

## TABLE OF CONTENTS

1	QUALIFICATIONS AND EXPERIENCE	1
2	SCOPE OF EVIDENCE	1
3	INTRODUCTION	2
4	DESCRIPTION OF THE WORKS	3
5	NAVIGATION MANAGEMENT PLAN	15
6	ALTERNATIVES TO THE PROPOSED BOSTON BARRIER SCHEME	17
7	WORKS TO DOWNSTREAM RIVER BANKS	24
8	GENERAL CONSTRUCTION MITIGATION	25
9	IMPACTS ON NAVIGATION	26
10	ISSUES RAISED IN OBJECTIONS	27
11	RESPONSE TO STATEMENT OF MATTERS	39
12	CONCLUSIONS	40



**1 QUALIFICATIONS AND EXPERIENCE**

- 1.1 My name is Peter Mallin. I am currently employed as a Senior Project Manager within the Ports, Coastal and Offshore practice at Mott MacDonald.
- 1.2 I have 28 years' experience in engineering consultancy, 19 years of which is specific to maritime engineering and construction.
- 1.3 During these 19 years my experience has covered all aspects of planning and engineering design of maritime works in the UK and internationally. My experience includes design of maritime structures from feasibility to detailed design. This includes engineering, spatial and navigational aspects of maritime developments for greenfield and brownfield sites, port expansion projects, river walls and river crossings. Through this I have scoped and managed real time navigation simulation studies to be able to assess impacts on navigation, refinement and modifications to the proposed works and general feasibility of the development in question.
- 1.4 In relation to the engineering works required for the Boston Barrier scheme I have experience in the design and design management of sheet pile walls, cofferdam structures, river walls, dredging, concrete structures in the marine environment, and design and build processes.
- 1.5 I am a qualified Engineer with a B. Eng (Hons) in Civil Engineering at Curtin University, Western Australia.
- 1.6 I am a member of the Institution of Engineers Australia (MIE Aust) that requires its members to follow a code of conduct. I am also an individual member of PIANC, the leading international technical body for all waterborne transport infrastructure.
- 1.7 I have been part of Mott MacDonald's Boston Barrier Scheme project team since June 2016.

**2 SCOPE OF EVIDENCE**

- 2.1 I am presenting evidence on behalf of the Environment Agency.
- 2.2 My evidence provides my opinion on engineering aspects related to the infrastructure provided as part of the works to deliver the Boston Barrier Scheme for both the construction and operational phases.
- 2.3 In my evidence I also:
  - 2.3.1 respond to objections raised which relate to the scope of my evidence; and
  - 2.3.2 summarise the EA's case in respect of aspects in the Statement of Matters that I address in my evidence.
- 2.4 Of those matters about which the Secretary of State particularly wishes to be informed, my evidence will address the following:

**Matter 2** The main alternatives options considered by the Environment Agency and the reasons for choosing the proposals comprised in the Scheme;

- Matter 5(b)** The justification for the location, design and operation of the Scheme including questions over the reinforcement and maintenance of 'earth banks' running from the site of the barrier downstream;
- Matter 5(d)** The justification for the location, design and operation of the Scheme including the omission of the 'water level management' scheme from the proposed plan at this time and why this is justified;
- Matter 9(a)** The measures proposed by the Environment Agency for mitigating any adverse impacts of the scheme including the proposed Code of Construction Practice;
- Matter 16** The likely impacts of constructing and operating the Scheme on statutory utility providers in the area, with particular reference to their apparatus, networks and existing surface and sub-surface assets.

2.5 My evidence should be read in conjunction with all other experts' evidence presented on behalf of the EA for the proposed barrier works.

### 3 INTRODUCTION

3.1 My evidence considers engineering aspects related to the proposed barrier works (**the Boston Barrier Scheme**) and seeks to address objections that relate to engineering aspects of the Scheme. My evidence addresses the following matters:

- 3.1.1 a summary description of all relevant construction works;
- 3.1.2 a description of the indicative construction programme highlighting the mitigation measures proposed to minimise disruption to existing operations on the Haven and within the immediate vicinity of the proposed construction works;
- 3.1.3 fuller descriptions of the enabling, temporary and permanent works highlighting mitigation measures that are to be incorporated into the design and construction of the works;
- 3.1.4 details of the proposed Navigation Management Plan (a copy of which is provided at **Appendix 1** to this proof of evidence (**EA/3/2**)) and its implementation;
- 3.1.5 responses to specific comments from the objectors related to design and engineering aspects of the Scheme; and
- 3.1.6 a summary of how my evidence has addressed the matters about which the Secretary of State particularly wishes to be informed.

3.2 Throughout my evidence I make reference to the left and right banks of the Haven. This is to remain consistent with the common terminology used for this the Scheme. To clarify, the left bank is the north bank of the Haven whilst the right bank is the south bank of the Haven.

## 4 DESCRIPTION OF THE WORKS

4.1 The general arrangement of the scheme is shown on planning direction drawing IMAN001472-PLG-001 Rev P1 (**A/16**). The Scheme is explained in full in Chapter 2 of Volume 1 of the Environmental Statement (ES) (**A/17/1**) with the principal associated construction works described below.

### 4.2 Summary of construction works

4.2.1 In this section on my evidence, to introduce the Scheme I have summarised the construction works associated with the Scheme.

#### Enabling works for the Scheme

4.2.2 Enabling works would include the demolition of the derelict Witham Wharf, diversion of 3no. High Voltage (**HV**) power cables from the right bank to Wyberton Low Road, demolition, and replacement of, the existing Frontier Agriculture grain loader and conveyor system, and upgrading works to the Port of Boston (**PoB**) internal access roads as necessary to accommodate construction traffic. A more detailed description of these works is provided in section 4.4 below.

#### The main works for the Scheme

4.2.3 Capital dredging works will also be required for the temporary vessel bypass, vessel mooring areas, wet dock entrance, and scour protection, as well as the installation of scour protection.

4.2.4 The Agency also proposes to construct temporary facilities to accommodate the Witham Sailing Club (**WSC**) and other recreational users at a location approximately 1.5km downstream of the PoB on the left bank of the Haven prior to the main construction works.

4.2.5 The provision of temporary berth and back of berth facilities is also proposed to enable the temporary relocation, during construction of the barrier, of the Boston Fishing Fleet to a new location at the existing PoB riverside berths during barrier construction.

4.2.6 The Scheme also includes the proposed widening of the existing PoB wet dock entrance to a width of 18m and the installation of a vertical sector entrance gate to replace the existing mitre gates.

4.2.7 It will also be necessary to install a temporary cofferdam to enable construction of the proposed barrier. In constructing the cofferdam, an 18m minimum width navigable bypass will be retained towards the left bank of the Haven.

4.2.8 The Scheme would include the construction of approximately 1.35km of flood defences up to +7.55m Above Ordnance Datum (**AOD**) on the left and right banks downstream of the proposed barrier. These works would comprise either land based freestanding walls, sheet pile retaining walls, raising existing flood defence embankments or a combination thereof.

- 4.2.9 A key component of the works would be the construction of a rising sector gate flood defence barrier providing a minimum navigable width of 25m towards the left bank of the Haven, and associated sheet pile tie-in walls back to the existing river banks.
- 4.2.10 It would also be necessary to erect a building for control operations and associated facilities in relation to the Barrier located on the left bank of the Haven adjacent to the Barrier including hardstanding areas for storage and use by heavy goods vehicles and parking, a crane pad hardstanding and perimeter fencing.

#### **Navigation control measures for the Scheme**

- 4.2.11 The Agency also proposes to install aids to navigation along the Haven. These will comprise a combination of fixed and automated signals related to operation of the barrier.
- 4.2.12 The Agency is also proposing to implement a Navigation Management Plan (**NMP**) for the Haven in respect of both the (temporary) construction and (permanent) operational phases of the Scheme. A copy of the proposed NMP can be found in **Appendix 1** to this proof of evidence (**EA/3/2**). The proposed NMP is being developed in consultation with the statutory harbour authority, the Port of Boston Limited. It adopts where possible existing controls on navigation and gives full consideration to present navigation practices along this reach of the Haven. It is proposed that the Environment Agency, the Port of Boston Limited and the Agency's main works contractor will all have specific responsibilities in respect of the implementation of the NMP. The NMP has been developed so as to mitigate navigation risks in the Haven as far as reasonably practicable during the construction and operation of the Scheme. I provide further information regarding the proposed NMP in section 5 of my evidence.

#### **4.3 Phasing of the Boston Barrier Scheme**

- 4.3.1 It is not possible to construct such extensive infrastructure without a certain level of temporary disruption to existing river operations and users. However, the Environment Agency proposes to adopt a phased approach to the works to ensure that construction impacts are mitigated as far as reasonably practicable. The proposed phasing of the construction works is shown in the indicative construction programme provided in Chapter 2 of Volume 1 of the ES (and described below. The final construction phasing will be developed by the contractor appointed to undertake detailed design and build the Scheme. However, the final approach to phasing of the works will comply with the overarching principle that, in so far as reasonably practicable, existing operations on the Haven can be maintained. Any deviation from the indicative phasing programme set out within the ES will first be considered by the Environment Agency to ensure compliance with this prescribed overarching principle. Further details of the effects of the construction works on existing river users is provided in the evidence of Gillian Watson (**EA/4/1**) whilst the Agency's proposals to compensate any existing users affected from any residual construction impacts are explained in the evidence of Richard Scriven (**EA/7/1**). I have described the indicative construction phasing in more detail below.

- 4.3.2 Prior to the commencement of the main construction works (which are anticipated to commence in late 2017), initial enabling works are to be carried out. These works comprise utility diversions, the proposed demolition and replacement of the existing grain loader and conveyor system belonging to Frontier Agriculture Limited, PoB internal access road upgrades, and initial capital dredging works. Further descriptions of the works are provided below in section 4.4 below. No other riverside works are proposed to be carried out during this phase which is expected to last 4 to 5 months. These enabling works are either entirely land based or in the case of dredging similar to activities previously experienced by existing river users. In addition, it is intended that these works will be carried out during the winter months when river traffic numbers are at their lowest.
- 4.3.3 Currently the Port of Boston Limited carries out and manages dredging in the Haven with 'Notices to Mariners' issued to advise of the location, extent, timing, duration and specific navigation procedures to be adhered to. Whilst the intensity and duration of capital dredging required for the proposed Scheme will be greater, the way these works would be managed with respect to navigation and the obstruction it poses would be similar to current practice. Once the enabling works are completed, the remaining river based construction works would then commence.
- 4.3.4 Immediately following the enabling works, the proposed temporary facilities for the WSC will be built allowing relocation of the sailing club's operations to a new location downstream of the construction site. The main works would not commence until the WSC has relocated.
- 4.3.5 The next phase of works would involve the proposed closure and reconstruction of the existing entrance to the PoB wet dock. During construction of the works proposed to the wet dock entrance no other river based works will be undertaken. PoB vessels which would ordinarily have berthed within the wet dock would be diverted to the existing riverside berths located between the Silo Berth and the wet dock entrance. Whilst the number of vessels using these riverside berths will increase, the size of the largest vessels using these berths will not increase. The proposed works to the wet dock entrance are due to be completed within approximately 9 months. It is anticipated that these works would start in January 2018, which would enable the wet dock to re-open in September 2018.
- 4.3.6 Whilst the works to the existing wet dock entrance are being constructed, works proposed to the right bank of the Haven will also commence. These works comprise the new sheet piled river walls and embankment crest improvements. It is anticipated that these works will start in April 2018 and that they will take approximately 21 months to complete. The right bank works can be largely constructed from the land. For the right bank works I understand that low impact press piling methods are to be employed for sections of the right bank works adjacent to Wyberton Low Road. This mitigation is proposed within the in the proposed Construction Noise and Vibration Management Plan (**CNVMP**), a copy of which can be found in the appendices to Max Forni's evidence (**EA/10/1**).
- 4.3.7 Immediately after the re-opening of the PoB wet dock, the placing of temporary scour protection will be carried out. This will be undertaken prior to any other river

based construction works. This activity is expected to take approximately one month.

- 4.3.8 Upon re-opening of the wet dock, and completion of the temporary scour protection, the left bank river works can commence. These works comprise the fishing fleet temporary facilities, the riverside berth piling and flood defence walls. They are expected to take approximately 13 months, with completion currently scheduled to occur late in 2019. During the left bank river works, the wet dock will have re-opened and PoB vessels will no longer require to use the riverside berths. This means that the Boston Fishing Fleet can be temporarily relocated to these berths.
- 4.3.9 During the left bank works, the riverside berths will initially be upgraded to facilitate their temporary use by the Boston Fishing Fleet. Following these works, the proposed new flood defence walls will be constructed. Much of this work could be carried out from land, minimising impacts on the river, and allowing temporary use of the riverside berths by the Boston Fishing Fleet. The temporary facilities proposed to be provided for the fisherman will allow the fisherman to operate at the temporary berth in effectively the same manner as they presently do at their existing facility. Further detail in relation to the temporary facilities to be provided for the Boston Fishing Fleet is provided in the evidence of Richard Scriven (**EA/7/1**) and Patrick Franklin (**EA/6/1**).
- 4.3.10 At this phase of the works, which is expected to commence in October 2018, the barrier cofferdam is also proposed to be constructed. It is expected that it will take 3 months to construct the cofferdam. In my opinion cofferdam construction will need to be timed to take place after completion of the works required to facilitate the delivery of the temporary mooring facilities to be made available to the Boston Fishing Fleet. This may add a further 1 to 2 months to the overall construction programme but the Agency has accepted this potential delay in view of its commitment to enable relocation of the Boston Fishing Fleet to the temporary facility at the earliest opportunity.
- 4.3.11 To assess the precise timing of the provision of temporary facilities for the Boston Fishing Fleet and commencement of the works to install the cofferdam, I have reviewed analysis of CCTV footage taken over a period of 5 months from Black Sluice, and records provided by the Canal & River Trust for vessels passing through Grand Sluice from 2000 to 2013. On average 5% of all annual traffic passes through the Grand Sluice Lock in October and of the 5 months of CCTV footage analysed 17% of all traffic passed the barrier site in October 2013. For comparison, during September 2013 these percentages are 13% and 39% for Grand Sluice and CCTV footage respectively. The temporary cofferdam is therefore proposed to be constructed during periods of less traffic to reduce potential impacts.
- 4.3.12 Once the cofferdam bypass has been constructed and temporary alternative facilities are in place for use by the Boston Fishing Fleet and WSC, construction of the proposed barrier would be undertaken. These works are scheduled to take approximately 7 months (from January 2019 through to July 2019) and will be undertaken in parallel with the left and right bank works.

- 4.3.13 Once the barrier works have been completed, the cofferdam can be removed restoring the Haven to its final configuration. The remaining construction works during this phase are limited to completing the works between the Barrier and the upgraded flood defences on the left bank.
- 4.3.14 The final completion phase comprises relatively short term tasks including the final phase of dredging and placement of scour protection, and riverbed sweep. These activities are expected to take approximately 4 months from September 2019 to December 2019. As noted in Paragraph 4.3.2 for the initial dredging works and scour protection placement, these activities are either similar to or will be managed in a similar way to current dredging activities on the Haven.
- 4.3.15 The core working hours for construction of the Boston Barrier Scheme are 07:30 to 18:30, Monday to Friday. There are some possible exceptions to this as outlined in the draft planning conditions proposed by the Environment Agency in its request for a deemed planning direction (**A/10**). These include:
- (a) dredging works and works to the wet dock entrance;
  - (b) completion of operations commenced during the core working hours which cannot safely be stopped;
  - (c) completion of works delayed or held up by weather conditions which disrupted or interrupted normal construction activities;
  - (d) highway works which the local highway authority requests be undertaken on a Saturday or a Sunday or outside the core working hours, and
  - (e) works required to be undertaken in the case of an emergency (subject to advance 24 hour written notification to Boston Borough Council) and
- 4.3.16 Longer working hours for the activities listed at (a) above are required in order to minimise the duration of works that are heavily dependent on a river based operation and / or are located within the PoB which currently operates on a 24 hours per day, 7 days per week basis.
- 4.3.17 I have provided further details of the indicative construction programme at **Appendix 2** to this proof of evidence (**EA/3/2**).

#### **4.4 Enabling works**

- 4.4.1 There are a number of pre-construction enabling works required. These are set out in full in Volume 1 of the ES. I have summarised these works below.
- (a) **Power utility diversions:** Three Western Power Distribution (WPD) 11kV electricity cables currently located on the right bank of the Haven will be affected by the proposed works to deliver the Scheme. The cables are installed below ground along the existing embankment from Black Sluice through to the proposed location of the barrier, where they divert south. It is proposed to permanently divert these electricity cables from the embankment to a location further south along Wyberton Low Road. The

diverted cables would remain below ground and would pass through ducts in trenches. New trenches will be necessary due to insufficient capacity in existing infrastructure. Protections for the benefit of WPD are contained within Schedule 7 to the Order (**A/2**) and I understand that the Environment Agency has been engaged in detailed discussions with WPD with regards to the proposed diversionary works and that the nature of the works required have been agreed in principle. The parties are working towards entering into an agreement to document the detailed arrangements for the carrying out of these diversionary works.

- (b) **Water and Sewer utilities:** I have reviewed drawings for the Boston Barrier Scheme overlaid with all recorded existing services and utilities. From this review, other than the private water distribution system within the PoB boundary, I did not identify any of the main barrier construction works occurring within the standard protected widths of any Anglian Water assets. There is, however, one 600mm diameter ductile iron water main beneath the WSC temporary downstream pontoon. Given that it passes beneath the Haven it is likely to be at some depth beneath the works. Although the pontoon piles are likely to be driven to or beyond the depth of this water main, they have been positioned outside its protected width. There is an adjacent network of sewer services to the east of the WSC facility beneath the temporary carpark. Again, as the sewers pass beneath the Haven or feed to an intertidal outfall they are likely to be at depth and not affected by the works proposed. Protections for the benefit of Anglian Water are contained within Schedule 7 to the Order (**A/2**). Furthermore, I understand that the Environment Agency has been engaged in detailed discussions with Anglian Water and the parties are working towards entering into an agreement to document the detailed arrangements for the carrying out of these works.
- (c) **Other utilities:** Having reviewed construction drawings for the Boston Barrier Scheme overlaid with all recorded utilities, I believe the only other affected public utility is an underground BT cable on the south bank of the Haven adjacent to Wyberton Low Road. From the information reviewed I am not able to identify the depth of the utility nor whether it will be affected by the proposed works. However, it is likely to be affected by the south bank piling and tie rod activities. At detailed design stage the need to temporarily or permanently divert this cable will be considered further. Protections for the benefit of statutory undertakers, including public communications providers, are contained within Schedule 6 to the Order (**A/2**) and I am not aware that BT have raised any concerns in relation to the Order or the Scheme.
- (d) **Disused Witham Wharf (right bank):** The derelict and disused jetty and loader currently situated on the right bank of the Haven will be demolished and disposed of off-site.
- (e) **Frontier Agriculture grain loader and conveyor relocation:** The close proximity of the proposed barrier to the grain quay necessitates the demolition of the existing loader and conveyor situated on that quay. The

Agency proposes to mitigate the effects of the proposed demolition of the conveyor through the provision of a new conveyor facility at a new location downstream along the quayside. The new facility will comprise construction of new conveyor and ship loader towers. These new towers will enable installation of an extended overhead conveyor projecting from the existing silos. The existing towers and conveyor will be dismantled and disposed of offsite. The new ship loader has been positioned such that the largest vessels expected at the grain berth (approximately 90m long) can load all hatches whilst maintaining a 50m minimum clearance to the barrier structure. The indicative location of the loader and conveyor towers is shown on drawings IMAN001472-CIV-DR-056 and IMAN001472-CIV-DR-073. These drawings are included in **Appendix 3** to this Proof of Evidence.

- (f) **WSC relocation:** A new pontoon with landside facilities to accommodate the WSC operation downstream of the barrier during construction will be provided. The location of the facility is approximately 1.5km downstream of the proposed barrier on the left bank.
- (g) **Relocation of the Boston Fishing Fleet:** The Boston Fishing Fleet will be invited to temporarily relocate to the PoB riverine berths after the wet dock works and prior to cofferdam construction. Specific details of the proposed temporary facilities can be found in the evidence of Richard Scriven (**EA/7/1**) whilst the evidence of Patrick Franklin (**EA/6/1**) explains why these facilities are appropriate.
- (h) **PoB internal access roads:** The internal access roads within the PoB estate would be improved to provide the required turning circles, safety aids and sight lines for the anticipated additional traffic that will be generated during construction of the Scheme.
- (i) **Dredging:** The enabling works dredging will be carried out in two phases. Phase 1 is to deepen the western riverine berths from the Black Sluice pontoon to the Frontier ship loader. This dredging creates the required depth for the cofferdam by-pass and allows installation of temporary scour protection. Phase 1 also comprises dredging at the WSC temporary mooring facility approximately 1.5km downstream of the barrier. It is anticipated that Phase 1 would be carried out over a 3 to 4 week period. Phase 2 is to dredge the main riverine berths from the Frontier loader to the wet dock turning circle prior to the closure of the wet dock. It is anticipated that Phase 2 would be carried out over a period of approximately 6 to 8 weeks.

#### **4.5 Contractor compounds**

- 4.5.1 Three temporary construction compounds will be required to construct the Boston Barrier Scheme. Two would be located on the left bank within the PoB estate and one would be situated on the right bank.

- 4.5.2 The main left bank compound would be located on the site of the proposed barrier control building and would extend to an area of approximately 21m x 50m. It would contain office and welfare facilities, equipment storage compounds, and working areas and car parking. A smaller remote compound will also be required to the north of the wet dock entrance adjacent to the northern access route. This compound would principally store and stockpile deliveries from barges. Both compounds would be accessed via St John's Road, the northern entrance into the PoB.
- 4.5.3 On the right bank the EA currently leases a parcel of land adjacent to Marsh Lane, on part of which the Boston Barrier Community Hub is situated. This site would be reconfigured to accommodate a further construction compound and site office. The construction compound would be able to store larger equipment with access to the barrier site.

#### **4.6 River wall works**

- 4.6.1 The Scheme comprises works along the left and right banks of the Haven to raise these existing defences to the required flood defence level of +7.55mAOD.
- 4.6.2 The left bank flood wall has two distinct elements; a flood risk management structure and sheet piling installed in front of the existing PoB quays to provide the required stability.
- 4.6.3 The crest of the flood wall structure will be set at +7.55mAOD providing protection to +7.12mAOD with a freeboard of 0.43m. Given the levels of the existing ground along the length of flood wall, the height of the structure varies from 1.5m to 2.4m above final ground level. The approximate length of the flood wall is 820m.
- 4.6.4 The wall would comprise two primary elements, the first being a steel sheet piled wall with concrete capping. This starts at the barrier and extends downstream to the eastern end of the existing load relieving platform at Lairage Quay. The second is a reinforced concrete wall, which provides the required flood protection from the eastern end of the existing load relieving to a tie-in with the Maud Foster Drain Sluice east of the PoB wet dock entrance. The concrete wall set back varies between 9m and 15m from the quayside to facilitate access to the berth face. In addition to the flood wall a new steel sheet piled stabilisation wall is proposed to be installed riverward of the existing PoB quay wall. This stabilisation wall is proposed to be tied back to a sheet pile anchor wall with steel tie rods. The stabilisation wall would extend from the barrier structure downstream along the existing PoB riverside quays (except along the existing load relieving platform and knuckle) and up to the wet dock entrance.
- 4.6.5 A section of sheet piled wall with tie rods and sheet piled anchorage is also proposed to form the northern face of the widened wet dock entrance.
- 4.6.6 The right bank works comprise installation of a steel sheet piled flood wall from approximately 100m upstream of the barrier structure. From this point, the sheet piling is proposed to be installed directly into the existing embankment down to the underlying competent boulder clay layer to provide a flood protection level of

+7.55mAOD. The sheet piled flood wall would continue along the existing embankment to tie in with the flood protection adjacent to the Western Power Distribution substation site. The flood protection level would be achieved with the sheet pile extending 1.2m above the final crest level of the existing embankment. A concrete capping beam is proposed along the top of the flood wall sheet piling.

- 4.6.7 The sheet piled floodwall wall is typically anchored back to a sheet piled anchor wall with steel tie rods. The anchor wall will be located along the landward edge of the existing embankment. However, there is no anchor wall proposed adjacent to the residences along Wyberton Low Road.
- 4.6.8 A 6m minimum width vehicle access route is provided to run alongside the flood wall on the crest of the existing embankment. This access way will allow routine maintenance by light vehicles such as ride on mowers, and would be shared with pedestrians and users of Boston Public Footpath. The access route will have a grassed surface similar to that of the existing embankment crest.

#### **4.7 Wet dock entrance works**

- 4.7.1 As part of the Scheme, works are necessary at the PoB wet dock entrance. These works comprise widening of the entrance from 15.3m to 18m and installing a new vertical sector dock entrance gate.
- 4.7.2 The entrance widening is necessary to allow wider beam vessels to enter the wet dock. This avoids the need for these wide vessels to moor at the Haven riverside berths.
- 4.7.3 The new wet dock gate is needed to provide the required +7.55mAOD flood defence level, and replace the existing wet dock entrance mitre gates. The existing mitre gates do not provide the required managed flood defence level, and are also in poor condition.

#### **4.8 Cofferdam design and construction**

- 4.8.1 A cofferdam is required to construct the barrier foundations and supporting walls, and install the gate assembly and mechanics. Other than initial construction of the cofferdam, this technique will allow the majority of the barrier to be constructed in dry conditions, further minimising the amount of waterborne plant required. Aside from the West and East wall of the cofferdam, which will be cut off at the sill level, the temporary cofferdam structure will be retained so as to form part of the permanent barrier.
- 4.8.2 The final size and form of the cofferdam will be determined by the contractor appointed to build the Scheme at detailed design stage. At this stage it has reasonably been assumed that the cofferdam will be constructed of driven steel sheet piling with an area at least the size of the completed barrier structure with additional allowance for temporary works and access. A clear navigable bypass width of 18m will be retained on the northern side of the Haven. Having reviewed the size of the permanent barrier structure, it may be possible to adopt a smaller cofferdam. In any event, the contractor will be required to provide a clear bypass channel with a minimum width of 18m.

- 4.8.3 The proposed 18m minimum width of the bypass is marginally wider than the equivalent navigable width of the channel where it passes the existing swing bridge situated upstream of the proposed location of the barrier, As is explained in the evidence of Gillian Watson (**EA/4/1**), vessels which may use the temporary bypass already pass through the swing bridge. The Swing Bridge has one way passage only through the left bank opening and is effectively unregulated, relying on the experience and judgement of mariners. The bypass, in contrast, will be permanently managed and regulated to ensure safe passage. The 18m bypass width is also only marginally narrower than the clear navigable width of the Haven with fishing vessels and pleasure craft moored on one or both sides of the quays at London Road and High Street. Again, I understand that navigation in these reaches of the Haven is effectively unregulated.
- 4.8.4 With the cofferdam in place, to aid navigation through it, a minimum 50m clear distance will be maintained to the westernmost vessel berthed on riverside quay.
- 4.8.5 The cofferdam structure will be designed to withstand all temporary construction loads, hydrostatic loads from the dewatering processing and environmental loads in line with the preferred construction method of the contractor appointed to build the Scheme.
- 4.8.6 For minor occasional contact and layby of the contractor's waterborne plant, fendering in the form of rubbing strips will be provided along with safety equipment in line with the Health and Safety Executive (HSE) Dock Regulations including safety ladders, grab rings and life buoys. These provisions will allow temporary vessel layby and prevent damage to vessels from minor controlled contact.
- 4.8.7 It will also be a requirement for the contractor to provide area lighting of the bypass and a prescribed arrangement of aids to navigation at, and leading up to the bypass. These aids to navigation will comprise fixed signage, port and starboard lights at the bypass and automated information boards on both approaches.
- 4.8.8 To investigate the impact of the temporary cofferdam on river hydraulics, the assumed cofferdam works were incorporated into the hydrodynamic modelling based on a smaller navigable width of 16m for a range of flow conditions. The results of this modelling are presented in Volume 2B of the Environmental Statement (**A/17/2B**). The results from the hydraulic modelling have been used in the navigation simulation exercises for the (temporary) construction phase.

#### **4.9 Barrier design and construction**

- 4.9.1 I have summarised the main elements of the construction works in section 4.2. In the section I describe in more detail the design of the barrier structure itself.
- 4.9.2 The final detailed design of the proposed barrier will be developed by the contractor appointed to construct the Scheme at detailed design stage. However, the design would include the structures and incorporate the design features discussed below.

## PROOF OF EVIDENCE OF PETER MALLIN (EA/3/1)

- 4.9.3 The barrier foundations would be constructed from a reinforced concrete base and walls to which the gate mechanics are attached. The outer face of the walls and base structures would be formed of steel sheet piling. Depending on the contractor's final design, additional piles to support the foundation may be required to limit vertical movement that would otherwise arise from settlement of the stratum below due to the additional weight of the structure.
- 4.9.4 The barrier would be positioned near to the right bank and a clear navigable width 25m would be provided. The length of the 25m navigable width is 33m.
- 4.9.5 There is limited guidance on the required navigable width of barriers of this type. For comparative purposes guidance set out in *PIANC Report N° 121, 2014 - Harbour Approach Channels Design Guidelines* (**Appendix 4** to this proof of evidence) has been followed to establish an initial estimate of the navigable width needed. Based on this guidance a 16m estimated width is needed for one-way passage by the most frequent users of the Haven, the Boston Fishing Fleet. A width of 33m is estimated for two-way passage of the fishing fleet. It should be noted that the PIANC guidance is suitable for planning purposes and preliminary design only as it based on typical characteristics of generic vessel groups, riverbed and bank profiles and river and wind conditions. It does not take account of issues such as visual impact, human factors, and pilot competence. A navigable width of 25m is considered adequate for one-way passage of the Boston Fishing Fleet vessels. Two-way passage would require navigation by experienced competent mariners and this matter is further addressed in the evidence of Gillian Watson (**EA/3/1**) and Captain Peter McArthur (**EA/5/1**). Passage through the barrier has also been tested through real time navigation simulations considering the fishing vessels and other river craft such as yachts, the Boston Belle, standard and wide beam narrow boats, and the PoB dredger to test navigation through the site of the proposed barrier during construction and operation of the Scheme and the results of this work are presented in the evidence of Gillian Watson (**EA/3/1**) and Captain Peter McArthur (**EA/5/1**).
- 4.9.6 Upstream and downstream of the proposed barrier tie-in walls constructed of steel sheet piling would connect the structure back to the upgraded river flood defences. The alignment of these tie-in walls would be angled to the direction of the navigable channel. The benefit of the angular alignment of the tie-in walls is a 'smoothing effect' of flow through the barrier when comparing to an alignment perpendicular to flow. In addition, the tie-in walls will naturally form a lead-in style structure for vessels approaching the barrier.
- 4.9.7 The prescribed design requirements for the barrier structure and tie-in walls are that it shall be able to withstand the force from accidental impact from vessels that are required to transit the temporary bypass. As well as this, the barrier structure will be designed to withstand live loads and surcharge from operations and equipment storage, earth pressures, hydrostatic pressure due to tidal lag and floatation, and environmental loads.
- 4.9.8 Permanent 2m high security fencing will be provided around the barrier right bank abutment and plant/equipment, and around the control building compound area on the left bank. This fencing will prevent access by the public, including those

working on the port estate when the barrier is operated for both tidal flood events and maintenance.

- 4.9.9 To mitigate against the possibility of vessel damage due to minor controlled contact, fendering in the form of rubbing strips will be provided on all vertical river facing structures. In addition, safety equipment in line with the HSE Dock Regulations including safety ladders, grab rings and life buoys are to be provided. These provisions will allow temporary vessel layby should it be required, and will prevent damage to vessels making minor impact through controlled contact.
- 4.9.10 Area lighting depicting the extents of the navigable channel and a prescribed arrangement of aids to navigation will be provided. These aids to navigation will comprise International Association of Lighthouse Authorities (**IALA**) signals and port and starboard lights at the bypass, and automated information boards on both approaches to the barrier. An additional automated information board will be located near the entrance to the Haven to provide maximum advance warning to mariners. More details on the aids to navigation proposed to be installed as part of the Scheme are provided in the draft NMP included in **Appendix 1** to this proof of evidence (**EA/3/2**).
- 4.9.11 To investigate the impact of the proposed barrier and tie-in walls on river hydraulics, the barrier configuration with 25m navigable width was incorporated into the hydrodynamic modelling for a range of flow conditions. The results of this modelling are presented in Volume 2B of the Environmental Statement (**A/17/2B**) and in the evidence of Sun Yan Evans (**EA/2/1**). The results of this modelling have been incorporated into the navigation simulations.
- 4.9.12 The likelihood of failure of the Barrier gate has been considered by the Environment Agency in developing its specification. Through a risk assessment process the Environment Agency has established a requirement for three levels of redundancy for the gate's operating power supply and hydraulics. These levels of redundancy are provided through the primary source of mains electricity and a main hydraulic pump supported by the secondary source of a standby generator and pump, with emergency hydraulic power packs situated adjacent to each side of the gate as a tertiary source. In addition to this, as a last resort when the proposed barrier is raised the hydraulics could be released such that the gate would be able to lower itself to a significant degree under its own weight. A planned maintenance regime has also been developed for the gate, comprising monthly, yearly and five yearly closures by trained operatives. This regular planned maintenance alongside the built-in redundancy will render the possibility of failure of the gates to lower or raise extremely unlikely.

### 4.10 Water level management

- 4.10.1 The use of the proposed barrier to facilitate water level management (**WLM**) does not form part of the proposed Boston Barrier Scheme. However, the Scheme has been designed in such a manner so as not to preclude the future delivery of WLM. For instance:

## PROOF OF EVIDENCE OF PETER MALLIN (EA/3/1)

- (a) space has been retained between the proposed barrier and the existing left bank river wall so as not to preclude the installation in future of infrastructure that would facilitate WLM;
- (b) the proposed barrier control building and a proposed load relieving platform for a mobile crane to service the barrier has been located landwards to allow space for the installation in future of infrastructure that would facilitate WLM;
- (c) all recesses, protrusions, openings and fixings required for the rising sector gate and its associated plant and equipment include provision for air vents (either imbedded pipes or recess pockets in the walls) to ensure that the potential operation of the barrier gate to facilitate WLM in the future has not been precluded;
- (d) the southern wall of the proposed barrier structure has been designed so as not to preclude the future construction of a fish pass, which would likely be necessary if WLM were to be implemented in the future;
- (e) the northern wall of the barrier structure has been designed so as not to preclude the future installation of a lock structure, which would likely be necessary if WLM were to be implemented, towards the existing left bank river wall;
- (f) the northern wall of the barrier structure has been designed so as not to preclude the removal, in future, of the fill proposed to be placed between it and the left bank river wall;
- (g) provision has been made for the inclusion of spare service ducts in the base of the barrier structure to allow for the installation of future services; and
- (h) the proposed sector gate has been designed so as not to preclude the future operation of the barrier in such a manner as to facilitate WLM,

4.10.2 Considering the above points, in my opinion the design proposed for the Boston Barrier Scheme does not preclude the delivery of WLM in the future, should proposals and funding come forward. Further information as to why WLM is not proposed to be implemented as part of the Boston Barrier Scheme is provided in the evidence of James Anderson (**EA/1/1**).

## 5 NAVIGATION MANAGEMENT PLAN

5.1 As with any construction activity proposed within a navigable waterway, navigation safety and effective marine traffic management has been a key consideration in the development of the

Boston Barrier Scheme. To assess the impact of the proposals a Navigation Impact Assessment (**NIA**) was carried out and is reported within Volume 2d of the Boston Barrier Environmental Statement (**A/17/2B**). In addition, three rounds of real time navigation simulations were undertaken at HR Wallingford's ship simulation centre in Oxfordshire. Further details of the configuration and results of the navigation simulations is provided in the evidence of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**).

- 5.2 I attended all three navigation simulation exercises to further consider the effectiveness and need for the mitigation measures proposed in the NIA. I was also able to obtain feedback from experienced mariners participating in the simulations relating to navigation safety during baseline conditions (existing situation), and construction and operation conditions.
- 5.3 Having regard to the concerns expressed by objectors to the Agency's Transport and Works Act Order application regarding navigation safety on the Haven the Environment Agency has developed a draft Navigation Management Plan (**NMP**). A copy of the draft NMP is provided at **Appendix 1** to my evidence (**EA/3/2**). It covers both the (temporary) construction and (permanent) operational phases of the Boston Barrier Scheme.
- 5.4 The draft NMP has been developed drawing on the information contained within the NIA and the outcome of the navigation simulations. The NMP has also been developed in consultation with the Port of Boston Limited, in its capacity as the statutory harbour authority for the whole of the area within which works are proposed. The Environment Agency continues to work with the Port of Boston Limited, and to take account of feedback from other river user groups, including the Inland Waterways Association (**IWA**) and the WSC, in order to finalise the content of the NMP.
- 5.5 The principal purpose of the NMP is to set out the procedures to be followed and aids to navigation to be provided to mitigate risks to navigation arising from the construction and operation of the Boston Barrier as far as reasonably practicable.
- 5.6 The draft NMP adopts, where possible, existing requirements for navigation, and gives full consideration to current navigation practice along this reach of the Haven. Mitigation and procedures set out in the NMP are, in the case of aids to navigation and signage, based on existing technology and the IALA buoyage system. In the case of navigation there are no requirements beyond the current obligations of a responsible mariner. Further details of the measures set out within the draft NMP are provided in the evidence of Gillian Watson (**EA/4/1**) who also confirms that in her professional opinion the measures detailed within the draft NMP are both suitable and practical in the context of the site. I agree with this.
- 5.7 The Environment Agency, the Port of Boston Limited and the contractor, once appointed, would all have specific responsibilities in relation to the implementation of the proposed NMP. To provide assurance that the NMP will be complied with, the Environment Agency has proposed that an additional planning condition be imposed on the grant of the deemed planning permission being sought to deliver the Boston Barrier Scheme. Further details regarding the condition proposed in respect of the draft NMP are provided in Emma Lunt's evidence (**EA/8/1**).
- 5.8 The Port of Boston Limited, as the statutory harbour authority for the Haven, is already subject to statutory powers and duties in relation to the regulation of navigation within its jurisdiction. By letter dated 13 March 2017, the Port of Boston Limited wrote to the Secretary

of State to express its full backing to the Boston Barrier Scheme and its willingness to work with the Environment Agency to ensure the continued safe navigation of vessels on the Haven.

## 6 ALTERNATIVES TO THE PROPOSED BOSTON BARRIER SCHEME

6.1 I have given consideration to the alternative locations considered by the Environment Agency and proposed by other interested parties from a design and engineering perspective. To assist me in this consideration, I have broken down the Haven into three separate zones, each of which are fundamentally different with regards to their geology, river width, construction access, exposure to prevailing conditions and impact on river traffic and discussed the engineering merits of each.

6.2 Figure 1 **Error! Reference source not found.** shows the extent of each of the following zones:

- 6.2.1 the current Barrier location to Geest Point,
- 6.2.2 Geest Point to Hobhole Drain, and
- 6.2.3 Hobhole Drain to Tabs Head where the Haven enters the Wash.



Figure 1: Barrier location zones considered

## 6.3 Geology

6.3.1 With regards to geology, I have reviewed soils data available to the project team from recent ground investigations and that available from British Geological Survey (BGS) records. There is extensive ground investigation data within zone 1 containing the preferred Barrier site from recent and historic records. Within zone 2, soils data is more limited, with more available closer to the PoB. Soils data in zone 3 is very limited with only four historic boreholes from 1956 near Hobhole Drain. In addition to these historic records, I have also reviewed an interpretation of information contained in BGS Map 128 (please see **Figure 2** below for a

relevant extract although a complete copy of the Map is provided at **Appendix 5** to this proof of evidence (**EA/3/2**).

- 6.3.2 The geological map describes the superficial geology within zones 2 and 3 as the Terrington Beds, comprising younger Marine Deposits and sandy Silt, Sand, and Clay from tidal creek and river deposits. Superficial geology at the preferred site within zone 1 is described as the Barroway Drove Beds comprising older marine deposits of silty Clay from saltmarsh deposits. Bedrock is classified similarly on the BGS map for all three zones as the Ancholme Group of the Ampthill Clay formation comprising smooth or slightly sandy mudstone.
- 6.3.3 The geological interpretation identified that all three zones comprise a soft alluvium layer overlying glacial till. Made ground overlying the soft alluvium is present at the preferred site and within zone 2. The boreholes within zone 3 did not identify made ground. Bedrock, identified at its upper boundary by the darker Kimmeridge Clay formation is only present in boreholes at depth within zone 1. Boreholes reviewed within zones 2 and 3 were not deep enough to derive bedrock level. In the context of engineering barrier foundations at the three sites, the geology near the preferred site within zone 1 comprises the thinnest layer of soft alluvium with the depth to the base of the alluvium ranging from 3m to 8m below ground level. Boreholes within zones 2 and 3, indicated depths to base of alluvium from 6m to 12m and 10m to 11m respectively. These greater alluvium depths would require deeper foundations or more extensive dredging to remove the alluvium so as to reach the competent boulder clay beneath. Importantly, the depth of alluvium near the preferred site is within the depth of the proposed barrier structure itself. This removes the need for deep foundations with bearing on the glacial till a possibility. See **Figure 3** below with glacial till (boulder clay) layer shown in light blue. Although dependent on the contractor's final design I do not expect piling to extend as far down as the bedrock.
- 6.3.4 The greater depth of alluvium in zones 2 and 3 would:
- (a) result in additional cost for deeper foundations;
  - (b) require additional construction over water to install the deeper foundations, and
  - (c) extend the construction programme, particularly with regards to over water work associated with the barrier foundations.

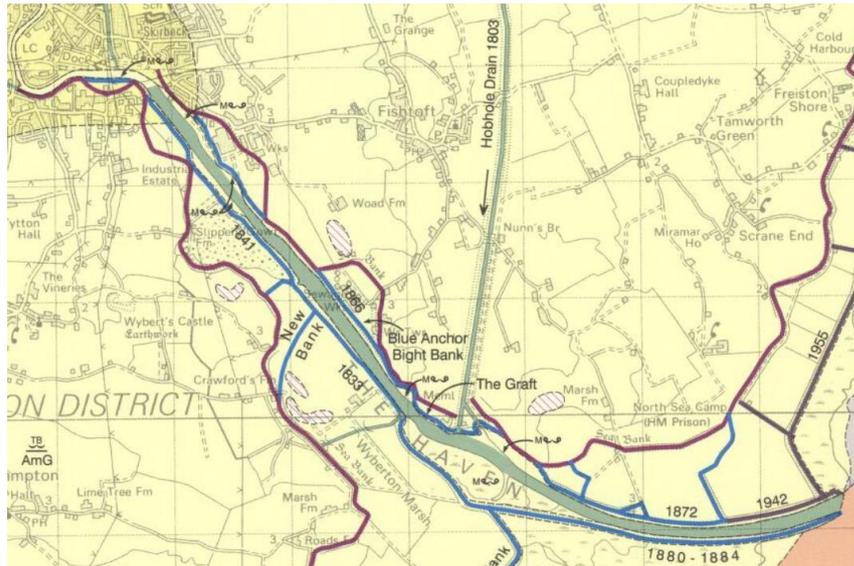


Figure 2: Extract from BGS Map 128 1995 (accessed January 2017)

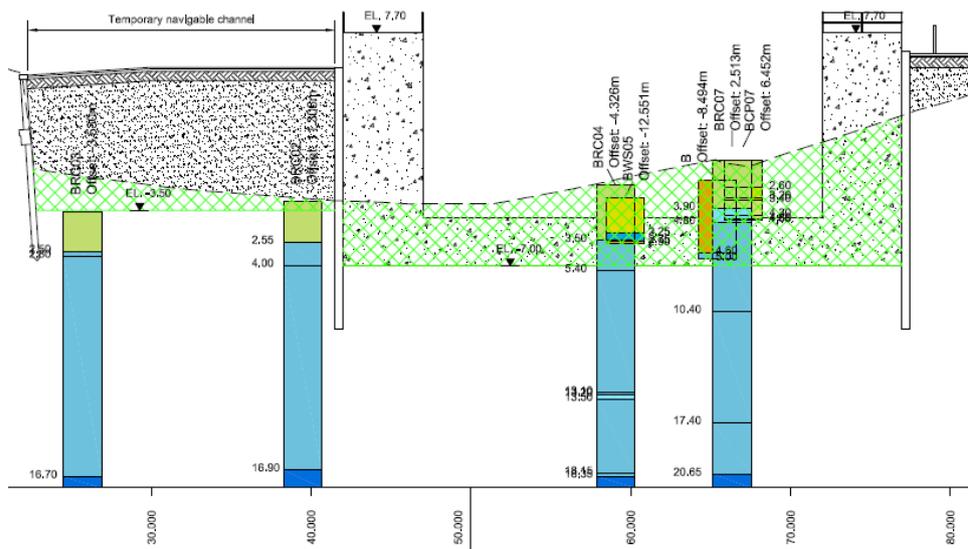


Figure 3: Geological Cross Section through Barrier (Zone 1)

## 6.4 Width of waterway

6.4.1 With regards to the width of the waterway, of the three zones, zone 3 possesses the greatest width of waterway at approximately 100m (high water) and a distance between defences of approximately 160m. The approximate waterway/flood defence width within zone 1 is in the order of 55m/65m respectively. Within Zone 2 the waterway/flood defence width increases to 80m/135m. At these widths, construction requirements for the structures tying back into the existing flood defences within the zone of the preferred site are significantly less than the alternatives. To quantify this, if the overall width of the barrier structure was 35m at all sites, the tie in wall length requirement for sites within zones 2 and 3 would be in the order of 200% to 300% greater than the preferred location. Additionally,

due to the greater depth of alluvium, foundations for the tie-in walls would also need to penetrate further, requiring additional materials and extended pile driving duration compared to the preferred site.

- 6.4.2 In conclusion, in my opinion the capital cost of connecting a barrier structure back into the adjacent flood defences would be lowest for schemes located within zone 1, where the preferred location identified by the Environment Agency is situated.

## **6.5 Site access**

6.5.1 In relation to site access, whilst I recognise that construction access to the preferred site may appear somewhat restricted, the areas surrounding access points on both sides of the Haven are developed and therefore already have clear access routes using existing public or internal port roads. The same standard of access is not available for alternative locations within zone 3, where construction access would need to be taken entirely from the left bank due to low lying wetland landward of the right bank. This itself is likely to necessitate greater use of water based plant for construction of the barrier and associated flood defence works. Access to the left bank would need to be taken through agricultural land necessitating new roads and significant improvements to existing narrow tracks and lanes. Closer to the PoB, access to alternative locations at the northern end of zone 2 would be less restrictive as land either side of the Haven is developed, but to a lesser extent than within zone 1. Although developed, the right and left embankments are not directly accessible by public roads necessitating short lengths of new road to gain direct access. Further to the south in zone 2, construction access to the Haven becomes more restrictive due to the lack of established roads, particularly the right bank. Again, new access roads or extensive upgrades of existing tracks will be necessary to gain access to the site and also minimise water based construction.

6.5.2 Of all possible barrier locations along the Haven, I consider those within zone 1 to have significantly better access for the required construction works with the least requirements for new roads or upgrades of existing tracks or private roads. In addition, there is more potential for construction works to be carried out from the landside for barrier locations within zone 1, the preferred location.

## **6.6 River traffic (construction)**

6.6.1 In respect of maintaining existing river operations during construction, barriers within zones 2 or 3 would need to cater for all river traffic during the construction period. When considering temporary facilities including berth access, back of berth operational area, ability to turn larger PoB vessels, and access to temporary facilities there are no sites downstream of the PoB where all existing river operations could be readily relocated without significant investment and impact on surrounding land. As currently proposed there are locations close to the PoB within zone 2 where small temporary facilities can be provided. However, these are limited to sailing and recreational use only. This area would not be suitable for relocating the operations of the PoB or the Boston Fishing Fleet. Taking this into account, without extensive channel diversion works construction related to a barrier within zones 2 or 3 would give rise to significant disruption from river traffic

or cause significant disruption to that traffic. River diversion works are not necessary at the proposed location for the barrier within zone 1, and so relocation requirements are comparatively very minor.

## **6.7 River traffic (barrier width)**

6.7.1 If a barrier were to be located in zone 2 or 3, it would then be necessary for all PoB commercial shipping traffic to transit the barrier. This is not the case for the current barrier location. The need to transit the barrier at its current width of 25m would most likely necessitate the provision of additional towage to control or be on standby for larger vessels. If to navigate the barrier unassisted, for a typical 13m beam cargo vessel, according to channel design guidelines set out by PIANC, a navigable barrier opening in the order of 40m would be required. If the barrier was to accommodate the maximum cargo vessel identified in the Navigation Impact Assessment, a navigable opening in the order of 50m would be required, twice the width of the current scheme.

6.7.2 The impact of a wider barrier would be;

- (a) increased capital cost associated with wider barrier span;
- (b) larger support structures and more powerful hydraulics;
- (c) longer construction period, and
- (d) significant dredging to create a suitable bypass for large PoB ships during construction.

## **6.8 River traffic (vessel impact)**

6.8.1 Due to the need for a barrier located in zones 2 or 3 to accommodate all PoB commercial shipping, the design requirements for designing the Barrier would be significantly greater to ensure it could resist the potential impact from aberrant ships would be significantly greater. To put this into context, the impact energy from a typical laden 90m long general cargo ship (6,500 tonne displacement) with a modest speed over ground of just 3 knots would be approximately 14,600kNm. In contrast, the impact energy from a typical fishing vessel (90 tonne displacement) travelling at the same speed is in the order of 200kNm impact.

6.8.2 In terms of the design of the barrier foundation and adjacent tie-in walls, the larger value is a significant impact load. It would most likely require additional protection structures upstream and downstream of the proposed barrier with the ability to absorb the impact energy of an aberrant cargo vessel. Similar structures are often adopted to protect bridge piers located adjacent to a navigable waterway. A 200kNm could easily be accommodated within the design of the barrier structures without additional strengthening or separate energy absorbing structures. Any separate protection structure would itself require additional maintenance and refurbishment work from general wear and tear and minor vessel impacts or full replacement in the event of a significant large vessel impact.

## **6.9 Site exposure**

- 6.9.1 For all three zones, exposure to sea conditions that could impact the engineering requirement for robustness and durability would typically not be an onerous requirement due to the sheltered nature of the Haven.
- 6.9.2 Of the three zones considered, with a prevailing East North East (**ENE**) wind, at higher states of tide zone 3 would be most exposed to wind generated waves developed over an extended fetch across the Wash. This is due to the ENE to West South West (**WSW**) alignment of the Haven entrance channel at Tabs Head. This would not only impact construction, it would also require the barrier to be designed for more onerous wave conditions as compared to zone 2 and zone 1, the preferred location. In addition to sea conditions, being located within a built-up area means that exposure to wind that could impact vessels navigating the barrier is significantly less at the preferred location within zone 1.

## 6.10 Conclusions

- 6.10.1 In conclusion, with regards to the engineering aspects of design and construction of a new barrier, the above points highlight many significant disadvantages of locating a barrier downstream of the preferred location. In simple terms, the disadvantages of zones 2 and 3 as compared to zone 1 are:
- (a) more onerous design conditions relating to site exposure and vessel impact would be necessary;
  - (b) construction costs would be significantly higher and would potentially be prohibitive to the viability of delivering much needed new barrier;
  - (c) poor site access would necessitate the construction of new roads and extensive upgrades to existing tracks;
  - (d) would have a significantly greater impact on river traffic; and
  - (e) a longer construction period with significantly more construction time over water would be required.

## 6.11 Sea lock

- 6.11.1 One alternative option to the proposed Scheme put forward by Captain Franklin (**OBJ/8**) is the downstream sea lock proposal located between Hobhole Drain and Tabs Head. Details of this proposal are set out in a Preliminary Feasibility Study by Balfour Maunsell dated July 1994 (**the Study**) (please see the appendices of James Anderson's evidence for a copy of the Study (**EA/1/2**)). The Study was commissioned by the National Rivers Authority (the Environment Agency's statutory predecessor) and the PoB.
- 6.11.2 The proposed scheme investigated would have involved the provision of a tidal barrage and sea lock downstream of the PoB along New Cut between Hobhole Draio and the Wash. A number of locations along this reach of the Haven were investigated as well as consideration of a range of managed river water levels, and sea lock configurations.

- 6.11.3 I have set out below my opinions regarding the engineering aspects of the proposals within the Study and, where appropriate, made comparisons with the proposals for the Boston Barrier Scheme.
- 6.11.4 During construction, temporary passage for all vessels needing access to Boston would be significantly compromised with the proposed sea lock scheme. To overcome this, substantial realignment of the river would be needed so as to maintain access for all vessels. These vessels include the large commercial ships visiting the PoB. Given the size of vessel to be accommodated any diversion would necessitate significant dredging volumes and realignment of existing embankments and these works would all be required within an environmentally sensitive area. The Environment Agency's proposed Scheme requires only a modest amount of dredging to allow passage through a comparatively small temporary bypass with no river realignment is needed.
- 6.11.5 During the operational lifetime of the proposals set down in the study, to provide access for all vessels at all states of tide, which as mentioned in the NIA have drafts of up to 5m, the total volume dredging was estimated to be 323,000 to 423,000m<sup>3</sup> for the sea lock scheme. This is significantly more than that necessary for the current Scheme. I also note that section 3.5.3 of the Study points out that dredging and disposal of such quantities '*could have significant environmental implications*'. This is not an issue for the Barrier Scheme in view of the relatively small amounts of dredging needed.
- 6.11.6 For the sea lock proposal there would also be an increased need for maintenance dredging due to the impounded nature of the river above the sea lock. The study estimated a requirement of 25,000m<sup>3</sup> to 100,000m<sup>3</sup> of dredging per annum. To provide the depth needed for the largest vessels, maintenance dredging requirements would be nearer the upper bound figure. This additional dredging in the 5km of channel leading to the Port of Boston would be ongoing year on year, leading to potential disruption to river traffic.
- 6.11.7 The Study raises issues about the ability of the Black Sluice (South Forty Foot), Maud Foster and Hobhole drains to discharge with the proposed sea lock scheme and recommends upgrades to the pumping stations at the outlets to these drains. Such upgrades are not needed for the Barrier Scheme.
- 6.11.8 At Section 3.6.2, the Study describes the need for 24 hour manning of the sea lock via a controlling officer and two attendants. This would be required for locking in and out operations. With implementation of the NMP, once operational, the manning needs for navigating the proposed Barrier Scheme are comparatively negligible. In addition to this, significant lay-by and lead in structures would be needed either side of the sea lock to facilitate the locking process. These structures are not required for the current Barrier Scheme.
- 6.11.9 In Section 3.5 the Study recognise engineering issues related to the limited site access and depth of soft alluvium. I have discussed the implications of these issues in section 6.3 of my proof of evidence.

6.11.10 In conclusion, in a number of key engineering respects, the proposed sea lock proposal would require significantly more investment and would cause significantly more disruption to river traffic than the Boston Barrier Scheme proposed by the Environment Agency. The one cost saving afforded by the sea lock proposal is that it would remove the need to raise existing flood defences. When looking at the Study cost estimates this saving is around 5% of the total capital cost of the downstream sea lock scheme (at 1994 costs). The current Barrier Scheme in my opinion provides at least the same level of flood defence with considerably less investment and less impact on river traffic. James Anderson's evidence (EA/1/1) provides further commentary on the commercial viability of the downstream sea lock proposal.

## **7 WORKS TO DOWNSTREAM RIVER BANKS**

7.1 I have had discussions with the Environment Agency regarding their ongoing work for maintaining the embankments downstream of the works to construct the proposed barrier. The Environment Agency has confirmed that consultants have been developing proposals for restoration of the existing left and right downstream embankments from the PoB to Hobhole. I have also discussed this with the project manager of the study who confirmed that its scope is to map the full length of both embankments and develop options for raising, restoring and maintaining the embankment defence level of +6.35mAOD and to retain current levels of vehicular access along the crest of the embankments to allow ongoing maintenance. These consultants are also preparing construction drawings and obtaining all necessary permissions and consents for the proposed works.

7.2 In the longer term, the Environment Agency will be raising the downstream embankments from the PoB to Hobhole to provide a 1 in 300 year standard of flood protection at the end of the 100 year horizon of the current Boston Barrier Scheme. I understand there are currently no engineering proposals for the future embankment works. The embankments would need to be raised in 50 years' time to take account of future climate change sea level rise. Below I describe the existing embankments, the Environment Agency's proposals to maintain existing defence levels, and engineering aspects of raising the embankments in 50 years' time.

7.3 The existing embankments are comprised of made ground and rest on the underlying alluvium. I understand much of the made ground was obtained from the Haven itself when the cut was originally created and has been maintained/raised during subsequent dredging campaigns. In many isolated locations, steel sheet piling has been driven into or near the crest of the embankments. This was to restore water tightness where seepage had occurred. The slopes of the embankment are typically vegetated with grass. Access for maintenance and grass cutting is along the top of the embankments via an unpaved track. I am advised that records of the downstream embankment are at best limited, dated and in certain cases do not mirror present day profiles.

7.4 There will be a number engineering aspects to address when raising the embankments from +6.35mAOD to +7.55mAOD. These include:

7.4.1 potential increased width at the base of the embankment;

7.4.2 the stability of the higher embankment;

7.4.3 maintaining access along the top of the embankment;

7.4.4 raising any affected navigation marks and lights; and

7.4.5 future settlement.

7.5 In considering such aspects, in my opinion I believe there are appropriate engineering solutions available which would enable future raising of the embankments by approximately 1.2m.

## **8 GENERAL CONSTRUCTION MITIGATION**

8.1 In this section of my evidence I summarise the measures the Environmental Agency are putting in place to seek to minimise the effects of construction activities on the local amenity, residents and river users.

8.2 A project specific Code of Construction Practice (**CoCP**) is not being produced for the proposed scheme. Instead, a number of Construction Management Plans (**CMP**) have been developed and / or proposed which will include the mitigation measures identified in Volume 1 (Main Report) of the ES (**A/17/1**) that would otherwise form part of a CoCP.

8.3 The management plans being developed for the proposed Scheme are:

8.3.1 an Environmental Action Plan;

8.3.2 a Construction Method Statement;

8.3.3 a Construction Noise and Vibration Management Plan;

8.3.4 an Ecological Management Plan;

8.3.5 an Archaeological Scheme of Investigation;

8.3.6 a Site Waste Management Plan;

8.3.7 a Construction Traffic Management Plan (**CTMP**);

8.3.8 a Sediment Management Plan; and

8.3.9 a Navigation Management Plan.

8.4 In its request for a deemed planning direction (**A/10**) the Environment Agency has proposed a number of planning conditions which would require it to produce and comply with these CMPs. An additional condition is now proposed to give effect to the proposed NMP.

8.5 Further information relating to the proposed planning conditions and the above CMPs is provided in the evidence of Emma Lunt (**EA/8/1**), Max Forni (**EA/10/1**) and Gillian Watson (**EA/4/1**).

8.6 The Scheme will be procured on a design and build basis and the contractor has yet to be appointed. It is proposed that the appointed contractor will finalise these CMPs and thereafter

submit them to Boston Borough Council, the relevant local planning authority, for approval. They will be more developed and will be specific to the successful contractors proposed solution. Notwithstanding this, two of the above CMP's, relating to Noise and Vibration and Navigation Management will be put before the Public Inquiry in their current form.

- 8.7 Having read the evidence of Emma Lunt (**EA/8/1**), and considering the design and build nature of the contract for the Scheme, in my opinion the principles of a CoCP to mitigate as far as practicable the impacts of the works during construction have been and will be adequately addressed.

## **9 IMPACTS ON NAVIGATION**

- 9.1 In this section I have briefly discussed, or referred back to other evidence in this proof with respect to mitigating impact of the Scheme on navigation on the Haven. I have also summarised other mitigation measures relevant to the proposed Scheme.

- 9.2 An indicative construction programme has been developed and was included in Chapter 2 of Volume 1 of the ES (**A/17/1**). This indicative programme incorporates the overarching principle that disruption to Haven users and the PoB shall be mitigated as far as reasonably practicable during construction. This principle is a requirement that the contractors will need to meet in their programme proposals for the works. The Environment Agency has the power to reject proposals that depart from the indicative programme and do not meet this overarching requirement. I have described how the construction programme mitigates impacts on existing operations in section 4.3 of this proof of evidence.

- 9.3 Infrastructure has been specified for inclusion with both the temporary cofferdam and permanent barrier structures to mitigate navigational risks. Such mitigation measures are fendering to allow the possibility of emergency, but controlled temporary vessel safe haven, the provision of furniture in line with the HSE Dock Regulations such as grab rings, safety ladders and life buoys.

- 9.4 In addition to the items above a Navigation Management Plan (see **Appendix 1** to my evidence (**EA/3/1**)) has been developed for both the construction and operational phases. The proposed NMP has been developed following the initial Navigation Impact Assessment to consolidate the mitigation measures specific to navigation risk. It takes consideration of the navigation simulation exercises recommended in the NIA and is also being developed in close consultation with the Port of Boston Limited. I have described the development of the NMP, how it will be implemented and my opinion of its suitability to mitigate navigation risk as far as practicable with the Barrier in place in section 5 of this proof of evidence.

- 9.5 At the PoB riverside berths, the flood barrier parapet has been set back a minimum of four metres from the quay face to allow access to the berth whilst the barrier is not in use. Clear openings through the parapet in the form of flood gates are also provided to allow vehicular and workman access to the working quay from with the PoB. The width of the flood gates varies depending on the type of access required. Gates are up to 10m wide adjacent to the Lairage Quay. In my opinion this gives adequate working space at the quay so as not to impact current operations.

- 9.6 The PoB riverside berths themselves will maintain at least the same load bearing and vessel berthing capacity as before. A new driven steel sheet pile wall will be constructed riverward of

the exiting quay encasing the existing structure. This form of sheet pile construction is used extensively on the Haven indicating its suitability to local ground and environmental conditions. The refurbished quay structures will be designed and constructed to current design standards. In my opinion the refurbishment proposals will provide a safer and more suitable berth for the types of vessel using these quays.

- 9.7 On the right bank, to minimise construction requirements the flood defences are formed primarily from the existing bank with new driven steel sheet piling to provide the required cut off and flood defence level. To mitigate impact on river hydraulics and visual appearance at lower tides, and to minimise construction activity near the river, the sheet pile wall becomes set back from the river some 150m downstream of the Barrier. The right bank works will also provide a wider more amenable footpath over the length of the Scheme compared to the existing footpath running along the top of the embankment.
- 9.8 Mitigation measures relating to construction traffic, control of waste, noise, air pollution, visual impact, impacts on the ecology are provided in the evidence of Emma Lunt (**EA/8/1**) and Max Forni (**EA/10/1**). In addition a Construction Noise and Vibration Management Plan (**CNVMP**) has been produced for the Scheme a copy of this is provided in the appendices to Max Forni's evidence (**EA/10/2**). With regard to noise, having reviewed the CNVMP I am of the opinion that with the Environment Agency's commitment to prescribing press piling techniques adjacent to sensitive receptors, all reasonable measures are being undertaken to manage construction noise to acceptable levels.

## **10 ISSUES RAISED IN OBJECTIONS**

- 10.1 In this section of my evidence, I seek to respond to the matters raised by objectors which fall within my areas of knowledge and specialism.

### **OBJ/21 - Mr. Howard M Smith**

- 10.2 Mr Smith comments on what he perceives to be the benefits of an alternative multi-function barrier at location 'E' (downstream of Maud Foster Drain). In section 6 of my evidence, I have considered the proposed Barrier location compared to that of a scheme located downstream of the Maud Foster Drain from an engineering perspective. I have also read James Anderson's evidence considering specific options previously assessed by the Environment Agency, including a multi-functional Barrier at location E. Based on my review I am of the opinion that there are significant disadvantages of a multi-functional barrier at location 'E' as compared to the proposed Boston Barrier Scheme.
- 10.3 Mr Smith suggests that a second navigation channel should be provided during construction which could be closed during extreme tides. In raising this comment Mr Smith acknowledges the fact that the WSC and the BDFA fleet will be able to relocate downstream of the Barrier construction site. I concur with Mr Smith's remarks in that the BDFA and WSC can be relocated downstream of the works. This mitigates the temporary construction impacts on these river users and in addition lessens the requirement for vessels to navigate the bypass. Considering this, and the fact that two-way traffic is not currently catered for at the 17m wide Swing Bridge, I see no reason to justify a second channel during the construction phase. Impacts on navigation during construction have been mitigated as far as reasonably practicable and to an acceptable level through:

- 10.3.1 carefully planned phasing of the proposed construction works;
- 10.3.2 the proposed provision of a minimum 18m wide navigable bypass;
- 10.3.3 the provisions set out in the proposed NMP, and
- 10.3.4 the provision of temporary facilities that will be available for use by the Boston Fishing Fleet and the WSC downstream of the proposed site of the barrier.
- 10.4 It would therefore not be necessary to provide a second channel for navigation past the construction works. Furthermore, construction of a second bypass would have a significant impact on the Environment Agency's ability to deliver the Boston Barrier Scheme in the timeframe proposed. Mr Smith also raises concerns about the measures that would be in place should the barrier fail. The risk of failure of the gate is extremely low given the built-in redundancy, which I have explained in section 4.9.12 of my evidence.
- 10.5 Mr Smith has raised concerns about the proposals to limit traffic through the barrier site to 'one way' and relates these comments back to safe two-way navigable channel width guidance set out by PIANC. I have also expressed my opinion on the channel width assessment in line with PIANC guidelines in paragraph 4.9.5 of this proof of evidence. I do not consider one-way traffic through the barrier to be a significant hindrance to existing navigation on the Haven. As observed in the navigation simulation exercises and within my evidence at paragraph 4.9.5 relating to the PIANC guidance, a complete restriction on two-way navigation through the permanent barrier is not necessarily a given as the simulations found that two-way traffic was possible in certain circumstances, and the PIANC guidance can be conservative when considering unique situations such as the barrier. Notwithstanding this, I have sought to understand the likelihood of two-way traffic and have reviewed an analysis of 5 months of CCTV footage from Black Sluice. This analysis identified that only 4.3% of all vessel transits resulted in an overtake or pass near the barrier site. In addition to this, as mentioned previously, navigation through the upstream Swing Bridge is restricted to the right bank opening only which has a navigable width of approximately 17m, narrower than the barrier opening of 25m. In essence, one-way traffic restrictions already exist on the Haven.
- 10.6 Mr Smith has commented on the run-down state of the Black Sluice pumping station and its ability to discharge flood water without activating the Barrier at high tide, just extreme tides. Mr Smith goes on to suggest that the inclusion of a navigable sluice within the barrier structure would provide more Black Sluice pumping options and a reduction in the need for pumping at high tides. The introduction of the Barrier will not affect the discharge ability of the Black Sluice as the water level regime on the tidal side of the sluice with the Barrier open will be no different to the present day. The condition of the pumps and their ability to discharge considering the tidal water of the Haven remains the responsibility of the Environment Agency. This will not need to change. I consider that incorporating a navigable sluice into the design of the Barrier would not be beneficial or justifiable on the grounds of the alleged poor condition of the pumps at Black Sluice and improving the number of discharge options available to the sluice operator.
- 10.7 Mr Smith has questioned the costs associated with the works proposed to be undertaken within the PoB, and in particular works to the existing wet dock entrance and the riverside

berths. In particular he states that this work would not be necessary if the barrier were to be located downstream of the Port.

- 10.8 The existing wet dock entrance gate is only operated on an 'as-needed' basis specifically for the PoB. If the PoB was required to operate and maintain a downstream lock in lieu of the wet dock entrance there would be a significant impact on all Haven operations rather than just PoB vessels entering the wet dock. In the event of maintenance closures in its current position no other Haven traffic is affected and the PoB will have alternative options at the upgraded riverine berths. Based on my observations during a PoB site visit, the current condition of the existing wet dock lock gates appeared to be very poor and they are substantially below the required defence level of +7.55mAOD. Replacement to both restore and raise the gates is therefore warranted. To keep expenditure to a minimum the proposed gate and widening solution has been planned to maximise the use of existing infrastructure in sound condition. In my view the nature and extent of the facilities required within the existing wet dock entrance to the PoB are modest and comparatively less than a control facility for a downstream lock which would need to operate on an around the clock basis to facilitate all river traffic.
- 10.9 The riverside berths at the PoB will not be redundant as they:
- 10.9.1 will serve as an alternative berth when the wet dock entrance is maintained or at capacity; and
  - 10.9.2 provide temporary lay-by berthing for vessels waiting to enter the wet dock.
- 10.10 To reinforce the continued use of the riverside berths I understand that the number of vessels visiting these berths has approximately tripled in the past three years from 2014 to 2016 inclusive.
- 10.11 Mr Smith suggests that a large exposed stand-alone safe haven is required considerably downstream of the current barrier location. He goes on to say that a safe haven would not be required if the lock itself was constructed downstream and a second smaller safe transit facility was integrated into the downstream lock solution to provide storm shelter.
- 10.12 As the proposed barrier would only be closed for short periods during storm events and maintenance, with advance notice being given of the pending closure, the Scheme does not require large downstream safe haven facilities. The only safe havens proposed, necessary for emergency situations only, are immediately upstream and downstream of the barrier location. These are not significant items of infrastructure compared the lay-by facilities needed for a downstream lock which must cater for all Haven traffic including the largest PoB ships. With respect to the need to wait for to pass through the barrier location, the proposed NMP (**Appendix 1**) sets out the procedures necessary to raise the barrier, which in combination with the matrix information boards provides ample time for mariners to assess their ability to navigate the Barrier well in advance of planning their transit. This significantly reduces any need for safe haven infrastructure.
- 10.13 Mr Smith has raised concerns of the potential for 'Just in Case' barrier closures. The Environment Agency will have strict governance over when the barrier is operated. For tidal flood events the barrier is only required to defend against tides of +5.30mAOD and over. As the barrier will be raised prior to the predicted high water, to take account of forecasting errors

the barrier gate will be activated when the tide reaches +5.10mAOD. When a high tidal surge is predicted, closure timing will allow sufficient time for implementation of the mechanical and power redundancy measures summarised in paragraph 4.9.12 of this proof.

- 10.14 The Environment Agency have advised that from their experience of existing barriers, a period of approximately 3 hours prior to the predicted peak will be required. This timing will vary according to the volume of fluvial flow discharging from the Lower Witham and South Forty Foot Drains. I have been advised that the Environment Agency's flood forecasting team use forecasts from the Met Office Storm Tidal Forecasting Service to provide early warning and subsequent interim forecasts of tidal events for various East Anglian coast locations. The decision to raise the barrier will be made approximately 12 hours before the predicted high water to allow barrier operational personnel to mobilise and prepare for a closure. Although the Environment Agency will be ready to close the barrier actual closure will be made approximately 3 hours prior to the predicted peak if it is +5.10mAOD or above. Considering these procedures based on Met Office storm forecasting, it is highly unlikely that the barrier will be raised on a 'just in case' basis.

**OBJ/2 - Mr. David CJ Matthews**

- 10.15 Mr Matthews suggests that the proposed barrier is located at the narrowest part of the Haven and that when built it will reduce its width by 60%. He goes on to say that the barrier will restrict fluvial discharge and cause flooding in the Witham catchment. In response to these comments I note that the barrier is not located at the narrowest part of the Witham. There are narrower river widths both downstream and upstream of the proposed barrier location. Further information regarding the impact of the proposed barrier on upstream flood risk is addressed in Sun Yan Evans' evidence (**EA/2/1**).
- 10.16 Mr Matthews also suggests that the barrier will extend the time of tidal locking by 30 to 40 minutes thereby reducing the time for the Grand and Black Sluices and local drains to discharge. My opinion of this is that there should be no impact on the duration of tidal locking with the barrier in place. The tidal regime downstream of the two Sluices will be unchanged from the present situation where the ability for the upstream sluices to discharge once the tide is above the managed upstream water level is compromised. Further details of this matter are addressed in the Proof of Evidence of James Anderson (**EA/1/1**).
- 10.17 Mr Matthews has queried who would be responsible for design failures pursuant to the Construction (Design and Management) Regulations 2015 (**B/16**). He also questions whether the effects of river flow through the barrier have been assessed with respect to navigation.
- 10.18 The Construction (Design and Management) Regulations 2015 (**B/16**) came into force April 2015, replacing the 2007 CDM regulations. The Regulations are geared around the management of health and safety through the design and construction process and place responsibilities on three main duty holders: the 'Client', the 'Designer' and the 'Contractor'.
- 10.19 The Regulations seek to secure health and safety on all projects through five key elements. In summary these are:

10.19.1 applying the principles of prevention;

10.19.2 appropriate resourcing;

10.19.3 ensuring competence;

10.19.4 cooperation and communication; and

10.19.5 dissemination of information.

- 10.20 With respect to design failures, the principles of prevention require the design to avoid risks where possible, evaluate those risks that cannot be avoided, and put in place proportionate measures to control them at source. It is fair to say that a flood defence barrier of some form is needed on the Haven to protect the town of Boston. I do not believe this is being challenged. In that respect, in applying the principles of prevention it comes down to evaluating and managing the risks to health and safety that the new barrier may pose.
- 10.21 With regard to navigation I have provided evidence in section 4 of this proof on the proposed construction phasing and the features built into the design of the cofferdam and the permanent barrier to mitigate risk.
- 10.22 In section 5 of my evidence I have considered the development and implementation of a NMP, the details of which were informed by the NIA, discussions with the Port of Boston Limited in its capacity as statutory harbour authority and a series of navigation simulation exercises for both the construction and permanent phases for the range of vessels expected to transit the barrier under a range of tidal and fluvial flows.
- 10.23 Considering these factors, in my opinion an extensive amount of work has been undertaken so as to adequately assess risk to navigation with consideration to river flow and to control them through implementing a number of mitigation measures. I am satisfied that the principles of prevention have been applied appropriately. Further evidence on the outcomes of the navigation simulations and risk to navigation are presented in the evidence of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**) which evidence relating to river flow through the barrier site is provided in Sun Yan Evans' evidence (**EA/2/1**).

**OBJ/8 - Capt. BD Franklin**

- 10.24 Captain Franklin has suggested that the cofferdam bypass will be 15m wide and will sometimes be blocked by jack-up platform. This is factually incorrect as the minimum navigable width of the cofferdam bypass would be 18m. The suggestion that the bypass will be blocked is in my opinion an exaggeration. The bypass is proposed to maintain navigation during construction. The proposed works to construct the barrier will be undertaken from within the cofferdam. There may, on occasion, be jack-up platforms at or near the cofferdam. However, the proposals set out in the proposed NMP (provided at **Appendix 1** to this proof of evidence (**EA/3/2**)) to manage traffic through the bypass and the contractor's ability to work within the cofferdam, minimising the need for river based plant, will significantly mitigate the risk of temporary blockage of the navigable bypass. I have provided more extensive discussion of the temporary bypass in sections 4.3 and 4.8 of this proof of evidence.
- 10.25 Captain Franklin has suggested that changes to the entrance of the wet dock lock and the gates will mean the lock can only operate on the level, thereby causing disruption. At present vessels entering and departing the wet dock generally only do so around high tide. This is a similar scenario to that for a typical wet dock entry or departure with the proposed single gate. The single gate solution will also allow vessels to enter or leave the wet dock faster due to the

shorter gate opening and closing times. Considering these matters, in my opinion I do not consider that the changes to the wet dock gates will cause any more disruption than the current situation. I understand that the Environment Agency has liaised closely with the Port of Boston Limited throughout the development of the Scheme, including as regards the configuration of the proposed new wet dock gate. As mentioned earlier, the Port of Boston Limited wrote to the Secretary of State on 13 March 2017 to confirm its full backing of the Boston Barrier Scheme.

- 10.26 Captain Franklin questions how the new wet dock entrance will operate in grain season when the need to retain water in the wet dock will mean there will be no opportunity for smaller or already loaded vessels to sail at an earlier level. I have discussed the operation of the existing wet dock gates with the Port of Boston Limited and understand that typically vessels leave and enter the lock either side of high water. I understand that the Port of Boston Limited does not currently accommodate non-commercial or other 'small' vessels in the wet dock as suggested by Captain Franklin. However, there are occasions when ships can leave the existing lock at a lower level, if at ballast for example. With the proposed single gate entrance it will also be possible to allow ships to enter or leave the wet dock at a lower level by opening the gate and allowing the water level within the dock to fall. The shorter single gate opening and closing times combined with the wider entrance width will in my opinion go some way to limiting the impact of not being able to lock out vessels as per the current situation due to the additional time the locking process takes. The Port of Boston Limited has also confirmed that it is desirable to retain the water level within the dock, although they do on occasion lower the wet dock level. I understand that retaining the wet dock water level is a year round preference and not related specifically to the grain season. In my opinion, although opportunities to release vessels at a lower level will be more restrictive with a single gate than the present situation, I believe the Port of Boston Limited will be able to manage operations effectively so as to mitigate impacts on their operations and note that they have raised no objection to the proposals.

**OBJ/3 - Councillor Yvonne Stevens - Trinity Ward**

- 10.27 Councillor Stevens suggests that there is a need to install a lock to allow more water to flow through and ensure the river is navigable. Having attended the navigation simulation exercises and reviewed the proposed NMP, and safety provisions that will be incorporated into the design of the proposed Barrier set out above in section 4.9, the Scheme has been developed to mitigate navigational risk as far as practicable and to an acceptable level without a lock in place.
- 10.28 Detailed evidence on navigational safety is presented in the evidence of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**). In my opinion a lock is not required to ensure the river is navigable.

**OBJ/17 and 18 - Mr Shane Bagley and Mr Jamie Lee**

- 10.29 Both of the above individuals suggest that the design of the proposed barrier would be safer if built perpendicular to the flow of the river rather than funnelling into a narrower channel. As mentioned in my response to Councillor Stevens the safety of navigation through the Barrier in its present configuration has been tested through the navigation simulations. By current configuration I mean the proposed barrier layout where the river narrows or 'funnels' down from its present width to the 25m barrier width. It is this configuration that the objectors are

suggesting is not as safe. To counter this suggestion I note the favourable outcome of the navigation simulations for all tested vessels, including fishing vessels, in its current configuration. For detailed evidence on the outcomes of the navigation simulation and navigation safety through the barrier, the proofs of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**) should be considered.

**OBJ/22 - Boston District Fisherman's Association (BDFa)**

- 10.30 The BDFa have suggested that the proposed barrier should be constructed downstream of the PoB given the presence of the Roman embankments on both sides of the Haven, thereby protecting more of Boston than the present Scheme. The BDFa goes on to recommend a site adjacent to Finn Forest. I have presented evidence on the implications of a site downstream of the Maud Foster Drain, where the Finn Forest option would be located, in my consideration of alternative sites in section 6 of this proof of evidence. In response to the perceived increased flood risk with the proposed Scheme, I draw attention to my evidence relating to the ongoing maintenance of the downstream flood defences in section 6 of this Proof. In my opinion, when the ongoing downstream embankment maintenance is complete, a barrier option at Finn Forest provides no better flood protection than that from the current Scheme.

**OBJ/10 - Mr R A Booth – Boston Motor Yacht Club (BMYC)**

- 10.31 Mr Booth suggests that the Scheme would put lives and property at risk. In my opinion risks to navigation have been adequately assessed and mitigated as far as reasonably practicable through the safety features provided, upstream and downstream safe havens, implementation of the proposed NMP, and thorough testing of the Scheme through hydrodynamic modelling and navigation simulation. Navigational safety is also addressed in the evidence of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**). In conclusion, I do not agree that the proposed barrier would put lives at risk as alleged, nor have I seen any evidence to substantiate these claims. With regards to the assessment of flood risk and risk to property, these matters are addressed in the evidence of Sun Yan Evans (**EA/2/1**).
- 10.32 Mr Booth questions whether consideration has been given in the design of the Scheme to vessels passing through the barrier site, taking account of potential flows through it. I have discussed the safety features built into the barrier design with respect to navigation in Section 4.9 of this proof of evidence and the implementation of the proposed NMP in section 5. In addition to these aspects, consideration of the flow through the barrier site has been given through the full bridge navigation simulation exercises. The simulations were carried out for typical winter and summer spring tide flow conditions and difficult high fluvial flow conditions which I understand were reported as difficult by the BDFa. In my opinion, there is no reason to question that the design of the barrier has not given full consideration to navigation, nor that it has not considered the effects of flows and the ability to navigate it with such flows.

**OBJ/7 - Councillor David Brown**

- 10.33 Councillor Brown has questioned whether 6.3m is an adequate height for the downstream earth banks given the last tidal surge was 6.08. I have provided further information in relation to the Environment Agency's ongoing project to restore and maintain the existing downstream embankments to +6.35mAOD in section 7 of my evidence. I note that at this level, the downstream embankments provide a 1 in 200 year standard of flood protection. The need to raise the embankments higher than +6.35mAOD is not required for a further 50 years. For

further evidence on ongoing and future downstream embankment works reference should be made to the evidence provided by James Anderson (**EA/1/1**)

- 10.34 Councillor Brown has commented that the cofferdam will impact the Boston Fishing Fleet. As discussed in section 4.3 of my evidence, the impact of the temporary cofferdam on the Boston Fishing Fleet is being mitigated as the Environment Agency has offered temporary berthing and operational facilities downstream of the cofferdam. Further details about the facilities proposed to be provided are contained within the evidence of Richard Scriven (**EA/7/1**) whilst Patrick Franklin's evidence (**EA/6/1**) considers the adequacy of these proposals.

**OBJ/15 - Mr Terry Despicht**

- 10.35 Mr Despicht's objection cites the potential for large vessels using the grain berth to break mooring and potentially impact the proposed barrier structure. Whilst vessel aberrancy can be a risk, I consider the likelihood of a vessel at the grain berth either breaking its mooring or losing control during berthing or let go operations to be very low. I note that with the relocation of the grain loading tower approximately 100m downstream of the proposed barrier there is no need to position grain ships closer than 50m from the nearest point to the barrier structure. Positioning a vessel that close would only be necessary when loading the eastern most hatches of the vessel after the vessel had already berthed. In my experience of considering acceptable clear distances at commercial berths, distances of less than 50m are acceptable between ships or to the nearest obstruction. This is particularly so when the design vessel is 90m in length. These clear distances are very much assessed on a case by case basis considering exposure conditions and the type and size of vessel at the berth. I also note that with the location of the grain berth being close to the Barrier, the berth is partially sheltered from ebb and fluvial flow, and flood flow is stronger along the opposite bank which aligns with the Barrier opening. Although I have not carried out a probabilistic assessment, in my opinion with the clearance provided the risk of grain vessels impacting the barrier structure is too low to warrant further consideration.
- 10.36 Mr Despicht considers that promises of installing a sea lock at a later date are unrealistic. I have provided evidence on the design of the Scheme and the fact that the design would not preclude the future inclusion of a sea lock, should funding and proposals come forward in the future, in section 4.10 of my proof of evidence.

**OBJ/9 - Inland Waterways Association (IWA)**

- 10.37 The IWA have suggested that if the Environment Agency requires powers to limit navigation it should provide suitable alternatives, such as a lock for all sizes of vessel normally requiring passage. For evidence related to the ability to navigate through the Barrier without a lock, the evidence of Gillian Watson (**EA/4/1**) and Captain Peter J McArthur (**EA/5/1**) should be considered. In my opinion and having read the evidence provided by Gillian Watson and Captain MacArthur I do not consider that the Barrier is a restriction to navigation necessitating an alternative lock solution.
- 10.38 The IWA perceives there to be a lack of information as regards what will be done to manage vessel transits during construction and the operational phase of the Boston Barrier Scheme. The IWA go on to suggest whether there will be one or two-way navigation and what up and downstream 'safe havens' are being provided during construction and operation. The Environment Agency has developed the proposed NMP (**Appendix 1**). This sets out the

## PROOF OF EVIDENCE OF PETER MALLIN (EA/3/1)

Agency's proposals as regards 'safe haven' provisions and the vessel priority passage requirements, including details of how those measures will be implemented. It is appreciated that the IWA did not have sight of the draft NMP when their comments were made and the Agency looks forward to discussing the provisions of the draft NMP with the IWA further.

- 10.39 The IWA have asked for further clarity regarding the navigational mitigation to be provided, how it will be delivered, and who will deliver it. I have explained in section 5 of this proof of evidence how the proposed NMP was developed and will be implemented. With regards to physical infrastructure being provided to mitigate navigational risks I have provided discussion in Sections 4.3, 4.4, 4.5 and 4.9 of this proof of evidence.
- 10.40 The IWA has raised concerns about the proposed 18m wide cofferdam by-pass and suggested that the width of the channel could be further reduced by protection and collision defences. I have provided evidence related to the 18m clear minimum width navigable bypass in section 4.8 of this proof of evidence. A minimum clear navigable bypass of 18m width is committed to and will be provided. With regard to the appropriateness of the 18m width proposed, this scenario, which is temporary, was thoroughly tested through the navigation simulations. The outcomes of these simulations are discussed in the evidence of Gillian Watson (**EA/4/1**) and Captain Peter McArthur (**EA/5/1**). The only vessel that would not be able to pass through the temporary cofferdam is the Port of Boston Limited's dredger. The Port of Boston Limited has agreed this proposed restriction.
- 10.41 The IWA has raised concerns about the ability to get information on changes to navigation in good time. This matter has been given particular consideration in the development of the proposed NMP. The NMP sets out requirements for the dissemination of information relating to navigation through the barrier site in advance of the proposed works. This dissemination will include workshops with key stakeholders and river users, updates to existing navigation guidance including the Navigation Chart and Admiralty Sailing Directions, production of a poster style Boston Barrier navigation information leaflet, and updates to Standing Notices to Mariners and interim Notices. These procedures are covered in more detail in the proposed NMP.
- 10.42 The IWA has raised concerns about the occasional closing of the Haven to navigation during construction of the Boston Barrier Scheme and the impact this would have on commercial fishing and leisure boaters. To mitigate the impact of the possibility of temporary closure of the cofferdam bypass on the Boston Fishing Fleet and the WSC temporary facilities downstream of the barrier are being provided. I have discussed the phasing of the construction programme to enable this in section 4.3 of this proof of evidence. For other leisure users needing to navigate the bypass the impact has been mitigated by the requirement for the contractor to liaise with the PoB who will issue Notices to Mariners in advance of any requirement to temporarily close the bypass. This advance notice will allow leisure users to plan their trips around any closure should the need arise. I understand the planned maintenance requirement for the barrier gate includes monthly, annual and five yearly, as well as significant maintenance at 25 year intervals. Procedures to manage river traffic through the temporary cofferdam bypass are set out in the NMP which is included in **Appendix 1** of this proof of evidence.
- 10.43 The IWA has provided comments on the evaluation of impacts on navigation arising from the Scheme. Since production of the Navigation Impact Assessment (**NIA**) further work has been carried out by the Environment Agency to assess and mitigate risks to navigation during

construction and operation of the proposed barrier. This further work comprised real time navigation simulations before, during and after construction and development of the proposed NMP, which has been produced in consultation with the statutory harbour authority, the Port of Boston Limited. The navigation simulations considered all regular river users including fishing vessels, sailing boats, the Boston Belle, the PoB dredger, and narrow and wide beam narrow boats. The findings of the navigation simulations are presented in the evidence of Gillian Watson (EA/4/1) and Captain Peter McArthur (EA/5/1).

- 10.44 The IWA has also stated that the decision to remove WLM from the scope of the Scheme has created uncertainty and controversy locally as to what the Scheme will provide. The current Scheme does not include WLM and the evidence of James Anderson (EA/1/1) explains why WLM is not currently being proposed. However, the Scheme has been developed in such a manner so as not to compromise the delivery of WLM at a future date. My evidence has explained how the design of the Scheme will not compromise the future provision of WLM in section 4.10.

**REP/4 - Witham Sailing Club (WSC)**

- 10.45 The WSC has expressed disappointment that the proposed barrier doesn't include a lock. I have provided my views as to why it is not necessary for the barrier to include a lock in section 4.10 of this proof. I have also explained in section 4.10 of this proof of evidence that the proposed Scheme will not preclude the future delivery of a lock or WLM.
- 10.46 The WSC has also commented on the need for downstream moorings to be made available for vessels entering Boston when the barrier is closed. They suggest that it is not reasonable to assume that navigation will not occur when the Barrier is closed for surge on the basis that surge events will be accompanied by bad weather and that no evidence suggesting this has been presented. Mariners wishing to use the Haven will always have advance warning of a pending barrier closure in the form of Notices to Mariners. It is reasonable to expect that mariners aware of such warnings would be able to plan their movements in advance. In addition to notices, aids to navigation in the form of lights and matrix information boards will be provided for both upstream and downstream navigation. This will include information on barrier status (open or raised) at key decision points such as entry from the Wash and passage through Grand and Black Sluice locks. These advance warning measures are set out in the draft NMP included in **Appendix 1** to this proof of evidence.
- 10.47 The WSC has assumed that the proposed barrier width and location pose an increased hazard to navigation and that safe havens are required to avoid vessels drifting in the area upstream of the barrier if they have mechanical difficulty. They also query whether the existing Black Sluice pontoon will be removed and that currently it does not function as needed. Safe Havens are proposed either side of the Barrier. These are against the new river wall on right bank (upstream) and the eastern end of the new right bank river wall (downstream). These facilities will be dredged and maintained to -3.00m AOD to provide suitable water depth. In addition, the Black Sluice pontoon facility is to be retained and will be dredged to make it suitable for continued use as a waiting facility for passing through the Black Sluice lock. In the context of safe havens, the need to use them would be very limited given the number of times and the type of event when the barrier will be raised, the aids to navigation and matrix message boards being installed, and the advance warning to be given prior to the proposed barrier being raised. Use of the safe havens is expected to be limited to exceptional circumstances only where a mariner decides to abort a transit of the barrier.

Details of the proposed safe havens, aids to navigation and advance warning regime are provided in the proposed NMP which is included in **Appendix 1** to this proof of evidence.

**OBJ/11-13 - Western Power Distribution (WPD)**

- 10.48 WPD has suggested that the proposed Scheme does not include all replacement cable or OH routes that would be required for an alternative substation site and other electricity apparatus that would need to be relocated as part of the implementation of the scheme. I understand that the only WPD utilities that are affected by the works are the three 11kV HV cable running along the right bank adjacent to Wyberton Low Road. Having reviewed the drawings showing the scheme overlaid with all known utilities I could not identify any other WPD infrastructure, including substations that would require relocation. I have provided evidence related to diversion of all required WPD utilities in section 4.4.1(a) of this proof of evidence
- 10.49 WPD allege that the EA has not properly considered the impact of the Scheme on the local and/or strategic electricity distribution network, or the need to ensure security of electricity supply in the area. Diversion of all affected WPD utilities will be carried out as part of the enabling works before the main works commence. The Environment Agency is working closely with WPD to agree the detailed arrangements for the diversions to be undertaken and protections for the benefit of WPD are contained within Schedule 7 to the draft Order (**A/2**).
- 10.50 In my opinion adequate consideration of the impact of the Scheme on WPD's network has been given and adequate safeguards are in place to protect the electricity network operated by WPD.

**REP/7 - Anglian Water Services Limited (AW)**

- 10.51 AW has suggested that the standard protected widths for watermain and foul sewer assets should be included in Schedule 8 to the draft Order (**A/2**). AW has commented further that it requires the standard protected easement widths for all of their water and waste water assets and that any requests for alteration or removal are to be conducted in accordance with the Water Industry Act 1991. All standard protected widths for Anglian Water assets will be observed. I have provided evidence in relation to AW assets in paragraph 4.4.1(a) of this proof of evidence.

**OBJ/5 - Frontier Agriculture Limited (Frontier)**

- 10.52 Frontier has raised concerns regarding the adequacy of the Environment Agency's proposals to replace the grain conveyor proposed to be demolished to enable the delivery of the Scheme. Frontier argues that it requires uninterrupted access to the grain loading berth and that it does not wish to share a berth with other users of the Port of Boston. Frontier suggests that the proposed Order should contains powers to provide it with exclusive use of the berth.
- 10.53 The Environment Agency is committed to delivering mitigation designed to place Frontier is as close a position as possible to its present one. However, the Environment Agency is also under a duty to consider the implications of the proposed mitigation on the Port of Boston Limited, the owner of the land in question and a statutory undertaker. The Environment Agency has now entered into a legal agreement with the Port of Boston Limited under the terms of which the Agency is now in a position to offer Frontier a replacement leasehold interest which is expressed in substantively the same terms as its existing lease.

- 10.54 As Frontier's existing lease does not provide it with exclusive use of the berth at present, it was not possible or necessary for the Environment Agency to negotiate a new lease which provided these rights. Nonetheless and in consideration of the concerns Frontier has expressed, the possibility of a priority berthing protocol for the benefit of Frontier to provide Frontier with confidence that its grain ships will be accommodated has been discussed with the Port of Boston Limited who has indicated a willingness to agree this. However, the Port of Boston Limited did not agree that Frontier should enjoy exclusive use of the berth as this was not necessary and would unduly sterilise the berth, having regard to Frontier's current level of usage.
- 10.55 Frontier has also suggested that the proposed Order and request for a deemed planning direction do not contain sufficient details of the new conveyor and loader system that the Agency is proposing to construct for its benefit. They go on to say that details of the new system must be made available in order for Frontier to assess the suitability of it for their purposes and that it will not cause unintended consequential impacts.
- 10.56 By letters dated 14 and 28 February 2017, the Environment Agency's solicitor wrote to Frontier's solicitor to provide further clarification as regards the design of the proposed conveyor structure. A copy of this correspondence can be found at **Appendix 6** to my proof of evidence. In particular it was explained that whilst the proposed Order and request for deemed planning permission sought consent for the construction of a replacement conveyor, detailed design work had not yet been undertaken. The letter also explained that the Agency has always sought and would continue to seek to develop the detailed design in close consultation with Frontier. The Environment Agency also offered to work with Frontier in developing a detailed works specification for the replacement conveyor facility and for Frontier to review the detailed designs, once available, to ensure compliance with the agreed works specification.
- 10.57 The above is reflective of the approach that the Environment Agency has sought to take for some time. For instance, only specialist contractors approved by Frontier have been approached to bid for the contract to design and build the conveyor. I have seen proposals from three designers, manufacturers and installers for the supply and installation of the new Frontier conveyor and ship loader system and associated works. All proposals detail the assumed scope of the supply and installation works required and I understand that their proposals are based on Frontier's standard specification and the layout indicated on the draft Frontier lease plan. Given they are based on Frontier's requirements and that they are all preferred Frontier suppliers, there is an adequate level of detail to allow Frontier to make an initial assessment of type and quality of infrastructure being provided and its suitability to their requirements. In my opinion the Environment Agency is committed to working with Frontier to ensure all of their concerns about the proposed Scheme have been addressed. I understand that discussions between the parties have led to an agreement having been reached in principle and that legal documentation is now being prepared to document the terms of agreement reached.

**REP/1 - Frampton Parish Council (FPC)**

**OBJ/20 - Wyberton Parish Council (WPC)**

- 10.58 FPC and WPC have both raised concerns regarding the downstream embankments and the need to raise them. In section 7 of my evidence I have explained the Environment Agency's

proposals for ongoing maintenance work and future raising of the downstream embankments. To summarise, the Environment Agency is currently in the early stages of raising, restoring and maintaining the downstream embankments to provide a 1 in 200 year standard of protection. Further raising to take account of future sea level rise is not required for another 50 years.

## 11 RESPONSE TO STATEMENT OF MATTERS

11.1 The Secretary of State has set out the matters about which she particularly wishes to be informed. My evidence addresses the following matters (or aspects of them).

**Matter 2        The main alternative options considered by the Environment Agency and the reasons for choosing the proposals comprised in the scheme.**

11.2 This matter is covered in section 6 of this proof of evidence. The alternatives considered by the Environment Agency are also explained in James Anderson's evidence (EA/1/1).

**Matter 5(b)     The justification for the location, design and operation of the scheme including questions over the reinforcement and maintenance of 'earth banks' running from the site of the barrier downstream**

11.3 This matter is covered in section 7 of this proof of evidence. Earth banks are also considered in James Anderson's evidence (EA/1/1).

**Matter 5(d)     The justification for the location, design and operation of the scheme including the omission of the water level management scheme from the proposed plan at this time;**

11.4 This matter is covered in section 4.10 of this proof of evidence. WLM is also considered in the evidence of James Anderson (EA/1/1) and Emma Lunt (EA/8/1).

**Matter 9(a)     The measures proposed by the Environment Agency for mitigating any adverse impacts of the Scheme including the proposed Code of Construction Practice**

11.5 This matter is covered in section 8 of this proof of evidence.

**Matter 13       The likely impacts of constructing and operating the barrier on navigational safety including that the phasing of the works accommodates a minimum level of operations to allow river and port operations to continue in safety**

11.6 This matter is addressed in section 9 of my evidence.

**Matter 16       The likely impacts of constructing and operating the Scheme on statutory utility providers in the area, with particular reference to their apparatus, networks and existing surface and sub-surface assets.**

11.7 I have addressed impacts arising to WPD apparatus in section 4.4.1(a) of this evidence and impacts arising to apparatus belonging to Anglian Water in section 4.4.1(b) of this evidence. I

have reviewed potential impacts on other utility providers and summarised my findings in section 4.4.1(c) of this proof of evidence.

- 11.8 Based on my review and due to provision within the Works Information for diversion of any utilities that would be affected by the Works, in my opinion there will be no adverse impacts on utility providers as a result of the Scheme.

## **12 CONCLUSIONS**

- 12.1 My evidence addresses the design and engineering aspects of the proposed Boston Barrier scheme and demonstrates that the proposed works:

12.1.1 satisfy the functional requirements of the tidal barrier and mitigates impacts on river users, the PoB and utility providers as far as reasonably practicable during both the construction and operational phases of the Scheme;

12.1.2 have been designed so as not to preclude the future delivery of WLM at a later date;

12.1.3 take full account of effects on navigation, including through the development of the proposed Navigation Management Plan;

12.1.4 take into account the needs of others including statutory undertakers and the local community have been considered and taken into account: and

12.1.5 are proposed to be sited in the most appropriate location in terms of the engineering requirements of the Scheme when compared to alternative locations downstream of the Port of Boston.

- 12.2 I believe that the proposed outline design of the Scheme, including construction phasing proposals and mitigation measures, as set out in this evidence, adequately address the engineering requirements of the Boston Barrier Scheme and associated works and that the engineering case for the Scheme has been made.

## **13 STATEMENT OF TRUTH**

- 13.1 I hereby declare as follows:

13.1.1 Insofar as the facts stated in this Proof of Evidence are within my own knowledge I believe them to be true, and that the opinions I have expressed represent my true and complete professional opinion.

13.1.2 this Proof of Evidence includes all facts which I regard as being relevant to the opinions which I have expressed and that I have drawn the inquiry's attention to any matter which would affect the validity of those opinions.

13.1.3 I understand that my duty to the Inquiry is to help it to help it with matters within my expertise and I have complied with that duty.