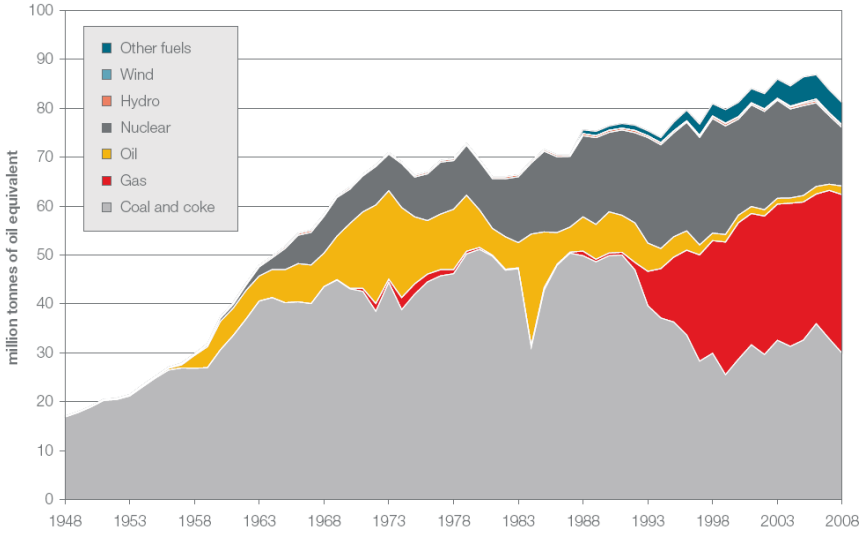
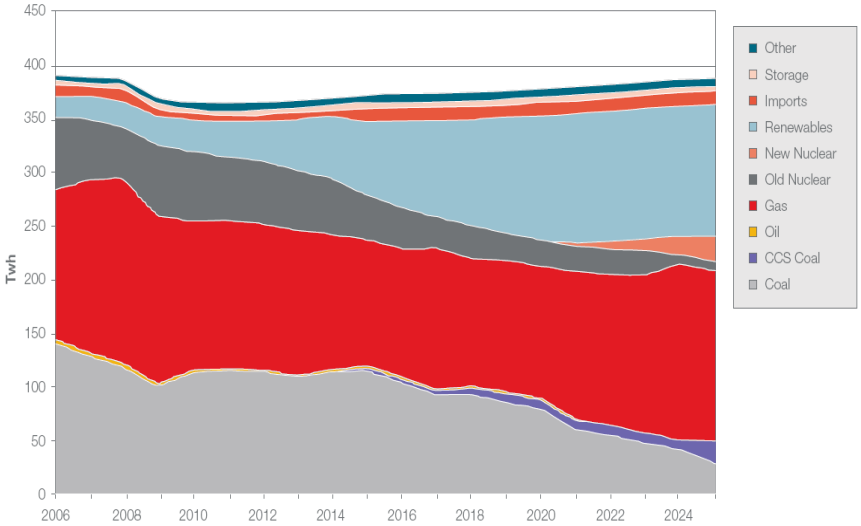
Mersey Tidal Power

The UK has committed to 15% Renewable Energy by 2020

Over 30% of our electricity will need to be sourced from renewables by 2020.



Fuels used to generate electricity in UK 1948–2008. Source: DECC 60th Anniversary: Digest of United Kingdom Energy Statistics, July 2009.



Projection of potential UK electricity supply by fuel 2006–2025. Source: DECC Energy and Emissions Projections, June 2010.

Climate Change Act 2008 has committed the UK to legally binding targets to reduce greenhouse gas emissions: a reduction in emissions of at least 34% by 2020, and at least an 80% by 2050, compared to 1990 levels.

UK demand for electricity is expected to more than double by 2050 as low carbon sources of energy are required for heating and transport.

Ocean Gateway – Atlantic Gateway

Energy schemes play an important role supporting sustainable development

Innovation - Energy, Waste and Water

Mersey Tidal Power –
Operational 2020

Frodsham Wind Farm
60MW – Operational 2014

Barton Biomass
20MW – Operational 2014

MANCHESTER

Scout Moor Wind Farm
65MW – Operational 2008

RUNCORN

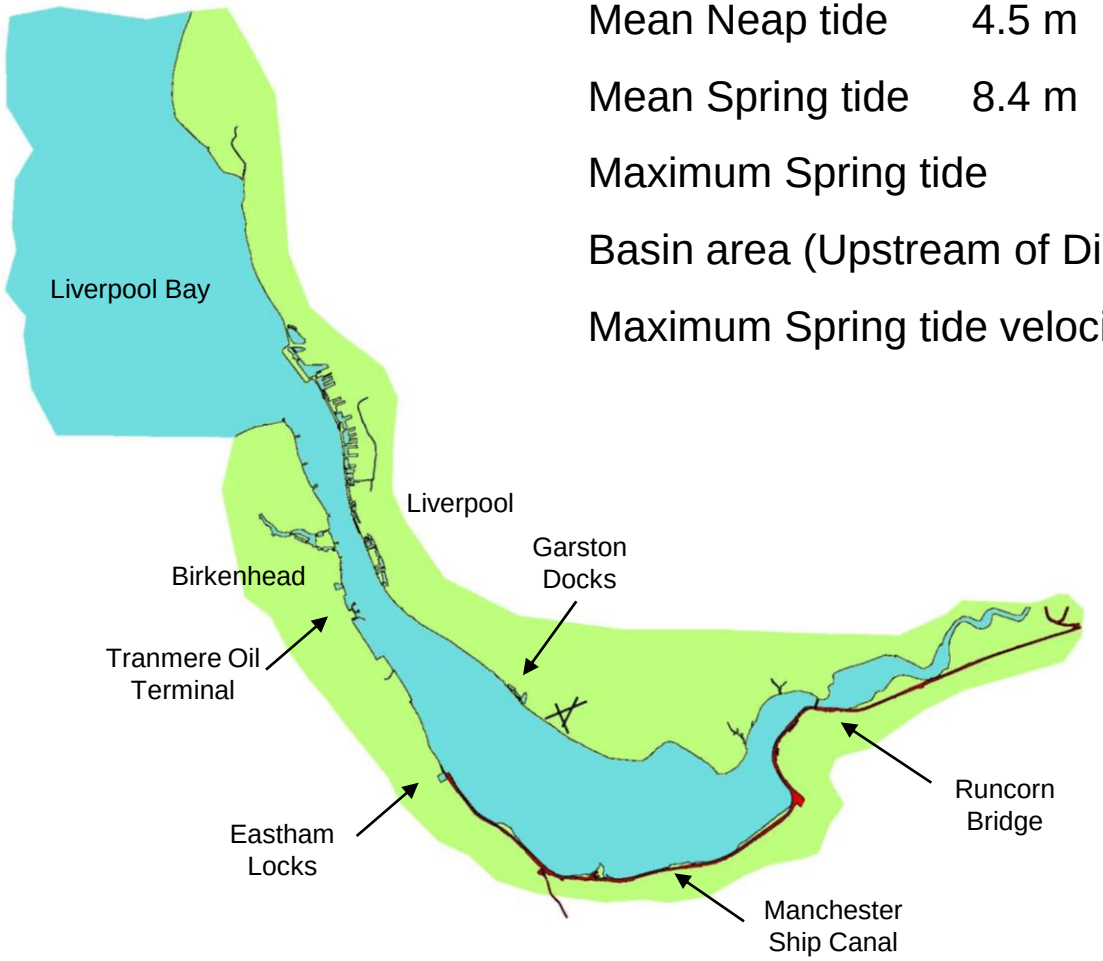
ELLESMERE PORT

Mersey Wind Farm
13.6MW – Operational 2009

Ince Biomass
20MW – Operational 2014

Ince RRP
95MW – Operational 2015
Waste reprocessing park
Tri-modal access

The Resource : Mersey Estuary



Tidal resource

Mean Neap tide	4.5 m	(190 M m^3)
Mean Spring tide	8.4 m	(350 M m^3)
Maximum Spring tide		10.5 m
Basin area (Upstream of Dingle)		60 km^2
Maximum Spring tide velocity		5.2 knots / 2.7 m/s

The Opportunity : Potential Benefits

- The first large scale tidal energy project in UK – of global significance
- Secure low carbon electricity
  - enough for a significant proportion of the homes in the Liverpool City Region
  - helping to meet the UK's carbon reduction commitment 15% by 2020, 80% by 2050
- Regeneration / low carbon economy
  - Jobs in construction and operation, and associated activities
  - Training, skills, research & development in renewable energy technologies and associated services
  - Renewable energy / tidal technology supply chain
  - Tourism & leisure – visitor centre destination, enhanced use of Mersey
  - Infrastructure – grid reinforcement, access
  - Supporting sustainable / low carbon development
- Flood defence

Scheme Objectives

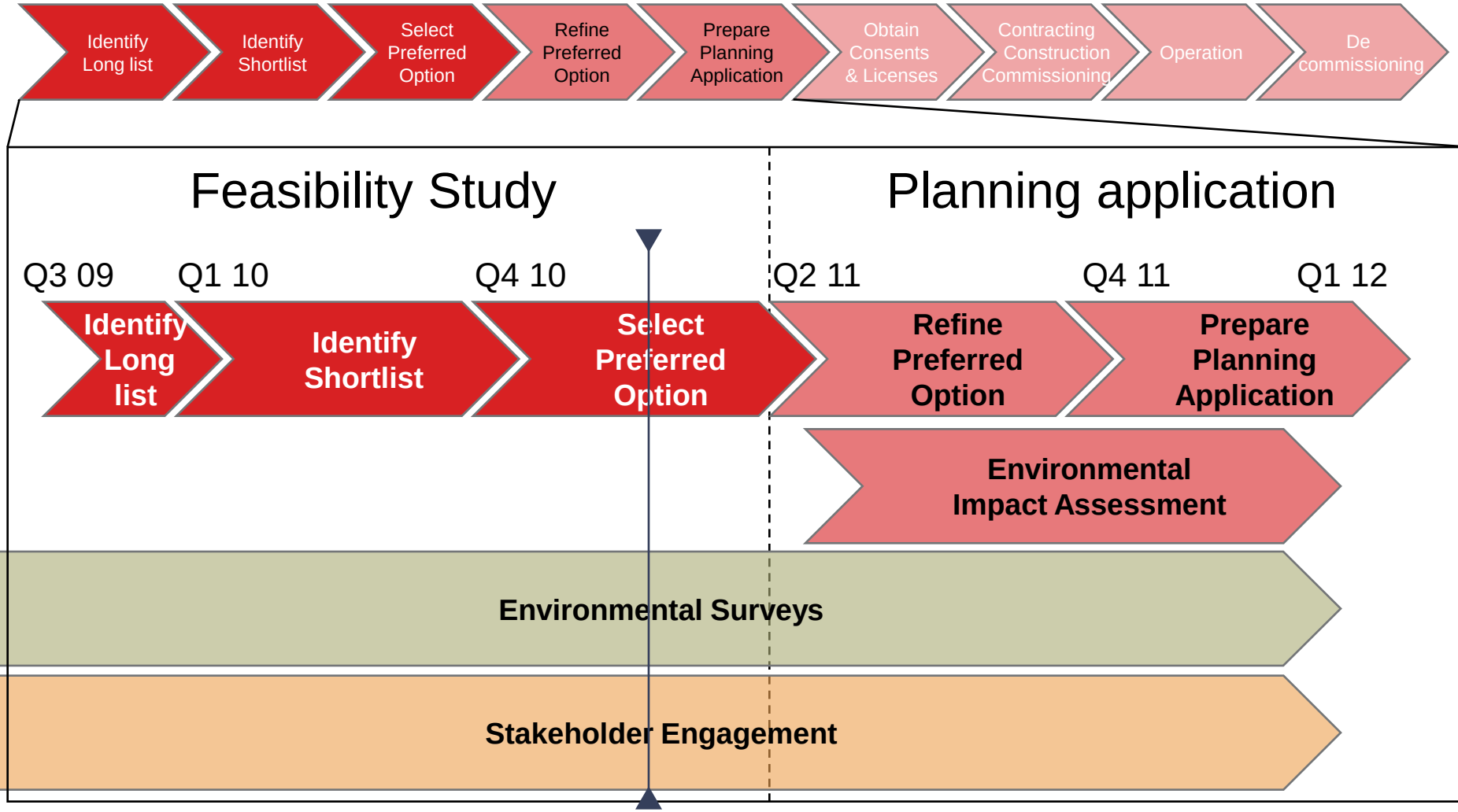
- To deliver the **maximum amount of affordable energy** (and maximum contribution to carbon reduction targets) from the tidal resource in the Mersey estuary with **acceptable impacts on environment, shipping, business and the community** either by limiting direct impact in the Mersey estuary or providing acceptable mitigation and/or compensation

and in doing so:

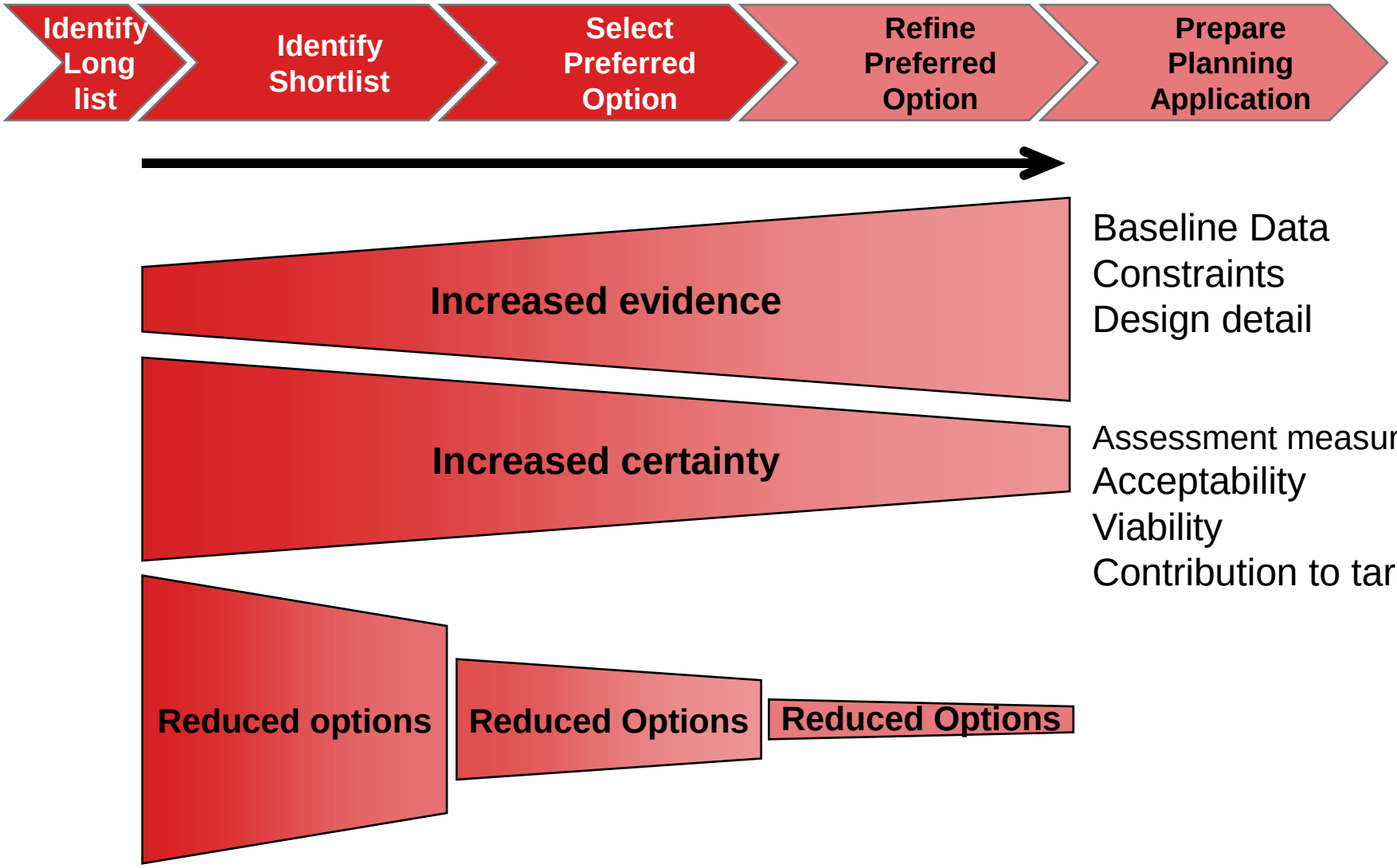
- To **maximise social and economic benefits** from the development and operation of a renewable energy scheme, including where appropriate:
  - development of internationally significant facilities and skills to support the **advancement of renewable energy technologies and their supply chains**
  - improvements to **local utility and transport infrastructure**
  - improvements to **green infrastructure and environmental assets**
  - development of a **leisure opportunity and tourist attraction**.

Project Timetable

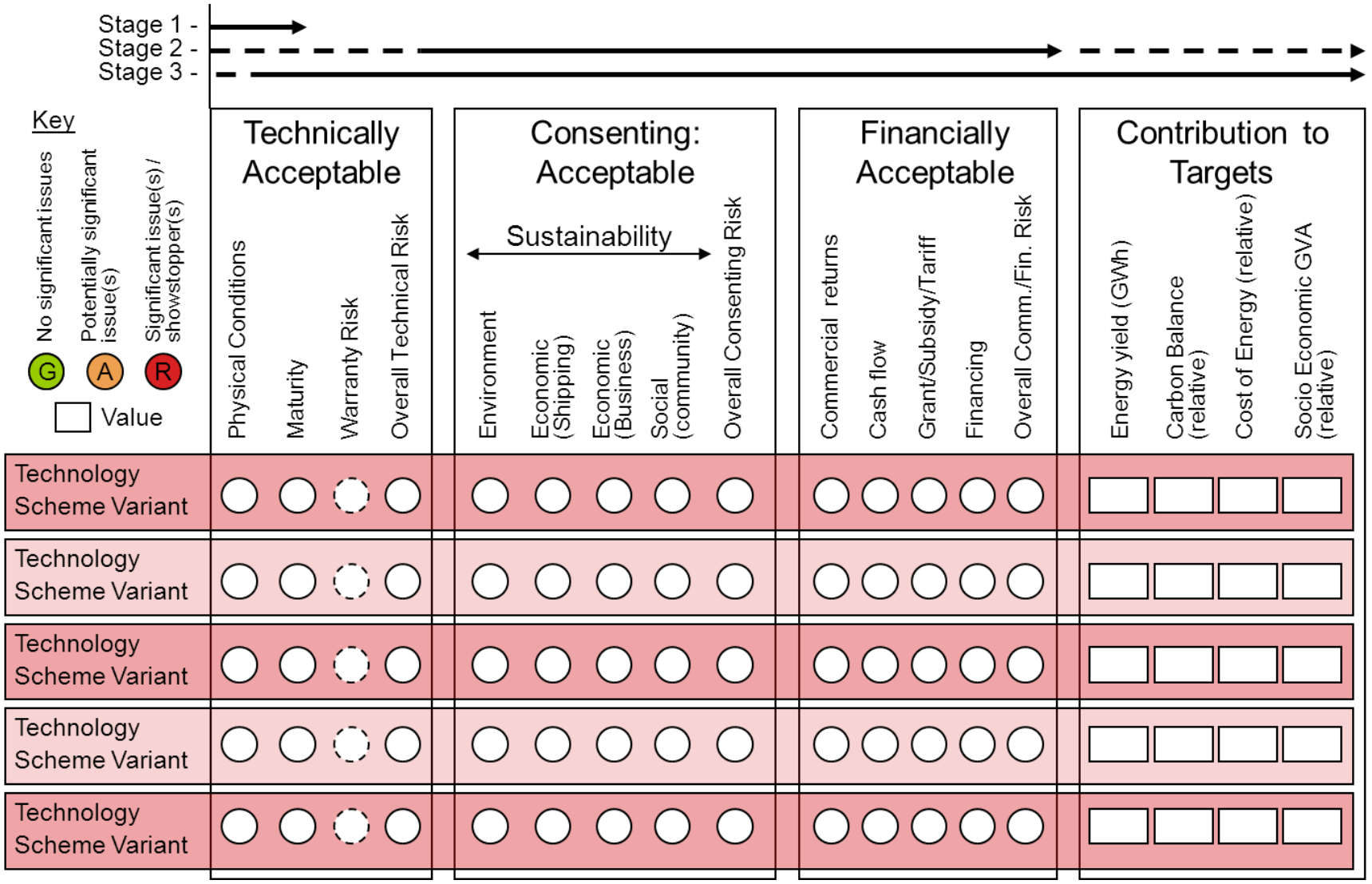
Contributing to 2020 Renewable Energy targets



Towards a consent on a deliverable scheme



Decision Making Framework



Stakeholder Engagement since April 2010

Key Stakeholder Advisory Group – 29 April & 28 September

Environment Advisory Group Meeting – 22 April, 3 June, 9 December

Northwest Tidal Energy Group – 11 May

Navigation Stakeholder Meeting – 18 May & 14 Dec

Low Carbon Liverpool Seminar – 27 May

Mersey Estuary Forum – 2 July

Design Advisory Group Meeting – 4 Aug & 14 Dec

RSPB 'Mersey Mission' Meeting – 9 September

Cheshire Wildlife Trust – 24 September

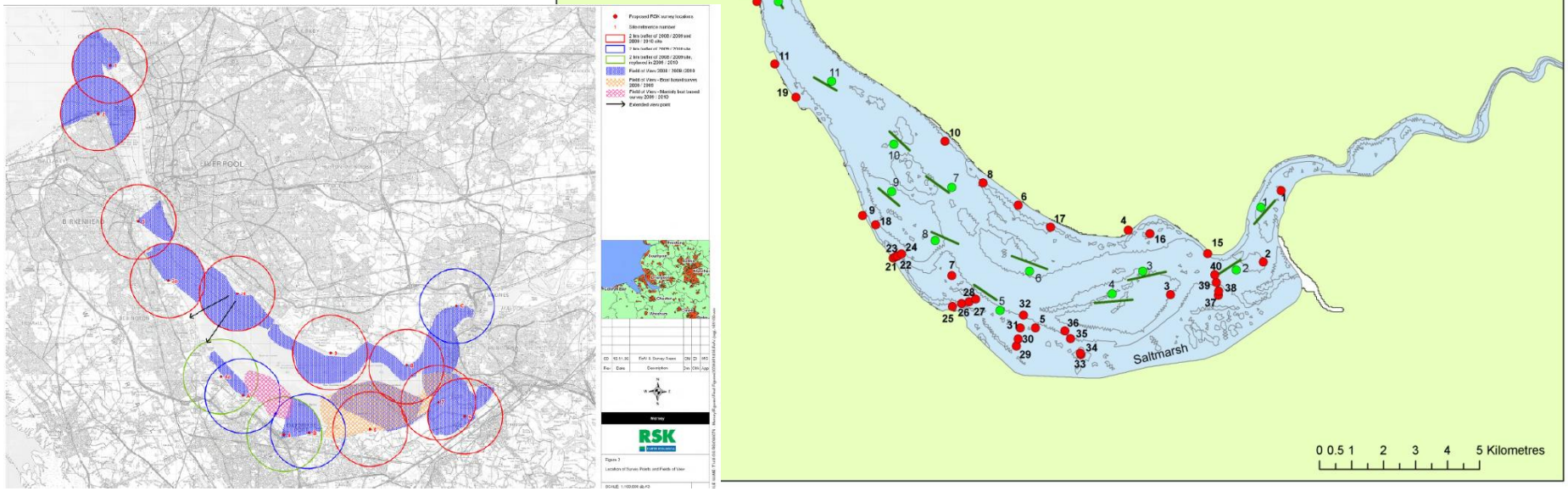
Relaunched Project Website – September 2010

Ebriefing 1 – October 2010

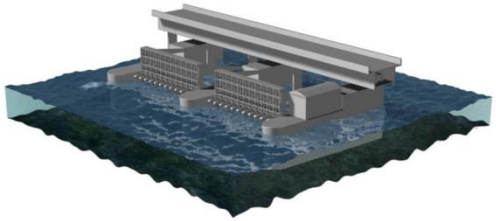
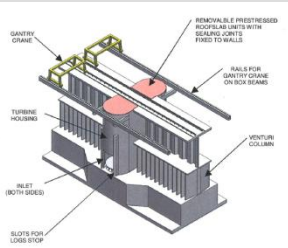
Round One Public Consultation – Dec 2010 to Feb 2011

Environmental surveys are ongoing

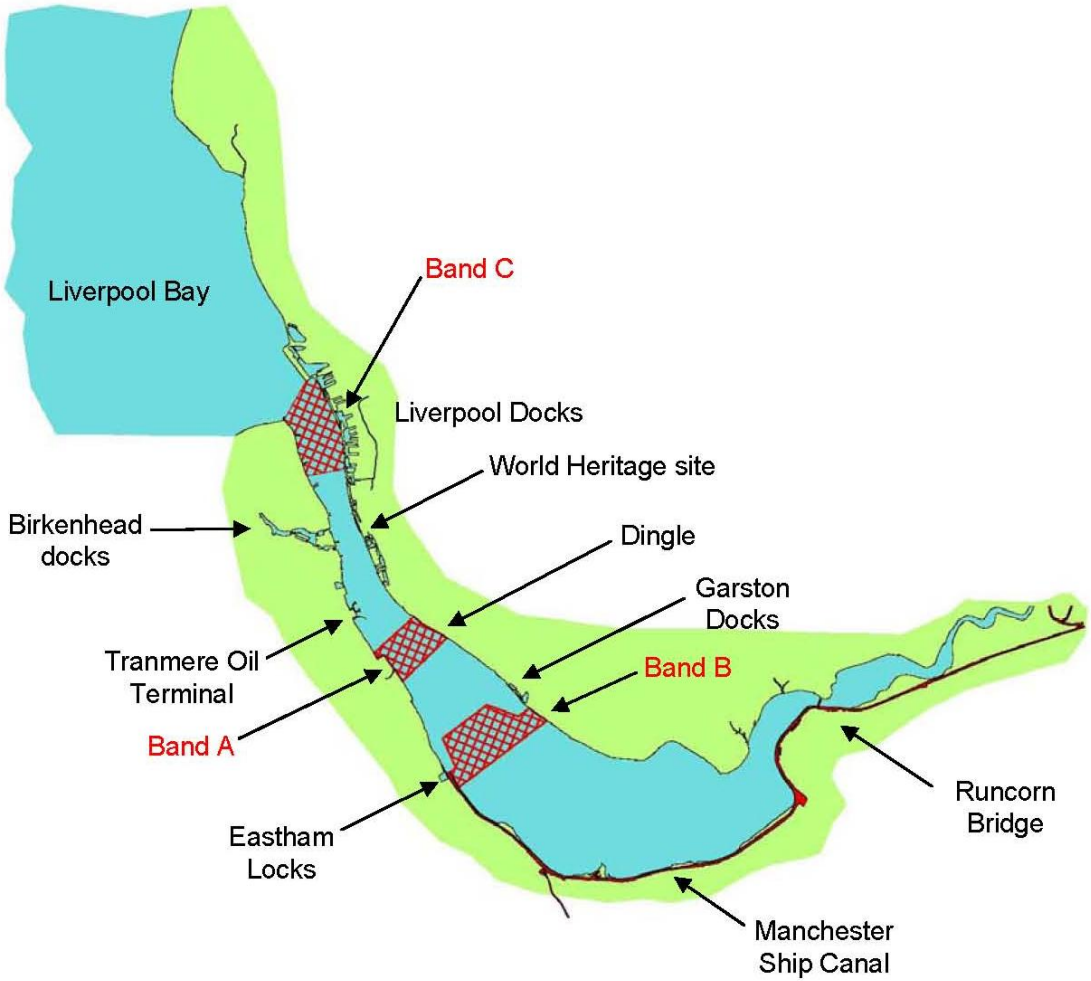
- Birds: two full years; winter, breeding and passage (Oct 2008 – present)
- Aquatic ecology: autumn 2009, spring 2010, autumn 2010



Stage 1 of the feasibility study identified four potential technologies

CONCEPT	OPTION	
Impounding scheme	**Tidal Barrage**	
Very low head barrage	**Tidal Power Gate / Very low-head turbine**	
Tidal fence	**Horizontal or Vertical axis Turbine**	
Tidal fence	**Spectral Marine Energy Converter**	

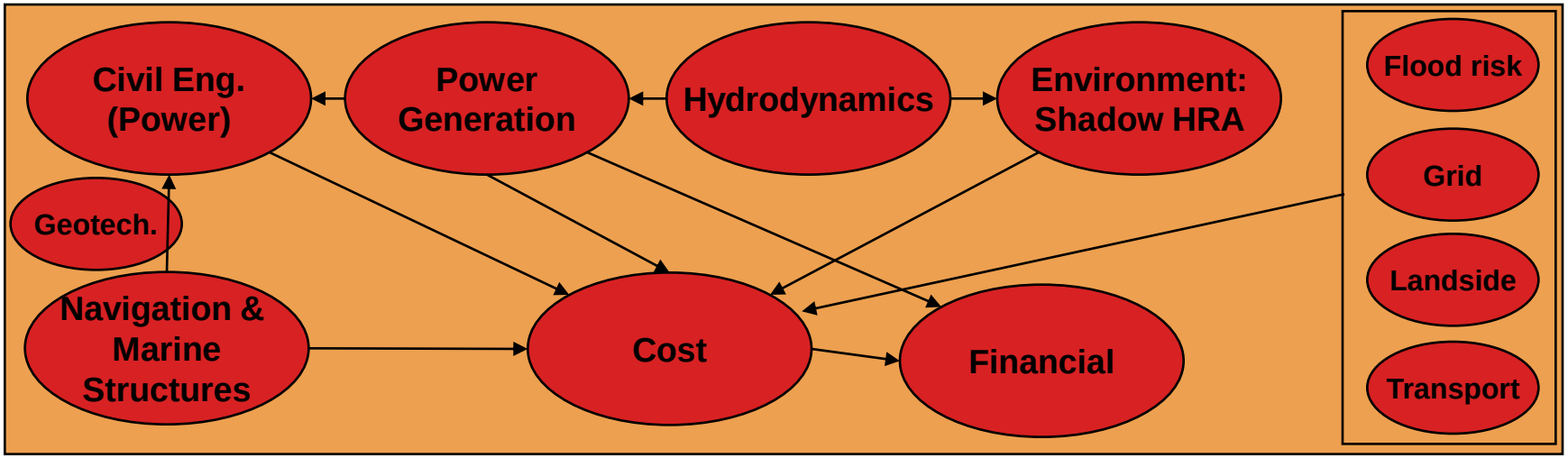
Scheme alignment bands for initial study to inform options



Shortlist three of the twelve options; ultimately chose one

TECHNOLOGY OPTIONS	BAND C	BAND A	BAND B
Impounding Barrage	O	O	O
Tidal Power Gate (VLH turbine)	O	O	O
Tidal Fence	O	O	O
Spectral Marine Energy Converter	O	O	O
NAVIGATION OPTIONS			
	Locks + ?	4 variants using different lock layouts, new channels and an extension to the Ship Canal	Single option with boat lock at Garston abutment

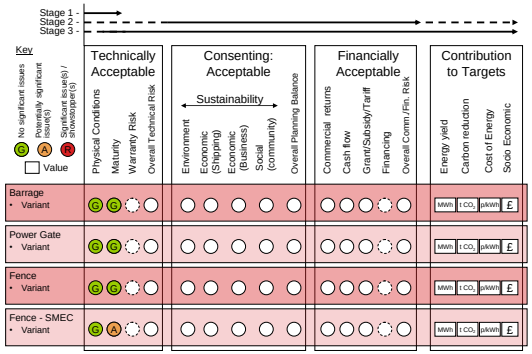
Stage 2A



- **Acceptability**
- **Performance Improvement**
- **Mitigation**

Sustainability Indicators
Carbon Lifecycle
Socio Economic benefit

Navigation Technical Feasibility



Constraints

TECHNOLOGY OPTIONS	BAND C	BAND A	BAND B
Impounding Barrage	O	O	x
Tidal Power Gate (VLH turbine)	O	O	O
Tidal Fence	O	O	O
Spectral Marine Energy Converter	O	O	O
NAVIGATION OPTIONS			
	Locks + ?	4 variants using different lock layouts, new channels and an extension to the Ship Canal	Single option with boat lock at Garston abutment

Sustainability Appraisal

Scoping Report consultation period ended 31st August - comments received from a range of consultees now being addressed

21 indicators cover an appropriate range of environmental, social and economic issues

SA/SEA not mandatory but sustainability appraisal framework enables balanced consideration of likely positive and negative impacts of options

Environment

- Internationally and nationally designated nature conservation sites
- Species and habitats of conservation importance
- Habitat creation or ecological enhancement
- Levels of flood protection
- Character and accessibility of places, landscapes and heritage assets
- Lifecycle carbon balance of the development
- Utilities infrastructure and resources
- Waste production, reuse and recycling
- Ecological status or potential of the Mersey Estuary and other water bodies (in relation to the Water Framework Directive)
- Emission of air pollutants
- Land quality

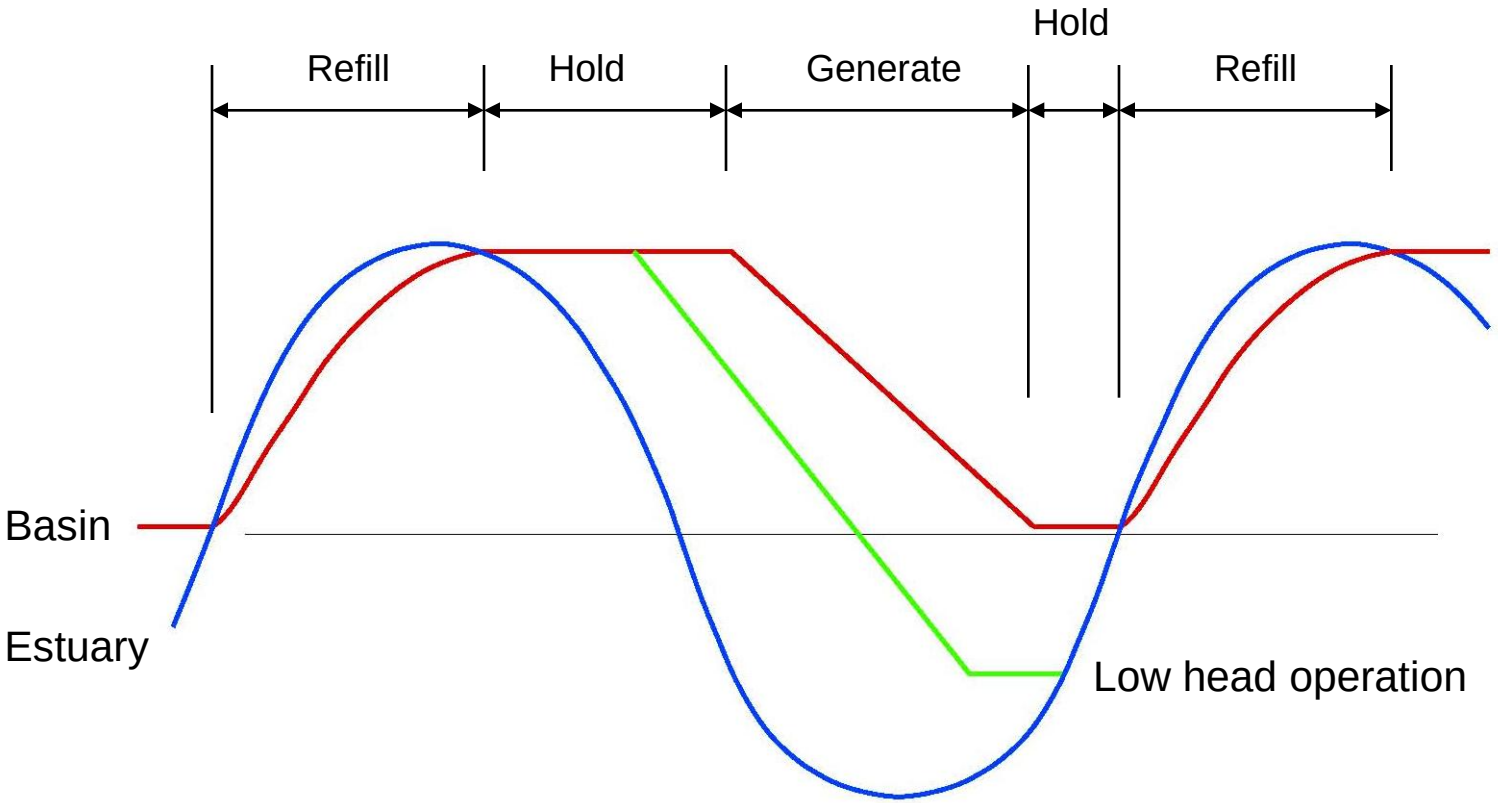
Society

- Transport infrastructure
- Amenity for recreation, tourism and leisure
- Human health and wellbeing
- Education and skills training

Economy

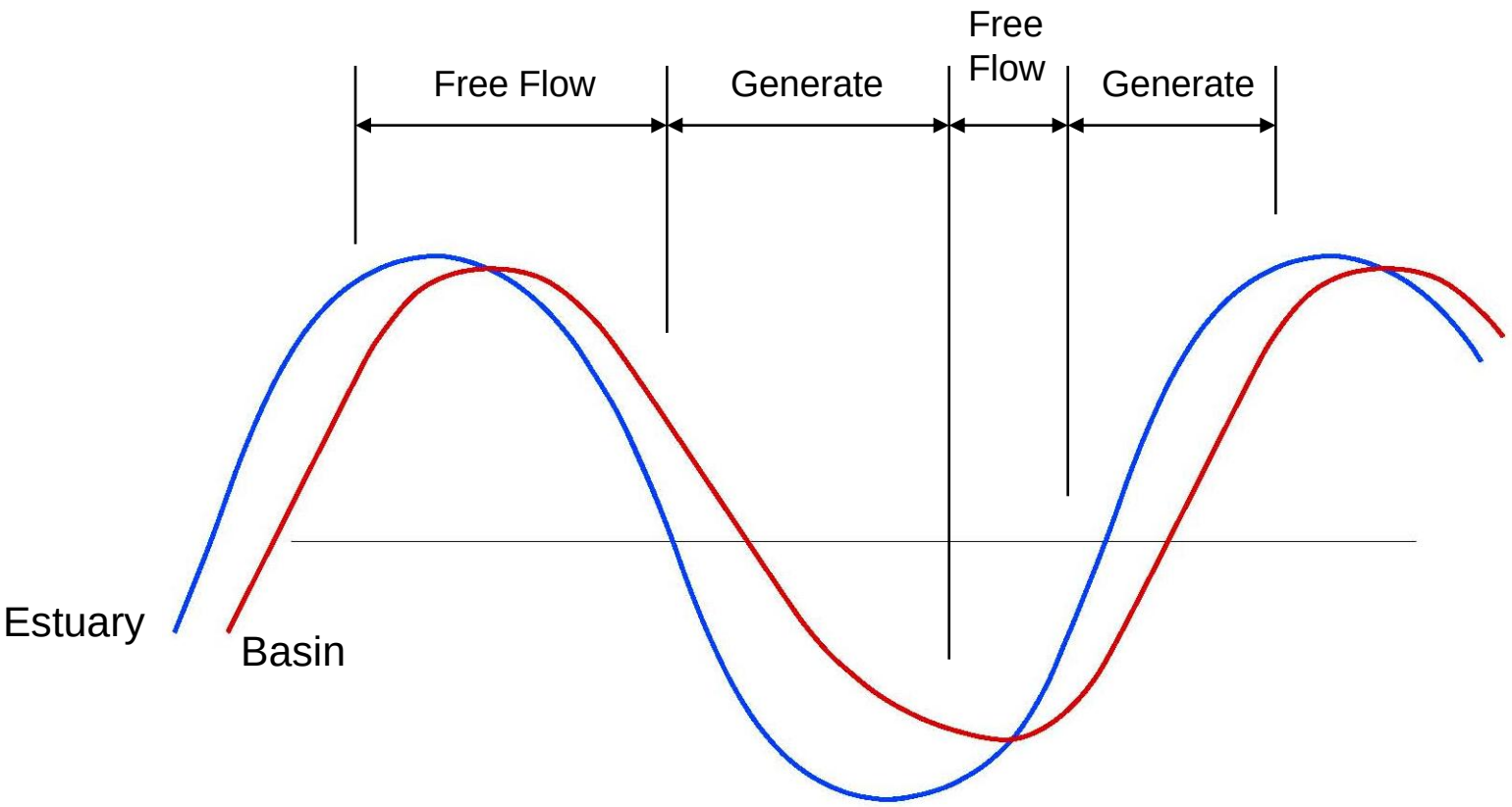
- Local business and jobs
- Inward investment and image
- Technological innovation
- Commercial navigation
- Generation of renewable energy from the Mersey Estuary
- Commercial fish stocks

Tidal Barrage



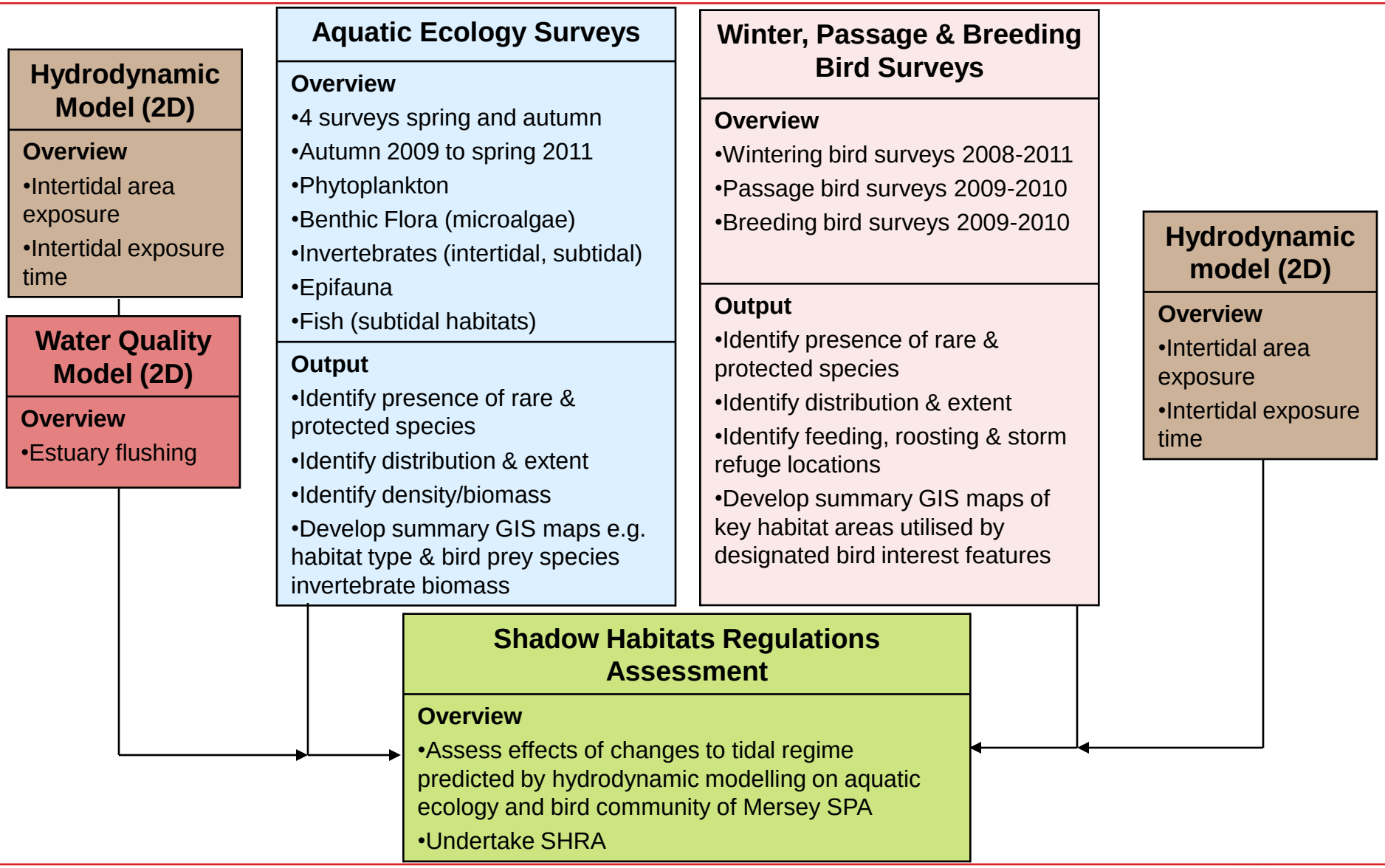
Ebb Flow Generation: Impact on Tidal Range

Tidal Fence



Typical Impact on Tidal Range

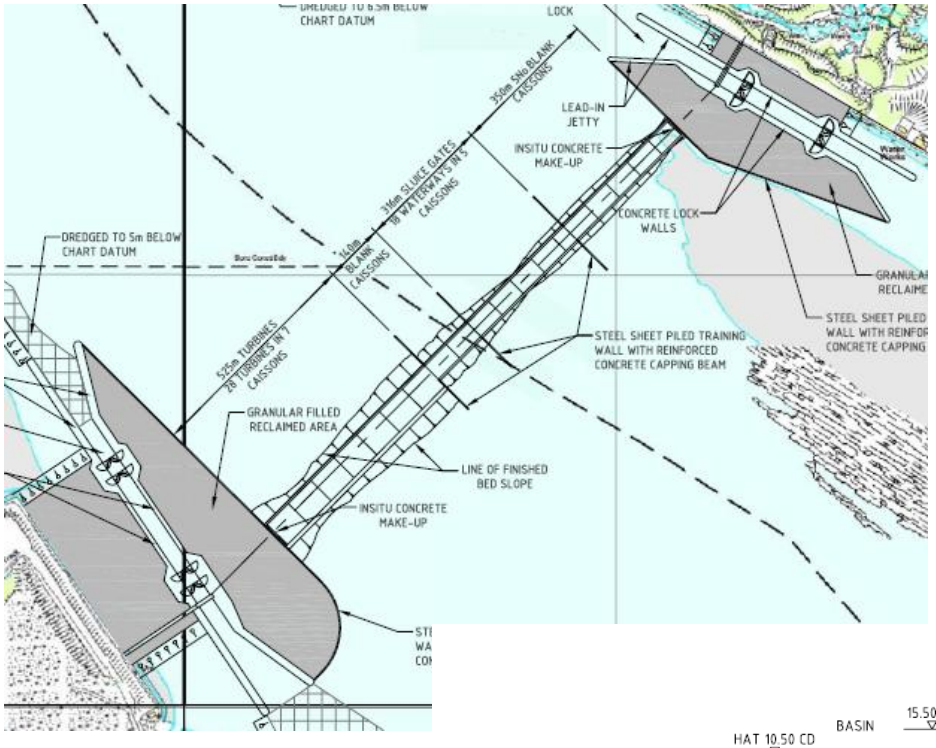
Overview of Ecological Assessment Process – Current Assessment



Each technology may have a number of variants

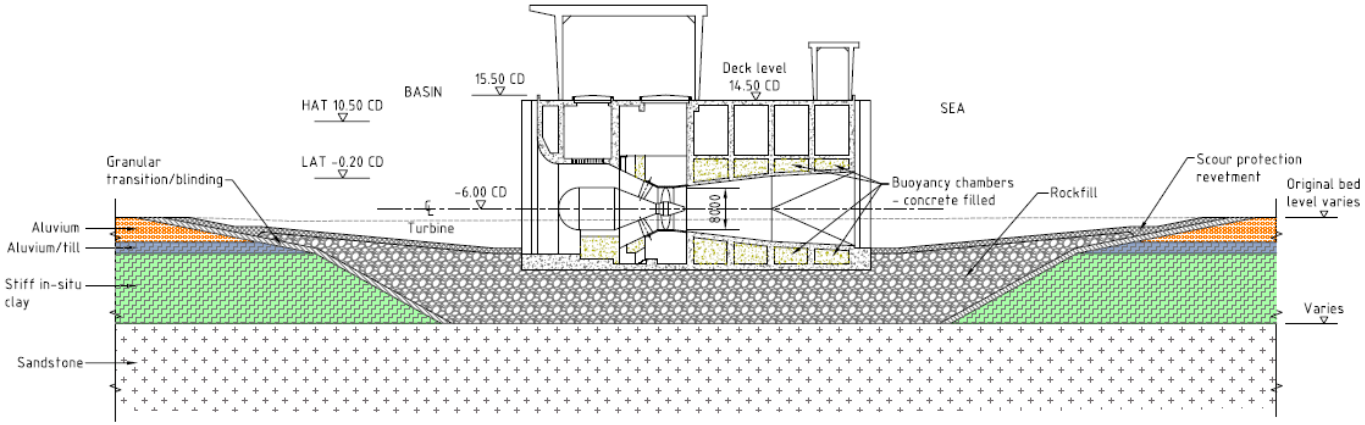
- Turbine choice & design – operating head, discharge rate, speed of rotation
- Full or partial barrier
- Alignment
- Positioning of turbines / sluices / locks
- Number and size of turbines – flow rate, required head
- Operating regime
  - Operating head / time tide held back on low and high tide
  - Ebb, Flood or Ebb and flood generation
  - Sluicing
  - Pumping

Impounding Barrage – Band A

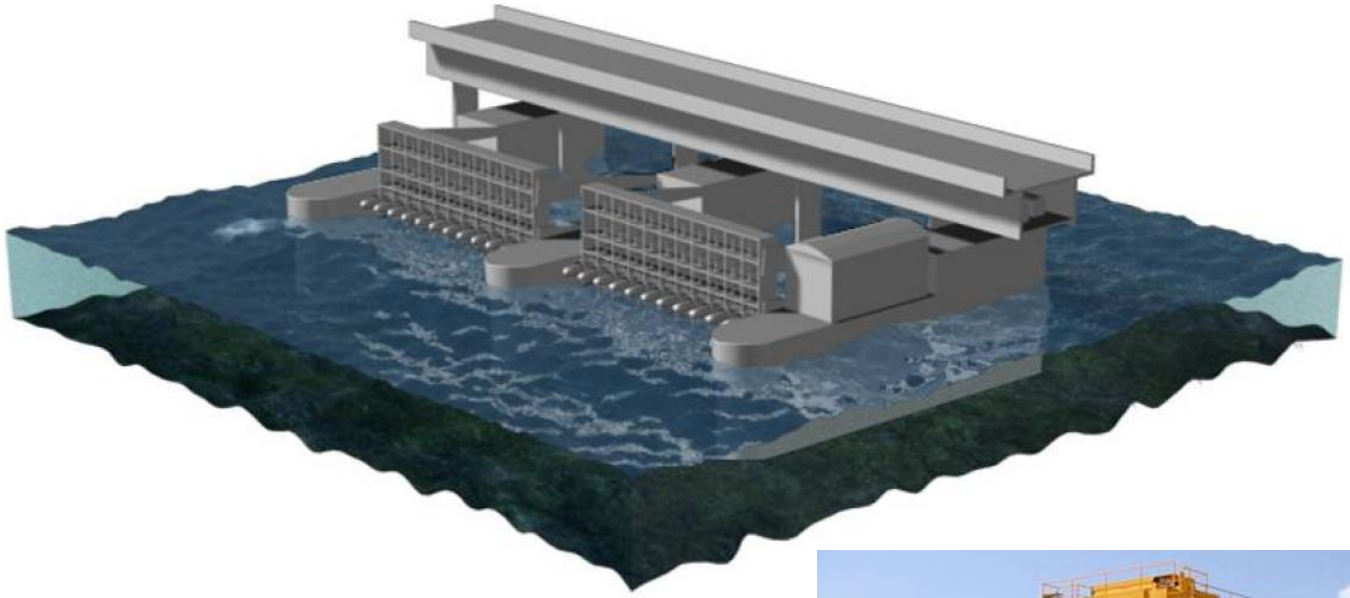


Mode of Operation	Installed Capacity	Annual Energy Output
High head, ebb generation	700 MW	900 GWhr

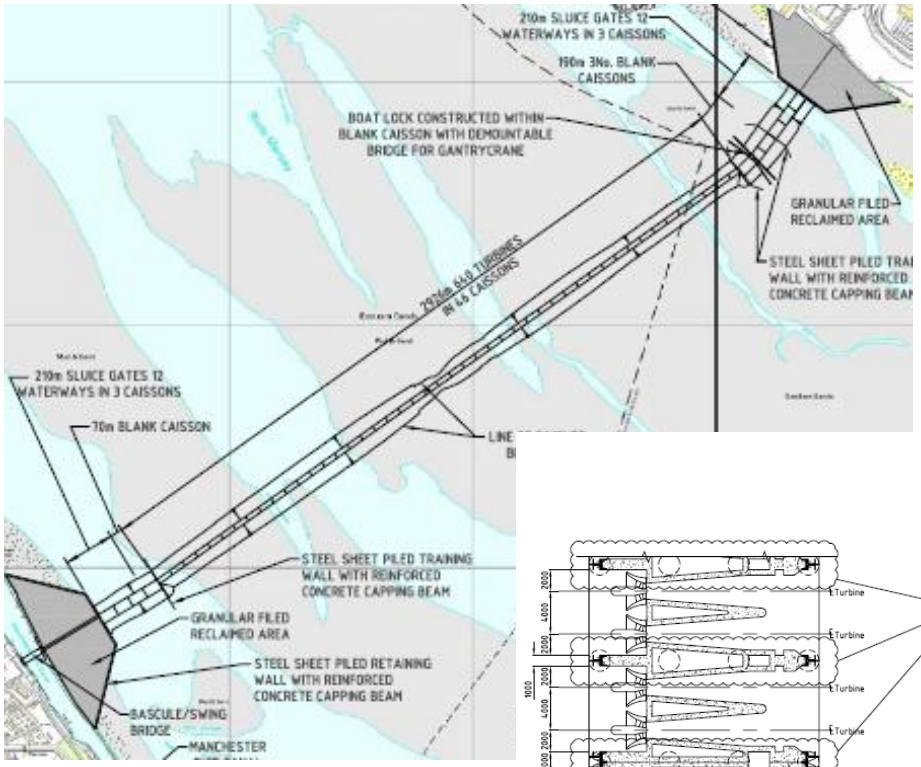
Type	Bulb
Runner Diameter	8 m
Mechanical Output	25 MW
Rated head	~ 6.00 m
Number of units	28



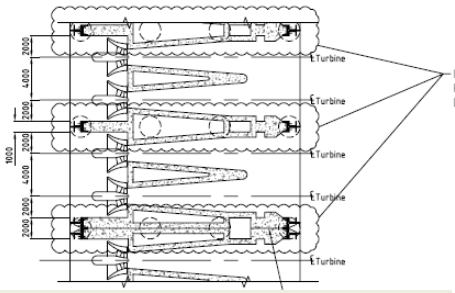
Low head barrage / Tidal Power Gate

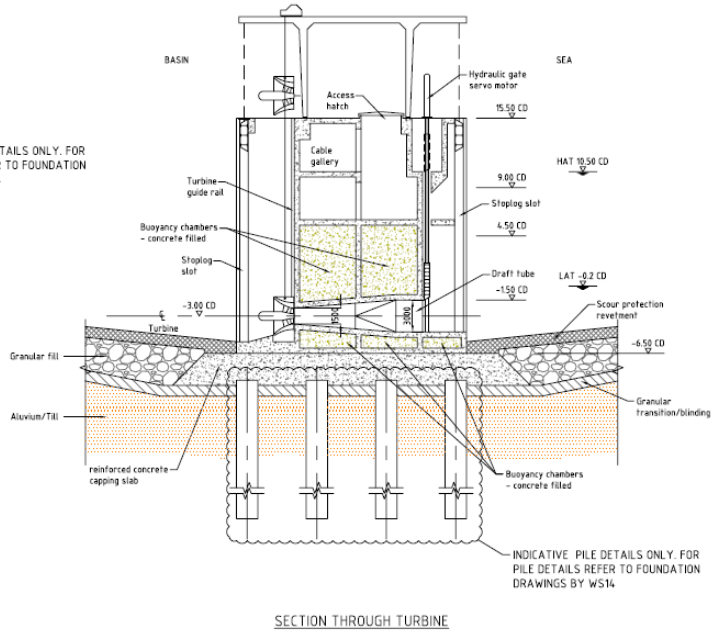


Low head barrage / Tidal Power Gate – Band B



Mode of Operation	Installed Capacity	Annual Energy Output
Low head, ebb generation	256 MW	400 GWhr

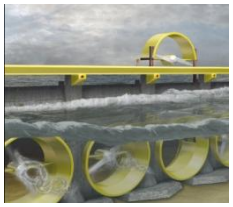


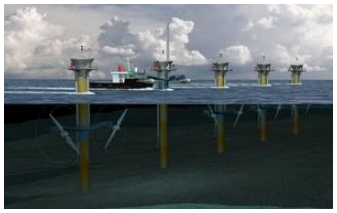


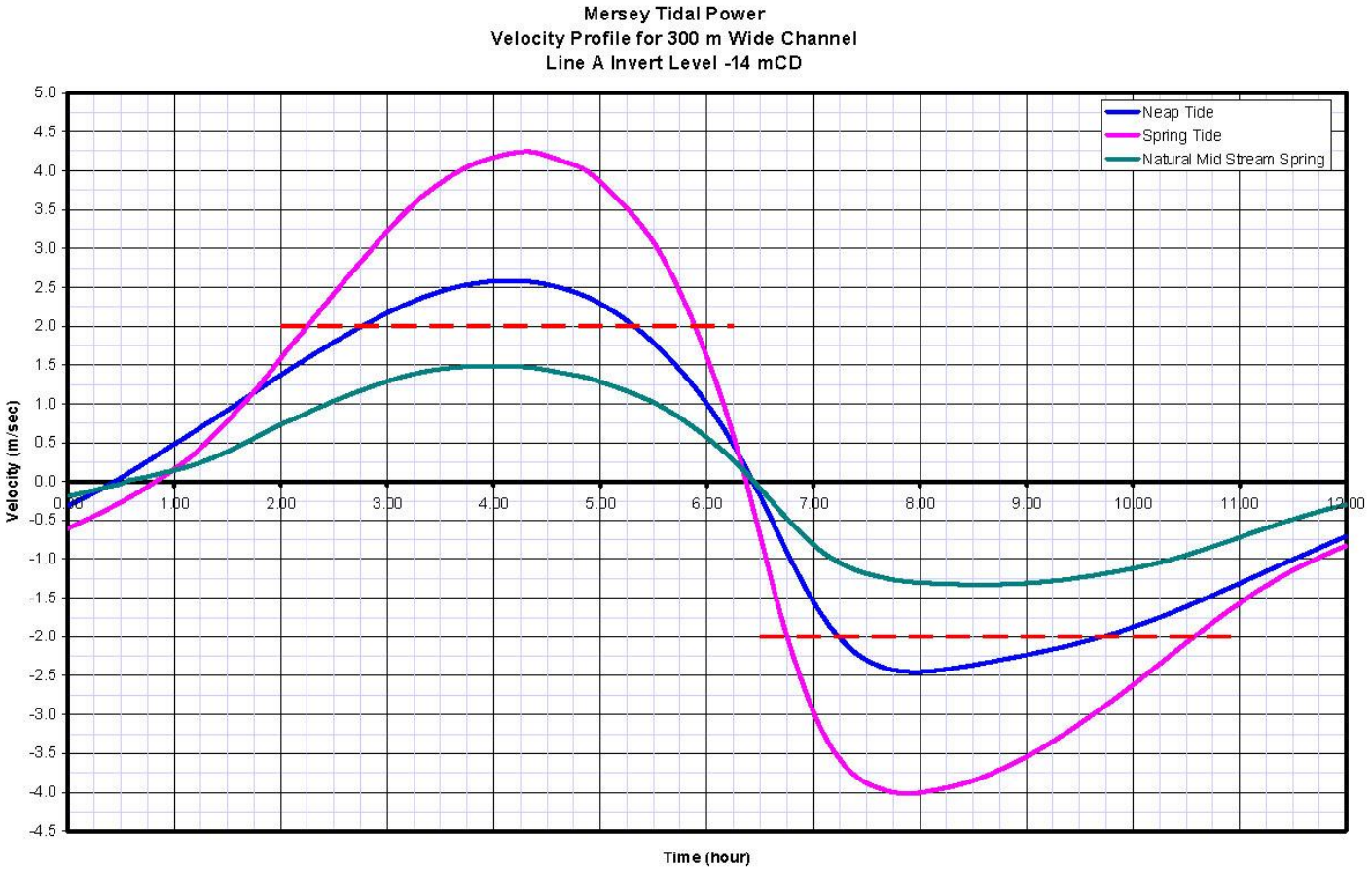
SECTION THROUGH TURBINE

Type	EcoBulb or Hydromatrix
Runner Diameter	1.45 m
Mechanical Output	400 kW
Rated head	~ 3.00 m
Number of units	640

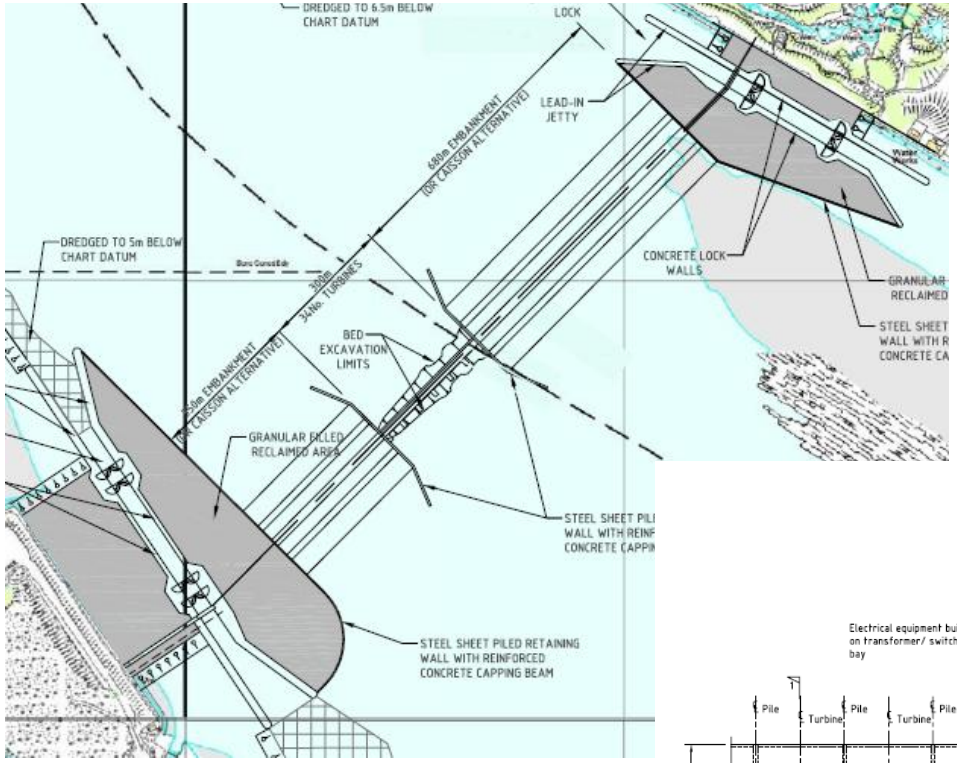
Tidal Fence modified current velocities



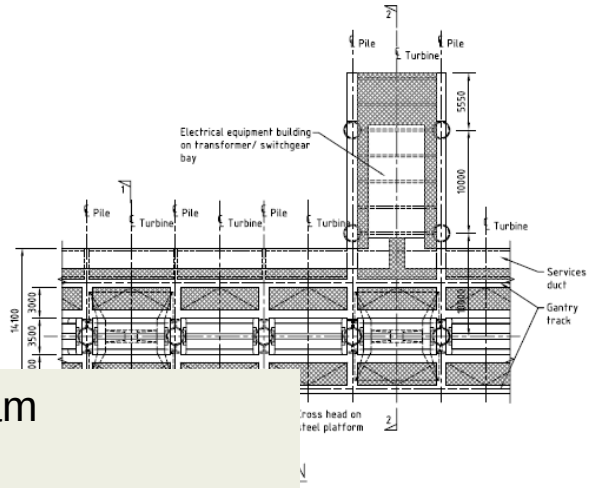


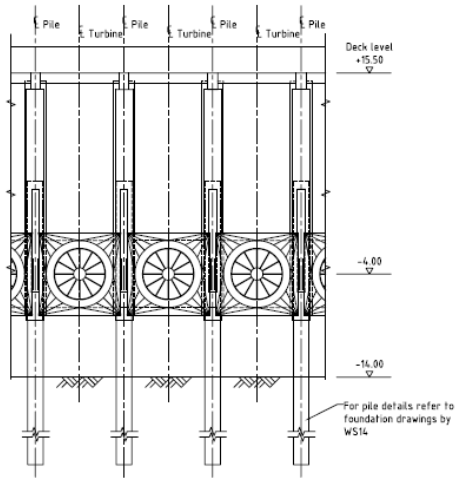



Tidal Fence – Band A and B



Mode of Operation	Installed Capacity	Annual Energy Output
Band A bi-directional	17 MW	27 GWhr
Band B bi-directional	14 MW	17 GWh

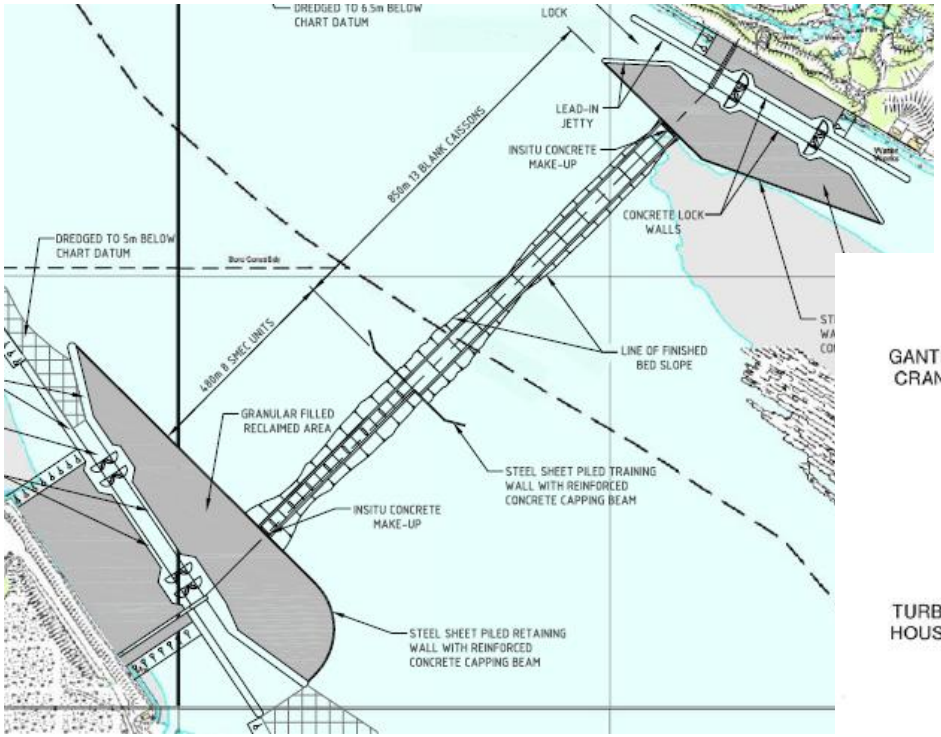




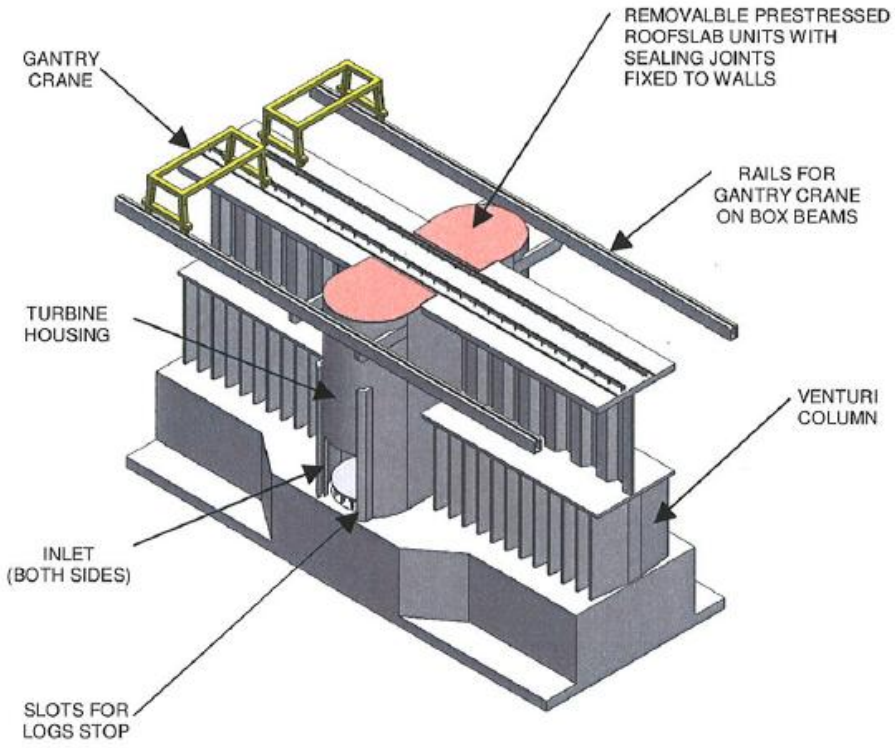
TYPICAL ELEVATION ON TURBINES

Type	Open stream	
Runner Diameter	5 m	
Mechanical Output	500 kW (A)	600kW (B)
Number of units	34 (A)	24 (B)

Spectral Marine Energy Converter – Band A



Mode of Operation	Installed Capacity	Annual Energy Output
bi-directional	n/a*	n/a*

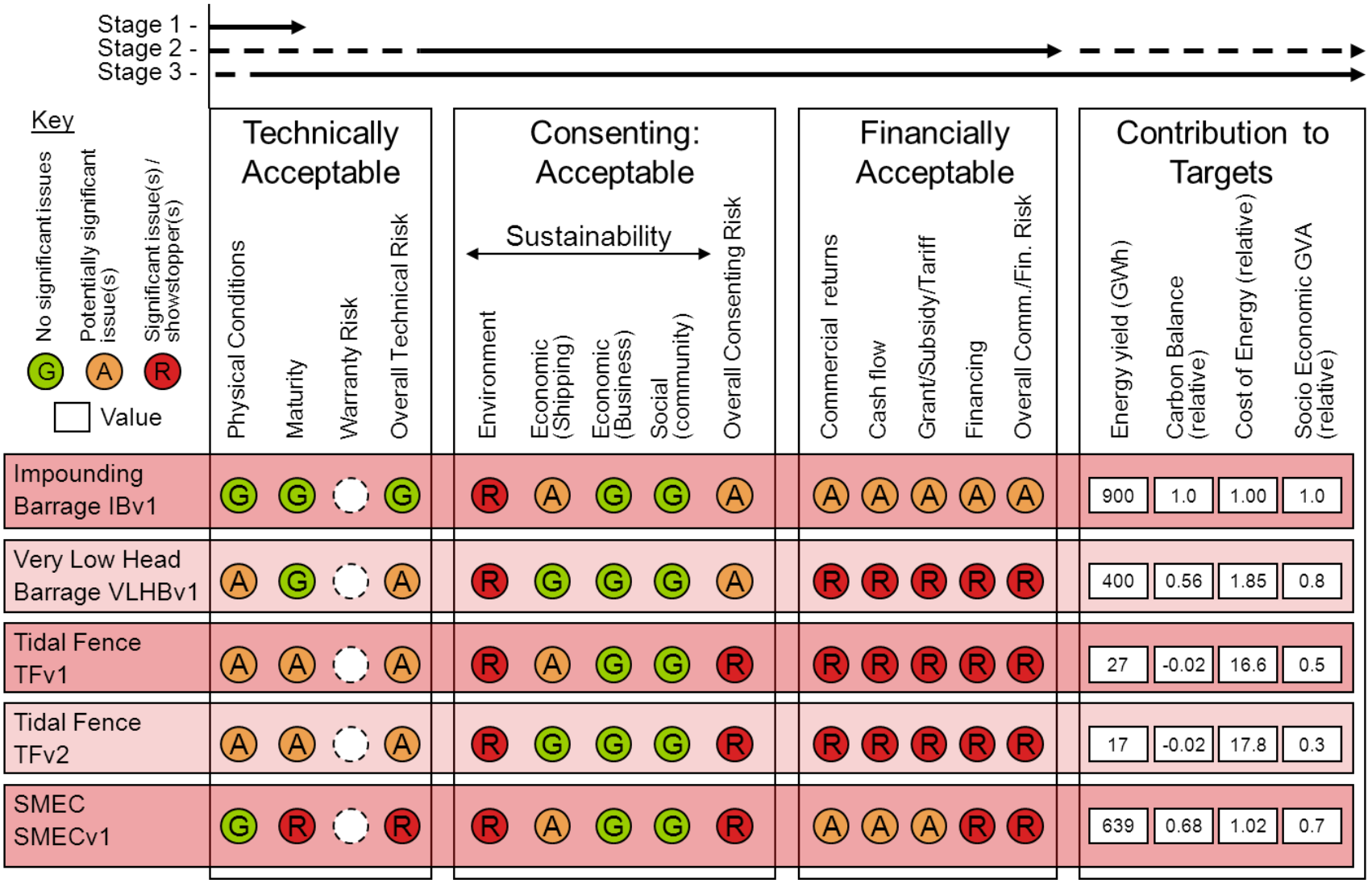


* Project team unable to verify figures provided by Verderg: 240 MW, 639 GWhr

Stage 2 assessment of four potential technologies

CONCEPT	OPTION	Capacity	Output
Impounding scheme	**Tidal Barrage**	**700 MW**	**900 GWh**
Very low head barrage	**Tidal Power Gate / Very low-head turbine**	**256 MW**	**400 GWh**
Tidal fence	**Horizontal or Vertical axis Turbine**	**17 MW** **14 MW**	**27 GWh** **17 GWh**
Tidal fence	**Spectral Marine Energy Converter (SMEC)**	**240 MW**	**639 GWh**

Stage 2 Assessment

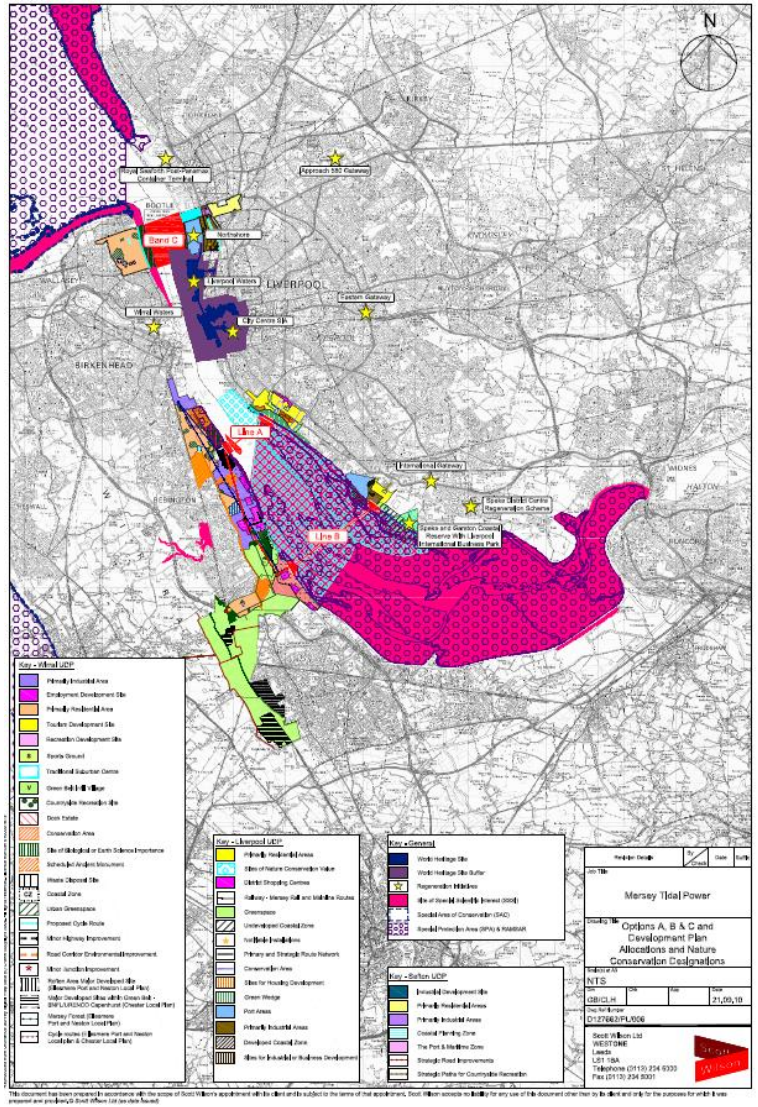


Location options – landside constraint assessment

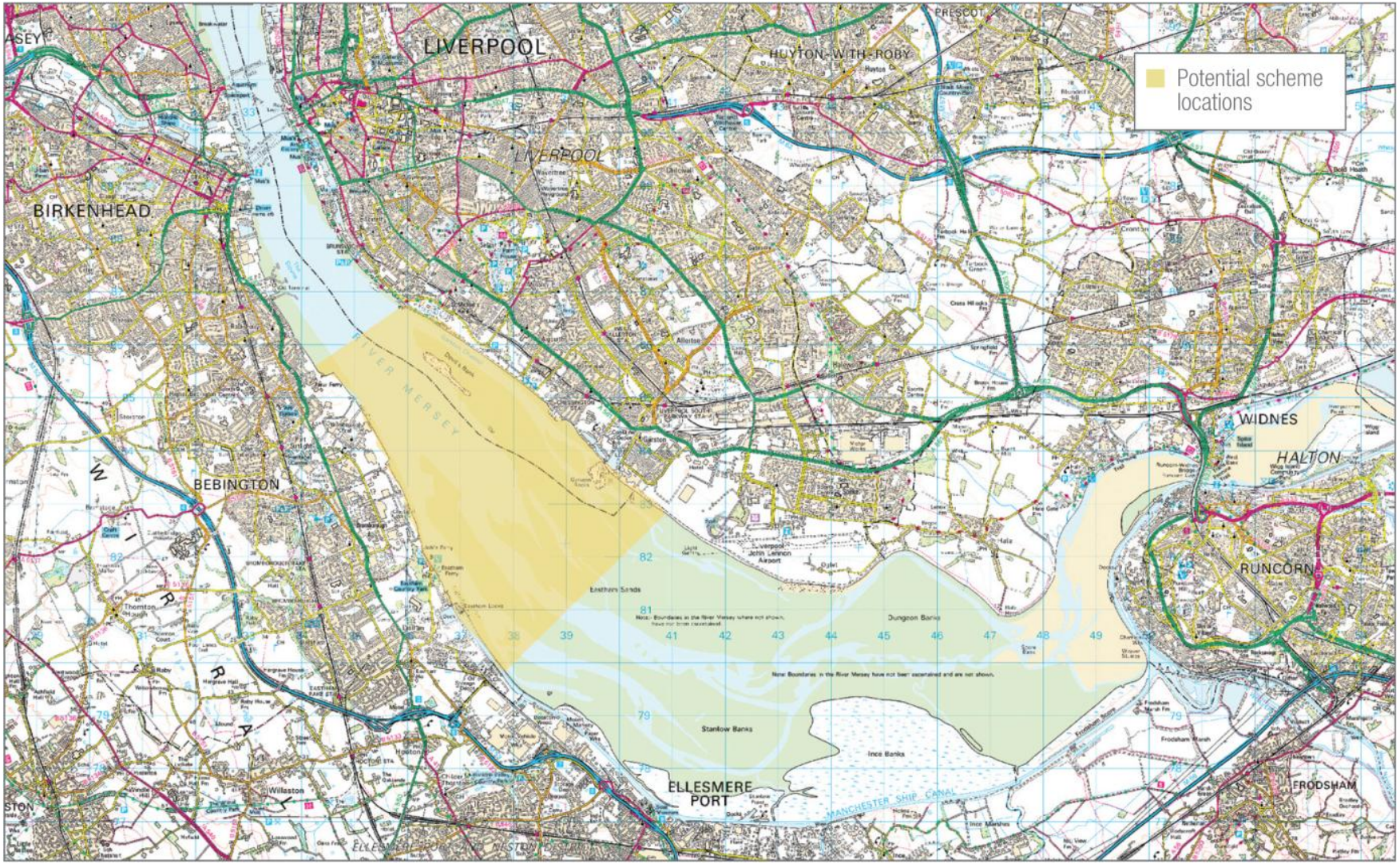
Band C – heavily constrained by landside and navigation uses, poor access, poor planning case: least feasible

Band C to Band A – very heavily constrained by landside and navigation uses: not feasible

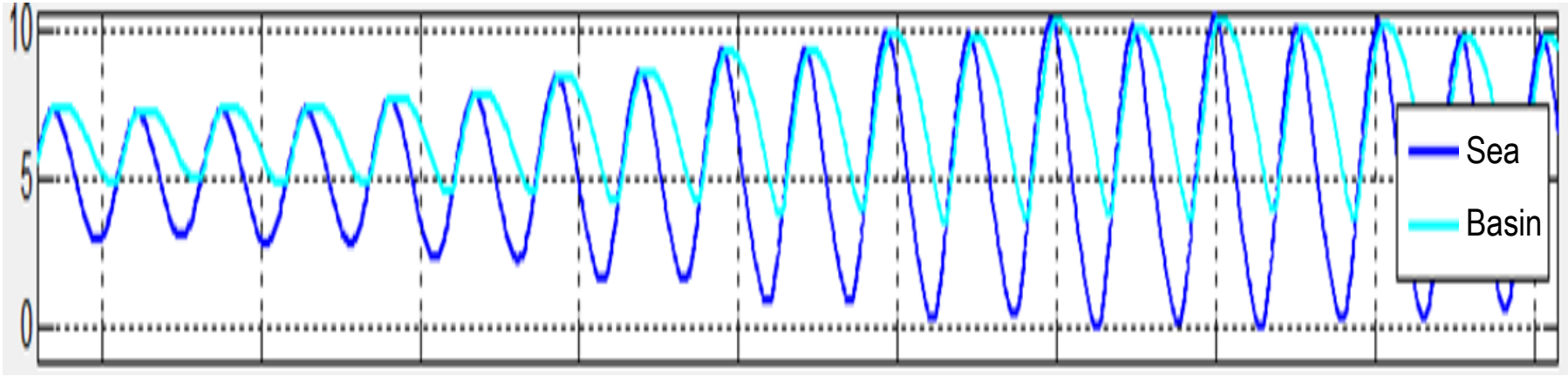
Band A to Band B – moderately constrained by landside and navigation uses, some access, some opportunities to complement regeneration initiatives, moderate planning case: most feasible



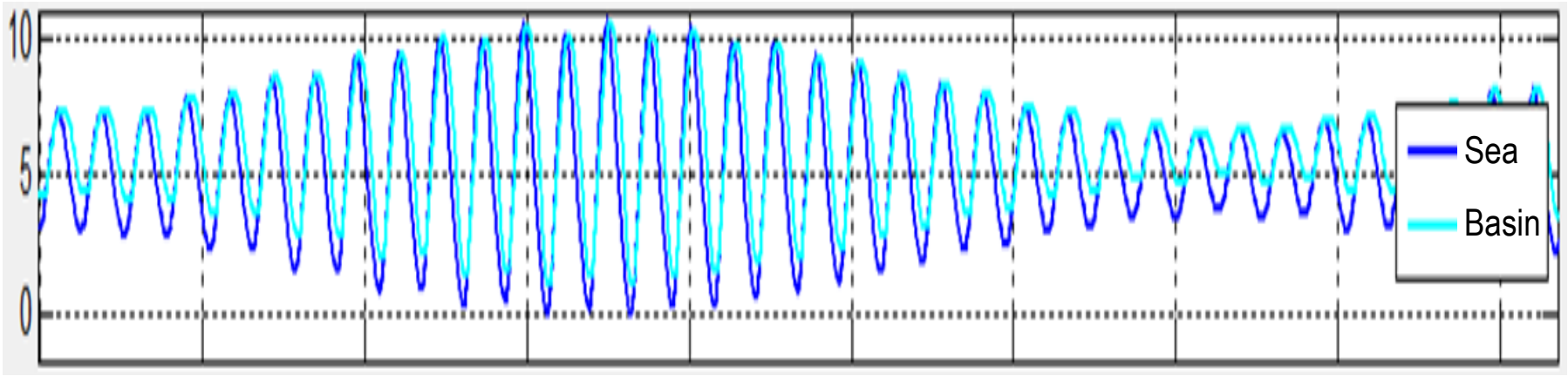
Location


Potential scheme locations
LIVERPOOL
HUYTON-WITH-ROBY
PRESCOT
BIRKENHEAD
BEBINGTON
WIDNES
HALTON
RUNCORN
ELLESMERE PORT
FRODSHAM
Willaston
Stanlow Banks
Ince Banks
Eastham Sands
Dungeon Banks
MANCHESTER SHIP CANAL

0-D modelling of potential impact of operating head on basin level



Low head operation ebb-only generation : no limit on head difference



Very low head ebb-only generation : limiting head difference to ~3m

Visualisations

Visualisations

Points of Contact

Peel Energy

- Anthony Hatton ahatton@peel.co.uk 0161 629 8388