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Tees Estuary Edges - Enhancement Study

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Presentation

1. Tees Estuary – Current Status
2. Objectives
3. Types of Enhancement
4. Methodology (boat and drone)
5. Results (GIS and bank characterisation)
6. Example Pilot Site
7. Summary

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1. Tees Estuary – Current Status

- The Tees Barrage has effectively reduced the length of the estuary by half.
- Anthropogenic features now constrain the High Water mark (e.g. flood defences, industry)
- Permanent inundation of most intertidal areas along the estuary, making the remaining intertidal zone very narrow and steep in profile.

- Challenging regulators to work together with operators and developers to find a balance between protecting the environment and supporting sustainable growth.

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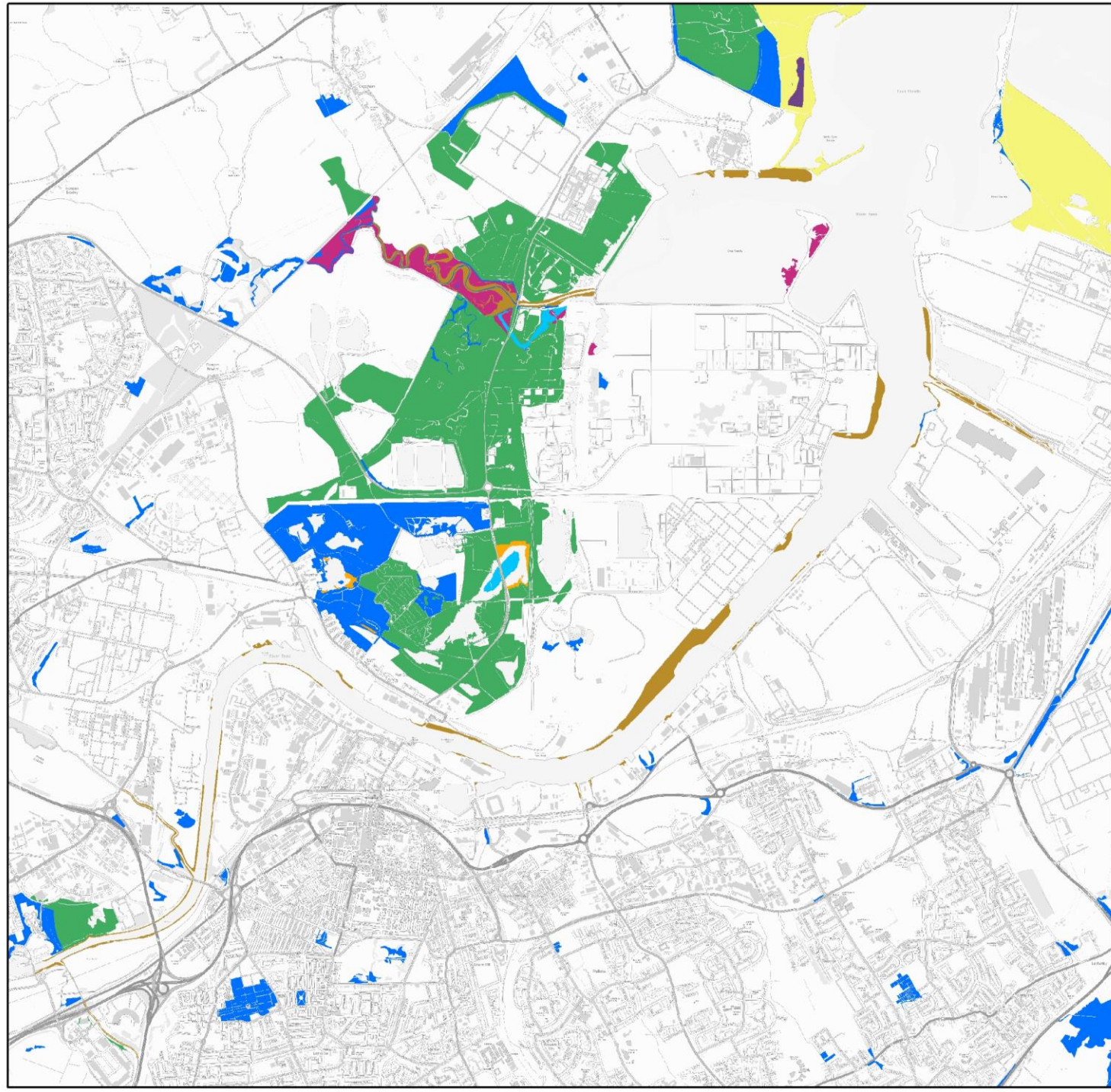
1. Tees Estuary - Current Status

Current priority habitats and their extent within the Tees catchment



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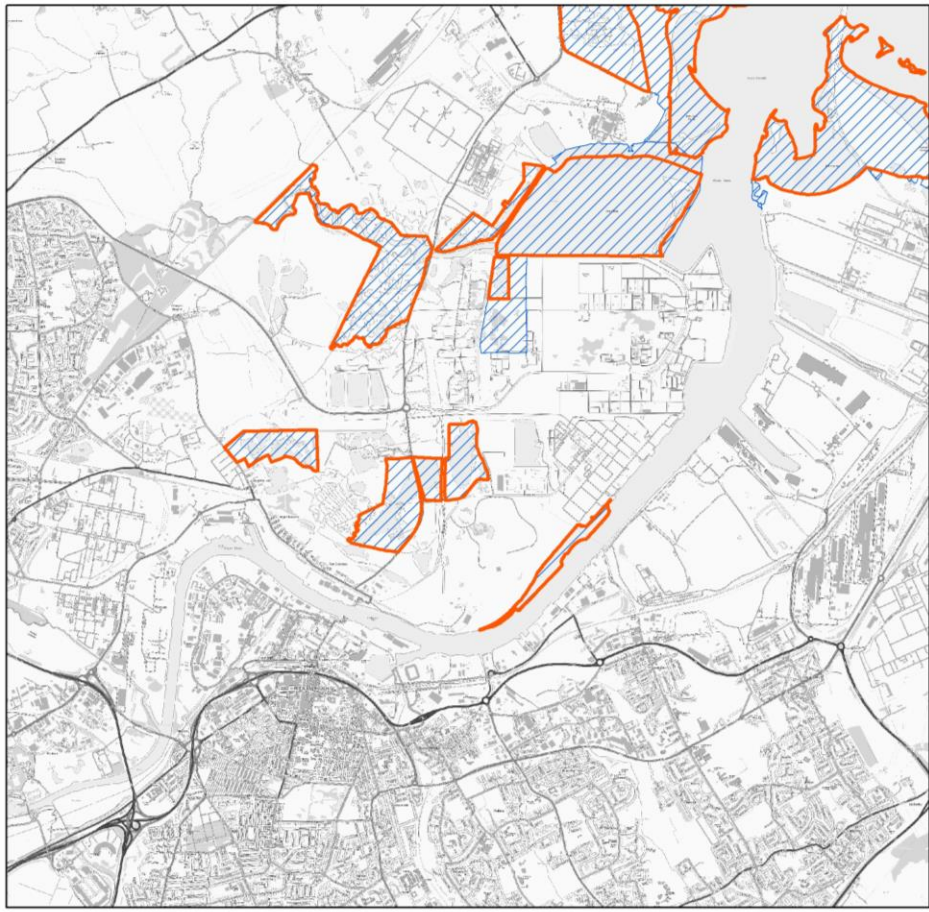
1. Tees Estuary – Current Status

Policy Drivers: Birds Directive

- Teesmouth and Cleveland Coast SPA designated in 1995 and extended in 2000.
- The species protected by the existing SPA are breeding Little Tern, passage Sandwich Tern, wintering Knot and wintering Redshank.
- The SPA is also classified for an assemblage of over 20,000 non-breeding waterbirds (NE, 2015).
- The boundary of the SPA is currently under review – Common Tern and Avocet.
- This will include the main channel of the River Tees below the barrage, estuary waters, and marine areas as important foraging areas.



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1. Tees Estuary – Current Status

Policy Drivers: Water Framework Directive (WFD)

- The Tees Estuary is classed as a Heavily Modified Water Body (HMWB).
- HMWBs need to meet maximum ecological potential (MEP).

  "MEP is the maximum ecological quality that could be achieved once all mitigation measures have been applied to potentially improve the ecology of the water body without having a significant adverse impact" (Brookes et al., 2009)

- Example mitigation measures to achieve MEP in transitional waters (estuaries) include:
  - removal of hard engineering (e.g. naturalisation);
  - modification to existing structures;
    - replacement with soft engineering solutions;
  - bank re-profiling;
  - managed realignment of flood defence;
  - restore/create/enhance aquatic and marginal habitats

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2. Aims & Objectives

Aims

- To identify a framework of habitat enhancement opportunities to improve biodiversity provision and habitat connectivity within the Tees.
- Link to policy drivers to justify enhancing and/or recreating estuarine habitat.
- Potential for functional provision to be improved for species associated with the existing and proposed SPA designation (e.g. increased foraging potential for waders using intertidal mudflat habitat and breeding birds such as tern species through improvements to essential fish habitats and associated populations).

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2. Aims & Objectives

Objectives

- To identify areas along the Tees estuary (from Barrage to mouth) where Estuary Edges Techniques could be applied
- Assessment based on environmental factors and operational constraints (engineering and financial aspects were not considered)
- To use or enhance existing infrastructure
- To identify pilot sites where the estuary edges options could be trialled in the future.

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3. Types of Enhancements

A. Re-profiling Existing Foreshore Levels

Benefits: Raising the profile of intertidal areas would allow longer bird feeding throughout the tidal cycle

A1. Using Existing Structures, e.g. Disused Timber Jetties

- Opportunities to use existing infrastructure (e.g. inner estuary)
- Existing timbers create retaining walls at low water for shoreline terracing

A2. Manufactured Retaining Structures

- Rock rolls or boulder packing can also be used to create terraced steps on the foreshore

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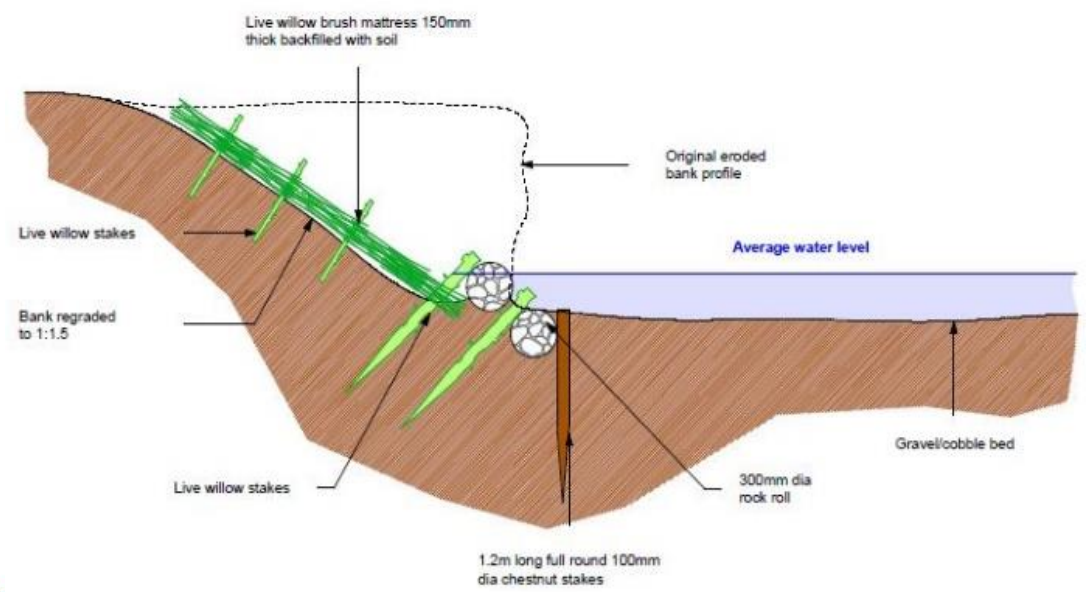
3. Types of Enhancements

A. Re-profiling Existing Foreshore Levels

Benefits: Raising the profile of intertidal areas would allow longer bird feeding throughout the tidal cycle

A3. Brushwood Fascines/Faggots

- Mattresses held by a grid of fixing posts and are effective at trapping sediment in intertidal areas and estuarine river banks
- Attach to timber posts to trap sediment either through natural accretion or through trapping pumped dredged spoil (beneficial use of dredge spoil)



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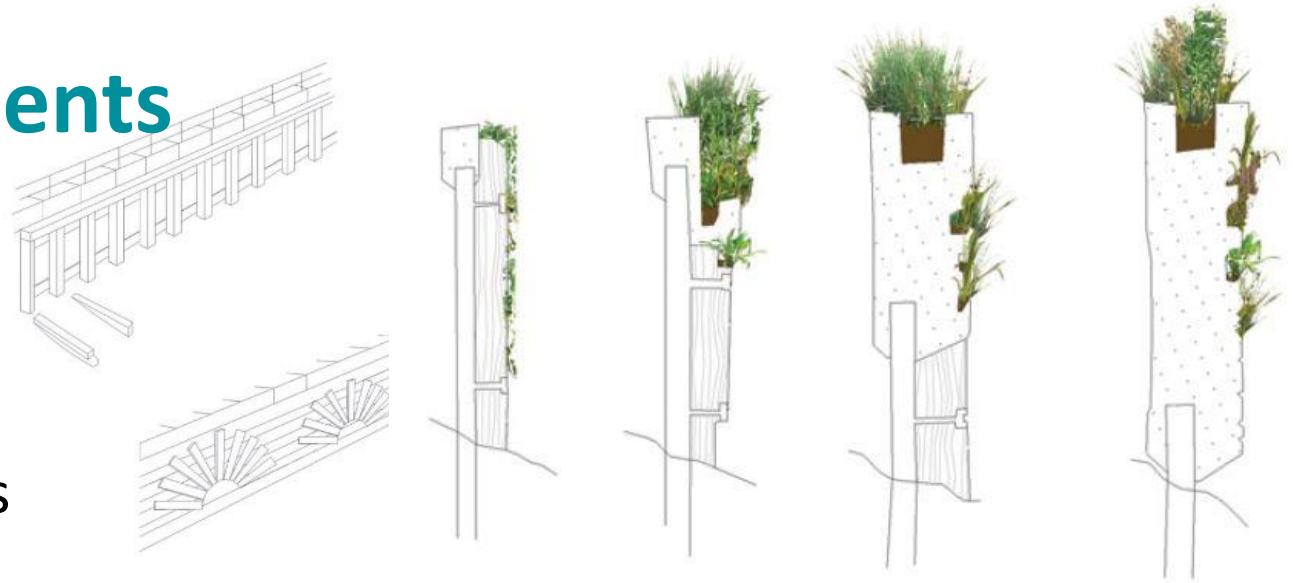
3. Types of Enhancements



B. Vertical Wall Enhancements

B1. Vertical Habitats

- Attach timber cladding to vertical surfaces
- Most beneficial when located in the main plant growth zone (between mean high water neaps and mean high water springs)
- Sediment seeded or planted to encourage vertical colonisation.
- In Australia, vertical walls have also been softened by attaching flower pots

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3. Types of Enhancements

B. Vertical Wall Enhancements

B2. Niche Creation

- Create more surface texture on vertical walls for vegetation and species to attach
- Holes and grooves on vertical walls and boulders
- Low cost interventions

B3. Grab Ropes and Chains

- Opportunities for enhancing vertical surfaces with grab ropes and chains to encourage the colonisation of algae and invertebrates

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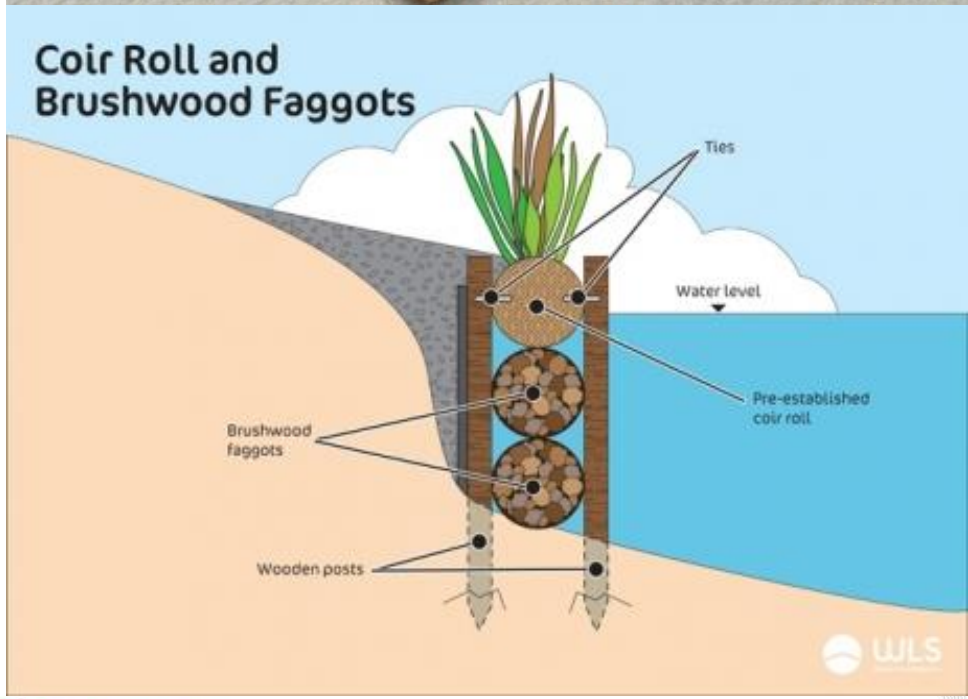
3. Types of Enhancements

C. Planting

C1. Pre-seeded Medium

- Pre-seeded coir mattresses/pallets, coir rolls, synthetic soil cells, turf reinforcement mats or in established containers.
- Additional protection in high energy areas (e.g. wire ‘rocknet’, wire mesh).
- Careful considerations to physico-chemical variables (e.g. tidal inundation, turbidity, currents, variable salinity conditions, boat wash) to ensure the survival of the plants.



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3. Types of Enhancements

D. Floating Pontoons / Rafts

D1. Vegetated Pontoons

- For artificial vegetated rafts/pontoons to be effective, they need to be at least 8m wide and with an area of 200m².
- The floating platforms need a buoyant frame which encloses a permeable material into which vegetation can be planted and establish.
- Securely anchored and in a low energy environment.

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3. Types of Enhancements

D. Floating Pontoons / Rafts

D2. Roosting Rafts

- Roosting/breeding rafts for Terns and waterfowl would require suitable substrate for the birds to roost or nest on.
- Additional screening around the perimeter of the raft would help to reduce predation from otters or seals (e.g. low growing species or perspex retaining walls).

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3. Types of Enhancements

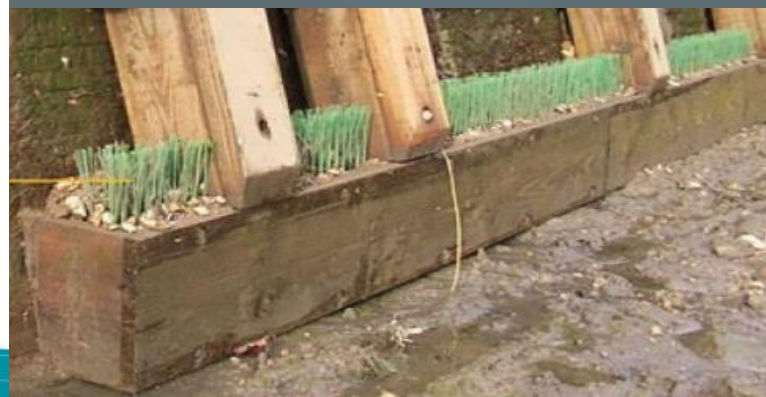
E. Fish Habitat Creation

E1. Fish Refuge Boxes

- Submerged cage-like structures containing suitable material can provide a niche for a variety of bivalves and refuge areas for young and small fish
- Suspended by steel cables from docks, quays and jetties to be submerged below mean low water.

E2. Egg-laying Medium

- Plastic fronds or ‘brushes’ can be included in an enhancement design to provide a substrate for egg laying by fish.



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3. Types of Enhancements

F. Extending intertidal areas

F1. Training Walls

- Extending existing training walls could help to improve the condition and/or extent of intertidal areas.
- Reduce the amount of navigational dredging required.
- Could bring ecological benefits to mudflat systems which are currently classed as being in unfavourable condition.

F2. Realignment

- Realigning the flood bank to create additional intertidal habitat.
- Limited opportunities along the Tees due to the nature of the bank use (also historic landfill sites).

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4. Methodology

- Boat surveys to assess the banks at low water.
- Photographic evidence was taken of the banks, in particular around potential areas of interest.
- Visits on foot and use of aerial photographs.
- Potential sites were filmed from above and obliquely by drone camera.
- Softening measures mapped in GIS.

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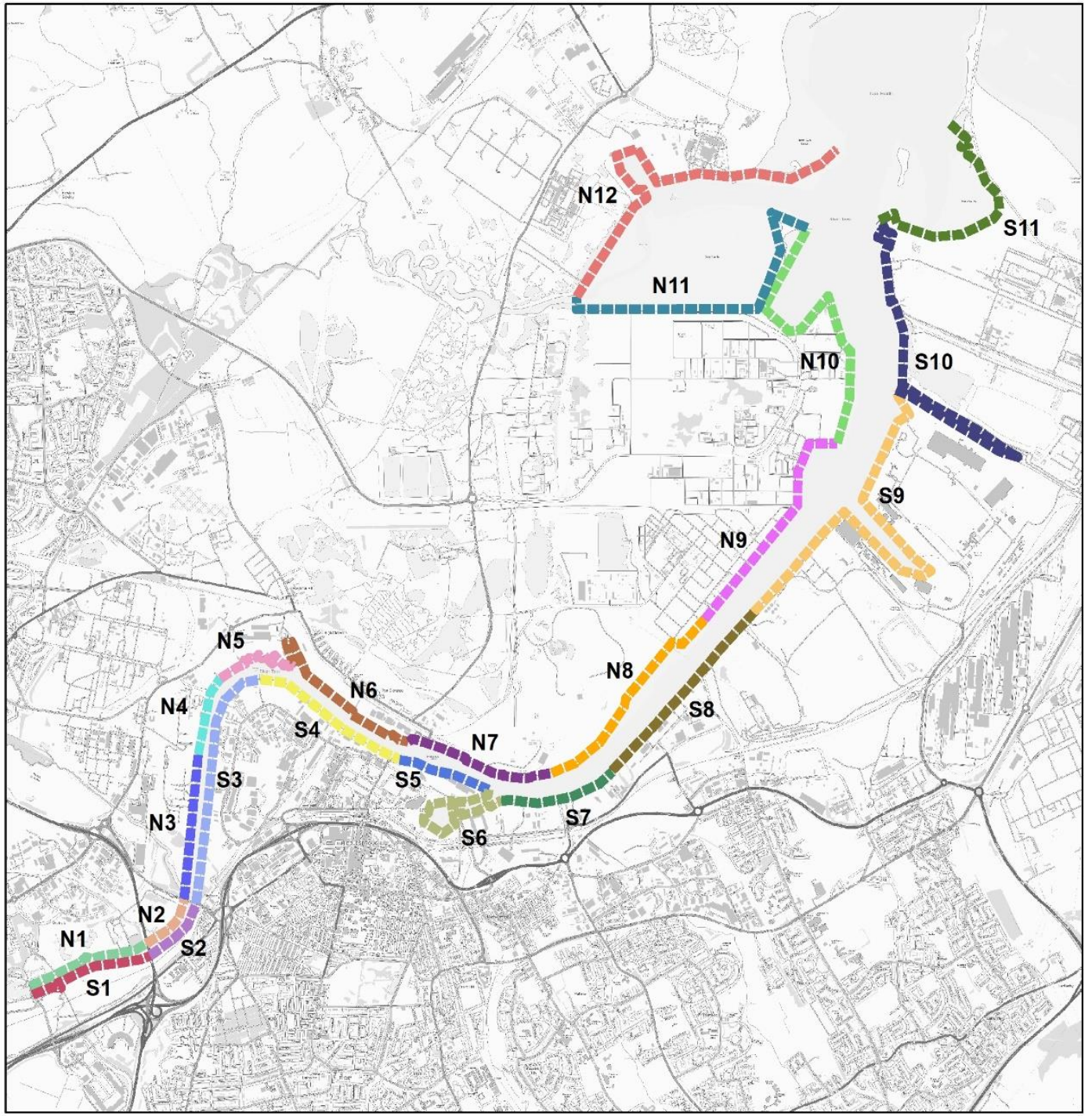
4. Methodology

- North and south banks of the Tees Estuary were divided into survey sectors (North bank N1-N12; South bank S1-S11)

- Each sector was assessed for the current bank characteristics and future enhancement potential

- Combination of bioengineered, and in some cases, structurally engineered designs, a range of options for estuary banks with the potential for enhancement have been identified.



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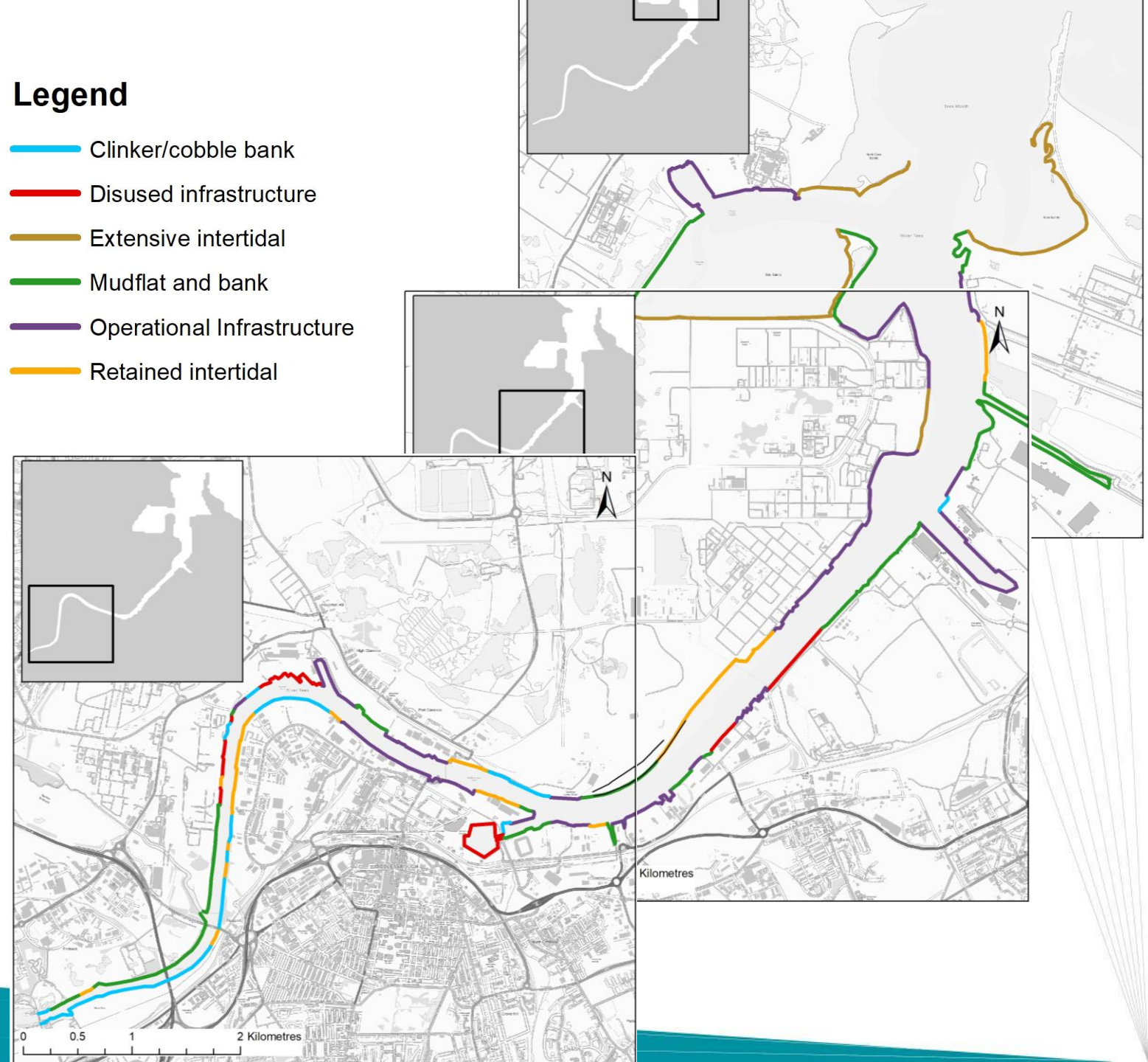
5. Results

Bank Characterisation

- The inner estuary is characterised by steep clinker and cobble banks
- The middle to outer estuary characterised by operational quays
- Outer estuary extensive intertidal areas: Seal Sands, Bran Sands, North and South Gares



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5. Results

Tees Estuary Bank Characterisation

Clinker/cobble bank

A. clinker/cobble foreshore with terraced upper shore
B. cobble/clinker bank of constant gradient <45 degrees
C. cobble/clinker bank of constant gradient >45 degrees
D. cobble/clinker bank with some timber structures at low water and rock gabions. Areas of erosion.
E. cobble/clinker bank with some timber structures

Disused infrastructure

A. disused jetty with existing mudflat below and behind
B. disused slipway/dock
C. disused vertical concrete quay
D. disused vertical timber quay

Extensive intertidal

A. extensive mud/sandflat backed by >45 degree clinker earth bank
B. extensive mud/sandflat backed by >45 degree engineered flood bank (sheet piled, gabions, mattresses, brick wall)
C. extensive mud/sandflat with some timber structures backed by >45 degree clinker earth bank.

Mudflat and bank

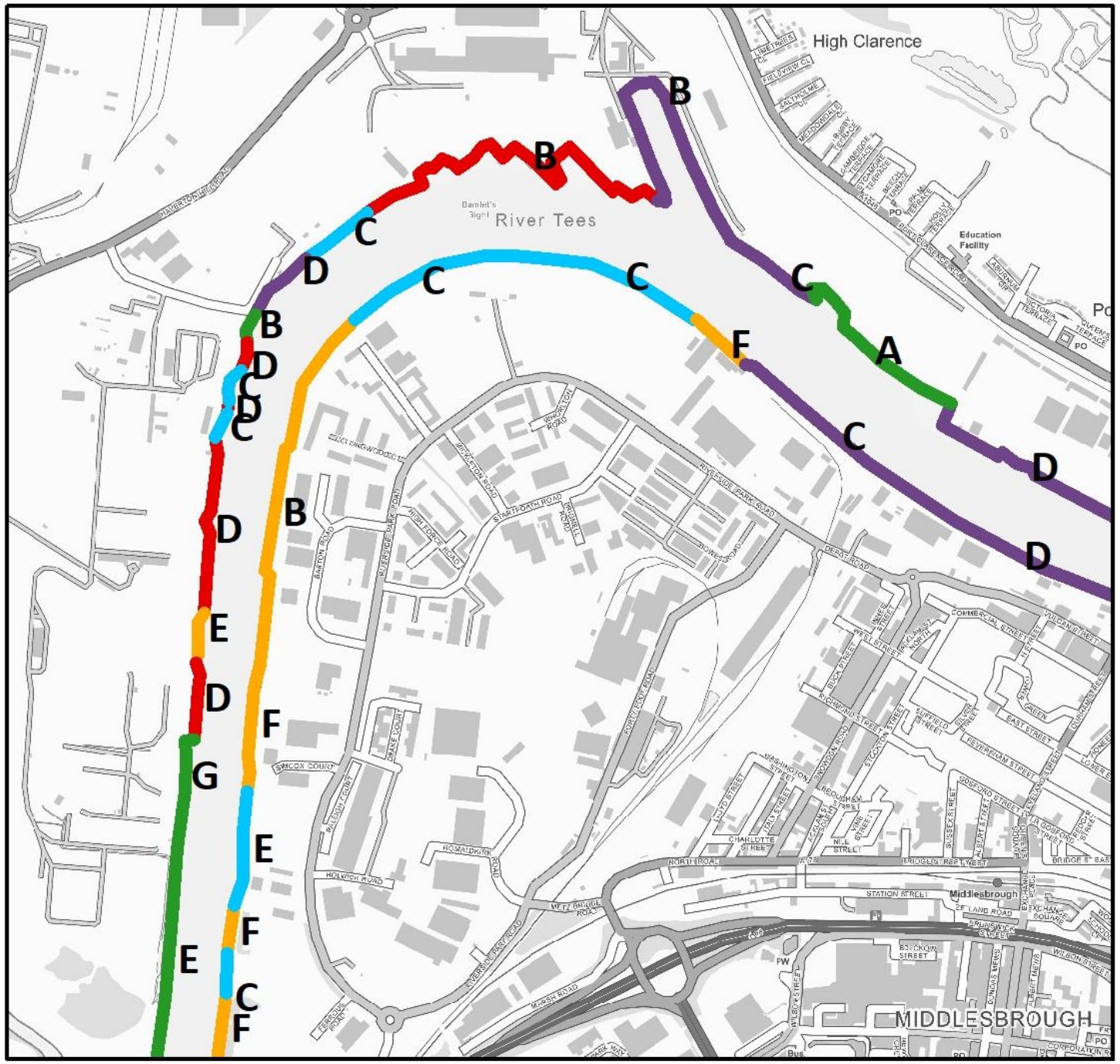
A. mudflat low shore backed by <45 degree clinker earth bank
B. mudflat low shore backed by >45 degree clinker earth bank
C. mudflat low shore backed by >45 degree clinker earth bank and operational jetties
D. mudflat low shore backed by >45 degree clinker earth bank. Occasional jetties.
E. mudflat low shore backed by >45 degree clinker/cobble earth bank
F. mudflat low shore backed by >45 degree engineered flood bank (sheet piled, gabions, mattresses, brick wall)
G. mudflat low shore backed by >45 degree engineered flood bank (sheet piled, gabions, mattresses, brick wall) with operational jetty

Operational infrastructure

A. operational jetties backed by engineered bank >45 degree
B. operational slipway/dock
C. operational vertical sheet piled quay
D. operational vertical timber quay

Retained intertidal

A. retained extensive mudflat (training wall) backed by clinker bank
B. retained low water (timber structure) with numerous horizontal and vertical timber structures on clinker shore
C. retained mudflat (training wall) backed by clinker bank
D. retained mudflat (training wall) backed by riprap and earth bank
E. retained mudflat at LW (sheet piles or timber) backed by clinker bank >45 degree
F. retained mudflat at LW (sheet piles or timber) backed by engineered bank >45 degree



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5. Results

Estuary Edges Options

Estuary Edges Enhancement Opportunities

Screening

Fish habitat creation
- A. Fish Refuge Box

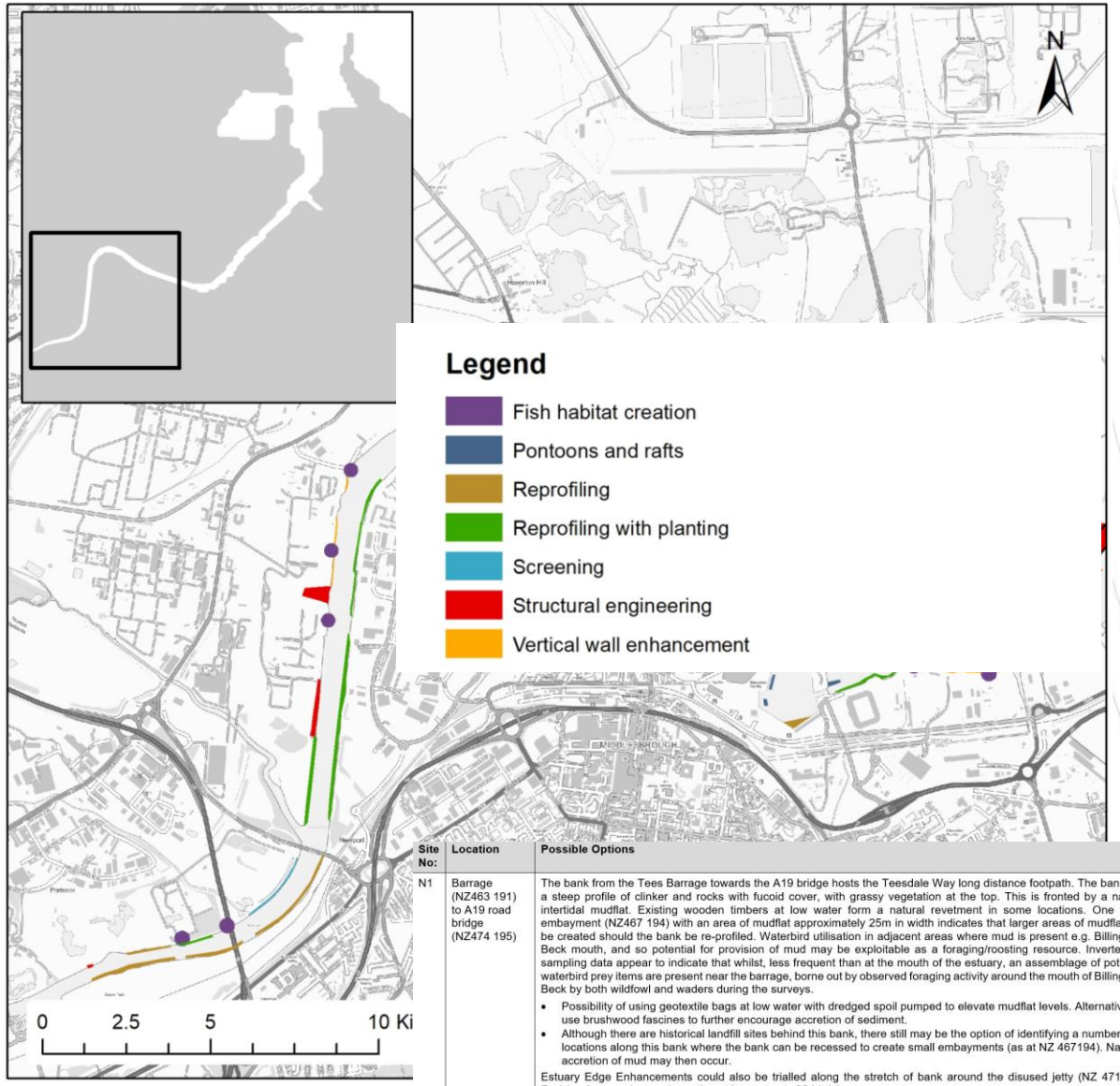
Pontoons and rafts
- A. Vegetated pontoons
- B. Tern roosts / rafts

Reprofiling
- A. Reprofile by terracing
- B. Recreate muddy embayments

Reprofiling with planting
- A. Opportunities to use existing timber infrastructure for raising the intertidal profile and planting
- B. Recreate zonation (mudflat to high marsh)
- C. Re-grading of shoreline and planting at high water

Structural engineering
- A. Extend existing training wall
- B. Create new training wall
- C. Regulated Tidal Exchange (RTE) device
- D. Realign the bank (small scale)
- E. Realign the bank (large scale)

Vertical wall enhancement
- A. Surface texture enhancements e.g. holes, grooves, Vertipools
- B. Opportunities for grab ropes, chains and fish refuge boxes where they would not interfere with operational quayside
- C. Vertical greening of walls and fish refuge boxes
- D. Vertical greening of walls, wooden cladding, fish refuge boxes and plant pots
- E. Vertical greening of walls, wooden cladding, fish refuge boxes and plant pots on new quay



Site No:	Location	Possible Options	Constraints
N1	Barrage (NZ463 191) to A19 road bridge (NZ474 195)	The bank from the Tees Barrage towards the A19 bridge hosts the Teesdale Way long distance footpath. The bank has a steep profile of clinker and rocks with fucoid cover, with grassy vegetation at the top. This is fronted by a narrow intertidal mudflat. Existing wooden timbers at low water form a natural revetment in some locations. One small embayment (NZ467 194) with an area of mudflat approximately 25m in width indicates that larger areas of mudflat can be created should the bank be re-profiled. Waterbird utilisation in adjacent areas where mud is present e.g. Billingham Beck mouth, and so potential for provision of mud may be exploitable as a foraging/roosting resource. Invertebrate sampling data appear to indicate that whilst, less frequent than at the mouth of the estuary, an assemblage of potential waterbird prey items are present near the barrage, borne out by observed foraging activity around the mouth of Billingham Beck by both wildfowl and waders during the surveys. • Possibility of using geotextile bags at low water with dredged spoil pumped to elevate mudflat levels. Alternatively use brushwood fascines to further encourage accretion of sediment. • Although there are historical landfill sites behind this bank, there still may be the option of identifying a number of locations along this bank where the bank can be recessed to create small embayments (as at NZ 467194). Natural accretion of mud may then occur. Estuary Edge Enhancements could also be trialled along the stretch of bank around the disused jetty (NZ 471194). Redshank were observed roosting at low water (c.30 birds). • Option to re-profile the bank to create a fixed marginal zone which could possibly be created by natural silt accretion. Geotextile bags at low water with dredge spoil pumped to elevate mudflat levels. • Consider screening of the existing mudflat from the footpath by planting on the bank. • As a floating pontoon may be unfeasible due to the 5m tidal range, look to install fish refuge boxes for small fish using the estuary. These could be attached via steel cables to the disused jetty. • INCA suggested an option of linking the estuary with the Portrack Marshes Nature Reserve behind by a Regulated Tidal Exchange structure through flood banks. This needs further consideration (see above) and modelling of the effects.	• Check historical timbers are not listed • Bank gradient • Any planting would need to withstand tidal range and boat wash and be tolerant of variable salinity conditions. • Historical landfill sites behind the bank
N2	A19 road bridge to Billingham Beck/A1032	The Teesdale Way continues to follow the flood bank between the two bridges, raised above the estuary. The flood bank again has a steep profile with a clinker bank leading to a grassy scrub at high water. Being on the inside of the river bend, the intertidal area is marginally wider (c.10 – 15m) with feeding Redshank and gulls noted during the surveys. • Some screening of the existing mudflat from the footpath by planting on the bank.	• Saltmarsh does survive in the intertidal zone, with *Phragmites* on the landward side of

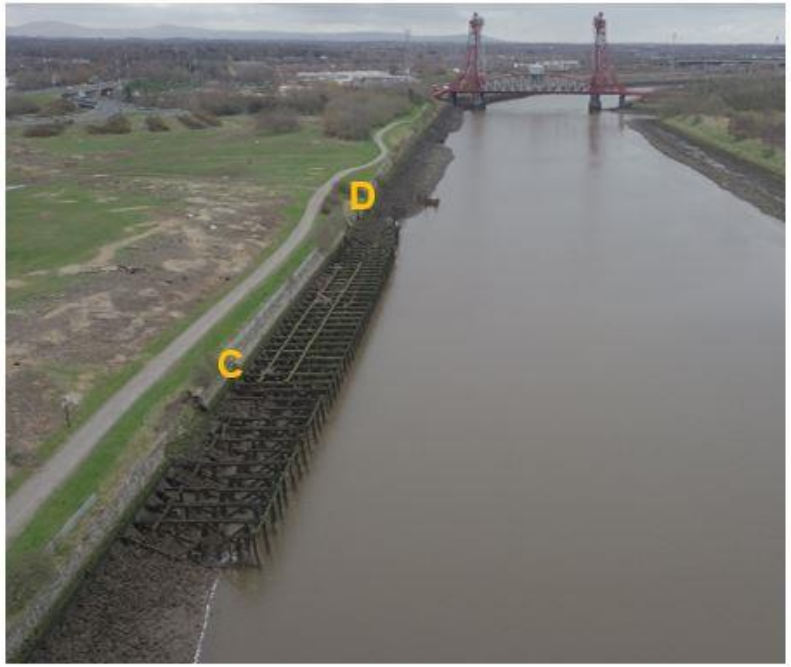
6. Example Pilot Site

Looking north along the south bank

Different types of pre-seeded estuarine plants could be trialled including grasses, reeds and saltmarsh plants.

A & B: Pilot sites for vegetation colonisation – pre-seeded coir mattresses (experiment with which species are suitable)

C & D: Pilot sites for established vegetation trials (experiment with established vegetated mattresses – monitor establishment and growth).



Looking south towards the A1032 Newport Bridge

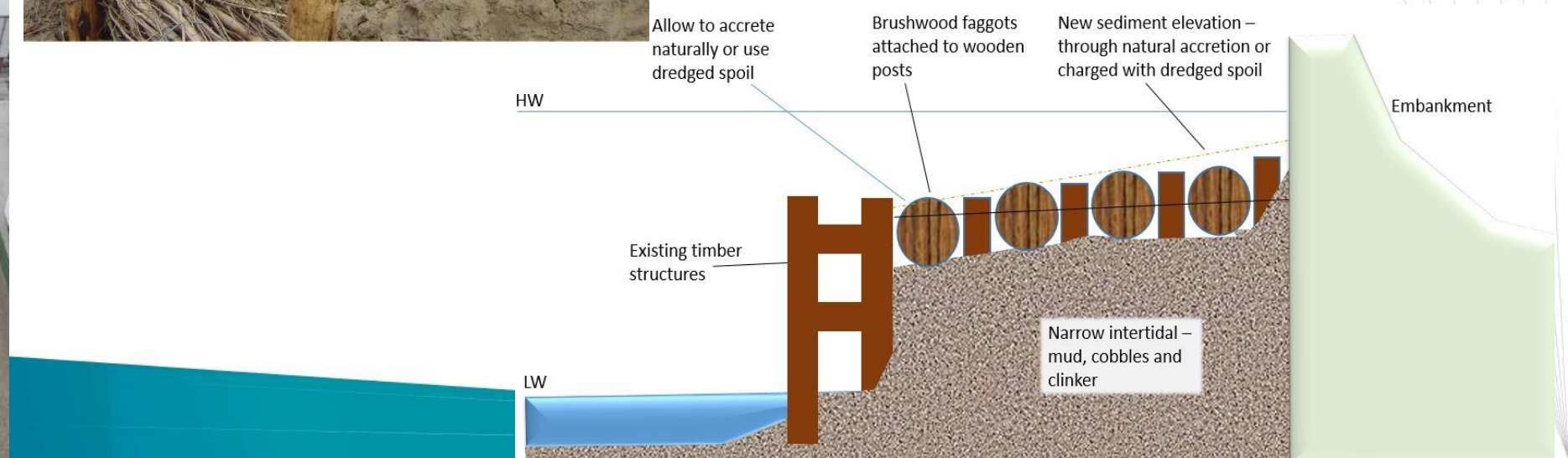
Looking north along the south bank

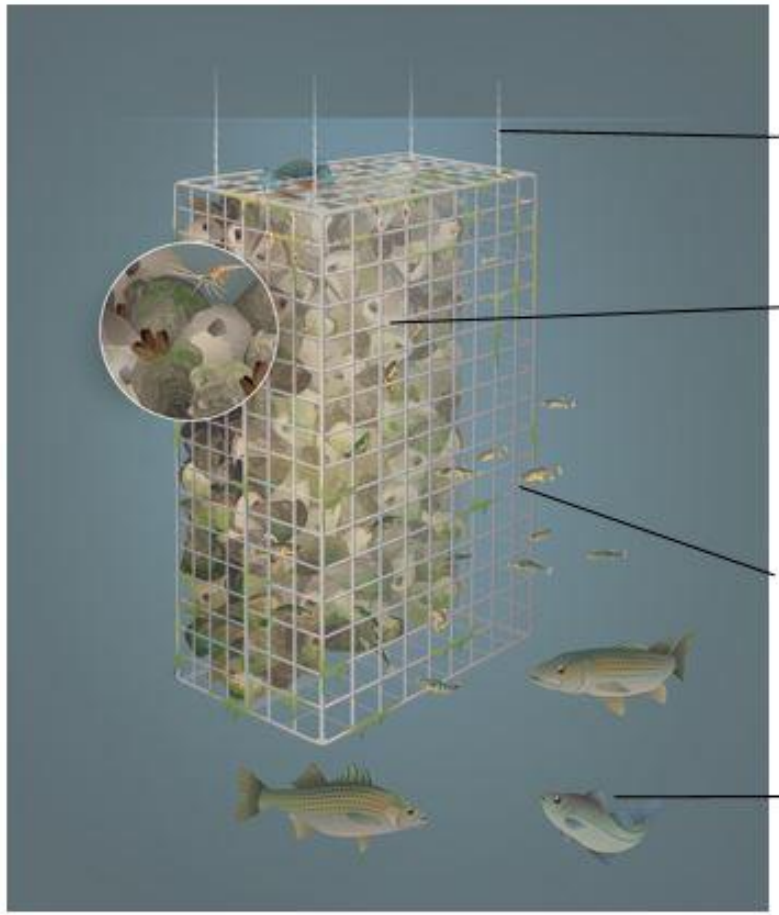
Pre-seeded/planted coir matting (© terraqua-es.co.uk)

Established estuary edge vegetation (© Salix.co.uk)

6. Example Pilot Site

Attach brushwood fascines/faggots to the existing timber posts parallel to the edge to assist sediment accretion and attainment.



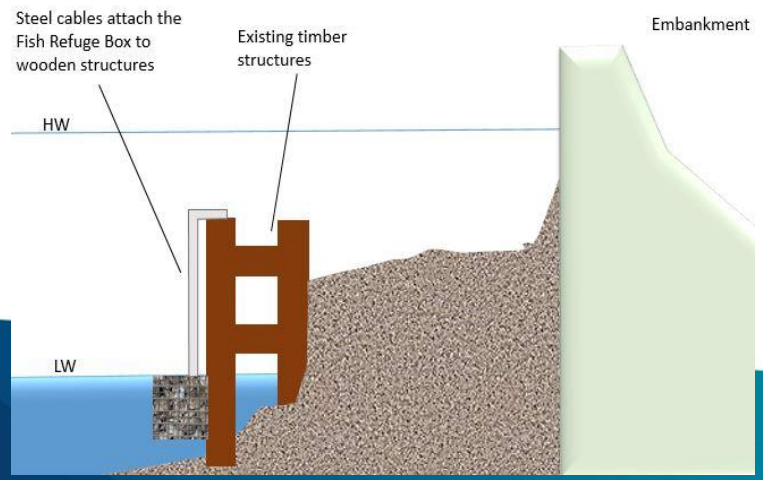


Hung by steel cables from quays and jetties

Inner core is made of shells providing a niche habitat for bivalves and crustacean

Smaller fish seek refuge inside the wire mesh outer frame from larger predators

Larger fish are able to use the box to hunt and feed



Siting Fish Refuge Boxes throughout the estuary provides a corridor of habitats for fish to use

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7. Summary

- Based on the environmental and biological attributes of the Tees Estuary, it is felt the pilot sites identified through this work offer the greatest opportunity for enhancement.
- All the enhancement options suggested will require engineering expertise and modelling as to their feasibility in the suggested locations, as well as a cost benefit assessment.
- Historic Landfill – limits both re-profiling and realignment of the Tees estuary banks.
- Trial areas should be investigated for:
  - Planting of different types of vegetation to assess their suitability and colonisation. Why isn't the natural vegetation already present?
  - Removing the clinker and cobble on the intertidal (assess natural accretion rates)
  - The use and effects of using pumped dredged sediment to raise intertidal elevation (consolidation and retention)
  - Test and monitor fish refuge boxes along the estuary

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Thank you

For more information
visit www.hull.ac.uk

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TEES RIVERS TRUST

PD PORTS

ITHICA FILMS

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