



Underwater Survey Report Steel Sheet Pile Survey Skerries Pier



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Executive Summary

The overall condition of the steel sheet piles is rated as **4 – CRITICAL**

Extensive corrosion and corresponding loss of pile thickness was found within the upper tidal – Splash zone around MHWS and also in the Low water zone around MLWS.

Accelerated Low Water Corrosion (ALWC) was found throughout the structure in the low water region.

There are significant hole defects in the piles around MLWS, particularly on the West (End) Face and South Face of the pier, with little remaining load carrying capability.

Voids and loss of core hatching fill material is evident where holes were found in the sheet piles

Recommendations

It would be recommended to carry out remedial works to the steel sheet piles as soon as possible to prevent further deterioration and possible failure.

Short term recommendations include:

- Investigation of the pier core by opening the deck in various locations to determine fill material, voids etc.
- Develop a repair solution based on the findings of the deck investigation, required repair design life, budget etc.

As a minimum short-term repair in the event of more substantial remedial works not being viable, the bottom section of the piles with holes should be sealed to prevent further loss of core fill material and localised concrete filling of the voids be carried out.



1. Introduction & Methodology

Introduction

Norfolk Marine Ltd was engaged to carry out a condition survey of the exposed steel sheet piles at Skerries Pier by Fingal County Council. The survey was carried out on the 6^h & 7th of December 2021.

The works involved a condition survey of the steel sheet piles, that support the West end of the pier structure to the North of the Harbour at Skerries. A visual and tactile inspection was carried out and thickness measurements taken of the existing steel piles at selected locations between MHWS and the seabed.

The survey of the sheet piles was undertaken due to known defects to the steel piles, to determine their current condition and identify further defects or deterioration in the structure.

The findings of the survey are to be used to assist the council and their consulting engineers in assessing the stability of the pier structure, it's suitability for use and proposals for remedial works if required.

Methodology

Diving operations were carried out in accordance with the HSA Safety, Health & Welfare at Work (Diving) Regulations 2018 and associated inland / inshore code of practice, using surface supplied diving equipment. A diving project plan was developed along with Risk Assessment / Method Statement for the works.

Access was provided from the deck of the pier using fixed ladders attached to the berth faces, with additional access and support provided by small inflatable boat. The survey was carried out over 2 days and full tidal cycles to ensure full access and overlap between underwater and above water levels.

Steel thickness measurements were taken using a Cygnus Dive, ultrasonic, wrist mounted gauge. The gauge velocity of sound was set at 5920 m/s for mild steel and checked before and after each use with a calibrated 15.00mm steel test block.

Inspection Location	Skerries Pier
Date of Inspection	06/12/2021 to 07/12/2021
Conditions	General – Heavy Rain / Showers Wind – Moderate to Strong – 21 to 35 kts to Very strong 50 kts on 7 th . Temp - 6°C In water visibility – Varied - < 0.3m to 1m dependant on tide level & location



2. Location Plan

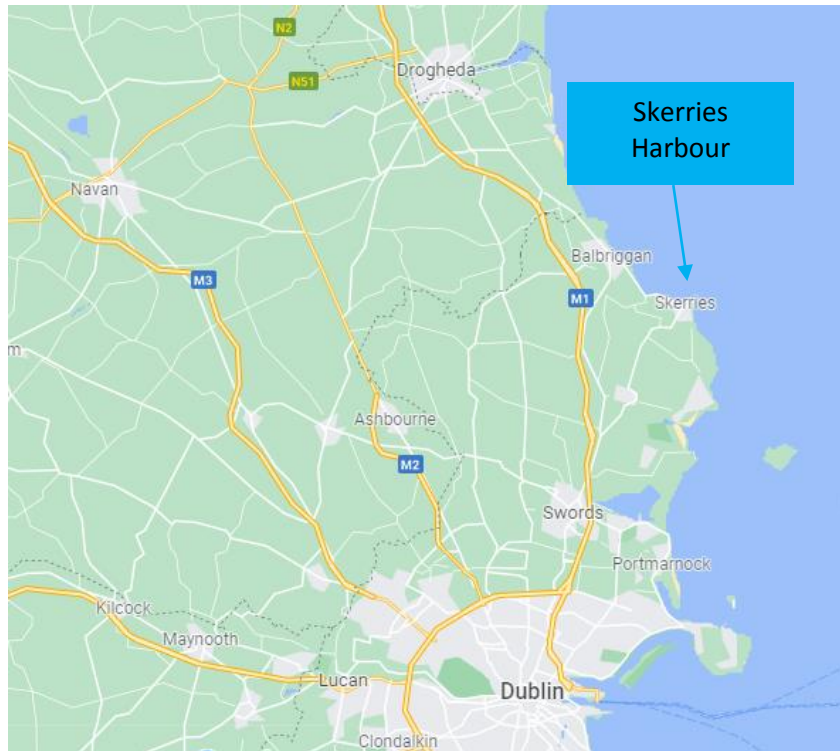


Fig 2.1 – Location Plan

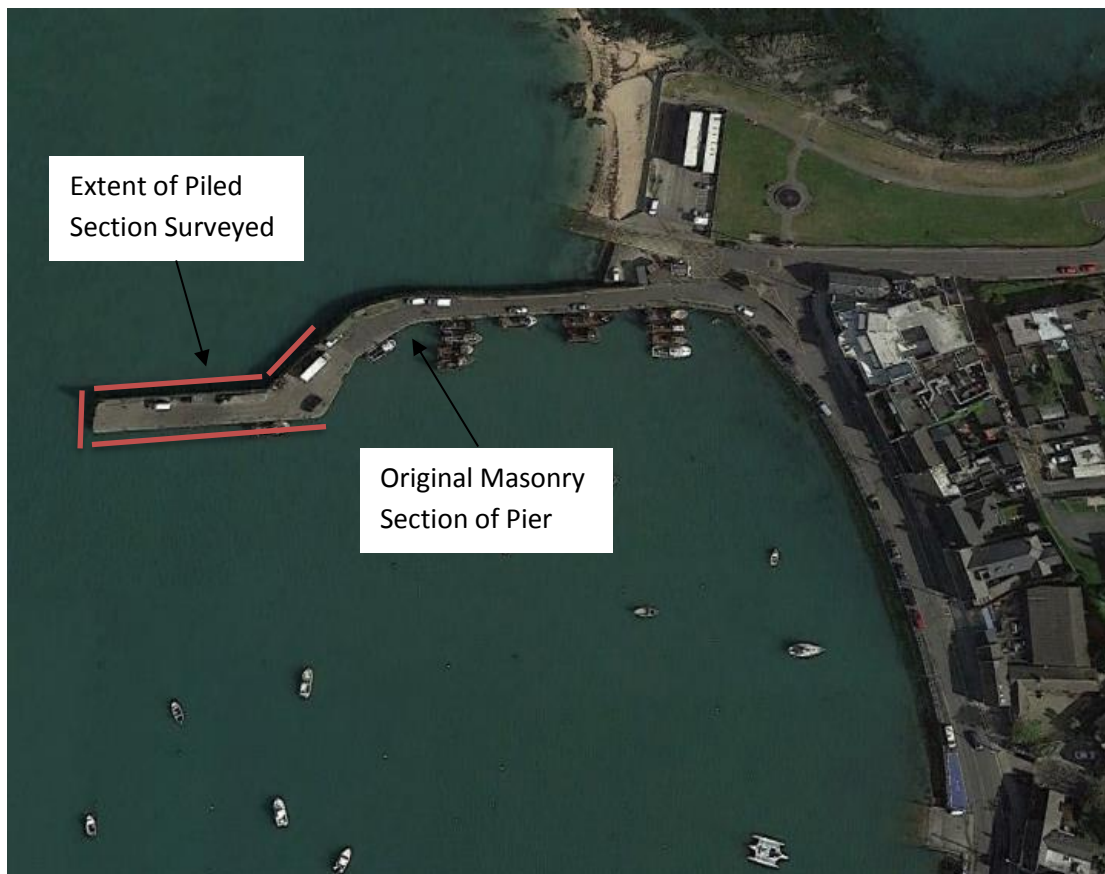


Fig 2.2 – Skerries Pier Layout



3. Details of Structure

3.1 Description

Skerries Harbour is situated on the East coast in North County Dublin. The pier is at the North side of the harbour, offering protection to the harbour and berth faces. The pier is used by numerous small fishing vessels and is a busy working environment. The harbour area within the protection of the pier is used by small pleasure and personal watercraft.

The pier is generally oriented in an East to West arrangement, with an original masonry section extending from the shore to the East and a newer steel piled section extending from the dogleg at the end of the masonry section toward the west.

The piled section is constructed using 'U' piles arranged in an Outpan-Inpan-Outpan arrangement.

There are tie bars fitted through the piles below the capping beam within the inpans, around the entire piled section. It is probable that the transverse tie bars connect the North and South faces with no intermediate anchor wall. It is not known if there is a transverse piled anchor wall to brace the end face piles at the West end. (Pics B13 & B14)

There is a concrete pile cap beam at the top of the piles, that is flush with the face of the outpan. It is more common, of piers constructed in the same era, that the sheet piles are recessed underneath the capping beam. It is not known if this is the original arrangement or if the concrete beam has been replaced at some point.

The deck is constructed from concrete, which has a gentle slope toward the berth face to the South side. It is assumed that the concrete is reinforced but the detail and thickness of slab is not known.

MHWS level is approximately 500mm below the top of the piles, approximately 1.1m below pile cap level. MLWS is approximately 5.5m below the top of the pile cap. At low tide there is little water surrounding the pier and it dries out completely toward the east end.

There is no cathodic protection installed to the pier piles.

A total of **237 piles** were inspected (Outpans and Inpans)

(See pics B1 to B7 for general layout)

3.2 Recorded Information

No previous information was provided prior to the inspection.

The general layout drawing shown in Appendix A shows an indicative view of the pier arrangement and the pile reference numbers used in this report.



3.3 Pile Information

As there were no drawings or details available prior to the survey, the original pile specification is not known.

The piles were measured during the survey as follows:

Pitch 1m (2x Width)
2 x Height Approximately 350mm
Max thickness 11.6mm

Based on these measurements, it is suggested that the piles are possibly a GU15-500.

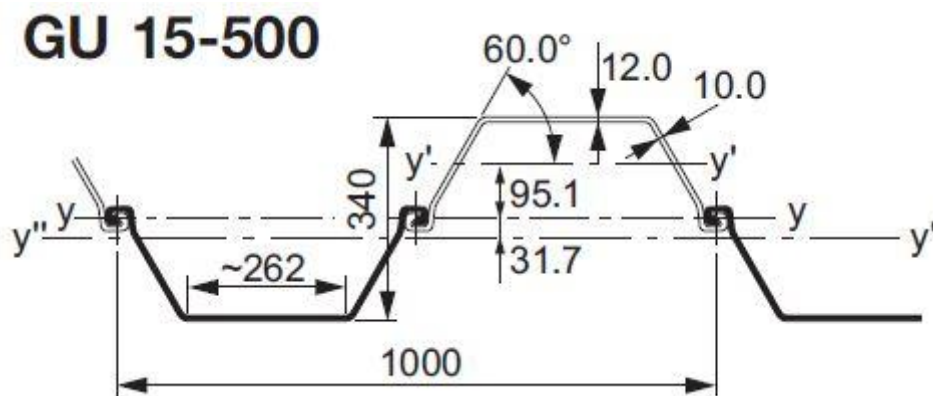


Fig 3.3.1 Suggested Original Pile Arrangement

Section	Width	Height	Thickness		Sectional area		Mass		Moment of inertia	Elastic section modulus	Static moment	Plastic section modulus	Class*																		
	b mm	h mm	t mm	s mm	cm ² /m	kg/m of single pile	kg/m ² of wall	cm ⁴ /m					cm ³ /m	cm ³ /m	S 240 GS	S 270 GP	S 320 GP	S 355 GP	S 390 GP	S 430 GP	S 460 AP										
PU-R sections																															
PU 8R	600	280	7.5	6.9	103	48.7	81	10830	775	445	905	3	3	4	4	4	4	-													
PU 9R	600	360	7.0	6.4	105	49.5	82	16930	940	545	1115	3	3	4	4	4	4	-													
PU 10R	600	360	8.0	7.0	114	53.8	90	18960	1055	610	1245	3	3	3	3	3	4	-													
PU 11R	600	360	9.0	7.6	123	58.1	97	20960	1165	675	1370	2	2	3	3	3	3	-													
PU 13R	675	400	10.0	7.4	124	65.6	97	25690	1285	750	1515	2	2	2	2	3	3	-													
PU 14R	675	400	11.0	8.0	133	70.5	104	28000	1400	815	1655	2	2	2	2	2	2	-													
PU 15R	675	400	12.0	8.6	142	75.4	112	30290	1515	885	1790	2	2	2	2	2	2	-													
GU sections																															
GU 7-600	600	309	7.5	6.4	100	47.0	78	11350	735	435	890	2	2	3	3	-	-	-													
GU 8-600	600	309	8.5	7.1	110	51.8	86	12690	820	485	995	2	2	2	2	-	-	-													
GU 9-600	600	309	9.5	7.9	121	57.0	95	14060	910	540	1105	2	2	2	2	-	-	-													
GU 12-500	500	340	9.0	8.5	144	56.6	113	19640	1155	680	1390	2	2	2	2	-	-	-													
GU 13-500	500	340	10.0	9.0	155	60.8	122	21390	1260	740	1515	2	2	2	2	-	-	-													
GU 15-500	500	340	12.0	10.0	177	69.3	139	24810	1460	855	1755	2	2	2	2	-	-	-													
GU 16-400	400	290	12.7	9.4	197	62.0	155	22580	1560	885	1815	2	2	2	2	-	-	-													
GU 18-400	400	292	15.0	9.7	221	69.3	173	26090	1785	1015	2080	2	2	2	2	-	-	-													

Fig 3.3.2 Suggested Original Pile Properties



4. Condition of Structure

The overall condition of the steel sheet piles is rated as **4 - CRITICAL**

4.1 Pile – General Condition Survey

The sheet piles are generally in poor condition throughout the entire structure, with numerous defects and areas of significant loss of section thickness. The survey findings can be broken down into the following pile levels:

Upper Tidal Zone - Splash Zone

The top 1m of the piles are located at the top of the tidal zone and into the splash zone, where advanced corrosion is usually expected in the marine environment. There is consistent loss of steel material thickness around the MHWS level with some holes evident.

The majority of the Outpan piles on the West (End) face and the South Face of the pier have been repaired in the past with a section of pile fitted over the original pile and bolted to the steel below and the face of the concrete capping beam above. Through historical photographs found online it is evident that there was advanced corrosion within the Splash zone in these locations with extensive holes throughout. The cover sections transfer load from the tidal zone of the pile to the pile cap, but the connection detail is not fully known. (Pics B8 & B9)

The piles along the North Face and Northeast Wing do not have the same repair plates and have significant loss of section thickness throughout, with a minimum thickness measured of 2.75mm.

There is moderate corrosion delamination in all locations within the splash zone, with moderate corrosion pitting evident on the steel surface. (Pics B10 to B12)

Intertidal Zone

The section of the piles within the intertidal zone are generally in better condition than found at the top of the piles, which would be as expected. There is light corrosion delamination with isolated spots of active corrosion blooming evident.

Steel thickness measurements within the intertidal zone were higher than at the MHWS level, with some locations still in excess of 10mm, particularly at the East end of both faces where the piled section joins the original masonry section

The majority of the measurements were between 8mm and 10mm with some readings below 8mm and a few 6mm and below.

Where more significant loss of thickness or hole defects have occurred, these have developed from more advanced corrosion below extending up into the intertidal zone. (Pics B15 to B17)



Low Water – Permanently Submersed Zone

MLWS spring level is close to the bottom of the piles. At the East ends, particularly on the Northeast Wing the seabed covers MLWS and at the deeper section to the West, the seabed is approximately 1m below MLWS.

There is active corrosion blooming around the MLWS level that is typical of Accelerated Low Water Corrosion (ALWC) along all faces of the pier.

The Northeast wing and North face do not have as significant material thickness loss as found elsewhere. The seabed covers some of the MLWS level offering protection in part. There are 3 piles with holes in the Northeast Wing and 4 piles along the North Face.

The East (End) Face and South Face have significantly more loss of material section and defects than the North side.

Most of the piles along the West and South faces have holes within the low water zone. Some of the holes extend up to 3m up the piles, with loose, sharp flaps of steel remaining at the bottom.

The hole defects and advanced corrosion at MLWS level along the West (End) Face and South Face are assessed as critical with load bearing capacity significantly affected.

(See pics B18 to 34)

4.2 Pile Thickness Measurements

Ultrasonic thickness measurements were taken on all Outpan pan faces, with a total of 119 outpans measured.

Pile thickness measurements were taken on the Outpan faces at all levels, with the maximum measurements between 11 and 12mm. This would indicate a probable original pile pan thickness in the region of 12mm.

Of the 119 outpans measured, the following thickness were recorded on the piles in at least one location:

< 10mm	100%
< 8mm	78%
< 6mm	40%
< 4mm or Hole	35%

It should be noted that a 12m section of the South Face could not be measured at the bottom of the piles, due to a berthed fishing vessel, and the recorded measurements below 6mm or holes would be expected to increase.

See Appendix D for UT thickness measurement results.



4.3 Pile Defects

Defects to the piles were found at MHWS and MLWS levels. There are significant hole defects at both levels.

More extensive holes were found within the low water zone area along the West (End) and South Faces. Some of these holes extend 3m up the piles.

42 outpans were found to have corrosion hole defects, and it would be expected that the piles that were not accessible at the bottom have similar holes.

The holes have developed through ALWC with the low water zone. ALWC was clearly visible during the survey along the entire pier length, and it would be reasonable to assume that further holes would continue to develop in short time.

See appendix D for details of individual defects.

4.4 Scour

Generally, the seabed slopes very gently from the inshore end at the East to the seaward end at the West of the pier. There is only approximately 1.5m difference in bed level from the East to West.

There was no noticeable scour pit at the corners of the pier and no localised scour along the faces.

4.5 Pier Core Fill

Where holes were found in the steel piles, large stone fill material was evident within the pier structure. The stone is a rounded boulder stone up to approximately 500mm in size. There was localised voiding within some of the holes where the fill material has escaped to the surrounding seabed.

There was no evidence of fines material within the stone fill matrix, as would be expected with the construction methods used, so it can be assumed that the fines material has washed out of the pier harking in the areas of the holes in the piles.

The extent of the washout of fines material, loss of stone fill and subsequent settlement of the core harking is unknown without further investigation and opening of the pier deck.

4.6 Pile Capping Beam and Deck

The concrete pile capping beam and deck are generally in good condition with no significant defects, holes or cracking.

There was no evidence of subsidence of the pier deck, which is usually evident where known loss of core fill material has occurred. The construction of the deck slab is not known, but consideration should be given to the possibility that the slab is currently suspended with little or no support.

It is not known whether there are piled foundations to the slab within the core of the pier.



5. Conclusions, Considerations and Recommendations

Conclusions

The overall condition of the steel sheet piles is rated as **4 – CRITICAL**

Extensive corrosion and corresponding loss of pile thickness was found within the upper tidal – Splash zone around MHWS and also in the Low water zone around MLWS.

Accelerated Low Water Corrosion (ALWC) was found throughout the structure in the low water region.

There are significant hole defects in the piles around MLWS, particularly on the West (End) Face and South Face of the pier, with little remaining load carrying capability.

Voids and loss of core hatching fill material is evident where holes were found in the sheet piles.

Considerations

The current condition of the steel sheet piles supporting the West end of the pier structure is critical and repair or replacement would be recommended before further loss of integrity occurs.

Common techniques used in the repair of similar defects include:

- Welded plate repairs over holes with MLWS region
- Grouting / Concreting over toe of piles to cover the affected area
- Welded plate repairs to top of tidal / splash zone.
- Installation of Cathodic Protection to the steel structure
- Coating of exposed sections of steel.

These techniques may not be suitable due to the situation at Skerries.

Welded Plate Repairs - MLWS

As the seabed is so close to the MLWS level and the extent of the corrosion / hole damage is so significant, individual welded repair plates would not be recommended as a satisfactory solution.

Welded repair plates need to transfer load across the defective area between areas of sufficient thickness and strength. The condition of the steel beneath the seabed is unknown and a satisfactory weld beneath bed level would be very difficult to achieve.

Welded Plate Repairs – MHWS

It would be possible to carry out further repairs at the tops of the piles, similar to those already in place on the West (End) and South Faces. A bolted / Welded connection could be made to the pile in the intertidal zone and then bolted to the side of the pile capping beam.

The integrity of this type of repair would be limited due to the reduced thickness of the piles in the intertidal zone and the pile cap / deck detail.



It should also be considered that the tie bars within the Inpans at the top of the piles are located in the area of significant thickness section loss at the top of the tidal zone. The bearing capacity of the pile in this area will be greatly reduced so the long-term resistance to the lateral load from the pier would be questionable.

Cathodic Protection

The current condition of the steel piles is beyond the scope of cathodic protection.

If repairs were carried out, cathodic protection could then be considered but as the piles mostly dry out at low water, the effectiveness of any CP system would need to be assessed by a specialist CP consultant.

Possible Solutions

Remedial works to the piled section of the pier would involve either repair of the existing piles or replacement with new piles in front of the existing faces.

Repair

Due to the extent of the defects / corrosion, localised repairs would have a very short lifespan, 5 to 10 years maximum, and the costs involved would be prohibitive.

A proposed possible repair sequence would be:

- Installation of a concrete filled plate cover repair from below bed level to cover the defective area around MLWS. This would seal and provide bearing strength to the toe of the piles. Repair height would be in the region of 2m above bed level on the North side and up to 3m above bed level on the West and South faces. The top of the repair would need to be chamfered to prevent a shelf that boats could catch on.
- Localised patch repairs to small holes and gaps to seal the pier faces
- Grouting / Colloidal Concreting of the pier core to penetrate and solidify loose fill and provide a homogenous core structure.

Estimated costs for this type of repair would be in the region of €500,000 depending on the findings of core investigation in the pier etc.

This type of repair would provide a longer design life than localised patch repairs, probably in the region of 15 to 20 years.

The preferred method of repair for the bottom sections would be to use a sacrificial steel plate as a shutter, which remains in place. However, the current cost of steel would need to be considered.



Replacement

The layout of the pier at Skerries would lend itself to replacement of the piles by installing a piled face in front of the current piles, and concreting / grouting between.

As the current berth face does not directly align with the original pier face, tying in a new piled wall would be straight forward.

As details such as ground conditions, pier internal construction, loading requirements etc. are not known, a consulting engineer would be required to assess the feasibility and cost of the installation of a new pile wall.

Recommendations

It would be recommended to carry out remedial works to the steel sheet piles as soon as possible to prevent further deterioration and possible failure.

Short term recommendations include:

- Investigation of the pier core by opening the deck in various locations to determine fill material, voids etc.
- Develop a repair solution based on the findings of the deck investigation, required repair design life, budget etc.

As a minimum short-term repair in the event of more substantial remedial works not being viable, the bottom section of the piles with holes should be sealed to prevent further loss of core fill material and localised concrete filling of the voids be carried out.



Appendix A – Layout Drawing



Seabed level below
concrete Deck level
shown in Blue

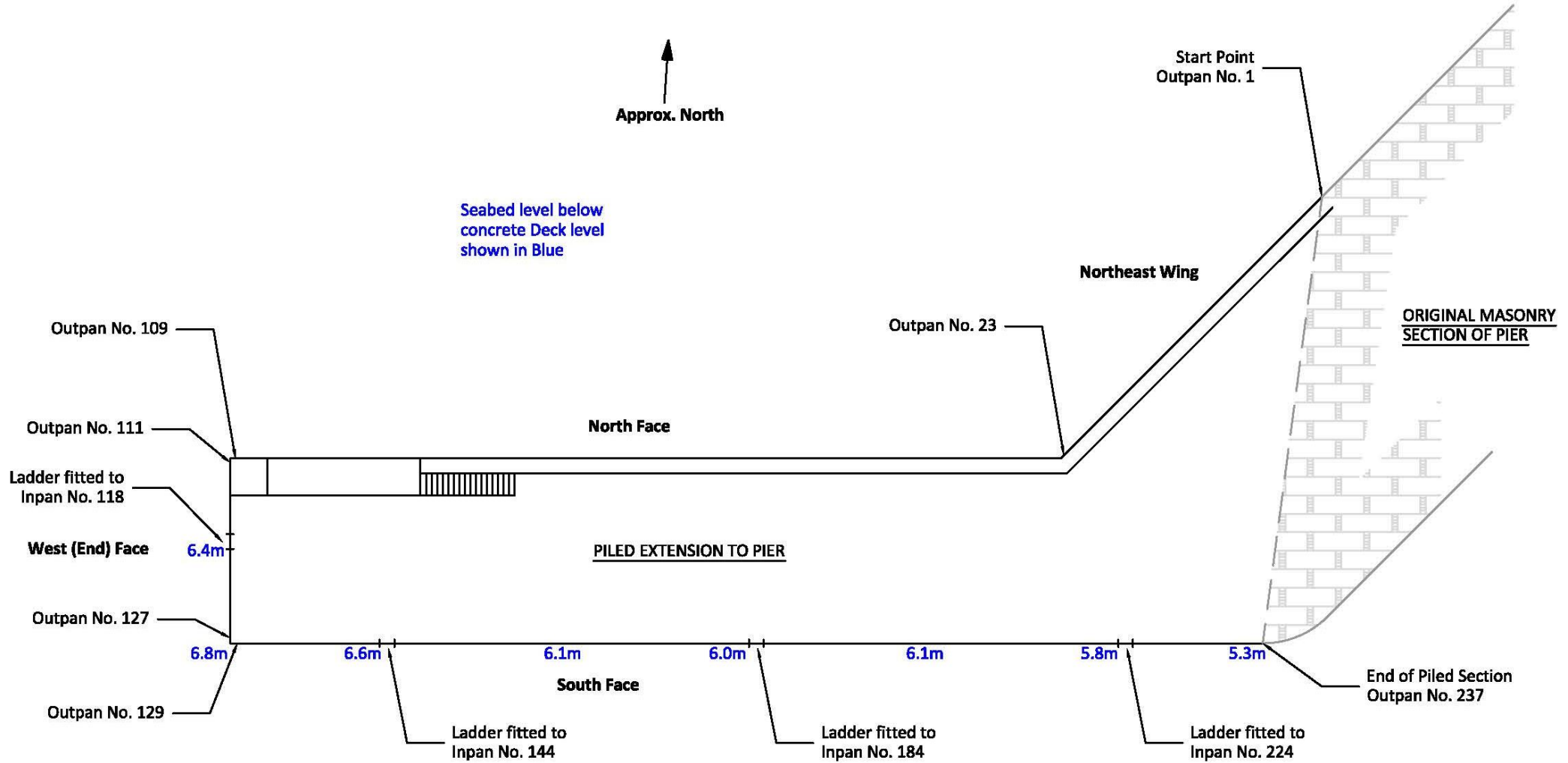


Fig A1 – Indicative Pier Layout



Appendix B – Photographs



Fig B1 – View of the West end of the Piled Section of Pier



Fig B2 – View of the East end of the Piled Section at the interface with the Original masonry pier



Fig B3 – View of the Northeast Wing of the Piled section (Start of Pile numbering)



Fig B4 – Northeast Wing at Outpan No.1 – Typical Condition



Fig B5 – West end of South Face



Fig B6 - East end of South Face



Fig B7 - Concrete Capping / Deck Detail

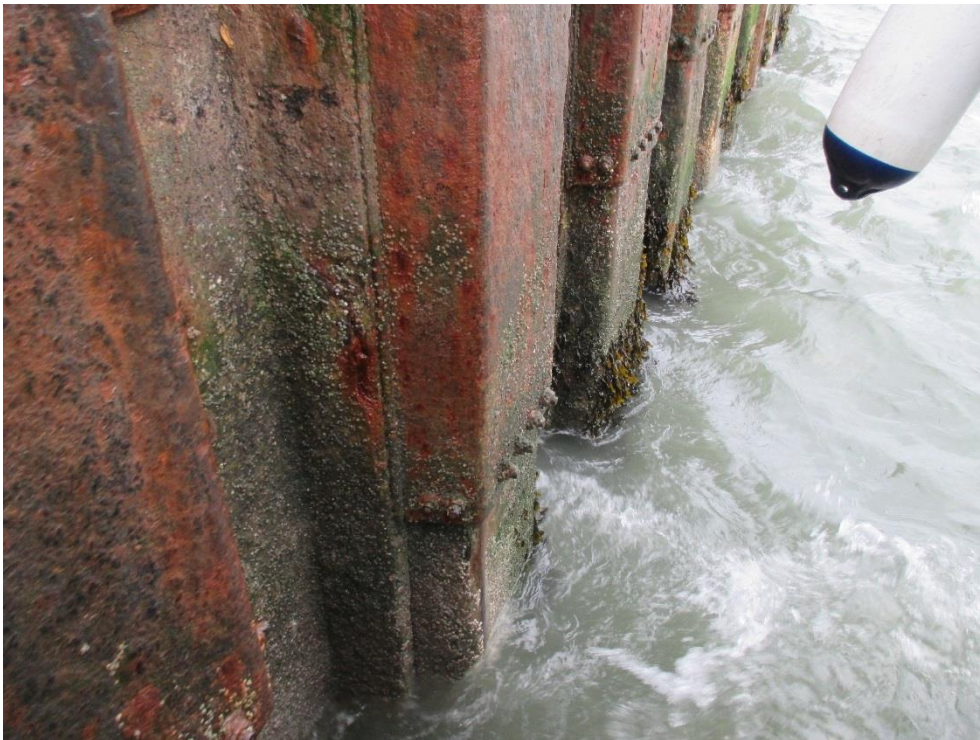


Fig B8 - Existing Repair at top of piles – Typical West and South Faces



Fig B9 - Existing Repair – Top Connection detail with Capping

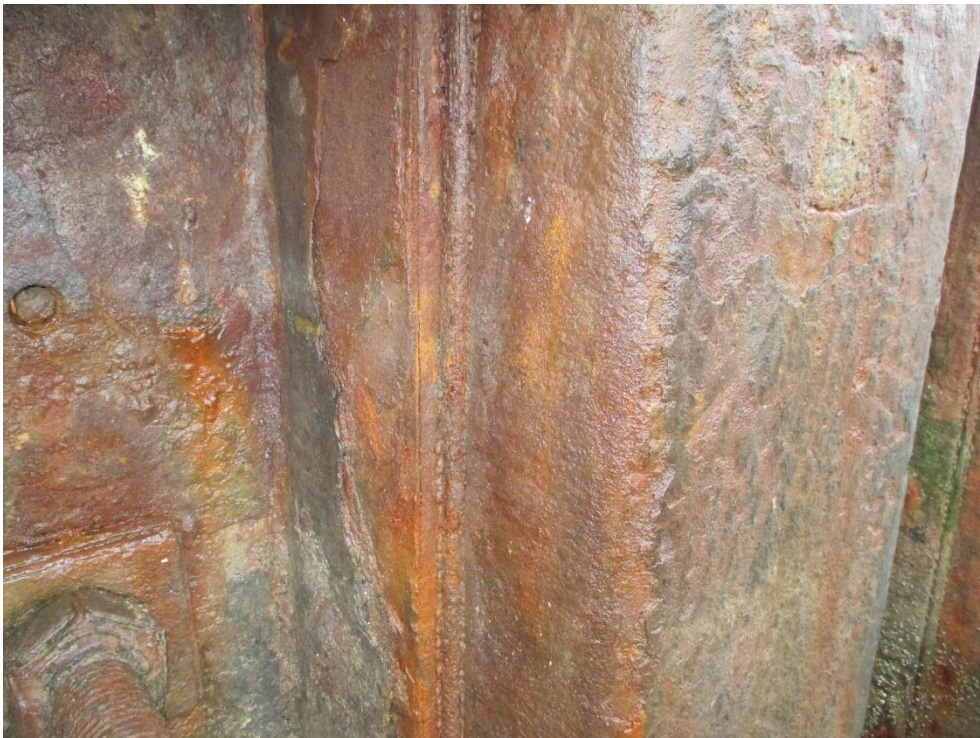


Fig B10 - Typical Steel Condition at Top of Tidal – Splash Zone



Fig B11 - Typical Condition within Intertidal Zone, beneath repair plates.



Fig B12 - Typical corrosion delamination and pitting

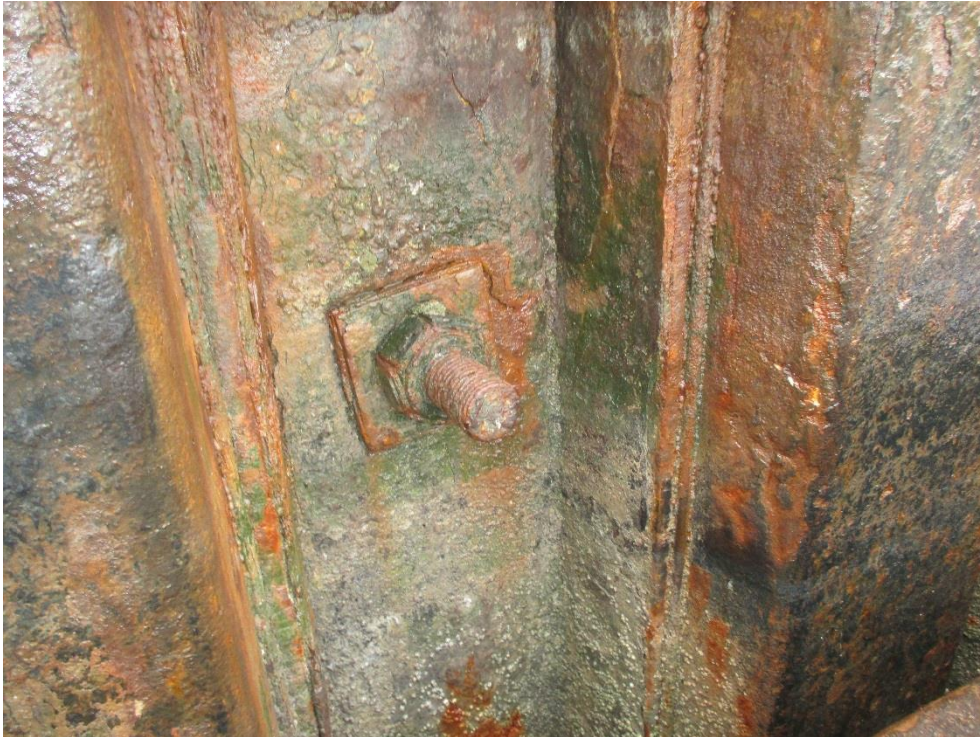


Fig B13 - Typical Condition at tie bar level at top of tidal zone

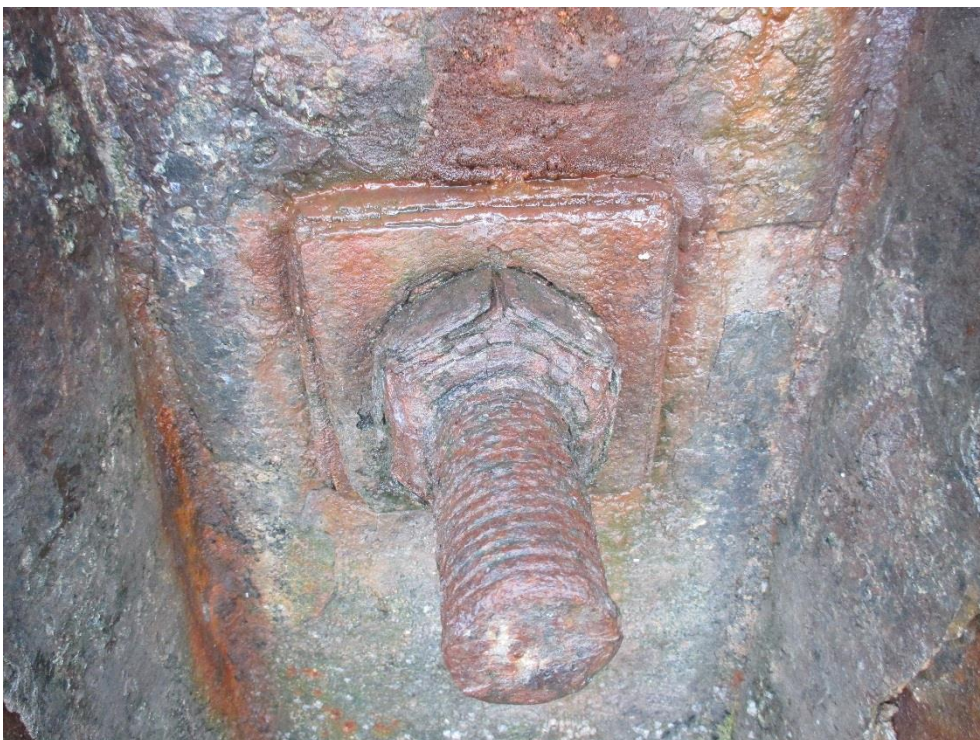


Fig B14 - Typical Tie Bar and surrounding steel condition



Fig B15 - Typical Steel Surface condition within intertidal zone along South Berth face



Fig B16 - Typical Steel Surface condition at lower Intertidal Zone
(Corrosion removed for UT measurement)



Fig B17 - Measurement location at lower intertidal zone (North Face)



Fig B18 - Hole at bottom of Pile above MLWS – Outpan No. 13, Northeast Wing



Fig B19 - Hole at bottom of Outpan No. 15 – Northeast Wing



Fig B20 - Typical Active Corrosion at MLWS



Fig B21 - Hole at MHWS level at corner with North – West Face. Outpan No. 111

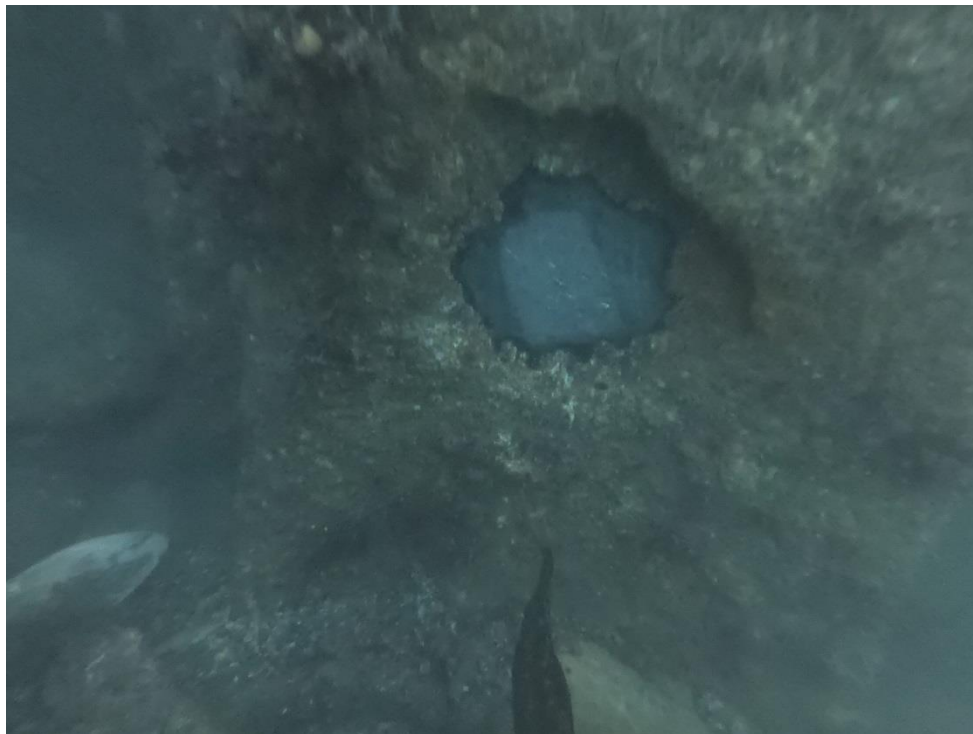


Fig B22 - Thickness Measurement location. Note clean steel beneath (MLWS)

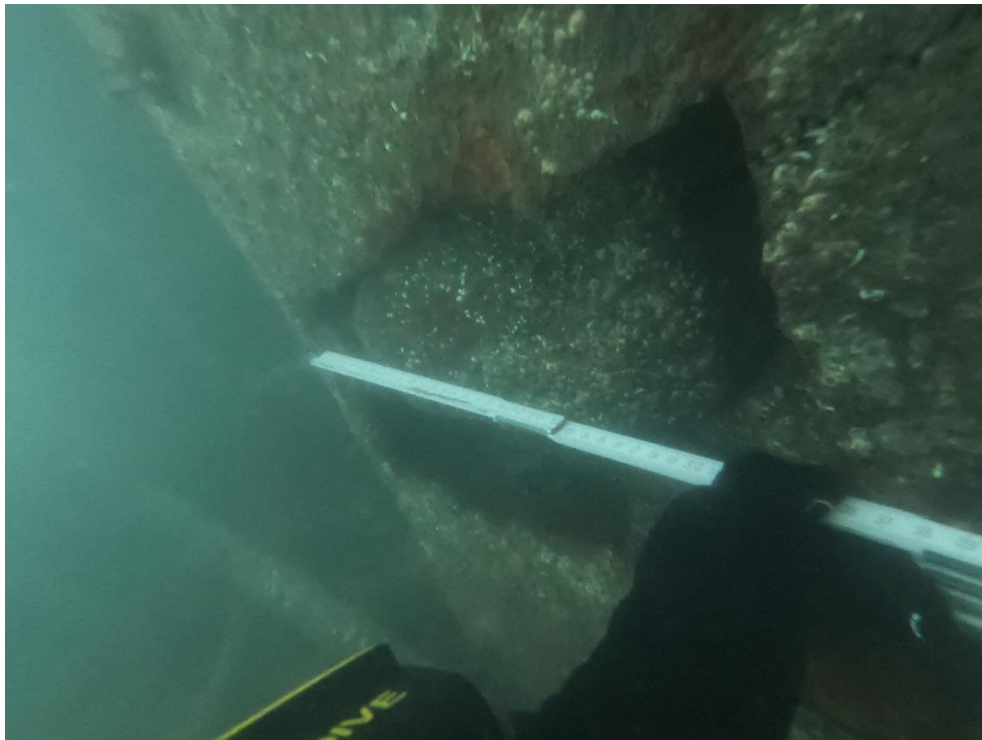


Fig B23 - Hole at Outpan No. 95 – Note Large fill stone within



Fig B24 - Hole at MLWS, Outpan No. 119 – ALWC evident at same level.



Fig B25 - Hole at MLWS, Outpan No. 117 – Typical at same level



Fig B26 - Thin remaining steel / Loose fill stone within – Typical detail

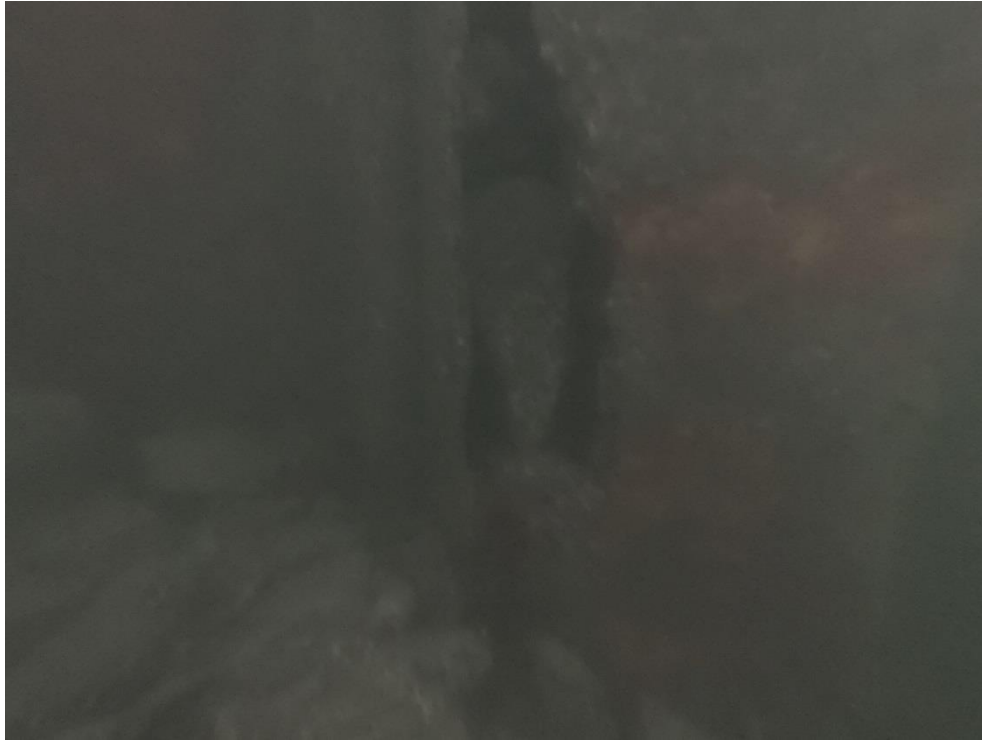


Fig B27 - Hole at bottom of Outpan No. 127

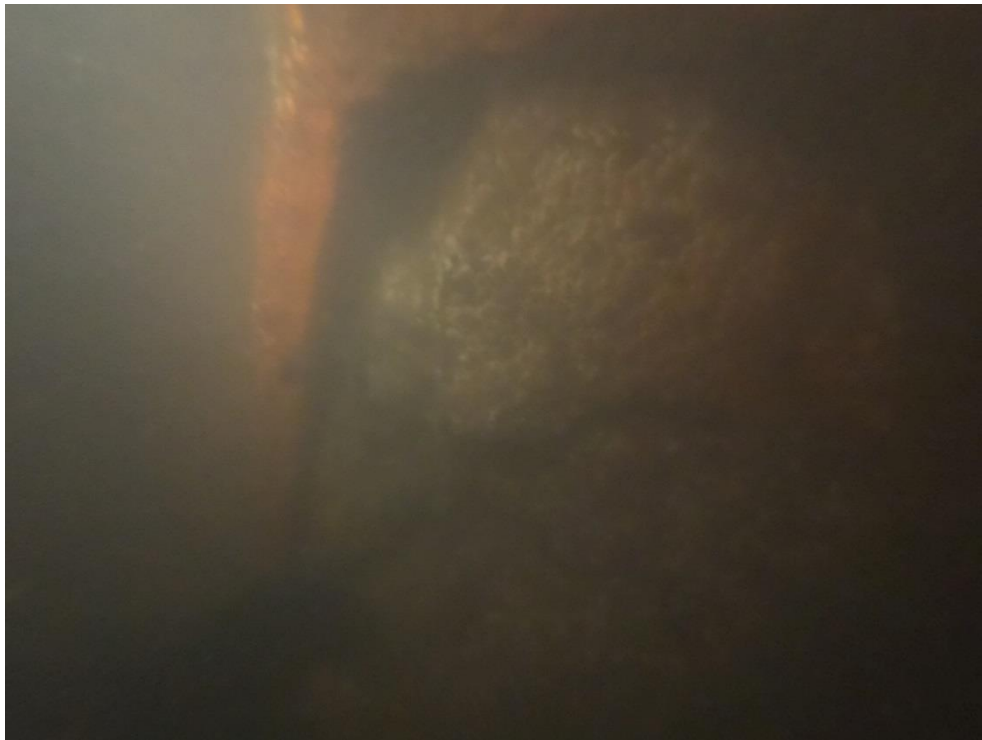


Fig B28 - Hole at MLWS, Outpan No. 149 – Full loss of pan face –
Typical detail along South face



Fig B29 - Typical Hole in Pile at MLWS along South Face -



Fig B30 - Hole at Bed level – Outpan N0. 217 – Note Void behind



Fig B31 - Complete loss of Pan Face at Outpan No. 219 (Typical Elsewhere)



Fig B32 - Loose flap of Steel following loss of pan face – Typical

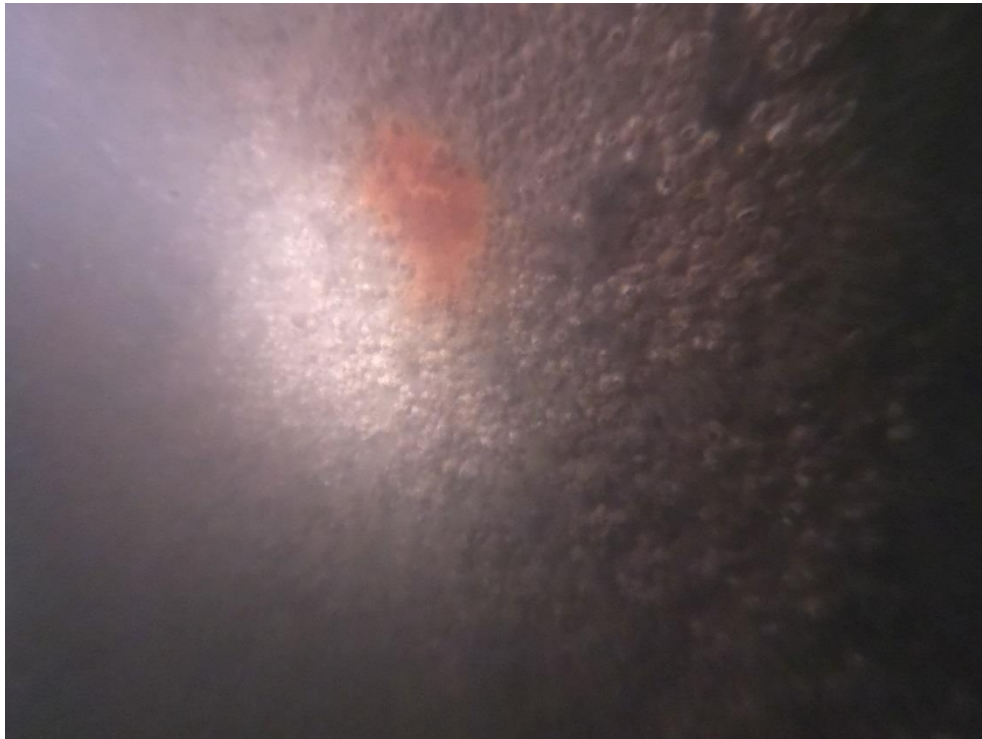


Fig B33 - Typical Isolated Corrosion Spot



Fig B34 - ALWC at MLWS level – Typical



Fig B35 - Hole beneath Repair Plate at top of Outpan No. 173 – Very thin material surrounding repair



Appendix C – Underwater Inspection Summary

Date of Inspection: 06/12/2021 – 07/12/2021
Structure: Sheet Piles
Location: Skerries Pier

Structure Condition Ratings	
Excellent Condition	0
Good Condition	1
Fair Condition	2
Poor Condition	3
Critical Condition	4
Unsafe Condition	5

Structural Element	Condition Rating
Steel Sheet Piles	4 - CRITICAL
General Condition	3 - POOR

OVERALL RATING	4 - CRITICAL
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Condition Rating Assessment Guide

Rating	Description
0	Excellent Condition. The structural element is of recent construction and exhibits no signs of deterioration.
1	Good Condition. The structural element exhibits no significant deterioration or defects. Minor defects/deterioration noted to not more than 5% of any structural element.
2	Fair condition. The structural element is intact and its load carrying capacity is considered to be unaffected. Moderate defects/deterioration noted to not more than 30% of the structural element.
3	Poor condition. Advanced deterioration or numerous moderate defects noted to the structural element with the load carrying capacity and /or functionality of the element considered to be affected.
4	Critical condition. Advanced deterioration and significant defects noted to the structural element with the functionality and/or load carrying capacity of the element considered to be significantly reduced with local failures possible.
5	Unsafe condition. Localised failures observed with future and widespread failures of failures of structural element likely to occur. Structural integrity of the structure is compromised.



Appendix D – Ultrasonic Thickness Measurements

Survey Location: Skerries Pier

Date: 06/12/2021 to 07/12/2021

Start Point : Northeast Corner of Piled Section (Adjacent to Masonry Section)

Outpan No.	1	3	5	7	9	11	13	15	17	19	21	23
Pier Section	Northeast Wing											
MHWS	6.60	8.75	8.65	4.80	5.80	6.20	4.10	4.80	3.55	8.65	10.25	5.80
-1	9.80	10.00	10.20	6.85	10.05	9.15	8.30	6.75	8.75	8.45	5.70	9.45
-2	10.20	10.00	11.15	11.05	10.75	10.50	10.10	9.20	9.30	9.90	9.25	10.20
-3	10.60	10.30	9.15	9.25	10.75	10.10	10.15	9.90	10.60	10.15	9.10	10.15
-4	BED	BED	BED	BED	10.15	8.25	10.75	10.15	10.35	10.20	10.90	9.25
MLWS					BED	BED	HOLE	HOLE	HOLE	9.10	9.80	7.10
							BED	BED	BED	BED	BED	BED
Bed Level												
Notes							Hole in pan at bed level. 620mm high, full width of pan face. Void within 500mm dp. Void continues vertically.	Hole at bed level. 1m high, full width of pan. Void within penetrates 1m.	Small hole in pan face Ø100mm. Loose fill in behind.			Corner - Northeast wing to North Face.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	25	27	29	31	33	35	37	39	41	43	45	47
Pier Section	North Face											
MHWS	4.90	5.80	7.50	6.85	6.85	4.20	2.75	7.20	8.70	6.10	6.15	5.90
-1	10.40	8.10	9.25	8.75	9.85	8.15	8.40	9.10	8.95	8.50	9.80	8.35
-2	10.20	9.90	10.00	9.95	10.10	9.25	10.30	10.30	9.25	9.95	10.10	9.80
-3	10.40	10.20	10.10	10.20	10.60	9.80	10.20	9.85	9.65	10.05	9.90	9.75
-4	6.60	8.95	8.70	8.65	8.00	9.90	10.05	9.70	9.85	8.75	9.85	9.60
MLWS	9.35	6.65	9.40	7.40	7.75	9.10	7.70	8.45	7.95	7.35	9.90	10.15
	BED	BED										
Bed Level			9.80		9.80		9.65		10.10		9.85	
Notes												

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	49	51	53	55	57	59	61	63	65	67	69	71
Pier Section	North Face											
MHWS	6.05	6.45	4.90	6.20	6.25	5.80	8.95	6.20	4.85	6.80	7.35	6.35
-1	8.10	7.10	6.80	8.95	7.80	8.25	9.80	7.90	7.85	8.20	9.80	7.95
-2	9.20	9.25	8.75	9.55	9.00	9.35	10.00	9.25	8.90	9.30	10.10	8.90
-3	9.85	9.60	9.15	10.10	9.60	9.60	10.20	10.10	9.40	9.65	10.15	9.80
-4	10.20	9.40	8.00	9.20	9.90	9.15	9.85	10.90	9.95	9.30	10.10	9.40
MLWS	7.85	5.50	8.95	6.90	8.75	8.60	9.40	11.05	9.90	9.85	9.90	8.30
Bed Level	10.30		8.45		10.60		9.80		10.90		9.95	
Notes												

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	73	75	77	79	81	83	85	87	89	91	93	95
Pier Section	North Face											
MHWS	6.05	5.60	4.75	6.95	7.00	6.80	3.80	6.90	5.65	5.40	3.75	4.20
-1	9.40	8.25	7.30	8.45	8.35	7.85	6.90	8.05	7.50	8.20	6.80	7.05
-2	9.60	8.65	8.65	10.10	9.20	9.65	8.45	8.80	8.20	8.90	8.40	8.10
-3	9.55	10.10	9.80	10.05	10.00	9.85	8.20	9.65	8.95	9.65	9.25	9.65
-4	9.80	10.05	9.35	9.55	10.10	10.30	8.65	9.70	9.30	9.55	9.30	10.15
MLWS	8.40	8.20	8.60	8.70	9.90	10.00	7.65	9.05	8.60	8.85	9.65	10.50
Bed Level	10.05		9.10		10.50				9.40	10.80		8.75
Notes							Hole at bottom of pile. 350mm high x 150mm wide. Large fill stone within.			Hole in face of pan. 500mm below MLWS 130mm high x 85mm wide. Large fill felt within.		Hole 500mm below MLWS 250mm high, full width of pan. Large stone fill behind.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	97	99	101	103	105	107	109	111	113	115	117	119
Pier Section	North Face							West (End) Face				
MHWS	4.55	8.75	9.00	7.20	6.75	5.40	3.60	Plate	Plate	Plate	Plate	Plate
-1	7.30	9.25	9.30	8.35	7.15	8.30	6.90	4.80	4.50	3.60	6.90	8.20
-2	8.90	9.65	8.40	8.60	7.55	9.60	7.85	8.25	6.20	8.95	9.20	10.10
-3	10.10	10.35	7.10	9.20	8.10	9.80	8.20	10.10	7.10	8.35	9.95	9.90
-4	9.95	10.70	4.85	9.00	7.80	8.90	8.35	10.25	7.20	8.90	8.25	9.35
MLWS	9.60	10.95		8.10	6.80	5.95	3.45	10.05	4.70	8.60		
			6.80								8.40	9.60
Bed Level		10.85	4.85		10.20		4.95		6.10		10.55	10.50
Notes			Hole at MLWS. 200mm high x 250mm wide. Large stone fill behind.				Corner - North Face	Corner - West (End) face. Hole at top of pile. 570mm high x 110mm wide. Void behind penetrates 630mm.			Hole 1.4m above bed. 800mm high, full width of pan. Ladder attached to Inpan No. 118	Hole at left hand corner of pan. MLWS. 220mm high x 90mm wide. Continues up RH web for 1.5m. Large fill within.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	121	123	125	127	129	131	133	135	137	139	141	143
Pier Section	West (End) Face				South Face							
MHWS	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
-1	6.95	6.05	6.70	6.90	6.05	7.10	7.35	7.10	10.20	8.65	9.75	9.60
-2	8.35	5.15			7.90	8.60	8.65	9.60	8.40		10.25	9.85
-3	8.70	4.60			8.25	9.85	8.90	9.85			10.10	9.40
-4					8.60	9.50	9.25	9.50			9.85	7.90
MLWS	7.60				8.00	8.40	8.65	8.20			9.65	
												8.65
Bed Level					8.90		9.10				9.50	5.80
Notes	Hole 1m above MLWS. 300mm high, full width of pan. Continues up LH web a further 2m.	Hole from bed level. Pile completely lost, 2m high, full face of pan. Continues up both webs. Loose material within.	Hole at bottom of pile. Full width of pan. Continues up both webs 2.5m. Loose flap of thin steel remaining.	Corner - West (End) face. Hole at bottom of pile. Steel connected at LH web, seperated at RH web for 3m above bed level. 1.6m void behind. Fill on bed.	Corner - South Face. Hole in web between corner pans at top of pile. 830mm high x 200mm wide.			Hole 500mm above MLWS 300mm high x 300mm wide. Large fill stone within.	Hole at MLWS. 2m high, full width of pan. Loose fill stone within.	Hole 1m above MLWS. Both webs completely lost, pan face loose. Extends to 1m below top of tidal zone. Loose fill stone within.		Hole 500mm above MLWS 300mm high, full width of pan.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	145	147	149	151	153	155	157	159	161	163	165	167
Pier Section	South Face											
MHWS	Plate	Plate	Plate	Plate	Plate	Plate	Plate	5.30	Plate	9.00	Plate	Plate
-1	10.10	8.45	8.20	8.40	8.60	9.10	9.20	7.90	7.30	9.80	6.75	7.90
-2	8.30	9.20	8.85	8.40	7.95	10.15	9.20	8.65	8.90	8.65	8.40	
-3	6.10	9.10	6.60	7.65	9.20	10.20	10.05	9.40	Access Restricted Due to Berthed Fishing Vessel. Condition assumed to be similar to piles either side of restricted access area.			
-4		6.35		5.80	5.10	8.20	9.60	9.35				
MLWS	6.90		5.40									
Bed Level		6.20	BED	BED	BED	BED						
Notes	Hole 1.5m above MLWS. 700mm high, full width of pan. Ladder attached to Inpan No. 144	Hole at 1.3m above bed. 200mm high, full width of pan. Loose fill stone within.	Hole 1.2m above bed. 300mm high, full width of pan.	Hole at Bed level. 130mm high x 140mm wide. Loose fill stone within.	Hole 350mm above bed level. 630mm high, full width of pan. Loose fill stone within.	Very Thin material remaining at MLWS. Holes developing on cleaning.	Hole at bed level. 250mm high, full width of pan.	Hole 500mm above bed level. 600mm high, full width of pan.				

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	169	171	173	175	177	179	181	183	185	187	189	191
Pier Section	South Face											
MHWS	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
-1	4.95	4.60	3.65	6.20	7.40	5.95	4.80	7.20	8.85	7.80	7.60	7.05
-2	Access Restricted Due to Berthed Fishing vessel. Condition assumed to be similar to piles either side of restricted access area.											
-3												
-4												
MLWS												
Bed Level												
Notes			Small hole at corner of pile extending beneath repair plate.		250mm area of impact damage beneath bottom of repair plate.				Ladder attached to Inpan No. 184			

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	193	195	197	199	201	203	205	207	209	211	213	215
Pier Section	South Face											
MHWS	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
-1	7.15	6.95	7.95	7.45	8.50	7.95	8.60	8.90	8.55	6.25	4.75	5.30
-2	Access restricted		8.00	8.90	9.55	10.10	8.75	10.00	9.20	7.80	8.30	6.65
-3			7.95	9.25	5.25	10.25	9.40	10.35	9.40	8.40	8.15	8.15
-4			6.25	9.60		9.60	9.55	9.65	8.15	9.65	8.90	
MLWS			5.30	6.10		4.25	6.15			6.90		
			BED	BED	BED	BED	BED	BED	BED	BED	BED	BED
Bed Level												
Notes					Holes in pile between 1m & 1.5m above bed level. Thin material surrounding.			Holes / very thin material covering bottom 600mm of pile. Loose fill stone within.	Hole in pile 300mm above bed level. 380mm high, full width of pan. Voiding behind. Loose fill stone on surrounding bed.		Hole in right hand corner of pile, 500mm above bed level. 200mm high x 90mm wide.	Holes / very thin material over bottom 1m of pile.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole

Outpan No.	217	219	221	223	225	227	229	231	233	235	237
Pier Section	South Face										
MHWS	Plate	Plate	Plate	Plate	6.75	8.45	10.05	9.80	9.75	10.10	11.60
-1	6.60	5.80	4.55	4.90	7.05	10.20	10.30	8.20	9.90	10.15	11.25
-2	9.80	7.85	6.20	9.15	7.95	10.15	10.50	8.45	9.70	10.45	11.05
-3	10.30	9.20	8.50	8.85	8.60	10.20	9.95	9.60	10.20	9.90	10.95
-4	9.70	5.85	7.40	8.25	7.15	8.45	7.65	9.10	8.60	7.20	8.75
MLWS				6.50					BED	BED	BED
	BED	BED	BED	BED	BED	BED	BED	BED			
Bed Level											
Notes	Holes in bottom 500mm of pile. Very thin material at base of pile.	Hole in pile 150mm above bed level. 360mm high, full width of pan. Large fill stone within.	Hole in pile 330mm above bed level. 250mm high, full width of pan. Void within.	Ladder attached to Inpan No. 224	Holes in pile at bed level on both sides, up to 900mm high. Very thin material between.	Hole in pile at bed level. 250mm high, full width of pan. Loose stone fill covering surrounding bed.	Holes in both corners of pan, 200mm above bed level. 150mm high x 90mm max width	Holes in both corners of pan, 200mm above bed level. 200mm high.			End of Piled section. Concrete to right hand side to tie into original masonry section.

Key

< 10mm
< 8mm
< 6mm
< 4mm / Hole