National Heavy Vehicle Regulator – HVSI Program

HVSI Project 620 National Truck Rollover Risk Map

NTRO project number 02037

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Summary

This report is a summary of the project delivered by the National Transport Research Organisation (NTRO) under the National Heavy Vehicle Regulator's (NHVR) Heavy Vehicle Safety Initiative (HVSI) funding program supported by the Australian Government. The objective of the project was to create a webmap to display the locations of heavy vehicle (HV) rollover crashes. The project successfully brought together data from 2 sources (road geometry and crash records) to display this information via the webmap. The webmap is publicly accessible via hvrollmap.seceda.au/map under the Open Data Commons Open Database License.

The first stage of the project involved evaluating various spatial datasets to determine the most suitable ones based on several criteria such as attribute availability, accuracy and licensing. The review included various mapping datasets, including those from HERE Technologies, OpenStreetMap and TomTom, among others. OpenStreetMap was selected as the primary non-commercial data provider for the project due to its suitability for the use case. The OpenStreetMap attributes were then applied to predefined key freight routes; these attributes included road geometry, curvature and speed limits.

The second stage of the project involved a review of crash data. Crash records were sourced from the NTRO's national crash database. Analysis of the database revealed 1,341,482 crash events from 2005 to 2021, with 107,349 involving HVs and 47,067 occurring near key freight routes. Although the focus of this project was to identify rollovers, there is no category in the national crash database for 'rollover'; therefore, 'run-off road' was used as a proxy. Run-off road crashes can occur for several reasons, and therefore, this classification is likely to include crashes that were caused by other factors such as fatigue or loss of control. The project focused on these run-off road incidents, of which there were 5,671. The crash records were stored and managed in an online database and visualised using a map server.

The final stage of the project involved the development of the online interactive webmap. The webmap is intuitive, allowing users to simply and quickly review crashes, select multiple background tiles and display detailed information on crashes and road segments. The final deliverables included a validated GIS map layer and an optional webmap service for integration in other applications.

The webmap provides a basis for further work, which could include a focused review of these crashes that potentially used safety expertise to identify likely causes and contributing factors. The approach could also be broadened beyond the key freight routes to the wider road network (major roads, for example), which would include a much greater number of HV crashes. The project demonstrated that it is possible to extract and display HV crashes with a basic level of categorisation. The process of extracting crash records and combining them with road attributes was largely automated, greatly reducing the need for human intervention or expertise in the initial stages of the process.

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1. Introduction

The Heavy Vehicle Safety Initiative (HVSI) program supports implementable, value-for-money projects that deliver tangible improvements to heavy vehicle (HV) safety. The federally funded grants program is administered by the National Heavy Vehicle Regulator (NHVR) on behalf of the Australian Government and is aimed at making Australia's roads safer for all users. The Australian Road Research Board (ARRB) led this project to produce a national truck rollover map. Shortly after the commencement of this project, ARRB was re-branded as the National Transport Research Organisation (NTRO), and as such, 'NTRO' will be used throughout this report. The aim of developing a national truck rollover map is to reduce the number of truck rollovers by identifying where they occur on Australia's road freight network.

This report documents the work completed by NTRO as part of HVSI project 620.

1.1 Background

A truck rollover can be extremely dangerous. Truck rollover crashes often result in death or serious injuries to the truck driver. Approximately 500 heavy truck occupants are hospitalised from road crashes each year. Of these, approximately 30 per cent are categorised with high-threat-to-life injuries (BITRE 2020). Data from 2019 showed there was a marked increase in the number of incidents where truck drivers lost their lives. The number of drivers who died in major incidents involving trucks (insured with National Transport Insurance (NTI) was over 2.5 times higher in 2019 than in 2017 (NTI 2020). This problem is not going away; in fact, it is getting worse. In Victoria in 2019, there were approximately 800 crashes involving a HV. Approximately 100 of these crashes (12.5%) involved a rollover event.

Often the approach to solving the problem of truck rollovers is more driver training. It is acknowledged that driver training plays an important role, but it should not be the only solution. The basic theory of crash investigation is to look at the problem in the following 3 areas:

- the driver
- the vehicle
- the road.

Training and education address **the driver** but leave the other 2 areas open. Technology, standards, regulation and compliance address **the vehicle**, areas in which the NHVR is active and has been effective. This project focused on the road.

1.2 Project Scope

The project scope was to collect and align road geometry and key attribute data for the purpose of creating a national dataset of locations posing a high risk of rollover for HVs.

The intention is that the national truck rollover map would be accessible to the public but would also be available for integration or display in the NHVR Route Planner and/or other websites. This project comprised the following tasks:

- identification of turns and bends posing a high risk of rollover
- identification of speed limits for high-risk locations
- alignment of crash history with high-risk locations (for HVs where available)
- development and maintenance of a GIS database of input and derived (output) data
- combined dataset to produce an interactive online webmap
- provision of a base map (GIS file).

1.3 Project Deliverables and Milestones

The major project deliverable was to provide a webmap and GIS dataset (map layer file and/or map tiles service) to be integrated into the NHVR Route Planner and made available for public display. In order to deliver this major deliverable, the project comprised 4 stages. The project milestone schedule is outlined in Table 1.1.

Table 1.1: Project milestone schedule included in this report

Milestone	Milestone	Status
1	Execute agreement	Completed
2	Stage 1a – Data review of available and open commercial data sources	Completed
3	Stage 1b – Data sourcing	Completed
4	Stage 2 – GIS database and layer	Completed
5	Stage 3 – Update and maintenance (Year 1 of 2)	Completed
6	Stage 4 – Update and maintenance (Year 2 of 2)	Completed

Stage 1a – Review of available and open commercial data sources

Stage 1 was completed in 2 parts. Part A was a review of available spatial datasets including open data (i.e. licensed under Creative Commons), NTRO-owned and commercial data sources. The aim of this review was to identify which datasets can provide the necessary road data. The deliverable for Stage 1a was a brief summary of the review findings including a recommendation as to which dataset(s) are most appropriate for the project based on availability of attributes, accessibility, refresh frequency, accuracy, cost and licensing requirements.

Deliverable 1: Review summary including a recommendation for the most appropriate dataset for this project.

Stage 1b – Data sourcing

The attributes for the pre-defined freight routes from the dataset identified in Stage 1a were sourced in Stage 1b. The attributes included:

- road centerline geometry
- radius curvature for turns and bends
- speed limits
- HV crash locations (where available) and other vehicle crash locations
- areas and boundaries (where available).

These attributes were collated and combined into a map layer and made available as a shapefile, CSV and WMS map tiles formats.

Deliverable 2: A map layer of key road attributes.

Stage 2 – Creation of GIS database and layer for high-risk locations

During Stage 2, a GIS database and map layer output containing the sourced input data was created. The rollover crashes were combined with point geometry to produce a GIS output layer of national high-risk rollover locations.

The deliverable for Stage 2 was a validated GIS map layer (shape file or CSV) that will be suitable for use in the Route Planner and an optional map tile display service (WMS endpoint). This provided the option to host a stand-alone interactive rollover webmap.

Deliverable 3: GIS map layer (shape file or CSV) and webmap tile service via WMS API requests.

Stages 3 and 4 – Update and maintenance

Stages 3 and 4 related to the hosting, regular data updates and maintenance of the GIS database and map layers. The tasks included:

- maintaining the datasets, hosting the web-tile mapping services and (optionally) webmap
- an update of all data, which included:
  - re-sourcing the input data sources
  - re-processing and analysing the outputs
  - realigning data and producing a GIS map layer (shape file) suitable for use in the Route Planner
- ensuring currency of map tiles via WMS services
- delivery of updated GIS map layer files to NHVR via download link.

Deliverable 4: Annually updated GIS map layer files (up to 2025) via download link and webmap.

2. Method

This section of the report outlines the work performed by NTRO to produce the major project deliverables.

2.1 Preliminary Scan of Available Mapping Datasets

The review of available datasets included the following datasets:

- HERE Technologies base map and additional content
- OpenStreetMap
- NTRO (ARRB) road survey geometry data
- TomTom
- Street Pro Navigation
- Public Sector Mapping Agency (PSMA)
- Road agency–maintained datasets.

HERE Technologies

HERE is a commercial map and data provider, which traces its map origins from Navteq. The primary focus of HERE maps is for vehicle navigation; however, it also has associated data products that are aligned to its base maps. HERE has a fleet of survey vehicles that regularly survey the network but also source data from community contributors to help keep its maps up to date. It has a minor map update every quarter and a major update every year.

HERE is also working towards having an HD Live Map that is updated in real-time as information is provided by connected vehicles on the road. The map will be based on their existing road network with the addition of data, such as LiDAR, to provide additional information about individual lanes and roadside infrastructure. The live portion will be provided from connected vehicles and other connected devices on the network to provide an up-to-date picture of the road at any point in time.

OpenStreetMap

OpenStreetMap is an open-source data project that can be used by anyone without having to pay licence fees. OpenStreetMap was created in the UK in 2004 and now has over 6 million registered users who update the map; it is as up-to-date and accurate as the contributors make it. This means that there are maps in some locations where it is not financially viable for a commercial provider to map, but also, there is not a requirement or financial support to update and maintain maps on a regular schedule. Community contribution can also mean that representations and tags are less consistent, for example some segments used to represent roundabouts use multiple arcs to form a circle and others segment are a complete circle. However, these limitations are less relevant to this project’s use case as it focused on major routes that are frequently trafficked.

Perhaps the biggest advantage of OpenStreetMap is that there is a large community of developers building open-source solutions on top of the platform. Some examples include things like base map viewers, routing engines and data visualisation tools, which provide additional functionality.

The OpenStreetMap project is also something that government organisations can contribute to, which may assist the timeliness of updates. While commercial organisations may need to drive the network to record network changes, a government organisation (or a construction contractor) could directly update the OpenStreetMap map when major construction projects are completed.

TomTom

TomTom is a commercial map and data provider that is well known for its navigation systems with base maps that originated from Tele Atlas. TomTom is also a traffic data provider, based on probe data, and has a slightly different offering to HERE. It also surveys the road network with its own vehicles and is moving towards a live HD map.

StreetPro Navigation

StreetPro Navigation is a commercial base map offering by Pitney Bowes based on PSMA streets with in-house customisation. Pitney Bowes offer several different levels of information on their maps, and both the 'Classic' and 'Navigation' levels offer routable networks. However, the 'Navigation' levels include extra attributes to do this more accurately. StreetPro Navigation is currently used by some road agencies as the base map for their road network.

Road agency–maintained datasets

Most jurisdiction utilise some form of road network map, many of which publish an open data version of these. The challenge with using various jurisdictions' data for the purpose of this project was in making the networks align where they join and in providing consistent attributes.

NTRO provides network survey services as a core service for road agencies and road managers. Over 25,000 km of video imagery suitable for manual and post-processing has been collected by NTRO since June 2017. The road survey data collected by NTRO is done with the latest release of the Hawkeye acquisition system fitted to either an iPAVE or Network Survey Vehicle (NSV). The equipment fitted to these survey vehicles includes a Digital Imaging System and Gipsi-Trac unit, which provide video imagery data that is geolocated. In addition, the vehicles are equipped with a range of sensors to measure road condition; however, road condition data was not part of this project scope and was not considered as part of the review.

2.2 Summary of Review of Available Base Maps

The criteria for assessing the suitability of these datasets included accuracy, availability/accessibility, update frequency, completeness for the use case, coverage, licensing costs and restrictions. There were two base maps that were considered suitable for this project; HERE Maps and OpenStreetMap. These were assessed in more detail. Table 2.1 shows a summary for each criterion.

Table 2.1: Summary of available base maps

Dataset	Accuracy	Accessibility	Frequency of updates	Completeness for use case	Coverage	Cost, licensing and restrictions on use
HERE Maps	High ●●●●●	High ●●●●●	Quarterly(1) ●●●●●	Complete ●●●●●	High ●●●●●	Major ○○○○○
OpenStreetMap	Med ●●●○○	Med ●●●○○	Frequent ●●●●●	Complete ●●●●●	High ●●●●○	Minor ●●●●●

1. HERE Maps are updated quarterly based on continual data collection. Major roads are surveyed more frequently.

2.3 Review and Sourcing of Available Datasets (Stages 1a and 1b)

The previous work and progress reports were reviewed as part of the project and OpenStreetMap had been decided as the preferred (potentially only viable) non-commercial mapping data provider. OpenStreetMap is licensed under the Open Database License (ODbL), which is designed to allow anyone to share, use and build upon the data while still protecting the rights of contributors. NTRO provided the national key freight routes and an extract of national crash data for use in the project. The OpenStreetMap data was extracted from openstreetmap.org directly.

The following sections describe the data review and findings.

2.3.1 National Key Freight Routes (KFR)

There were 9,230 records representing the KFRs and which were provided in a single Key_Freight_Routes.gdb file. Unfortunately, the data was not represented consistently from state to state or route to route. The state counts are shown in Table 2.2.

Table 2.2: Road segment counts by state

State	Segment length (Minimum)	Segment length (Maximum)	Total segments
Queensland	4	94,671	8,921
Western Australia	10	1,724,976	128
Australian Capital Territory	555	33.928	7
New South Wales	164	1,262,553	49
Northern Territory	2,476	1,895,626	15
Victoria	715	759,719	39
Tasmania	2,120	282,938	8
South Australia	195	1,115,539	63

Anecdotal examination of the geometries and centrelines for many of the routes showed similar inconsistencies, and there was poor alignment with the OpenStreetMap geometries or with other base map providers.

An example of the key freight routes (centrelines) available from OpenStreetMap is shown in Figure 2.1.

Figure 2.1: Road geometries and centrelines

Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Consequently, the KFR data was transformed into a series of geospatial buffers of varying magnitudes for filtering the other datasets.

2.3.2 OpenStreetMap Data

The data sourced for this project and determined to be most suitable for the use case was OpenStreetMap data.

The OpenStreetMap data extract for Australia was downloaded from https://download.geofabrik.de/australia-oceania/ (12 December 2021) for use in the project and was refreshed annually throughout the duration of the project.

The analysis process to utilise the OpenStreetMap data was:

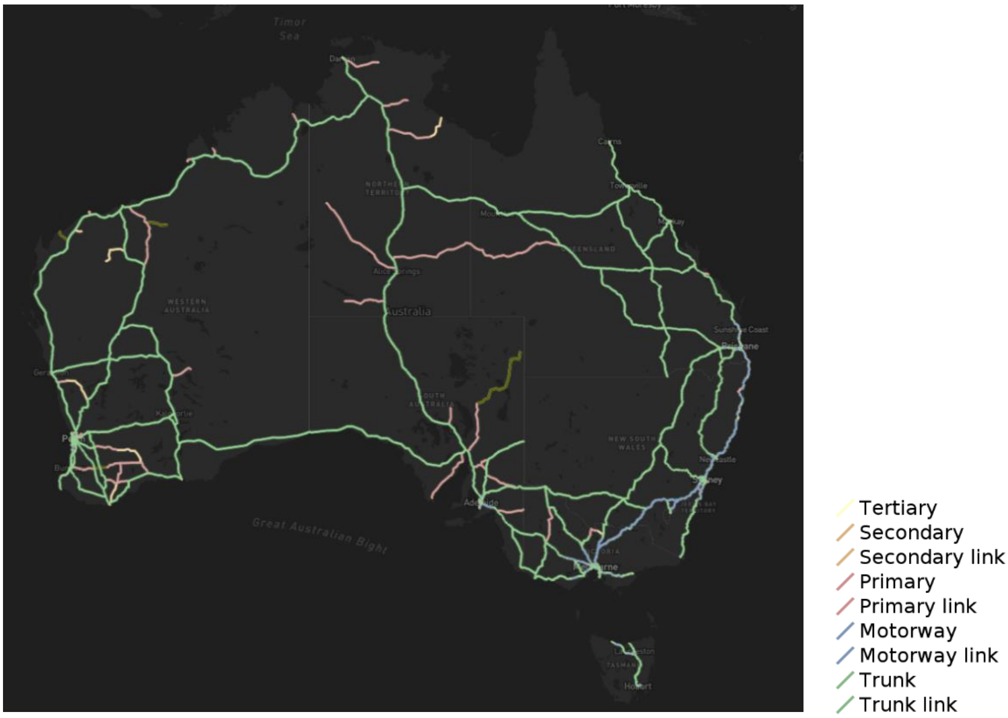
1. Download and extract the data.
2. Filter the data to ways and nodes with a highways tag.
3. Further filter to ways with specific highway tags (excluding 'unclassified', 'residential', 'track' and 'service').
4. Use the KFR buffers to further filter the OpenStreetMap map data.

Comprehensive map matching and conflation of the OpenStreetMap data to the KFRs was out of the scope of the project. Given the variability (and potential inaccuracies) of the KFR centrelines, a relatively large buffer was required to associate the OpenStreetMap data to the KFRs. As such, the resulting way datasets are ‘close-to’ the KFRs and should be considered indicative only.

The OpenStreetMap data was investigated for its suitability in the project. There was reasonably good coverage for the following way datasets described in the previous section (without comment on ground-truth accuracy for the attribute data or geometries). The outputs are presented in the following sections.

Figure 2.2 shows the identified road types (OpenStreetMap classifications) associated with the KFR.

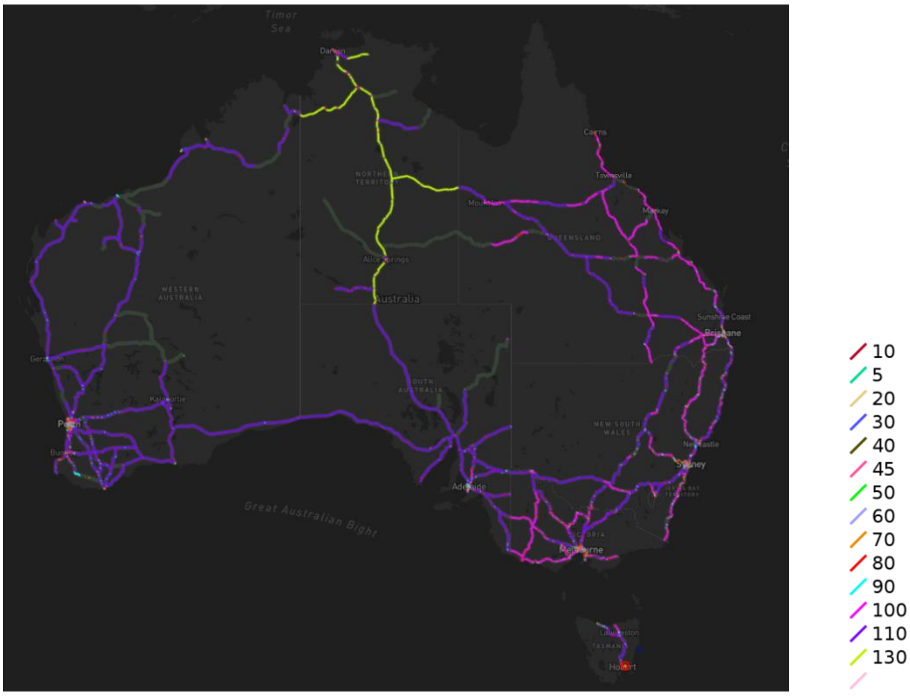
Figure 2.2: Road types



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 2.3 shows the speed limit ('maxspeed') data extracted from the OpenStreetMap database.

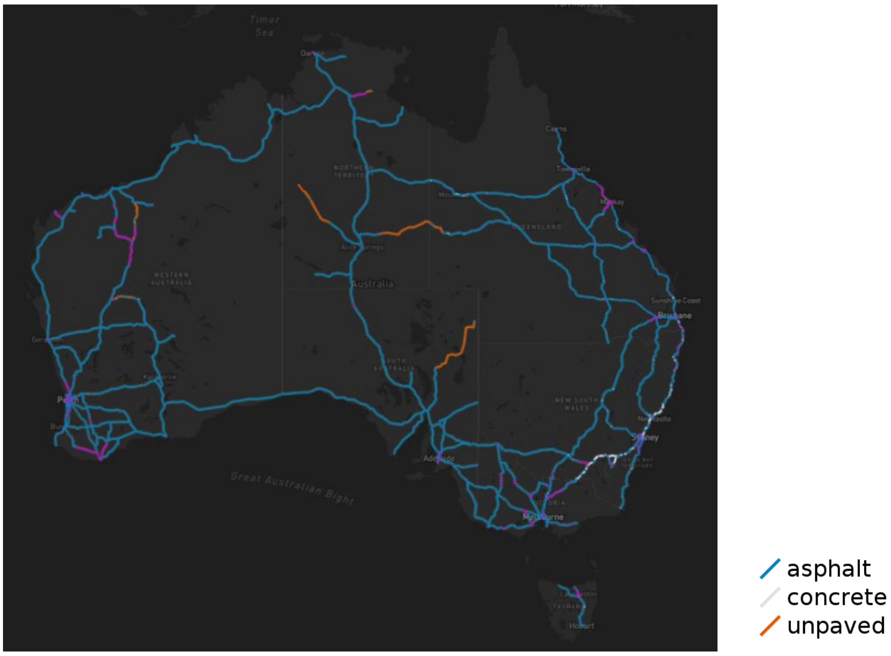
Figure 2.3: Speed limits



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 2.4 shows the pavement type classifications for the identified OpenStreetMap roads. Most are labelled with a small percentage of unclassified.

Figure 2.4: Surface types



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 2.5 shows the coverage of conditional and advisory speed limits in the dataset. There is low coverage of the KFRs; however, the comparison to actual conditional speed locations is unknown.

Figure 2.5: Conditional speed limits and advisory speed limits

Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Additional attributes were also investigated but were found to be either low-quality or without suitable coverage for the KFRs as a consequence of the open-source nature of the map data:

2.3.3 Method for Extracting Curvature

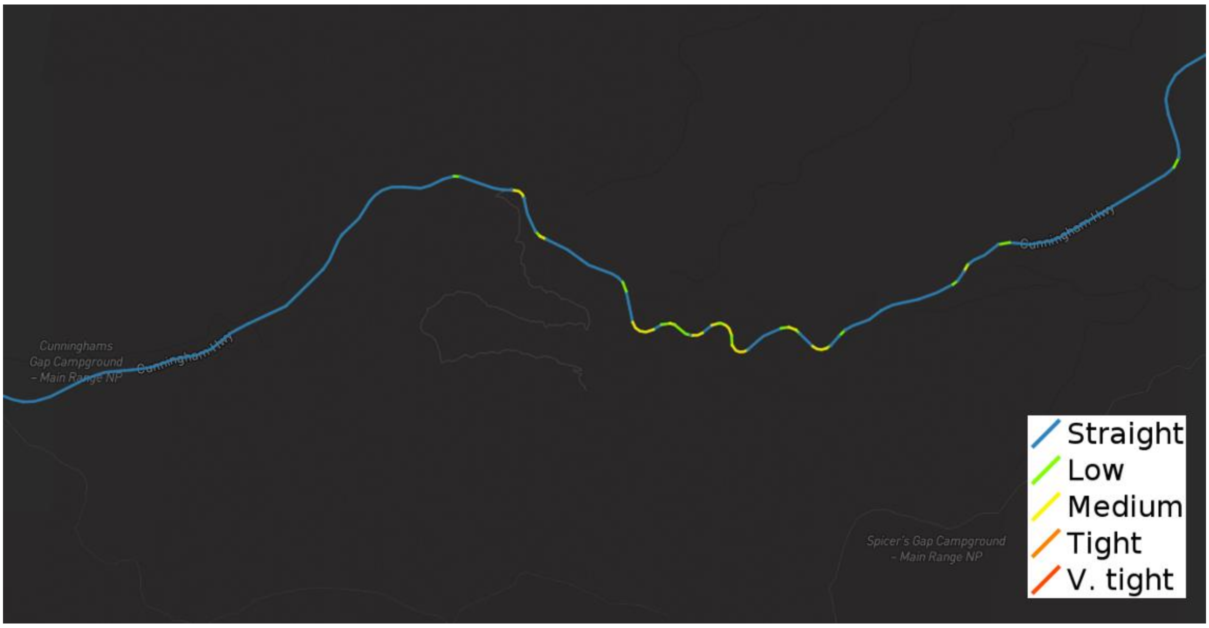
Significant work was undertaken to extract a useful curvature measure from the OpenStreetMap geometry data for the project. A Python-based analysis method was developed based on the work at https://github.com/adamfranco/curvature, which although intended for a different purpose, provided a useful starting point for the analysis.

A brief overview of the method is provided below.

1. Using the downloaded OpenStreetMap data, data was filtered to specific ways and nodes of interest.
2. Similar ways that were likely to be the same road were joined and combined.
3. Roads that were not of interest – driveways, parking, emergency access lanes etc. – were filtered out along with road sections that were too close to traffic signals, intersections, roundabouts and other traffic calming devices.
4. Potential GPS noise was filtered out.
5. Road segments were extracted based on the geometry coordinates.
6. The path length and radius of curvature were calculated.
7. Typical weighted curvature was determined for the segment and the curvature was categorised:
    a. Near straight: Straight or large turns (> 175 m radius)
    b. Low: Broad turns (100–175 m turn radius)
    c. Medium: Medium typical turns (60–100 m turn radius)
    d. Tight: Significantly tight turns and corners (25–60 m turn radius)
    e. Very tight: Very sharp turns on a road (< 25 m turn radius).
8. The curvature can be considered for a road, route or individual road section and was mapped for the whole road network. Note that that turns at intersections were not considered.
9. The segments were grouped into lengths of similar curvature (up to 300 m in length) and visualised.

The curvature was filtered to all curves within approximately 100 m of the KFR centrelines. The following graphics provide some examples of detected curvature using the colour key shown in Figure 2.6.

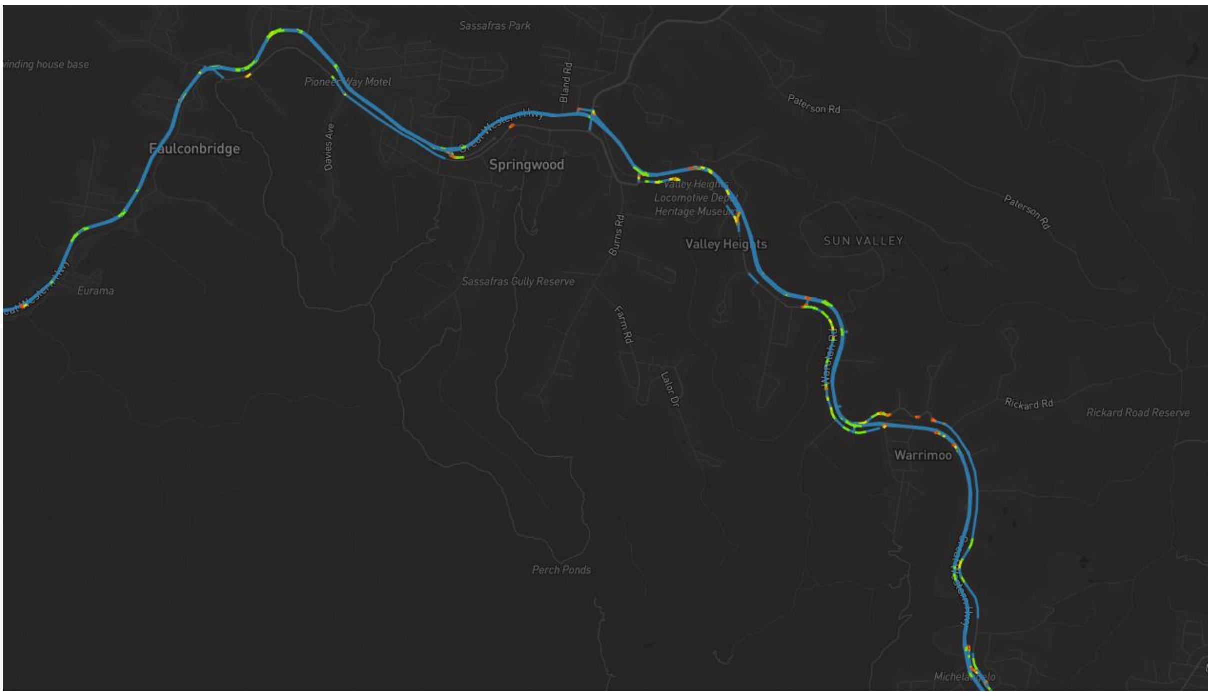
Figure 2.6: Road curvature (example 1)



Source: ‘Truck Rollover Risk Map’, Seceda Software, 2024.

Example 2 (Figure 2.7) shows a consequence of the method which uses a buffer to identify the curvature.

Figure 2.7: Road curvature (example 2)

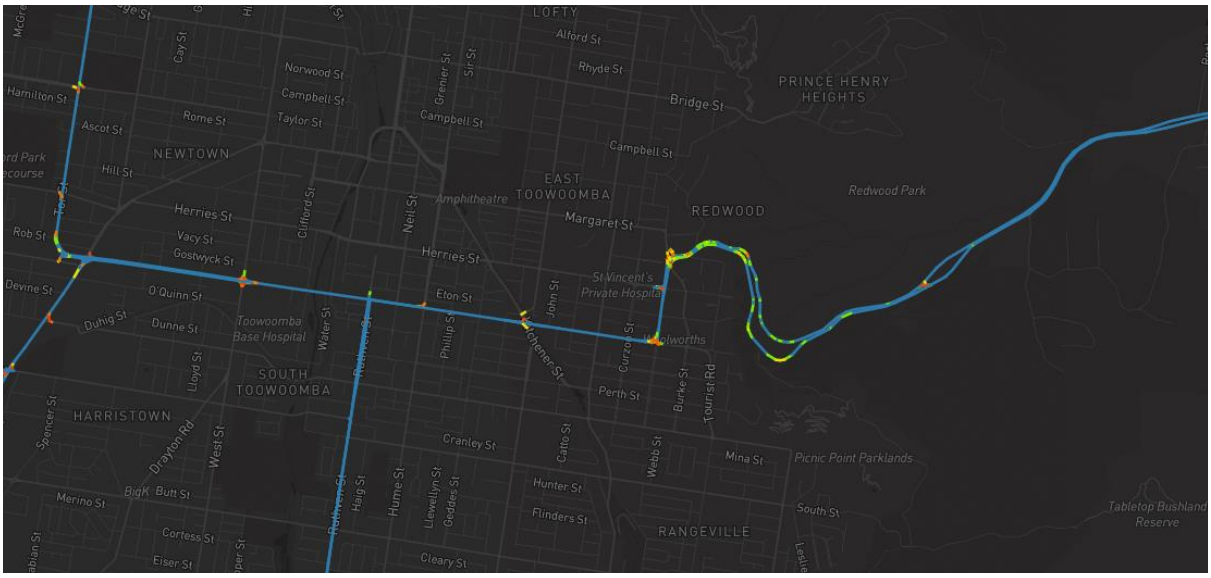


Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

This example shows how the 100 m buffer identifies nearby roads and includes these in the automated classification process. The process could be refined to exclude these nearby roads; however, including more roads had minimal impact on the project outputs and was considered favourable compared with refining the buffer and potentially excluding roads.

Example 3 (Figure 2.8) shows the effect of the buffer identifying the turning lanes at intersections.

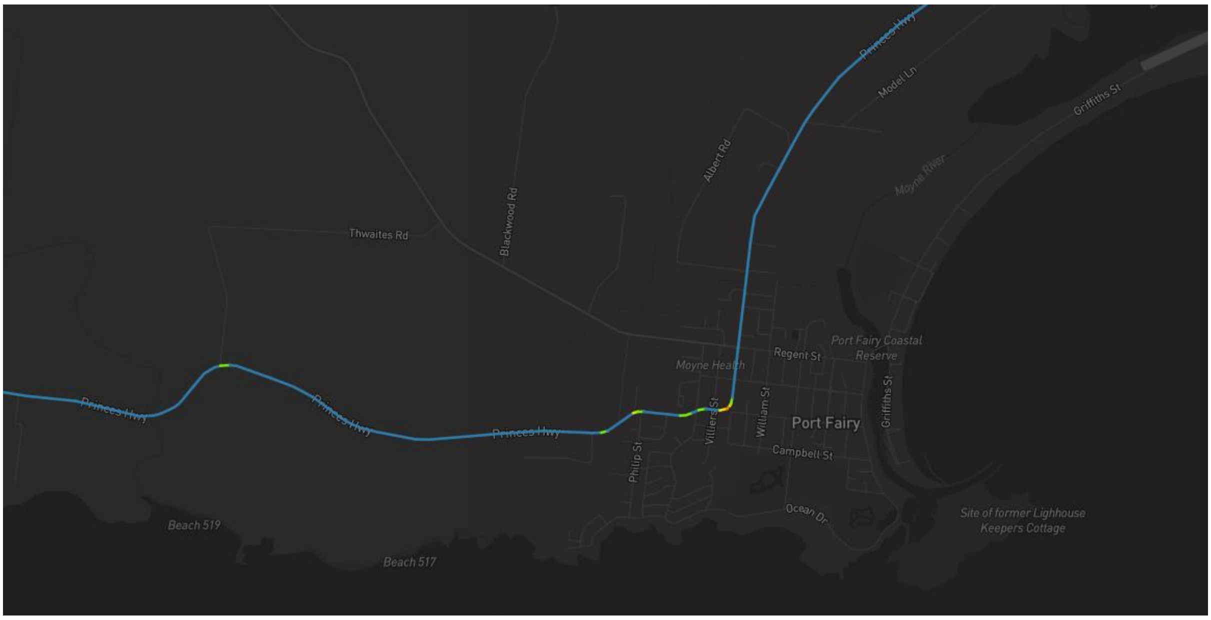
Figure 2.8: Road curvature (example 3)



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 2.9 shows an example where the classification system has identified a very tight turn on the Princes Highway in the regional tourist town of Port Fairy, Western Victoria.

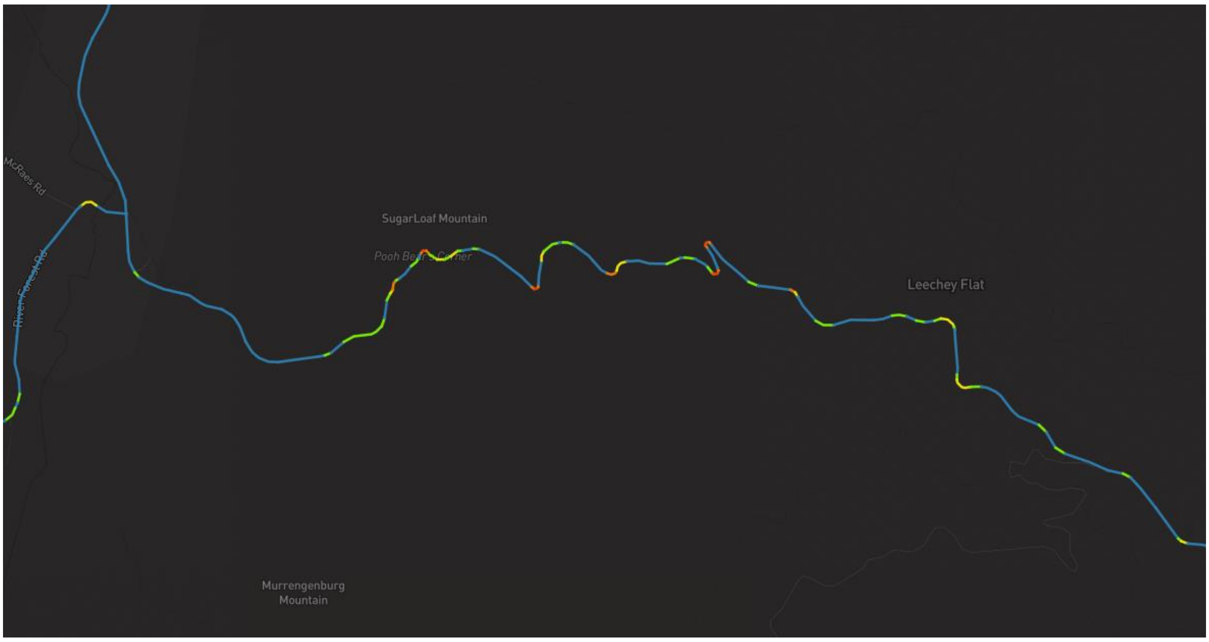
Figure 2.9: Road curvature (example 4)



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

It should be noted that most of the KFRs are only main highways with low levels of curvature, whereas many other roads can have significantly tighter curves. This is illustrated in example 5 (Figure 2.10), which shows the Kings Highway between Canberra and Bateman's Bay. This example shows a narrow and windy road where the classification system has identified the tight and very tight turns.

Figure 2.10: Road curvature (example 5)



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 2.11 shows the image of a section of the Kings Highway shown in example 5.

Figure 2.11: Road image of very tight radius turn on Kings Hwy (example 5)

Source: Mapillary 2024, 'Kings Hwy', Meta Platforms, Inc. CA, USA, CC BY-SA 2.0

The curvature information has great potential, but the following limitations should be noted:

- The captured curvature may also include unrelated side roads or ramps not related to the actual KFRs.
- The results are limited by the quality and resolution of the OpenStreetMap geometry data, which varies from road to road.
- Vehicle speed is not considered in the radius of curvature severity.

2.4 Identifying HV Crashes (Stage 2a)

The national crash database was provided as a CSV export of the database and included 1,341,482 total crash records from approximately 2005 to 2021 (state dependent). A summary of the data availability for each year by state is shown in Table 2.3. The third and fourth columns show the dates of the last crash record for the year 1 update and the year 2 refresh, respectively.

Table 2.3: Summary of years available in crash database

State	Date of first crash record (Minimum)	Date of last crash record (Year 1 update)	Date of last crash record (Year 2 refresh)
Australian Capital Territory	2012	2021	2021
New South Wales	2015	2021	2021
Northern Territory	2010	2021	2022
Queensland	2009	2021	2022
South Australia	2012	2021	2022
Tasmania	2011	2021	2022
Victoria	2006	2020	2023
Western Australia	2005	2021	2021

The quality of the crash data is dependent on the accuracy of coding by the relevant local authority when recording the crashes. Inspection of many of the crash records shows that a percentage are incorrectly coded. Nonetheless, the data is enormously valuable, and the ANRAM crash type filed ‘Run-off road’ was selected as the most reliable field to initially filter the data. The crash database also contains a ‘components’ table which lists the vehicles involved in the crash. The crash data was further filtered to crashes that only involved a HV.

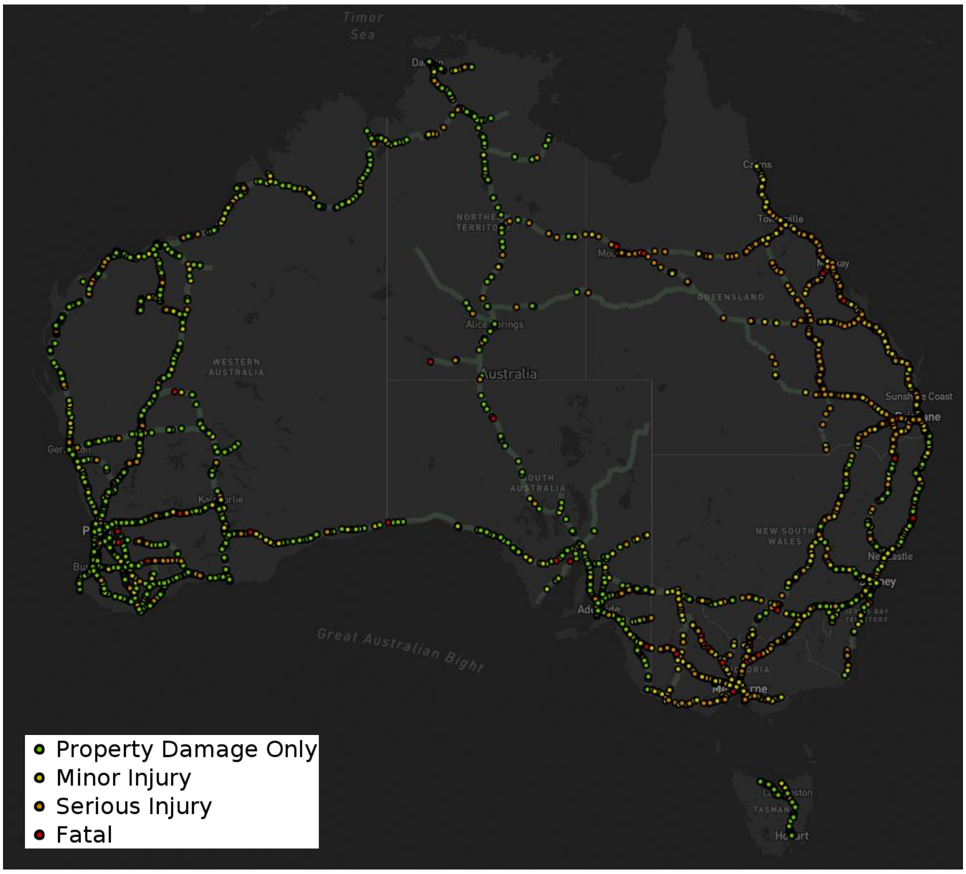
A summary of the analysis is as follows:

- There were 1,341,482 recorded crash events in the data from 2005 to 2021 nationally.
- 107,349 crashes were identified as involving a HV.
- 47,067 of these HV crashes were within 500 m of a KFR (44%).
- The crash types and count for these HV crashes near KFRs are:
  - Rear-end: 13,0920
  - Run-off road: 5,671
  - Intersection: 3,664
  - Head-on: 1,824
  - Pedestrian: 425
  - Other: 21,581.
- Of the KFR HV crashes, 12% were coded as the ANRAM 'Run off road' crash type.

While not all these crashes would be an actual HV **rollover** event, they do represent crashes where a HV left the carriageway. The crash data could be further refined by filtering on other fields like vehicle makes and models where the vehicle type was misclassified as a passenger vehicle.

The crash locations were added to a GIS layer, as shown in Figure 2.12, and compared against the other attributes generated by the report.

Figure 2.12: Visualisation of crash locations on KFRs



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

2.5 Creation of Layers and Map for High-risk Locations (Stage 2b)

As a result of the data analysis as described in the previous sections, the following GIS layers were produced for the areas around the identified KFRs:

- speed limits (all)
- surface types
- road curvature (segments)
- HV run-off road crashes.

2.5.1 Map Layers Creation

The data was loaded into a Postgres database (PostGIS) and the resulting tables and views visualised using a map server with layer styling rules.

The GIS export files were created from the database directly and have been provided in ESRI Shapefile format.

2.5.2 Concept Website

An interactive mapping website was developed to enable users to explore the project data in more detail.

The site has the following features:

- interactive server-side webmap accessible from a web browser without any plugins or specialised software requirements
- multiple background tiles (including satellite imagery)
- pan/zoom in on data
- switch on and off the GIS layers
- click on the map for more information about the crash, curve or OpenStreetMap data.

The site utilises a hosted WMS service, which can be integrated into thirty-party systems.

The site is a basic 'proof of concept' to demonstrate capability and is not intended for production or wide public release; however, there is currently no restrictions on accessing the site, and it can be promoted by the NHVR or industry. The intention of the webmap is to demonstrate the outputs of this project and provide a foundation for integration into other services or an information source for training with the aim of reducing rollovers and improving safety in the HV industry.

2.5.3 Visualisation and Delivery

As part of the deliverables, the GIS files and website have been made available at the locations listed in Table 2.4.

Table 2.4: Location of deliverables and project outputs

Deliverable	Address/location
GIS layer download location	https://seceda-tmp.s3.ap-southeast-2.amazonaws.com/HV+Rollover+Layers+-+export+shp.zip (available upon request)
Website	https://hvrollmap.seceda.au

2.6 Update and Maintenance (Stages 3 and 4)

Stages 3 and 4 of the project relate to the continued hosting of the webmap including data updates and maintenance to ensure the data is available beyond the completion of the project.

The web services (Stages 3 and 4) include:

- web hosting – including the supply of the software, hardware and services (cloud services in AWS) to host the project software and data; this consists of Webserver (ubuntu server)
- database (Postgres)
- map server (GeoServer on ubuntu server)
- firewall and backend
- backups
- technical support services; no direct user support services supplied (contact details provided on page)
- second level support – respond to NTRO service requests where NTRO has identified a problem with the web services as specified above
- data maintenance including a data refresh in year 1 of go-live
- one additional data refresh of the current project data prior to end June 2024 in year 2.

The maintenance schedule is outlined in Table 2.5.

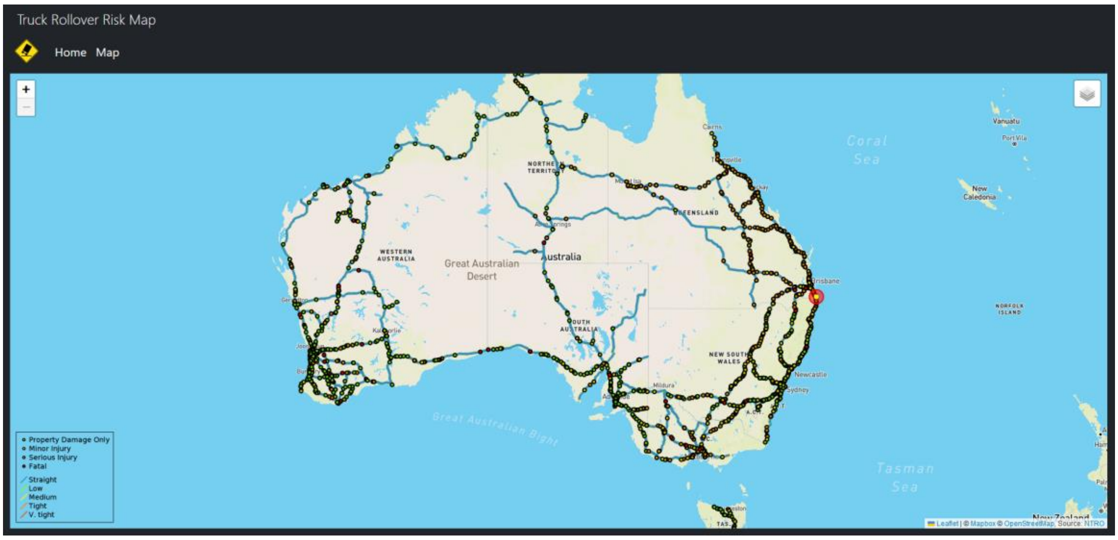
Table 2.5: Update and maintenance schedule

Item	Milestone	Date	Status	Location
1	Data upload – Year 1	April 2023	Completed	NA
2	Web services – Year 1	June 2023	Completed	Truck Rollover Risk Map (seceda.au)
3	Data refresh – Year 1	June 2023	Completed	https://seceda-tmp.s3.ap-southeast-2.amazonaws.com/HV+Rollover+Layers+-+export+shp.zip
4	Web services – Year 2	June 2024	Completed	Truck Rollover Risk Map (seceda.au)
5	Data refresh – Year 2	June 2024	Completed	https://seceda-tmp.s3.ap-southeast-2.amazonaws.com/HV+Rollover+Layers+-+export+shp.zip

3. Rollover Risk Map

The scope of this project was to create a HV rollover map that brought together data from 2 sources (road geometry and crash records) and display this information via a webmap. This was successfully completed. The webmap is shown in Figure 3.1.

Figure 3.1: Webmap hosted online to display location of truck rollovers

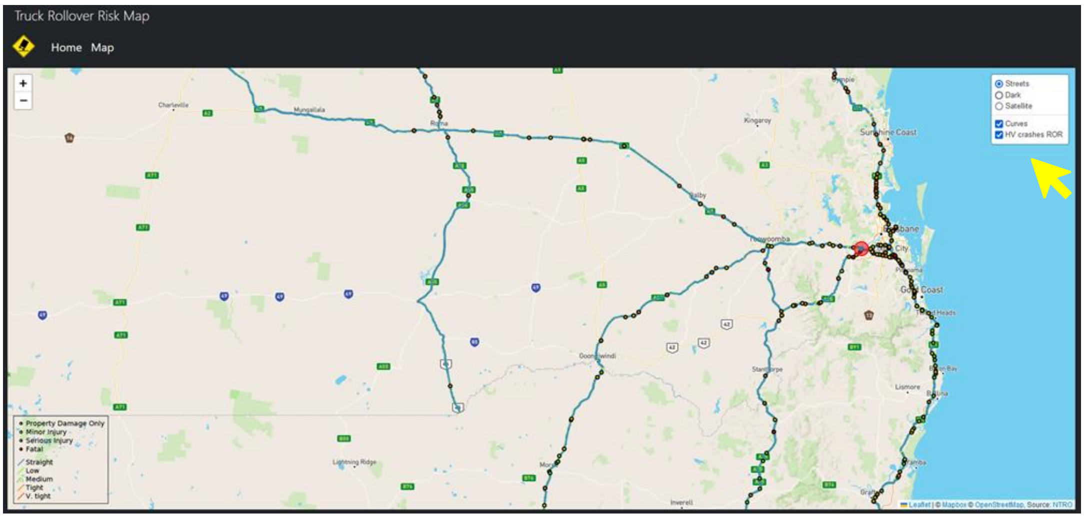


Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

3.1 Webmap Functionality

The webmap is interactive allowing users to pan, zoom and select crashes and road segments. The webmap functionality is shown in the examples below. Figure 3.2 shows the background tiles and data layers.

Figure 3.2: Webmap functionality: toggle layers and data

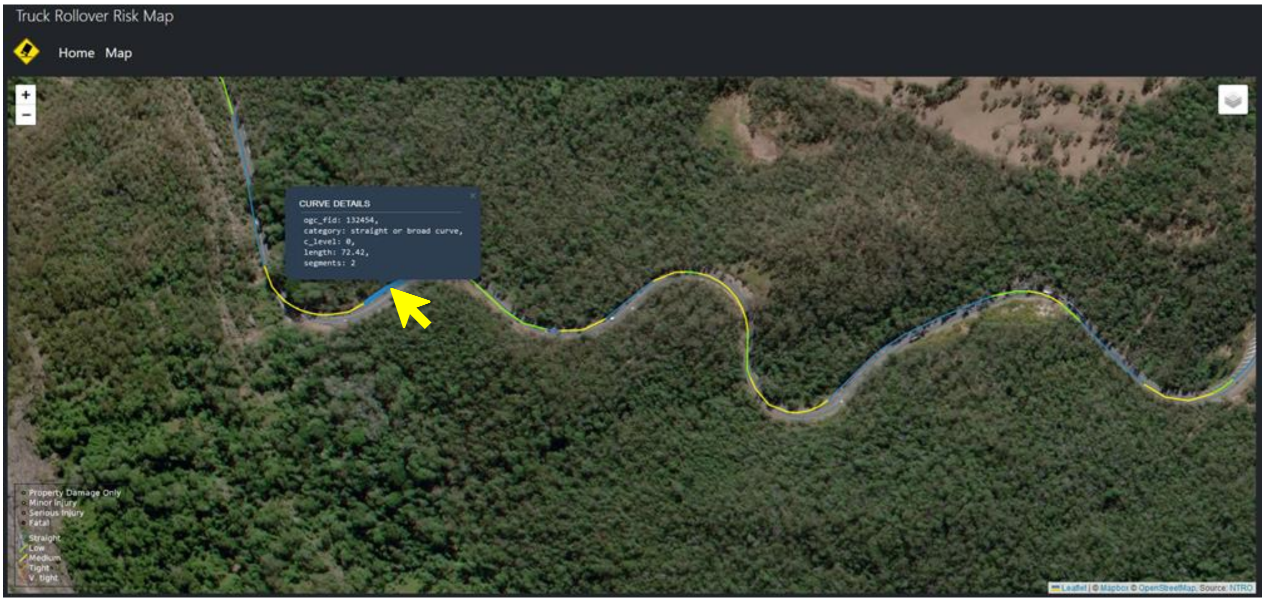


Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

The user can select from multiple background tiles (including satellite imagery) and toggle the curve and crash layers on or off.

Figure 3.3 shows the additional information displayed in a pop-up dialog box when the user selects a curve segment. In this example, the detailed information includes: ogc_fid: 132460, (OpenStreetMap segment ID) category: straight or broad curve, length: 96.02, segments: 1.

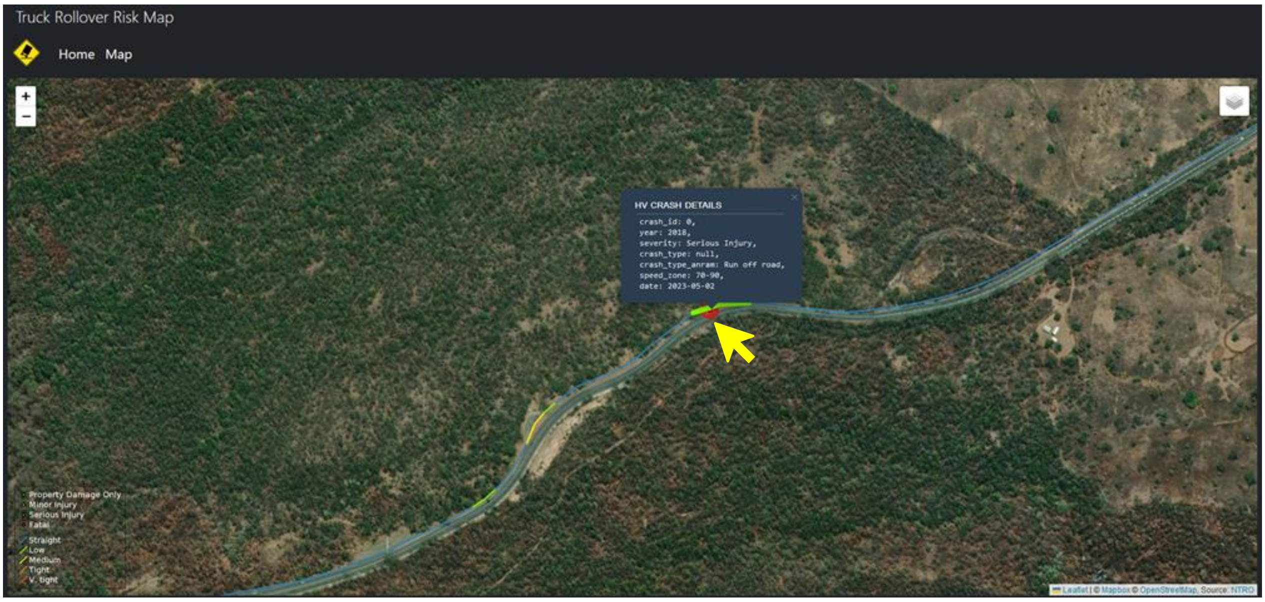
Figure 3.3: Webmap functionality: display curve details



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 3.4 shows the additional information displayed when the user selects a crash record. In this example, the detailed information includes: year: 2018, severity: serious injury, crash_type_anram: Run off road, speed zone: 70–90.

Figure 3.4: Webmap functionality: display crash details

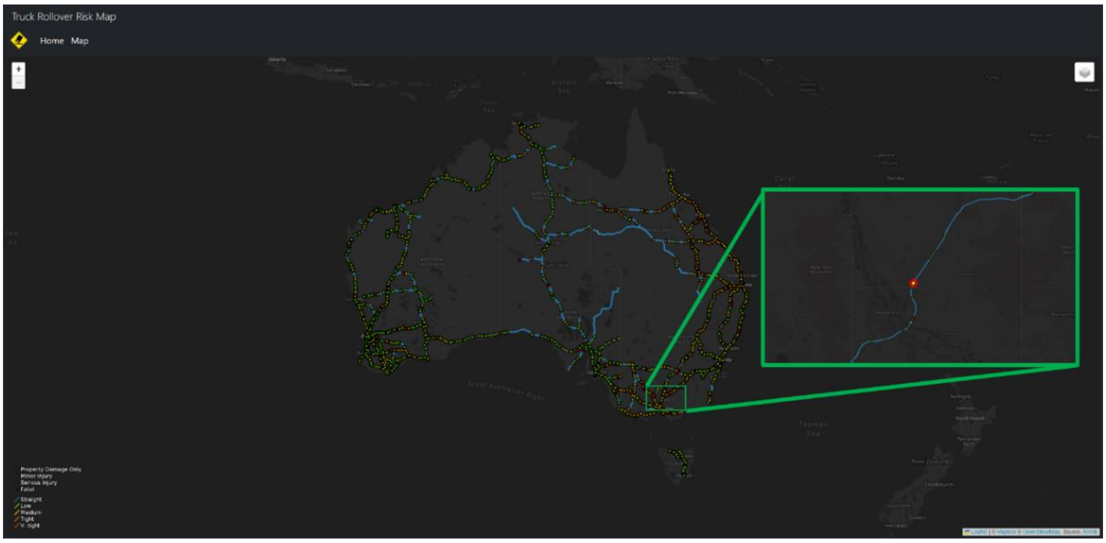


Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

3.2 Review of Select Crashes

To deliver this project successfully a number of complex tasks related to the database, GIS and software development were completed, requiring skills specific to these areas. Simply, the project scope was to create a platform to display information that could be used to review road and crash data more easily. It was not within the scope of the project to review the data and draw any conclusions regarding risk or potential causes. However, the Truck Rollover Risk Map does offer this potential. For illustrative purposes of the webmap functionality, 2 crashes were randomly selected and highlighted to demonstrate this capability. The first example was selected in Victoria as shown in Figure 3.5.

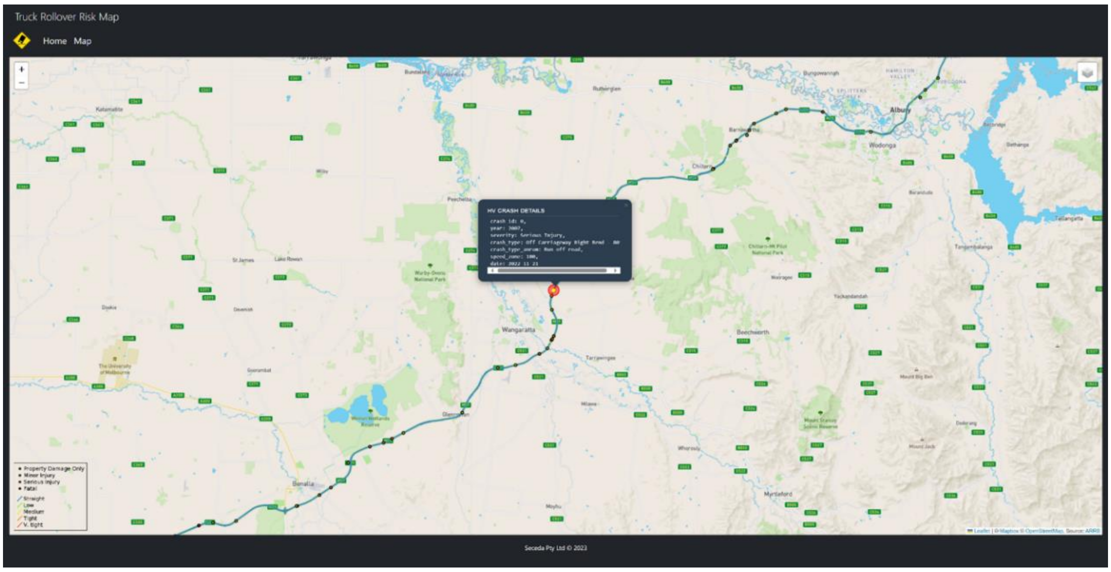
Figure 3.5: Example 1: HV run-off road crash in Victoria



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 3.6 shows the crash details which include crash details: 2007, serious injury, off-carriage way right bend, run-off road, speed zone: 100 km/h.

Figure 3.6: Example 1: crash details



Source: 'Truck Rollover Risk Map', Seceda Software, 2024.

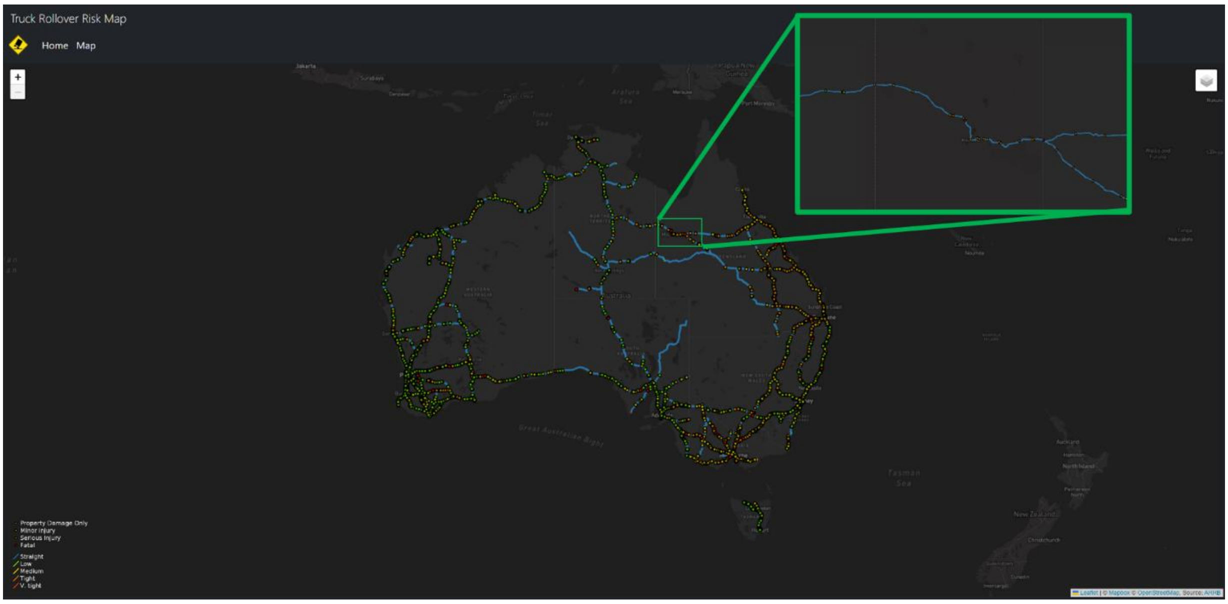
Figure 3.7 shows the location of the crash on a tight radius bend, estimated to be approximately 75 m in radius, with an advisory speed sign of 50 km/h. As this crash occurred on a tight radius bend, it can be assumed that the probable cause of this incident was excessive speed.

Figure 3.7: Example 1: crash location with road imagery

Source: Adapted from 'Truck Rollover Risk Map', Seceda Software and Mapillary 2024, 'Wangaratta, Hume Freeway on-ramp', Meta Platforms, Inc. CA, USA, CC BY-SA 2.0.

Figure 3.8 shows the location of a crash that occurred in the north of Queensland near Mt Isa.

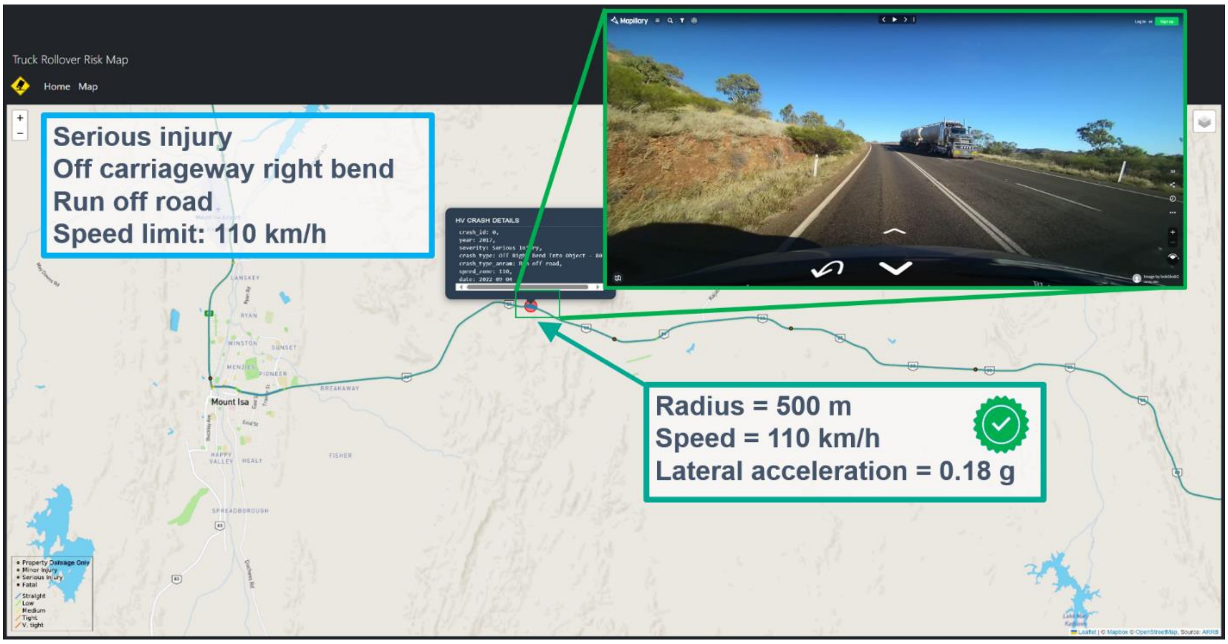
Figure 3.8: Example 2: HV run-off road crash in Queensland



Source: Adapted from 'Truck Rollover Risk Map', Seceda Software, 2024.

Figure 3.9 shows that this run-off road incident occurred on a road segment with an approximate radius of 500 m. This road segment was classified in the OpenStreetMap database as a ‘straight or broad curve’, and the speed limit at this location was 110 km/h. A vehicle travelling at 110 km/h on a curve with this radius would only generate 0.18 g of lateral force (less than half the roll threshold of a typical heavy vehicle); therefore, it is very unlikely that rollover was the cause of this incident. The incident was more likely to be related to fatigue, and it is possible that the vehicle rolled over after leaving the carriageway, particularly as it resulted in a serious injury.

Figure 3.9: Example 2: crash location with road imagery



Source: Adapted from ‘Truck Rollover Risk Map’, Seceda Software and Mapillary 2024, 'Barkly Hwy', Meta Platforms, Inc. CA, USA, CC BY-SA 2.0.

4. Discussion and Future Work

The following observations were made by the project team for recommendations for future project directions:

- A review of the crash database showed there were more HV run-off road crashes than expected.
- Although the focus of this project was to identify rollovers, there is no category in the national crash database for 'rollover'; therefore, 'run-off road' was used as a proxy. Run-off road crashes can occur for several reasons, and therefore, this crash type is likely to include crashes that were caused by other factors such as fatigue or loss of control.
- A basic desktop review of 2 crashes demonstrated that, based on the location of the crash, reasonable assumptions were able to be made about the probable causes of the crash i.e. a run-off road incident on a tight radius bend was more likely related to excessive speed and a run-off road incident on a straight section was more likely to be related to fatigue.
- Most KFRs have low levels of curvature with some exceptions. The curvature data combined with surface and speed may be a useful measure of rollover risk.
- The approach could be broadened beyond KFRs to the wider road network (major roads, for example).
- This project demonstrated that it is possible to extract and display HV crashes with a basic level of categorisation.
- Further work to refine the crash data to more specific crash events may be useful. This would require a more detailed classification of the crash to identify the circumstances of the rollover event.
- The process of extracting crash records and combining with road attributes was able to be largely automated, greatly reducing the requirement for safety expertise and manual intervention in the initial stages of the process.
- The webmap is intuitive allowing users to review crashes simply and quickly.
- The webmap also provides a basis for further work, which could be a focused review of these crashes, potentially using external data sources and HV safety expertise to identify likely causes and contributing factors.

5. References

Bureau of Infrastructure, Transport and Regional Economics 2020, *Road trauma involving heavy vehicles: 2018 statistical summary,* BITRE, Canberra, ACT.

National Truck Accident Research Centre 2020, *Major accident investigation 2020 report: covering major incidents in 2019*, NTARC.

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