BAWDSEY COASTAL PARTNERSHIP – PHASE 1

EXECUTIVE SUMMARY.

1. Introduction

There have been many studies carried out to investigate the coastal processes and shoreline management options for the shoreline between Orford Ness and the Deben Estuary.

Regrettably there has been no resolution of an agreed approach to Shoreline Management of the frontage. A cursory review of the more significant pieces of work signposts that this lack of resolution derives from a 'one-size –suits-all' approach to the definition of the coastal process regime.

Whilst it is clearly important for Government to apply consistency of approach to risk assessment and value-for-money evaluation around the UK shoreline it is not appropriate to standardise the assessment of coastal processes. Even though the forcing agents of waves, tides (including surges), wind and fresh water flow have universal application around the UK shoreline, the relative significance of these forcing agents and their interaction with each other can be unique for any specific coastal frontage.

This report examines a selection of 23 previous reports on the shoreline around Bawdsey with the objective of providing a collated definition of coastal process influences on beach behavior over the frontage; identification of gaps in the work undertaken to date and current view on the likely appropriate form of future shoreline management for the area.

2. Coastal Process Regime

The shoreline between the Ore/Alde Estuary and the Deben Estuary has been identified as a technically coherent unit within which to consider the coastal process regime for the purposes of shoreline management. The area is shown in Figure ES1.
This will therefore be regarded as the main system but, in addition, it is important to consider –

- north boundary system (Alde/Ore Estuary)

- south boundary system (Deben Estuary)

- beach sub-system (contained within the main system area)

Previous studies show that sediment supply into the main system from the north is likely to be maintained in the medium term (50 yr). There is no significant sediment supply from the south into the main system and the net output from the system to the south is considerd to be relatively small (< 10,000 m3/annum) from the available evidence.

Previous studies acknowledge that the beach sediment along the main system frontage and forming the Knolls and the banks off North Weir Point comprise a mixture of sand and shingle. Within the main system beaches there is natural process separation of this material in to shingle-dominated (upper beaches) and sand-dominated (lower beaches). Orford ness and the Knolls are referred to as formed of shingle.

Away from the northern and southern boundaries within the main system area the beaches are generally perched on an underlying clay platform (whose level varies over the main system frontage – generally lower north of East Lane and higher south). It is concluded that shingle transfer offshore to banks (Whiting, Cutler, Bawdsey) is negligible. This infers that the beach sub-system has an effective offshore boundary, at least for shingle-size material.

The beach-sub system is controlled by coastal processes that move sediment –
(i) alongshore due to wave-induced motion
(ii) on-offshore due to wave-induced motion
(iii) alongshore in the sub-tidal zone by tidal currents acting on wave-agitated sediments.

Previous studies have carried out calculations regarding (i) but a clear contradiction of mass conservation in the results shows that in isolation (i) is not an adequate definition of coastal processes controlling the beach sub-system.

The beach sub-system requires more comprehensive definition than has been achieved with previous studies in order to inform the design of any coastal defences and to better understand alongshore movement of sediments in the main system area.

The main system frontage can be conveniently divided in to seven sub-units as shown on Figure ES2 –

(i) Shingle Street
(ii) Hollesley Bay
(iii) East Lane
(iv) Bawdsey Cliffs (unprotected)
(v) Bawdsey Cliffs (groynes)
(vi) Bawdsey Manor Cliffs
(vii) Bawdsey Manor/Deben Estuary

At the present time I have not discovered any information on –

(a) sediment classification for the main system beach features and the northern and southern boundary system relevant banks.
(b) beach profile modeling to determine the potential extent of wave-induced on-offshore movements of shingle and sand (model inputs would be derived from the sediment classification study (a))
(c) analysis of wave-tide interactions within the on-offshore sediment movement zone defined by (b).

Information from the above investigations is needed to understand how sediment is moving alongshore both within the intertidal and the sub-tidal zone. This will help to clarify certain alongshore sediment movement issues and thereby the on-offshore extent of any potential interventions to reorient sections of the shoreline around East Lane and to secure the Bawdsey Manor frontage.

In my opinion it is also important to carry out a comprehensive beach and nearshore sea bed (offshore depth limit to be 5m below CD) level and habitat survey of the main system area and relevant sections of the northern and southern boundary systems. This will allow volumetric assessments of available shingle deposits for any recycling works within shoreline management of the area alongside definition of habitat types and environmental sensitivity of such locations.

In my opinion it is necessary to examine in more detail shoreline orientation changes in the main system area using available aerial survey data since 1992 (held by the EA) and from the topographic part of the survey referred to above. This will need to be related to wave exposure information.

In my opinion there remains uncertainty over the mechanism of sediment transfer from the Main System to the Knolls. The results from the above studies will need to be supplemented by examination of any historical surveys of the Deben estuary and its approaches (especially after 1990). The objective of this work will be to form an estimate of the sediment transfer volume across the mouth of the estuary; the division of this transfer volume into volume continuing to move south and volume contained within the estuary for recirculation back to the Knolls and the conversion of such episodic event(s) into an annual transfer rate to inform shingle recycling operations.

In my opinion it would be prudent to investigate more significant realignments of the shoreline further inland than have been considered previously once suitable topographic data are available (LiDAR data may be available here from the EA). Such desk studies would provide essential baseline data for the subsequent cost evaluation of alternative shoreline management approaches.

The execution of the further investigations will provide the detail for finalisation of shoreline management policy selection and the appropriate strategy to implement policy including scheme design and finalizing of costs and timings.

Future Shoreline Management

Based upon the presently available evidence and therefore in advance of the essential further study results defined above I would consider that such evidence indicates the following approach to future shoreline management. Any implementation of this approach would require the confirmation (or otherwise) to be derived from the recommended further studies.

Previous studies have focused on three policy options for shoreline management in the main system area –

- do nothing and thereby allow the existing defences to be breached and the hinterland to be flooded.
- managed realignment located around the East Lane promontory to reduce the abrupt change in shoreline orientation at the promontory by resetting the shoreline locally inland.
- hold-the-line comprising a continuation of present rock-based intervention actions.

Setting aside the do-nothing policy option, the option of localised managed realignment has received some support from previous studies. However the relevant studies have not identified a specific reset alignment or location and have not included any details of how such work would be carried out. If East Lane promontory were removed then the shoreline is forecast to relocate 400m to landward. If the promontory effect is removed by a smooth transition connecting beach alignments to either side then a set back of 70 to 80m at East Lane is recommended. However once the shoreline is reset to this revised line the southern control point on Hollesley Bay is forecast to relocate 750m to the south onto the protected Bawdsey Cliffs frontage. The forecast time for system adjustment to this recessed shoreline at East Lane is 20 years.

It is my opinion therefore that a realignment of the shoreline at East Lane by recessing the present shoreline will have an adverse effect on beach processes and increase the vulnerability of the Hollesley Bay flood defences to breaching. It will also increase uncertainty with no fixed hardpoint control of the southern end of Hollesley Bay where there would be no protection from an offshore spit and associated banks as applies at Shingle Street/North Weir Point.

Clearly a continuation of present shoreline management at East Lane is not acceptable comprising emergency works with no defined end objective. It is also clear that the Bawdsey Manor Cliffs frontage is in need of intervention to prolong the service life of the existing coastal defences, so that beach processes within the main system area can be sustained through to the Deben Estuary. A summary of proposed intervention locations to achieve a 'hold-the-line' policy is presented on Figure ES3.

I would therefore recommend that the existing rock armour protection to either side of East Lane is modified in orientation by the introduction of rock groynes of varying length. The location of East Lane promontory would not be changed although its profile would be reshaped and flattened to improve wave energy dissipation. The rock armour groynes would become progressively longer moving away from the promontory in either direction but their seaward limits would remain set back from the promontory. As such these groyne fields would effectively re-orient the shoreline to reside across their seaward extremities reducing the severity of shoreline orientation change that exists around the present promontory. This work around East Lane would be combined with a shingle recycling operation to advance the southern end of Hollesley Bay beach to link to the terminal groyne along the northern flank of the promontory (this groyne

would be the largest in order to achieve shoreline orientation change back to the promontory). The groyne compartments would also be nourished with shingle to improve their wave energy dissipation characteristics. These proposals are shown schematically on Figure ES6 based upon currently available evidence. The proposals comprise managed realignment of the existing shoreline which would remove or significantly reduce present impacts on the conservation area caused by previous human intervention at East Lane.

To the south of the promontory a similar groyne field would be established with the largest terminal groyne located where the present 'bonio' termination structure is located. Shingle nourishment of the groyne compartments would be carried out here also. In addition a new 'hardpoint' would be established at the southern end of the cliff erosion associated with the promontory. This would take the form of a fishtail-shaped rock groyne. Figure ES6 shows these proposals schematically also and Figure ES4 summarises proposed shingle recycling operations over the main system frontage.

These new works would improve the dissipation of wave energy around the East Lane promontory reducing wave energy transmission onto the adjacent shorelines increasing stability to the south and allowing the beach to be advanced to the north. In order to deal with the varying wave exposure conditions the scheme would include provision for shingle recycling, to maintain satisfactory levels of defence around Hollesley Bay. Shingle recycling south of East Lane is not anticipated except for periodic top-ups of the groyne compartments and, less frequently, the eroded bay frontage immediately to the south.

There are no interventions proposed for Bawdsey Cliffs (unprotected) and Bawdsey Cliffs (groyned), but I would recommend the establishment of a rock armour toe to protect the exposed steel sheet piling along the Bawdsey Manor Cliffs frontage with a suitable rock groyne field to seaward to stabilise a higher beach along the rock armour toe. This shingle is likely to be imported and require periodic top-ups.

It is not possible at this stage to provide details of the beach sub-system and therefore the typical dimensions of proposed structures or typical quantities and frequencies of shingle recycling operations. However I am of the opinion that the results from further studies are unlikely to change my view on shoreline management policy for the main system area, which is to 'hold-the-line' in both the short (20 yr) and medium (50 yr) terms.

Implementation of this policy to include shoreline orientation changes to either side of East Lane; the protection of the Bawdsey Manor sea wall and the introduction of shingle recycling to allow adaptability of shoreline management policies to cope with wave exposure variations over the next 50 years. Effective implementation of such a policy will require specific regular monitoring of beach and sea bed levels over the frontage. Monitoring results will require quantitative analysis of sediment availability in each of the sub-units as shown on Figure ES2 to inform the shingle recycling operations over the service life of the scheme. Whilst the sourcing of shingle for recycling should be local if possible for economic and technical reasons it will be necessary to identify other more remote sources of supply to cover any shortfall in the locally available resource over the service life of the policy implementation.

A key requirement of shoreline management interventions in the present day is that they be adaptable to changing conditions over their service life. The approach outlined above is adaptable in three inter-related ways –

- shingle recycling allows accommodation of wave climate variability over time;
- rock groynes can be modified in elevation and plan extent to accommodate sea level rise and/or any increased storminess;
- rock used to form the proposed new structures together with rock already in place represents a re-usable asset which can be totally re-deployed if it became necessary to alter shoreline management policy in the face of unforeseen exposure changes.

With the commitment to manage the Deben and the Alde/Ore estuary systems it is important to manage the shoreline between in an adaptable way and in a way that minimizes risk to the local communities and to the achievement of value-for-money from shoreline management investments.

With the present uncertainties described above any estimate of scheme costs can only be speculative at this stage. However based upon unit costs for similar works at Hopton carried out in 2015 the proposed shoreline management approach outlined above should be considered against the following initial budgets –

(a) East Lane rock groynes (as located on Figure ES6) including initial shingle nourishment = £5 to 7 million (inclusive of design and construction management fees at this stage);

(b) Bawdsey Manor cliffs rock armour sea wall protection, rock groynes including initial shingle nourishment = £2 to 3 million (inclusive of design and construction management fees at this stage);

(c) Shingle recycling (as shown on Figure ES4) –

- Hollesley Bay / East Lane = £0.10 to 0.15 million per annum;
- Bawdsey Manor Cliffs = £0.01 to 0.03 million per annum;
- The Knolls = £0.02 to 0.05 million per annum.

(d) Monitoring and Maintenance = £0.1 million per annum. (Monitoring to comprise annual topographic/hydrographic survey of the main system frontage and relevant sections of the north and south boundary systems to be aligned with an annual wave climate inshore energy direction assessment for each of the seven sub-units of the main system area to inform shingle recycling operations. Maintenance to include for replacement of any dislodged rocks due to storm action and any local reprofiling to improve stability where sea bed level against a structure perimeter has lowered to unacceptable levels).

(e) Phase 2 recommended studies –
- sediment classification field study = £30K;
- beach profile modelling = £25K;
- wave-tide interaction analysis = £15K;
- beach/sea bed survey = £20K;
- shoreline orientation analysis = £10K;
- Deben estuary historic charts analysis = £15K;
- Inland managed realignment – options assessment = £10K.

(f) Phase 2 project management and reporting to advance the Phase 1 study findings = £35K (including the provision of technical specifications for recommended studies where appropriate).

There is presently a higher level of uncertainty over the shingle recycling budgets due to the potential environmental sensitivities of such operations and budgets provided here being in advance of the recommended relevant study results.

The proposed shoreline management approach for the main system frontage could be considered as two independent schemes if required.

The north scheme would comprise the works set out on Figures ES3 and ES4 shown in sub-units (i) to (iii) (both elements) and the south scheme would comprise the works shown in sub-unit (vi). Any proposed works in sub-unit (vii) may need to be shared between the two schemes.

Recommendations and Conclusions.

(A) To accept the findings of this Phase 1 report and to implement the recommendations for Phases 2 and 3 set out in items (B) to (E) below.

Phase 2.

(B) To prepare detailed specifications for studies and fieldwork recommended in this report.

(C) To interpret the results of the studies and fieldwork in (B) to finalise understanding of system behaviour and to produce outline designs and refine budget costs and to carry out consultations.

Phase 3.

(D) To carry out any further design studies to allow finalisation of scheme design to a format suitable for obtaining necessary consents.

(E) To provide input for any review of the Shoreline Management Plan to ensure that such review takes full account of the Phase 1 and Phase 2 information and findings.

Costs for recommendations (B) and (C) – Phase 2 - have initial budgets shown in 8.21 (e) and (f). There are no initial budgets provided for costs against recommendations (D) and (E) – Phase 3 – at this stage.

Previous studies have provided a robust platform upon which to base an understanding of coastal process behavior and its influence on beach behaviour in the main system area. Whilst there are gaps in knowledge that need to be filled, it is clear from the available coastal process evidence considered for this report that the best future shoreline management policy for the frontage between the Deben Estuary and the Ore/Alde estuary for the next 50 years regarding BCP objectives is likely to be 'hold-the-line'. This

policy to be implemented with effective managed realignment of the shoreline in its existing location to either side of East Lane.

Dr. P. Barber
15 October 2017

Figure ES1

General Location Plan

Ore/ Alde Estuary to Deben Estuary

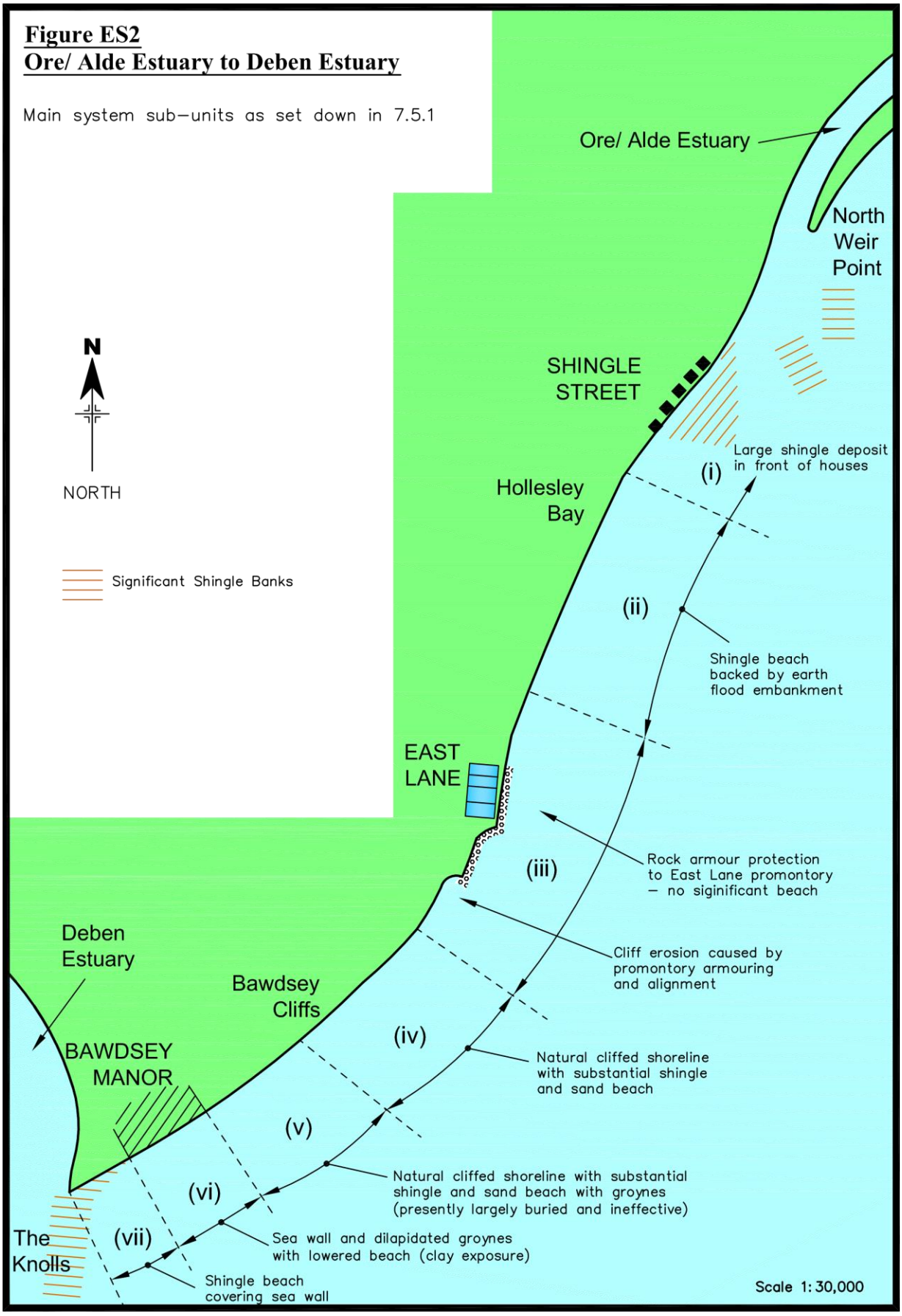
Figure ES2
Ore/ Alde Estuary to Deben Estuary
Main system sub–units as set down in 7.5.1
Ore/ Alde Estuary
North Weir Point
N
NORTH
SHINGLE STREET
Large shingle deposit in front of houses
(i)
Hollesley Bay
Significant Shingle Banks
(ii)
Shingle beach backed by earth flood embankment
EAST LANE
(iii)
Rock armour protection to East Lane promontory – no siginificant beach
Deben Estuary
Cliff erosion caused by promontory armouring and alignment
Bawdsey Cliffs
(iv)
BAWDSEY MANOR
Natural cliffed shoreline with substantial shingle and sand beach
(v)
Natural cliffed shoreline with substantial shingle and sand beach with groynes (presently largely buried and ineffective)
(vi)
The Knolls
(vii)
Sea wall and dilapidated groynes with lowered beach (clay exposure)
Shingle beach covering sea wall
Scale 1: 30,000

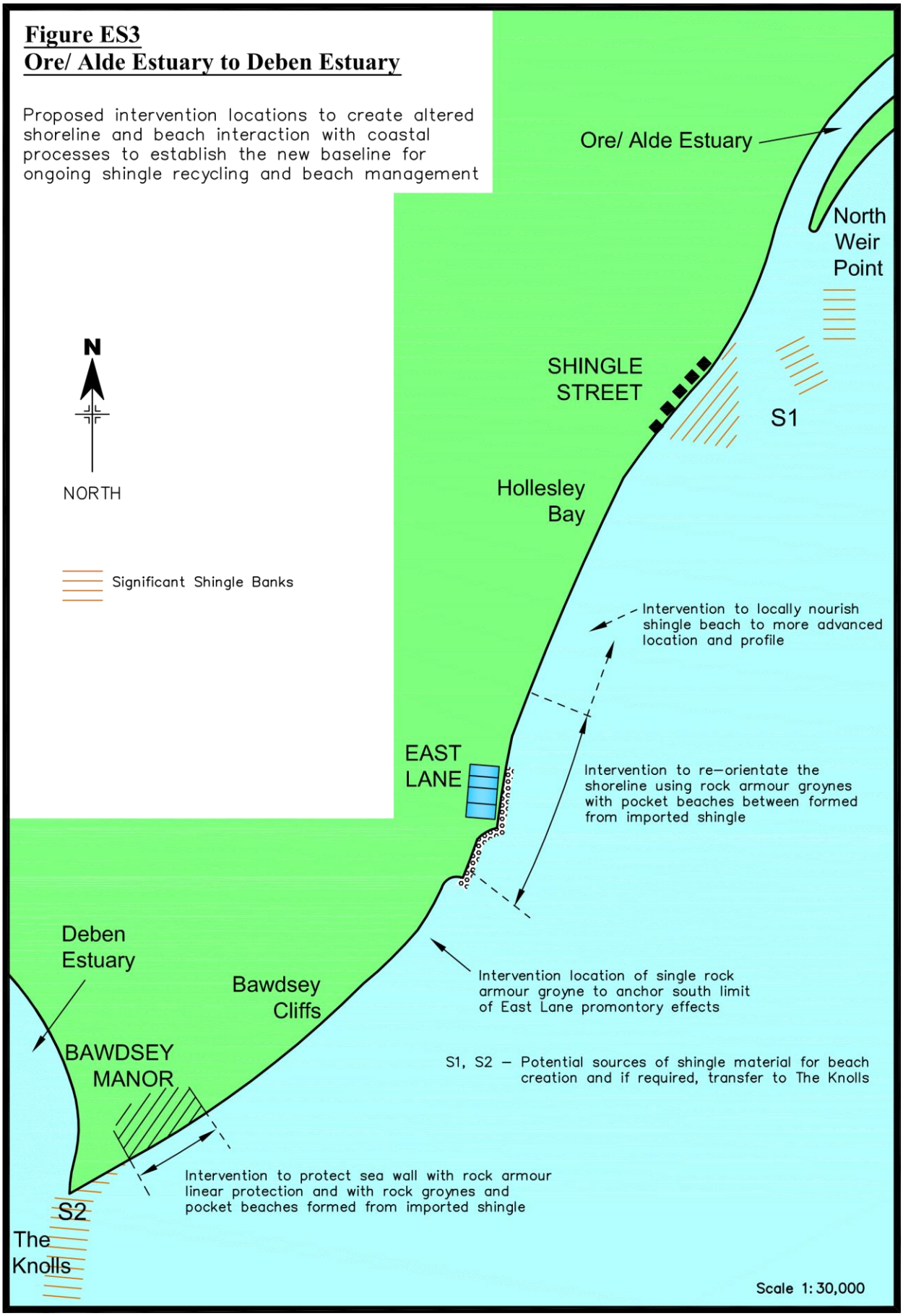
Figure ES3
Ore/ Alde Estuary to Deben Estuary
Proposed intervention locations to create altered shoreline and beach interaction with coastal processes to establish the new baseline for ongoing shingle recycling and beach management
Ore/ Alde Estuary
North Weir Point
SHINGLE STREET
S1
Hollesley Bay
N
NORTH
Significant Shingle Banks
Intervention to locally nourish shingle beach to more advanced location and profile
EAST LANE
Intervention to re-orientate the shoreline using rock armour groynes with pocket beaches between formed from imported shingle
Deben Estuary
Bawdsey Cliffs
Intervention location of single rock armour groyne to anchor south limit of East Lane promontory effects
BAWDSEY MANOR
S1, S2 – Potential sources of shingle material for beach creation and if required, transfer to The Knolls
Intervention to protect sea wall with rock armour linear protection and with rock groynes and pocket beaches formed from imported shingle
S2
The Knolls
Scale 1: 30,000

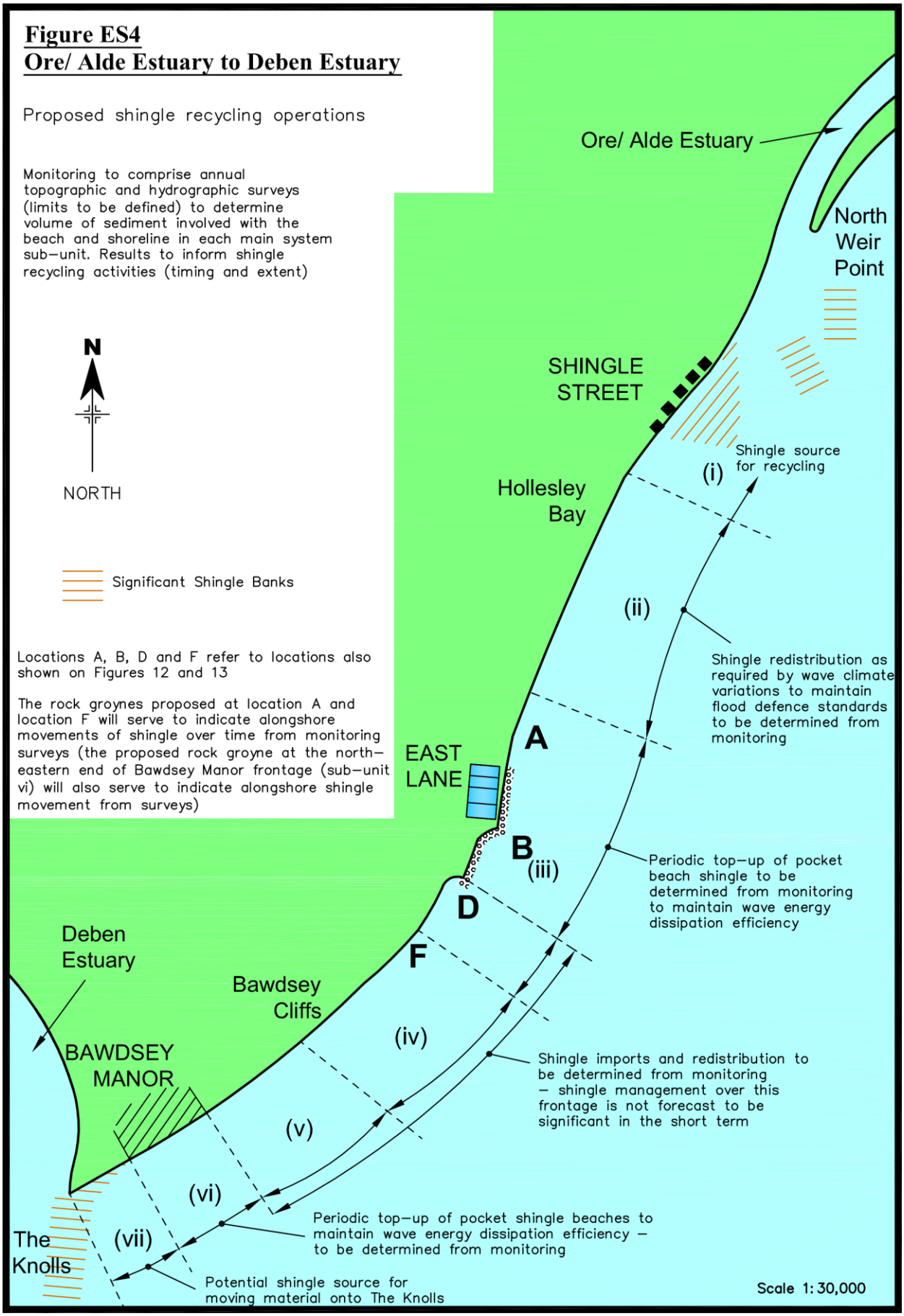
Figure ES4
Ore/ Alde Estuary to Deben Estuary
Proposed shingle recycling operations
Monitoring to comprise annual topographic and hydrographic surveys (limits to be defined) to determine volume of sediment involved with the beach and shoreline in each main system sub–unit. Results to inform shingle recycling activities (timing and extent)
N
NORTH
Significant Shingle Banks
Locations A, B, D and F refer to locations also shown on Figures 12 and 13
The rock groynes proposed at location A and location F will serve to indicate alongshore movements of shingle over time from monitoring surveys (the proposed rock groyne at the north–eastern end of Bawdsey Manor frontage (sub–unit vi) will also serve to indicate alongshore shingle movement from surveys)
Ore/ Alde Estuary
North Weir Point
SHINGLE STREET
Hollesley Bay
Shingle source for recycling
(i)
(ii)
Shingle redistribution as required by wave climate variations to maintain flood defence standards to be determined from monitoring
A
EAST LANE
B
(iii)
Periodic top–up of pocket beach shingle to be determined from monitoring to maintain wave energy dissipation efficiency
D
F
Deben Estuary
Bawdsey Cliffs
(iv)
BAWDSEY MANOR
Shingle imports and redistribution to be determined from monitoring – shingle management over this frontage is not forecast to be significant in the short term
(v)
(vi)
Periodic top–up of pocket shingle beaches to maintain wave energy dissipation efficiency – to be determined from monitoring
The Knolls
(vii)
Potential shingle source for moving material onto The Knolls
Scale 1: 30,000

Figure ES5

Schematic of wave interaction with shoreline around East Lane promontory

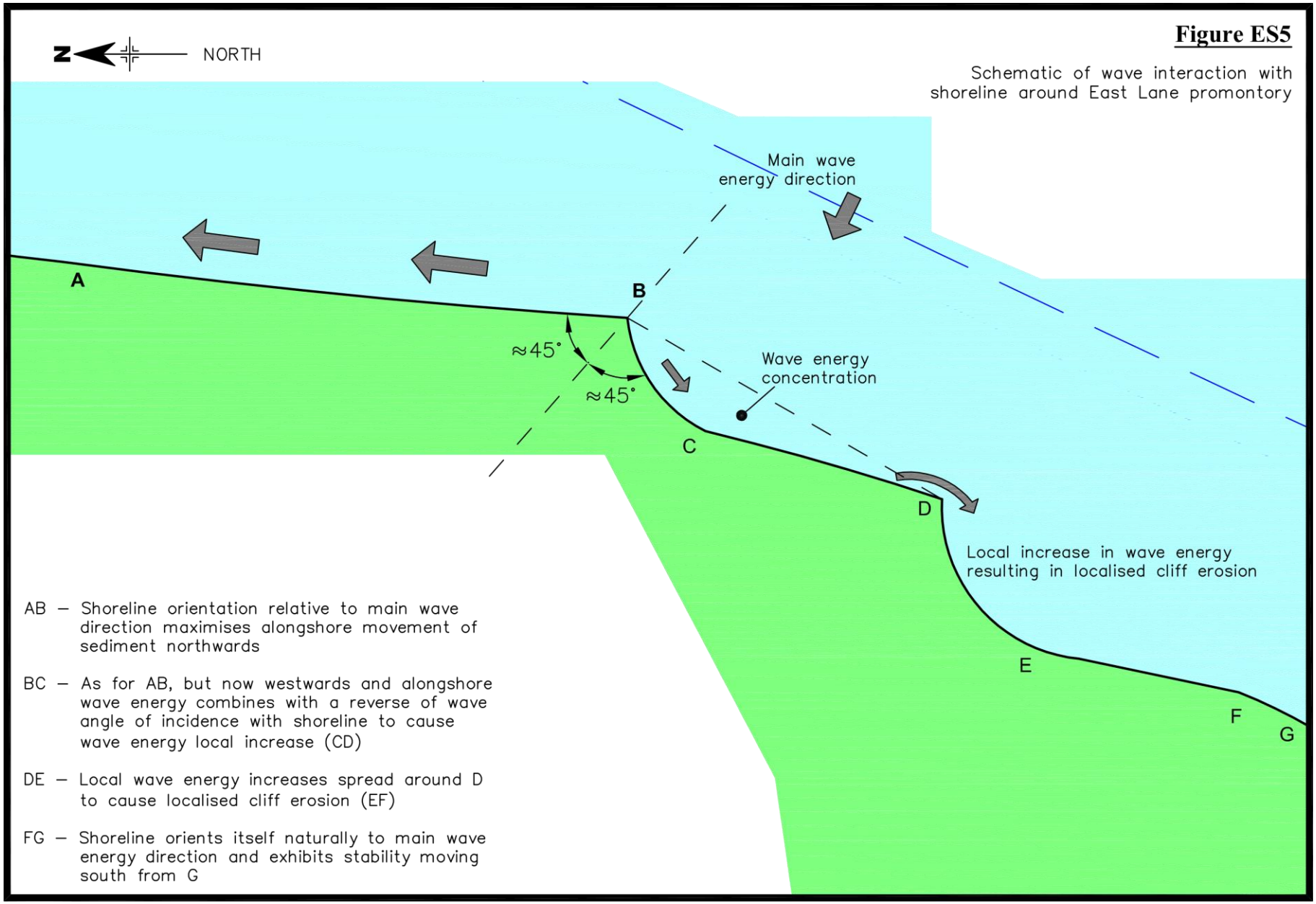

Figure ES6

Schematic of rock groyne modification of shoreline orientation and creation of pocket beach and embayments