Bridge Assessment

West Springfield Solar EIA Report

TRIO West Springfield Solar LLP

Prepared by:

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Making Sustainability Happen

Revision Record

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Acronyms and Abbreviations

SLR	SLR Consulting Ltd
GVW	Gross Vehicle Weight
STGO	Special Types General Order
SV	Special Vehicle
DMRB	Design Manual for Roads and Bridges
CD	Construction Document

1. Executive Summary

SLR Consulting Ltd was commissioned by TRIO West Springfield Solar LLP to assess the suitability of an existing bridge for construction traffic during the development of a proposed solar farm west of the village of Springfield, Fife. The bridge was visually inspected on March 3, 2025, by SLR engineers. The use of alternative crossing points utilising existing bridges within the area was reviewed but deemed unsuitable due to ownership restrictions, structural limitations, or impractical access routes.

The inspection revealed significant structural deterioration. The steel I-beams exhibited severe corrosion, with perforations and material loss, reducing their load-bearing capacity. The concrete deck showed signs of moisture penetration that indicates potential long-term degradation. The masonry abutments have cracks and scour damage, particularly at the upstream western and downstream eastern corners, compromising stability. These structural deficiencies raise concerns about the bridge's ability to support heavy construction traffic, making its use unsafe in its current condition.

Alternative locations for a new bridge were considered, whilst some are technically feasible, based on current information, SLR's view is that the costs associated with alternative locations would outweigh potential benefits.

Given the extent of deterioration, remediation of the existing bridge was deemed impractical.

Therefore replacement, or a temporary bridge installation are presented as feasible solutions. A full bridge replacement would involve demolishing the existing structure and constructing a new structure inclusive of new abutments. Alternatively, a temporary modular bridge could be installed to provide site access during construction, requiring minor abutment reinforcement. While a temporary bridge offers a quicker and lower-cost solution, a permanent replacement ensures long-term reliability and reduced maintenance.

2. Introduction

2.1.1 SLR Consulting Ltd (SLR) was commissioned by TRIO West Springfield Solar LLP (TRIO) to inspect the existing bridge structure within the site of the Proposed Development. The aim of the inspection is to determine whether the bridge is suitable for use during the construction of the proposed solar farm and potentially for routine maintenance and pedestrian access thereafter. This report details the extent of the inspection, SLR's assessment of the likely construction traffic and loadings, and our recommendation on whether the structure is suitable in its current condition or if alternative solutions are required.

2.1.2 It is understood that permissible construction access to the development is via the eastern side, adjacent to the town of Springfield. Access during construction will not be permissible from the western public road. SLR understands that the bridge is required to link the east and west portions of the site, which are separated by the Rankeilour Burn watercourse.

2.1.3 The watercourse has three established bridge crossings within the vicinity of the development. The main bridge under consideration is located adjacent to an old mill farm building near the centre of the site, downstream of a historic weir structure.

3. Inspection of Existing Structure

3.1 Inspection Conditions

3.1.1 SLR attended site on Monday 3rd March 2025. The site inspection was undertaken by Ross Manson (Associate Civil Engineer) and Angus Dickson (Project Civil Engineer) from SLR. The inspection conditions were good, and the river water level was low enough that a detailed inspection of the existing structure was possible.

3.1.2 SLR reviewed the existing bridge structure, shown below in Photo 1 located at National Grid Reference: NO 33020 11253 (What Three Words: faster.salary.guitar). No historical records were available regarding the structure's construction date or original purpose. However, based on its location, design and materials, it is presumed to have been constructed for farm traffic. This structure was selected for review as it appears to be best located to handle the proposed construction traffic.

Photo 1 - Existing Bridge Structure

3.1.3 SLR reviewed the feasibility of other nearby bridge structures for potential use in the development. However, for the following reasons, these alternatives were not considered viable:

- Southern Bridge (Public Footpath Bridge) – A brief walkover inspection was conducted on a bridge located to the south of the site, just beyond the proposed development boundary. This bridge is part of a public footpath and is outside the client's site limits. Therefore, it is not suitable for construction traffic and was therefore not considered further.
- Northern Bridge (Stone Arch Bridge near Stables and Main House) – To the north, a substantially larger stone arch bridge was identified near the stables and main house. This structure appears to be in good condition and capable of carrying significant loads. However, it is understood that the landowner has

declined permission for construction access through this area. As such, despite its likely suitability in terms of structural integrity, it is not an available option.

- Western Bridge (Small Ditch Crossing) – Further west along the track, another crossing exists over a disused mill lade, which appears to serve as a runoff channel from the old mill building rather than an active watercourse. Given the minor scale of this crossing, it is likely that the simplest and most practical approach for construction access would be to infill the ditch rather than upgrade the existing structure.

3.2 Bridge Composition

3.2.1 The bridge is composed of a concrete bridge deck which is supported by four steel I-beams spanning between masonry abutments. The bridge spans a small stream which is controlled upstream (approx. 100m) via a historic weir and sluice gate.

3.2.2 The span between the two abutments is 5.2m. The height of the abutments from water level to underside of steel I-beams is variable with a noticeable fall from the east bank to the west, on the east the height is 2.1m and on the west it is 1.6m. The abutments are composed of large random coursed masonry units which project down to the water level. Masonry units were of variable size.

3.2.3 The road is 4.3m wide between the bridge parapets, which are composed of metal railings embedded in a raised brick masonry edge. The road has a cobbled stone finish above a concrete deck, which is only visible below. The road surface is overgrown across the bridge, other than defined tyre tracks. On the west side of the bridge at the end of the span the road surface abruptly falls away onto a steep dirt track as seen in Photo 2, which would require regrading to be suitable for construction traffic. The east side track rises away from the bridge.

Photo 2 - Drop on Eastern End

3.2.4 The main bridge support is provided by the four steel I-beams, these are not distributed equally and appear to perhaps have been positioned to better manage wheel loadings. The I-beams were measured at 203mm in height and 130mm in width with a 10mm steel thickness on the flange, this would be consistent with a standard beam 203x133x30UB. The beams are projected into the masonry abutments with a concrete surround and while not visible it is assumed that they have a simple fixed end bearing connection.

3.2.5 The concrete deck is visible on the underside of the bridge and spans across the four steel beams. The deck thickness varies, with a noticeable reduction in depth beyond the outermost steel beam towards the bridge edge.

3.2.6 Photo 3 shows the general arrangement of the underside of the bridge, with the four steel beams projecting into the masonry abutments and the concrete deck.

Photo 3 - Bridge Structural Arrangement

3.3 Bridge Condition

3.3.1 SLR inspected the general condition of the main structural elements. This was limited to visual observation and measurements and did not include any in-situ testing or sampling.

Steel Beams

3.3.2 The Steel I-Beams were in poor condition. Severe corrosion was observed on all steel beams, with notable section loss, particularly in the web and top flange, where perforations were present. The pitting suggests deep material loss beyond surface oxidation only, which will have resulted in loss of section.

3.3.3 This corrosion will have severely reduced the structural capacity of the beams. Photo 4 below evidences the corrosion evident. The corrosion was not consistent across all four beams, the downstream beam appeared to be in worse condition than the others, thought there is no apparent reason why this should be the case.

3.3.4 Despite the section loss, no visible deflection or bending of the steel beams was observed. This suggests that, under current loading conditions, the remaining section retains sufficient capacity to prevent yielding. However, the compromised structural integrity significantly reduces its safe load-carrying capacity.

Photo 4 - Steel Beam Corrosion

Concrete Deck

3.3.5 The concrete deck did not show evidence of structural cracking, some hairline cracking was visible, although cracking may be obscured by the calcium deposits as discussed below.

3.3.6 There was no major spalling or flaking of the concrete. No reinforcement was visible and there was no sign of major abrasion or erosion of the deck.

3.3.7 Significant calcium carbonate deposits were observed, forming stalactite-like formations. These deposits likely result from efflorescence or leaching, indicating moisture penetration into the concrete, either through the road surface or from the river below. These formations appear to be a significant cause of moisture and corrosion around the steel beams. The presence of these deposits suggest that moisture is penetrating the concrete which could indicate cracking and loss of cement binder, this could lead to an accelerating corrosion and loss of strength of the concrete deck. These can be seen as the white discolouration in Photo 3.

Abutments

3.3.8 The masonry abutments show evidence of damage from the river.

3.3.9 On the upstream western corner, river-induced scour has led to backfill washout behind the masonry, resulting in separation between the abutment and retained soil. Although the abutments remain aligned, the loss of backfill compromises their stability. This is likewise seen on the eastern downstream edge of the abutments where large vegetation has grown through the masonry and allowed scour and erosion to remove large sections.

3.3.10 Prominent vertical and horizontal cracks were observed in the masonry walls. These cracks may indicate differential settlement, loss of mortar integrity, or structural distress due to water infiltration. Crack widths were variable and up to 50mm in places, with larger gaps where stones have been lost.

3.3.11 Large, visible cracks in the masonry abutment indicate structural movement as seen in Photo 5 & Photo 6. The crack at the bearing area suggests differential settlement, lateral movement, or washout of backfill material. This might result in the abutment not fully supporting the beam as intended, as the gap appears to be between the underlying masonry and the concrete surround.

Photo 5 - Abutment Damage

Photo 6 - Cracking Around Steel Embedment

3.4 Inspection Summary

3.4.1 The inspection findings indicate that the existing bridge structure has suffered significant deterioration, particularly in the steel beams, masonry abutments, and concrete deck. The severity of the corrosion, material degradation, and structural deficiencies raises serious concerns regarding the bridge's ability to safely support construction traffic required for the proposed development.

3.4.2 The steel I-beams exhibit extensive corrosion, with perforations and section loss, particularly in the web of some members. This has likely resulted in a substantial reduction in their load-bearing capacity, even though no visible deflection or bending was observed under current loading conditions. Given the pitted nature of the corrosion, it is highly probable that the structural integrity of the beams has been compromised beyond surface-level degradation.

3.4.3 The concrete deck, while not exhibiting major cracking or spalling, shows visible signs of moisture ingress, indicated by calcium carbonate deposits forming stalactites. This is symptomatic of microcracking, cement binder degradation, or reduced concrete strength. If unchecked, continued moisture penetration could accelerate reinforcement corrosion and long-term structural deterioration of the deck.

3.4.4 The bridge abutments have experienced significant erosion and material loss, particularly at the upstream western and downstream eastern corners. This is likely due to a combination of hydraulic scour, washout of backfill, and vegetation growth, which will have compromised structural integrity. The visible vertical cracks within the masonry indicate potential differential settlement or mortar failure, which could lead to progressive instability of the abutments over time. If further degradation occurs, this could undermine the overall stability of the bridge and pose a risk of partial or full structural collapse under increased loading.

3.4.5 Given the observed deterioration, it is not recommended that the bridge be used in its current condition to support construction traffic for the solar farm development. The combined effects of steel corrosion, moisture ingress, and masonry degradation significantly reduce the bridge's load-carrying capacity and resilience. The original design load of the bridge is unknown, and with material degradation, its safe capacity is now highly uncertain.

3.4.6 The bridge's current condition does not support safe operation under increased loading, and remedial action is required before any further usage. Without intervention, further structural deterioration is inevitable, posing a risk to both users and the surrounding environment.

3.4.7 SLR does not believe that it is worthwhile to undertake a full structural assessment, as this will likely confirm the above conclusion.

4. Discussion

4.1 Construction Traffic Assumptions

4.1.1 It is assumed that during the development of the solar farm construction vehicles will need to traffic between the eastern and western areas of the site. While the installation of solar panels does not necessitate the need for heavy machinery, it is anticipated that associated works such as construction of permanent or temporary roads, installation and trenching of cables, site drainage and other works may necessitate the need for large construction plant. The larger elements of this plant might include:

- Dump truck (loaded) – weight 20-30 tonnes
- Concrete Mixer (full) – weight 26-32 tonnes
- Tracked excavator – weight 13-22 tonnes

4.1.2 To allow for a reasonable factor of safety and to align the structure to a standard design criteria it is recommended that the Minimum Load Capacity should be 45 tonnes GVW, in line with UK STGO (Special Types General Order) Category 1, and a Vehicle Load Class of HA Loading + 40/44 tonnes SV (Special Vehicles) per DMRB/CD 127.

4.1.3 The road width should be 3.5m minimum for single way traffic.

4.2 Flood Risk

4.2.1 SLR have undertaken Flood Risk Assessment and Drainage Impact Assessment[1] for the area. This suggests substantial flooding in the area in the event of a 1:200yr + 39% climate change flood event. This would include flooding of the western access route, with the bridge deck being overtopped (See Figure 1 below). It is unlikely that the existing bridge would survive this scenario.

4.3 Remediation or Replacement

4.3.1 SLR have not undertaken any structural calculations of the existing structure, but based on the visible damage, find it highly unlikely that the bridge has sufficient capacity to safely manage the anticipated loadings. As such it is recommended it either be remediated, replaced or a temporary bridge be installed for the construction.

Remediation

4.3.2 Remediating the bridge would require extensive work, including replacing or strengthening the corroded steel beams, waterproofing and resurfacing the concrete deck to prevent further moisture damage, and stabilizing the abutments

[1] West Springfield Solar, Flood Risk Assessment & Drainage Impact Assessment, TRIO West Springfield Solar LLP, SLR Consulting Ltd. 428.013383.00001, Rev01

through mortar repointing, backfill replacement, and scour protection. However, given the severity of the structural deterioration, these repairs would be highly challenging and could potentially exceed the cost of a full replacement or temporary bridge. As a result, remediation is not recommended as a viable option.

Replacement

4.3.3 Due to the severe structural deficiencies of the existing bridge, full replacement is recommended as a more viable option than remediation. The replacement process would involve several key construction stages, beginning with the demolition and safe removal of the existing bridge deck structure while ensuring continued access to adjacent site areas. Environmental protection measures would need to be implemented to prevent contamination or disruption to the watercourse.

4.3.4 New abutments would be constructed, elevated to account for flood risk, and incorporating appropriate scour protection to mitigate against future erosion. Once the abutments are in place, a new bridge deck would be installed, likely consisting of a reinforced concrete or composite steel structure, designed to accommodate a minimum load capacity of 45 tonnes GVW. To ensure long-term durability, waterproofing and surfacing treatments would be applied to protect against moisture ingress and wear.

4.3.5 Final works would include road realignment to improve the approach to the bridge, as well as drainage improvements and erosion control measures to enhance resilience. Several key factors must be considered, including potential environmental impacts requiring permits, the need for temporary access solutions during construction, and cost implications. This solution ensures a durable, compliant, and low-maintenance crossing for future use.

Temporary Structure

4.3.6 An alternative to the full replacement would be for a temporary bridge structure. The preferred solution would be an over-bridge structure utilizing the existing bridge location, which would reduce the need for significant earthworks. This option would involve the installation of a pre-engineered modular bridge, such as the Midi Vehicle Bridge from VP Groundforce, which is rated to 50 tonnes with a clear span of 7.25m, meeting the required load capacity.

4.3.7 To ensure stability, the western abutment would require to be built up and reinforced, likely through the placement and compaction of rockfill material to create a solid foundation. Additional scour protection measures, such as gabion rock baskets or reinforced concrete works, may be necessary to prevent erosion and provide required stability. The installation process would be significantly faster and cheaper than a full bridge replacement, minimizing delays to construction.

4.3.8 Environmental considerations, including potential permitting requirements and watercourse protection, would need to be addressed. The temporary structure would be dismantled upon project completion, restoring the site while ensuring that any modifications to the landscape do not contribute to future erosion or instability. While a temporary solution offers lower upfront costs and quicker implementation, the long-term feasibility of a permanent replacement should be assessed to determine the most cost-effective approach over the lifespan of the development.

4.3.9 It is unclear whether, following construction, light vehicle access could be established for routine maintenance from the western public road, which would potentially negate the requirement for a permanent bridge in this location.

4.4 Location

4.4.1 SLR did inspect the wider environment to determine if a permanent or temporary replacement solution was selected, where it might be best placed. Upstream of the current bridge is an old mill pond with weir and sluice gate leading to a wide pond. This is located within a forested area and likely highly disruptive and damaging to the environment to construct and access a bridge in this area.

4.4.2 Following a review of the Flood Risk Assessment and Drainage Impact Assessment[2] SLR considered three locations downstream of the existing bridge location for the revised structure, these are shown in Figure 1, and identified as Existing Location, Mid-Bank and Lower Section.

Existing Location

4.4.3 The benefit of this site is that the existing site access track is already routed to this location. However, the existing location appears to have a wider extent of deeper flooding for the 200-year storm, likely due to the flat area upstream and the adjacent mill lade. As such the new structure would likely need to be installed higher and have a longer span than the existing structure and the access tracks would have to be raised above the proposed flood limits to ensure use in high flood events.

Mid-Bank

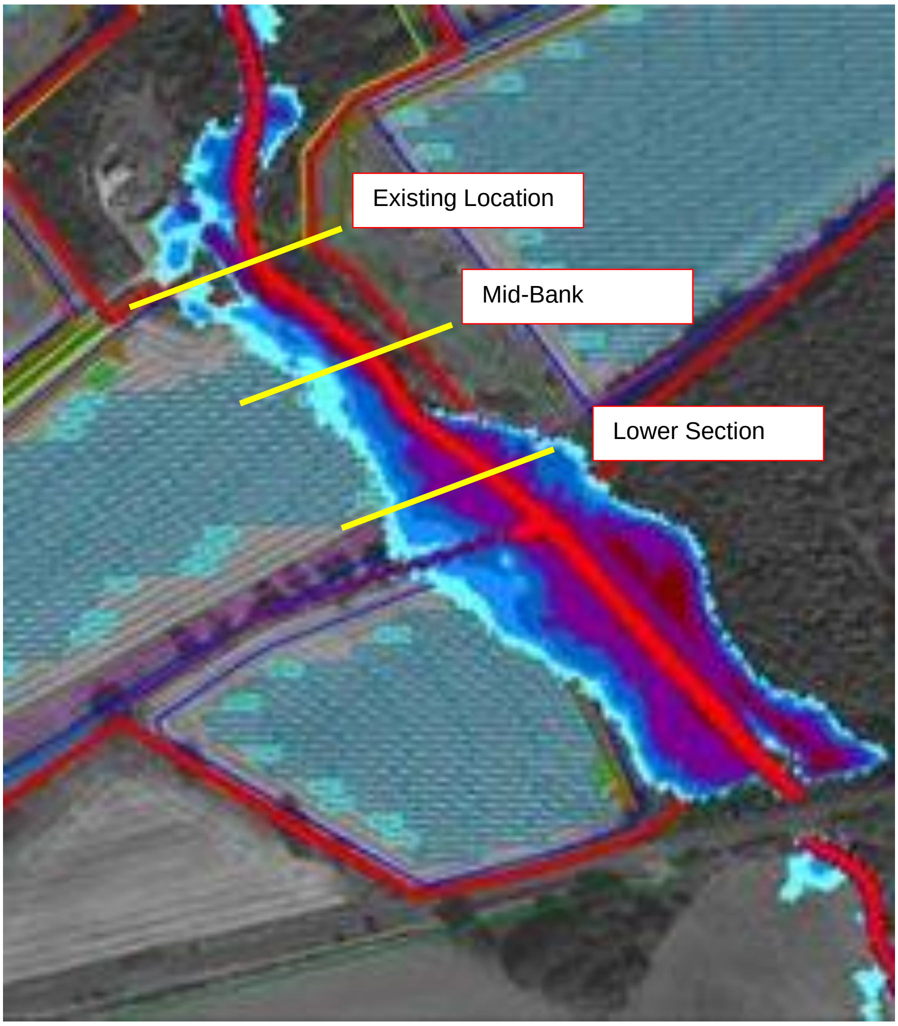
4.4.4 Immediately to the south of the existing bridge, the flooding extent map shows a slight constriction of the limits of the flooding, this may provide an opportune location for the new structure as it will limit the length of structure required. However, as can be seen in Figure 1, the flooding does infringe on the limits of the solar layouts and the road design may require some slight movement of the panels to accommodate. There would be additional earthworks on either side of the bridge to allow the existing access track to reach this location and form abutments.

[2] West Springfield Solar, Flood Risk Assessment & Drainage Impact Assessment, TRIO West Springfield Solar LLP, SLR Consulting Ltd. 428.013383.00001, Rev01

Lower Section

4.4.5 Downstream, the high bank on the east side continues for around 130m, where it then drops off for 50m before entering a wooded section ultimately before leaving the site. This lower section may offer a far easier construction for a temporary or permanent replacement bridge. The downstream location is considered unsuitable due to the significant extent of flooding in that area. Constructing a bridge at this point would require a substantially larger structure to span the wider flood extents.

Figure 1 - Abstract from Flood Risk Assessment



5. Conclusions

5.1.1 Based on the findings of the structural inspection, the existing bridge is not suitable for construction traffic due to severe deterioration in its steel I-beams, concrete deck, and masonry abutments. The extent of corrosion, material loss, and structural deficiencies significantly compromises the bridge's load-bearing capacity and overall stability. Without intervention, continued degradation poses an increasing risk to both safety and site accessibility.

5.1.2 Given these conditions, remediation is not considered a viable solution due to the extensive repairs required. The most practical and sustainable options are either a full bridge replacement or the installation of a temporary modular bridge to facilitate construction access.

5.1.3 The current bridge location remains likely to be the most practical location for a replacement bridge, though other locations could be considered if additional barriers to the current bridge location were identified.

5.1.4 Two feasible solutions are therefore presented:

- A permanent replacement would ensure long-term reliability and structural integrity, whereas;
- A temporary bridge offers a cost-effective and expedited solution for the duration of the solar farm's construction.

The choice between these alternatives should be guided by project requirements, cost considerations, and long-term access needs.