International perspectives on environmental risks of wave and tidal energy development

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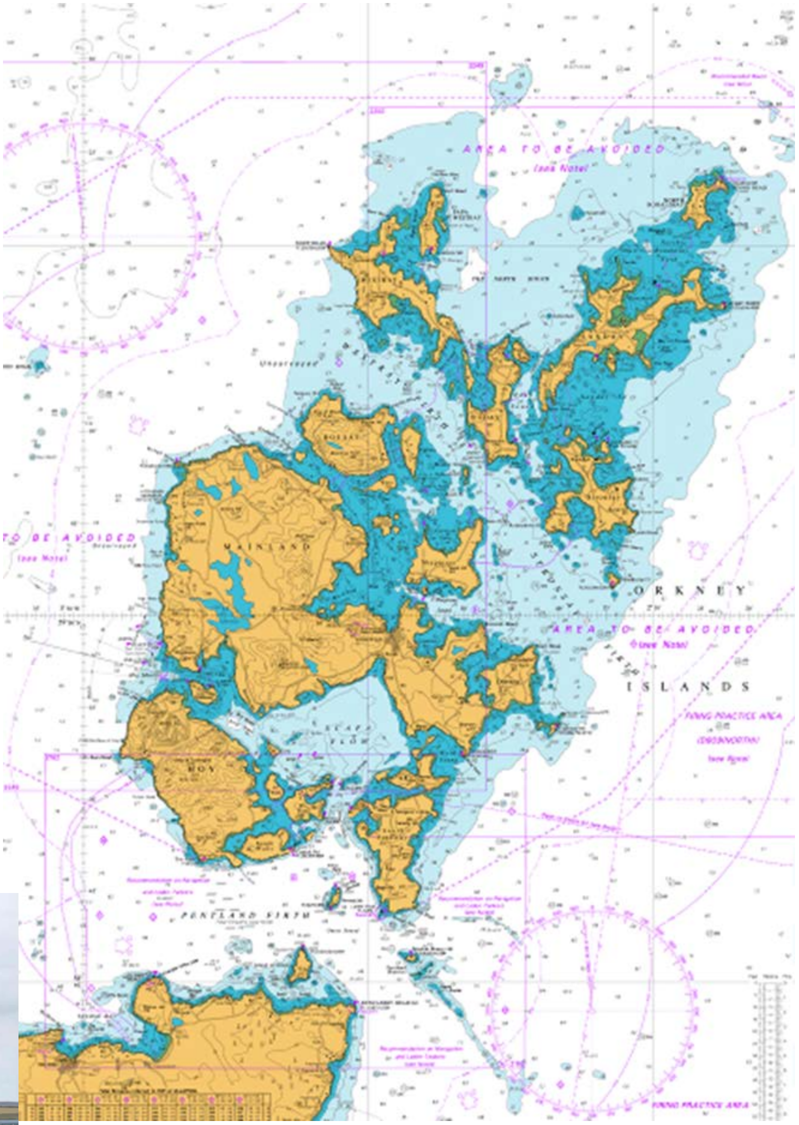
Overview

- Introduction to Orkney
- Environmental issues and sensitivities
- Current energy related risks
- Realities of deployments so far
- Future development pressures
- Managing risks and opportunities as capacity grows
- International collaboration and application of local lessons and experience

An Orkney case study

- Orkney lies off the north of Scotland – the global centre for marine energy
- 6 wave & 6 tidal energy devices being deployed
- 2 & 2 more on the way
- Over 50 deployment & recovery operations
- 20 years of effort & 8 years operations experience



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Key issues – local community

- Population 20,000
- Stromness 2,000
- Kirkwall 7,000
- Eday 350
- Over 150 employed in marine renewables sector
- Need over £200,000 income per month
- Aquatera is one of 20 or so companies in the local supply chain
- Work in over 20 countries globally
- Work for over 30 governments, technology and utility companies

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Key sensitivities – mammals & large sealife

Cetaceans

- Porpoise
- Killer whales (Orcas)
- Minke whale
- Dolphin

Seals

- Common (harbour) seal
- Grey seal

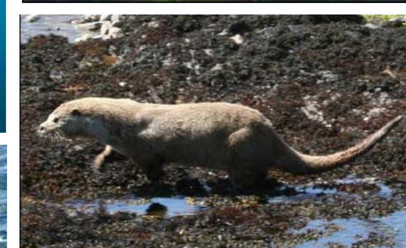
Others

- Basking sharks
- Leatherback turtles
- Coastal otters





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Key sensitivities - birds

Resident around tidal streams

- Shag
- Black Guillemot
- Fulmar
- Eider duck

Seasonal (breeding)

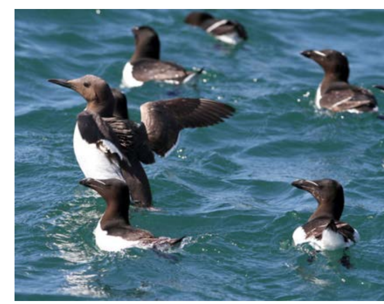
- Auks
  - Common Guillemot, Razorbill
- Great Skua
- Gulls
  - Blacked backed, herring
- Gannet

Seasonal (wintering)

- Seaduck
  - Longtailed
- Divers
  - Red throated, great northern, black throated





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Key sensitivities – tidal site seabed

- Generally bedrock
- Any sediment thin & mobile
- Prolific faunal turf
- Formed by common and widespread species

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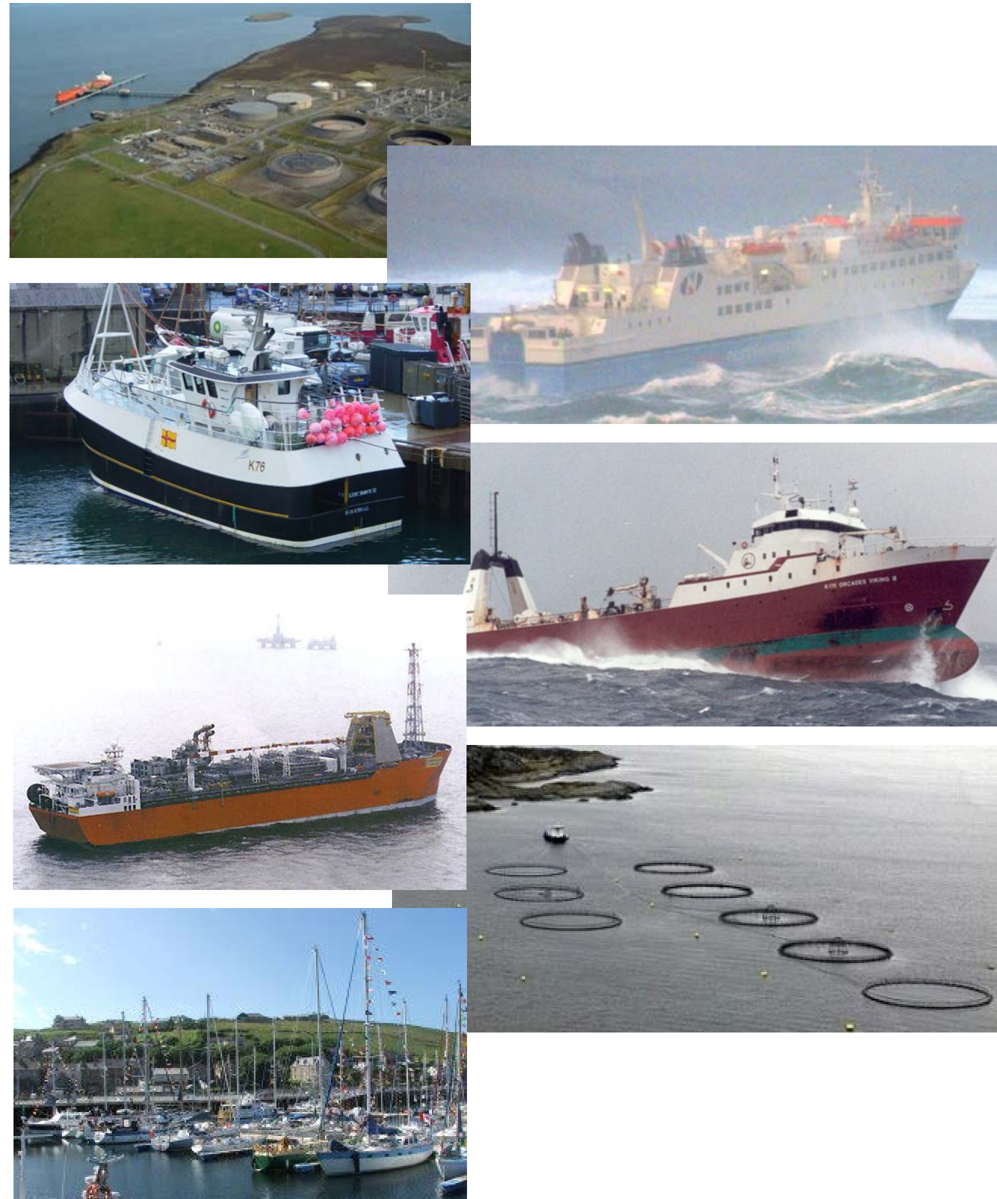
Key sensitivities – wave site seabed

- Generally sedimentary
- Patches of bedrock and glacial moraine debris

Key sensitivities - sea users

- Merchant shipping
- Ferries
- Fishing
  - Coastal creeling
  - Bottom trawling
  - Mid-water trawling
- Offshore oil and gas
- Coastal aquaculture
- Recreation
  - Yachting and boating
  - Surfing
  - Scuba diving
  - Coastal recreation



Current energy risks & impacts

Our existing energy systems have lead to:

- Sea temperature rise
- Seawater acidification
- Polar ice melt
- Changing species distributions
- Increase in species extinctions
- Oil spills
- Oily water and chemicals discharges
- Radionuclide contamination
- Thermal pollution
- Water filtration
- Water abstraction
- Underwater noise
- Light pollution
- Flare mortality for birds
- Obstruction to shipping and fishing
- Seabed disturbance
- Seabed subsidence

The starting point is not without existing issues!!

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Wave energy experiences

- Shoreline system operating for 10 years
- Moorings – installed for 6 years without incident
- 6 piles drilled near shore
- Devices – 12 operational months without incident
- Birds fly by without apparent interest, seals and cetaceans seem unaffected
- No audible mechanical noise from devices









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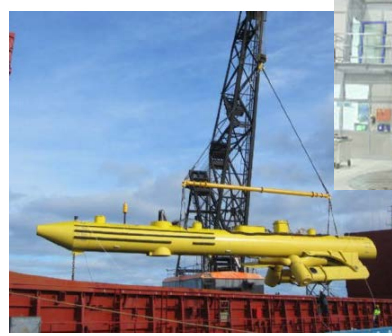
Tidal energy experiences

- Two piles in position for 5 years
- Turbine operations for 12 months plus duration
- Gravity base in place for 5 years
- No shipping accidents but rising concerns in frequent channel users
- No signs of behavioural change in birds or seals
- Fish seen at slack water but not when tide is running
- Jack-up rigs installed and removed without wildlife disturbance
- Basking sharks observed swimming without any change in behaviour past manoeuvring tugs
- No seals observed in tidal streams over 5 days of observation



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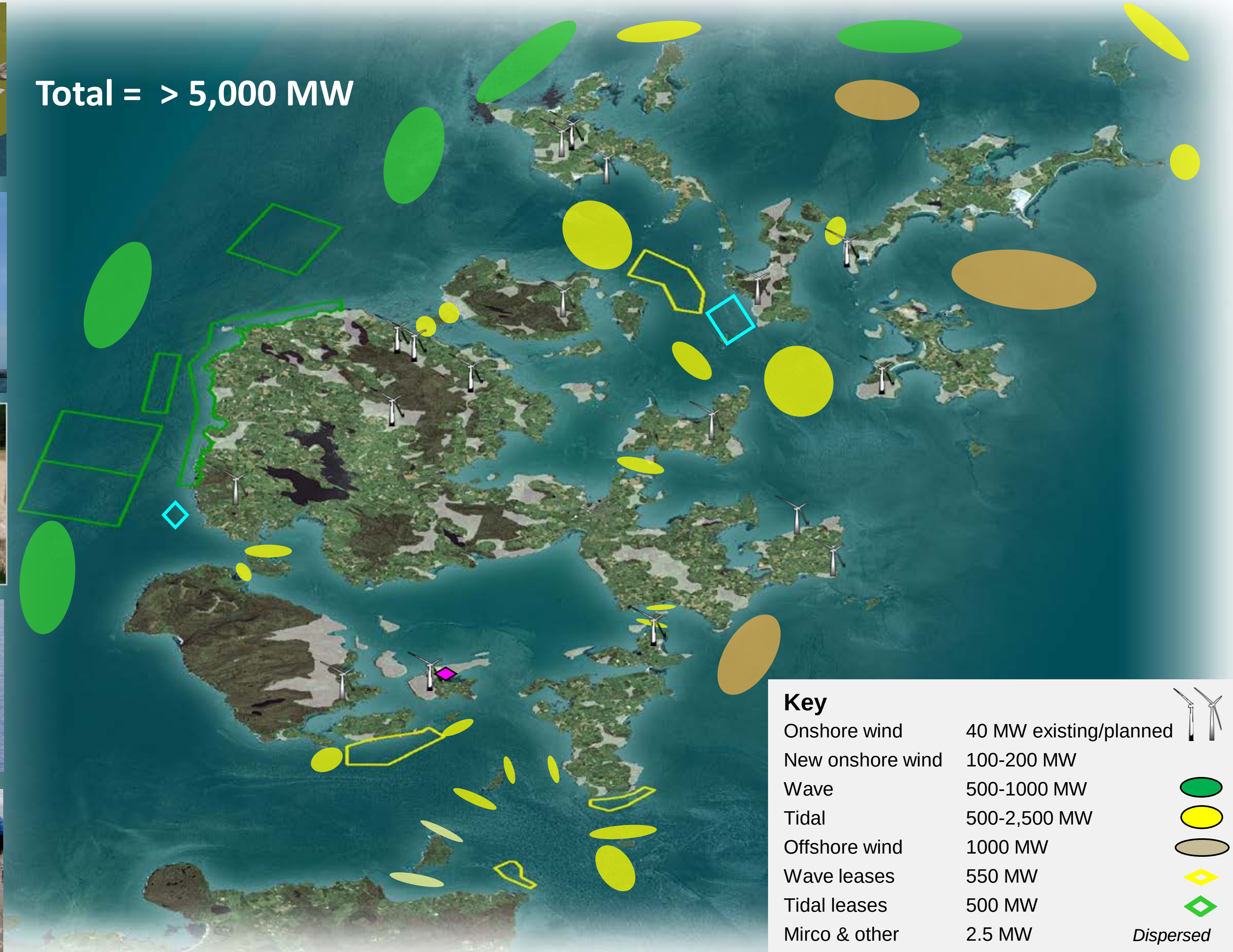
Orkney's future energy developments



Key

Onshore wind	40 MW existing/planned
New onshore wind	100-200 MW
Wave	500-1000 MW
Tidal	500-2,500 MW
Offshore wind	1000 MW
Wave leases	550 MW
Tidal leases	500 MW
Mirco & other	2.5 MW *Dispersed*
Gas & other	20 MW *Dispersed and*
EMEC sites	5 + 7 MW

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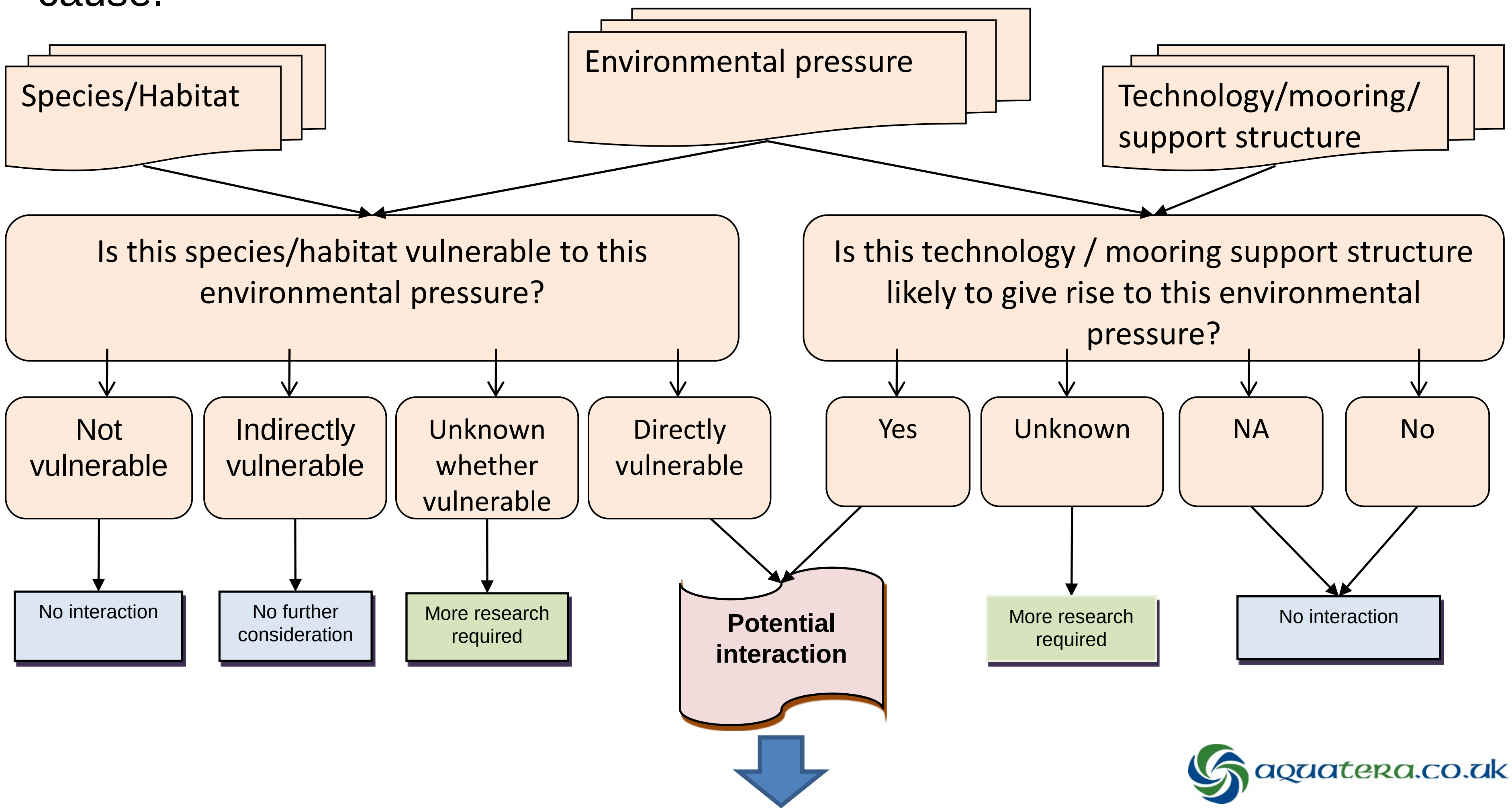
Identification & prioritisation of potential interactions

For an interaction to occur between a species/habitat and a technology/ mooring/support structure combination, the species/habitat must be vulnerable to an environmental pressure that the technology etc is likely to cause.



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Priority issues

Marine birds
Displacement and visual disturbance
Noise above the surface
Underwater noise and vibration
Collision
Loss of habitat
Changes in turbulence

Marine mammals and basking sharks
Underwater noise and vibration
Shock/pressure waves
Noise above the surface
Collision
Barrier to movement
Entanglement
Entrapment
Loss of habitat
Displacement

Offshore and coastal habitats
Loss of habitat
Changes in sediment dynamics
Loss of coastal habitat & change in coastal character
Change in coastal processes

These were the key issues to arise from the assessment – They will individually be applicable to certain technologies and certain species and habitats in specific locations

Overview of output from the assessment

The tool identified about 29,400 potential interactions

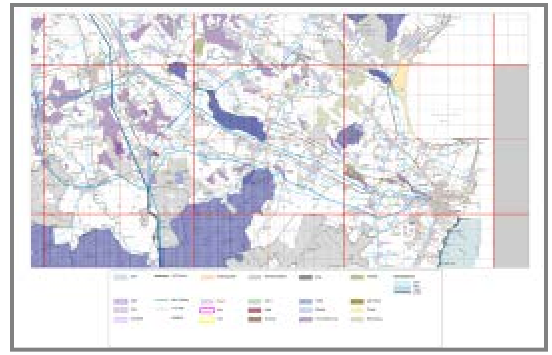
Of these potential interactions:

- ~ 1800 were scored as significant
- ~ 5500 were scored as unknown
- ~18500 were scored as non-significant
- ~ 3600 were scored as not-applicable

- For a particular development
  - e.g. Horizontal axis turbine with a monopile
    - only 345 of these interactions are potentially significant or unknown
    - These relate to 12 priority issues

Approach to weighting

- The distribution of the various factors identified in the weighting analysis was entered into a GIS
- The various scores are applied to the areas, line and points representing the various features
- Maps are prepared showing the distribution of suitability for the different major project activities
- Detailed maps follow:



Landfalls

Switching station

Converter station

Buried cables

Overhead lines

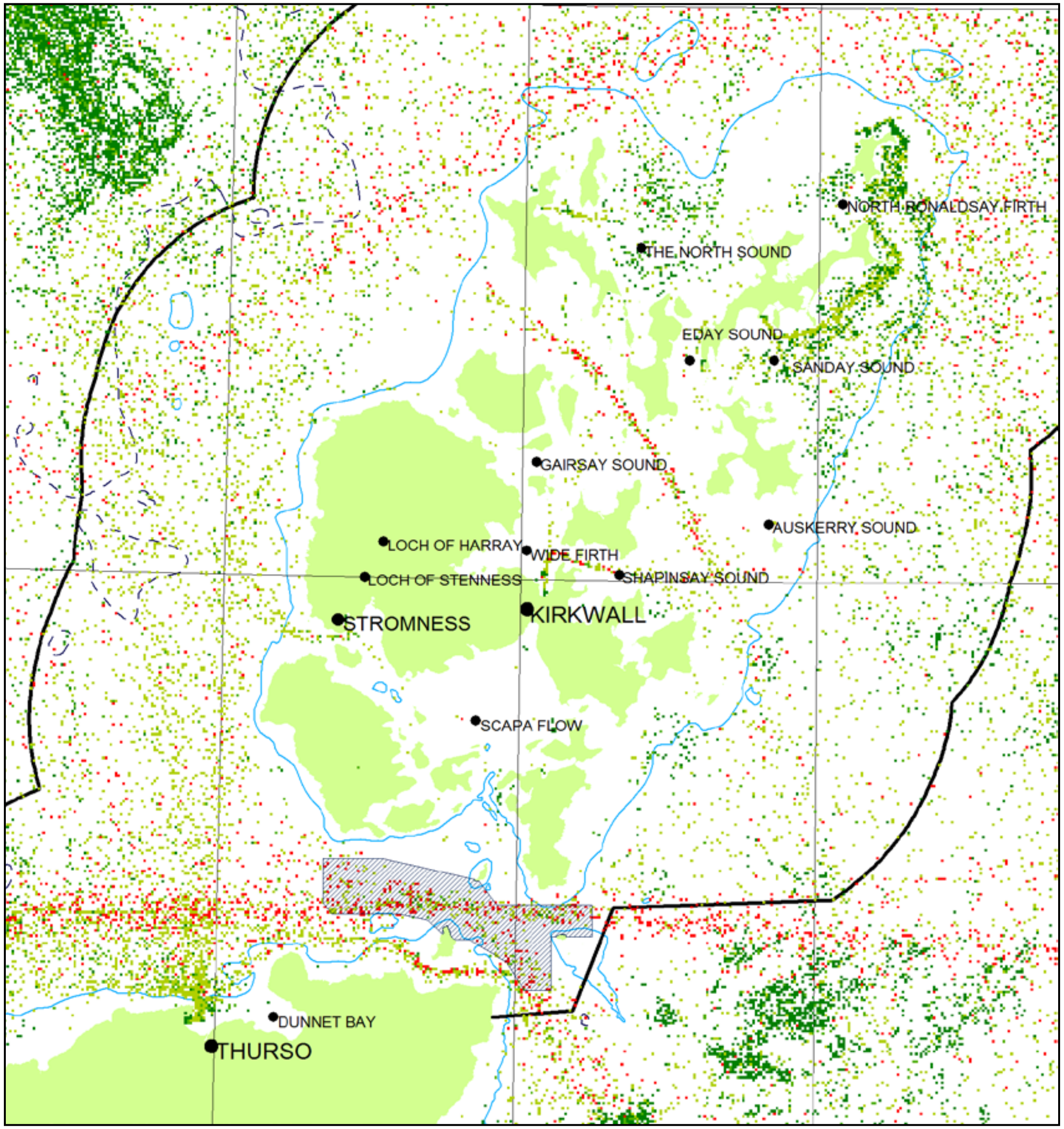
Key sea user interactions

- Key relationships for wave and tidal technologies are with
  - The local activities
  - Other industries
    - Shipping
    - Fishing
    - Tourism
  - Conservation & amenity
    - Wildlife and habitats
    - Cultural heritage
    - Recreation and amenity

	Offshore	Near shore	Coastal	Cable
Shipping				
Fishing				
Boating				
Surfing				
Aquaculture				
Leisure-tourism				
Eco-tourism				
Archaeology				
Conservation				

Example – VMS fishing data

- VMS data provides unparalleled insight into the distribution of fishing activity
- No need to link in catches, vessels etc
- Key interest is effort
- Need to be able to separate steaming and fishing



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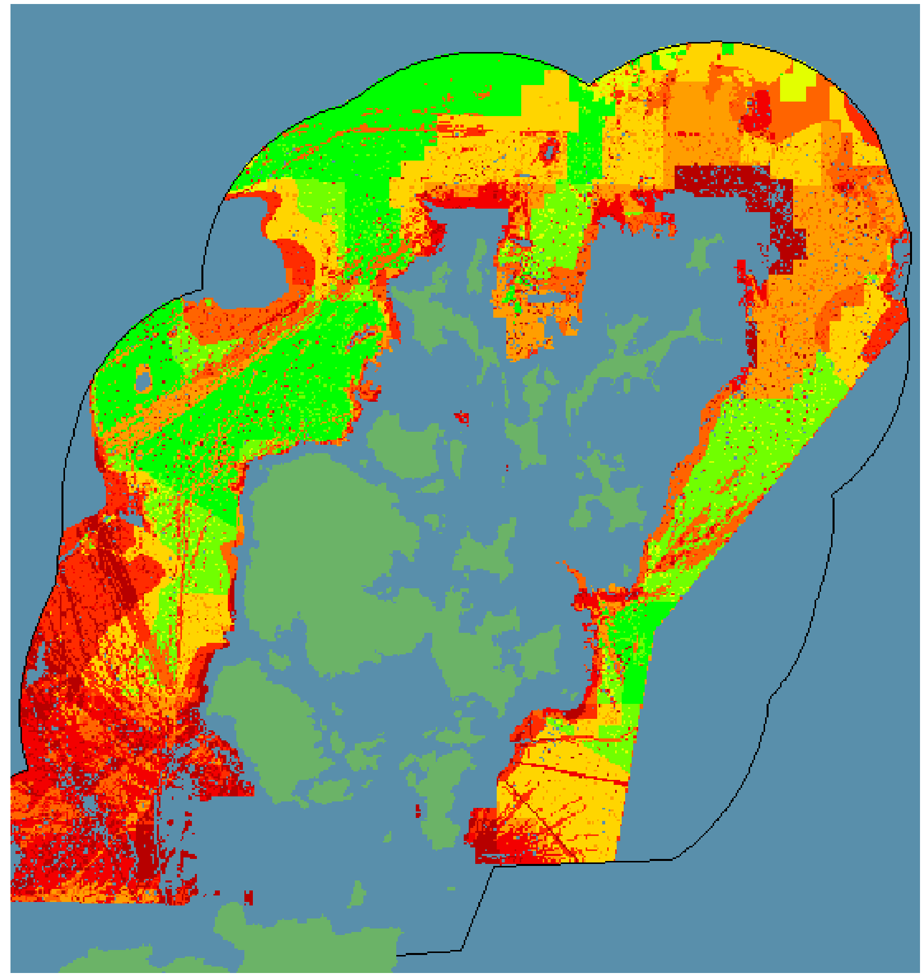
Where for energy generation?

- Wide range of possible site options
- Sites need to be based upon multiple criteria
  - Energy resources
  - Technical limits
  - Cost factors
  - Planning factors
  - Infrastructure
- Sites need to take into account scale of development, timing & relationship to others

Suitability for wave developments



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International collaboration and exchange in lessons learned

- Marine renewables is a global business
- Sites are not universal but they are widespread
- Species may be different but the niches they fill are similar
- Devices may be different but their principles are similar
- Early devices have not shown any “hidden” impacts
- Key issues are around use of DP vessels and seals, navigation and community benefits
- Learning so far can avoid un-necessary costs, delay and precaution
- Need to build mechanisms for sharing data and experiences
- Renewables are better for the environment than existing energy systems – should we start treating them in that way?