WARRIP
WESTERN AUSTRALIAN ROAD RESEARCH & INNOVATION PROGRAM



Independent Comparison of AusRAP Star Rating results from AiRAP and Manual Coding using iRAP model v3.02

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Background

Main Roads initiated the Network LiDAR Project in 2022 to establish a comprehensive and contemporary 3D point cloud dataset and 360° imagery of the entire state road network (~19,000 km). The dataset was subsequently coded for Australian Road Assessment Program (AusRAP) Star Ratings using AiRAP (Accelerated and Intelligent) coding processes, including the extraction of data from LiDAR and 360° imagery by Anditi, and the application of business rules developed by Main Roads and default iRAP values for the remaining attributes.

As the first application of the AiRAP methodology, an independent review was undertaken to verify the accuracy, consistency and reliability of the resulting AusRAP assessments compared with Manual coding, and to validate the Main Roads business rules used to derive the remaining AusRAP attributes.

Approach

NTRO undertook an independent review to compare AiRAP derived AusRAP star ratings and traditional manual coding across a diverse sample of representative road types, including rural open roads, rural forest roads, urban freeways, urban highways and fringe highway environments. Collectively, these representative road environments account for approximately 94.8% of the Western Australian State road network by length and 88.3% of vehicle kilometres travelled (VKT), enabling the findings to be interpreted in the context of statewide AiRAP implementation. The objective was to determine where AiRAP aligns with manual coding, where it diverges, the practical implications of those differences for star ratings and star rating scores (SRS), and the opportunities to improve future large-scale deployment.

Findings

The review found that AiRAP generally produced strategically comparable outcomes to Manual coding for Vehicle Occupants and Motorcyclists across much of the assessed network. Strong agreement was observed on rural open roads, representing 77.1% of the State road network by length and 18.0% of vehicle kilometres travelled (VKT), and urban freeways, representing 2.8% of the network by length but 34.6% of VKT. Across these representative road environments, the proportion of road achieving 3-star or better remained broadly consistent between the AiRAP and Manual assessments, despite some variation in individual road attribute coding. The representative rural open road (Great Northern Highway (H006-9)) and urban freeway corridor (Mitchell Freeway (H016-150)) demonstrated only minor differences in smoothed Vehicle Occupant and Motorcyclist star ratings, with the urban freeway environment producing almost identical Vehicle Occupant star ratings between the two methods. Similarly, the representative rural forest road environment (Caves Road (M043-123)) showed strong alignment in overall star rating outcomes, with differences in roadside hazard coding having only a limited influence on network-level results. These findings demonstrate that, despite differences in individual coding attributes, the proportion of road achieving 3-star-or-better outcomes for Vehicle Occupants remained broadly comparable between the AiRAP and Manual assessments, providing confidence that AiRAP can reliably support strategic network-level safety assessment and investment prioritisation across the predominant road environments within the Western Australian State road network.

The greatest differences between AiRAP and Manual coding were observed on road environments characterised by greater geometric and operational complexity. Urban highways, representing 5.7% of the State road network by length but 30.6% of VKT, exhibited some of the most practical coding differences. The representative urban

highway corridor (Albany Highway (H001-134)) demonstrated that AiRAP commonly overestimated intersection-related risk through driveway misclassification, lane count overestimation and differing median type interpretation, contributing to higher assessed risk. Outer metropolitan/fringe highways, representing 0.9% of the State road network by length and 2.9% of VKT, demonstrated strong agreement in Vehicle Occupant outcomes. The representative fringe highway (Great Northern Highway (H006-140)) demonstrated differences in merge treatment, median interpretation and recognition of bicycle facilities primarily influenced Motorcyclist and Bicyclist star ratings. These findings demonstrate that the greatest differences between AiRAP and Manual coding occur in environments characterised by more complex intersections, lane configurations, medians, roadside hazards and vulnerable road user infrastructure, although these differences generally had a limited influence on the proportion of road achieving 3-star-or-better Vehicle Occupant outcomes.

The review identified that the largest divergence between AiRAP and Manual coding occurred for vulnerable road users. Across the representative road environments assessed, differences in Pedestrian and Bicyclist Star Ratings were driven less by differences in the physical road infrastructure than by differing assumptions regarding road user applicability, exposure and facility recognition. For the Manual assessment, pedestrian and bicyclist applicability was generally assigned only where facilities and surrounding land use indicated that meaningful pedestrian or cyclist activity could reasonably be expected. In contrast, the AiRAP assessment applied jurisdictional pedestrian and bicyclist volume datasets, with pedestrian flows assigned in accordance with Main Roads business rules that applied pedestrian volumes to residential land use irrespective of the presence of pedestrian facilities. AiRAP also more consistently recognised adjacent facilities within the Principal Shared Path (PSP) network, including shared paths that were not directly accessible from the roadway or not readily identifiable in the available imagery. These differing assumptions resulted in AiRAP assessing a greater proportion of the network for vulnerable road users and contributed to more pronounced differences in Pedestrian and Bicyclist Star Ratings and SRS than those observed for Vehicle Occupants and Motorcyclists. This was most evident on Albany Highway (H001-134), where differences in lane count, median type and pedestrian applicability substantially increased Pedestrian Crossing SRS, and on Great Northern Highway (H006-140), where recognition of bicycle facilities influenced Bicyclist Star Ratings.

While differences were identified between AiRAP and Manual coding, these largely reflected ambiguity in coding guidance or differences in implementation rather than fundamental limitations of automated assessment. Despite differences in coding, Star Ratings and SRS, the proportion of road achieving 3-star-or-better outcomes for Vehicle Occupants remained broadly comparable across the representative road environments, reinforcing the suitability of AiRAP for strategic, network-wide AusRAP assessments. More importantly, the review demonstrates the value of independent validation in strengthening both automated and Manual coding practices, increasing confidence in AiRAP while directly informing improvements to coding guidance, the AiRAP methodology and Main Roads Western Australia business rules. Collectively, these outcomes provide a stronger foundation for consistent, transparent and scalable AusRAP assessments, supporting robust, repeatable and evidence-based road safety investment decisions.

Implementation opportunities

A significant outcome of the project and subsequent review was the direct translation of its findings into improvements for future AusRAP delivery. The review informed updates to the iRAP Coding Manual for Star Ratings Version 3.10 to improve consistency in Manual coding, refinements to the AiRAP methodology and quality assurance processes to improve the detection and classification of key road attributes, and changes to Main Roads Western Australia business rules governing pedestrian and bicyclist applicability and pedestrian flow estimation to better reflect likely vulnerable road user activity and improve consistency with the intent of the iRAP methodology.

Next stage

The next phase of this research will involve implementing iRAP approved improvements into the AiRAP coding and understanding the effect of these changes on the star rating outcomes. This phase will be undertaken independently by Main Roads and may not be delivered through WARRIP.