Proceedings of the Australian Society of Sugar Cane Technologists, volume 45, 387-407, 2024

Peer-reviewed paper

Cane railway track: inspection methodology and best practice

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Abstract Wilmar Sugar, as a part of its standardisation efforts, investigated the methods and practices used to inspect cane railway track. These have evolved over the last ~10 years aiming at industry best practice across the eight individual cane railway networks that Wilmar owns and maintains. The experiences and lessons learnt over the last ~10 years regarding the methodology adopted in executing track inspections are presented. Condition scoring thresholds were developed to standardise ratings among the rail networks. The ASMC Guideline for Track and Civil Infrastructure Design and Maintenance Practices provides an adequate foundation for identifying defects and developing/accepting priority thresholds. Walking inspections provide an adequate level of detail to report on the health of the cane railway. A condition heat map is a suitable tool to understand at a high level, the overall performance of the track. Track condition is divided into seven categories (rail, joints, sleepers, fasteners, ballast, track profile, and geometry), each of which is assigned a condition score by a suitably trained track inspector. Identifying and prioritising track defects occur concurrently with the condition inspection and the process is an adequate way ensuring operational security and safety.

Key words Track; railway; inspection; condition; defect; GIS

INTRODUCTION

Wilmar Sugar owns, maintains, and operates eight cane railway networks. Of which there are (current 2023): 1,590 km of track, with 1010 km mainline, 458 km of sidings and loops, 122 km of yards; 1,843 culverts; 262 structures, with 49 concrete bridges, 138 steel bridges, 48 cattle grids, and 27 other structures.

Construction, maintenance, and inspection practices have varied greatly. Wilmar, as a part of its standardisation efforts, has investigated a range of methods and practices used to inspect cane railway track with the aim of best practices. Implementation has occurred through several iterations and is regularly scrutinised internally for improvement.

The *Guideline for Track and Civil Infrastructure Design and Maintenance Practices* provides a foundation for the inspection process. The Australian Sugar Milling Council (ASMC) is the current custodian of this document. This will be referred to as the *ASMC Guidelines* for simplicity throughout this report.

BACKGROUND

Here, we focus on the currently accepted practices, where information is captured using a Geographic Information System (GIS) in combination with mobile devices. To achieve a useable and reliable level of detail within set budget constraints, a walking inspection is used. This involves a trained track inspector to physically walk the entire mainline track whilst looking for condition and defects. Inspections are carried out by trained

employees during the maintenance season; they typically have operational roles in the production season. Over the last 10 years various methods have been explored to report on track condition:

- 2010 – 2015 - Walking inspections in the Burdekin region each year; arbitrary rating system and variance in track components scored; track condition generalised between points of significance, irrespective of length.
- 2016 – 2017 - Assimilated and transposed past inspection data; inspection criteria expanded; introduced variable weighting for track components; Proserpine and Plane Creek inspections completed.
- 2017 – 2018 - Standardised inspection form; standardised rating system criteria; continue to use MS Excel based heat map.
- 2019 - Introduced defect priority rating; introduced geospatial component to defects; defect concentrations dictate condition.
- 2020 - Used the ESRI ArcGIS mobile applications Collector and Survey123 and developed dashboards; reintroduced condition rating.
- 2021 - Additional inspection resources required, so training developed; inspections completed in all eight networks; GIS dashboard development; asset mapping occurred concurrently.
- 2022 – 2023 - Training package refined; moved to ESRI ArcGIS Field Maps; track condition rating expanded from four to seven components (rail; joints; sleepers; fasteners; track geometry; ballast; and track profile) (Figure 1); defect identification and prioritisation; asset mapping; GIS dashboard development.

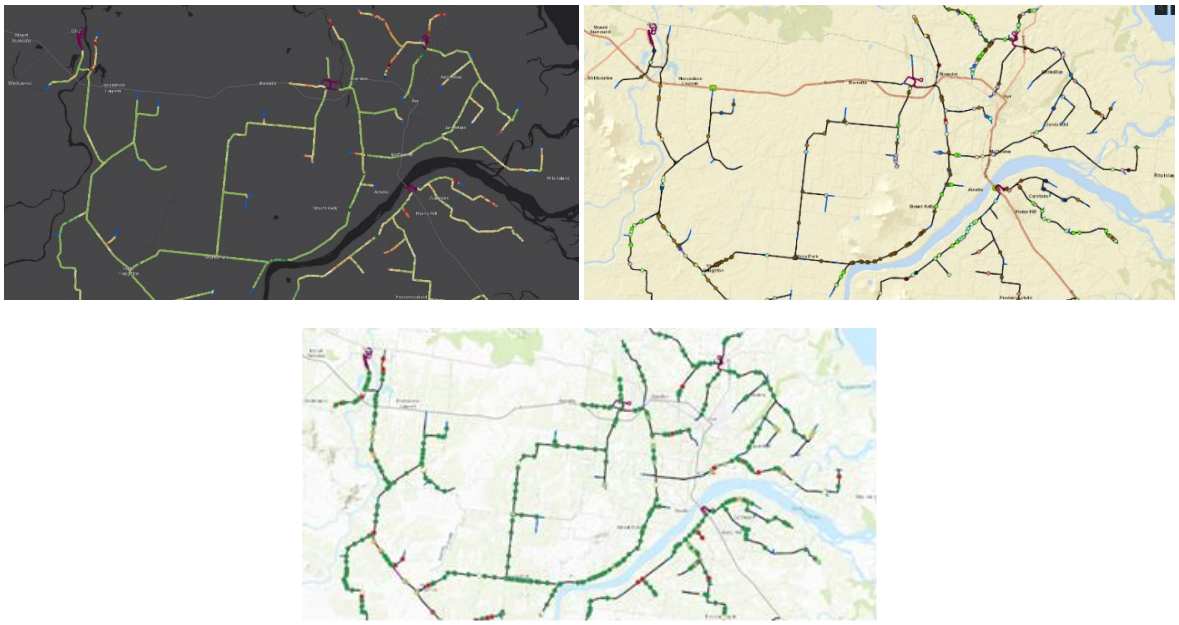

Figure 1. Upper left, condition heat map 2022 – 2023; upper right, track defect map 2022 – 2023; lower, culvert inspection map showing blockage levels.

OBJECTIVES

Here, we describe the approach taken and practices engaged for inspecting cane railway track (specifically walking inspections). We focus on the practices being used in 2023.

Inspections are required to satisfy three primary objectives:

1. Condition assessment standardised across various mill networks to enable cross comparison, motivated by the business need to make data driven decisions regarding capital and maintenance expenditure.
2. Identify and prioritise track defects according to type and criticality. Driven by the need to ensure operational security, safety, and reliability of the cane railway.
3. Asset data collection and mapping for culverts, sleepers, rails, joints and ballast, and other components as required.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

GIS provides an efficient and timely method to document, analyse, and share rail asset information in a format that is valuable for asset management purposes and that conforms to Best Management Practices for the business. ESRI Enterprise GIS, including Portal, is utilised for storing, managing, analysing, and sharing geospatial information through various desktop and web applications. This system offers users access to geographic and other important business information that is critical in making informed and timely decisions, including streamlined processing in near real-time and convenient accessibility to the necessary information.

We performed a discovery process to determine the quality of the existing data. We found that track information was incomplete and stored in different formats such as ESRI, Mapinfo, and tabular text formats for the different rail networks. The standardisation and consolidation of the data helped identify the accuracy of the information (which varied). This also highlighted the need to identify and record the assets that are currently unavailable or missing and gather up-to-date key details to properly assess the condition.

Currently, data is gathered using mobile devices, web applications, and desktop applications into an enterprise geodatabase (Figure 2). It is then processed and shared with important stakeholders for their use on mobile devices, desktop applications, and web applications. The Portal allows secure sharing of map applications and other information within the organisation through the dashboards (Figure 3) and web maps. The map and charts are interactive, clicking one of the defect points will display a popup that shows details of the defect, and statistics can be filtered by date by zooming in or out on the map and or selecting one or multiple items in any chart. There is a search function and addition asset and background layers options available. All dashboards have similar functionality with different layouts to suit the workflow.

Figure 2. System Architecture – Illustration sourced from ESRI Technical Workshop (5 February 2014) ArcGIS Server, Portal For ArcGIS and the Road Ahead.

Figure 3. Left, snapshot of the Track Defects Dashboard showing how statistics such as defect type, priority and totals are displayed through various charts; right, Track Condition Dashboard (current maintenance period) – condition symbolised by standard deviation bands of the mainline condition scores across Wilmar rail networks displayed in near real-time.

TRACK CONDITION INSPECTION

Condition inspections of the cane railway have had several iterations over the years. The current approach places an emphasis on standardisation and consistency to make comparisons across milling networks. Annual After-Action Reviews (AAR) should be carried out to guide opportunities to improve the methodology.

Condition assessment methodology

Condition scores are based on seven categories: rail, joints, sleepers, fasteners, ballast, track profile, geometry. These can be combined to provide an overall condition score for the track or separated out if the rail infrastructure manager requires such information. The categories that the condition is assessed against follows:

The present scoring condition is somewhat subjective, so it is important to develop and refine the training being provided to inspectors. Each of the seven categories is rated on a scale from 1-to-5 (1-worst, 5-best). It is advised to have an experienced inspector oversee the individual inspectors to ensure they are rating the condition consistently across the regions.

Track inspection data is collected directly into the GIS via the mobile application ESRI ArcGIS Field Maps. The track is broken down in to 100 m segments (Figures 4 and 5). Condition scores are assigned to these segments according to the seven categories. These are judged by the individual inspector and generalised for the entire segment. Generally, condition seldom varies within a segment. This resolution of 100 m over ~1000 km of mainline track provides a balance of detail to develop condition heat maps with the need to maintain inspection performance.

Figure 4. Condition heat map resolution at 100 m track segments.

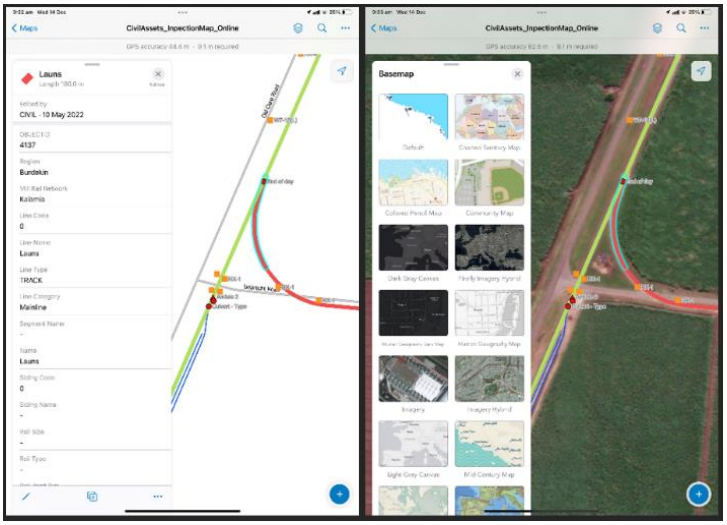

Figure 5. ESRI ArcGIS Field Maps user selection screen for 100 m track segment, background imagery can be useful to confirm segment start / end locations.

Criteria

It is vital to invest in detailed training for the track inspectors so as to overcome individual inspectors' subjective bias. Establishing criteria for scoring the categories can minimise any bias.

Rail (Figure 6)

The condition of the rail does not often vary dramatically within a given 100 m segment. If the condition drastically changes within a given segment, inspectors can decide the condition score.

Figure 6. Condition rating thresholds – Rail.

Joints (Figure 7)

We found that he condition score of the rail joints is very reliant on the individual inspector's judgement. Challenges arose when a number of "bad" joints were present and the inspector was required to consider the proportion. Emphasis must be placed on inspector training to achieve consistent judgements on the condition score thresholds. For this score, a sound mechanical joint has been defined as having at least one correctly tightened bolt on either side of the rail gap.

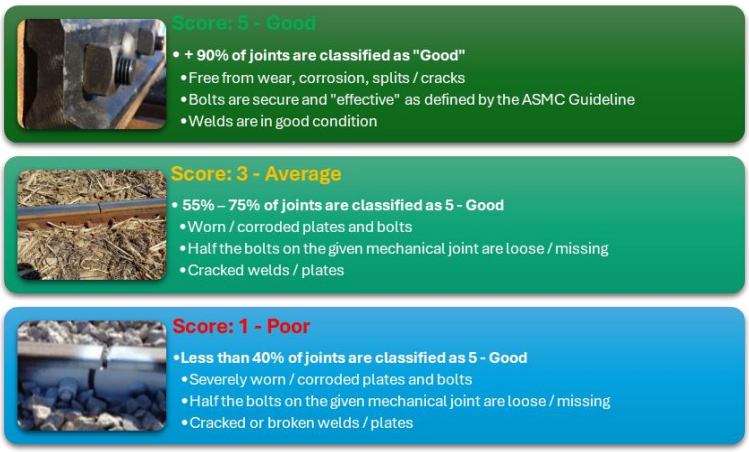

Figure 7. Condition rating thresholds – Joints.

Sleepers (Figure 8)

The condition score of the sleeper has been defined by the proportion of sound-to-ineffective sleepers in each segment. Ineffective includes broken sleepers or timber sleepers (most timber sleepers in service are beyond their useful life). Inspectors were advised to rate sleepers with cast in shoulders more favourably than those without, as these will continue to hold gauge regardless of the clip/fastener. Challenges arose when the track is buried, and it is difficult to assess the condition. Inspectors were advised to take one or more sample point where the sleeper is to be excavated for visual inspection. The condition is then generalised for the segment.

Figure 8. Condition rating thresholds – Sleepers.

Fasteners (Figure 9)

Some generalisations were required for this category as the inspectors needed to balance confidence in the scoring with overall inspection efficiency. Inspectors were advised to rate fasteners that provide a toe load more favourably than those that do not. Challenges arise if the track section is buried. An approach was adopted where one or more sample point is taken and this condition is generalised for the segment. Inspectors have reported that fasteners may appear visually sound but, upon slight aggravation (generally a tap with a hammer), will break.

Figure 9. Condition rating thresholds – Fasteners.

Ballast (Figure 10)

Condition of the ballast directly effects the longevity of the overall track. Failing/fouled ballast, particularly due to ponding of water, leads to compounding defects that are not easily addressed and often require complete track relays to eradicate the problem. Condition rating the ballast is considerably straight forward and seldom varies within a given track section.

Figure 10. Condition rating thresholds – Ballast.

Track profile (Figure 11)

This component is purely related to the track section's ability to drain water away.

Figure 11. Condition rating thresholds – Track Profile.

Geometry (Figure 12)

Condition scoring this category may take time, experience, and coaching to develop. It takes a keen and experienced eye to be able to critically assess this component.

Figure 12. Condition rating thresholds – Geometry.

TRACK DEFECT INSPECTION

A key learning experienced by Wilmar is a need to balance confidence in the inspection results with the ability to cover the extent of the railway network. It is also prudent to keep in mind the goal of the inspection; ensuring a safe and reliable rail network that meets the needs of the cane transport operational demands. Focus should be placed on identification of high-priority defects that can hinder the performance of the railway system.

Defect data collection methodology

Inspectors are expected to provide a preliminary priority rating and designate a defect type. Preliminary priorities are confirmed after review with the wider rail infrastructure management team. Defects are recorded in the GIS through ESRI ArcGIS Field Maps as a point feature with several attributes related to the specific defect. Figure 13 shows the mobile device screen that an inspector would typically see when entering a defect point feature.

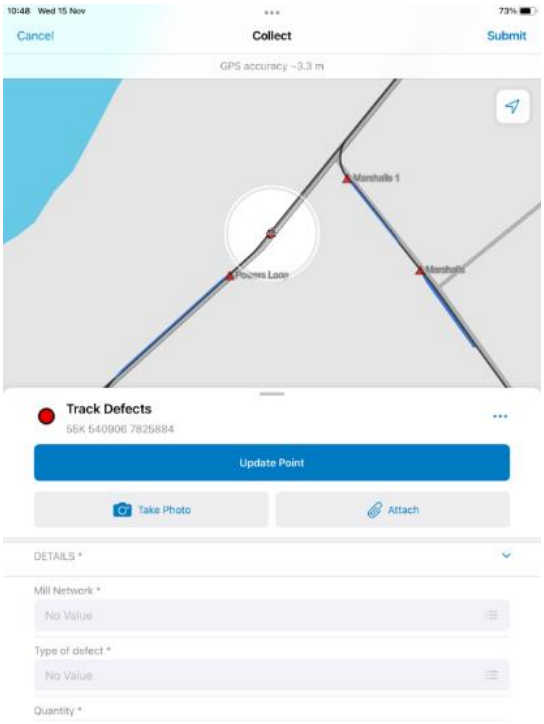

Figure 13. Extract from inspection E-form user guide.

Defect priority rating threshold definitions

Track defects have two primary variables: defect type and priority rating. The ASMC Guidelines have heavily influenced the priority thresholds that have been adopted.

The ASMC Guidelines (Tables 8.4 and 9.11) provide a priority rating system as well as recommendations for reducing operating speeds as a temporary solution. A practical approach must be taken in aligning with the recommendations provided in the ASMC guidelines. Table 1 was adopted from the ASMC guidelines:

Table 1. Priority response adopted from ASMC Guidelines.

Priority code	Response		
	MTCE Season	Production season	ASMC Guidelines Recommendation
P1	Break-in work – Coordinators discretion	Break-in work – immediate execution	Prior to next train
P2	Planned for execution in the next MTCE season Earlier if possible or the opportunity presents itself		7 days
P3	Considered for following MTCE season, continue to monitor on annual inspection Earlier if possible or the opportunity presents itself		12 months
P4	Monitor – check if defect priority changes		Monitor

Sleeper defects

ASMC Gguidelines (Section 9.3.9.1, Table 9.7 and Table 9.8) adequately define priority thresholds for sleeper related defects (Figure 14) and have been adopted. This approach includes defects related to the rail fasteners (the ability to hold gauge), where if the fasteners have failed the sleeper is to be considered ineffective.

Figure 14. Example of a sleeper consecutive defect (left) and a cluster defect (right).

Geometry defects

Track geometry defect thresholds are adopted directly from the ASMC Guidelines (Table 9.2) with some minor exceptions.

Geometry defect – Gauge

Gauge is checked and recorded at the end of every segment as part of the condition inspection process. Gauge (and cross-level) measurements are taken at every segment and the apex of every curve (Figure 15). Variation is measured from the design gauge of 610 mm for all mill networks except the Pioneer Mill network's 1067 mm.

Figure 15. Track gauge defect – noticed due to wheel flange markings.

Geometry defect – Horizontal Alignment (Line)

Defects related to the horizontal alignment (Figure 16) can be difficult to measure by the inspectors. This is especially challenging around curves as it is impractical for the inspectors to know the design radius let alone quantify the variation from design. The current accepted practise is for the inspector to visually approximate the variation along a 10 m chord.

Figure 16. Geometry defect – horizontal alignment fault on tangent track.

Geometry defect – Vertical Alignment (Top)

As it is with horizontal alignment fault, vertical alignment faults (Figure 17) are also difficult to accurately quantify. Similarly, the inspectors are instructed to visually approximate the variation from design, record this value, and assign the appropriate priority level.

Figure 17. Geometry defects: (left) vertical alignment fault on tangent track; (right) vertical + horizontal alignment fault on curved track.

Geometry defect – Twist

Twist defects are quantified by the track inspector (Figure 18) using a spirit level, a 5 mm incremental cant block, and referring to the table in the ASMC guidelines to decide on the priority rating. Superelevation ramps are applied at 1-in-1000, so in a 10 m chord it is expected to see a cross level differential of 10 mm. Inspectors are instructed to only enter this defect type at a curve transition if it exceeds 15 mm in a 10 m chord.

Figure 18. Left, 3D printed superelevation/cant block with 5 mm increments; Right, options available for purpose-built tools, this tool suits 610 mm gauge, measures gauge and superelevation/cross level.

Geometry defect – Superelevation

It is challenging for the inspectors quantify superelevation variation without design parameters. An initiative to investigate the ability to provide curve radius, operating speed, and thus superelevation through the GIS via the mobile application is underway.

Inspectors are instructed to look for extreme cases in regards to this defect type. This can occur one of two ways (both of which are P1): as a negative superelevation (reverse cant); ≥ 60 mm cross level – maximum design superelevation is 40 mm.

Geometry defect – Cross level (Tangent track)

Quantifiable from a cant block and spirit level, these defects are assigned a preliminary priority rating according to the defect thresholds detailed in the ASMC guidelines.

Rail defects

The ASMC Guidelines Table 9.10 lists several common rail defects that are likely to be observed, appropriate priority ratings, and are used as a basis. The ARTC rail defects handbook RC2400 provides a deeper insight into

rail defects and can be referred to for further information. Inspectors are educated on these common rail defects and are instructed to remain vigilant in identifying them.

Rail defect – Wear

Inspectors are advised to check for wear at the approximate apex of all curves and to remain vigilant in looking for wear along tangent track (although is unlikely). Wear gauges are commonly used in mainline railway systems to quantify rail wear, but there are limiting factors that restrict the practical use of these devices:

- Availability – typically suited for normal railways not used in the cane railway;
- Variation in rail profiles – wide variety of rail profiles in cane railway mainline with different key dimensions - challenges arise in correctly identifying the specific rail profile to apply specific wear limits;
- Access – gauges require access to the rail foot. Challenge arises where cane railway main line is either buried or the ballast is flooded above the foot of the rail.

The ASMC Guideline Table 9.9 notes wear limits for selected rail profiles, but it is not comprehensive and is challenging for new inspectors to be able to identify the specific rail. New inspectors have to balance identifying the rail profile with meeting inspection targets. Considering the challenges, this remains a viable approach given sufficient education is provided and inspectors take a hard copy of the list with them while inspecting.

Wilmar has adopted a practical and efficient approach allowing inspectors to record defects with minimal expertise in the varying wear limits for the different rail profiles. A measurement is taken from the web of the rail to the remaining gauge face of the rail head. This value is recorded in the defect point feature that is entered into the GIS. Inspectors are advised to use the thresholds in Table 2 when assigning the preliminary defect priority to the point feature in the GIS. There will be rare instances where the rail has been transposed and it has worn on both head faces. In this instance, inspectors are required to notify a supervisor and make mention of this in the comment field of the point feature.

Figure 19. Rail wear defect identified in the 2022 annual inspection.

Table 2. Defect priority thresholds concerning worn rail.

Priority rating	Measurement – web to remaining gauge face
Priority 1 (P1)	0 - 10 mm
Priority 2 (P2)	10 - 15 mm
Priority 3 (P3)	15 - 20 mm

A separate process is later undertaken by an engineer or experienced inspector where all locations that have been identified in the walking inspection are assessed with specialised tools for recording and monitoring rail wear.

Rail defect – Broken

Broken rails (Figure 20) are immediately recorded in the GIS as a Priority 1 (P1) defect. If the broken rail is immediately adjacent to a welded joint, this is recorded as a joint (weld) defect with the same priority rating.

Figure 20. Defect – broken rail identified in the 2023 track inspection.

Rail defect – Cracked

ASMC guideline recommended thresholds are adopted for this defect type (Figure 21). Inspectors are advised to pay close attention to the rail foot where exposed. If the crack occurs immediately adjacent to a weld, this is logged as a joint (weld) defect.

Figure 21. Defect – cracked rail identified in the 2023 track inspection.

Rail defect – Corrosion

The amount of corrosion can be difficult to quantify by track inspectors. They are advised to estimate the percentage of corrosion loss to the rail foot and enter this value in the point feature. The thresholds in Table 3 have been adopted in order to prioritise and gauge the severity of corrosion.

Table 3. Defect priority thresholds concerning corroded rail.

Priority rating	Measurement – visual approximation of rail foot material loss due to corrosion
Priority 1 (P1)	85% - 100%
Priority 2 (P2)	75% - 85%
Priority 3 (P3)	60% - 75%
Priority 4 (P4)	60% - 75%

"100%" loss of foot is reached once the corrosion severity causes the rail foot to recede to the web of the rail, there are pitting holes through the full thickness of the foot, or there is complete loss of the rail web (Figure 22). This preliminary priority rating is heavily reliant on inspector judgement.

Figure 22. Severe rail corrosion, foot is receding towards web (left) and complete loss of rail web (right).

Rail defect – Wheel burns and Impact damage

Wheel burns and Impact damage are not typical defect type that will be encountered. Due to their infrequent nature, inspectors are instructed to use the "Other (comment)" defect type when logging these defects and describe the defect in the comment text. ASMC guideline recommendations are adopted, in that "action and priority to be determined by competent worker" for both.

Rail defect – Weld defect

ASMC guidelines are adopted in priority rating this type of defect, wherein the crack length (Figure 23) ultimately dictates the priority rating.

Figure 23. Defect – weld defect (crack).

Joint defects

The ASMC Guidelines (Table 9.12) effectively establish priority thresholds for defects concerning the rail joints and has been adopted with minor variation.

Fishplate wear

This is not a typical defect type that will be encountered (Figure 24). Due to the infrequent nature, inspectors are instructed to use the “Other (comment)” defect type when logging this defect and describe in the comment text. ASMC guidelines adopted for this defect type.

Figure 24. Worn fishplate defects observed in the 2022 annual inspection.

Fishplate cracking

Cracked or broken fishplates (Figure 25) are a common defect that is likely to be observed. ASMC Guideline recommendations were adopted and expanded upon (Table 4). Track inspectors are educated on the scenarios and the associated priority ratings. Inspectors are advised cracks predominantly originate on the fishplate foot if the plate has been cut with an oxy acetylene to allow for rail fasteners / shoulders.

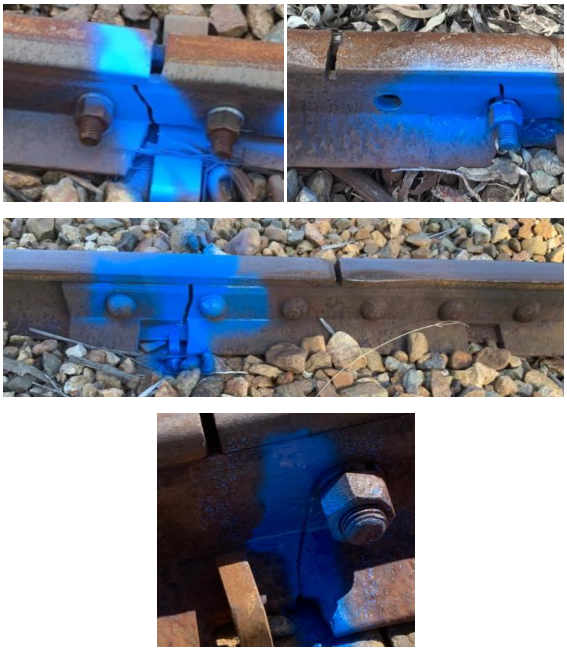

Figure 25. Cracked or broken fishplate defects: Upper, P1 Complete failure of one or both plates on or within the middle four bolt spaces (note the crack originates from the cut section); Middle, P2 Complete failure of one or both plates outside the middle four bolt spaces (note the crack originates from the cut section); Lower, P3 (note the crack originates from the cut section).

Table 4. Defect priority thresholds concerning cracked fishplates.

Priority rating	Description
Priority 1 (P1)	Complete failure of one or both plates on or within the middle four bolt spaces
Priority 2 (P2)	Complete failure of one or both plates outside of the middle four bolts spaces. Both plates cracked
Priority 3 (P3)	One plate is cracked, the opposing plate is sounds

Battered rail ends

ASMC Guidelines recommendations are adopted and expanded upon, wherein defects are defined and rated with respect to a dip at a mechanical joint over a certain length. The following thresholds (Table 5) are followed for assigning preliminary defect priority. In instances where the table may conflict with itself, the more severe priority is adopted.

Table 5. Defect priority thresholds concerning hogged (Figure 26) and battered rail ends (Figure 27).

Priority	ASMC Guidelines	Adopted approach and thresholds	Practical measurement – 150 mm steel ruler	Practical measurement – 800 mm spirit level
Priority 2 (P2)	-	Greater than 2% dip over the mechanical joint	Greater than 3 mm dip over the mechanical joint	Greater than 16.0 mm dip over the mechanical joint
Priority 3 (P3)	Greater than 100 mm in length and 2 mm in depth	1% - 2% dip over the mechanical joint	1.5 mm - 3.0 mm dip over the mechanical joint	8.0 mm - 16.0 mm dip over the mechanical joint
Priority 4 (P4)	Less than 100 mm in length and 2 mm in depth	≤1% dip over the mechanical joint – inspector's discretion	≤1.5 mm dip over the mechanical joint – inspector's discretion	≤8 mm dip over the mechanical joint – inspector's discretion

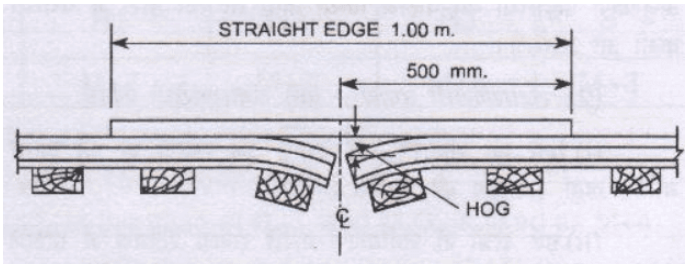

Figure 26. Illustration of hogging sourced from https://civilnoteppt.com/hogged-buckling-and-tilting-of-rails/.

Figure 27. Battered rail end defects.

Fish bolts

The ASMC Guidelines provide a fundamental basis to prioritise these defects (Figure 28). Wilmar has adopted the guideline recommendations and expanded upon them in identification and prioritisation (Table 6). We advise

paying careful attention to this in the inspectors' training as it has required considerable desktop rework before inspectors understood this correctly.

Figure 28. Fish bolt defect – preliminary priority rating of P2 (>50% loss of nut from corrosion).

Table 6. Defect thresholds concerning mechanical joint bolts.

Priority	ASMC Guidelines	Adopted approach and thresholds
Priority 1 (P1)	-	All bolts a missing
Priority 2 (P2)	Less than two effective bolts (must have at least one effective bolt either side of the rail gap). An effective bolt is defined as correctly tightened.	Less than one effective bolt on either side of the rail gap / joint An effective bolt is defined as correctly tightened. Severe corrosion: >50% of the nut missing
Priority 3 (P3)	-	At least one effective bolt on either side of the rail gap / joint Moderate corrosion: 25% - 50% of the nut is missing
Priority 4 (P4)	Incorrect bolts	-
Not a defect	-	Two or more effective bolts on either side of the rail gap (even if the fishplate has six bolt holes)

Insulation

Track inspectors are advised to only record defects related to insulated track if the fault is related to the physical security of the rail, that is, the insulated rail joint has failed and is no longer supporting the rail ends effectively. Track inspectors are not tasked with testing the effectiveness of the insultation which may cause false activation of road crossing flashing lights. Inspection of the insulated rail joints is incorporated in a separate inspection process.

Ballast defects

This defect type (Figure 29) is primarily used to identify locations where the track structure has partially or fully washed away due to high surface run off / flows. A guidance for rating is given in Table 7.

Table 7. Defect thresholds concerning ballast.

Priority	Adopted approach and thresholds
Priority 1 (P1)	Complete ballast washaway – bottom of sleeper/s is not supported and is suspended in air
Priority 2 (P2)	Loss of ballast to the bottom level of the sleeper Evidence that the track is not supported laterally (insufficient shoulder ballast)
Priority 3 (P3)	Minor loss of shoulder ballast Evidence that the sleeper is pumping
Priority 4 (P4)	Used at inspector's discretion – if a minor observation is needed regarding deficiency in ballast material

Figure 29: Ballast defects: Upper left, preliminary priority rating of P1; Upper right, preliminary priority rating of P2; Lower left, preliminary priority rating of P3; Lower right, preliminary priority rating of P2 (evidence that the track is not supported laterally (insufficient shoulder ballast)).

Other defects

Inspectors are instructed to use the "*other (comment)*" defect type if a suitable option isn't available from the preset list and to use their best judgement in assigning a preliminary priority rating.

Review and reporting process

There are many options available in managing the incoming data that is collected by inspectors (Figure 30). The importance of this is reflected in the number of defects identified that have potential to lead to a derailment event. Lines of communication are vital to ensure critical defects are not overlooked.

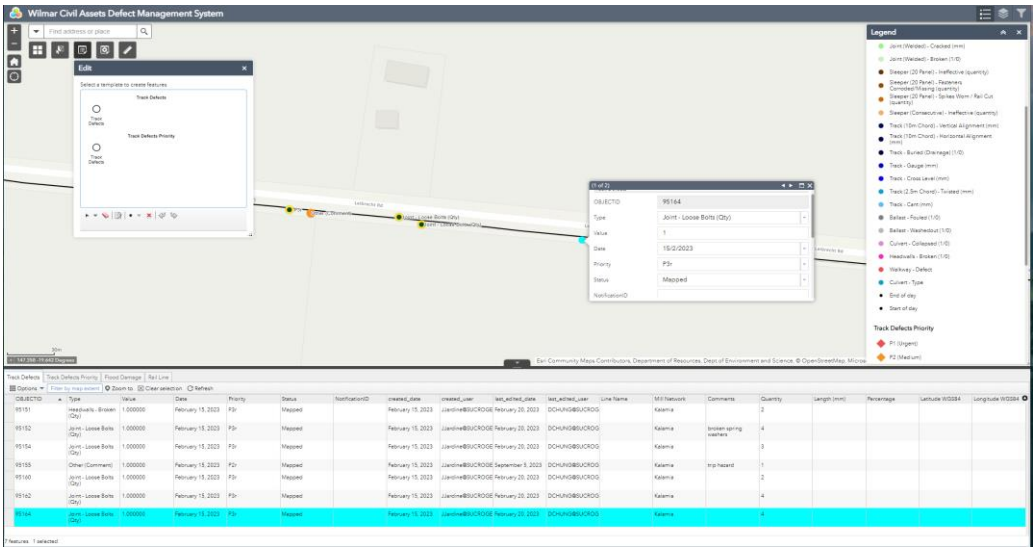

Figure 30. The Defect Management System web app tool used to validate, prioritise, plan and execute track defect repairs through weekly meetings.

Regular review with the rail infrastructure management team

All defect preliminary priorities are to be reviewed and confirmed by senior rail infrastructure management team. An emphasis is placed on the Priority 1 and Priority 2 defects. Upon review, the team ultimately confirms if the priority rating is correct and can make plans to address the defect on an as needs basis.

Automatic email notification

Wilmar has selected to deploy an automatic email notification generated every 24 hours that reports on the defects that have been assigned preliminary priority 1 (P1) by the track inspector. The report provides details of all P1 defect including: defect type; status; a location hyperlink (google maps or the internal GIS); and other useful information.

Direct reporting to local execution team

Track inspectors are encouraged to provide regular check-ins with the regional rail infrastructure management team on high priority defects that have potential to derail track maintenance machines.

ASSET DATA COLLECTION AND MAPPING

The concentrated effort required to carry out condition inspections and defect identification provides a unique opportunity to develop and update asset records. Wilmar has capitalised on the inspection process to include capturing data on features of the cane railway including: culverts, sleepers, rail, joint type, and ballast.

Culvert identification and mapping

Wilmar identified and rectified a deficiency in the inspection program wherein culvert structures were being overlooked. A concerted effort was made in the 2021 inspections to map all culverts and to capture basic information including type, size, and number of barrels. 1800+ culverts were mapped into the GIS with high confidence in the details that were captured (Figure 31). Wilmar has since been able to incorporate culvert inspections into a regular regime and is able to report on metrics such as culvert blockages and observed defects.

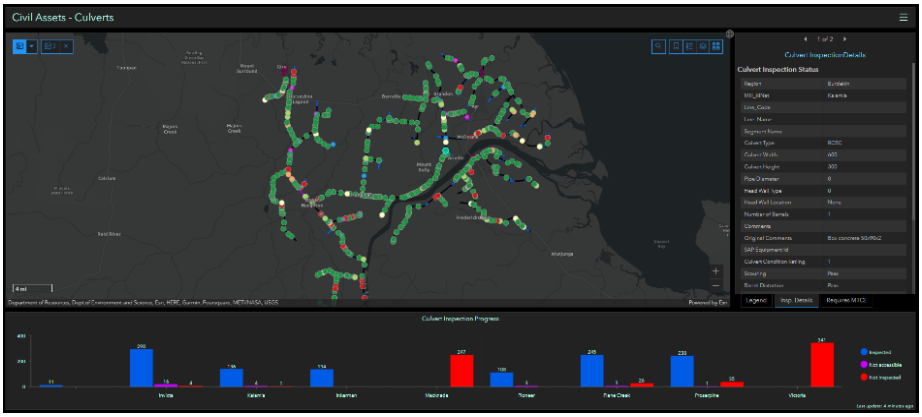

Figure 31. Culverts dashboard displaying the level of blockage and latest inspection scores in the right window.

Track material / component mapping

The identification of several component and aspects of the track was included in the inspection process. This was incorporated into the condition scoring methodology, with these track components were generalised over 100 m segments and entered into the GIS (Figure 32). Information captured is as in Table 8.

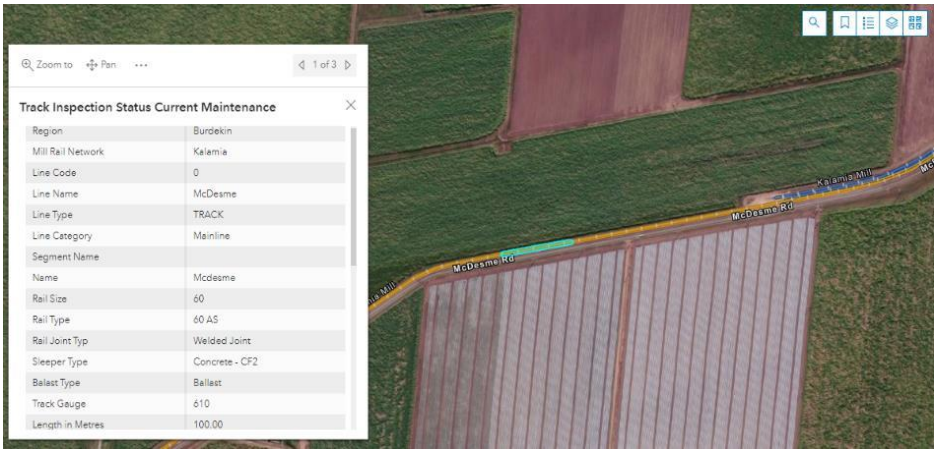

Figure 32. Extract from GIS showing track details.

Table 8. Asset data collection scope.

Track component	Description and scope of data collection
Sleeper type	Sleeper type can often change multiple times within a 100 m segment. Inspectors are instructed to list the dominant type within the 100 m segment Types include: Cane Clip, CF2, Gauge Spike, MS, PS, O'Hara Sprin Spike, Plate and Bolt, Composite, Steel BB, Steel EC, Steel TL1, Steel TL2, Steel Pandrol Shoulder, Timber, Other
Rail type	Rail type seldom changed within the 100 m segments Broken down into weight class and specific profile (e.g. 60 lb rail – profile AS60 A). Where profile is undetermined, inspectors record rail foot dimension
Joint type	Joint type seldom changed within the 100 m segments Available option: Bolted Joint; Huck Joint; Welded Joint
Ballast type	Ballast type seldom changed within the 100 m segments Available options: Ballast, Gravel, or Earth

RECOMMENDATIONS

We recommend further investigation to improve the inspection performance while maintaining confidence in the data. Areas of particular interest are where automation or mechanical assistance can be introduced This will improve consistency, standardisation, and inspection performance.

One opportunity for improvement is to integrate the GIS with the workorder and financial management system, in Wilmar's case, SAP system.

Buried track is detrimental to the longevity of the steel, particularly the rail, shoulders, and fasteners and should be avoided when carrying out track relay works (Figure 33). This includes flooding the ballast above the top face of the sleeper.

Figure 33. Effects of burying or flooding on track corrosion.

ACKNOWLEDGMENTS

We thank the senior management staff for supporting the rail infrastructure team along this journey, in particular Mr Rod Taylor, Mr Raymond De Lai, and Mr Paul Giordani, in addition to the industry support provided by Wilmar Sugar. We also appreciate the support for the process and the supply of resources required to execute the inspections from the regional operation and execution teams: Cane Supply Managers – Lindsay Wheeler, John Tait, Jed Page, Jim Kirchner; Transport Operations Managers – Chris Winship, Mark Lazzarini; and Cane Rail Superintendents – Scott Gofton, Bradley Garner, Rod Hinschen, and Trent Vernon. Our deep gratitude goes to those who assisted in the GIS development and testing stages, workflow mapping, and After Action Reviews that ultimately resulted in the success of the inspection process: Lead Planner Tess Marano and Leeanne Marriot, Inspection Coordinator David O'Donnell, GP One Solutions Engineer Christopher Hardie, and Microsoft Team Lead David Bailey. Without your continual and reliable assistance, the inspection project would not have been possible. Last but not least, thanks to all the inspectors who have the daunting task of walking 1000+ km of mainline track in a very restrictive maintenance-season window.

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