



**Comhairle Contae  
Dhún na nGall**  
Donegal County Council

## **RATHMULLAN PIER**

# **Condition Report**



**Sept 21**

**DONEGAL COUNTY COUNCIL**

**RATHMULLAN PIER**

**2021 CONDITION REPORT**

**Nicholas O'Dwyer Ltd  
Consulting Engineers  
Nutmog Office Park  
Nutmog Avenue  
Dublin 14**

**Sept 2021**

<b>PROJECT NO. Project No. 30425</b>					
<b>Revision</b>	<b>Reason for Revision</b>	<b>Prepared by</b>	<b>Reviewed by</b>	<b>Approved by</b>	<b>Issue Date</b>
-	First Issue	K. McGauran	R Crowe	R Crowe	Sept 21
A					
B					
C					
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## 1 EXECUTIVE SUMMARY

This condition report is a follow up with an inspection and recommendation from our previous reports in 1991 and 2008. The pierhead was constructed in 1957, and is accessed by a viaduct 120.3 m long built in 1934. The pier is still in operation though there is a weight restriction currently recommended for use of the viaduct and pier.

Condition inspections were carried out in 1991 and 2008 and the reports outlined the condition of the viaduct and pierhead. The 2008 report also made recommendations on repairs and provided cost estimates for the various options. Due to the ongoing deterioration of the viaduct substructure, especially in spans 1,2,3 and 4 (the landward spans) the assessment load for the viaduct was reduced to a 3 tonne working load in April 2008.

From our inspection in February 2021 and due to the increasing progressive deterioration of the pier structure particularly in relation to the beams and decking on the viaduct section the piers ongoing use may need to be curtailed for safety reasons.

The recommended solution at the time of the 2008 report was Option 4 as set out in section 7.2 of that report. This was to replace the viaduct deck slab and cross beams, repair the substructure of the viaduct and to repair and strengthen the superstructure of the pierhead. All other options noted in the 2008 report are now not possible with the current condition of the structure. A summary of same is set out in section 6.1.

The estimated cost of construction in 2008 was €2,093,000 (ex VAT). The current adjustment for additional repairs and inflation over the 13-year period now has the estimated cost at around €2,606,000 (ex VAT).

To ensure the ongoing safe use of the pier the recommended remedial works need to be carried out in the very near future. With the accelerating progression of the spalling, cracking of beams and corrosion of the reinforcement it may require the pier to be closed off to all access unless remedial works are carried out.

As outlined in this report protection measures are needed to be taken to protect the public from possible falling concrete under the bridge along the beach section.

## **2 INTRODUCTION**

### **2.1 Brief**

Nicholas O'Dwyer Ltd. were appointed by Donegal County Council as Consultant Engineers for Refurbishment of Rathmullen Pier back in 2008. This inspection and condition report is a follow up to the previous 2008 report to assess the current condition of the pier and the impact on its operation.

In order to preserve and improve the amenity provided by the pier, Donegal County Council proposes to repair and/or improve the pier, and in particular the approach viaduct section, to an extent that will permit the full potential of the pier to meet local needs to be realised.

### **2.2 Background**

Rathmullen Pier, located on the west of Lough Swilly, provides berthage for vessels at a 43 m long pierhead with a depth of water of 7.9 m at low water. The pierhead, which was constructed in 1957, is accessed by a viaduct 120.3 m. long built in 1934.

The pier was the subject of a previous inspections in 1991 and 2008, which were also carried out by Nicholas O'Dwyer Ltd. These inspections showed deterioration of the concrete structure of both the pierhead and the access viaduct. The pier and particularly the approach viaduct section were found to be in need of repair.

The 2008 inspection consisted of:

- An underwater examination of the structure
- A visual inspection of the pier and viaduct
- Sampling of concrete members and testing of concrete for strength and for chemical degradation
- A check on reinforcement to determine size, spacing and cover
- Proposals for the repair of the structure and an assessment of the structural capabilities of the structure following repairs
- Proposals for improvements to the structure to provide vehicle weights within statutory limits and to develop the potential of the facility.

### **2.3 Previous Recommendations**

The 2008 inspection found that the viaduct was in a poor state of repair and a load restriction of 3.0 tonnes should be imposed pending repair.

From a structural assessment of the members and the proposed repairs the study found that the capacity of the pier when repaired would be limited to vehicles of 20 tonne Gross Vehicle Weight. This was dictated by the capacity of the main beams of the pierhead.

### **2.4 Scope of Inspection carried out in 2021**

This report is to provide updated information on the existing structure and highlight areas of any concern since the inspection of April 2008.

This study consists of:

- A full visual inspection and condition assessment of the pierhead and the viaduct from above and below.
- Review the underwater survey carried out by a separate contractor on behalf of Donegal County Council. (This is addressed in Section 4.4)
- Review the previous proposals for repair of all damaged structural members to assess if they are still applicable.
- Review the costing of the options proposed previously, assess their potential costs at current values and make a recommendation of the preferred solution.

### **3 SITE AND FUNCTION**

#### **3.1 Site Location**

Rathmullen Pier is located in Lough Swilly at Rathmullen Town, approximately 10km north east of Letterkenny.

#### **3.2 Function**

The Pier provides berthage for vessels at a 43m long Pierhead , having a low water depth of 7.9m. The Pierhead, which constructed in 1957 is accessed by a 120m long viaduct, which dates back to 1934. A small private marina and a slipway are located adjacent to the pier. A roll on roll off car ferry operates from the slipway at Rathmullen to Buncrana during the summer months.

#### **3.3 Description of Structure**

##### **3.3.1 Pierhead**

The pierhead was completed in 1957. It is in 6 bays with each bay divided in two panels. The deck is constructed of prestressed concrete planks with an in-situ concrete topping. The planks are supported on precast reinforced concrete beams in pairs. The beams span 6m to cylindrical concrete columns 2.06 m in diameter. Each cylindrical column consists of precast concrete cylinders encasing 3 No. octagonal reinforced concrete piles. The precast concrete cylinders are filled with concrete. These columns are braced diagonally on the EW axis in all bays and on the NS axis in the end bays. There are horizontal bracing members in both directions at 5.03 m below deck level.

There is an additional concrete cylindrical column supporting a protruding section of pierhead on the shoreward side connecting the pierhead to the approach viaduct at a movement joint.

##### **3.3.2 Viaduct**

The viaduct was completed in 1934. The deck consists of a reinforced concrete slab supported on reinforced concrete beams. The beams are supported on reinforced concrete piers. The piers consist of 4No. reinforced concrete columns 406mm square, 2 each side of the deck at a rake of 1:12 to the longitudinal axis of the viaduct. The tops of the columns are connected by reinforced concrete cross beams in directions parallel and perpendicular to the longitudinal axis. The beams perpendicular to this axis support the deck beams. There is a further set of cross beams bracing the columns at a level 4.89 m below deck and there are reinforced concrete diagonal braces in the horizontal plane at this level. In the N/S direction, perpendicular to the longitudinal axis of the viaduct, there



are reinforced concrete diagonal braces in the vertical plane between the two levels above. At the shore end of the viaduct deck beams are seated on a stone pier that predates the viaduct.

### **3.4 Dimensions**

The pierhead is 43 m long. The prestressed concrete planks forming the deck span 5.46 m and are supported on precast reinforced concrete beams in pairs. The beams span 6.04 m to cylindrical concrete columns 2.06 m in diameter.

The viaduct deck slab 152mm thick and spans 1.35 m between beams. The beams span 7.11 m to the reinforced concrete piers.

Section dimensions of the various members are shown on Drawing 70487-02

### **3.5 Existing Underground and Overground Services**

There are lights on the pier and viaduct. The electrical services are carried in a duct on the northern side of the viaduct deck adjacent to the parapet and protected by concrete.

### **3.6 Ground Conditions**

Drawings for the pier show the piles are driven to rock. There is no data available for the viaduct. The landward end of the viaduct is founded on a bankseat on an old masonry pier.



## 4 CONDITION OF EXISTING STRUCTURE

### 4.1 Visual Inspection

A structural visual inspection was carried out of the pier during February 2021. The inspection was generally under the viaduct and pier head as these are the areas where the more serious levels of deterioration had occurred in the report from 2008.

A series of photographs were taken of each element and the level of deterioration of the structure was compared to the similar photos from the 2008 survey.

The piers were inspected at low water. Pier 1-4 along the viaduct were inspected from the shore the remaining piers were inspected from a boat. The underside of the pierhead and viaduct decks were inspected from below.

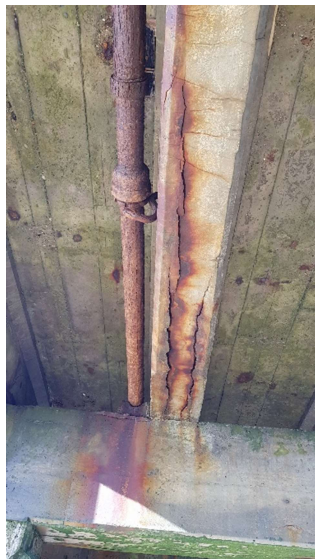
### 4.2 Condition of Viaduct Structure

#### 4.2.1 Deck Slab

The deck slab is still generally in good condition but there are some areas of corrosion on the soffit of the deck slab to the viaduct.

#### 4.2.2 Deck Beams

Almost all deck beams to the viaduct are severely cracked. Cracks in the soffits and on the sides of the beams run longitudinally and vary in width from hairline to 20mm. There is corrosion of reinforcement in all spans.



There are large areas of concrete spalling and in several the beams reinforcement is exposed. In some areas where the concrete has spalled away the reinforcement is severely corroded.

The cross beams at the top of the columns also show severe cracking and spalling of concrete with associated corrosion of the reinforcement. This is evident at all piers along the viaduct.

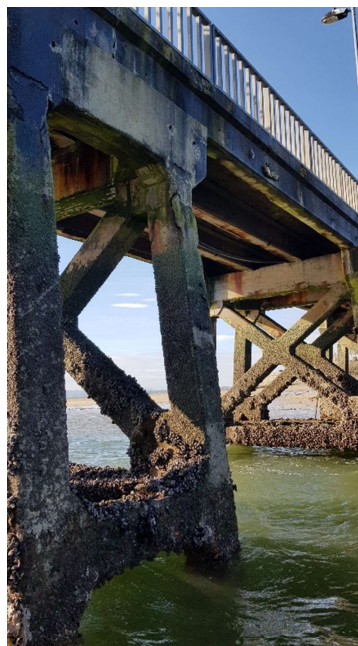
The level of deterioration for the beams under the decking shows significant increase from the 2008 inspection. There are areas where whole concrete beams have cracking along its full length.

We have attached a summary schedule in Section 4.3 indicating the previous and current levels of deterioration for the structural members. The beams supporting the deck are now at deterioration level 2 which shows significant progression of spalling and corrosion from the previous 2008 report.

#### 4.2.4 Piers

There are areas on all the columns where there is visible cracking and local deterioration of the reinforcement. The damage is normally at the corners of the columns in every column.

The diagonal bracing members in the vertical plane are cracked and concrete is spalling off these elements. Due to this there is visible corrosion of the reinforcement at all piers locations. The damage is severe on piers 8, 9, 11 and 12.



The lower beams and the diagonal cross bracings in the horizontal plane are in good condition.

There has not been the significant level of deterioration of these members from the previous inspection in 2008 but they do indicate some level of further corrosion.

### 4.3 Condition of Pierhead Structure

#### 4.3.1 Deck Slab

There is no evidence of any additional longitudinal cracking in the deck slab. There are some transverse cracks near to the joints in the slab where the joint in the slab does not coincide with the joint between adjacent precast deck beams and the slab has cracked on the line of the beam joints.

Generally speaking, the deck slab is in reasonable condition however the edges of the slab have considerable local damage and are in need of repair as was indicated in the 2008 report. This damage would appear to be caused by usage, probably by contact with moored vessels. There is no edge protection or rub strip on the pierhead. This area shows little sign of progressive deterioration.

#### 4.3.2 Deck Beams

There is notable deterioration in the condition of the cross beams. since the previous inspection.

Like the viaduct beams, the pier beams have longitudinal cracks. These range in width from hairline to 15mm. The most sever cracking is visible on beams at gridlines 19,20,21,22 18/P-Q 17/P-Q.



The beams supporting the deck are in need of repair to varying degrees. Some beams will require patch repair over a limited area whilst other beams will require a full depth repair over the length of the soffit with additional patch repairs on the sides. The level of deterioration has increased but not as significantly as the Viaduct section since the 2008 report.

#### **4.3.3 Columns**

No significant damage was recorded on the main pierhead columns. The column supporting the steps is damaged from use as a mooring post and will require repair.

#### **4.3.4 Bracings**

No significant damage was recorded on either the diagonal bracing or on the lower level bracing members between the columns.

### **4.4 Underwater Inspections**

An underwater inspection was carried out by Norfolk Marine on 25<sup>th</sup> and 26<sup>th</sup> February 2021 and their report issued on 9<sup>th</sup> April 2021. There were some minor cracks and spalls of the structure below water level but nothing significant. Their conclusions and recommendations were as follows.

#### *Conclusions*

The overall Condition of the underwater pier elements is rated as 1 – GOOD

- The underwater concrete elements are generally in good condition.
- Limited, minor defects were noted
- More significant defects were located above the water level, particularly to the soffit level beams and tops of diagonal members within the splash zone. These were inspected separately to the underwater inspection.
- There is some scour to base of the columns, particularly to the East and North edges of the pier head. This has exposed a larger diameter concrete ring at 3 locations that might be part of the column foundation or socket.

#### *Recommendations*

There are no urgent recommendations following the underwater inspection. However, the separate principle inspection report should also be consulted.

#### 4.5 Comparison of level of deterioration

Based on the 2008 report where there were schedules for the various spans and structural members we have prepared a summary table below to provide an indication of the progression of the deterioration levels between the 2008 inspection and the 2021 inspection.

VIADUCT STRUCTURE				
	2008 Inspection		2021 Inspection	
	Average Delapidation level	Comments	Average Delapidation level	Comments
<b>Decking Structure</b>				
Slab	5		5	
Internal support beams	2 to 3	Span 1 was level 1	2	Spans 1,4,10 and 11 are level 1 and exposed
Edge Support Beams	3 to 4	Span 1 and	2 to 3	Exposed
<b>Support Structures</b>				
Main Support Beam	3 to 4	reinforcement exposed	3	reinforcement exposed and corroded
Diagonal Bracing	6		5	
Columns	4		3 to 4	Some additional

PIER HEAD STRUCTURE				
	2008 Inspection		2021 Inspection	
	Average Deterioration level	Comments	Average Deterioration level	Comments
Slab	5		5	
Main Support Beam	3 to 4	One span has level 2 on grid 22	3	Reinforcement exposed in some areas. One span has
Diagonal Bracing	6		6	
Columns	6		6	

#### Deterioration level categories

- 1) Substantial areas of concrete spalled off. Substantial areas of main reinforcement corroded with loss of steel cross section. Reinforcement will require replacement over the full extent of the member and large areas of damaged concrete will require removal and replacement.
- 2) Significant longstanding corrosion of reinforcement is evident. Wide longitudinal cracks and some spalling of concrete. Loss of some of the steel cross. Additional reinforcement will be required and replacement of large areas of concrete.
- 3) Longstanding corrosion evident. Cracks, caused by expansion of corroding reinforcement, are clearly visible. Repair will require removal of damaged concrete, cleaning and protection of steel and replacement of cover. On exposure of reinforcement the damage may be found to fall into level 2 above and additional reinforcement may be required
- 4) Local corrosion of main reinforcement, minor cracking.
- 5) Local corrosion of secondary reinforcement or of shear links.
- 6) No visible signs of deterioration

It will be evident from the Table above the level of deterioration to the support beams of the decking are the more significant structurally. There is also the progression of the spalling to the pier supports which if not rectified will progressively deteriorate in a short time.

#### 4.6 Progressive Deterioration

From our inspection since the 2008 report there has been significant progressive deterioration to the Viaduct which is now at a point where the rate of damage will increase significantly over the next short period. Deterioration of a structure increases progressively with time whereby we could see the same level of deterioration that has taken 13 years to develop increase the same amount in a number of years. There is also the consequence where it is proposed to carry out repairs such as the Pierhead structure and the main supports for the



Viaduct that if these repairs are not carried out soon it could result in having to replace these structures.

It is also evident that in the near future the pier will have to be closed to all access as the condition of the decking support beams are not capable of sustaining the 3 tonne restricted loading currently allowed.

## **5 LOAD ASSESSMENT OF STRUCTURES**

An assessment of the load bearing capacity was carried as part of 2008 report which indicated the requirement to have a weight restriction placed on the pier. This weight restriction of 3 tonnes should remain in place but we recommend that inspections are carried out at a maximum of 2-year intervals if repairs are not proposed in the very near future. These inspections are to monitor if the level of deterioration has reached a significant point where the pier will need to be closed to all access for safety reasons.

### **5.1 Protection of Public under the Viaduct.**

Due to the continuous spalling of the concrete from the deck beams we would recommend netting is placed under the viaduct for the first 4 spans to protect public from falling concrete along the beach section. The alternative is to prevent access under the viaduct by closing off this area.

## 6 OPTIONS FOR REFURBISHMENT

At the time of the original report in 2008 there were 5 different options available for the repairs to the pier which are shown in the below table.

### 6.1 Options Considered

Option	Treatment of Viaduct	Treatment of Pierhead
<b>1</b>	Repair Deck(6.2), Cross Beams and Substructure(6.3).	Repair Superstructure(6.5)
<b>2</b>	Repair Deck(6.2), Cross Beams and Substructure(6.3)	Repair and Strengthen Superstructure (6.6)
<b>3</b>	Replace Deck(6.4). Repair Cross Beams and Substructure (6.3).	Repair Superstructure(6.5)
<b>4</b>	Replace Deck(6.4). Repair Cross Beams and Substructure (6.3).	Repair and Strengthen Superstructure (6.6)
<b>5</b>	Replace Deck(6.4). Repair Cross Beams and Substructure (6.3).	Replace superstructure(6.7)

### 6.2 Current Options for Repair

We no longer consider that repair of the Viaduct slab or beams is possible due to their condition. The only current solution is the following.

#### Option 6

*Viaduct:* Replace deck, replace cross beams and repair substructure.

*Pier head:* Repair and strengthen superstructure.

The replacement of the existing decking and beams to the viaduct can be carried out using precast concrete T Beams and slabs supported on the existing repaired structure.

The support structures for the decking on both the viaduct and pier head will have repairs carried out on areas where there is cracking or spalling.

Details of these replacement proposals have been itemised in the report from 2008.

## 7 COST ESTIMATES AND ASSESSMENT OF OPTIONS

### 7.1 Cost Estimates

Cost estimates were included in the 2008 report for the various options which were based on the condition of the pier at that time.

Due to the continuous deterioration of the structure over the last 13 years most of the proposals are not applicable for the current pier condition.

The following schedule indicates the estimate as noted from the previous report and makes the necessary adjustments to cater for current costs. We have estimated the costs will have increased by 33% over that period.

	Option 4 at 2008 rates	Current Estimate
Preliminary and General Items	325,000	432,000
Access and Temporary Support Works	36,000	47,000
Demolition of Viaduct Deck	80,000	104,000
Substructure Repairs to Viaduct	211,000	275,000
New Deck to Viaduct	891,000	1,158,000
Superstructure Repairs to Pierhead	155,000	181,000
Strengthened Deck to Pierhead	171,000	222,000
Ancillaries	77,000	100,000
Finishes	47,000	61,000
Sub Total	1,993,000	2,476,000
Contingency	100,000	130,000
<b>Total Excluding VAT</b>	<b>€2,093,000</b>	<b>€2,606,000</b>

The estimate is based on costs obtained from previous similar works. There is potential for this estimate to be exceeded and is dependent on a full design being carried out and a full tender package prepared.

## **7.2 Full Viaduct Pier Replacement Cost.**

If repairs were not carried out in the very near future to the Viaduct support structure and due to the ongoing progressive deterioration, there will be a point where the main support structures will need full replacing.

Based on the current spans and assuming the piled foundations remain at their current condition the replacement of the Viaduct support structure would be estimated to be in the region of an additional €1,500,000 (ex VAT) to the estimate provided in 7.1.

## **7.3 Phased Options on repairs.**

To maintain the pier in its current restricted access loading of 3 tonnes and if funding was available over a number of years we would recommend the following as a sequence of the repairs.

*Phase 1* carry out repairs to support structure of the Viaduct and Pier Head. This will provide some protection from progressive deterioration and not require full replacement in years to come. If the decking is not replaced on the Viaduct load restrictions, netting and inspections will need to be continuous until the decking and support beams are replaced.

*Phase 2* carry out replacement of the decking of the Viaduct including ladders and barriers.

If a phased approach is taken there will be some impact on the cost estimate due to mobilising and demobilising of contractors and possible increases in construction costs.

## 8 CONCLUSIONS AND RECOMMENDATIONS.

Based on an assessment of the pier and viaduct in its current condition and the comparison to the previous inspection and assessment in 2008 there has been some areas where significant deterioration to the structure has occurred, in particular to the support beams to the Viaduct decking. There is currently only one option available from the previous options provided in 2008 and that is Option 4. These remedial works will need to be carried out as soon as possible to prevent the pier been closed to all access in the near future.v

The works proposed are:

- Complete replacement of the Viaduct deck with a new deck of precast bridge beams.
- Repair of the Viaduct cross beams.
- Strengthening of the Pier deck by inserting a new beam between each pair of main beams.
- Repair of main beams in the Pier deck.
- Repair of the substructure of the Pier and Viaduct (columns and bracing).
- New fenders and ladders to the Pier.

As can be seen from table 7.1 above the estimated cost of this is €2,606,000. This is the most cost effective solution as it enables for the full loading of 20 tonne for the viaduct as well as achieving a capacity of 18 tonne for the pier head. This will allow use by vehicles with axle loads of up to 11,5 tonnes.

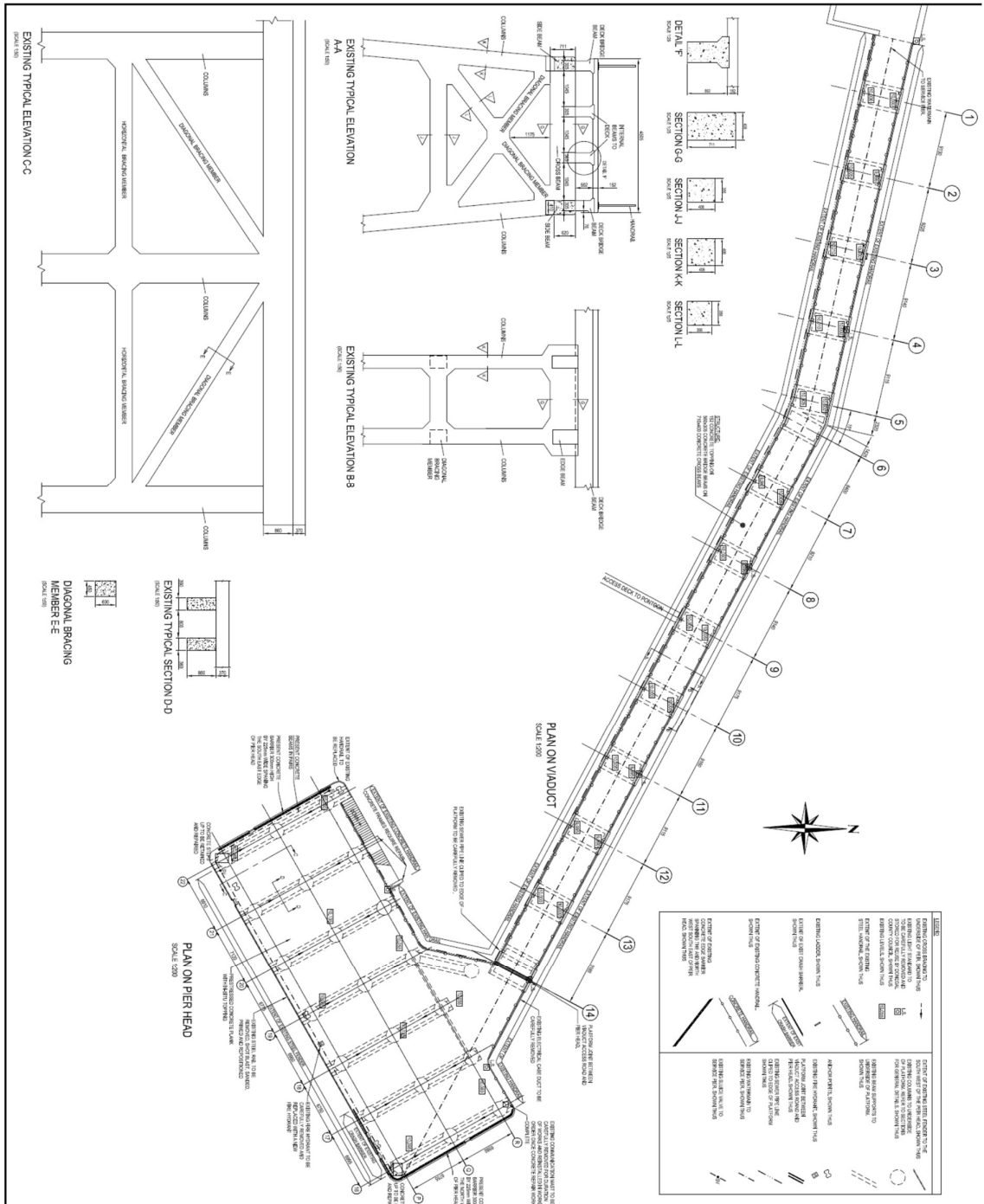
It is critical to realise that the viaduct in its current state will continue to deteriorate progressively over time and will need to be closed should repair works not be addressed as early as possible.

The current restricted 3 tonne maximum loading needs to remain in place until repairs are carried out.

Consideration should be given to erecting either netting to the underside of the pier or restrict access on the beach or to preventing access under the viaduct if there is a risk of more concrete being dislodged.

These measures, however, are a short term solution and this structure will continue to deteriorate unless full repair works as outlined in this report are carried out.

### APPENDIX 1 PIER LAYOUT



**APPENDIX 2**  
**SAMPLE PHOTOGRAPHIC RECORD**

