

Project Appraisal Report

Authority Scheme Reference

Environment Agency Number

Promoting Authority

Scheme Name



This form is to be submitted to the appropriate Area Flood Risk Manager



Local Authority and Internal Drainage Board

Financial Scheme of Delegation Coversheet for Strategies and Projects

Box 1	Project Title	Whitby East Pier Extension Urgent Works	Start date	1 April 2009
			End date	31 March 2010
	Promoting Authority	Scarborough Borough Council		
	Authority Project ref		EA Region & Area	North East, Yorkshire

Box 2	Role/ Post Title	Name	Signature	Date
	Project Manager	Stewart Rowe		
	Project Executive	John Ribby		

Box 3	Strategy/Project value	£k
	Total strategy/project value	£1,856k
	Strategy/Project costs (for approval)	£1,856k

Box 4	EA Recommender – name	Post title	Signature	Date
	PAB/NRG Chair – name	Post title	Signature	Date
	EA Approver – name	Post title	Signature	Date

Completion Notes

Box 2: Project Governance

Signatories on behalf of an applicant authority agree to fulfil the requirements of the grant memorandum.

Box 3: Project Value

Total Project Costs refers to the combined costs of capital and maintenance over the appraisal period.

Box 4: Environment Agency Approval

Signatures required for approval are entered here.

PAR for *Whitby East Pier Extension Urgent Works*

Version	Status	Signed off by:	Date signed	Date issued
01	Submitted to PAB	Stewart Rowe	??/??/09	??/??/09

Cover Photograph:

Whitby East Pier Extension

Notes:

This scheme is urgent works as recommended by the '*Whitby Coastal Strategy - Further Investigations at Whitby Harbour*'.

CONTENTS

I Approval History Sheet

1. Executive Summary / Briefing Paper

2. Business Case

2.1 Introduction and Background

2.2 Problem

2.3 Options Considered

2.4 Cost of Options

2.5 Benefits of Options

2.6 Environmental Assessment

2.7 Choice of Preferred Option

2.8 Other Considerations

3. Project Plan

4. Project Appraisal Report - Data Sheets

Appendices

- A Location Map
- B Reports Produced and Available for Inspection
- C Photographic Report
- D Technical Report
- E Cost Breakdown of Preferred Option
- F Benefits Appraisal
- G Environmental Report
- H Consultation
- I Natural England Letter
- J Outline Plan and Sections of the Proposed Works
- K Programme

APPROVAL HISTORY SHEET			
To be completed by Promoting Authority			
Authority: Scarborough Borough Council		Authority Project Code:	
Project Title: Whitby East Pier Extension Urgent Works		Date of PAR: February 2009	
Consultant: Royal Haskoning			
REVIEW			
Position	Name	Signature	Date
"I have reviewed this document and confirm that this project meets our quality assurance requirements, satisfies all the required environmental obligations and meets Defra investment appraisal criteria"			
Authority Project Manager	Stewart Rowe		
"I confirm that all internal approvals have been completed for this project and recommend submission to the Environment Agency for approval in the sum of £1,856,224"			
Authority Project Executive	John Riby		
"I have reviewed this document and confirm that it complies with the current PAR guidelines"			
PAR Reviewer	Chris Matthews		
"I confirm the project is ready for submission to PAB/NRG"			
Area Flood Risk Manager	Peter Holmes		
PAB – Project Assessment Board (Projects less than £2 million)		NRG – National Review Group (Projects greater than £2 million)	
(Delete as appropriate)			
Date of Meeting:	Chairman:	PAR Amendment No:	
Project Presenter(s): Stewart Rowe			
Detailed record of any comments/actions required/additional information provided, to be appended to the PAR for onward transmission			
Recommended for approval: In the sum of: £1,856,224		Date:	
PROJECT APPROVAL			
AGENCY	Officers in accordance with the Agency's SoD: Specified Officer; Regional Director; Director of Operations; Chief Executive or Director of Finance: Agency Board		
PAR Submitted		Date:	
Project Approval	By: In the sum of: £1,856,224	Date:	
DEFRA APPROVAL – (Projects £50 million or above)			
Submitted to Defra		Date:	
PAR Amendment No. (if different):			
Project approved by: On behalf of Secretary of State			
			Date

1. EXECUTIVE SUMMARY/RECOMMENDATIONS

TO COMMIT EXPENDITURE

Promoting Authority: Scarborough Borough Council

Project Title: Whitby East Pier Extension Urgent Works

Approval Value: £1,856,224

Sponsor: Peter Holmes, Area Flood Risk Manager ???????

1.0 INTRODUCTION AND BACKGROUND

- 1.1 This report seeks investment approval in urgent works to the East Pier Extension at Whitby Harbour, North Yorkshire. This structure is around 85 years old and is comprised of mass concrete with protective sheet piles.
- 1.2 The urgent works are needed to reduce the risk of failure of the structure, which is presently in a very poor condition (Condition Grade 5) and in one section is severely undermined, leaving part of the structure cantilevered from the main body.
- 1.3 The structure plays a critical role in the overall flood and erosion risk management system between Sandsend and Abbey Cliff. It both reduces flood risk to the lower reaches of the River Esk estuary and reduces erosion risk along the adjacent coastlines.
- 1.4 The scheme is being promoted by Scarborough Borough Council as the coast protection authority and has support from a Project Board comprising officers from a wider range of organisations, including the Environment Agency.
- 1.5 The scheme is in full compliance with the adopted River Tyne to Flamborough Head Shoreline Management Plan and the adopted Whitby Coastal Strategy.
- 1.6 Scheme development has been supported by a large number of wide-ranging studies and investigations, including numerical coastal modelling, Ground Investigations, topographic and digital measured surveys, dive and visual inspections, hydrographic, seismic and sonar surveys of the sea bed, and geophysical surveys of the structure.

2.0 PROBLEM

- 2.1 Following completion of the Whitby Coastal Strategy, further investigations at Whitby Harbour have led to the identification of a number of structural condition and overtopping performance issues associated with the coastal defence structures at Whitby Harbour. A PAR is being prepared for investment in the detailed design, assessment and implementation of a major capital scheme to address all of these issues.
- 2.2 As this work is progressing, a real and imminent risk has been identified of failure to the East Pier extension in the interim. Due to the urgency of this situation, capital works are needed to the East Pier Extension to prevent collapse and breaching.

2.3 If a collapse or breach were to occur, gaining access to temporarily or permanently construct remedial works would be extremely difficult, especially as the breach is likely to form during winter storm conditions. Furthermore, it would increase the risk of damage to the main East Pier, main West Pier and West Pier Extension, all of which also have identified structural defects. The rate of deterioration of these structures would all accelerate due to increased exposure following any failure of the East Pier Extension.

3.0 OPTIONS

3.1 From a longer list of options assessed for Whitby Harbour as a whole, the following options have been taken forward for further consideration specifically for the East Pier Extension:

- Do Nothing – the base case against which other options will be compared.
- Do Minimum – only involving activities such as controlling public access for health and safety purposes.
- Do Something – a range of options involving pro-active intervention to prevent failure and breaching, including:
 - Option A - Repairs to the existing cantilevered section – involving 25m of interlocking sheet piles and filling of voids with concrete.
 - Option B - Repairs to the existing cantilevered section and an adjacent length of potentially vulnerable sections of the Extension – involving 75m of interlocking sheet piles and filling of voids with concrete.
 - Option C - Repairs to the existing cantilevered section and all identified defective lengths on the seaward side of the Extension – involving 100m of interlocking sheet piles and filling of voids with concrete.
 - Option D - Repairs to the existing cantilevered section and the whole seaward and landward length of the Extension – involving 340m of interlocking sheet piles and filling of voids with concrete.
 - Option E - Repairs to the existing cantilevered section and the whole seaward and landward length of the Extension plus the whole seaward and landward length of the West Pier Extension – involving 680m of interlocking sheet piles and filling of voids with concrete.

4.0 PREFERRED OPTION

4.1 The preferred option is Do Something Option B - repairs to the existing cantilevered section and an adjacent length of potentially vulnerable sections of the Extension – involving 75m of interlocking sheet piles and filling of voids with concrete.

4.2 This option is considered the most cost-effective method of addressing the immediate risks faced to the East Pier Extension and has minimum impact on the natural and historic environment.

5.0 ECONOMIC CASE AND PRIORITY SCORE

5.1 A summary of the costings for various 'Do Something' options on the East Pier Extension is provided in the following table.

Summary of 'Do Something' Scheme Costings

Option	Description	Cost (£)
A	Minimum sheet pile protection around scour hole (25m length)	913,632
B	Sheet pile protection along 75m on seaward face of Extension	1,856,224
C	Sheet pile protection along 100m on seaward face of Extension	2,177,633
D	Sheet pile protection to whole of Extension (both sides of structure)	5,705,646
E	Sheet pile protection to whole of both Extensions	10,909,387

5.2 The benefits appraisal presented here is intended simply to determine whether early intervention in the form of urgent works to the East Pier Extension in advance of the main capital scheme to the whole of Whitby Harbour has a 'benefit:cost' ratio greater than unity and, if so, to then help guide selection of a preferred length of wall to undertake works on.

5.3 For the purposes of this assessment, the benefits of implementing the urgent works are measured here as the direct equivalent of the avoidance of costs associated with demolition, clear-up and reinstatement following failure and ongoing deterioration of the structure.

5.4 If the East Pier Extension failed and was immediately repaired (Scenario 1), the costs of this intervention (purely in engineering repair costs) would be £1,859,000. When compared against 'Do Something' Option A, this gives a benefit:cost ratio >2.

5.5 If the failure was not immediately repaired, but instead not addressed until 5 years (Scenario 2), 10 years (Scenario 3), or 25 years (Scenario 4) later the East Pier Extension would deteriorate and both the main East and West Piers would also become affected and require remedial works. Under these scenarios the costs of remedial work (using net present values) rises to £4,191,342 (Scenario 2), £15,747,214 (Scenario 3) and £23,455,884 (Scenario 4).

5.6 This appraisal clearly shows the benefit of urgent intervention in advance of the main capital scheme in order to avoid failure and subsequent deterioration of the East Pier Extension.

5.7 It should be noted that the benefits from early intervention to prevent breaching through the urgent works relate to a wider range of aspects than solely avoidance of engineering repair works. For example, it includes avoidance of damage or deterioration to amenity, environmental and heritage

aspects, avoidance of economic damages to the harbour and the fishing economy, and avoidance of decline to the tourism industry and so on.

- 5.8 Having identified that a Do Something option is preferable in the form of proactive works to prevent failure, the development of a breach, and further deterioration of the structure, focus must now turn to the cost-effectiveness of various approaches. As a minimum requirement, there is a need to repair the East Pier Extension over a 25m length at its south-east corner (Do Something Option A). This would require the mobilisation and demobilisation of a jack-up barge and result in an estimated cost of £913,632.
- 5.9 Having mobilised the jack-up barge, it appears cost-effective to extend the works over a length of 75m (Do Something Option B) or 100m (Do Something Option C) since the 'inclusive' cost per metre run effectively becomes:

Do Something Option A	£36,545
Do Something Option B	£24,750
Do Something Option C	£21,776

- 5.10 The advantage of Option B is that it focuses on the section of the East Pier Extension that is presently extremely vulnerable and the immediately adjacent section which would be likely to be the next section deteriorating to this state. Option C would address these areas and also a section of defects further seaward along the extension, although still would not cover works along the entirety of the East Pier Extension, which ultimately will still be required as part of the main capital scheme.
- 5.11 Due to the above, the preferred option is to undertaken works along 75m of the seaward face of the East Pier Extension in order to: (i) immediately safeguard the section that is voided and undermined in order to prevent failure; and (ii) safeguard the likely next most vulnerable section of the structure against further deterioration in advance of the main capital scheme's implementation.

6.0 ENVIRONMENTAL CONSIDERATIONS

- 6.1 The preferred option has a large number of positive environmental impacts, including:
- Avoidance of debris and pollution from failing and deteriorating structures being released into the marine environment (resulting in chemical, biological, and physical issues).
 - Avoidance of loss of amenity to tourists, anglers and local community of the pier extension and ultimately other harbour structures.
 - Avoidance of ultimate damage to Grade II listed structures (the main piers).
 - Avoidance of increased mobilisation of beach sediment that would require further dredging and disposal of spoil.
 - Avoidance of increased mobilisation of beach sediment that would smother a geological SSSI and cover its interest features.

- Avoidance of increased erosion and flooding risk.
- Avoidance of increased risk of damage to vessels entering the harbour or moored in the marina, thereby reducing potential for pollution or spillage incidents.

6.2 The preferred option also has some negative environmental impacts, including:

- Disturbance during construction activities (noise, vibration, physical).
- Pollution or spillage risk during construction activities.

6.3 The environmental benefits of the preferred option by far outweigh the negative impacts. Furthermore the negative impacts relate to construction activities and therefore will be relatively short-duration and can be minimised through adherence to pre-agreed Environmental Action Plans and Works Method Statements to minimise environmental impact.

7.0 RISKS

7.1 The table below provides a high-level Risk Schedule that shows how the top five ranked risks to the construction phase will be mitigated.

High-Level Risk Schedule

Risk	Description	Key Mitigation
Weather and sea state	Working conditions on the outer face of the pier extension are severe, especially when wave action is high and overtopping occurs.	Harbour Master will have final say on when plant and personnel are to be removed from site following review of weather forecasts. Contingency in programme and budget for weather delays.
Site access	Difficult access due to topography, numerous pedestrians and absence of link bridge between extension and main pier.	Access to be undertaken by barge and working to be from deck of jack-up barge
Current structural condition	Due to the very poor condition, the pier extension could fail during the works.	Further GI to inform working methods. Use of Safe Systems of Work.
Damage to SSSI	Adverse impact on adjacent geological SSSI	Engage Natural England at an early stage and design works to minimise any encroachment onto, or working from, the SSSI.
Construction impacts	Noise, vibration, spillages, etc. during construction activities	Agree Environmental Action Plan in advance and work to agreed Method Statements.

8.0 IMPLEMENTATION

8.1 Key dates are:

- Detailed design and assessment completion - ????? 2009
- Planning applications – Pre-qualification of Contractors – ????? 2009
- Select preferred Contractor – ????? 2009
- Construction commencement – ????? 2009
- Construction completion – ????? 2009
- Project completion - ????? 2009

8.2 The Procurement Strategy for Contractors will involve an Expression of Interest, a Pre-qualification Questionnaire from which a short-list will be established and a competitive tendering exercise based on selection of the most cost-effective tender.

8.3 The Consultant for the design and site supervision of the urgent works will be appointed using Scarborough Borough Council's Coastal Framework Agreement.

8.4 The role of CDM Co-ordinator will be provided by one of the Consultants on Scarborough Borough Council's Coastal Framework Agreement.

8.5 Scheme costs are presented below:

ITEM	COST
Authority Costs	£47,596
Design Costs	£95,191
SI costs	£95,191
Construction Costs	£951,910
Supervision Costs	£95,191
Contingency @ 60%	£571,145
Total	£1,856,224

9.0 CONTRIBUTIONS AND FUNDING

9.1 An application is made to the Environment Agency for coastal erosion risk management Grant-in-Aid of £1,856,224.

9.2 The Further Investigations at Whitby Harbour that have identified the need for the urgent capital works to the East Pier Extension were funded through Grant-in-Aid from the Environment Agency.

9.3 PAR preparation costs have been funded by Scarborough Borough Council.

10.0 STATUS

10.1 The proposed scheme concurs with the existing Shoreline Management Plan (SMP) and Whitby Coastal Strategy. The SMP has been adopted by Scarborough Borough Council in 2007 and approved by the Environment Agency in 2009. The Whitby Coastal Strategy was adopted by Scarborough Borough Council and approved by Defra in 2002.

10.2 The proposed scheme does not need Defra/Treasury approval and can be assessed by the Environment Agency's Regional PAB.

11.0 RECOMMENDATIONS

11.1 This Project Appraisal Report recommends investment approval for a coastal defence scheme to urgently manage the real and imminent risk of failure and breach of the East Pier Extension at Whitby Harbour.

11.2 The works will involve repairs to the existing cantilevered section of the East Pier Extension and an adjacent length of potentially vulnerable sections. This will involve some 75m of interlocking sheet piles and filling of voids with concrete.

11.3 The recommended approval for Grant-in-Aid is £1,856,224 (including £571,145 contingency) in financial year 2009/10.

11.4 The detailed design will be undertaken in ??? 2009 and construction will commence in ??? and is planned to be completed by ???.

The Executive Summary ends here

Briefing Paper

Authority:	Scarborough Borough Council	Project Executive:	John Riby
EA Region:	North East	Project Manager:	Stewart Rowe
Project Title:	Whitby East Pier Extension Urgent Works	Code:	
Consultant	Royal Haskoning	Contractor:	t.b.c.
Cost Consultant:			N/A
The Problem:	The East Pier Extension at Whitby Harbour is at imminent risk of failure, which would lead to increased flood and erosion risk in and around Whitby.		
Assets at risk from flooding:			
Existing standard of flood protection:	Not relevant	Proposed standard of flood protection:	Not relevant
Description of proposed scheme:	Steel sheet piling and void filling with concrete along nominally 75m of the seaward face of Whitby East Pier Extension to prevent failure of a section that is presently cantilevered due to undermining.		
Costs (PVc): (100 year life inc. maintenance)	£1,856,224	Benefits: (PVb)	£
Ave. B:C ratio: (PVb/PVc)			
NPV:	£	Incremental B:C ratio:	
Whole life cost (cash value):			£
Choice of Preferred Option:	Following an appraisal of different options, the preferred approach is the pro-actively undertake urgent capital works before a failure occurs.		
Total cost for which approval is sought:	£1,856,224 (incl. £0 inflation & £571,145 contingency)		
Delivery programme:	Planning Approval: Award Construction Contract: Construction Start: Construction End: End of Project:		
Is project in the Local Authority/IDB three year plan?			
Project outcomes	Defra priority score: ** (economics **, people **, environmental **). Contribution to Defra SDA Targets:		

2. BUSINESS CASE

2.1 Introduction and Background

1. The Whitby Coastal Strategy (High-Point Rendel, 2002) covers approximately 5km of North Yorkshire's coastline from Sandsend to Abbey Cliff and extends approximately 2km upstream in the River Esk estuary (Appendix A).
2. The Strategy recognises the critical importance of the Whitby Harbour structures (main piers and extensions) to the overall flood and coastal defence system across the wider Strategy frontage, as well as directly to the harbour itself. This view is supported by the approved River Tyne to Flamborough Head Shoreline Management Plan (Royal Haskoning, 2007).
3. One of the most significant findings of the Strategy is the identification of the poor or very poor structural condition and overtopping performance of the structures at Whitby Harbour.
4. The Strategy recommended that a series of further investigations be undertaken at Whitby Harbour to better characterise the extent and nature of these problems and help better define the capital works required and associated costs and timescales for their implementation.
5. These further investigations on the Whitby Harbour structures were undertaken in 2008 (Appendix B). Resulting information has led to a re-evaluation of the concept schemes that were proposed for the harbour structures in the original Whitby Coastal Strategy. The re-evaluation has been undertaken in accordance with changes since the original Strategy was published, including new scheme prioritisation and assessment procedures, and changes in guidance relating to sea level rise. This is presently leading to the preparation of a Project Appraisal Report for a major capital scheme to upgrade the aged structures to improve their condition and overtopping performance into the future.
6. Critically, these further investigations also revealed that a section at the south-east corner of the East Pier Extension is severely voided and undermined and at present is only remaining attached to the main body of the structure by cantilevering action. There is a real and imminent risk of failure of this section which would lead to increased exposure and accelerated deterioration of other structures within the harbour and increased exposure to flooding and erosion risk (Appendix C).
7. This PAR is seeking investment approval in urgent works to the East Pier Extension so that a failure can be prevented. In parallel with the urgent works, the major capital works on the other harbour structures are being developed in accordance with standard Environment Agency procedures.
8. Key environmental constraints are the proximity of the works to a geological foreshore SSSI, an amenity beach at Whitby Sands, and the main harbour piers which are Grade II Listed Structures.

2.2 Problem

1. Following completion of the Whitby Coastal Strategy, further investigations at Whitby Harbour have led to the identification of a number of structural condition and overtopping performance issues associated with the coastal defence structures at Whitby Harbour (Appendices B, C and D).
2. Following the further investigations, a PAR is being prepared for investment in the detailed design, assessment and implementation of a major capital scheme to address all of these issues.
3. In the meantime, however, a real and imminent risk has been identified of failure to the East Pier Extension. The Technical Report accompanying the Further Investigations at Whitby Harbour (Appendix D) has concluded as follows:

“The most critical area requiring works occurs on the landward end of the East Pier Extension where there is a high risk of failure due to loss of the supporting material (steel and granular fill) at the bed level. The removal of this material has caused the concrete pier above to cantilever or hang off the existing structure, which is not how the structure is intended to perform.”

4. Due to the urgency of the situation, the Technical Report (Appendix B) recommended the following:

“Capital works are needed at the south-east corner of the East Pier Extension, and a Project Appraisal Report should immediately be produced to seek funding to prevent a collapse and breach in this area in advance of the main works.

A solution to this defect must then be designed and implemented with urgency because if a collapse or breach were to occur, gaining access to temporarily or permanently construct remedial works would be extremely difficult, especially as the breach is likely to form during winter storm conditions.

Therefore prevention of collapse and breaching is essential.”

5. This PAR is intended to enable urgent capital works to the East Pier Extension in advance of the main scheme so that such a failure and breach can be avoided.

2.3 Options Considered

1. In the present study, the following options have been considered as a solution to the identified urgent problem at the East Pier Extension:
 - Do Nothing – the base case against which other options will be compared.
 - Do Minimum – only involving activities such as controlling public access for health and safety purposes.
 - Do Something – a range of options involving pro-active intervention.

[Note that a fuller range of options has been considered in the Technical Report (Appendix D) for the main capital works at Whitby Harbour following the further investigations.]

2. Do Nothing

The Technical Report (Appendix D) has revealed the following likely consequence of a Do Nothing scenario.

“The present investigations have highlighted that the existing piers are in poor condition and that the East Pier Extension particularly is at risk of failure and could possibly collapse in the short term. The probable failure and breach scenario is identified below.

The landward end of the East Pier Extension is likely to collapse, due to the scouring of the supporting material under the landward end of the structure. This collapse would lead to increased exposure to the bullnose and seaward end of the main East Pier from tidal surges and wave attack.

The collapse would expose the core of the East Pier Extension. The sea would continue to attack the remains of the outer sheet piles, scour the foundation to the next section of the structure and outwash the newly exposed core of the structure. This is likely to have been formed of the original weaker mass concrete construction and will erode faster than the reinforced concrete repair on the outer face. With time, further sections of the East Pier Extension are likely to collapse in the same manner, propagating the breach.

The outer face of the main East Pier at the seaward end currently has damage to the stone block facing where scour has eroded the mortar from the joints and blocks are settled and cracked. The displaced blocks mean that seawater flushes the fill material out from the pier core from behind the blocks leaving cavities. This narrow section of pier is shown to have significant voiding behind the stone block faces on both sides and below the deck at present. These voids would increase in size at a greater pace than previously due to the increased exposure to sea conditions caused by the absence of protection from the East Pier Extension.

As the worst conditions are from the north and northeast, the blocks would be dislodged into the voids by wave energy, causing the outer face to collapse taking away part of the pier deck. This would expose the core of the main pier structure.

With the core exposed, the waves would further attack the core of the structure, dislodging the fill material and removing the support to the deck. This would reduce the pier height and eventually lead to a breach of the East Pier. With the breach, debris could disperse into the navigational channel presenting a hazard to vessels using the harbour.

The breach would continue to extend laterally during storm and high tide conditions as waves will propagate over and through the breach, causing it to enlarge. Eventually the whole of the northern section of the main East Pier would collapse into a mound with an ever decreasing defence height and effectiveness. This would allow larger waves to enter the harbour and attack the inner face of the main West Pier and its extension. Waves may also begin to impact assets further upstream in the River Esk estuary.

With the increased exposure to the main West Pier on its inner faces this structure too would eventually collapse and breach in a similar manner described for main East Pier. This is demonstrated by the defects recorded along the inner face of the main West Pier which leave it vulnerable to such processes. The analogue can be further extended to the West Pier extension, due to the scour action on the inner landward end, which could extend to collapse part of this structure.

If the structures receive no capital investment, they will continue to erode, collapse and disintegrate until only the ruins remain. This will expose the town and estuary to increase wave and tide conditions.

With the loss of the main West Pier and its extension, the beach deposits shift and deplete from the current profiles on the Whitby Sands beach. The sediment would block the navigation channel and drift further along the coast to cover the bedrock foreshore to the east of the harbour.”

3. Under this Do Nothing option, the resulting consequence will be that flood and erosion risk will increase dramatically. Environmental and heritage damage will be caused by the deterioration process and through the absence of the structures, and health and safety risks will increase. This option is rejected as a management response, but it does present the necessary base case against which other options are compared.
4. Do Minimum will reduce the health and safety risks by restricting public access to the deteriorating structure, but will not address the increased flood and erosion risk or environmental and heritage damage and therefore has been rejected.
5. Do Something options have been considered as follows:
 - Option A - Repairs to the existing cantilevered section – involving 25m of interlocking sheet piles and filling of voids with concrete.
 - Option B - Repairs to the existing cantilevered section and an adjacent length of potentially vulnerable lengths of the Extension – involving 75m of interlocking sheet piles and filling of voids with concrete.

- Option C - Repairs to the existing cantilevered section and all identified defective lengths on the seaward side of the Extension – involving 100m of interlocking sheet piles and filling of voids with concrete.
 - Option D - Repairs to the existing cantilevered section and the whole seaward and landward length of the Extension – involving 340m of interlocking sheet piles and filling of voids with concrete.
 - Option E - Repairs to the existing cantilevered section and the whole seaward and landward length of the Extension plus the whole seaward and landward length of the West Pier Extension – involving 680m of interlocking sheet piles and filling of voids with concrete.
6. Option A represents the minimum required engineering works to rectify the most significant present-day defects (i.e. the cantilevered section) in advance of the major capital scheme to all the pier structures. This is in full compliance with the Technical Report (Appendix D) which reveals that the preferred major capital scheme would involve sheet piling and concrete filling of voids around both pier extensions.
7. Having identified that a significant component of the costs associated with the necessary urgent works would be in the mobilisation and demobilisation of a jack-up barge, Options B to E are used here to investigate the added-value of extending the minimum works (Option A) to additional lengths of the structure in advance of the subsequent major scheme.

2.4 Costs of Options

1. To inform the economic appraisal of the potential urgent works options, outline estimates of scheme costs have been performed. The estimates have largely been based on the use of *Spon's Civil Engineering and Highway Works Price Book 2008*. Due to the particularly specialist nature of the works envisaged as part of the various options, some specific inputs have also been made from other sources, including:
- Activity schedules from recently completed coastal defence and pier refurbishment schemes in the north east as a 'benchmarking' exercise;
 - Discussions with Carillion regarding their recent experiences of similar pier refurbishment at Roker Pier (Tyne and Wear);
 - Discussions with Easipoint regarding restoration mortar costs, noting the need for underwater works on parts of the structures;
 - Discussions with Cemex regarding concrete costs;
 - Discussions with Keller Ground Engineering regarding grouting costs; and
 - Discussions with Briggs Marine regarding costs for use of jack-up barges.
2. These sources have been used to develop outline scheme construction costings for various works implementation options. A 60% optimism bias has then been added to the estimated scheme construction costs.

3. The following components have contributed to the overall cost estimates:
 - Outline scheme construction costs;
 - Optimism bias @ 60% of outline scheme construction costs;
 - Design and supervision costs @ 20% of outline scheme construction costs;
 - Site Investigation costs @ 15% of outline scheme construction costs; and
 - Scarborough Borough Council staff costs @ 5% of outline scheme construction costs.

4. A summary of the costings for various 'Do Something' options is provided in the following table, with a more detailed breakdown for each in Appendix E.

Summary of 'Do Something' Scheme Costings

Option	Description	Cost (£)
A	Minimum sheet pile protection around scour hole (25m length)	913,632
B	Sheet pile protection along 75m on seaward face of Extension	1,856,224
C	Sheet pile protection along 100m on seaward face of Extension	2,177,633
D	Sheet pile protection to whole of Extension (both sides of structure)	5,705,646
E	Sheet pile protection to whole of both Extensions	10,909,387

2.5 Benefits of Options

1. The Technical Report (Appendix D) presents a benefits appraisal for the strategic management options considered for Whitby Harbour as a whole. This appraisal will be further enhanced during the PAR for the main capital scheme to all structures.
2. Due to this, the benefits appraisal presented here focuses on the benefits of implementing the urgent works on the East Pier Extension only in advance of the main capital scheme. The purpose of the benefits appraisal is to simply determine whether early intervention in the form of urgent works has a 'benefit:cost' ratio greater than unity and, if so, to then help guide selection of a preferred length of wall to undertake works on.
3. For the purposes of this assessment, the benefits of implementing the urgent works are measured here as the direct equivalent of the avoidance of costs associated with demolition, clear-up and reinstatement following failure and ongoing deterioration of the structure.
4. The table below summarises the benefits appraisal. Detail is provided in Appendix F. As can be seen, if the structure failed and was immediately repaired (Scenario 1), the costs of this intervention (purely in engineering repair costs) would be £1,859,000. When compared against 'Do Something' Option A, this gives a benefit:cost ratio >2.

5. The table also shows the anticipated costs that would be incurred if the failure was not immediately repaired, but instead not addressed until 5 years (Scenario 2), 10 years (Scenario 3), or 25 years (Scenario 4) later. Under these scenarios the East Pier Extension would deteriorate and both the main East and West Piers would also become affected and require remedial works. Under these scenarios the benefit:cost ratio increases (using net present values) to 4.6 (Scenario 2), 17.2 (Scenario 3) and 25.7 (Scenario 4). This appraisal clearly shows the benefit of avoiding failure and subsequent deterioration of the East Pier Extension.

	Action	Cost (£) ¹	Net Present Value (£) ²
Do Nothing	Scenario 1 Remedial Work Year 0-5	1,859,000	1,859,000
	Scenario 2 Remedial Work Year 5-10	4,978,000	4,191,342
	Scenario 3 Remedial Work Year 10-25	22,213,000	15,747,214
	Scenario 4 Remedial Work Year 25-50	55,432,000	23,455,884

6. It should also be noted that the benefits from early intervention to prevent breaching through the urgent works relate to a wider range of aspects than solely avoidance of engineering repair works. For example, it includes avoidance of damage or deterioration to amenity, environmental and heritage aspects, avoidance of economic damages to the harbour and the fishing economy, and avoidance of decline to the tourism industry and so on.

2.6 Environmental Assessment

1. The Whitby Coastal Strategy has an accompanying Environmental Studies Report (Appendix G) which addresses the impacts of the concept scheme options that were recommended at the time.
2. Following the Further Investigations at Whitby Harbour, these concept scheme options have been re-evaluated in the light of more recent information and changes in regulation. The conclusion of the Further Investigations (Appendix D) is that in general the concept scheme options remain valid, and hence the conclusions of the previous Environmental Studies Report remain valid.
3. The principal environmental issues associated with the concept scheme designs are:
 - Potential for loss of, or damage to, Grade II listed structures (the main piers).
 - Potential for disturbance to marine ecology (including fisheries and migratory species of conservation importance) via noise, water quality, and changes to sediment transport/geomorphology during construction activities.

¹ Rounded to nearest £1k.

² Cost assumed to be incurred at lower end of time range.

- Potential for socio-economic effects on fisheries, tourism and maritime trade (including potential for effects to safety of navigation).
 - Potential for disturbance to roosting and feeding bird species (especially summer and winter migrants). It is considered unlikely that breeding birds could be affected.
 - Potential impacts from material placement across the foreshore to both the immediate west (amenity) and immediate east (geological designations) of the harbour structures.
 - Potential implications of the Water Framework Directive regarding inshore and river water quality.
4. It is acknowledged that in developing the main capital scheme, an Environmental Impact Assessment is likely to be required. This will need to include all recent changes and address the above issues.
5. The table below summarises the key negative and positive environmental impacts associated with the main options for the East Pier Extension urgent works, as identified from the Whitby Coastal Strategy Environmental Studies Report (Appendix G), the Technical Report (Appendix D) and consultations with relevant bodies (Appendix H).

Option	Key Positive Impacts	Key Negative impacts
Do Nothing	<ul style="list-style-type: none"> • Reinstatement of more 'natural' coastal processes. 	<ul style="list-style-type: none"> • Debris and pollution from deteriorating structures released into marine environment (chemical, biological, and physical issues). • Loss of amenity to tourists, anglers and local community. • Lead to damage to Grade II listed structures. • Increased mobilisation of beach sediment requiring further dredging and smothering a geological SSSI. • Increased erosion and flooding risk. • Increased risk of damage to vessels entering harbour or moored in marina, leading to pollution incidents.
Do Minimum	<ul style="list-style-type: none"> • As above 	<ul style="list-style-type: none"> • As above

Option	Key Positive Impacts	Key Negative impacts
Do Something	<ul style="list-style-type: none"> Avoidance of all key negative impacts identified under Do Nothing. 	<ul style="list-style-type: none"> Disturbance during construction activities (noise, vibration, physical). Pollution risk during construction activities.

6. In recognition that the principal negative environmental impacts associated with Do Something options relate to construction activities, they are likely to be relatively short-term and relatively localised. The positive environmental benefits of Do Something options by far outweigh the negative environmental impacts associated with Do Nothing. Furthermore, the negative impacts from Do Something can all be minimised through careful urgent works design and adherence to appropriate Works Methods Statements that would be agreed with regulatory bodies, such as Natural England or CEFAS (as appropriate) and the Environment Agency.

2.7 Choice of Preferred Option

- The above assessment has demonstrated that it is economically viable to implement a Do Something option in preference to a Do Nothing or Do Minimum option. Furthermore the environmental benefits of Do Something by far outweigh the negative impacts of Do Nothing or Do Minimum.
- Having identified that a Do Something option is preferable, focus must now turn to the cost-effectiveness of various approaches. As a minimum requirement, there is a need to repair the East Pier Extension over a 25m length at its south-east corner (Do Something Option A). This would require the mobilisation and demobilisation of a jack-up barge and result in an estimated cost of £913,632.
- Having mobilised the jack-up barge, it appears cost-effective to extend the works over a length of 75m (Do Something Option B) or 100m (Do Something Option C) since the 'inclusive' cost per metre run effectively becomes:

Do Something Option A	£36,545
Do Something Option B	£24,750
Do Something Option C	£21,776

- Extending this argument further, to extend the works around the whole East Pier Extension (Do Something Option D) becomes even more cost-effective per metre run at £16,781, but the capital costs are considerably higher and really must be considered as the main capital scheme works. Furthermore, there is no significant advantage between Option D and Option E (£16,043 per metre run) in extending the works to include the West Pier Extension at the same time.
- The most cost-effective solution for urgent works in advance of the main scheme appears to be Option B or Option C. The advantage of Option B is that it focuses on the section of the East Pier Extension that is presently extremely vulnerable and the immediately adjacent section which would be likely to be the next section deteriorating to this state. Option C would address

these areas and also a section of defects further seaward along the extension, although still does not cover works along the entirety of the East Pier Extension, which ultimately will still be required as part of the main capital scheme.

6. Due to the above, the preferred option is to undertaken works along 75m of the seaward face of the East Pier Extension in order to: (i) immediately safeguard the section that is voided and undermined in order to prevent failure; and (ii) safeguard the likely next most vulnerable section of the structure against further deterioration in advance of the main capital scheme's implementation.

2.8 Other Considerations

1. Natural England has been consulted with relating to both the proposed urgent capital works and the main capital scheme. A letter from Natural England is provided in Appendix I.
2. Throughout the Further Investigations at Whitby Harbour, including the re-evaluation of concept options and identification of the options to remedy the urgent problem on the East Pier Extension, CDM-Coordinator input has been made. The purpose of this is to ensure that all parties are fully aware of the Health and Safety risks and that these risks are, as far as practicably achievable, designed-out through the options development process.
3. In defining scheme costings, inputs have been provided by contractors and suppliers with expertise of working in the marine environment.
4. The effects of sea level rise have been incorporated into our assessments of the likely breaching mechanisms and deterioration timescales of the structures.

3. PROJECT PLAN

1. The preferred option is to re-install steel sheet piling at the toe of the East Pier Extension along approximately 75m of the seaward face and then infill the voids using concrete. An outline plan and example sections are presented in Appendix J.
2. The outline construction approach will be to:
 - Obtain approval and funding from the Environment Agency.
 - Finalise scheme design and assessment, including all necessary licences, consents and permissions;
 - Place information boards and notices on the site before any construction activity commences;
 - Establish site compound at Endeavour Wharf including docking arrangements for marine vessels
 - Mobilise jack up barge to East Pier Extension with crane and piling rig.
 - Excavate a trench around the perimeter of the pier over the work extent.
 - Install the sheet piles into the excavated trench. Sheet piles to be transported out from Endeavour Wharf.
 - Anchor top of sheet piles to the existing pier structure by drilling and fixing bars into the mass concrete body

- Backfill the trench with cementitious grout on both sides of the sheet piles.
 - Fill in the void under and between pier and sheet pile wall with concrete up to the top of the sheet piles. Concrete to be transported from Endeavour Wharf.
 - Demobilise jack up barge and clear site compound from Endeavour Wharf.
3. During construction, all activities will be undertaken in accordance with an agreed Environmental Action Plan.
 4. The construction activities are planned to commence in **October 2009** and finish in **March 2010**.
 5. It is envisaged that further capital works will be needed on this structure and all other structures at Whitby Harbour as this scheme is addressing the identified urgent problem with the south-eastern section of the East Pier Extension only in order to prevent failure of the cantilevered section.
 6. **The Procurement Strategy for Contractors will involve an Expression of Interest, a Pre-qualification Questionnaire from which a short-list will be established and a competitive tendering exercise based on selection of the most cost-effective tender.**
 7. **The Consultant for the design and site supervision of the urgent works will be appointed using Scarborough Borough Council's Coastal Framework Agreement.**
 8. **The role of CDM Co-ordinator will be provided by one of the Consultants on Scarborough Borough Council's Coastal Framework Agreement.**
 7. The table below is a High-level Risk Schedule that shows how the top five ranked risks to the construction phase will be mitigated.

High-Level Risk Schedule

Risk	Description	Key Mitigation
Weather and sea state	Working conditions on the outer face of the pier extension are severe, especially when wave action is high and overtopping occurs.	Harbour Master will have final say on when plant and personnel are to be removed from site following review of weather forecasts. Contingency in programme and budget for weather delays.
Site access	Difficult access due to topography, numerous pedestrians and absence of link bridge between extension and main pier.	Access to be undertaken by barge and working to be from deck of jack-up barge
Current structural condition	Due to the very poor condition, the pier extension could fail during the works.	Further GI to inform working methods. Use of Safe Systems of Work.
Damage to SSSI	Adverse impact on adjacent geological SSSI	Engage Natural England at an early stage and design works to minimise any encroachment onto, or working from, the SSSI.
Construction impacts	Noise, vibration, spillages, etc. during construction activities	Agree Environmental Action Plan in advance and work to agreed Method Statements.

4. PROJECT APPRAISAL REPORT - DATA SHEET

Entries required in clear boxes, as appropriate.

GENERAL DETAILS

Authority Project Ref. (as in forward plan):	
Project Name (60 characters max.):	Whitby East Pier Extension Urgent Works
Promoting Authority:	
Name	Scarborough Borough Council
Environment Agency Region	North East
Emergency Works: (Y/N)	No (but considered as 'urgent works')
Strategy Plan Reference:	Whitby Coastal Strategy
River Basin Management Plan	
Shoreline Management Plan:	River Tyne to Flamborough Head SMP2
Project Type:	Coastal protection and sea defence
Shoreline Management Study/ Preliminary Study/ Strategy Plan/Prelim. Works to Strategy/ Project within Strategy/Stand-alone Project	
Coast Protection/Sea Defence/Tidal Flood Defence/Non-Tidal Flood Defence/Flood Warning - Tidal/Flood Warning - Fluvial/Special	

CONTRACT DETAILS

Estimated start date of works/study:	
Estimated duration in months:	
Contract type	Consultant = Framework Contractor = Non Framework
Direct labour, Framework, Non Framework, Design/Construct	

COSTS

APPLICATION (£)

Appraisal:	N/A
Costs for Environment Agency approval:	£1,856,224
Total Whole Life Costs:	£1,856,224
For breakdown of costs see Table in Section 2.4	

CONTRIBUTIONS:

Windfall Contributions:	£0
Deductible Contributions:	£0
ERDF Grant:	£0
Other Ineligible Items:	£0

Entries required in clear boxes, as appropriate.

LOCATION - to be completed for all projects

EA Region/Area of project site (all projects):	North East, North Yorkshire Coast
Name of watercourse (fluvial projects only):	N/A
District Council Area of project (all projects):	Scarborough Borough Council
Grid Reference (all projects):	
(OS Grid reference of typical mid point of project in form ST064055)	
Specific town/district to benefit:	Whitby, North Yorkshire

DESCRIPTION

Brief project description including essential elements of proposed project/study
(Maximum 3 lines each of 80 characters)

Postcode zones of protected property wholly or partially within proposed benefit area

DETAILS

Design standard (chance per year):		yrs
Existing standard of protection (chance per year)		yrs
Design life of project:		50yrs
Fluvial design flow (fluvial projects only):		m ³ /s
Tidal design level (coastal/tidal projects only):		m
Length of river bank or shoreline improved:		75m
Number of groynes (coastal projects only):		
Total length of groynes* (coastal projects only):		m
Beach Management Project? Y/N		
Water Level Management (Env) Project? Y/N		
Defence type (embankment, walls, storage etc)		Pier

* i.e. total length of all groynes added together, ignore any river training groynes

ADDITIONAL AGREEMENTS:

Maintenance Agreement(s):		Not Applicable/Received/Awaited	
EA Region Consent (LA Projects only):		Not Applicable/Received/Awaited	
Non Statutory Objectors: Y/N			
Date Objections Cleared:			

Entries required in clear boxes, as appropriate.

ENVIRONMENTAL CONSIDERATIONS

Natural England (or equivalent) letter:		Not Applicable/Received/Awaited
Date received		

Sites of International Importance (Y/N for each)

Answer Y if project is within, adjacent to or potentially affects the designated site

Special Protection Area (SPA):	N
Special Area of Conservation (SAC):	N
Ramsar Site	N
World Heritage Site	N
Other (Biosphere Reserve etc)	N

Sites of National Importance (Y/N for each)

Answer Y if project is within, adjacent to or potentially affects the designated site

Environmentally Sensitive Area (ESA):	N
Site of Special Scientific Interest (SSSI):	Y, adjacent to SSSI
National/Regional Landscape Designation:	N
National Park/The Broads	N
National Nature Reserve	N
AONB, RSA, RSC, other	N
Scheduled Ancient Monument	N
Other designated heritage sites	Adjacent to Grade II Listed Structures (main piers)

Other Environmental Considerations

Listed structure consent	N/A	Not Applicable/Received/Awaited
Water Level Management Plan Prepared? Y/N	N	
FEPA licence required? NA/R/A	A	

Compatibility with other plans

Shoreline Management Plan	Y	Yes/No/Not Applicable
River Basin Management Plan	N/A	Yes/No/Not Applicable
Catchment Flood Management Plan	N/A	Yes/No/Not Applicable
Water Level Management Plan	N/A	Yes/No/Not Applicable
Local Environment Agency Plan	N/A	Yes/No/Not Applicable

SEA/Environmental Impact Assessment

SEA	
Statutory required/Agency voluntary/not applicable	
EIA	
Yes (schedule 1); Yes (schedule 2); SI1217; not applicable	
SEA/EIA status	
Scoping report prepared/draft/draft advertised/final	
Other agreements	

(Not Applicable/Received/Awaited for each)

Entries required in clear boxes, as appropriate.

COSTS, BENEFITS & SCORING DATA

(Apportion to this phase if part of a strategy)

Local authorities only: for projects done under Coast Protection Act 1949, please separately identify:

FD = Benefits from reduction of asset flooding risk; CE = Benefits from reduction of asset erosion risk

Benefit type (DEF: reduces risk (contributes to Defra SDA 27); CM: capital maintenance; FW: improves flood warning; ST: study; OTH: other projects)

LAND AREA

Total area of land to benefit:			ha
of which present use is:	FD	CE	
Agricultural:	ha	ha	
Developed:	ha	ha	
Environmental/Amenity	ha	ha	
Sched. for development:	ha	ha	

PROPERTY PROTECTED

	Number		Value (£'000s)	
	FD	CE	FD	CE
¹ Resid.				
Comm./ind.				
Other: (description below)				
Description:				

COSTS AND BENEFITS

¹ Present value of total project whole life costs (£'000s):		
Project to meet statutory requirement?	Y/N	
		£'000s
	FD	CE
Present value of urban benefits:		
Present value of agricultural benefits:		
Present value of environmental/amenity benefits:		
¹ Present value of total benefits (FD & CE)		
Net present value:		
Benefit/cost ratio:		:1
Base date for estimate:		
Project Appraisal Guidance used:	Y/N	
PAG Decision rule stages III and IV applied:	Y/N	

OTHER PRIORITY SCORING DETAILS¹

Economics	People	Environmental
Non-works study, eg coastal process (Y/N)?	Risk*: Vuln**:	BAP net gain (Ha): SSSI protected (Ha): Other habitat (Ha): Heritage sites***:

* (VH, H or N/A); ** (from ODPM website) *** ("I or II*", "II or other" or "N/A") See back page for score calculation details

Exemption Details (if exempt from priority scoring system)

Exempt from Scoring (Y/N):

Reason (max 100 chars):

¹Highlighted fields all used to generate priority score - see Annex for calculation flowchart

PRIORITY SCORE CALCULATION FLOWCHART ECONOMIC SCORE

	Benefits (£'000s)		Costs (£'000s)		Economic Score
Divide		by		multiply by 2 and subtract 1 =	

Economic score = (benefits / costs * 2) - 1

(Max is 20)

PEOPLE SCORE

No of residences	Cost (£'000s)	Base People Score	Risk factor very high = 2 high = 1	Affluence factor: 1 to 300 301 to 1500 1501 to 6664 6665 to 8114 8115 to 8414	Add: +2 +1 no adjustment -1 -2	People Score
()	()	()	()	()	()	()
multiplied by 75, divided by	=	plus	plus	plus	=	=

(Max is 8)

(Max. is 12)

People score = (number of residences protected * 75 / cost) + risk factor + vulnerability factor

ENVIRONMENTAL SCORE

BAP (Ha)	SSSI (Ha)	Other (Ha)	Cost (£'000s)	Heritage I or II* = 2 II or other = 1	Environmental Score	()
()	()	()	()	()	()	()
multiplied by 2)	plus	multiplied by 1.5)	multiplied by 25 divided by	plus	=	=

Environmental score = (((BAP area created * 2) + (SSSI area protected * 1.5) + other designated area protected) * 25 / cost) + heritage factor (Max is 12)

TOTAL SCORE

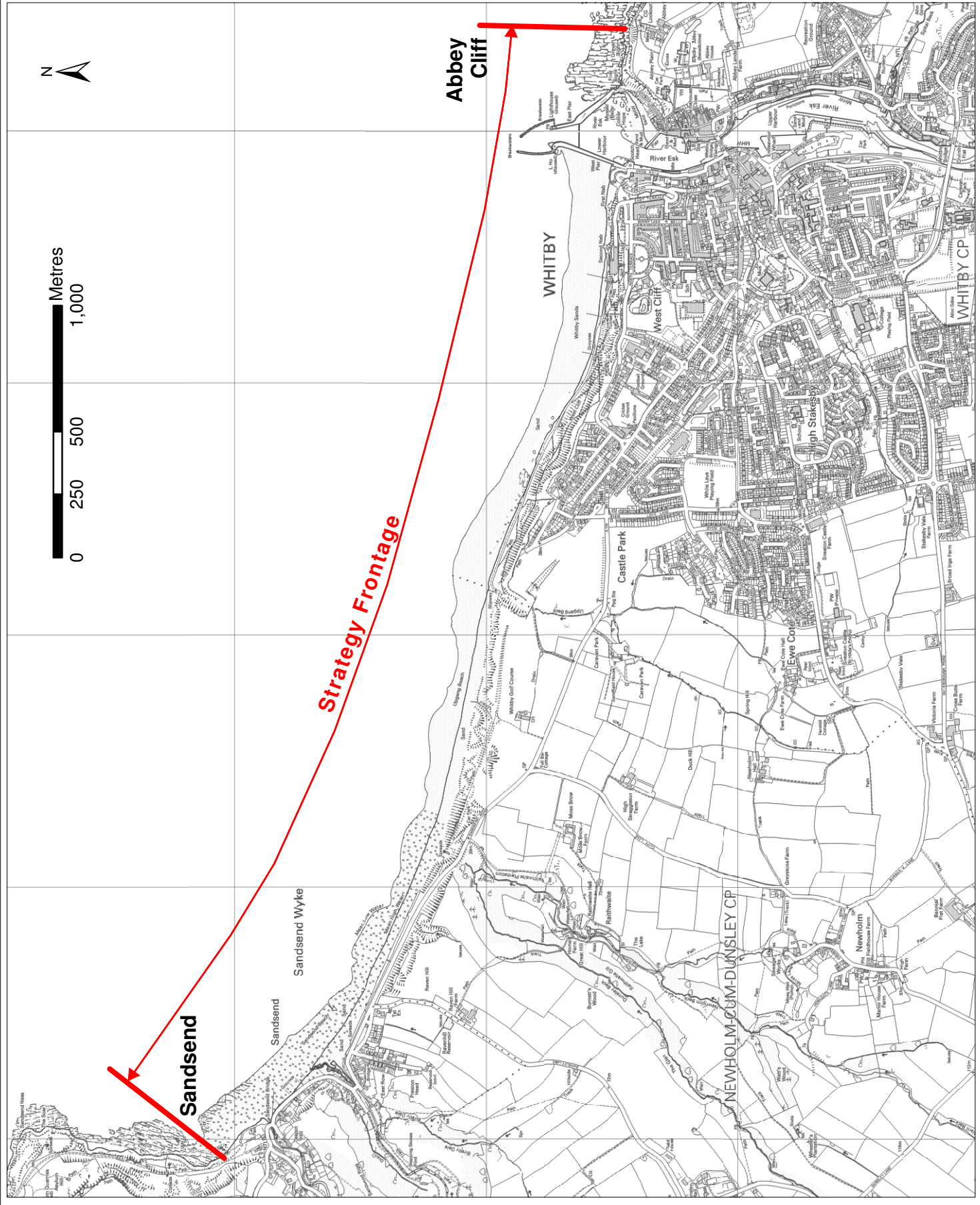
Economic + People + Environmental =	
-------------------------------------	--

Studies should be scored as for the works to which they relate; studies not related to works (eg coastal process studies for SMPs) score 20. (Max is 44)

Please note there is an Internet Score Calculator at <http://www.defra.gov.uk/environ/fcd/policy/grantaid.htm>

Appendices

Appendix A
Location Plans



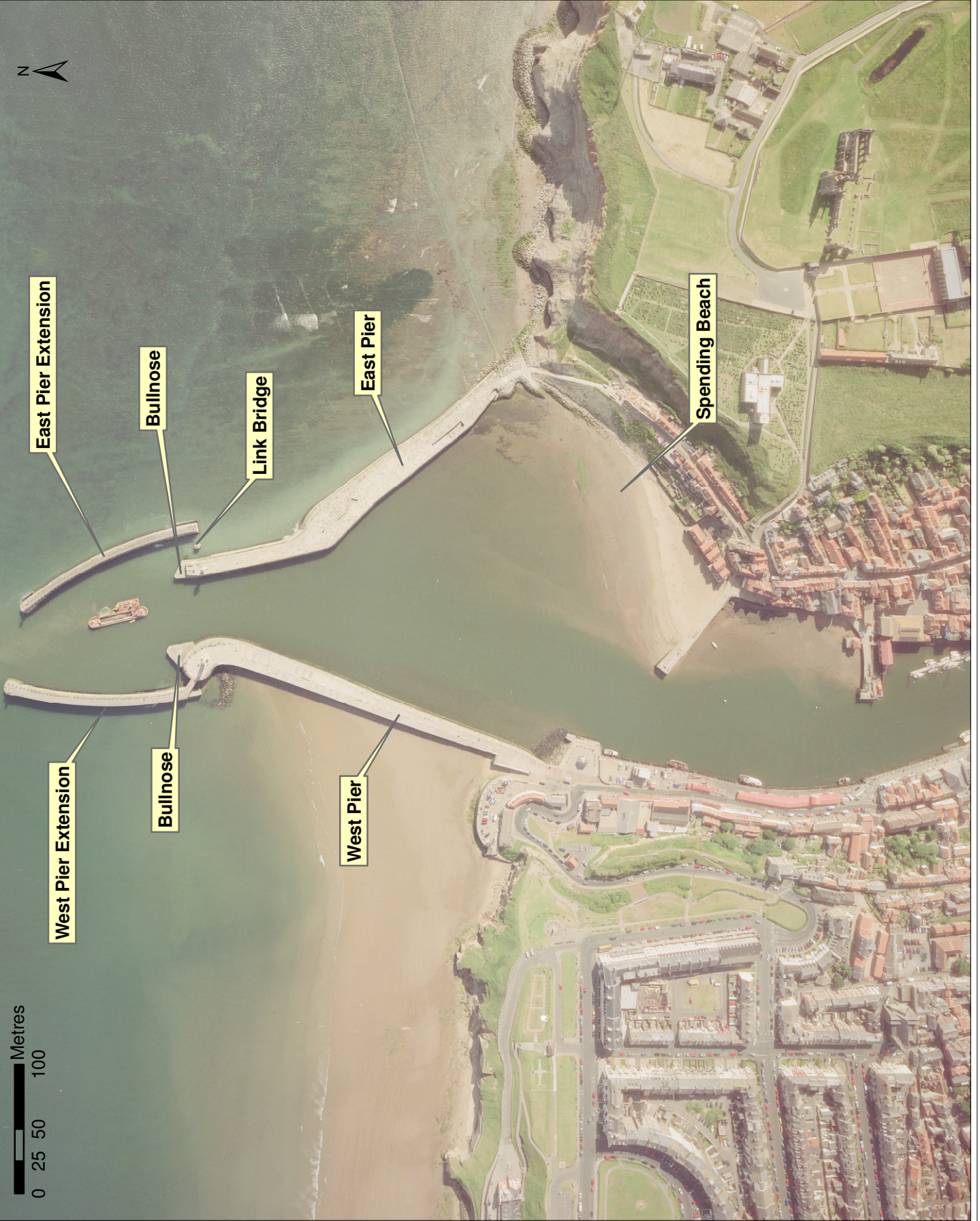
Title: Whitby Coastal Strategy Frontage
Project: Whitby East Pier Extension Urgent Works
Client: Scarborough Borough Council

Date: February 2009
Scale: 1 : 20,000

Figure: A1
Drawn: TC
Checked: NC



191029 Technical Drawings\reports\report\figure_A1.mxd



Note: The Link Bridge was demolished following storm damage and there is presently no pedestrian access between the East Pier and its extension.

Title:
Whitby Harbour Structures

Project:
Whitby East Pier Extension
Urgent Works

Client:
Scarborough Borough Council

Date:
February 2009

Scale:
1 : 4,000

Figure:
A2

Drawn:
TC

Checked:
NC



ROYAL HASKONING

L:\170429\Technical\Bridges\reports\report\figure_A2.mxd

Appendix B

Reports Produced and Available for Inspection

Reports Produced and Available for Inspection

The following reports are relevant to the Whitby East Pier Extension Urgent Works and are available for inspection from Scarborough Borough Council.

Whitby Coastal Strategy

The Whitby Coastal Strategy was completed in July 2002, comprising three main volumes and seven supporting appendices as follows:

Volume	1	Text and Figures
	2	Aerial Photographs
	3	Management Units
Appendix	I	Wave Climate, Coastal Processes and Flood Risk
	II	Condition Assessment of the Coastal and River Defences
	III	Coastal Slope Condition and Management
	IV	Environmental Studies
	V	Economic Assessment
	VI	Beach Survey
	VII	Factual Report on Ground Investigation at Metropole Cliff

River Tyne to Flamborough Head Shoreline Management Plan 2

This SMP2 is available from 'www.northeastsmp2.org.uk'.

Whitby Coastal Strategy: Further Investigations at Whitby Harbour

The following documents have been produced as outputs from the Further Investigations at Whitby Harbour.

- Whitby Coastal Strategy: Further Investigations at Whitby Harbour (Draft) by Royal Haskoning, January 2009.
- Whitby Coastal Strategy Harbour Pier Survey – Topographical and Digital Measured Survey by Durham University, dated March – April 2008 (UoD ref: RH_08_001) and attached survey drawings referenced in the report.
- Whitby Coastal Strategy Harbour Pier Survey – Topographical and Digital Measured Survey Cross Sections by Durham University, dated March – April 2008 (no reference).
- Whitby Coastal Strategy Harbour Pier Survey – Additional Cross Sections by Durham University, Dated March – April 2008 (UoD ref: RH_08_001a).
- Whitby Coastal Strategy Harbour Piers Survey – Diving and Visual Survey by Royal Haskoning, dated July 2008 (RH ref: 9T0429/05/R080215/303315/Hayw).

- West & East Piers Whitby Harbour – Investigation of Voiding Within Pier Construction By GB Geotechnics Ltd, dated July 2008 (GBG ref: 3034) and appendices folder with Drawing nos. 3034-1 & 3034-2.
- Whitby Pier Ground Investigation – Factual Ground Investigation Report by Soil Mechanics, dated September 2008 (SM report No: A8067).
- Whitby Coastal Strategy Harbour Piers Survey – Interpretative Report on Ground Investigation. Royal Haskoning, August 2008 (RH ref: 9T0429/R003/MS/Newc).
- Whitby Piers Geophysical Survey Report by EGS International Ltd, dated November 2008 (EGS ref: 4531).
- Whitby Coastal Strategy Harbour Piers Survey – Structural Inspection of East Pier Extension. Royal Haskoning, dated November 2008 (RH ref: 9T0429/R004/303392/Newc).
- Whitby Coastal Strategy Further Studies: Physical Processes. Royal Haskoning, November 2008.
- East and West Piers Survey – Whitby Geometric Survey – Preconstruction Information by Royal Haskoning, dated February 2008.
- East and West Piers Survey – Whitby Diving – Preconstruction Information by Royal Haskoning.
- East and West Piers Survey – Whitby Geophysical Survey – Preconstruction Information by Royal Haskoning, dated February 2008.
- East and West Piers Survey – Whitby Land Based GI – Preconstruction Information by Royal Haskoning.
- East and West Piers Survey – Whitby Hydrographic Survey – Preconstruction Information by Royal Haskoning, dated April 2008.
- Whitby Coastal Strategy Surveys of East & West Piers – Health & Safety File. Royal Haskoning.

Appendix C
Photographic Report



Whitby Coastal Strategy – Further Investigations

Structural Inspection of East Pier Extension

Scarborough Borough Council

28 November 2008

Final Report

9T0429/R004

Marlborough House
Marlborough Crescent
Newcastle upon Tyne NE1 4EE
United Kingdom
+44 (0)191 211 1300 Telephone
01912111313 Fax
info@newcastle.royalhaskoning.com E-mail
www.royalhaskoning.com Internet

Document title Whitby Coastal Strategy – Further
Investigations
Structural Inspection of East Pier Extension
Document short title EPE Structural Inspection
Status Final Report
Date 28 November 2008
Project name Whitby Coastal Strategy
Project number 9T0429
Client Scarborough Borough Council
Reference 9T0429/R004/303392/Newc

Drafted by Mark Donoghue
Checked by Chris Grogan
Date/initials check
Approved by Nick Cooper
Date/initials approval

SUMMARY

Royal Haskoning were commissioned by Scarborough Borough Council to review the Whitby Coastal Strategy including undertaking a series of surveys and investigations into the condition of the harbour piers. These included a Diving survey that identified the presence of a large scour hole, 5 m deep, at the landward end of the East Pier Extension. On this basis, it was agreed to undertake a structural inspection of the east pier extension around the landward end of this structure to determine the overall condition of this part of the pier.

The inspection was undertaken in October 2008 from the pier and by boat. The inspection identified that the structure was showing signs of distress with joints opening at the top and narrowing at the base. There were also a significant crack on the east face of the structure which had severely spalled at the edges indicating signs of compression. It was considered that the landward end of the structure was currently in tact through a fragile support system which could collapse in the short term.

Therefore, this report recommends that the landward end of the structure should be repaired in the short term in order avoid collapse. The potential collapse would lead to increased exposure to both the east main pier and east pier extension.

CONTENTS

	Page
1 INTRODUCTION	1
2 SURVEY LIMITATIONS	1
3 DESCRIPTION OF STRUCTURE	1
4 SURVEY FINDINGS	2
4.1 Inspection from deck level	2
4.1.1 Panel 1 / Panel 2	2
4.1.2 Panel 2 / Panel 3	3
4.1.3 Panel 3	4
4.1.4 Panel 3/4	5
4.1.5 Panel 47 / Panel 48	5
4.1.6 Panel 48 / Panel 49	6
4.1.7 Ladders	7
4.2 Inspection from Boat	8
5 DISCUSSION ON FINDINGS	13
6 CONCLUSION & RECOMMENDATIONS	14

1 INTRODUCTION

Royal Haskoning were commissioned by Scarborough Borough Council to review the Whitby Coastal Strategy including undertaking a series of surveys and investigations into the condition of the harbour piers. These surveys and investigations were undertaken between February and June 2008. These include digital topographical survey, ground penetrative radar survey, photographic survey, hydrographic, side scan and seismic survey, ground investigation and diving, boat and visual survey. From the findings of the dive survey, it was noted that a large scour hole has developed under the landward end of the East Pier extension, due to the loss of sheet piles around this area and erosion of supporting material. In consideration of this defect, a structural condition survey of the East Pier extension was requested to look for signs of stress and fatigue that would indicate the stability of the cantilever section. Whilst present on the structure, the seaward end of the structure was also inspected to see if there were signs of stress or stability that would correlate with the corroded piles and scour at the nose found during the dive survey

A visual inspection of the East Pier Extension was carried out by Chris Grogan and Mark Donoghue on Friday 10th October 2008. The inspection started around two hours before high tide (4.44mCD/1.44mOD). The weather was overcast with strong offshore winds.

The East Pier Extension was inspected from a boat and from the lower deck level, accessed via the ladders attached to the structure. The survey was limited to a visual survey with measurements made using a crack width gauge.

2 SURVEY LIMITATIONS

The high water level reduced the visibility of the lower levels of the structure but provided sufficient draught to access the pier by boat. The sheet piles around the perimeter of the structure and the upper surface of the infill were identified but no assessment of their condition could be made.

3 DESCRIPTION OF STRUCTURE

The pier extensions were originally constructed in 1910, although major repairs were known to occur in 1975-76. The East Pier extension is constructed from a sheet pile cofferdam at the base driven into the bedrock. The main body of the structure was originally formed from mass concrete placed in portions to the top of the sheet piles as a base and then as trapezoidal shape per body above. A timber truss structure was formed above the body to provide a promenade connected to the main land by a link bridge. The link bridge has since been removed after scour occurred to the Central Pier causing it to subside.

It is understood that repairs were undertaken to the structures during 1970's. These consisted of sheet piling to the toe, and possible reinforced concrete capping or shell covering the landward and seaward ends. This repair can clearly be seen today, as the condition of the concrete is in significantly better condition than the mass concrete body. It is not definitely known if reinforcement is present in the concrete repair, but there are signs that it is as discussed below.

4 SURVEY FINDINGS

The concrete deck panels were numbered in the dive, boat and visual survey with Panel 1 at the landward end and Panel 49 at the seaward end of the structure, based on the position of the wood gantry trusses and associated construction joints in the concrete. Significant findings are described according to location based on the existing panel numbering:

4.1 Inspection from deck level

4.1.1 Panel 1 / Panel 2

The construction joint between Panel 1 and Panel 2 (chainage 2.9m from the landward end of the structure) appeared to have widened along the full width of the structure. The joint was measured to be 2.0mm wide at the eastern edge (**Fig. 1**), 2.5mm in the centre (**Fig. 2**) and 2.5mm wide at the western edge (**Fig. 3**).



Figure 1
East Edge



Figure 2
Centre



Figure 3
West Edge

4.1.2 Panel 2 / Panel 3

The construction joint between concrete Panel 2 and Panel 3 (chainage 5.8m from the landward end of the structure) appeared to have widened along the full width of the structure. The joint was measured to be 4mm wide at the eastern edge (**Fig. 4**), 5.5mm wide in the centre (**Fig. 5**) and 4.5mm wide at the western edge (**Fig. 6**).



Figure 4
East Edge



Figure 5
Central



Figure 6
West edge

4.1.3 Panel 3

A longitudinal crack ran along the length of Panel 3, at a distance of 1.5m to 1.7m from the western edge of the structure. The crack was measured to be 0.4mm wide. (**Fig. 7** and **Fig. 8**)



Figure 7



Figure 8

4.1.4 Panel 3/4

The construction joint between Panel 3 and Panel 4 (chainage 8.7m from the landward end of the structure) appeared to have widened along the full width of the structure. The joint was measured as up to 4.0mm wide at the worst point. This showed that the joint opened slightly but not to the extent of panel 2/3 joint.



Figure 9
Vertical view down east face

4.1.5 Panel 47 / Panel 48

The construction joint between Panel 47 and Panel 48 appeared to have widened. The crack is approximately 3mm wide across the full width of the structure.



Figure 10

4.1.6 Panel 48 / Panel 49

The construction joint between Panel 48 and Panel 49 appeared to have widened. The joint was measured to be 3mm wide at the eastern edge, 3.5mm wide in the centre and 2.5mm wide at the western edge.



Figure 11



Figure 12



Figure 13

4.1.7 Ladders

The steel ladders providing access to the lower deck level were badly rusted with evidence of damaged and missing rungs was noted on four/five cast in ladders always around the structures. These were noted as several attempts were made to gain access to the deck from the boat. The ladders along the eastern face of the structure were generally in a poorer condition to those on the western face. **Fig. 14** shows the ladder on the western face of Bay 3.



Figure 14

The steel ladder at the seaward end of the structure providing the only access between the upper and lower deck levels was severely rusted. **Fig. 15** shows the foot of the ladder.



Figure 15

4.2 Inspection from Boat

From the boat it was evident that the construction joints at the landward end of the pier had widened and suffered damage particularly on the east outer face. The joints were widest at the top of the pier and narrowed towards the base.



Figure 16
Landward End of East Pier Extension



Figure 17
East face Panel 1 – Panel 2 Upper

Figure 18
East face Panel 1 – Panel 2 lower

Corroded Reinforcement at Spalled Edge

Stepped Crack at base

Whilst minimal movement was seen at the top deck, there were significant signs of damage below the formal construction joint from the deck. A crack had formed in the lower half directly beneath the upper joint but about 300 mm parallel to the lower joint, as the construction joint was staggered. Signs of exposed corroded reinforcement could be seen from the spalled crack joint. Noted the rust spots occur at regular centres. It also appeared that crack had pushed the left hand outward from the main face.

Again signs of pebble impact damage can be seen on the face and patches / scratches of spalled concrete, where the surface has been removed.



Figure 19
East face Panel 2 – Panel 3

It can be seen that there is some spalling at the upper end of the construction joint and some impact damage spalling the concrete from pebbles in wave action producing the spotted effect.



Figure 20
East face Panel 3 – Panel 4

Again signs of impact damage were noted around this joint and patches of spalling. The joint was wider at the top than at the base.



Figure 21
West Face of Pier extension
with subsided pillar in
foreground



Figure 22
West face Panel 1 – Panel 2

Localised spalling

As can be seen damaged to the west face was generally less than the east face due to the more sheltered conditions. Around the first construction joint there were signs of spalling and some discolouration. Concrete cover is considered to be minimal from the rust spots noted occasionally.



Figure 23
West face Panel 2 – Panel 3

Again rust spots can be seen in the panels adjacent to the joint and spalling to the horizontal and vertical construction joints.



Figure 24
West face Panel 3 – Panel 4

The construction joints appear to have opened at the third joint with rust stains emanating from the reinforcement within the joint. A crack can clearly be seen at the top left of the joint.

5 DISCUSSION ON FINDINGS

At the landward end of the structure, there are clear signs that two construction joints nearest the pier end have opened by up to 5.5 mm. This joints were widest at the top concrete surface and narrowed as they descended down the sides of the pier, although marine life may have covered any cracks at the base. The second joint showed the greatest evidence of movement. The third joint also showed some evidence of movement at the surface.

There was also evidence at the base first joint on the east side that a stepped crack has formed away from the main line of the construction joint. The joint was also noted to have spalled edges and a series of rust spots, which we consider are signs of corroding reinforcement exposed by the spalling action. This is based on the regular spacing along the crack.

It is considered that evidence from the first two joints shows that the rear portion of the structure is cantilevering from the main body of the pier. This is shown by the opening of joints in the top of the structure where it would be under tension and narrowing of joints in the base where it would act in compression. The stepped crack at the base of the east side potentially shows that the concrete may be unable to cope with the compression exerted on it by the cantilevering section. It is thought that the overhanging section is probably relying on any reinforcement that may have been used in the repair works in combination with skeletal support from the piles below and tensile strength from the timber gantry above. This is considered fairly incredible considering that this support system is probably carrying in the order of 1000 tonnes of concrete structure from the overhang.

Overall, the structural inspection identified that defects were occurring probably due to the failure/loss of the sheet pile toe. This has then lead to scouring of the founding fill material below the concrete structure body. It is considered that the worst affected area is the landward end of the east pier extension where the structure is notably hanging from the main body. This area is deteriorating due to the continual scour and increasing stress on the concrete body, which will collapse in the future if left. No certainty can be provided as to a timescale on when this may occur, as it is dependent upon storm frequency and severity.

It is considered that urgent action is required to repair the damage around the scour hole and lose of sheet piles at the landward end. If no work is undertaken, then the end of the structure will collapse exposing the core of the structure and he East Main Pier to sea conditions. This in-action would increase the cost of repair works to the structures, particularly the East Pier extension.

6 CONCLUSION & RECOMMENDATIONS

A structural inspection of the east pier extension structure at Whitby harbour was requested after the discovery of an 8m long by 2m high by 5 m deep scour hole to the base of the structure. The scour hole was located at the landward end of the pier extension adjacent to the remains of the central supporting pillar for original link bridge. The structural inspection was undertaken in October 2008 from the top of the deck and from water level by boat.

The survey noted that construction joints had opened at the deck level, so acting in tension and were narrower at the base indicating compression. This confirms that the structure is under stress. A significant number of other defects were also noted to the concrete structure, adding to the instable condition from the scour hole. Thus, it can be concluded that the structure is in a state of distress and mostly likely to collapse at the landward end in the short term, unless further action is undertaken.

Appendix D

Technical Report

In submitted PAR this will be provided on CD

Appendix E
Cost Breakdowns

COST BREAKDOWNS

Pre-amble

To inform the economic appraisal of the potential early works options, outline estimates of scheme costs have been performed. The estimates have largely been based on the use of *Spon's Civil Engineering and Highway Works Price Book 2008*. Due to the particularly specialist nature of the works envisaged as part of the various options, some specific inputs have also been made from other sources, including:

- Activity schedules from recently completed coastal defence and pier refurbishment schemes in the north east as a 'benchmarking' exercise;
- Discussions with Carillion regarding their recent experiences of similar pier refurbishment at Roker Pier (Tyne and Wear);
- Discussions with Easipoint regarding restoration mortar costs, noting the need for underwater works on parts of the structures;
- Discussions with Cemex regarding concrete costs;
- Discussions with Keller Ground Engineering regarding grouting costs; and
- Discussions with Briggs Marine regarding costs for use of jack-up barges.

These sources have been used to develop outline scheme construction costings for various works implementation options. A 60% optimism bias has then been added to the estimated scheme construction costs.

The following components have contributed to the overall cost estimates:

- Outline scheme construction costs;
- Optimism bias @ 60% of outline scheme construction costs;
- Design and supervision costs @ 20% of outline scheme construction costs;
- Site Investigation costs @ 15% of outline scheme construction costs; and
- Scarborough Borough Council staff costs @ 5% of outline scheme construction costs.

A summary of the costings for various options (and associated works implementation methods) is provided in the following table, with a more detailed breakdown for each on the relevant accompanying sheet.

Summary of Scheme Costings

All rates and assumptions are documented in Sheet 1.

Option	Description	Location	Reference	Cost (£)
A	Minimum sheet pile protection around scour hole (25m length)	East Pier extension	Sheet 2	913,632
B	Sheet pile protection along 75m on seaward face of extension	East Pier extension	Sheet 3	1,856,224
C	Sheet pile protection along 100m on seaward face of extension	East Pier extension	Sheet 4	2,177,633
D	Sheet pile protection to whole of extension (both sides of structure)	East Pier extension	Sheet 5	5,705,646
E	Sheet pile protection to whole of both extensions	East and West Pier extensions	Sheet 6	10,909,387

SHEET 1

Whitby East Pier Extension Urgent Works

Rates and Assumptions

Description	Quantity	Unit	Rate	Total	
Grout injection	25	m3			Keller estimate based on 14-20 weeks, 4No. Drilling rigs, 1No. Grouting setup and 4No. Grout pumps. Rate given for 5% pier volume. Using cement/PFA blend of grout (NOT heritage or specialist)
Grout injection	20	m3			Keller estimate based on 14-20 weeks, 4No. Drilling rigs, 1No. Grouting setup and 4No. Grout pumps. Rate given for 10% pier volume. Using cement/PFA blend of grout (NOT heritage or specialist)
Foamed concrete	83	m3			Figure provided by Cemex (includes £8 increase expected early 2009)
Restoration Mortar	600	Ton			Figure provided by Easipoint (Trevor Wilson)
Restoration Mortar	15	bag			Figure provided by Easipoint (Sue). Could potentially drop with size of order. 1.07/m3
Grout	300	m3			
Grout	600	m3			
Concrete (C40 20mm agg)		m3	£ 86.33		SPONS p.189
Concrete gang		hr	£ 89.45		SPONS p.188
Pumping from readymix truck @25m3/hour		m3	£ 2.97		SPONS p.188
Plant		hr	£ 33.52		SPONS p.188
Placing of mass concrete		m3	£ 14.76		walls >500mm thickness SPONS p.191
Piling		m2	£ 84.35		SPONS p.267 6-18m length clear site, reasonable access.
Total					

SHEET 2

Whitby East Pier Extension Urgent Works Option A Minimum sheet pile protection around scour hole

Description	Quantity	Unit	Rate	Total	SPONS
Mobilisation	25				
£20k per day - 2m panel placed every other day	1	nr	200000	£ 200,000.00	
	4	days	20000	£ 83,333.33	
	50				
25m of interlocking sheet piles; 8m high driven 2m into ground.	25				
Pre boring 600mm diameter holes	200	m ²	109.25	£ 21,850.00	267
Bored to 10m maximum depth	42	nr	223.8	£ 9,325.00	257
Removal of material arising from pile bores	83	m	109.14	£ 9,095.00	
Disposal of material arising from pile bores	24	m ³	3.08	£ 72.51	255
	24	m ³	26.93	£ 633.98	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	21	m	78.24	£ 1,630.00	
Provision of concrete; Grade C40 20mm aggregate	124	m ³	86.33	£ 10,704.92	
Placing of mass concrete	124	m ³	47.03	£ 5,831.72	
Pumping from readymix truck @25m ³ /hour	124	m ³	2.97	£ 368.28	188
Steel footbridge 25m span, 2m wide	0	m ²	1194	£ -	579
Sub Total				£ 353,094.74	
Add Preliminaries	15%			£ 52,964.21	
Sub Total				£ 406,058.95	
Add OH & P	12.5%			£ 50,757.37	
Sub Total				£ 456,816.32	
Design and supervision costs	20.0%			£91,363.26	
Site Investigation costs	15.0%			£ 68,522.45	
Scarborough BC	5.0%			£ 22,840.82	
Risk	60%			£ 274,089.79	
Total				£ 913,632.64	

Quote based on Briggs Marine (Option 1)

SHEET 3

Whitby East Pier Extension Urgent Works Option B Sheet piling around void and 75m up eastern edge of East extension pier

Description	Quantity	Unit	Rate	Total	SPONS
Mobilisation	75	nr	200000	£ 200,000.00	
£20k per day - 2m panel placed every other day	13	days	20000	£ 250,000.00	
	200				
	75				
75m of interlocking sheet piles; 8m high driven 2m into ground.	616	m ²	109.25	£ 67,298.00	267
Pre boring 600mm diameter holes	125	nr	223.8	£ 27,975.00	257
Bored to 10m maximum depth	250	m	109.14	£ 27,285.00	
Removal of material arising from pile bores	71	m ³	3.08	£ 217.53	255
Disposal of material arising from pile bores	71	m ³	26.93	£ 1,901.93	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	63	m	78.24	£ 4,890.00	
Provision of concrete; Grade C40 20mm aggregate	1071	m ³	86.33	£ 92,427.06	
Placing of mass concrete	1071	m ³	47.03	£ 50,351.49	
Pumping from readymix truck @25m ³ /hour	1071	m ³	2.97	£ 3,179.76	188
Steel footbridge 25m span, 2m wide	0	m ²	1194	£ -	579
Sub Total			£	735,775.76	
Add Preliminaries	15%		£	110,366.36	
Sub Total			£	846,142.13	
Add OH & P	12.5%		£	105,767.77	
Sub Total			£	951,909.89	
Design and supervision costs	20.0%		£	190,381.98	
Site Investigation costs	10.0%		£	95,190.99	
Scarborough BC	5.0%		£	47,595.49	
Risk	60%		£	571,145.94	
Total			£	1,856,224.29	

Quote based on Briggs Marine (Option 1)

SHEET 4

Whitby East Pier Extension Urgent Works Option C Sheet piling around void and 100m up eastern edge of East extension pier

Description	Quantity	Unit	Rate	Total	SPONS
Mobilisation	100				
£20k per day - 2m panel placed every other day	1	nr	200000	£ 200,000.00	
	17	days	20000	£ 333,333.33	
	200				
	100				
100m of interlocking sheet piles; 8m high driven 2m into ground.	800	m ²	109.25	£ 87,400.00	267
Pre boring 600mm diameter holes	167	nr	223.8	£ 37,300.00	257
Bored to 10m maximum depth	333	m	109.14	£ 36,380.00	
Removal of material arising from pile bores	94	m ³	3.08	£ 290.03	255
Disposal of material arising from pile bores	94	m ³	26.93	£ 2,535.91	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	83	m	78.24	£ 6,520.00	
Provision of concrete; Grade C40 20mm aggregate	1094	m ³	86.33	£ 94,459.41	
Placing of mass concrete	1094	m ³	47.03	£ 51,458.66	
Pumping from readymix truck @25m ³ /hour	1094	m ³	2.97	£ 3,249.68	188
Steel footbridge 25m span, 2m wide	0	m ²	1194	£ -	579
Sub Total				£ 863,177.02	
Add Preliminaries	15%			£ 129,476.55	
Sub Total				£ 992,653.57	
Add OH & P	12.5%			£ 124,081.70	
Sub Total				£ 1,116,735.27	
Design and supervision costs	20.0%			£ 223,347.05	
Site investigation costs	10.0%			£ 111,673.53	
Scarborough BC	5.0%			£ 55,836.76	
Risk	60%			£ 670,041.16	
Total				<u>£ 2,177,633.77</u>	

Quote based on Briggs Marine (Option 1)

SHEET 5

Whitby East Pier Extension Urgent Works Option D Sheet piling around whole of East pier extension

Description	Quantity	Unit	Rate	Total	SPONS
Mobilisation	340				
£20k per day - 2m panel placed every other day	1	nr	200000	£ 200,000.00	
	57	days	20000	£ 1,133,333.33	
	680				
	340				
340m of interlocking sheet piles; 8m high driven 2m into ground.	2720	m ²	109.25	£ 297,160.00	267
Pre boring 600mm diameter holes	567	nr	223.8	£ 126,820.00	257
Bored to 10m maximum depth	1133	m	109.14	£ 123,692.00	
Removal of material arising from pile bores	320	m ³	3.08	£ 986.11	255
Disposal of material arising from pile bores	320	m ³	26.93	£ 8,622.09	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	283	m	78.24	£ 22,168.00	
Provision of concrete; Grade C40 20mm aggregate	2920	m ³	86.33	£ 252,097.99	
Placing of mass concrete	2920	m ³	47.03	£ 137,335.44	
Pumping from readymix truck @25m ³ /hour	2920	m ³	2.97	£ 8,672.90	188
Steel footbridge 25m span, 2m wide	0	m ²	1194	£ -	579
Sub Total				£ 2,321,137.86	
Add Preliminaries	15%			£ 348,170.68	
Sub Total				£ 2,669,308.54	
Add OH & P	12.5%			£ 333,663.57	
Sub Total				£ 3,002,972.10	
Design and supervision costs	20.0%			£600,594.42	
Site investigation costs	5.0%			£ 150,148.61	
Scarborough BC	5.0%			£ 150,148.61	
Risk	60%			£ 1,801,783.26	
Total				<u>£ 5,705,646.99</u>	

Quote based on Briggs Marine (Option 1)

SHEET 6

Whitby East Pier Extension Urgent Works Option 5 Sheet pile protection to whole of both west and east pier extensions

Description	Quantity	Unit	Rate	Total	SPONS
Jack up barge and labour	1		2500000 £	2,500,000.00	
	1360				
	680				
680m of interlocking sheet piles; 8m high driven 2m into ground.	5440	m ²	109.25 £	594,320.00	267
Pre boring 600mm diameter holes	1133	nr	223.8 £	253,640.00	257
Bored to 2m maximum depth	2267	m	109.14 £	247,384.00	
Removal of material arising from pile bores	640	m ³	3.08 £	1,972.23	255
Disposal of material arising from pile bores	640	m ³	26.93 £	17,244.18	173
Mobilisation of plant and equipment for ties	1	nr	10250 £	10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	567	nr	78.24 £	44,336.00	
Provision of concrete; Grade C40 20mm aggregate	5640	m ³	86.33 £	486,929.98	
Placing of mass concrete	5640	m ³	47.03 £	265,264.88	
Pumping from readymix truck @25m3/hour	5640	m ³	2.97 £	16,751.79	188
Steel footbridge 25m span, 2m wide	0	m ²	1194 £	-	579
Sub Total				£ 4,438,093.05	
Add Preliminaries	15%			£ 665,713.96	
Sub Total	12.5%			£ 5,103,807.00	
Add OH & P				£ 637,975.88	
Sub Total				£ 5,741,782.88	
Design and supervision costs	20.0%			£1,148,356.58	
Site investigation costs	5.0%			£ 287,089.14	
Scarborough BC	5.0%			£ 287,089.14	
Risk	60%			£ 3,445,069.73	
Total				£ 10,909,387.47	

Quote from Briggs Marine. 15-20k per day. 58 panels.
1 panel every other day = 116 days (NO MATERIAL NO RISK)

Appendix F
Benefits Appraisal

BENEFITS APPRAISAL

Pre-amble

To inform the economic appraisal of the potential urgent works options, the following benefits appraisal was undertaken.

Whilst the benefits from early intervention to prevent breaching through the urgent works relate to a wide range of aspects, including amenity, environmental and heritage aspects, benefits to the fishing economy, and to the tourism industry and so on, the assessment here has been undertaken more simplistically.

The purpose of the benefits appraisal is to simply determine whether early intervention in the form of urgent works has a benefit : cost ratio greater than unity and, if so, to then help guide selection of a preferred length of wall to undertake works on.

In this assessment, the benefit of the urgent works to prevent structural failure of the East Pier extension is determined through direct comparison with the costs that would otherwise be incurred under a Do Nothing scenario. These costs have been determined using a similar approach to that described in Appendix C.

Consequently, the benefit of the urgent works to the East Pier extension is the avoidance of demolition, clear-up and reinstatement costs following failure and ongoing deterioration of the structure.

Methodology

Under a Do Nothing scenario it has been assumed that the East Pier extension would fail at its southern-most end within 0-5 years.

In the appraisal we have assumed the following scenarios:

- Scenario 1 - Following failure in years 0-5 clear-up, demolition and reconstruction will immediately be undertaken.
- Scenario 2 - Following failure in years 0-5 no works would be taken at first. Instead deterioration would occur over the next 5-10 years before a solution was implemented, involving clear-up, demolition and reconstruction.
- Scenario 3 - Following failure in years 0-5 no works would be taken at first. Instead deterioration would occur over the next 10-25 years before a solution was implemented, involving clear-up, demolition and reconstruction.
- Scenario 4 - Following failure in years 0-5 no works would be taken at first. Instead deterioration would occur over the next 25-50 years before a solution was implemented, involving clear-up, demolition and reconstruction.

The degree of damage to the Whitby Harbour structures under each of the four scenarios was estimated based on expected deterioration in present condition and performance of the structures due to material deterioration and ongoing coastal processes (including sea level rise).

The assumptions under each scenario are described below:

Year 0-5 (Figure F1)

A 5m length of the East Pier Extension will collapse at the southern extent of the structure.

Year 5-10 (Figure F2)

A 5m length of the East Pier Extension will collapse at the southern extent of the structure.

The piles and fill material at the exposed end of the East Pier extension will be eroded leaving a further 5m length of the concrete structure unsupported.

Increased exposure will lead to damage to the eastern face of the main East Pier. The stone facing on the eastern face will collapse over a 20m length. The loss of the facing will expose fill material and paving stone which will be eroded (Figure F5). The bull-nose will be damaged as sheet piles erode and fill material is lost.

Year 10-25 (Figure F3)

A 20m length of the East Pier extension will collapse as the structure deteriorates at an increasing rate. Increased exposure will lead to damage to the eastern face of the main East Pier. The stone facing will collapse over a 60m length. The loss of the facing will expose fill material and paving stone which will be eroded leading to a failure of the stone facing on the western side of the pier, effectively breaching the structure over a 40m length (Figure F6).

The breach will expose the eastern face of the main West Pier, erosion of which will lead to a collapse of the eastern face over a 20m length (Figure F5). The exposed fill material will be eroded. The main East Pier bull-nose will collapse and the lighthouse will be lost.

Year 25-50 (Figure F4)

A 75m length of the East Pier extension will collapse as the structure deteriorates at an increasing rate. Increased exposure will lead to the complete loss of a 100m length of the main East Pier (Figure F7). The bull-nose will collapse and the lighthouse will be lost.

The loss of the northern extent of the main East Pier will expose the main West Pier. Collapse of the stone facing and erosion of fill material will lead to a 40m wide breach in the main West Pier

(Figure F6). The breach will allow the ingress of beach material into the harbour and navigable channel, requiring dredging (not costed here). The main West Pier bull-nose will collapse and the lighthouse and link bridge will be lost.

Findings

A summary of the outline cost estimates for each scenario is provided in the table below:

	Action	Cost (£) ¹	Net Present Value (£) ²
Do Nothing	Remedial Work Year 0-5	1,859,000	1,859,000
	Remedial Work Year 5-10	4,978,000	4,191,342
	Remedial Work Year 10-25	22,213,000	15,747,214
	Remedial Work Year 25-50	55,432,000	23,455,884

¹ Rounded to nearest £1k.

² Cost assumed to be incurred at lower end of time range.



Collapse of 5m length
of East Pier Extension

0 12.5 25 50 75 100
Meters

Title: Whitby Piers - Projected Condition
Year 0 - 5

Project: Whitby East Pier
Extension Urgent Works

Client: Scarborough Borough Council

Date:
Feb 2009

Scale:
approx. 1:1800

Figure:
F 1

Drawn:
AV

Checked:
MD





Loss of fill material from East Main Pier bull-nose

Loss of fill material and undermining of 5m length of East Pier Extension

Collapse of 5m length of East Pier Extension

Collapse of stone facing and loss of fill material and decking over 20m length of East Main Pier

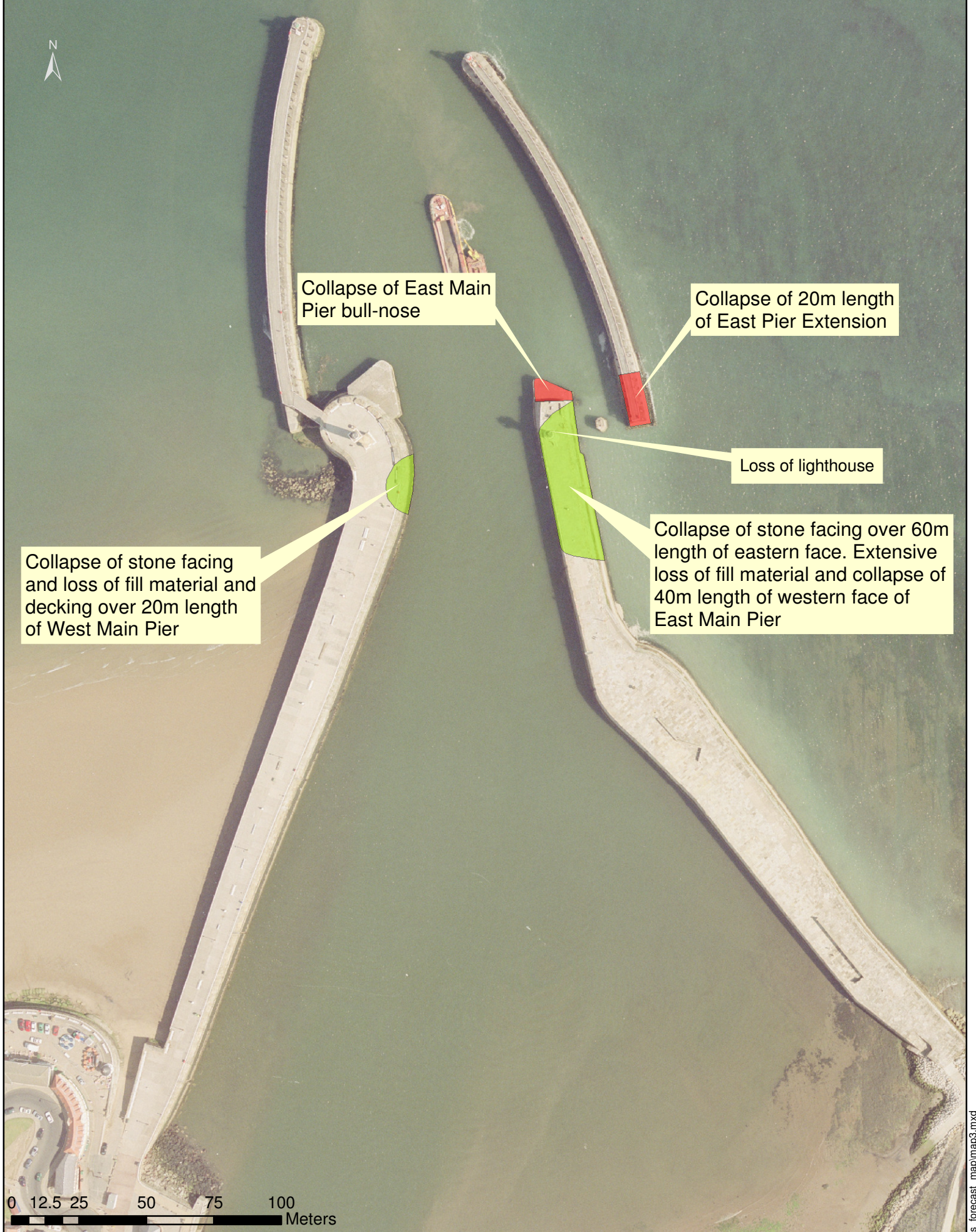
0 12.5 25 50 75 100 Meters

Title: Whitby Piers - Projected Condition
Year 5 - 10
Project: Whitby East Pier
Extension Urgent Works
Client: Scarborough Borough Council

Date: Feb 2009	Scale: approx. 1:1800	
Figure: F 2	Drawn: AV	Checked: MD



I:\910429\Technical_Data\gis\Piers_forecast_map\map2.mxd



Collapse of stone facing and loss of fill material and decking over 20m length of West Main Pier

Collapse of East Main Pier bull-nose

Collapse of 20m length of East Pier Extension

Loss of lighthouse

Collapse of stone facing over 60m length of eastern face. Extensive loss of fill material and collapse of 40m length of western face of East Main Pier



Title: Whitby Piers - Projected Condition
Year 10 - 25

Project: Whitby East Pier
Extension Urgent Works

Client: Scarborough Borough Council

Date:
Feb 2009

Scale:
approx. 1:1800

Figure:
F 3

Drawn:
AV

Checked:
MD



I:\910429\Technical_Data\GIS\Piers_forecast_map\map3.mxd



Collapse of West Main Pier bull-nose

Collapse of East Main Pier bull-nose

Collapse of 75 length of East Pier Extension

Loss of footbridge

Loss of lighthouse

Loss of lighthouse

Collapse of 100m length of East Main Pier

Collapse of stone facing and loss of fill material over 40m length of West Main Pier



Title: Whitby Piers - Projected Condition
Year 25 - 50

Project: Whitby East Pier
Extension Urgent Works

Client: Scarborough Borough Council

Date:
Feb 2009

Scale:
approx. 1:1800

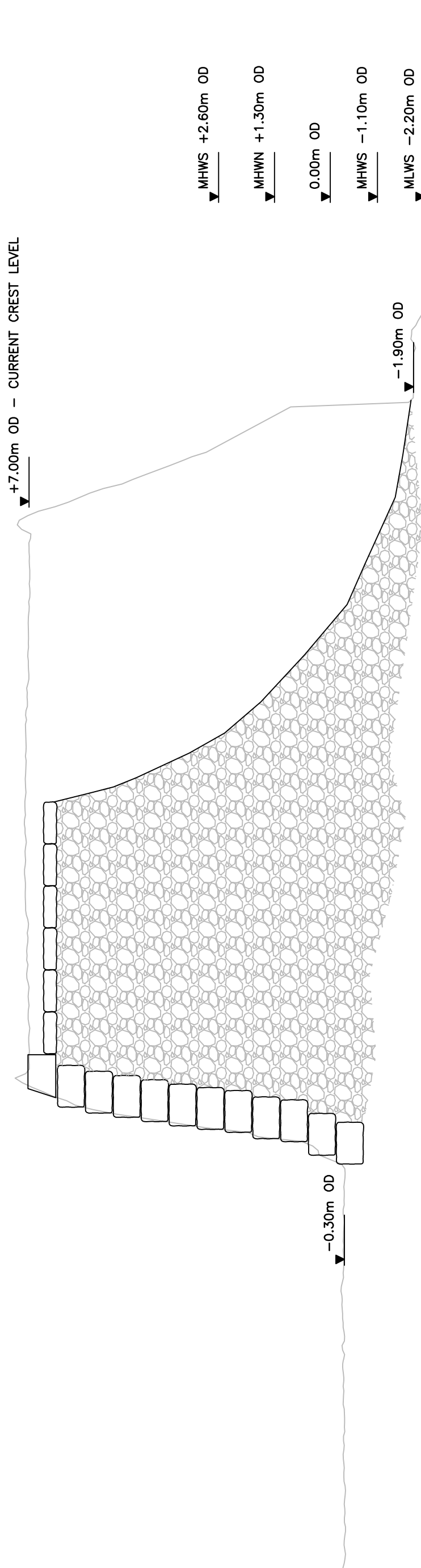
Figure:
F 4

Drawn:
AV

Checked:
MD



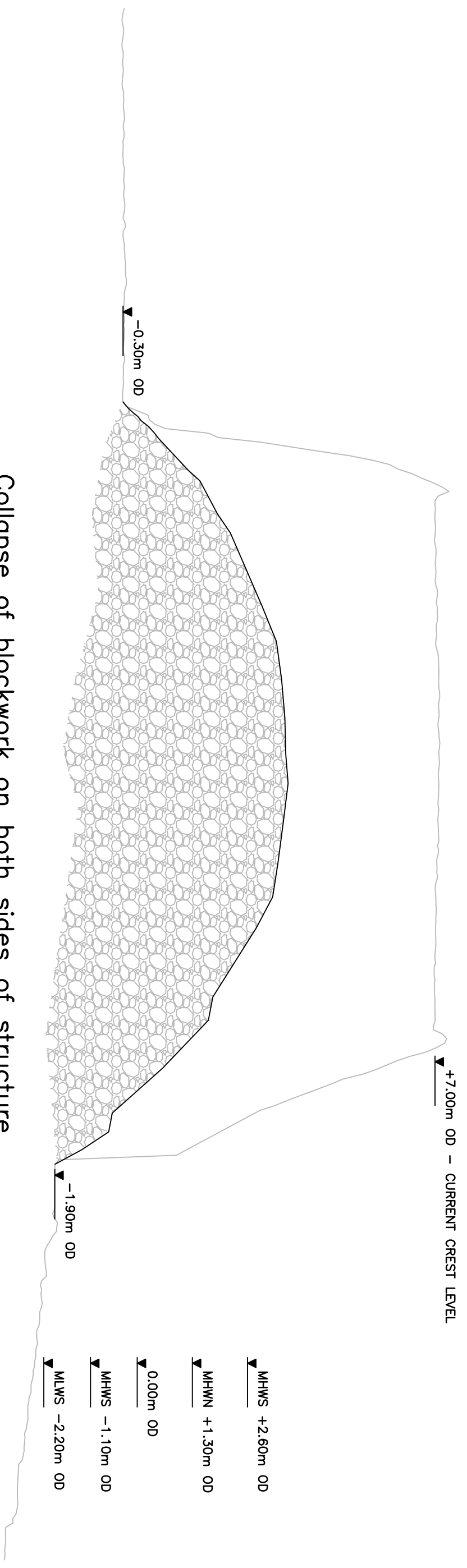
I:\910429\Technical_Data\GIS\Piers_forecast_map\map4.mxd




Collapse of blockwork and erosion of fill material

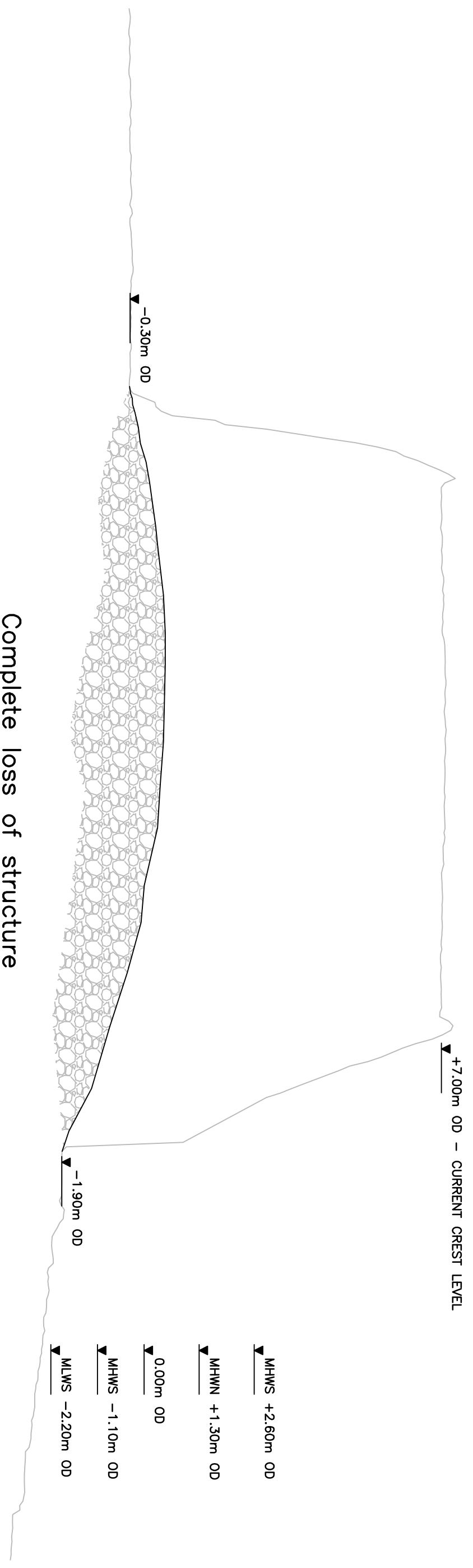
TITLE FIGURE F5 TYPICAL MAIN PIER SECTION	PROJECT WHITBY EAST PIER EXTENSION URGENT WORKS	HASKONING UK LTD NEWCASTLE <small>Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE Telephone: +44 (0)191 211 1370 Fax: +44 (0)191 211 1370 E-mail: info@newcastle.royalhaskoning.com Internet: www.royalhaskoning.com</small>	DRAWN MD DATE FEB' 08 JOB No. 9T0429 SCALE AT A3 1:100 AUTOCAD REF. MAIN PIERS DRAWING No. FIGURE F5 REV 0
--	--	--	---

Collapse of blockwork on both sides of structure
and erosion of fill material



© Haskoning UK Ltd.

TITLE FIGURE F6 TYPICAL MAIN PIER SECTION		PROJECT WHITBY EAST PIER EXTENSION URGENT WORKS		 HASKONING UK LTD NEWCASTLE Marlborough House Newcastle upon Tyne NE1 4EE +44 (0)191 211 1300 +44 (0)191 211 1301 info@newcastle.haskoning.com www.gyrf.haskoning.com	
DRAWN MD	DATE FEB' 09	JOB No. 9T0429			
SCALE AT A3 1:100	AUTOCAD REF. MAIN PIERS				
DRAWING No. FIGURE F6					
REV 0					



© Haskoning UK Ltd.

<p>TITLE</p> <p>FIGURE F7 TYPICAL MAIN PIER SECTION</p>	<p>PROJECT</p> <p>WHITBY EAST PIER EXTENSION URGENT WORKS</p>	<p>HASKONING UK LTD NEWCASTLE</p> <p>Marlborough House Newcastle upon Tyne NE1 4EE +44 (0)191 211 1300 +44 (0)191 211 1301 info@newcastle.haskoning.com www.royal.haskoning.com</p> <p>ROYAL HASKONING</p> <p>Telephone E-mail Internet</p>	<p>DRAWN MD</p> <p>SCALE AT A3 1:100</p> <p>DRAWING No. FIGURE F7</p>	<p>DATE FEB' 09</p> <p>AUTOCAD REF. MAIN PIERS</p>	<p>JOB No. 9T0429</p> <p>REV 0</p>
--	--	---	--	--	--

9T0429
Whitby Pier Urgent Work

Year 0-5

Cost of removing collapsed structure and reconstructing to original standard

Description	Quantity	Unit	Rate	Total	SPONS
East Pier/Extension Demolition/Removal					
Disposal of timber	6	m ³	26.93 £	161.58	
Jack-up barge time	9	days	20000 £	180,000.00	
Remove material for disposal	9	days	10000 £	90,000.00	assume 100T / day
Dispose of material	360	m ³	26.93 £	9,694.80	360m/900T
East Pier/Extension Reconstruction					
Formwork; fair finish, plain battered, width exceeding 1.22m	102	m ²	55.1 £	5,620.20	196
Provision of concrete: Grade C40 20mm aggregate	260	m ³	86.33 £	22,445.80	188 main structure
Placing of mass concrete	260	m ³	47.03 £	12,227.80	188
Pumping from ready mix truck @25m ³ /hour	260	m ³	2.97 £	772.20	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	26.0	T	1319.19 £	34,298.94	198 1 T per 10m ³
Provision of imported rock fill	100	m ³	33.68 £	3,368.00	allow for loss of fill from exposed end of extension
Jack-up Barge Mobilisation	1	nr	200000 £	200,000.00	
Jack-up Barge operation	4	days	20000 £	83,333.33	£20k per day - 12m panel placed every other day
	50				
	25				
25m of interlocking sheet piles; 8m high driven 2m into ground.	200	m ²	109.25 £	21,850.00	267
Pre boring 600mm diameter holes	42	nr	223.8 £	9,325.00	257
Bored to 10m maximum depth	83	m	109.14 £	9,095.00	
Removal of material arising from pile bores	24	m ³	3.08 £	72.51	255
Disposal of material arising from pile bores	24	m ³	26.93 £	633.98	173
Mobilisation of plant and equipment for ties	1	nr	10250 £	10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	21	m	78.24 £	1,630.00	
Provision of concrete: Grade C40 20mm aggregate	150	m ³	86.33 £	12,949.50	
Placing of mass concrete	150	m ³	47.03 £	7,054.50	
Pumping from ready mix truck @25m ³ /hour	150	m ³	2.97 £	445.50	188
Provision of timber decking	20	m ²	52.28 £	1,045.60	507
Provision of timber beams	20	m	109.41 £	2,188.20	94 greenheart 400 x 400
Provision of guardrail for upper deck	9	m	7.97 £	71.73	362
Sub Total				£ 718,534.17	
Add Preliminaries	15%			£ 107,780.13	
Sub Total				£ 826,314.29	
Add OH & P	12.5%			£ 103,289.29	
Sub Total				£ 929,603.58	
Design and supervision costs	20.0%			£185,920.72	
Site investigation costs	15.0%			£ 139,440.54	
Scarborough BC	5.0%			£ 46,480.18	
Risk	60%			£ 557,762.15	
Total				<u>£ 1,859,207.16</u>	

9T0429
Whitby Pier Urgent Work

Year 5-10
Cost of removing collapsed structure and reconstructing to original standard

Description	Quantity	Unit	Rate	Total	SPONS
East Pier Extension Piling around undercut section (5-10m)					
Mobilisation	1	nr	200000	£ 200,000.00	
£20k per day - 12m panel placed every other day	5	days	20000	£ 100,000.00	
	30				
	15				
15m of interlocking sheet piles; 8m high driven 2m into ground.	240	m ²	109.25	£ 26,220.00	267 length +5m for damaged tie in
Pre boring 600mm diameter holes	25	nr	223.8	£ 5,595.00	257
Bored to 10m maximum depth	50	m	109.14	£ 5,457.00	
Removal of material arising from pile bores	14	m ³	3.08	£ 43.51	255
Disposal of material arising from pile bores	14	m ³	26.93	£ 380.39	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	13	m	78.24	£ 978.00	
Provision of concrete; Grade C40 20mm aggregate	114	m ³	86.33	£ 9,852.41	sides only - no 'end'
Placing of mass concrete	114	m ³	47.03	£ 5,367.30	
Pumping from readymix truck @25m3/hour	114	m ³	2.97	£ 338.95	188
East Pier Extension Demolition/Removal					
Disposal of timber	6	m ³	26.93	£ 161.58	
Jack-up barge time	9	days	20000	£ 180,000.00	
Remove material for disposal	9	days	10000	£ 90,000.00	assume 100T / day
Dispose of material	360	m ³	26.93	£ 9,694.80	360m/900T
East Pier Extension Reconstruction (0-5m)					
	50				
	25				
25m of interlocking sheet piles; 8m high driven 2m into ground.	200	m ²	109.25	£ 21,850.00	267
Pre boring 600mm diameter holes	42	nr	223.8	£ 9,325.00	257
Bored to 10m maximum depth	83	m	109.14	£ 9,095.00	
Removal of material arising from pile bores	24	m ³	3.08	£ 72.51	255
Disposal of material arising from pile bores	24	m ³	26.93	£ 633.98	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	21	m	78.24	£ 1,630.00	
Provision of concrete; Grade C40 20mm aggregate	150	m ³	86.33	£ 12,949.50	
Placing of mass concrete	150	m ³	47.03	£ 7,054.50	
Pumping from readymix truck @25m3/hour	150	m ³	2.97	£ 445.50	188
Formwork; fair finish, plain battered, width exceeding 1.22m	102	m ²	55.1	£ 5,620.20	196
Provision of concrete; Grade C40 20mm aggregate	260	m ³	86.33	£ 22,445.80	
Placing of mass concrete	260	m ³	47.03	£ 12,227.80	
Pumping from readymix truck @25m3/hour	260	m ³	2.97	£ 772.20	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	26.0	T	1319.19	£ 34,298.94	198 1 T per 10m3
Provision of imported rock fill	100	m ³	33.68	£ 3,368.00	allow for loss of fill from exposed end of extension
Provision of timber decking	20	m ²	52.28	£ 1,045.60	507
Provision of timber beams	38	m	109.41	£ 4,157.58	94 greenheart 400 x 400
Provision of guardrail for upper deck	9	m	7.97	£ 71.73	362
East Main Pier Reconstruction					
Reclaim stone facing	100	No	100	£ 10,000.00	80% of stone
Provision of stone facing	25	No	1025	£ 25,625.00	20% of stone Cut stone from quarry in Staindrop (Dunhouse Stone)
Placement of rock	6.25	days	5000	£ 31,250.00	188
Provision of concrete; Grade C40 20mm aggregate	240	m ³	86.33	£ 20,719.20	198
Placing of mass concrete	240	m ³	47.03	£ 11,287.20	
Pumping from readymix truck @25m3/hour	240	m ³	2.97	£ 712.80	395
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	24.0	T	1319.19	£ 31,660.56	
Provision of imported rock fill	880.0	m ³	33.68	£ 29,638.40	
Stone paving	140	m ²	83.04	£ 11,625.60	
East Main Pier Demolition/Removal					
Jack-up barge time	28	days	20000	£ 560,000.00	
Remove material for disposal	28	days	10000	£ 280,000.00	assume 100T / day
Dispose of material	1120	m ³	26.93	£ 30,161.60	1120m3/2800T
East Main Pier Bull-nose					
Sheet piles around toe					188
Provision of concrete; Grade C40 20mm aggregate	59	m ³	86.33	£ 5,093.47	
Placing of mass concrete	59	m ³	47.03	£ 2,774.77	
Pumping from readymix truck @25m3/hour	59	m ³	2.97	£ 175.23	
£20k per day - 12m panel placed every other day	3	days	20000	£ 50,000.00	mobilisation included previously
	30				
	15				
15m of interlocking sheet piles; 6m high driven 2m into ground.	90	m ²	109.25	£ 9,832.50	
Pre boring 600mm diameter holes	25	nr	223.8	£ 5,595.00	
Bored to 10m maximum depth	50	m	109.14	£ 5,457.00	
Removal of material arising from pile bores	14	m ³	3.08	£ 43.51	
Disposal of material arising from pile bores	14	m ³	26.93	£ 380.39	
Sub Total				£ 1,923,684.99	
Add Preliminaries	15%			£ 288,552.75	
Sub Total				£ 2,212,237.74	
Add OH & P	12.5%			£ 276,529.72	
Sub Total				£ 2,488,767.45	
Design and supervision costs	20.0%			£ 497,753.49	
Site Investigation costs	15.0%			£ 373,315.12	
Scarborough BC	5.0%			£ 124,438.37	
Risk	60%			£ 1,493,260.47	
Total				£ 4,977,534.91	

9T0429

Whitby Pier Urgent Work

Year 10-25

Cost of removing collapsed structure and reconstructing to original standard

Description	Quantity	Unit	Rate	Total	SPONS
East Pier Extension Demolition/Removal					
Disposal of timber	22	m ³	26.93 £	592.46	
Jack-up barge time	20	days	20000 £	405,000.00	
Remove material for disposal	20	days	10000 £	202,500.00	assume 100T / day
Dispose of material	810	m ³	26.93 £	21,813.30	810m3/2025T
Piling					
Mobilisation	1	nr	200000 £	200,000.00	Quote based on Briggs Marine
E20k per day - 12m panel placed every other day	12	days	20000 £	233,333.33	
	120				
	80				
60m of interlocking sheet piles; 6m high driven 2m into ground.	480	m ²	109.25 £	52,440.00	267 length +5m for damaged tie in
Pre boring 600mm diameter holes	100	nr	223.8 £	22,380.00	257
Bored to 10m maximum depth	200	m	109.14 £	21,828.00	
Removal of material arising from pile bores	57	m ³	3.08 £	174.02	255
Disposal of material arising from pile bores	57	m ³	26.93 £	1,521.55	173
Mobilisation of plant and equipment for ties	1	nr	10250 £	10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	50	m	78.24 £	3,912.00	
Provision of concrete; Grade C40 20mm aggregate	257	m ³	86.33 £	22,143.65	
Placing of mass concrete	257	m ³	47.03 £	12,063.20	
Pumping from readymix truck @25m3/hour	257	m ³	2.97 £	761.81	188
East Pier Extension					
Formwork; fair finish, plain battered, width exceeding 1.22m	282	m ²	55.1 £	15,538.20	196
Provision of concrete; Grade C40 20mm aggregate	1040	m ³	86.33 £	89,783.20	
Placing of mass concrete	1040	m ³	47.03 £	48,911.20	
Pumping from readymix truck @25m3/hour	1040	m ³	2.97 £	3,088.80	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	104.0	T	1319.19 £	137,195.76	198 1 T per 10m3
Provision of imported rock fill	400.0	m ³	33.68 £	13,472.00	395
Provision of timber decking	80	m ²	52.28 £	4,182.40	507
Provision of timber beams	138	m	109.41 £	15,098.58	84 greenheart 400 x 400
Provision of guardrail for upper deck	44	m	7.97 £	350.68	362
East Main Pier Demolition/Removal					
Jack-up barge time	75	days	20000 £	1,500,000.00	
Remove material for disposal	75	days	10000 £	750,000.00	assume 100T / day
Dispose of material	3000	m ³	26.93 £	80,790.00	3000m3/7500T
East Main Pier					
Reclaim stone facing	158	No	100 £	15,800.00	20% of stone
Provision of stone facing	632	No	1025 £	647,800.00	80% of sto Cut stone from quarry in Staindrop (Dunhouse Stone)
Placement of rock	39.5	days	5000 £	197,500.00	
Provision of concrete; Grade C40 20mm aggregate	1250	m ³	86.33 £	107,912.50	
Placing of mass concrete	1250	m ³	47.03 £	58,787.50	
Pumping from readymix truck @25m3/hour	1250	m ³	2.97 £	3,712.50	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	125.0	T	1319.19 £	164,898.75	198 1 T per 10m3
Provision of imported rock fill	1750.0	m ³	33.68 £	58,940.00	395
Stone paving	600	m ²	83.04 £	49,824.00	
Construct lighthouse	1	No.	250000 £	250,000.00	
East Main Pier Bull-nose Demolition/Removal					
Jack-up barge time	15	days	20000 £	296,000.00	
Remove material for disposal	15	days	10000 £	148,000.00	assume 100T / day
Dispose of material	592	m ³	26.93 £	15,942.56	592m3/1480T
East Main Pier Bull-nose					
Provision of concrete; Grade C40 20mm aggregate	592	m ³	86.33 £	51,107.36	188
Placing of mass concrete	592	m ³	47.03 £	27,841.76	198 1 T per 10m3
Pumping from readymix truck @25m3/hour	592	m ³	2.97 £	1,758.24	
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	59.2	T	1319.19 £	78,096.05	
	50				
	25				
25m of interlocking sheet piles; 6m high driven 2m into ground.	150	m ²	109.25 £	16,387.50	
Pre boring 600mm diameter holes	42	nr	223.8 £	9,325.00	
Bored to 10m maximum depth	83	m	109.14 £	9,095.00	
Removal of material arising from pile bores	24	m ³	3.08 £	72.51	
Disposal of material arising from pile bores	24	m ³	26.93 £	633.98	
West Main Pier Demolition/Removal					
Jack-up barge time	28	days	20000 £	560,000.00	
Remove material for disposal	28	days	10000 £	280,000.00	
Dispose of material	1120	m ³	26.93 £	30,161.60	1120m3/2800T
West Main Pier Construction					
Reclaim stone facing	25	No	100 £	2,500.00	20% of stone
Provision of stone facing	100	No	1025 £	102,500.00	80% of sto Cut stone from quarry in Staindrop (Dunhouse Stone)
Placement of rock	6.25	days	5000 £	31,250.00	
Provision of concrete; Grade C40 20mm aggregate	240	m ³	86.33 £	20,719.20	
Placing of mass concrete	240	m ³	47.03 £	11,287.20	
Pumping from readymix truck @25m3/hour	240	m ³	2.97 £	712.80	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	24.0	T	1319.19 £	31,660.56	198 1 T per 10m3
Provision of imported rock fill	880.0	m ³	33.68 £	29,638.40	395
Stone Paving	140.0	m ²	83.04 £	11,625.60	
West Main Pier Bull-nose Demolition/Removal					
Jack-up barge time	32	days	20000 £	640,000.00	
Remove material for disposal	32	days	10000 £	320,000.00	
Dispose of material	1280	m ³	26.93 £	34,470.40	1280m3/3200T
West Main Pier Bull-nose (replaced as mass concrete)					
Provision of concrete; Grade C40 20mm aggregate	1280	m ³	86.33 £	110,502.40	
Placing of mass concrete	1280	m ³	47.03 £	60,198.40	
Pumping from readymix truck @25m3/hour	1280	m ³	2.97 £	3,801.60	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	128.0	T	1319.19 £	168,856.32	198 1 T per 10m3
	80				
	40				
40m of interlocking sheet piles; 6m high driven 2m into ground.	240	m ²	109.25 £	26,220.00	
Pre boring 600mm diameter holes	67	nr	223.8 £	14,920.00	
Bored to 10m maximum depth	133	m	109.14 £	14,552.00	
Removal of material arising from pile bores	38	m ³	3.08 £	116.01	
Disposal of material arising from pile bores	38	m ³	26.93 £	1,014.36	
Sub Total				£ 8,584,673.72	
Add Preliminaries	15%			£ 1,287,701.06	
Sub Total				£ 9,872,374.78	
Add OH & P	12.5%			£ 1,234,046.85	
Sub Total				£11,106,421.63	
Design and supervision costs	20.0%			£2,221,284.33	
Site investigation costs	15.0%			£ 1,665,963.24	
Scarborough BC	5.0%			£ 555,321.08	
Risk	60%			£ 6,663,852.98	
Total				£22,212,843.26	

9T0429
Whitby Pier Urgent Work

Year 25-50
Cost of removing collapsed structure and reconstructing to original standard

Description	Quantity	Unit	Rate	Total	SPONS
East Pier Extension Demolition/Removal					
Jack-up barge time	135	days	20000	£ 2,700,000.00	
Remove material for disposal	135	days	10000	£ 1,350,000.00	assume 100T / day
Dispose of material	5400	m ³	26.93	£ 145,422.00	5400m ³ /2160T
Piling					
Mobilisation	216				Quote based on Briggs Marine
E20k per day - 12m panel placed every other day	36	days	20000	£ 720,000.00	
	320				
160m of interlocking sheet piles; 8m high driven 2m into ground.	1280	m ²	109.25	£ 139,840.00	257 length +5m for damaged tie-in
Pre boring 600mm diameter holes	267	nr	223.8	£ 59,880.00	257
Bored to 10m maximum depth	533	m	109.14	£ 58,208.00	
Removal of material arising from pile bores	151	m ³	3.08	£ 464.05	255
Disposal of material arising from pile bores	151	m ³	26.93	£ 4,057.45	173
Mobilisation of plant and equipment for ties	1	nr	10250	£ 10,250.00	159
Permanent anchorage in rock, 0-50t load. Ties at 1.2m centres	133	m	78.24	£ 10,432.00	
Provision of concrete; Grade C40 20mm aggregate	901	m ³	86.33	£ 77,754.55	
Placing of mass concrete	901	m ³	47.03	£ 42,358.35	
Pumping from readymix truck @25m ³ /hour	901	m ³	2.97	£ 2,674.98	188
East Pier Extension Reconstruction					
Formwork; fair finish, plain battered, width exceeding 1.22m	941	m ²	55.1	£ 51,849.10	196
Provision of concrete; Grade C40 20mm aggregate	5200	m ³	86.33	£ 448,916.00	
Placing of mass concrete	5200	m ³	47.03	£ 244,556.00	
Pumping from readymix truck @25m ³ /hour	5200	m ³	2.97	£ 15,444.00	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	520.0	T	1319.19	£ 685,978.80	198 1 T per 10m3
Provision of imported rock fill	1600.0	m ³	33.68	£ 50,520.00	395
Provision of timber decking	300	m ²	52.28	£ 15,684.00	507
Provision of timber beams	486.0	m	109.41	£ 53,173.26	94 greenheart 400 x 400
Provision of guardrail for upper deck	154.0	m	7.97	£ 1,227.38	362
East Main Pier Demolition/Removal					
Disposal of timber	78	m ³	26.93	£ 2,100.54	
Jack-up barge time	260	days	20000	£ 5,200,000.00	
Remove material for disposal	260	days	10000	£ 2,600,000.00	assume 100T / day
Dispose of material	10400	m ³	26.93	£ 280,072.00	10400m ³ /26000T
East Main Pier Reconstruction					
Reclaim stone facing	300	No	100	£ 30,000.00	20% of stone
Provision of stone facing	1200	No	1025	£ 1,230,000.00	80% of sto Cut stone from quarry in Staindrop (Dunhouse Stone)
Placement of rock	75	days	5000	£ 375,000.00	20 blocks per day
Provision of concrete; Grade C40 20mm aggregate	2500	m ³	86.33	£ 215,825.00	
Placing of mass concrete	2500	m ³	47.03	£ 117,575.00	
Pumping from readymix truck @25m ³ /hour	2500	m ³	2.97	£ 7,425.00	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	250.0	T	1319.19	£ 329,797.50	198 1 T per 10m3
Provision of imported rock fill	7900.0	m ³	33.68	£ 266,072.00	395
Stone paving	1200	m ²	83.04	£ 99,648.00	
Lighthouse	1	No.	250,000	£ 250,000.00	dressed stone lighthouse
East Main Pier Bull-nose Demolition/Removal					
Jack-up barge time	15	days	20000	£ 296,000.00	
Remove material for disposal	15	days	10000	£ 148,000.00	assume 100T / day
Dispose of material	592	m ³	26.93	£ 15,942.56	592m ³ /1480T
East Main Pier Bull-nose (replaced as mass concrete)					
Provision of concrete; Grade C40 20mm aggregate	592	m ³	86.33	£ 51,107.36	
Placing of mass concrete	592	m ³	47.03	£ 27,841.76	
Pumping from readymix truck @25m ³ /hour	592	m ³	2.97	£ 1,758.24	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	59.2	T	1319.19	£ 78,096.05	198 1 T per 10m3
E20k per day - 12m panel placed every other day	4	days	20000	£ 83,333.33	
	50				
	25				
25m of interlocking sheet piles; 6m high driven 2m into ground.	150	m ²	109.25	£ 16,387.50	
Pre boring 600mm diameter holes	42	nr	223.8	£ 9,325.00	
Bored to 10m maximum depth	83	m	109.14	£ 9,095.00	
Removal of material arising from pile bores	24	m ³	3.08	£ 72.51	
Disposal of material arising from pile bores	24	m ³	26.93	£ 633.98	
West Main Pier Demolition/Removal					
Jack-up barge time	75	days	20000	£ 1,500,000.00	
Remove material for disposal	75	days	10000	£ 750,000.00	
Dispose of material	3000	m ³	26.93	£ 80,790.00	
West Main Pier Construction					
Reclaim stone facing	100	No	100	£ 10,000.00	20% of stone
Provision of stone facing	400	No	1025	£ 410,000.00	80% of sto Cut stone from quarry in Staindrop (Dunhouse Stone)
Placement of rock	25	days	5000	£ 125,000.00	
Provision of concrete; Grade C40 20mm aggregate	1250	m ³	86.33	£ 107,912.50	
Placing of mass concrete	1250	m ³	47.03	£ 58,787.50	
Pumping from readymix truck @25m ³ /hour	1250	m ³	2.97	£ 3,712.50	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	125.0	T	1319.19	£ 164,898.75	198 1 T per 10m3
Provision of imported rock fill	1750.0	m ³	33.68	£ 58,940.00	395
Stone Paving	240.0	m ²	83.04	£ 19,929.60	
Lighthouse	1.0	unit	250,000	£ 250,000.00	dressed stone lighthouse
Steel footbridge - 15m span, 4m wide	60.0	m ²	1116	£ 66,960.00	579
Hire of trailing suction dredger	5.75	days	20000	£ 115,000.00	169 8000m ³ per day
Mobilisation/Demobilisation of dredger	1	No.	10000	£ 10,000.00	169
Dredged volume	46000	m ³	3.12	£ 143,520.00	169 2m depth of material over 23000m ² area
West Main Pier Bull-nose Demolition/Removal					
Jack-up barge time	32	days	20000	£ 640,000.00	
Remove material for disposal	32	days	10000	£ 320,000.00	
Dispose of material	1280	m ³	26.93	£ 34,470.40	
West Main Pier Bull-nose (replaced as mass concrete)					
Provision of concrete; Grade C40 20mm aggregate	1280	m ³	86.33	£ 110,502.40	
Placing of mass concrete	1280	m ³	47.03	£ 60,198.40	
Pumping from readymix truck @25m ³ /hour	1280	m ³	2.97	£ 3,801.60	188
Reinforcement - mild steel to BS4449. Bars 12mm nominal size, supplied in bent & cut lengths.	128.0	T	1319.19	£ 168,856.32	198 1 T per 10m3
	80				
	40				
40m of interlocking sheet piles; 6m high driven 2m into ground.	240	m ²	109.25	£ 26,220.00	
Pre boring 600mm diameter holes	67	nr	223.8	£ 14,920.00	
Bored to 10m maximum depth	133	m	109.14	£ 14,552.00	
Removal of material arising from pile bores	38	m ³	3.08	£ 116.01	
Disposal of material arising from pile bores	38	m ³	26.93	£ 1,014.36	
Sub Total				£ 24,099,700.61	
Add Preliminaries	15%			£ 3,614,955.09	
Add OH & P	12.5%			£ 126.80	
Sub Total				£ 27,715,796.86	
Design and supervision costs	20.0%			£ 5,543,159.37	
Site Investigation costs	15.0%			£ 4,157,369.53	
Scarborough BC	5.0%			£ 1,385,789.84	
Risk	60%			£ 16,629,478.11	
Total				£ 55,431,593.71	

Appendix G

Environmental Report

In submitted PAR this will be provided on CD

Appendix H

Consultation

Consultation

Consultation on the East Pier Extension Urgent Works has been undertaken as part of the consultation processes associated with the Further Investigations at Whitby Harbour.

This has involved the following:

- Optioneering and Risk Workshop at Sneaton Castle on 20th November 2009.
- Presentations at Evening Meetings [Stewart Rowe to add details].
- Public Consultation Event at Whitby Pavilion in the afternoon and evening of 20th February 2009.
- Update Workshop at Sneaton Castle on 25th February 2009.

Minutes from the above are available on request from Robin Siddle at Scarborough Borough Council.

Appendix I

Natural England Letter

Whitby Strategy
Strategic management options

Comments of Natural England

East Pier at Whitby is immediately adjacent to Whitby – Saltwick SSSI which is notified for its geological features from the Jurassic period including vertebrate palaeontology (marine reptile fossils), toarcian sections and palaeobotany (fossil plants).

Natural England does not have an issue with modification of the harbour walls in principle, however our formal response will depend on the nature of the works proposed. Potential impacts on the SSSI could include any engineering works that could reduce the erosion rate of the cliffs south of the harbour or any materials (such as rock armouring) that are located on the foreshore within the SSSI.

It may be necessary to obtain specialist advice on the specific geological interest of the area that may be affected by modifications to the harbour walls.

Any works that will impact on the SSSI will require the assent of Natural England under The Wildlife and Countryside Act 1981 (as amended).

Susan Wilson
24 November 2008

Date: 17 February 2009
Our ref: NZ91 SR2G
Your ref: Whitby coastal strategy

Stewart Rowe
Scarborough Borough Council
Town Hall
St Nicholas Street
Scarborough
North Yorkshire
YO11 2HG

Dear Stewart

**Whitby Coastal Strategy
Impacts on Whitby – Saltwick SSSI**

This advice is a response to the information provided in the document 'Whitby Coastal Strategy- Further Investigations at Whitby Harbour' (Royal Haskoning Jan 2009). Our understanding is that there is a possibility that a rock revetment will be placed against the outer faces of the East Pier and extension which would cover a strip of the Whitby – Saltwick SSSI between 5m and 10m wide at the extreme northern end of the SSSI. Scarborough Borough Council has requested advice about the potential impacts this would have on the SSSI features and procedures with respect to SSSIs.

The features of the SSSI are:

- Vertebrate palaeontology, in particular Jurassic and Cretaceous reptilia (fossil reptile sites)
- Palaeobotany, in particular exposures of the plant fossil beds from the middle Jurassic.
- Stratigraphy, important exposures of the Lower Jurassic (Toarcian) Whitby Mudstone Formation.

A rock revetment placed against the East Pier and extension would have minimal impact on the coastal processes which are required to maintain rock exposures on the cliff faces in the SSSI. There would also be no impact on the majority of the SSSI to the south of the pier area with respect to concealment of features. We understand that there is unlikely to be excavation required before the rock revetment is installed. We are unaware of any geological features in the area adjacent to the East Pier that are not present in other parts of the site. However, there is a small risk that the rock revetment could conceal a feature (eg fossil bed). We therefore advise that the area should be checked by a geological consultant (and the results discussed with Natural England) before plans for a rock revetment are finalised.

This advice is based on current information, once the preferred scheme has been finalised, we will be providing our statutory advice on the Environmental Impact Assessment. If any aspects of the preferred scheme will impact on the SSSI, Scarborough Borough Council should give Notice to

Natural England under the Wildlife and Countryside Act 1981 (as amended). Details of the assenting procedure are laid out on Natural England's website.

www.naturalengland/ information for SSSI owner and occupiers/ duties of public bodies to conserve and enhance SSSIs.

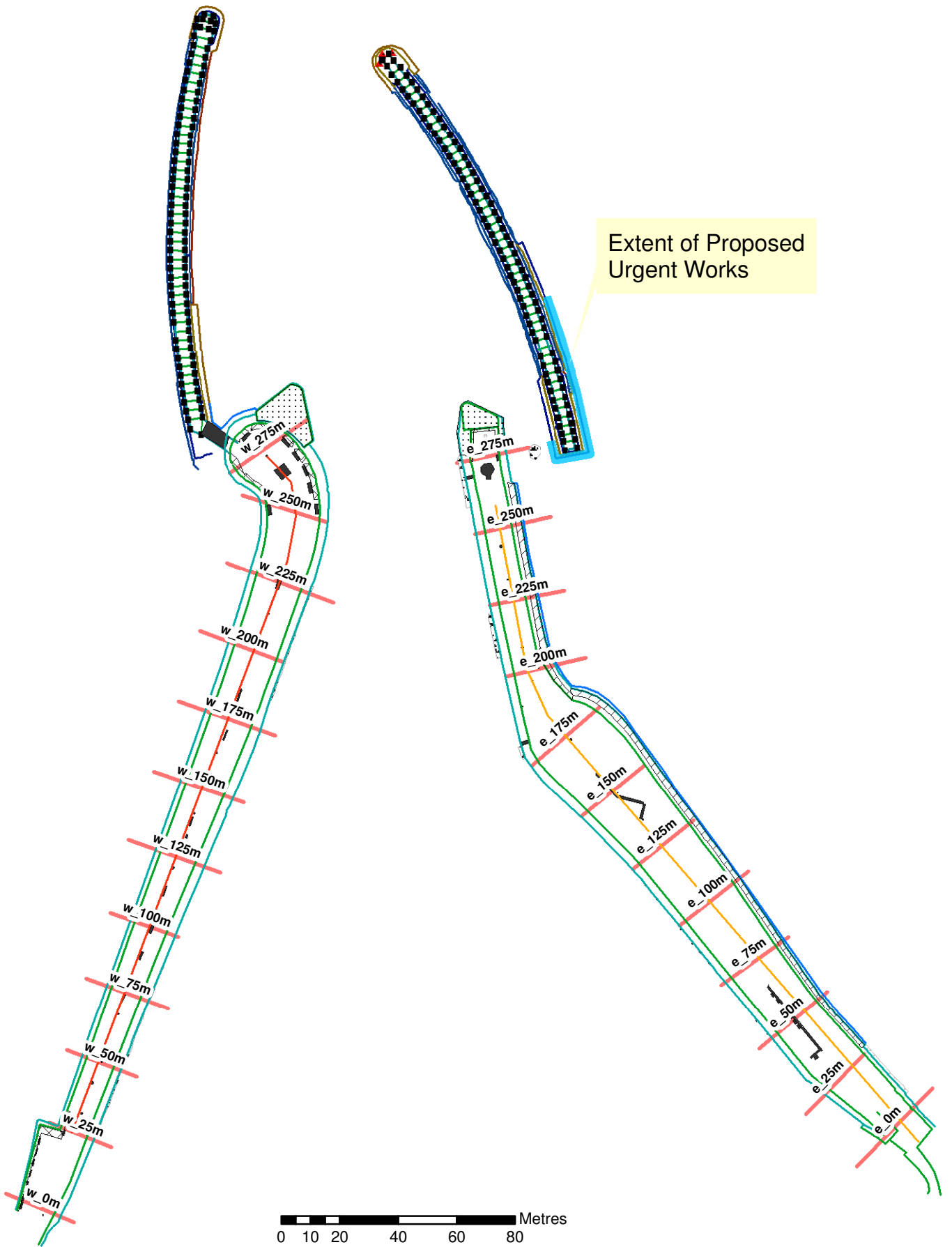
I trust that the above is of use.

Yours sincerely

Susan Wilson
Conservation Adviser
Susan.wilson@naturalengland.org.uk

Appendix J

Outline Plan and Section



Extent of Proposed Urgent Works

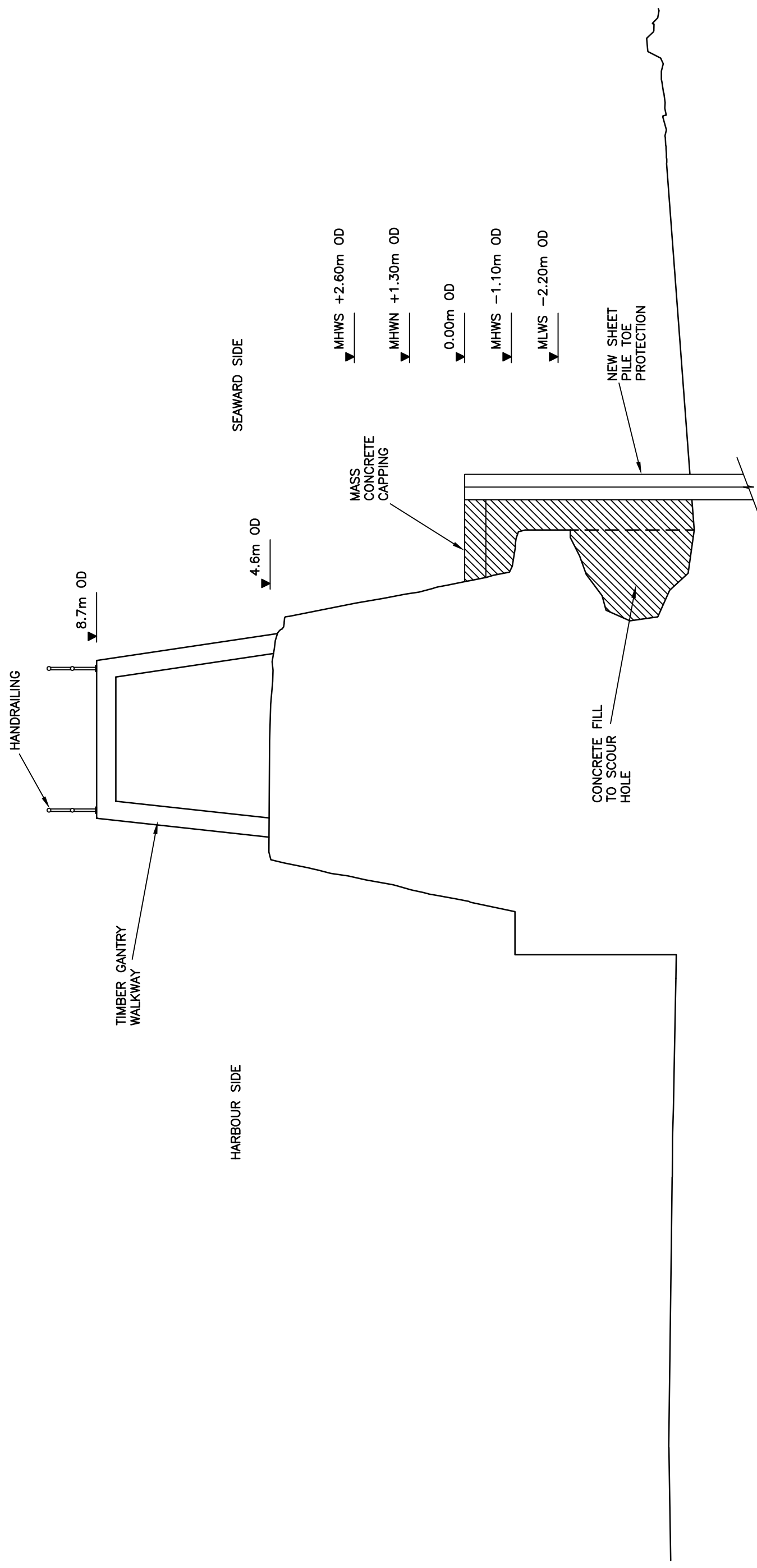
0 10 20 40 60 80 Metres

Key:

Title:
Whitby East Pier Extension
Urgent Works
Project:
Whitby Coastal Strategy
Client:
Scarborough Borough Council


Date: Feb 2009	Scale: 1 : 1,800	
Figure: J1	Drawn: AV	Checked: CG





TYPICAL EAST PIER EXTENSION SECTION

© Haskoning UK Ltd.

TITLE FIGURE J2 WHITBY EAST PIER EXTENSION URGENT WORKS	PROJECT WHITBY COASTAL STRATEGY	CLIENT SCARBOROUGH BOROUGH COUNCIL	 ROYAL HASKONING HASKONING UK LTD NEWCASTLE Marlborough House Marlborough Crescent Newcastle upon Tyne NE1 4EE (0191) 211 1300 +44 (0)191 211 1300 info@newcastle.royalhaskoning.com www.royalhaskoning.com Telephone E-mail Internet	DRAWN IT SCALE AT A3 1:100 DRAWING No. FIGURE J2	DATE FEB' 09 JOB No. 9T0429 AUTOCAD REF. 9T0429-FIGURE J2	REV 0
---	--	---	--	---	--	--------------

Appendix K

Programme

Whitby Coastal Strategy: Further Investigations - Implementation Programme

ID	Task Name	Duration	Start	Year 1												Year 2			
				01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04
0	Whitby Coastal Strategy: Further Investigations	252 days	Mon 30/03/09																
1																			
2	Detailed Design of East Pier Extension (EPE) Urgent Works	16 wks	Mon 30/03/09																
3	EPE Urgent Works Procurement	10 wks	Mon 20/07/09																
4	EPE Urgent Works Mobilisation	4 wks	Mon 28/09/09																
5																			
6	EPE Urgent Construction Works	102 days	Mon 26/10/09																
7	Site Mobilisation	15 days	Mon 26/10/09																
8	Pre-excavation	6 days	Mon 16/11/09																
9	Sheet Piling	20 days	Tue 24/11/09																
10	Grouting to Pre-bores	15 days	Tue 22/12/09																
11	Anchors	6 days	Tue 12/01/10																
12	Concrete Filling	30 days	Wed 20/01/10																
13	Demobilisation	10 days	Wed 03/03/10																

Project: Whitby Coastal Strategy: Furt Date: Tue 24/02/09	Task		Milestone		External Tasks	
	Split		Summary		External Milestone	
	Progress		Project Summary		Deadline	