

Appendix 3-8

L-8221 Local Road Bridge Assessment

Carrownagowan Wind Farm

Assessment of Existing Structures along L-8221 Local Road



ISSUE FORM	
Project number	19107
Document number	600X
Document revision	A
Document title	Assessment of Existing Structures along L-8221 Local Road
Document status	Draft
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Document checked by	Cormac Murphy

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1 Introduction

It is proposed that two separate planning applications will be made by Coillte to An Bord Pleanála, in respect of the proposed wind energy project as set out below:

1. Application for the Carrownagowan Wind Farm (proposed development), including substation, met mast, access tracks, borrow pits, works on the turbine delivery route; and
2. Application for the Grid Connection, which is the underground cable to provide a connection to the national grid from the Carrownagowan Wind Farm.

For the purposes of the wind farm development described in Volume II, Chapter 2, the 'project' includes both the Carrownagowan proposed development and the Grid Connection. The current planning application relates to the proposed development, as outlined in Item 1 only.

Malachy Walsh and Partners (MWP) were engaged by Coillte to review existing road infrastructure along the L-8221 Local road that would be used for the delivery of wind turbine components to Carrownagowan Wind Farm. The proposed development is at a site located approximately 4km north-east of Broadford, County Clare. The proposed development comprises 19 no. wind turbines with associated infrastructure including access roads (new and upgrading of existing roads), a substation compound containing a control building and a substation building, a permanent meteorological mast as well as temporary infrastructure which comprises 2 no. site construction compounds.

This report does not assess the condition of infrastructure along the Motorway, National Primary and Regional road network which forms part of the proposed delivery route as these structures are regularly inspected by Transport Infrastructure Ireland (TII) and local authorities. This report only identifies the extents of any works envisaged along the L-8221 Local road but does not include detailed road or bridge improvement designs. Instead this report outlines potential issues relating to structures and recommends preliminary solutions that will facilitate the delivery of wind turbine components.

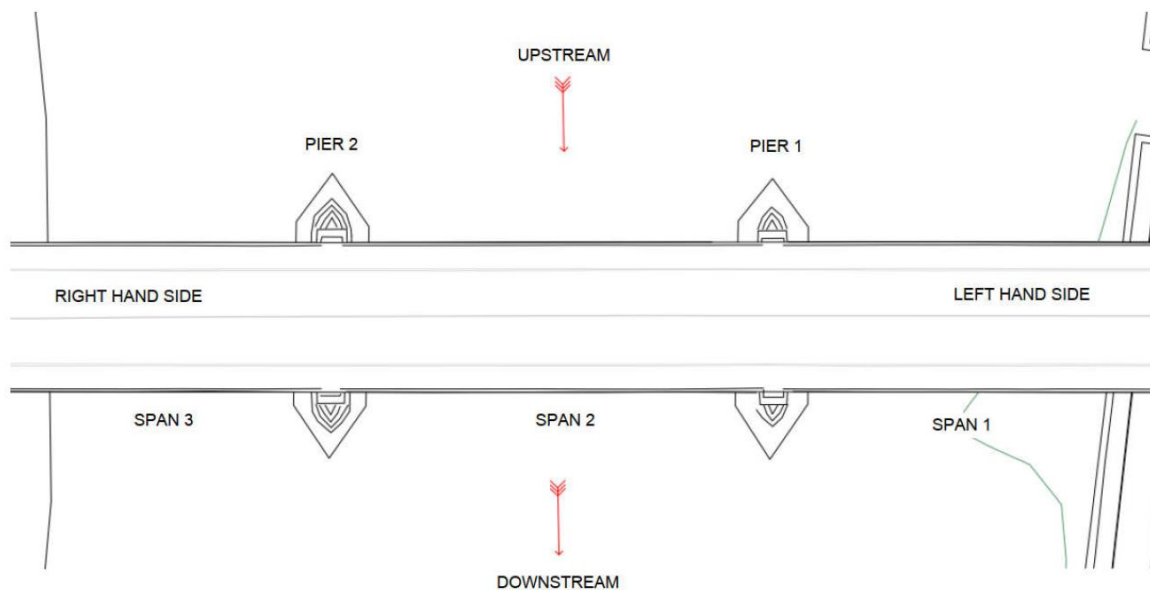


Figure 1 Naming Convention of Bridge Components

The locations of bridge components are identified in this report as upstream or downstream, left hand side or right hand side. Left and right hand sides are taken from an upstream viewpoint. Piers, spans, etc. are numbered from left to right.

2 Assessment Methodology

Following the initial assessment of the transport route, as outlined in **Appendix 3-6 of Volume 3 of the EIAR**, bridge inspections were carried out along the L-8221 Local road by MWP in December 2019.

The suitability of existing road infrastructure has been assessed on the assumption of a turbine chosen with a maximum tip height of 168m and a maximum rotor diameter of 136m, as outlined below:

- Blade Section Length: 68m;
- Max Diameter of Tower Section: Up to 4.5m;
- Max Clearance Envelope: Up to 6m wide x 7.5m high;
- Minimum Road Width Required: 5m;
- Maximum Axle Loading for Main Crane and Turbine Delivery Vehicles: 12t

3 Turbine Delivery Route

The components for the 19 no. turbines will be delivered by cargo ships to either Foynes Port in County Limerick or Galway Port in Galway City. The components for each turbine will be delivered in separate loads, some of which are abnormal in terms of their width and length. The components will be transported from either Foynes Port or Galway Port to the site along the Motorway, National, Regional and Local road network.

A permit for moving abnormal loads to the wind farm site will be sought from An Garda Síochána and the applicable local authorities on the selected haulage route with a transportation plan for the time of deliveries established at construction stage.

Refer to **Appendix 3-6 of Volume 3 of the EIAR** for a detailed description of the proposed turbine delivery routes, from both Galway and Foynes, and of the transport assessment.

The road route for starting at Galway Port is as follows:

- I. Starting at Galway Port;
- II. Lough Atalia Road to the R339 Regional road (Wellbrook Road);
- III. Wellbrook Road to the R336 Regional road (Tuam Road);
- IV. Tuam Road to the N6 National Primary road (Bóthar na dTreabh);
- V. Bóthar na dTreabh to the M6 Motorway;
- VI. M6 Motorway to the M6 / M18 Motorway interchange;
- VII. M6 / M18 Motorway interchange to Junction 18 on the M18 Motorway;
- VIII. Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;
- IX. Coolready to the Junction of the R465 Regional road / L-8221 Local road;
- X. L-8221 Local road to the site entrance.

Alternatively the road route for starting at Foynes Port is as follows:

- I. Starting at Foynes Port;
- II. N69 National Secondary road to Junction 2 on the N18 National Primary road;
- III. Junction 2 on the N18 National Primary road to Junction 18 on the M18 Motorway;
- IV. Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;
- V. Coolready to the Junction of the R465 Regional road / L-8221 Local road;
- VI. L-8221 Local road to the site entrance.

The Limerick Tunnel on the N18 National Primary road has a height clearance of 4.65m and will accommodate the turbine blades and the upper tower sections on the route above. However, it may not be high enough for the bottom tower sections or the nacelles for the turbine types envisaged on this project. Therefore these turbine components will travel as follows:

- I. Starting at Foynes Port;
- II. N69 National Secondary road to Junction 2 on the N18 National Primary road;
- III. Junction 2 on the N18 National road to Shannon Bridge on the R510 Regional road;
- IV. Shannon Bridge to the Roundabout on the R527 Regional road / R857 Regional road;
- V. R857 Regional road to Junction 4 on the N18 National Primary road;
- VI. Junction 4 on the N18 National Primary road to Junction 18 on the M18 Motorway;
- VII. Junction 18 on the M18 Motorway to Coolready on the R352 Regional road;
- VIII. Coolready to the Junction of the R465 Regional road / L-8221 Local road;
- IX. L-8221 Local road to the site entrance.

4 Analysis of Structures

4.1 Methodology

All identified structures were assessed along the L-8221 from the junction of the R465 Regional road / L-8221 Local road at Drummod to the site entrance at Caherhurly. Each structure was surveyed by MWP and measurements were taken of all relevant dimensions. The overall condition of the structures was assessed, noting any cracking and any other signs of damage or deformation to the structures. Photographs were taken to record the condition of the bridges or culverts at the time of the survey. A standard maximum axle load of 12t for the main crane, and a maximum load of 12t for the turbine delivery vehicles were used during the assessment. Minimum axle spacing for the crane and delivery vehicles is typically at 1.6m and 1.2m centres respectively.

4.2 Location and Type of Structures

The location and type of each bridge or culvert along the L-8221 Local road is tabulated below. Refer also to the location map in Figure 2.

Structure No.	Structure Type	Single / Double Span	Co-ordinates (ITM)
1	Stone Clapper Culvert	Double	559570, 679760
2	Stone Clapper Culvert	Single	560014, 679871
3	Stone Clapper Culvert	Single	560299, 679881
4	Cast In-Situ Concrete Culvert	Single	560335, 679876
5	Cast In-Situ Concrete Culvert	Single	560344, 679885
6	Stone Clapper Culvert	Single	560912, 679894
7	Stone Clapper Culvert	Single	561071, 679852
8	Reinforced Concrete Bridge	Single	561258, 679789

Table 1 Location and Summary of Structures along L-8221 Local Road

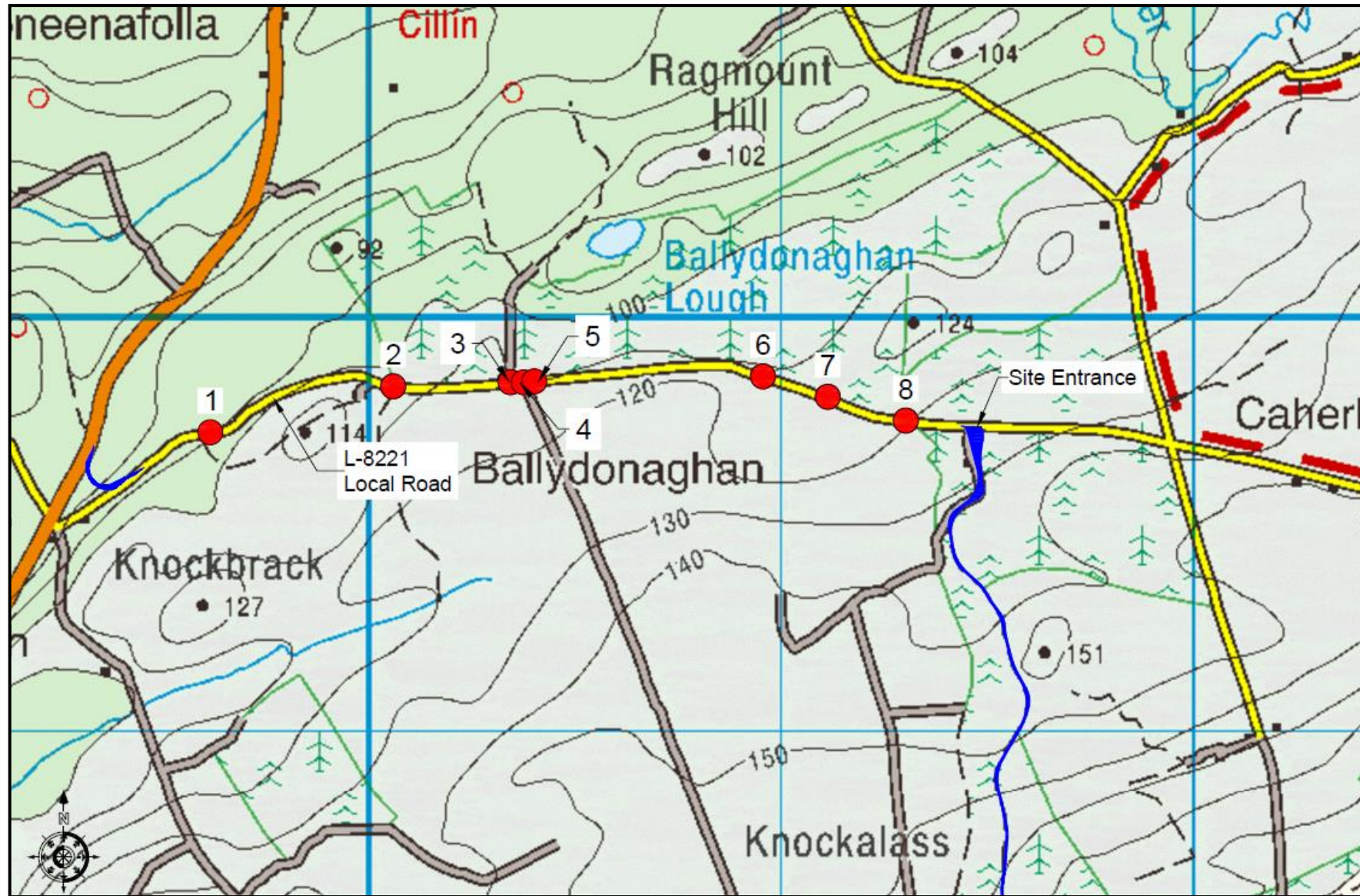


Figure 2 Location Map of Structures along L-8221 Local Road

4.2.1 Structure No. 1

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	1		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Stone Clapper Culvert		
Co-ordinates (ITM):	559570, 679760		
Culvert Geometry:			
No. of Span(s):	2	Parapet Height:	N/A
Span(s):	0.70m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.95m	Depth of Fill over Structure:	1.50m
Rise at Crown (Upstream)	1.80m	Downstream Road Verge Width:	2.50m
Thickness of Central Pier:	0.65m	Upstream Road Verge Width:	1.80m
Carriageway width:	4.20m	Length of Structure:	8.50m
Structural Assessment Summary:			
Condition of Culvert	Tree growing at upstream elevation blocking water flow within span 1 of culvert		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a double span stone clapper culvert serving a stream crossing. The culvert was generally found to be in good condition with no signs of cracking or deformation present. A tree was found to be growing on the upstream elevation of the structure which is currently blocking the flow of water within span 1 (Figure 4 and Figure 6). Water flow within span 2 remains uninterrupted (Figure 5). The road carriageway above the structure was also found to be in good condition (Figure 7).

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 3 View of Downstream Elevation of Structure No. 1



Figure 4 View inside Span 1 of Structure No. 1



Figure 5 View inside Span 2 of Structure No. 1



Figure 6 View of Upstream Elevation of Structure No. 1



Figure 7 View of Road Carriageway above Structure No. 1

4.2.2 Structure No. 2

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	2		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Stone Clapper Culvert		
Co-ordinates (ITM):	560014, 679871		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	0.50m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.45m	Depth of Fill over Structure:	1.40m
Rise at Crown (Upstream)	No Access	Downstream Road Verge Width:	2.20m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	1.80m
Carriageway width:	3.40m	Length of Structure:	7.40m
Structural Assessment Summary:			
Condition of Culvert	Adequate		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span stone clapper culvert serving a land drain crossing. The culvert was generally found to be in good condition with no signs of cracking or deformation present. Water flow within the channel was found to be uninterrupted (Figure 8). The road carriageway above the structure was also found to be in good condition (Figure 9). Note access could not be obtained to view the upstream elevation of the structure.

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 8 View of Downstream Elevation of Structure No. 2



Figure 9 View of Road Carriageway above Structure No. 2

4.2.3 Structure No. 3

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	3		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Stone Clapper Culvert		
Co-ordinates (ITM):	560299, 679881		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	0.60m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.30m	Depth of Fill over Structure:	0.50m
Rise at Crown (Upstream)	0.80m	Downstream Road Verge Width:	2.80m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	0.90m
Carriageway width:	3.30m	Length of Structure:	7.00m
Structural Assessment Summary:			
Condition of Culvert	Downstream side of channel blocked		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span stone clapper culvert serving a land drain crossing. The culvert was generally found to be in good condition with no signs of cracking or deformation present. Water flow was found to be blocked at the downstream side of the structure but flow was uninterrupted at the upstream side (Figure 10). The road carriageway above the structure was also found to be in good condition (Figure 11).

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.

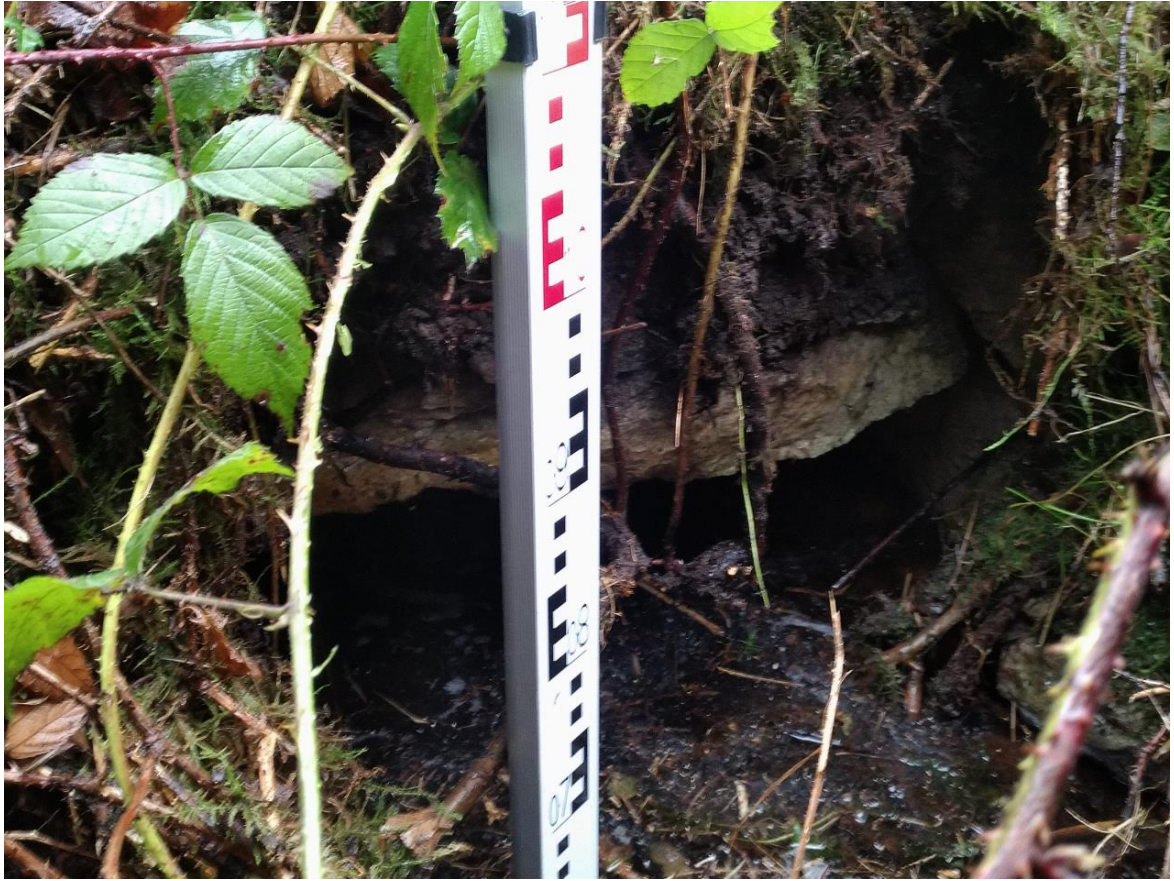


Figure 10 View of Upstream Elevation of Structure No. 3



Figure 11 View of Road Carriageway above Structure No. 3

4.2.4 Structure No. 4

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	4		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Cast In-Situ Concrete Culvert		
Co-ordinates (ITM):	560335, 679876		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	1.00m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.35m	Depth of Fill over Structure:	0.50m
Rise at Crown (Upstream)	0.45m	Downstream Road Verge Width:	1.20m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	1.90m
Carriageway width:	3.30m	Length of Structure:	6.40m
Structural Assessment Summary:			
Condition of Culvert	Adequate		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span cast in-situ concrete culvert serving a land drain crossing. The culvert was previously a stone clapper structure but the original flagstones have been replaced with cast in-situ concrete slabs. The structure was generally found to be in good condition with no signs of cracking or deformation present. Water flow within the channel was found to be uninterrupted (Figure 12). The road carriageway above the structure was also found to be in good condition (Figure 13).

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 12 View of Downstream Elevation of Structure No. 4



Figure 13 View of Road Carriageway above Structure No. 4

4.2.5 Structure No. 5

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	5		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Cast In-Situ Concrete Culvert		
Co-ordinates (ITM):	560335, 679876		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	1.20m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.35m	Depth of Fill over Structure:	0.65m
Rise at Crown (Upstream)	0.45m	Downstream Road Verge Width:	1.20m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	1.90m
Carriageway width:	3.30m	Length of Structure:	6.40m
Structural Assessment Summary:			
Condition of Culvert	Adequate		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span cast in-situ concrete culvert serving a land drain crossing. The culvert was previously a stone clapper structure but the original flagstones have been replaced with cast in-situ concrete slabs. The structure was generally found to be in good condition with no signs of cracking or deformation present. Water flow within the channel was found to be uninterrupted (Figure 15 and Figure 16). The road carriageway above the structure was also found to be in good condition (Figure 17).

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 14 View of Upstream Elevation of Structure No. 5



Figure 15 View inside Channel of Structure No. 5



Figure 16 View of Downstream Elevation of Structure No. 5



Figure 17 View of Road Carriageway above Structure No. 5

4.2.6 Structure No. 6

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	6		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Stone Clapper Culvert		
Co-ordinates (ITM):	560912, 679894		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	0.50m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	No Access	Depth of Fill over Structure:	1.00m
Rise at Crown (Upstream)	0.50m	Downstream Road Verge Width:	1.00m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	0.70m
Carriageway width:	3.20m	Length of Structure:	4.90m
Structural Assessment Summary:			
Condition of Culvert	Adequate		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span stone clapper culvert serving a land drain crossing. The culvert was generally found to be in good condition with no signs of cracking or deformation present. Water flow within the channel was found to be uninterrupted (Figure 18). The road carriageway above the structure was also found to be in good condition (Figure 20). Note access could not be obtained to view the downstream elevation of the structure.

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 18 View of Upstream Elevation of Structure No. 6



Figure 19 View Upstream at Structure No. 6



Figure 20 View of Road Carriageway over Structure No. 6

4.2.7 Structure No. 7

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	7		
Location:	L-8221, Ballydonaghan, Co. Clare		
Structure Type:	Stone Clapper Culvert		
Co-ordinates (ITM):	561071, 679852		
Culvert Geometry:			
No. of Span(s):	1	Parapet Height:	N/A
Span(s):	0.30m	Crown to Top of Parapet:	N/A
Rise at Crown (Downstream):	0.30m	Depth of Fill over Structure:	1.80m
Rise at Crown (Upstream)	No Access	Downstream Road Verge Width:	1.30m
Thickness of Central Pier:	N/A	Upstream Road Verge Width:	1.00m
Carriageway width:	3.30m	Length of Structure:	5.60m
Structural Assessment Summary:			
Condition of Culvert	Upstream channel blocked. 300mm Ø CorriPipe installed at downstream elevation of structure		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span stone clapper culvert serving a stream crossing. The structure has been modified at the downstream elevation with the installation of a 300mm Ø CorriPipe (Figure 22). There were no signs of cracking or deformation present at the structure. Water flow was found to be blocked at the upstream side of the structure but flow was uninterrupted at the downstream side (Figure 18 and Figure 23). The road carriageway above the structure was found to be in good condition (Figure 24). Note access could not be obtained to view the upstream elevation of the structure.

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 21 View of Downstream Elevation of Structure No. 7



Figure 22 View of 300mm \varnothing CorriPipe within Structure No. 7 at Downstream Elevation



Figure 23 View Upstream of Structure No. 7



Figure 24 View of Road Carriageway above Structure No. 7

4.2.8 Structure No. 8

A summary of the structure is presented below, along with the findings in relation to structural issues and remedial options.

Structure Ref No.	8		
Location:	L-8221, Caherhurly, Co. Clare		
Structure Type:	Reinforced Concrete Bridge		
Co-ordinates (ITM):	561258, 679789		
Culvert Geometry:			
No. of Span(s):	1	Crown to Top of Parapet:	1.20m
Span(s):	2.00m	Depth of Fill over Structure:	0.10m
Rise at Crown (Downstream):	0.75m	Parapet to Parapet (at Skew):	9.50m
Rise at Crown (Upstream)	No Access	Length of Parapets:	4.70m
Thickness of Central Pier:	N/A	Downstream Road Verge Width:	1.90m
Carriageway width:	3.40m	Upstream Road Verge Width:	2.20m
Parapet Height:	1.10m	Length of Structure:	7.50m
Structural Assessment Summary:			
Condition of Bridge	Adequate		
Remedial works required?	Yes, installation of reinforced concrete slab over structure		
Vertical Alignment	No vertical alignment issues		
Horizontal Alignment	No horizontal alignment issues		

This structure consists of a single span reinforced concrete bridge serving a stream crossing. The bridge was generally found to be in good condition with no signs of cracking or deformation present. Water flow within the channel was found to be uninterrupted (Figure 26 and Figure 27). The bridge parapets and road carriageway above the structure were both found to be in good condition (Figure 28). Note access could not be obtained to view the upstream elevation of the structure.

To cater for the maximum 12t axle loadings expected from the main crane and turbine deliveries, it is recommended that a reinforced concrete slab should be laid above the existing structure. The installation of a reinforced concrete slab will cater for the delivery of abnormal loads to the wind farm but will also be of long term benefit by protecting the existing fabric of the structure and preventing any failure from other heavy loads.



Figure 25 View of Downstream Elevation of Structure No. 8



Figure 26 View of Downstream Elevation of Structure No. 8



Figure 27 View of Channel within Structure No. 8



Figure 28 View of Road Carriageway above Structure No. 8

5 Summary

The majority of structures identified along the L-8221 Local road consist of small stone clapper culverts serving land drain crossings. Generally all the structures identified were found to be in good condition with some having had previous repair work carried out.

It is recommended that a reinforced concrete slab be installed above each of the 8 no. identified structures to ensure that they have sufficient structural capacity to cater for the delivery of abnormal loads to the wind farm (Figure 29). This action will also be of long term benefit to the L-8221 as it will protect the existing fabric of each structure and prevent any failure from other heavy loads.

It is also recommended that pre and post-construction surveys be carried out to ensure the structural integrity of the selected haulage route. During construction of the wind farm the appointed contractor should implement a monitoring regime to ensure the condition of each structure along the L-8221 does not deteriorate below a standard that could affect its use. Following completion of the works the condition of the structures and public road network should be of at least the same standard as they were prior to commencement of construction.



Figure 29 Typical Installation of a Reinforced Concrete Slab over a Stone Clapper Structure