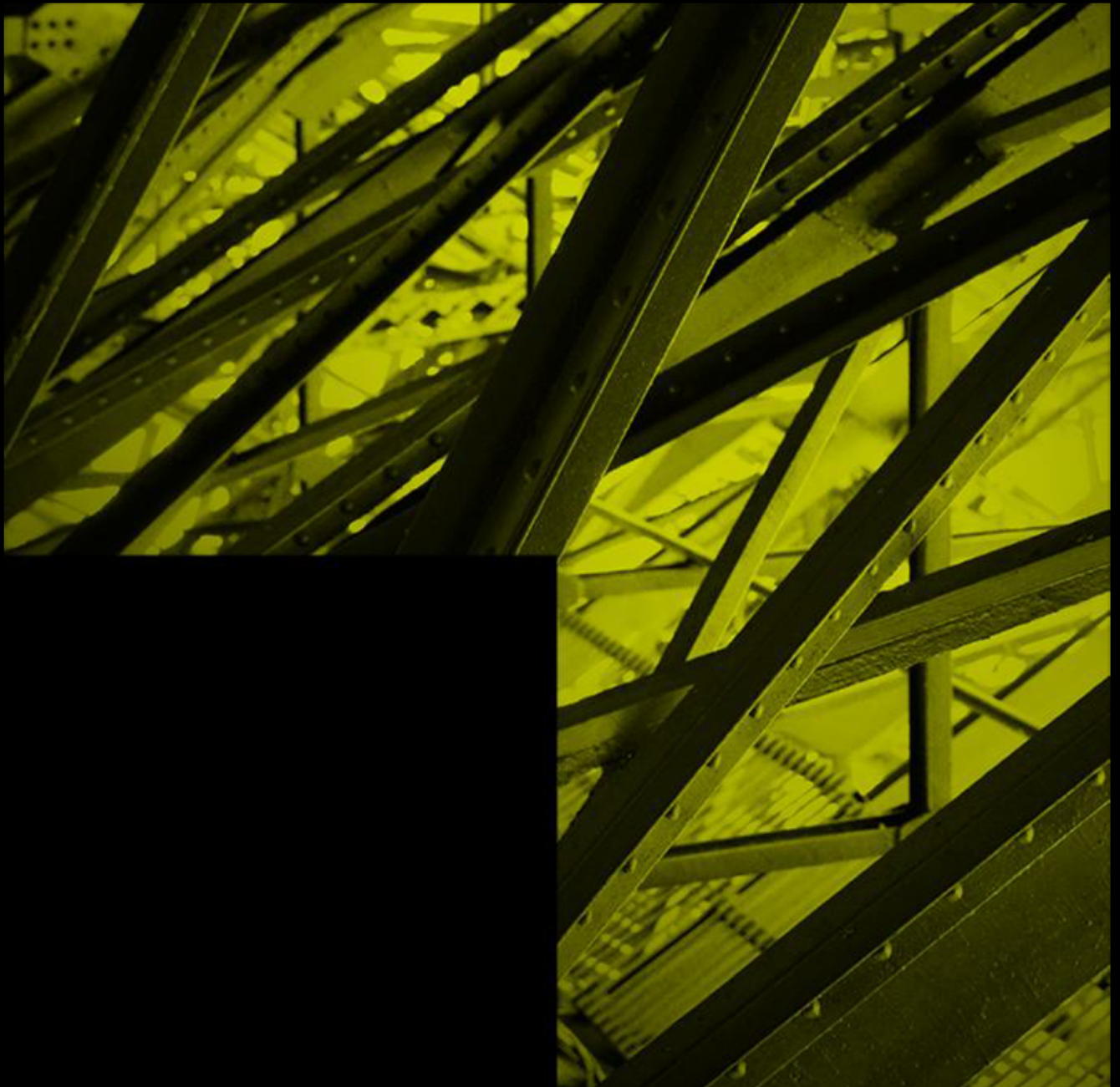


WATERLOO TRAIN STATION CANOPY REASSESSMENT

Greater Wellington Regional Council





DOCUMENT
CONTROL
RECORD

CLIENT	Greater Wellington Regional Council
PROJECT	Waterloo Train Station Canopy Reassessment
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HG DOCUMENT NO.	REP002-A2414842.01_KTT_MTL
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ORIGINATOR	s7(2)(a)	Structural Engineer
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s7(2)(a)

REVIEWED	s7(2)(a)	Principal Engineer Structures
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s7(2)(a)

APPROVED FOR ISSUE	s7(2)(a)	Principal Engineer Structures
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Appendix 1	Corrosion Score Maps
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EXECUTIVE SUMMARY

Harrison Grierson has been engaged by the Greater Wellington Regional Council (GWRC) to carry out a condition reassessment of the canopy and roof structure at Waterloo Train Station, Lower Hutt. This reinspection has been performed in line with the recommendations provided by Harrison Grierson in their previous assessment report for this canopy performed in April 2024.

The purpose of the assessment is to provide corrosion scores and maps based on the following criteria to ascertain the expected residual life span of the canopy in years.

CORROSION SCORING SYSTEM

The corrosion scoring system incorporated for each of the members is as follows:

1	No Corrosion Evident
2	Light Corrosion Evident
3	Medium Corrosion Evident
4	Heavy Corrosion (Partial Repair/ Maintenance Required)
5	Heavy Corrosion (Full Repair)

ESTIMATED LIFESPAN OF INDIVIDUAL CANOPY ELEMENTS

ROOF

The top roof sheeting exhibits widespread deterioration, including visible corrosion and the presence of moss, particularly on the southern side of the station. Significant corrosion was observed on a roof sheet adjacent to a newly replaced panel on the northeast, while the northeast edge roofing generally shows heavy corrosion and/or dense moss growth. Roof sheeting near the ticketing office and across the southeast portion of the station also displays evident rusting. In multiple locations, the protective paint coating on the roof sheeting has flaked away, exposing the substrate.

Water ponding was observed within the internal box gutters, preventing a full assessment of the extent of corrosion in these areas.

Some screws have been replaced in sections where roof sheeting was recently renewed, hold-down screws in other areas show heavy corrosion.

The lower roof sheeting presents corrosion along sheet overlaps, with localized corrosion noted between gridlines GL 4-6 and GL C-D.

Corrosion is evident on the underside of the roof sheeting supported by canopy columns, particularly at beam and truss junctions, and nail fixings connecting the roof sheeting to the purlins are heavily corroded.

We estimate that the current roof has an estimated lifespan of 1 year if no maintenance is carried out.

PURLIN VERTICAL SUPPORT POSTS

The purlin support posts are short lengths of SHS steel of varying depths which support the purlins off the top chord of the spaceframe truss enabling the pitch of the roof to be formed.

The purlin support members display the heaviest corrosion of all the canopy elements.

The vertical flat roof sheeting on the North side of the station (ticketing side) is fixed to a new timber plank, which is attached to the purlin's vertical support post; however, it is in a severely corroded condition, with a corrosion rating of 4.

We estimate that maintenance to some of these elements will be required immediately where we rated the corrosion score to 4 to prevent more extensive repairs (possibly even member replacement) being required.

STEEL PURLINS

The steel purlins supporting the roof sheeting appear to be DHS elements that run longitudinally along the length of the canopy supported off the vertical SHS purlin support posts.

These purlins are generally in good condition with a corrosion score of 2. With only isolated cases requiring remediation in the next 12 months due to them having a corrosion score of 4.

Most of the nails connecting the purlins to the roof sheeting exhibit corrosion with a corrosion score of 4. The plate connecting the purlins to the vertical support post have a corrosion score of 4 in localised areas. Paint flaking is evident in some purlins.

Vegetation growth was observed in one area on the purlin.

SPACE FRAME TOP CHORDS

The truss top chords are "C" channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The top chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

Most of the bolts connecting the top chord members display medium-level corrosion. The recommended corrective measures must be actioned within 12 months before there is a need to replace these bolts and nuts.

The paint in some areas was observed to have flaked off the top chord members, which can accelerate the corrosion process.

Most of the connection bolts display medium-level corrosion.

SPACE FRAME DIAGONALS

The truss diagonals are CHS tubes in groups of 4 spanning between the top and bottom chords.

The diagonals are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the diagonal members, which can accelerate the corrosion process.

Grease was applied to certain diagonals possibly as a protective coating against corrosion.

SPACE FRAME BOTTOM CHORDS

The truss top chords are "C" channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The bottom chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the bottom chord members, which can accelerate the corrosion process.

Some of the connection bolts display heavy-level corrosion.

PIGEONS PRESENCE

On the northeast side, most of the bottom roof sheeting and walls are covered by Pigeon droppings, accelerating the corrosion process.

All pigeon access holes to the roof cavity must be blocked and the affected areas cleaned up.

ROOF BRACING

The roof bracing at the Amenities Building/Bus Building exhibits visible corrosion, assessed at a corrosion rating of 2 or 3.

1.0 INTRODUCTION

Harrison Grierson has been engaged by the Greater Wellington Regional Council (GWRC) to carry out a condition assessment of the Waterloo Train Station Canopy located at Waterloo Train Station Lower Hutt, Wellington.

The station is located between Oxford and Cambridge Terraces as per the below screenshot. The two sides of the station are connected by a subway.



Site Location (Image from Google Maps)

2.0 CANOPY DESCRIPTION

The canopy is split over two levels and features steel long-run roofing with Clearlite panels supported on steel DHS purlins which span longitudinally along the length of the structure.

There are 3 internal gutters all running along the length of the roof and a seismic joint to the adjoining building. The purlins are supported on small square hollow section (SHS) upstands of varying heights which enable the roof pitch to be formed. The SHS purlin supports are then supported on a steel spaceframe structure featuring longitudinal and transverse channel sections as top and bottom chords with diagonal circular hollow section members spanning between them. The spaceframe spans between concrete circular columns with 4 diagonal members located on the top which support the bottom chords of the spaceframe structure.

The canopy has a 2-degree telecommunications installation on the roof which relies on elements of the spaceframe for structural support.

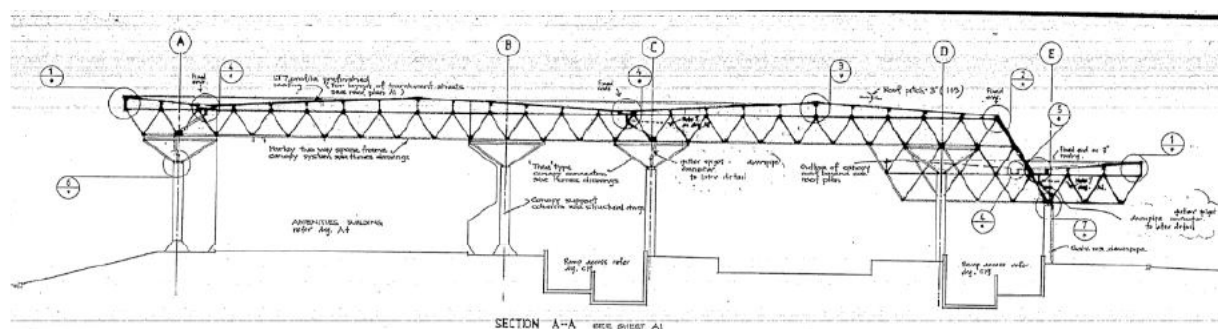
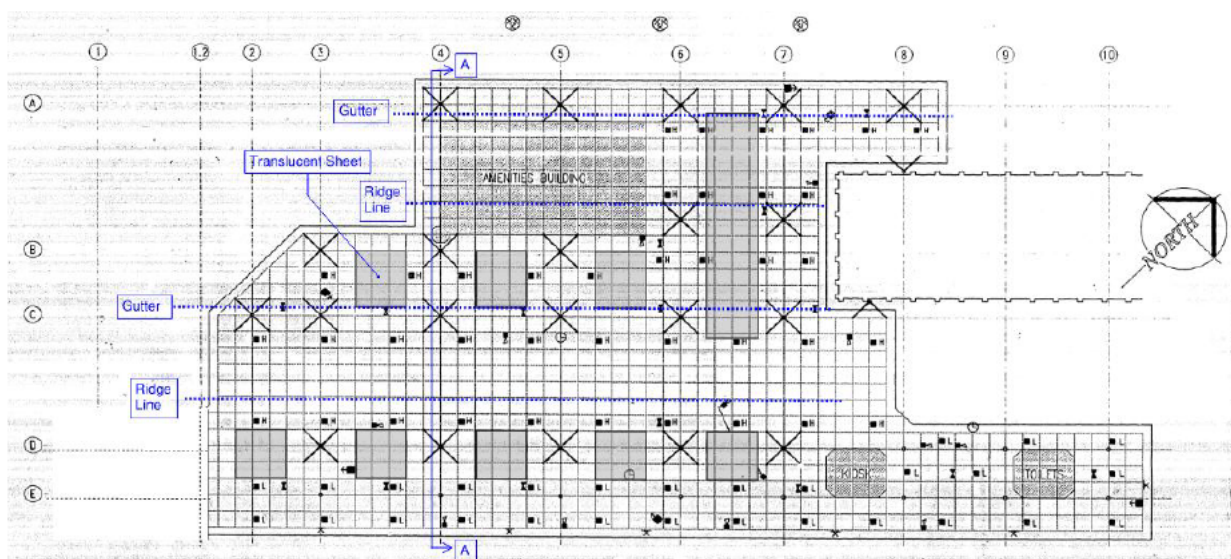


Photo 001 - Upper Roof Level



Photo 002 – Upper Roof Level.



Photo 003 – Internal Box Gutter.



Photo 004 – Translucent Sheet.



Photo 005 – Purlin and SHS Support onto Top Chord.



Photo 006 – Top Chord and Diagonals (Truss Level).

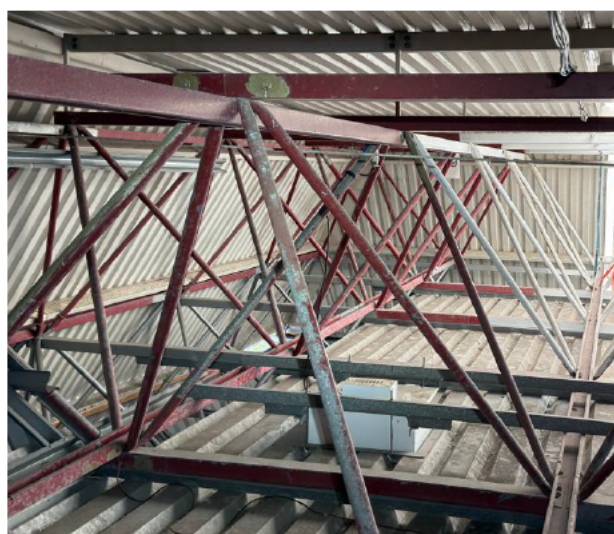


Photo 007 – Bottom Chord and Diagonals (Truss Level).



Photo 008 – Canopy Support Columns.

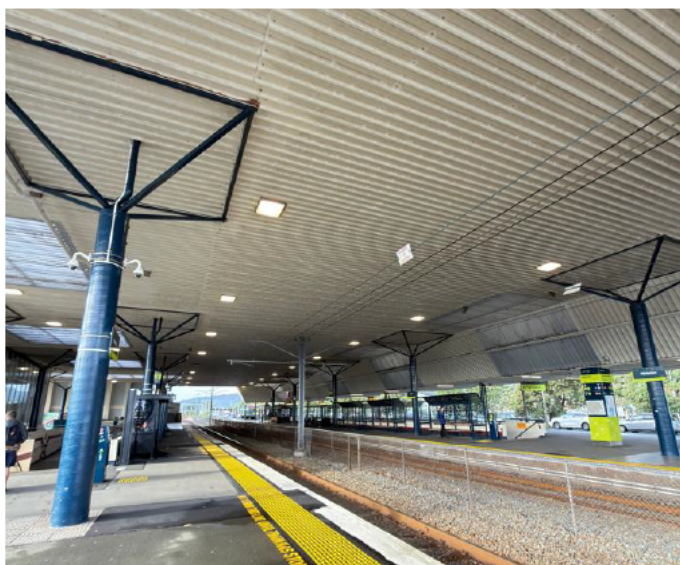


Photo 009 – Bottom Chord and Diagonals (Lower Roof Level).

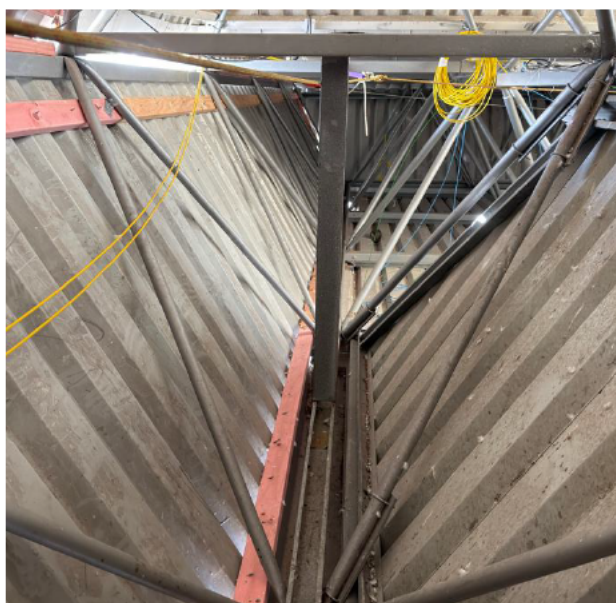


Photo 010 – Purlin vertical support (Lower Roof Level North side near Ticketing office).



Photo 011 – Top and Bottom Chord and Diagonals (Amenities Building).



Photo 012 – Roof Bracing (Amenities Building/Bus building).



3.0 CANOPY CONDITION

3.1 INSPECTION METHODOLOGY

The canopy was inspected by Structural Engineers **s7(2)(a)** and **s7(2)(a)** from Harrison Grierson on 22 and 23 April 2026. Abseil Access Ltd provided fall protection services and accompanied HG personnel whilst the inspection was being conducted.

The roof space was accessed through the access hatch located in the Amenities Building located on the West side of the train station.

A corrosion score consistent with the previous HG inspection in April 2024 was used for the inspection to provide a consistent comparison. The scoring system is described in the table below.

Score	Corrosion Level
1	No Corrosion Evident
2	Light Corrosion Evident
3	Medium Corrosion Evident
4	Heavy Corrosion (Partial Repair/ Maintenance Required)
5	Heavy Corrosion (Full Repair)

3.2 INSPECTION RESULTS

Condition maps have been produced to show the condition of each of the structural members. These can be found in Appendix A as well as in the sections below.

3.2.1 ROOF

The top roof sheeting exhibits widespread deterioration, including visible corrosion and the presence of moss, particularly on the southern side of the station. Significant corrosion was observed on a roof sheet adjacent to a newly replaced panel on the northeast, while the northeast edge roofing generally shows heavy corrosion and/or dense moss growth. Roof sheeting near the ticketing office and across the southeast portion of the station also displays evident rusting. In multiple locations, the protective paint coating on the roof sheeting has flaked away, exposing the substrate.

Water ponding was observed within the internal box gutters, preventing a full assessment of the extent of corrosion in these areas.

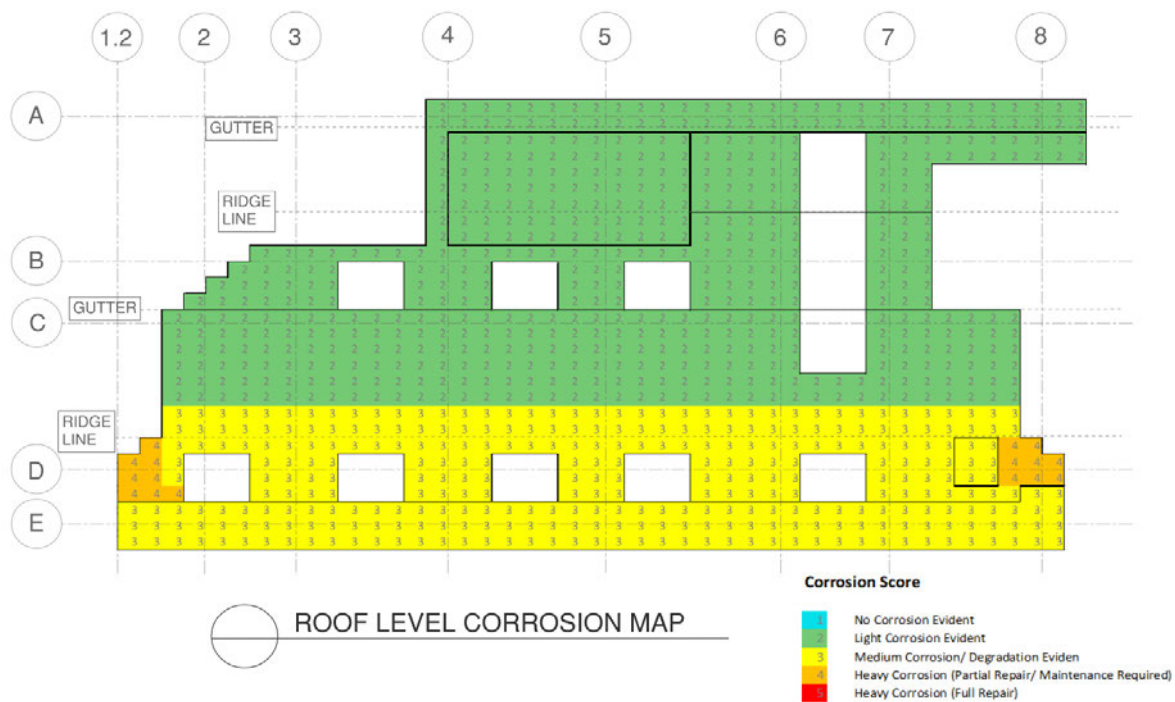
Some screws have been replaced in sections where roof sheeting was recently renewed, hold-down screws in other areas show heavy corrosion.

The lower roof sheeting presents corrosion along sheet overlaps, with localized corrosion noted between gridlines GL 4-6 and GL C-D.

Corrosion is evident on the underside of the roof sheeting supported by canopy columns, particularly at beam and truss junctions, and nail fixings connecting the roof sheeting to the purlins are heavily corroded.

We estimate that the current roof has an estimated lifespan of 1 year if no maintenance is carried out.

Top Roof Corrosion Score Map



Bottom Roof Corrosion Score Map

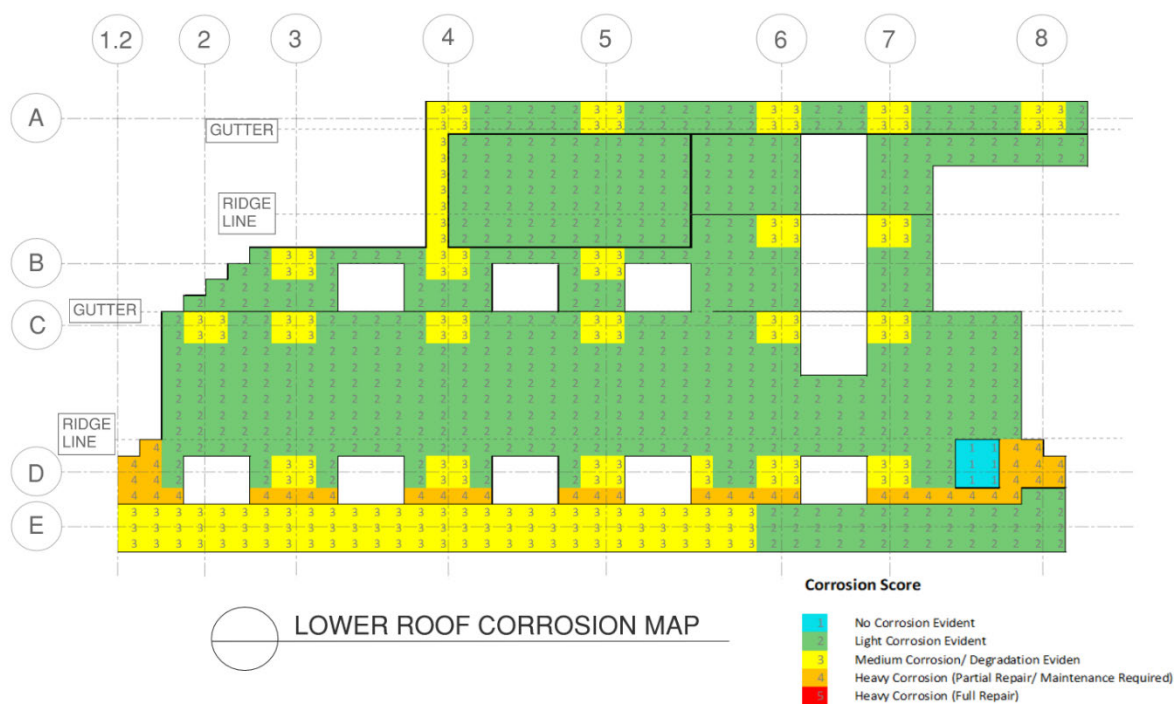


Photo 001 – Roof Level Clearlite Panel corrosion score 3



Photo 002 – Orange Lyceum on lower roof corrosion score 4. Photo is from 2024 as this area was not deemed to be safely accessible.



Photo 003 – Internal Gutter corrosion score 2. Water ponding was observed on the southern side of the station.



Photo 004 – Heavy presence of moss on the roof sheeting and roof walkway was observed mostly on the southern side.



Photo 005 – Ridge capping at roof level corrosion score 2.



Photo 006 – Roof seismic joint corrosion score 3. Photo is from 2024 site inspection. No access to that side of the building at the time of inspection.



Photo 007 – Roof hold down screws in most areas show heavy corrosion with corrosion level score 4.

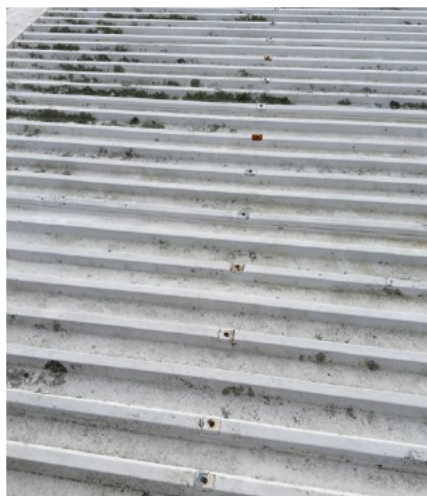


Photo 008 – Corrosion at lower internal gutter. Corrosion level 4.



Photo 009 – Corrosion at lower internal gutter. Corrosion level 4.



Photo 010 – Corrosion at lower internal gutter. Corrosion level 4.



Photo 011 – Corrosion at intersection of upper and lower roof due to flashing at the corner. Corrosion level 4 on East side of the station.



Photo 012 – Paint at the roof sheeting flaked off.



Photo 013 – Corrosion at the joint of the beam and underside roof sheeting observed. Visible in all of the joints for the column. Corrosion score 3.



Photo 014 – Corrosion at the roof sheeting (Truss Level) between GL 4-6/ GL C-D. Corrosion score 3.



Photo 015 – Corrosion at the bottom roof sheeting (Truss Level) between GL 4-6/ GL C-D. Corrosion score 4.



Photo 016 – Corrosion at the roof sheeting (Truss Level – Northern side).



Photo 017 – Roof sheeting at Northern side of the station. Corrosion score 4.



Photo 018 – Roof sheeting at Southern side of the station. Corrosion score 4.



Photo 019 – Corrosion at the bottom of roof sheeting on the Western side. Corrosion score 3.

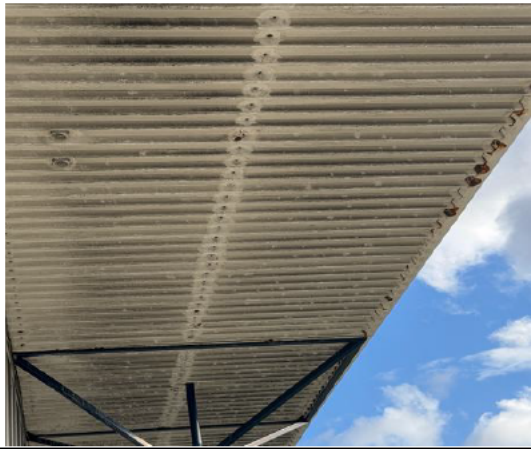


Photo 020 – Corrosion at the bottom of roof sheeting on the Western side. Corrosion score 3.



Photo 021 – Damage to the roof sheeting on the Eastern side of the station.



Photo 022 – Damage to the roof sheeting on the Eastern side of the station.



Photo 023 – Heavy corrosion at hold down screws connecting the roof sheeting to the purlins. Corrosion score 4.



Photo 024 – Vegetation growth was observed in one area on the western side.



Photo 025 – Translucent sheeting covered in moss.



Photo 026 – Translucent sheeting covered in moss.



Photo 027 – Pigeon droppings observed in Truss level.



Photo 028 – Pigeon droppings on the diagonals.



Photo 029 – Pigeon droppings at the lower roof on the eastern side.



Photo 030 – Pigeon droppings at the lower roof on the eastern side. Opening for birds to enter the roof.



3.2.2 PURLIN VERTICAL SUPPORT POSTS

The purlin support posts are short lengths of SHS steel of varying depths which support the purlins off the top chord of the spaceframe truss enabling the pitch of the roof to be formed.

The purlin support members display the heaviest corrosion of all the canopy elements.

The vertical flat roof sheeting on the North side of the station (ticketing side) is fixed to a new timber plank, which is attached to the purlin's vertical support post; however, it is in a severely corroded condition, with a corrosion rating of 4.

We estimate that maintenance to some of these elements will be required immediately where we rated the corrosion score to 4 to prevent more extensive repairs (possibly even member replacement) being required.

The area of most concern is highlighted in the corrosion map where the supports have a corrosion score of 4.

Purlin Vertical Support Posts Corrosion Score Map

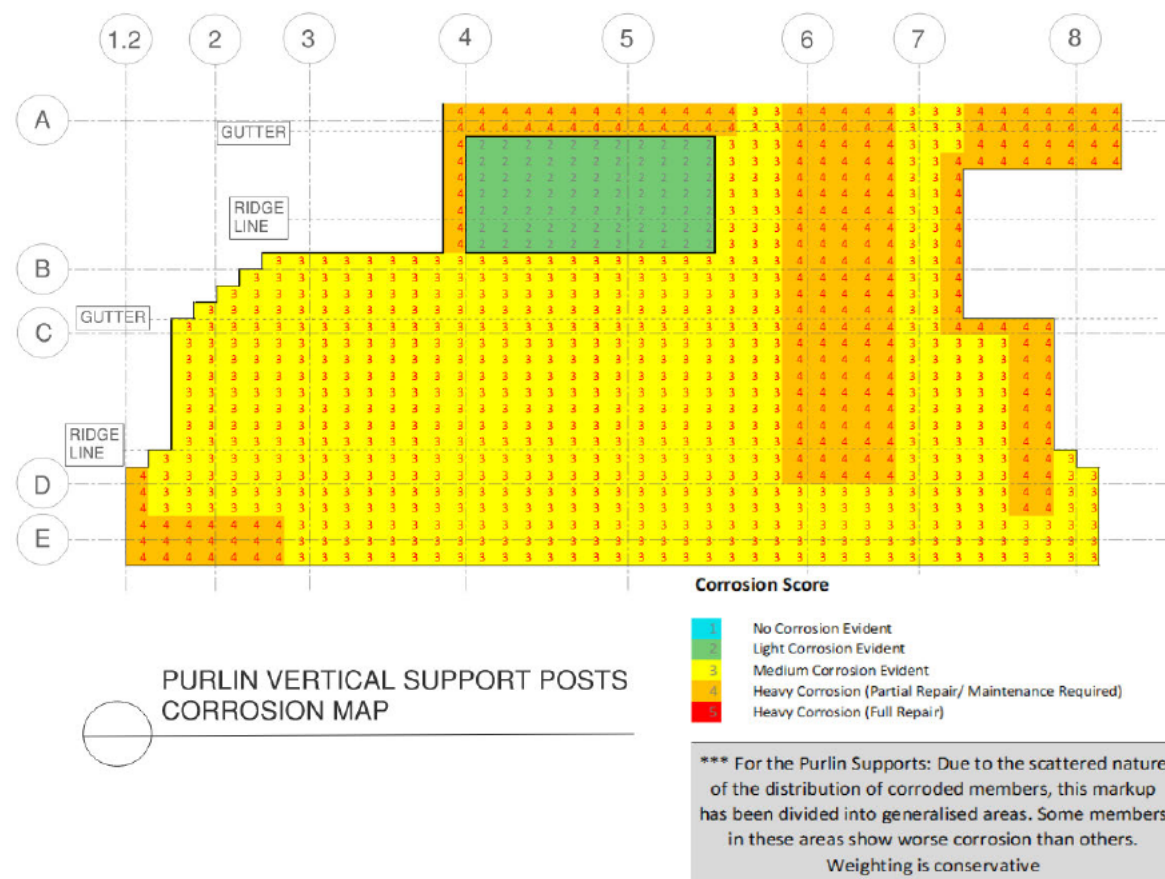


Photo 001 – Purlin Vertical Support Post Eastern side. Corrosion score 4.



Photo 002 – Purlin Vertical Support Post Eastern side. Corrosion score 4.



Photo 003 – Purlin Vertical Support Post. Corrosion score 4.



Photo 004 – Purlin Vertical Support Post. Corrosion score 4.



Photo 005 – Purlin Vertical Support Post northern side. Corrosion score 4.



Photo 006 – Purlin Vertical Support Post northern side. Corrosion score 4.



Photo 007 – Purlin Vertical Support Post. Corrosion score 4.



Photo 008 – Purlin Vertical Support Post. Corrosion score 3.



Photo 009 – Purlin Vertical Support Post lower roof northern side. Corrosion score 4.



3.2.3 STEEL PURLINS

The steel purlins supporting the roof sheeting appear to be DHS elements that run longitudinally along the length of the canopy supported off the vertical SHS purlin support posts.

These purlins are generally in good condition with a corrosion score of 2. With only isolated cases requiring remediation in the next 12 months due to them having a corrosion score of 4.

Most of the nails connecting the purlins to the roof sheeting exhibit corrosion with a corrosion score of 4. The plate connecting the purlins to the vertical support post have a corrosion score of 4 in localised areas. Paint flaking is evident in some purlins.

Vegetation growth was observed in one area on the purlin.

Steel Purlin Corrosion Score Map

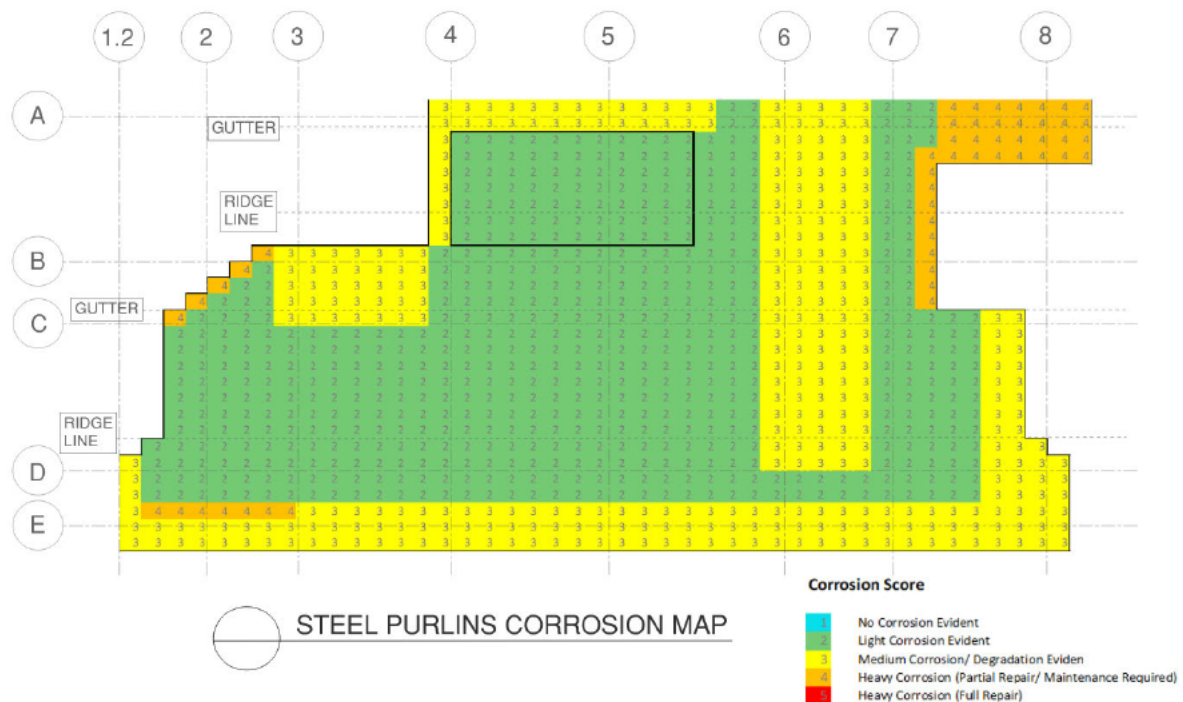


Photo 001 – Purlin corrosion. Corrosion score 3.



Photo 002 – Purlin corrosion. Corrosion score 4.



Photo 003 – Purlin corrosion. Corrosion score 4.



Photo 004 – Purlin corrosion. Corrosion score 4.

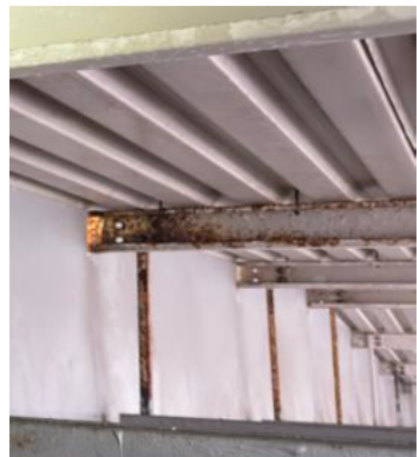


Photo 005 – Purlin corrosion. Corrosion score 4.



Photo 006 – Purlin corrosion. Corrosion score 2.



3.2.4 SPACE FRAME TOP CHORDS

The truss top chords are “C” channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

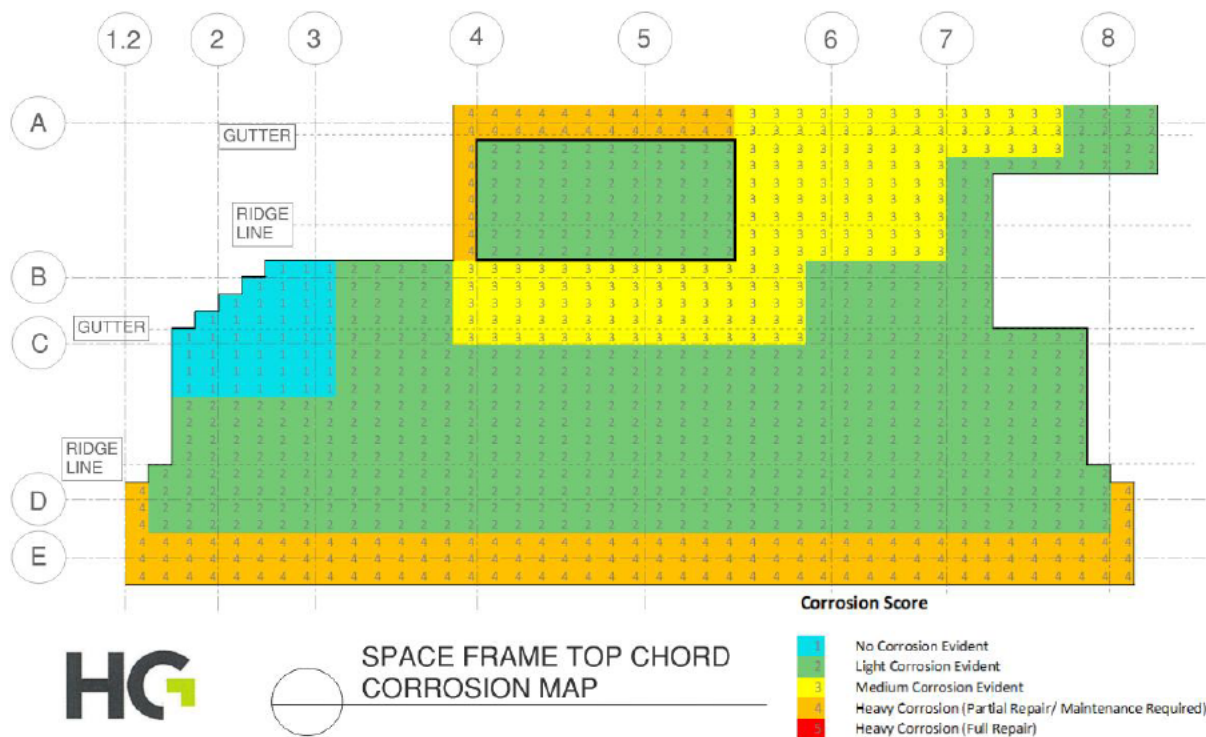
The top chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

Most of the bolts connecting the top chord members display medium-level corrosion. The recommended corrective measures must be actioned within 12 months before there is a need to replace these bolts and nuts.

The paint in some areas was observed to have flaked off the top chord members, which can accelerate the corrosion process.

Most of the connection bolts display medium-level corrosion.

Space Frame Top Chord Corrosion Score Map



*** For the Space Frame Top Chord: Due to the scattered nature of the distribution of corroded members, this markup has been divided into generalised areas. Some members in these areas show worse corrosion than others. Weighing is conservative

Photo 001 – Truss Top chord. Corrosion score 2.

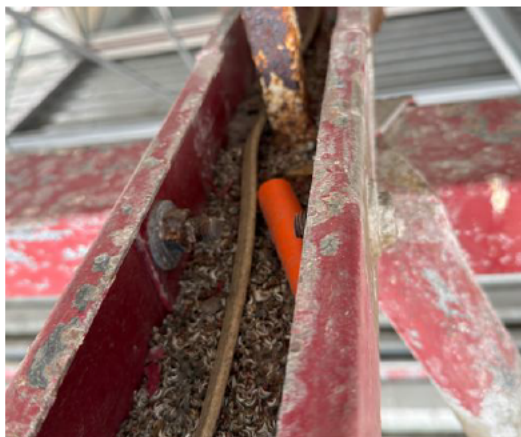


Photo 002 – Truss Top chord. Corrosion score 3.



Photo 003 – Truss Top chord. Corrosion score 4.



Photo 004 – Truss Top chord. Corrosion score 4.



Photo 005 – Truss Top chord corrosion. Corrosion score 3.



Photo 006 – Truss Top chord corrosion. Corrosion score 3.



3.2.5 SPACE FRAME DIAGONALS

The truss diagonals are CHS tubes in groups of 4 spanning between the top and bottom chords.

The diagonals are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the Southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the diagonal members, which can accelerate the corrosion process.

Grease was applied to certain diagonals as a protective coating against corrosion.

Space Frame Diagonals Corrosion Score Map

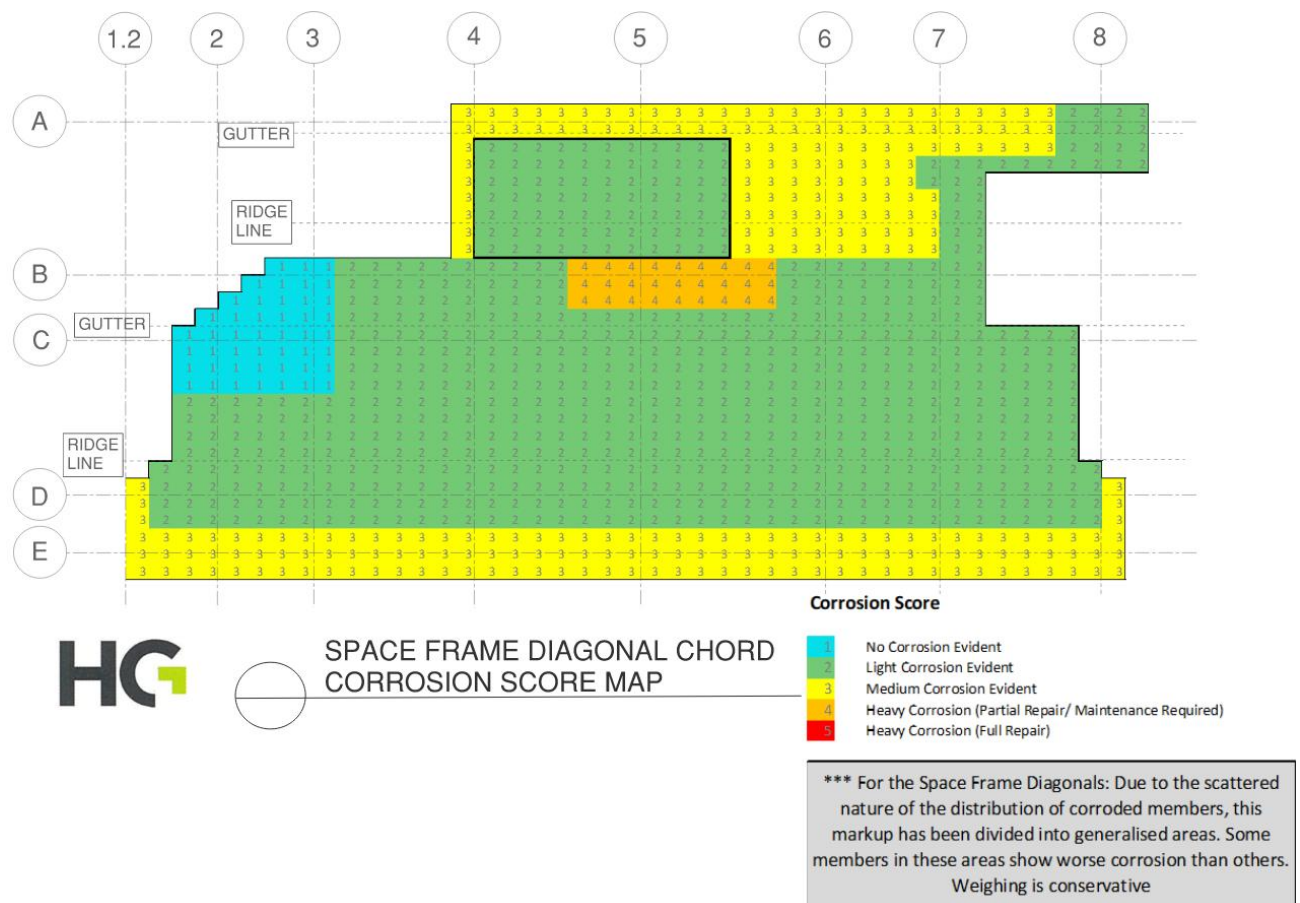


Photo 001 – Truss Diagonal. Corrosion score 1.

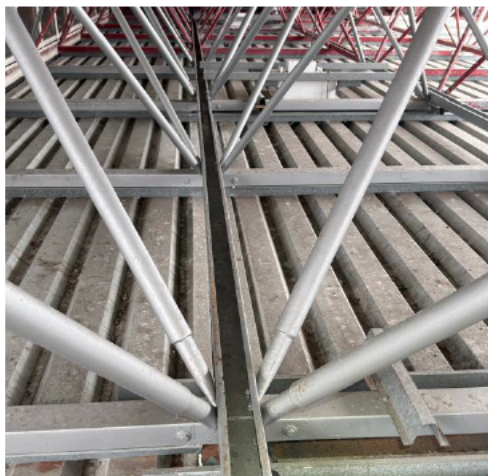


Photo 002 – Truss Diagonal. Corrosion score 4.



Photo 003 – Grease was applied to truss diagonal to help with the corrosion.



Photo 004 – Truss Diagonal. Corrosion score 4.



Photo 005 – Paint on truss diagonal has been stripped off.



Photo 006 – Truss diagonal. Corrosion score 3.



3.2.6 SPACE FRAME BOTTOM CHORDS

The truss top chords are “C” channel-shaped steel members running longitudinally and transversely as part of the space frame structure.

The bottom chords are generally in good condition with a corrosion score of 1 or 2. However, there are areas of heavier corrosion located in the southwest corner with a corrosion score of 4.

The paint in some areas was observed to have flaked off the bottom chord members, which can accelerate the corrosion process.

Some of the connection bolts display heavy-level corrosion.

Space Frame Bottom Chords Corrosion Score Map

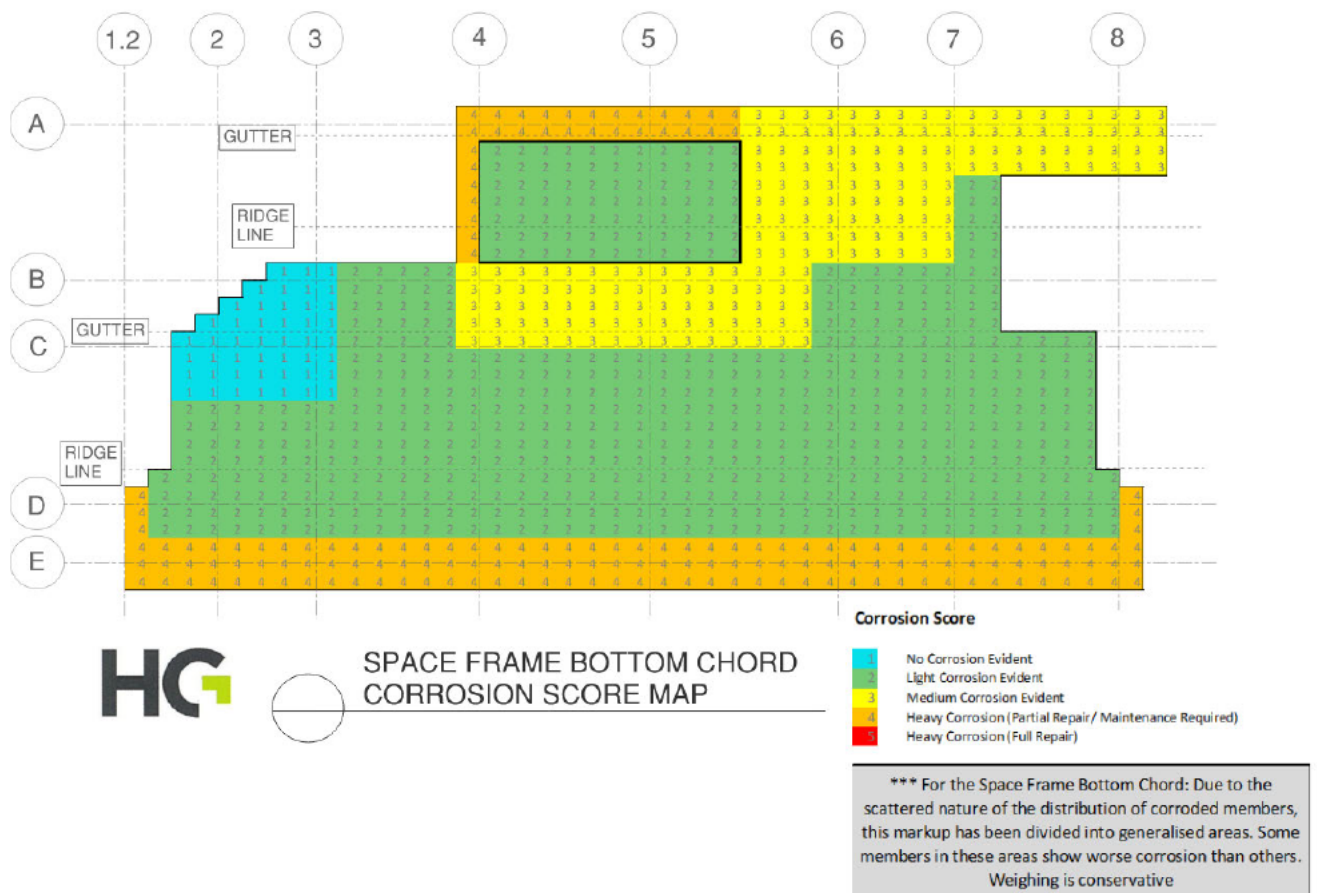


Photo 001 – Heavy corrosion on bolts connecting the truss diagonal. Corrosion score 4.



Photo 002 – Truss Bottom chord. Corrosion score 4.



Photo 003 – Truss Bottom chord. Corrosion score 4.



Photo 004 – Truss Bottom chord. Corrosion score 4.



Photo 005 – Truss Bottom chord. Corrosion score 4.



Photo 006 – Truss bottom chord. Corrosion score 1.



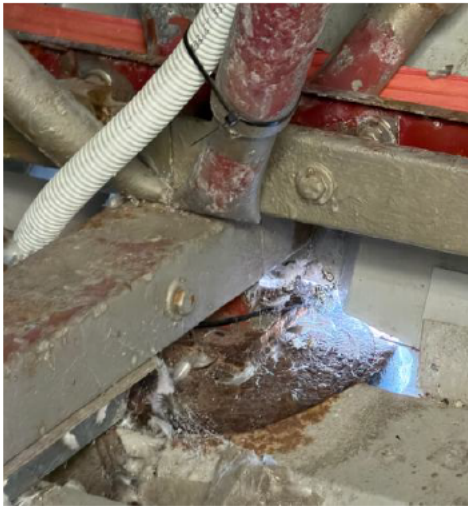
Photo 007 – Heavy corrosion between column and bottom chord. Corrosion score 4.



Photo 008 – Heavy corrosion between column and bottom chord. Corrosion score 4.



Photo 009 – Heavy corrosion between column and bottom chord. Corrosion score 4.



4.0 CONCLUSION AND RECOMMENDATIONS

Overall, the canopy structure is in reasonable condition apart from the following locations.

We recommend that the following remedial works be carried out within the next 6-12 months depending on the corrosion score map to prevent further deterioration of the structure. We recommend that remedial works on areas with corrosion score of 4 be carried out immediately to avoid compromising the stability of the structure.

As an alternative to remedial works or retrofitting the structure, we might recommend that the whole roof structure is demolished and replaced. We understand that this is to be a staged process; please see below our recommendation for the staged demolition of the roof structure, shown in cross section and plan highlighting the proposed demolition stages.

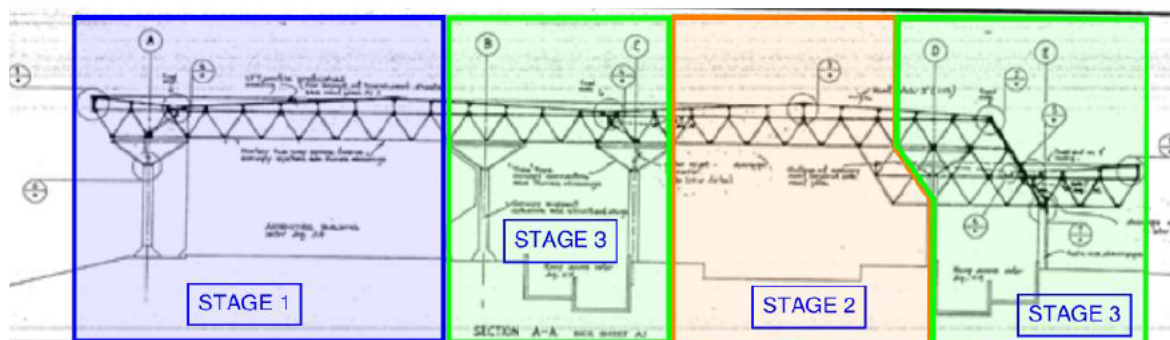


Figure 1 – Proposed Roof Structure demolition staging – Cross Section (NTS.)



Figure 2 – Proposed Roof Structure demolition staging – Plan (NTS.)

4.1 ROOF

- Power-wash the entire roof.
- Touch up the areas of corroded sheeting around the internal gutters.
- Replace the corroded areas of internal gutters at the upper and lower levels.
- Replaced the corroded hold-down screws between sheeting and purlin.
- Block all pigeon/vermin entry points.
- Power wash pigeon droppings.
- Fix the ridge overlapping and flashing details at joints/corners.
- Paint touch-up required in the areas of corroded bottom roof sheeting below the ridge line.

4.2 PURLIN SUPPORTS

- Abrasive blast and re-paint the square hollow section supports and connections in the upper and lower-level portions of the roof. Replaced as required where the steel is flaking due to corrosion.

4.3 TOP CHORDS

- Abrasive blast and re-paint the top chord connection bolts. Also, repaint the chord members to prevent corrosion as most paint has already flaked off.

4.4 DIAGONALS

- Repaint the diagonal member to prevent the start of the corrosion as most of the paint has been flaked off.

4.5 BOTTOM CHORDS

- Repaint the bottom chord members to prevent corrosion as most paint has already flaked off.

4.6 GENERAL

- Inspect the structure every 2 years to assess for further corrosion and degradation.

5.0 LIMITATIONS

5.1 GENERAL

This report is for the use by Greater Wellington Regional Council only and should not be used or relied upon by any other person or entity or for any other project.

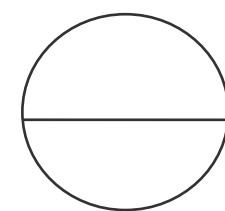
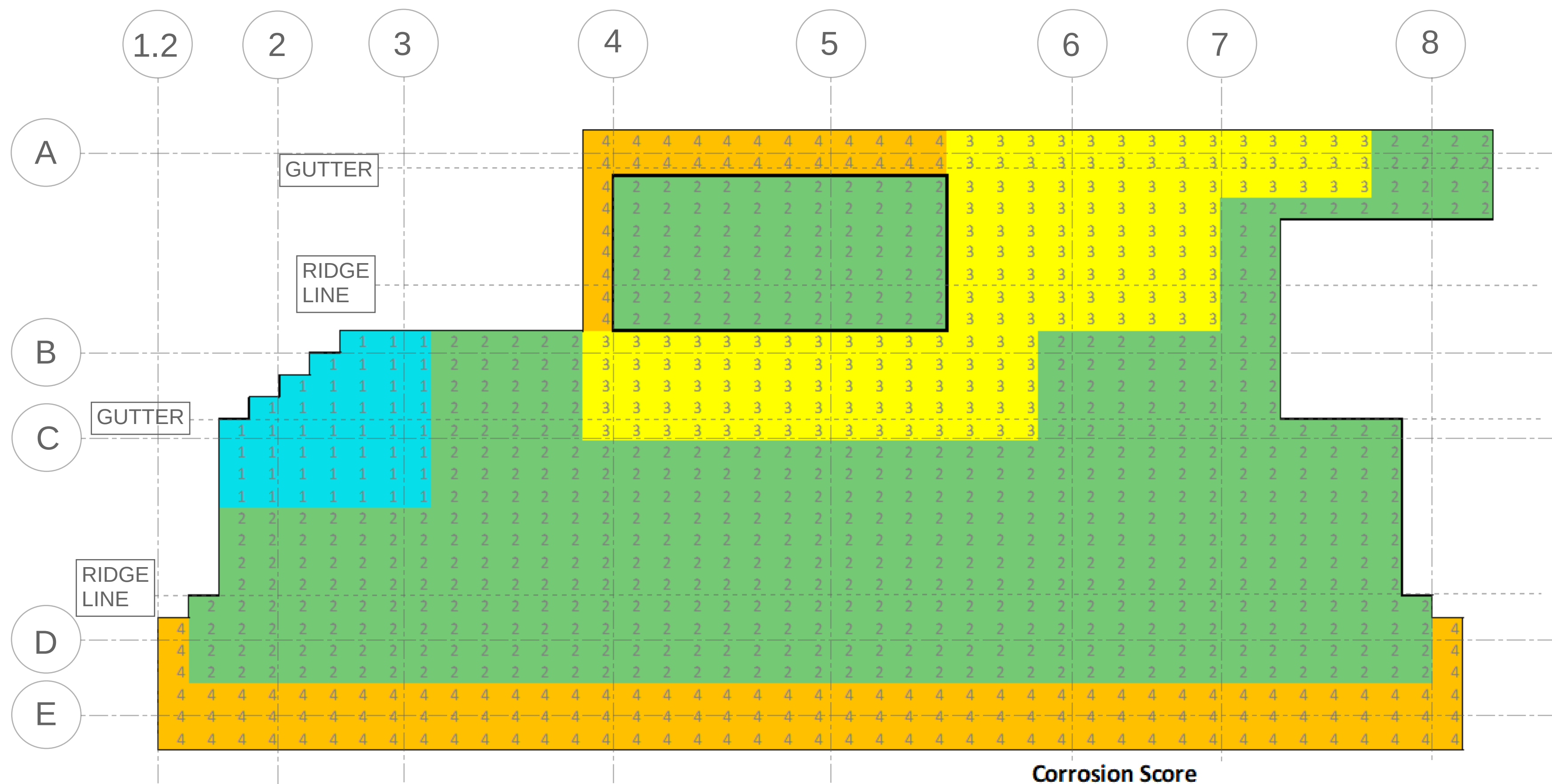
This report has been prepared for the particular project described to us and its extent is limited to the scope of work agreed upon between the client and Harrison Grierson Consultants Limited. No responsibility is accepted by Harrison Grierson Consultants Limited or its directors, servants, agents, staff, or employees for the accuracy of information provided by third parties and/or the use of any part of this report in any other context or for any other purposes.



APPENDICES



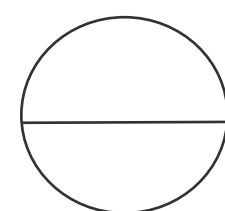
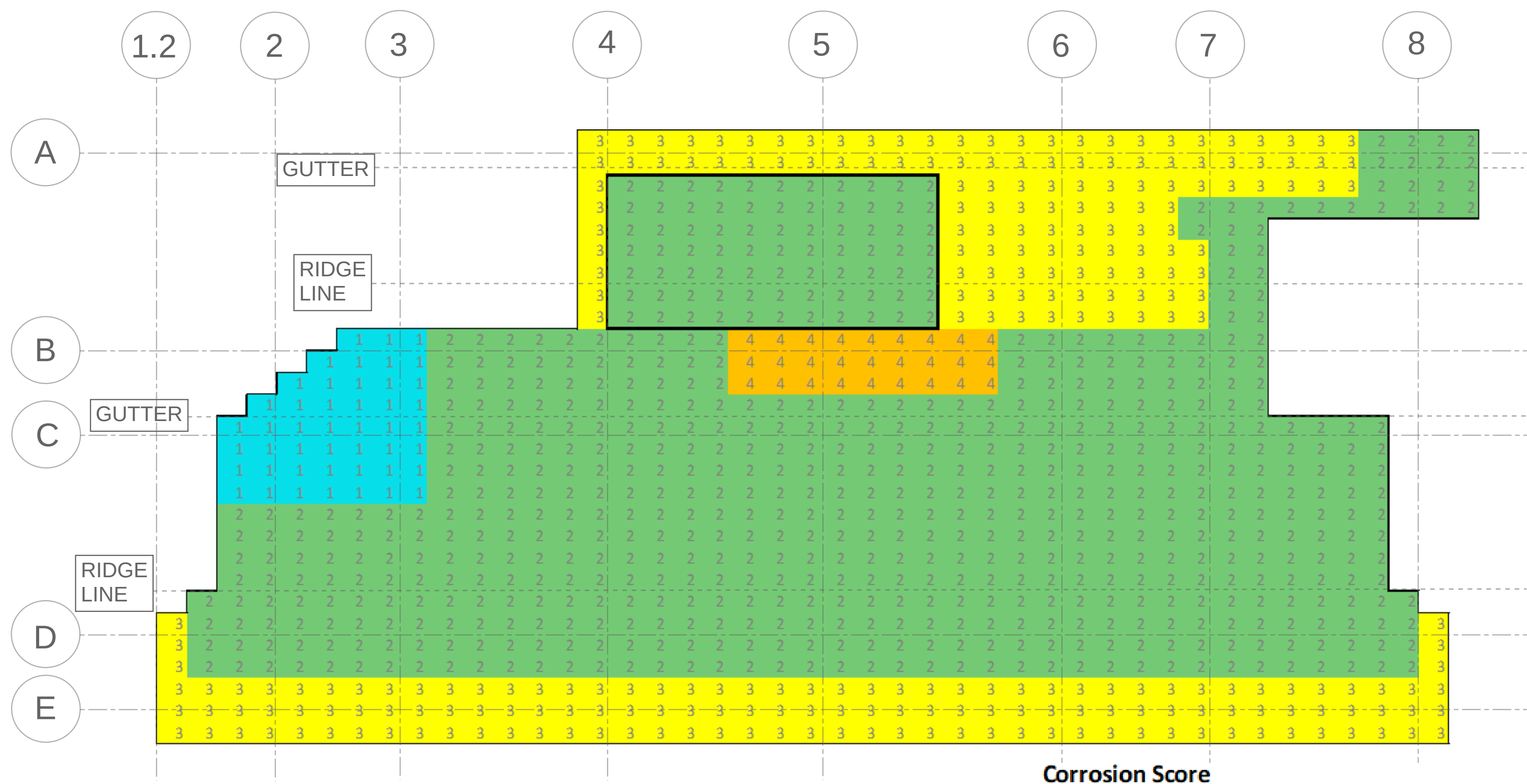
APPENDIX 1 CORROSION SCORE MAPS



SPACE FRAME TOP CHORD CORROSION SCORE MAP

- 1 No Corrosion Evident
- 2 Light Corrosion Evident
- 3 Medium Corrosion Evident
- 4 Heavy Corrosion (Partial Repair/ Maintenance Required)
- 5 Heavy Corrosion (Full Repair)

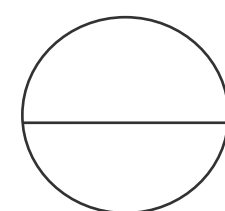
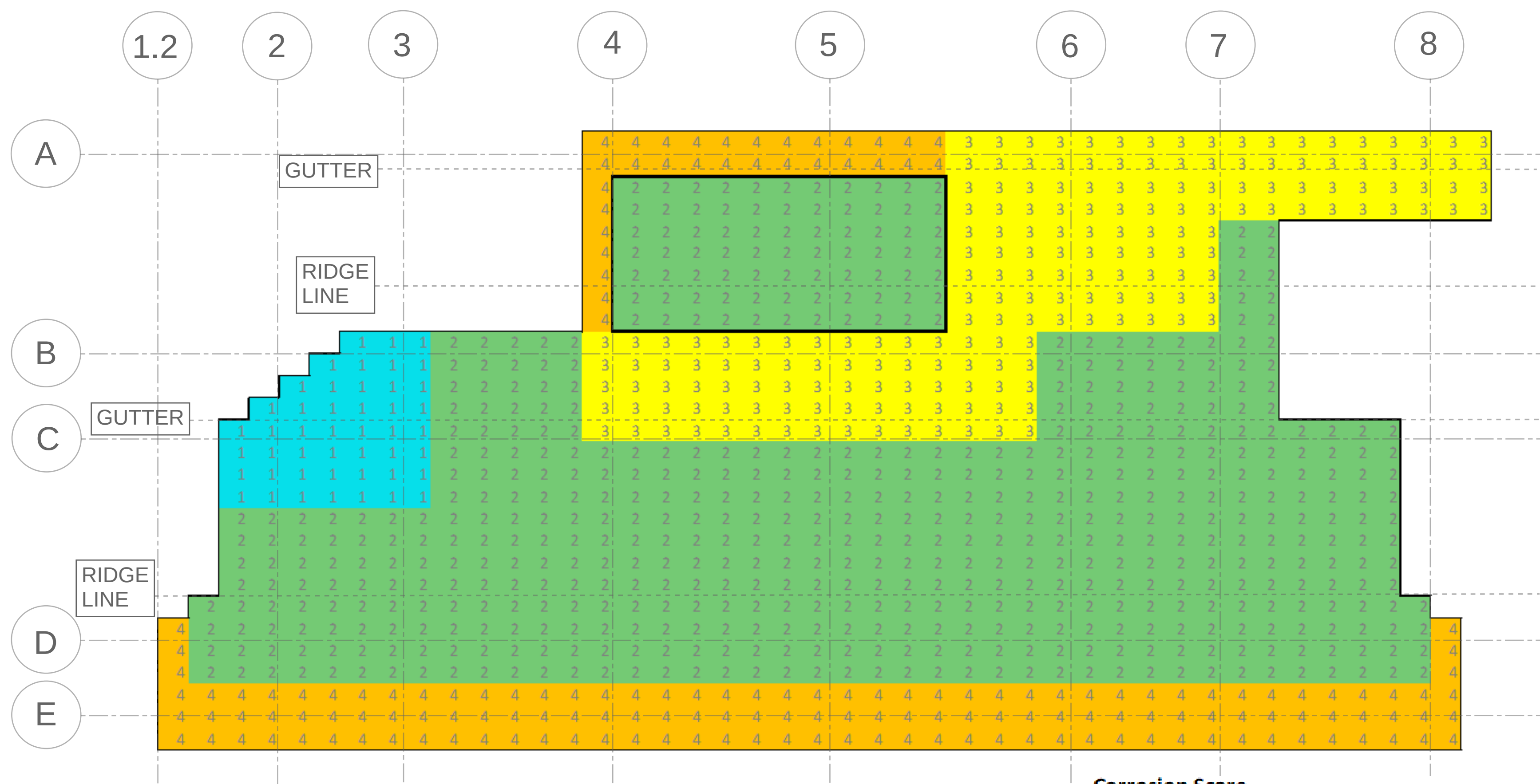
*** For the Space Frame Top Chord: Due to the scattered nature of the distribution of corroded members, this markup has been divided into generalised areas. Some members in these areas show worse corrosion than others. Weighing is conservative



SPACE FRAME DIAGONAL CHORD CORROSION SCORE MAP

- 1 No Corrosion Evident
- 2 Light Corrosion Evident
- 3 Medium Corrosion Evident
- 4 Heavy Corrosion (Partial Repair/ Maintenance Required)
- 5 Heavy Corrosion (Full Repair)

*** For the Space Frame Diagonals: Due to the scattered nature of the distribution of corroded members, this markup has been divided into generalised areas. Some members in these areas show worse corrosion than others. Weighing is conservative

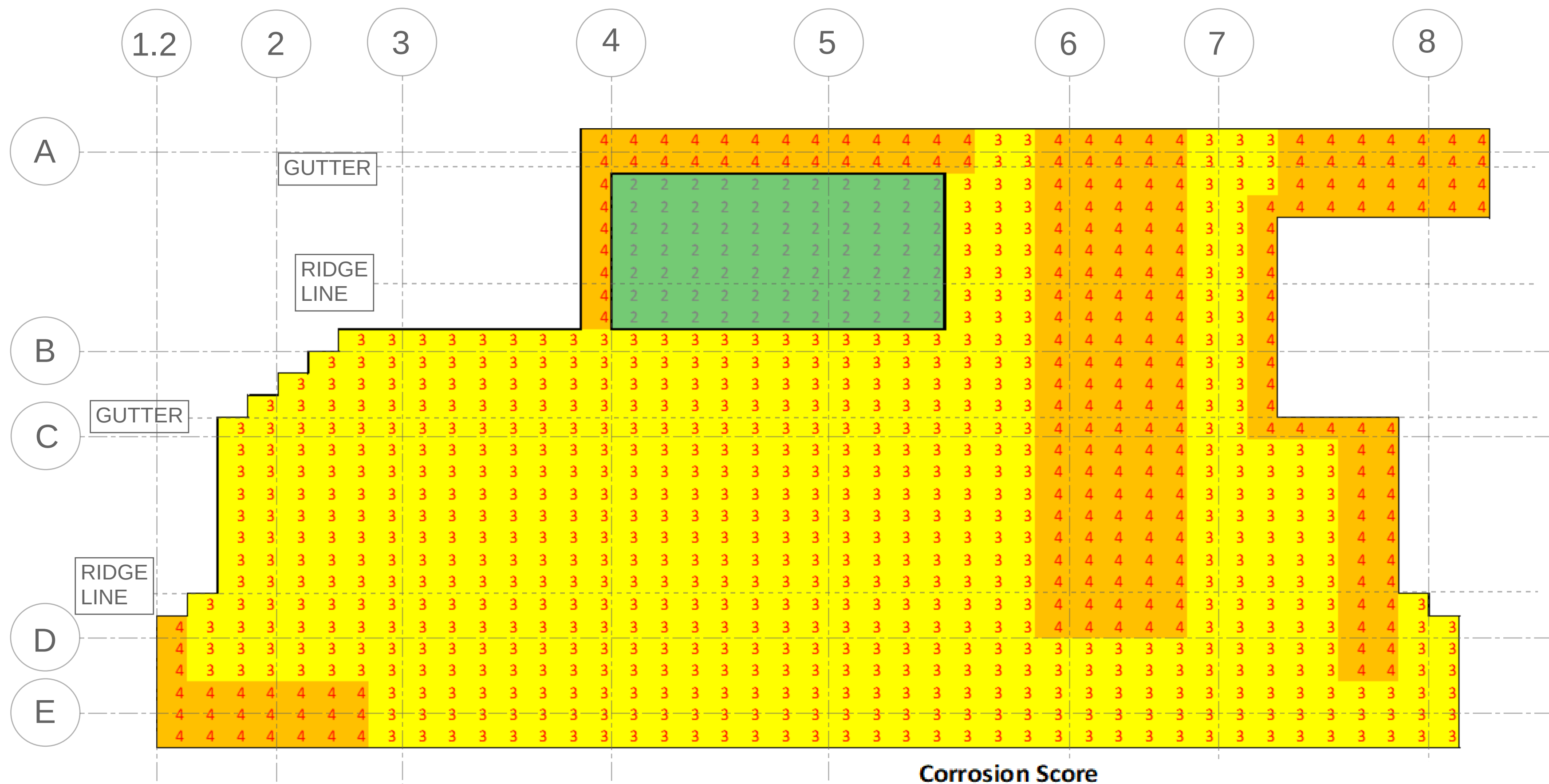


SPACE FRAME BOTTOM CHORD CORROSION SCORE MAP

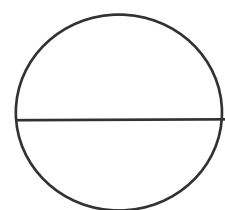
Corrosion Score

- 1 No Corrosion Evident
- 2 Light Corrosion Evident
- 3 Medium Corrosion Evident
- 4 Heavy Corrosion (Partial Repair/ Maintenance Required)
- 5 Heavy Corrosion (Full Repair)

*** For the Space Frame Bottom Chord: Due to the scattered nature of the distribution of corroded members, this markup has been divided into generalised areas. Some members in these areas show worse corrosion than others. Weighing is conservative



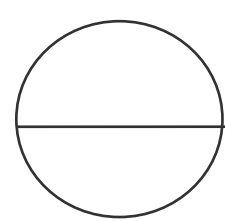
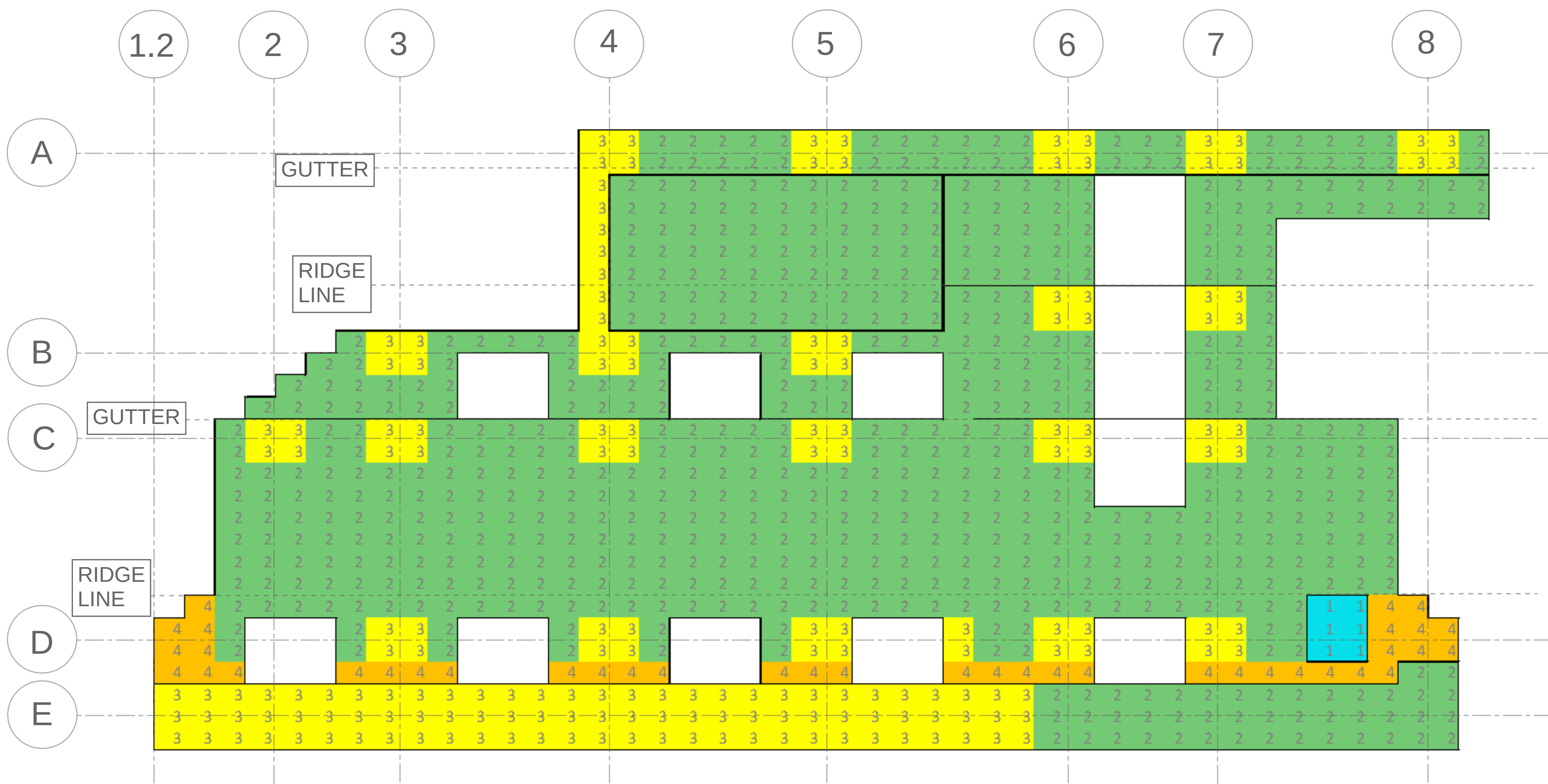
PURLIN VERTICAL SUPPORT POSTS CORROSION SCORE MAP



1	No Corrosion Evident
2	Light Corrosion Evident
3	Medium Corrosion Evident
4	Heavy Corrosion (Partial Repair/ Maintenance Required)
5	Heavy Corrosion (Full Repair)

*** For the Purlin Supports: Due to the scattered nature of the distribution of corroded members, this markup has been divided into generalised areas. Some members in these areas show worse corrosion than others.

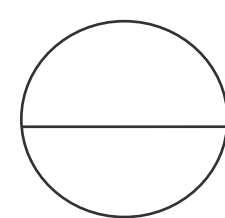
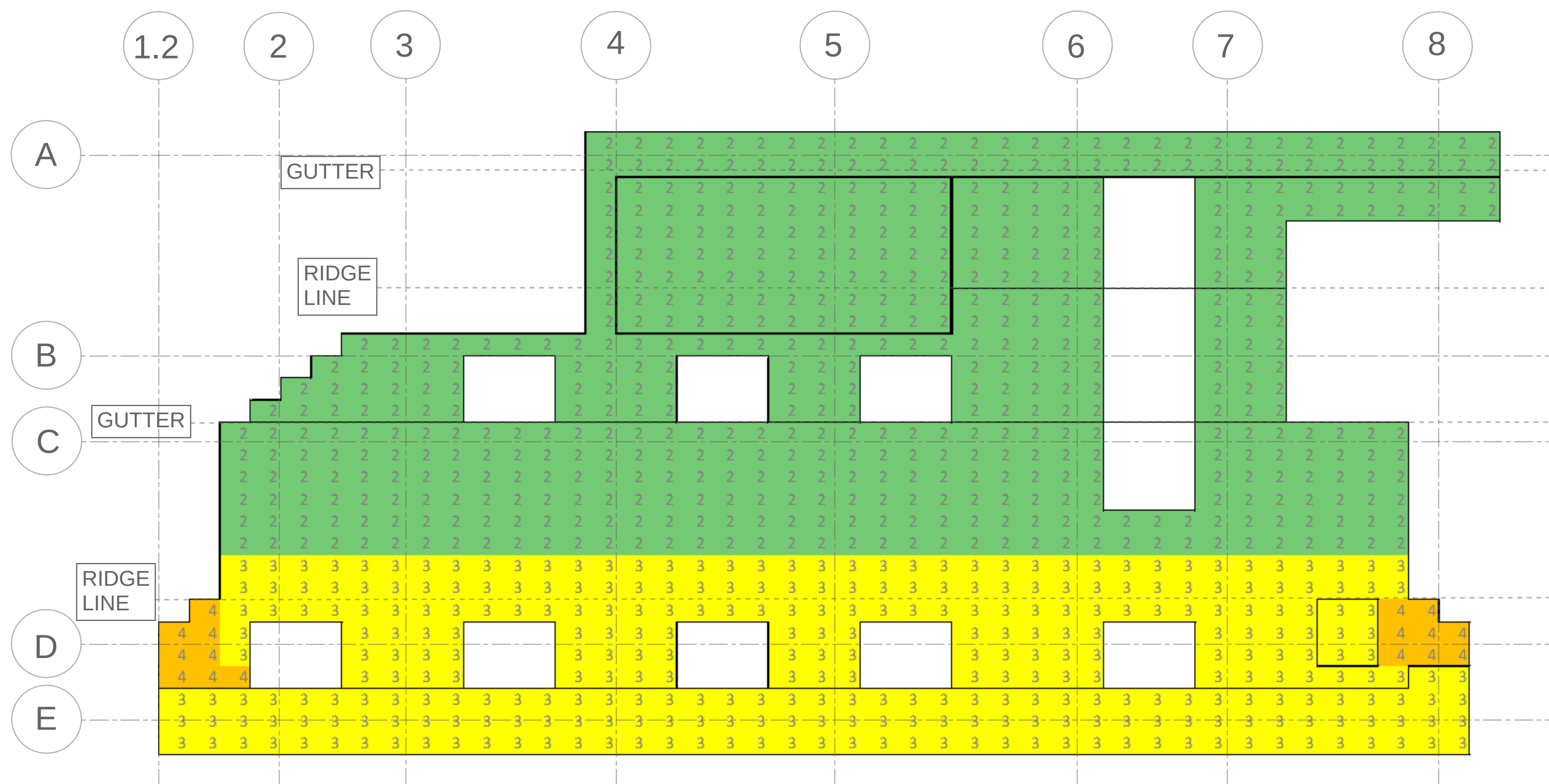
Weighting is conservative



LOWER ROOF CORROSION SCORE MAP

Corrosion Score

- 1 No Corrosion Evident
- 2 Light Corrosion Evident
- 3 Medium Corrosion/ Degradation Eviden
- 4 Heavy Corrosion (Partial Repair/ Maintenance Required)
- 5 Heavy Corrosion (Full Repair)



ROOF LEVEL CORROSION SCORE MAP

Corrosion Score

- 1 No Corrosion Evident
- 2 Light Corrosion Evident
- 3 Medium Corrosion/ Degradation Evident
- 4 Heavy Corrosion (Partial Repair/ Maintenance Required)
- 5 Heavy Corrosion (Full Repair)