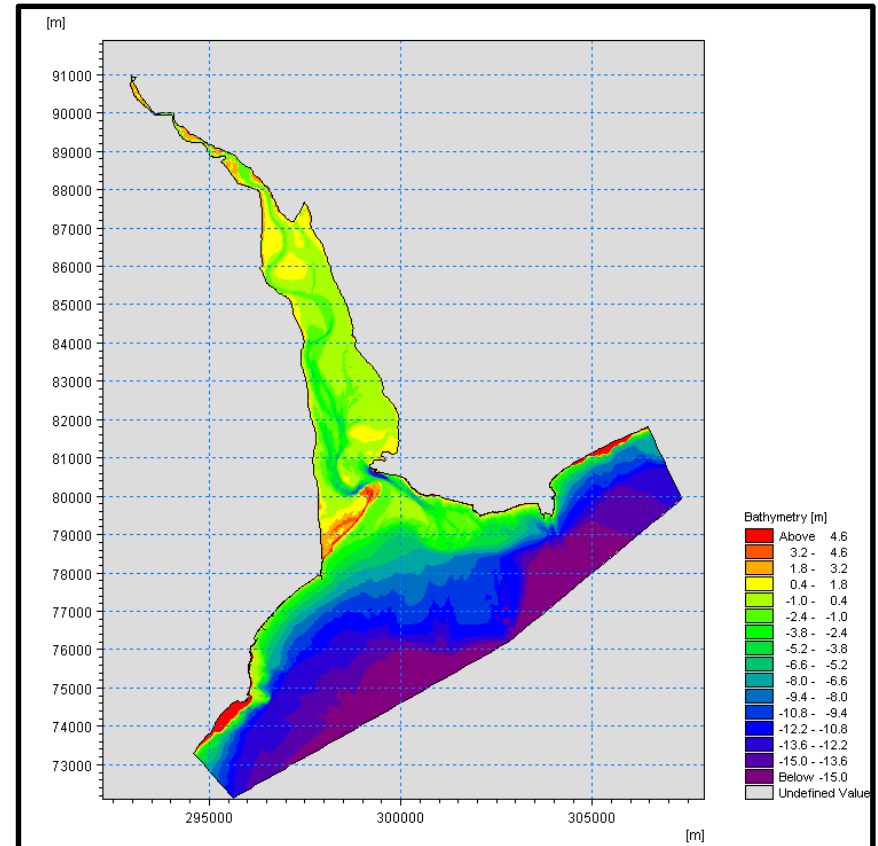


Scheme development to date



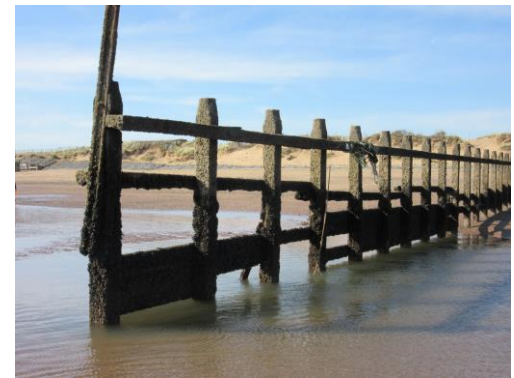
Numerical Modelling: introduction

- Need for Modelling
- Data Collection
- Modelling Approach
 - Model Build
 - Calibration and Validation
- Results
 - Impact on wave climate
 - Impact on tidal hydrodynamics
 - Dredge Plume assessment



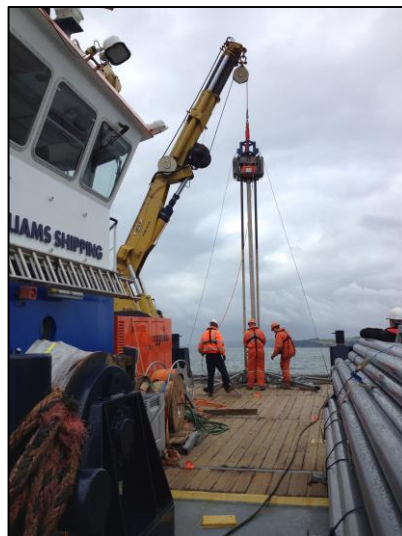
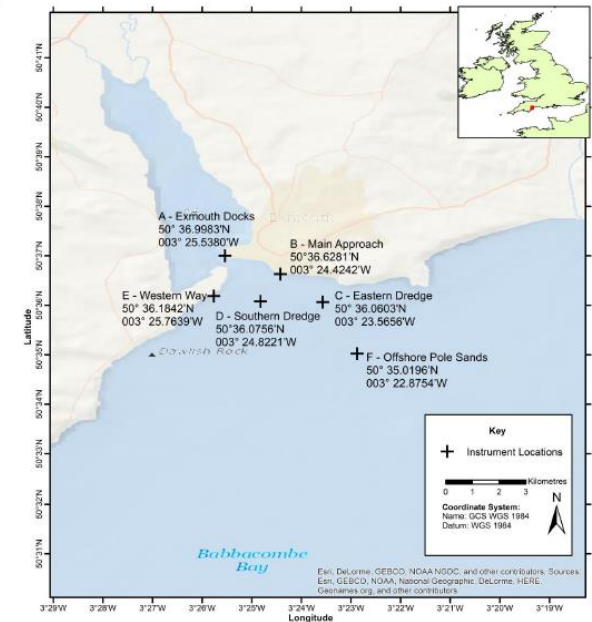
Numerical Modelling: need for modelling

- **Need for Modelling**
 - **Support the EIA**
 - WFD Assessment
 - Habitats Regulations Assessment
 - Coastal Impact Assessment
 - **Formal licencing**
 - Marine Licence
 - Crown Estate
 - Planning Permission –Teignbridge District Council
 - **Inform the design**



Numerical Modelling: data collection

- Data Collection
 - Acoustic Doppler Current Profiler
 - Tide Gauge
 - Dye release
 - Drogue
 - Vibrocore survey
 - Geophysical survey

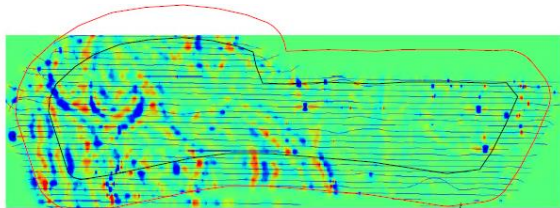


| Site | Parameter |
|--|--|
| A - Exmouth Docks | Water Levels, Currents, Wave |
| B - Exmouth Main Approach Channel | Water Levels, Currents |
| C - Pole Sands (east) | Water Levels, Currents, Wave*, Turbidity, Dye |
| D - Pole Sands (west) | Water Levels, Currents, Wave**, Turbidity, Dye |
| E - Western Way | Water Levels, Currents |
| F - Offshore | Water Levels, Currents, Wave** |

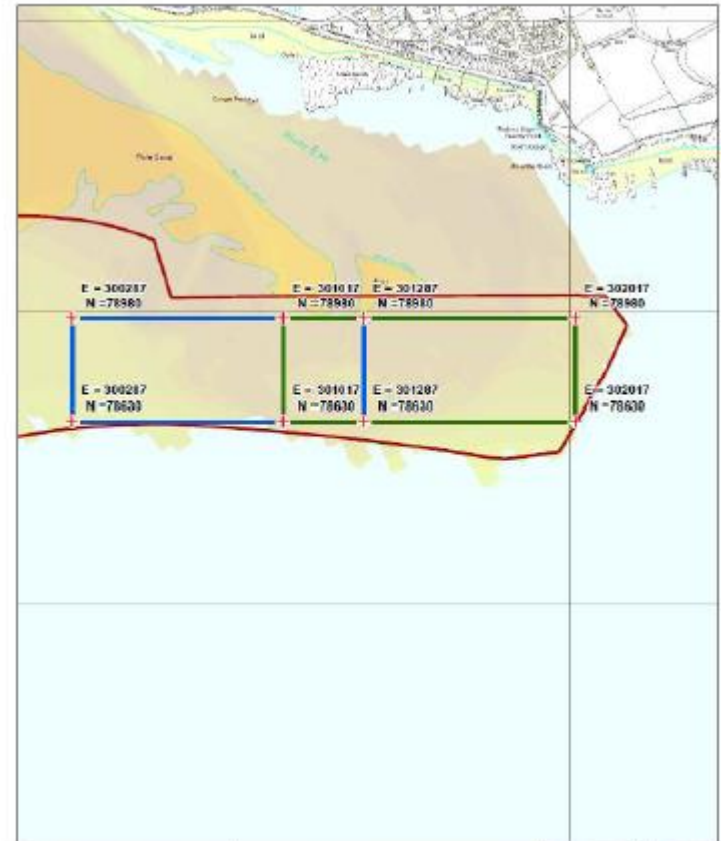
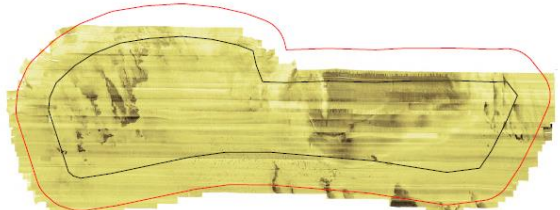
Dredge Scheme development

Dredge Areas

- **Dredge Options**
 - Eastern Site
 - Western Site
 - Combined Site
- **Scheme Representation in the model**



A. Gridded Magnetometer Data with Tracklog (x=10m)



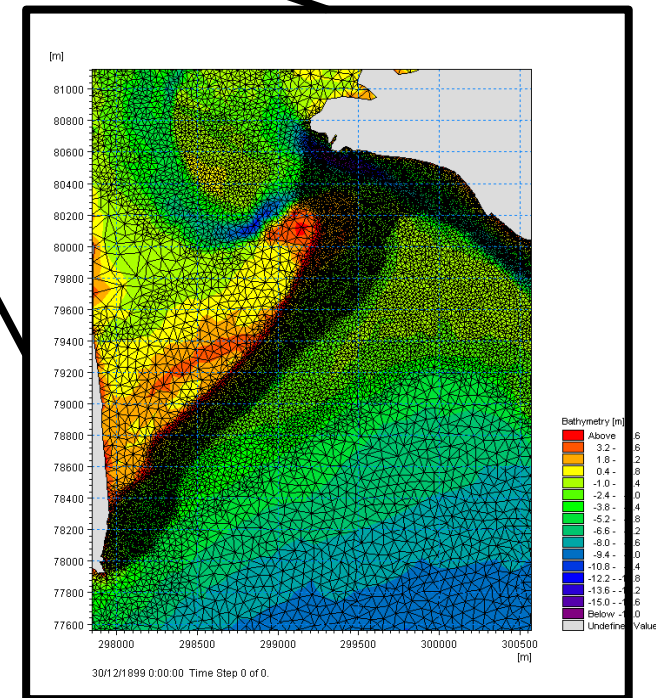
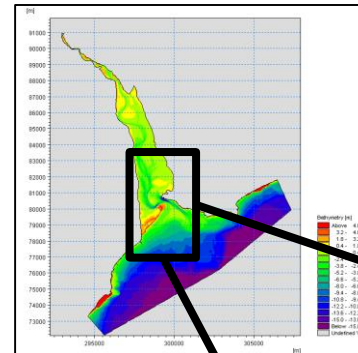
| | | | |
|--|--|--|---|
| Dawlish Warren-Exmouth BMS | | Dredge Area 2015 | |
| <ul style="list-style-type: none"> Condensed Survey Area Dredge Area (Sept 2016) West Area East Area Dredge Location Points | | <p>Scale 1:10,000</p> <p>0 0.2 0.4 km</p> <p>© Crown Copyright and the Controller of Her Majesty's Stationery Office. All rights reserved. 2015. VBA</p> |  |

Numerical Modelling: modelling approach



Modelling Methodology

- **Mesh Development**
- **MIKE21 Hydrodynamic (HD)**
 - Baseline Calibration
 - Dredge Pocket Comparison
- **MIKE21 Spectral Wave (SW)**
 - Baseline Calibration
 - Dredge Pocket Comparison
- **MIKE21 Particle Tracking (PT)**
 - Cutter Suction Dredger
 - Trailer Hopper Dredger

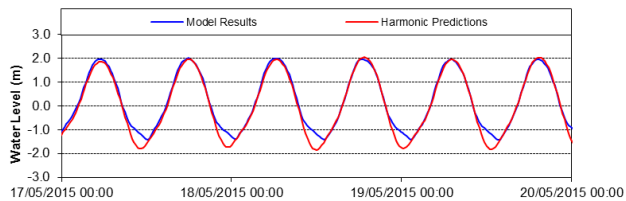


Numerical Modelling: calibration

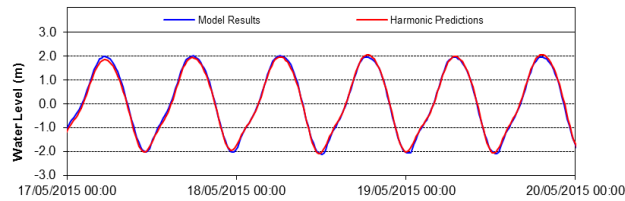


Calibration Parameters:

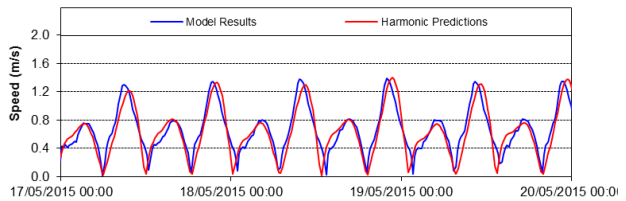
- Water Level, Current Speed & Current Direction



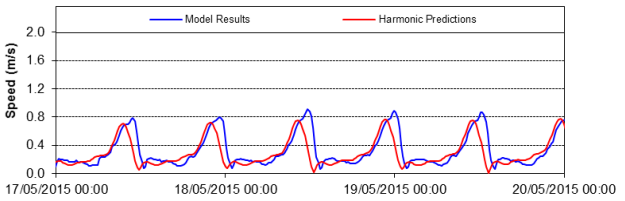
Water Level Calibration, Site B-spring



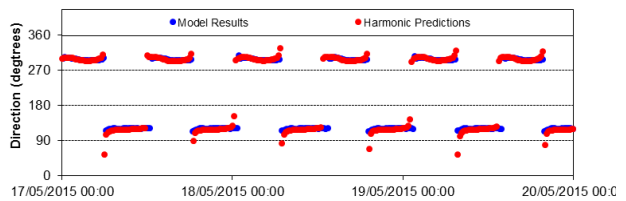
Water Level Calibration, Site C-spring



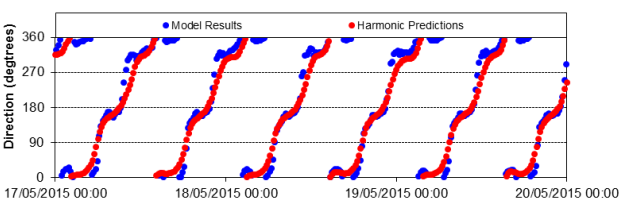
Current Speed Calibration, Site B-spring



Current Speed Calibration, Site C-spring



Current Direction Calibration, Site B-spring



Current Direction Calibration, Site C-spring

Water Level Calibration, Statistics

| Site | Percentage time tolerance achieved | Phase | Degree of Calibration |
|------|------------------------------------|---------|-----------------------|
| A | 96.9% | 15 mins | Excellent |
| B | 89.0% | 15 mins | Very Good |
| C | 100% | 0 mins | Excellent |
| D | 100% | 0 mins | Excellent |
| E | 88.3% | 10 mins | Very Good |

Current Speed Calibration, Statistics

| Site | Percentage time tolerance achieved | Phase | Degree of Calibration |
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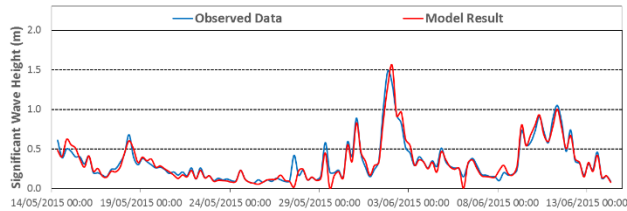
Current Direction Calibration, Statistics

| Site | Percentage time tolerance achieved | Phase | Degree of Calibration |
|------|------------------------------------|---------|-----------------------|
| A | 79.7% | 7 mins | Good |
| B | 94.0% | 14 mins | Excellent |
| C | 82.6% | 15 mins | Very Good |
| D | 81.0% | 1 mins | Very Good |
| E | 80.5% | 5 mins | Very Good |

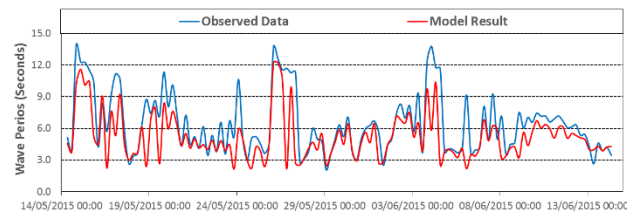
Numerical Modelling: calibration

Calibration Parameters:

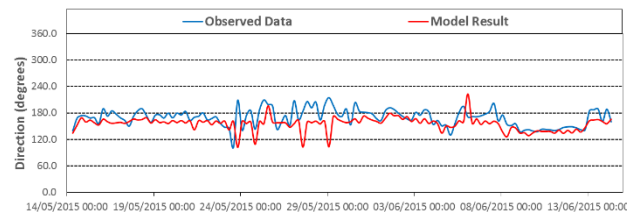
- Waves
- Wind
- Dispersion Coefficient



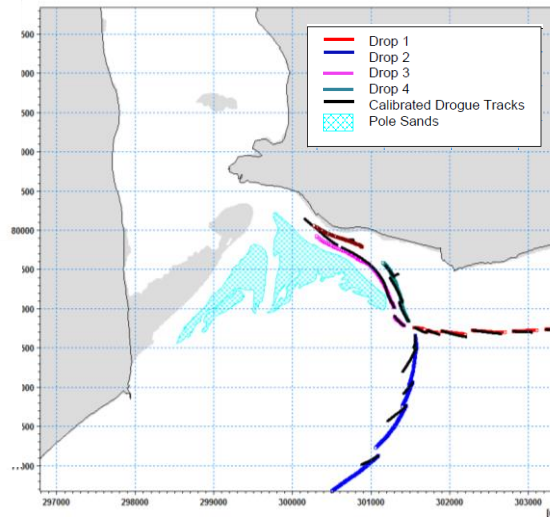
Wave Height, Site D



Wave Period, Site D



Wave Direction, Site D



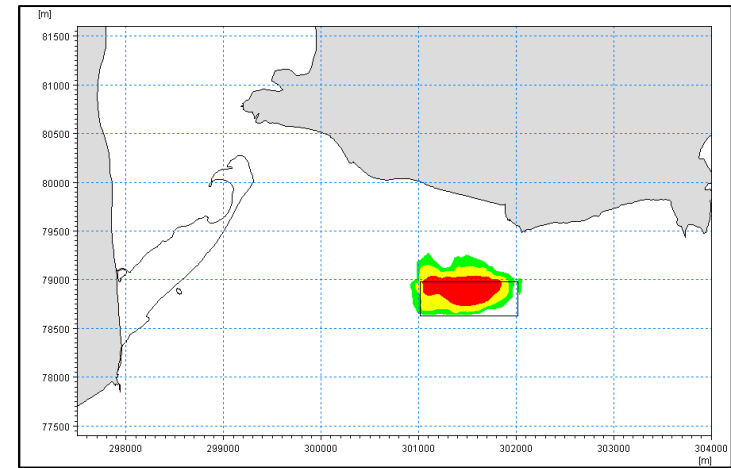
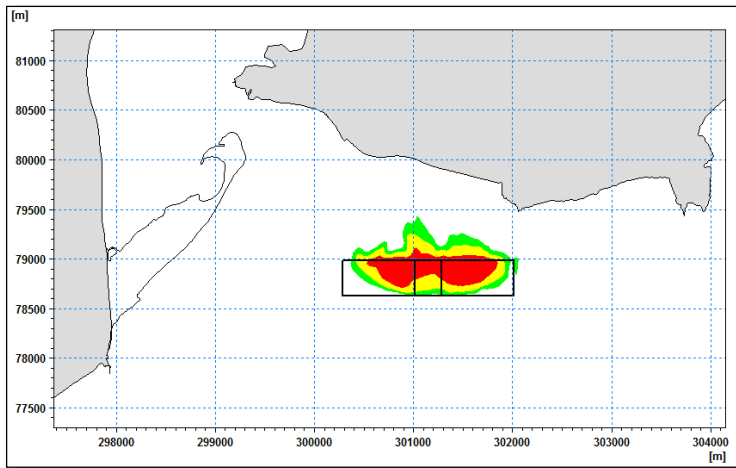
Droge calibration, Spring tide (4th June)

Comparison of measured and modelled aerial plume extent, neap tide (25th June)

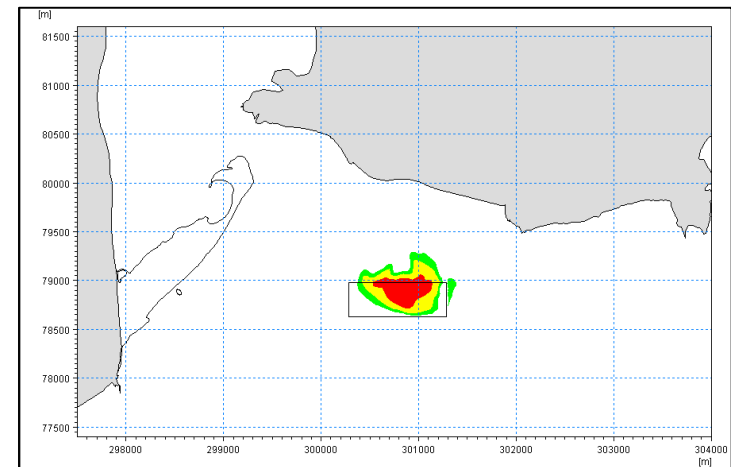
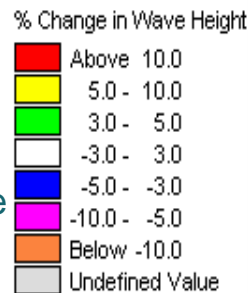
| Transect | Measured Result (m ²) | Model Result (m ²) | Factor difference |
|--------------|-----------------------------------|--------------------------------|-------------------|
| 1 | 6,794 | 10,595 | 1.6 |
| 2 | 30,041 | 12,691 | 2.4 |
| 3 | 39,984 | 14,300 | 2.8 |
| 4* | 0 | 27,108 | - |
| 5 | 12,500 | 10,015 | 1.2 |
| 6 | 29,345 | 14,530 | 2.0 |
| 7 | 19,007 | 48,100 | 2.5 |
| 8* | 2,471 | - | - |
| 9 | 10,786 | 10,516 | 1.0 |
| 10 | 5,807 | 10,484 | 1.8 |
| 11 | 5,244 | 8,793 | 1.7 |
| 12* | 0 | 8,836 | - |
| 13* | 0 | 8,379 | - |
| 14 | 7,274 | 9,693 | 1.3 |
| 15 | 14,545 | 14,986 | 1 |
| 16 | 8,936 | 15,056 | 1.7 |
| TOTAL | 192,734 | 224,082 | 1.2 |

Numerical Modelling: model results

Wave Modelling



Percentage change in wave height contours corresponding to high water for 100% AEP for wave direction 150° for combined dredge site (above left), eastern dredge site (above right) and western dredge site (right)



Numerical Modelling: model results



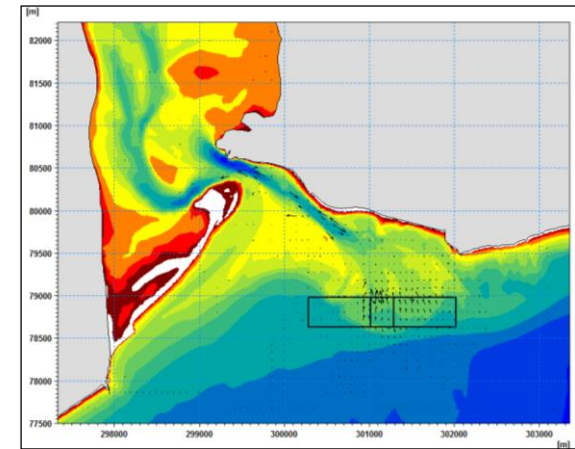
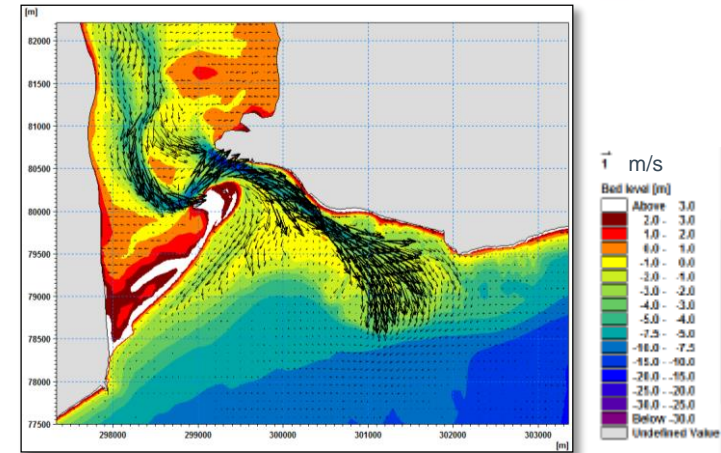
Tidal Flow Modelling

Summary of change of current speed (%),
Combined Site - neap

Summary of change of current speed (%),
Combined Site - spring

| Area | State of tide | | | |
|--------------|---------------|-----|-----|------|
| | LW | PF | HW | PE |
| Overall | 16.3 | 3.0 | 4.6 | 6.0 |
| Dredge area | 26.0 | 4.8 | 3.5 | 13.8 |
| Nourish site | 2.6 | 1.4 | 8.4 | 1.0 |
| Exe Channel | 0.1 | 0.5 | 1.0 | 0.2 |

| Area | State of tide | | | |
|--------------|---------------|------|-----|------|
| | LW | PF | HW | PE |
| Overall | 22.0 | 9.9 | 2.5 | 12.6 |
| Dredge area | 34.2 | 11.9 | 3.2 | 12.6 |
| Nourish site | 1.7 | 3.5 | 1.9 | 0.4 |
| Exe Channel | 0.6 | 0.3 | 0.6 | 0.3 |

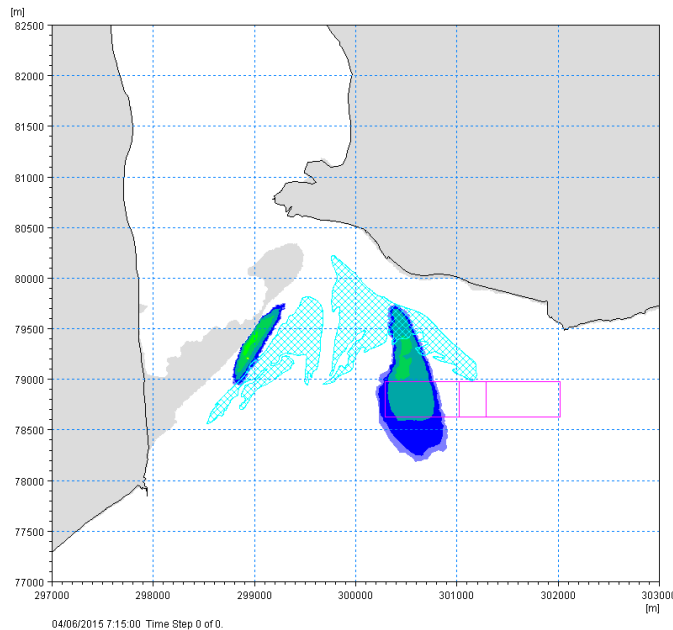


Change in current velocity for calm conditions, baseline (top) and change in velocity (right) for combined dredge option.

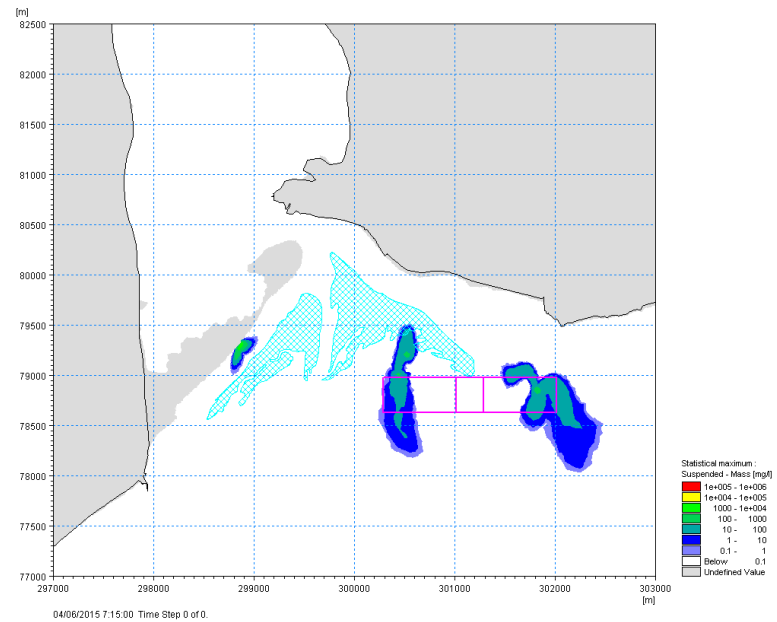
Numerical Modelling: model results



Dredge Plume Modelling



Dredge plume extent – Cutter Suction Dredger (spring tide, west site)



Dredge plume extent – Trailing Suction Hopper Dredger (spring tide)

Thank you and questions

Andrew.Wareing@atkinsglobal.com

Josh.gibson@atkinsglobal.com

<https://www.gov.uk/government/publications/dawlish-warren-and-exmouth-beach-management/dawlish-warren-and-exmouth-beach-management>