BETA EDITION

iRAP Star Rating and Investment Plan Manual

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Because every life counts.

FIA FOUNDATION

iRAP
INTERNATIONAL ROAD ASSESSMENT PROGRAMME

ABOUT iRAP

The International Road Assessment Programme (iRAP) is a registered charity dedicated to saving lives by eliminating high risk roads throughout the world. Like many life-saving charities working in the public health arena, we use a robust, evidence-based approach to prevent unnecessary deaths and suffering.

iRAP works in partnership with governments, road authorities, mobility clubs, development banks, NGOs and research organisations to:

- inspect high-risk roads and develop Star Ratings, Risk Maps and Safer Roads Investment Plans

- provide training, technology and support that will build and sustain national, regional and local capability

- track road safety performance so that funding agencies can assess the benefits of their investments.

The programme is the umbrella organisation for EuroRAP, AusRAP, ChinaRAP, KiwiRAP, usRAP, IndiaRAP, BrazilRAP and SARAP. Road Assessment Programmes (RAP) are now active in more than 100 countries throughout Europe, Asia Pacific, the Americas and Africa.

iRAP is financially supported by the FIA Foundation for the Automobile and Society. Projects receive support from the Global Road Safety Facility, mobility clubs, regional development banks and donors. Our partners, charities, the motor industry and institutions such as the European Commission also support RAPs in the developed world and encourage the transfer of research and technology to iRAP. In addition, many individuals donate their time and expertise to support iRAP.

For more information

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To find out more about the programme, visit www.irap.org.
You can also subscribe to 'WrapUp', the iRAP e-newsletter, by signing up on the website homepage.

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1 INTRODUCTION

iRAP was established to help tackle the devastating social and economic cost of road crashes. Without intervention, the annual number of road deaths worldwide is projected to increase to some 2.4 million by 2030. The majority of these will occur in low-income and middle-income countries, which already suffer nine out of ten of the world's road deaths. Almost half of those killed will be vulnerable road users – motorcyclists, bicyclists and pedestrians.

Large as the problem is, making roads safe is by no means an insurmountable challenge. The requisite research, technology and expertise to save lives already exists. Road safety engineering makes a direct contribution to the reduction of road death and injury. Well-designed intersections, safe roadsides and appropriate road cross-sections can significantly decrease the risk of motorised vehicle crashes occurring and the severity of crashes that do occur. Sidewalks, pedestrian crossings and bicycle paths can substantially cut the risk that pedestrians and bicyclists will be killed or injured by avoiding the need for them to mix with motorised vehicles. Motorcycle lanes can minimise the risk of death and injury for motorcyclists.

By building on the work of Road Assessment Programmes (RAP) in high-income countries (EuroRAP, AusRAP, usRAP and KiwiRAP) and with the expertise of leading road safety research organisations worldwide, including ARRB Group (Australia), TRL (United Kingdom), MRI Global (United States) and MIROS (Malaysia), iRAP has developed four globally-consistent protocols to assess and improve the safety of roads.

> **The iRAP Protocols**
>
> 1. **Risk maps** use detailed crash data to illustrate the actual number of deaths and injuries on a road network.
> 2. **Star Ratings** provide a simple and objective measure of the level of safety provided by a road's design.
> 3. **Safer Roads Investment Plans (SRIP)** draw on approximately 90 proven road improvement options to generate affordable and economically sound infrastructure options for saving lives.
> 4. **Performance Tracking** enables the use of Star Ratings and Risk Maps to track road safety performance and establish policy positions.

This Manual relates to Protocols 2, 3 and 4. The iRAP Star Rating and Investment Plan Manual is one of a number of specifications and guides provided for completing projects, accreditation and results analysis shown below.

- Project Planning Manual (includes the Standard Terms of Reference)
- Inspection System Accreditation Specification
- iRAP Survey Manual
- iRAP Coding Manual
- **iRAP Star Rating and Investment Plan Manual**
- Upload File Specification
- ViDA User Guide
- Star Rating for Designs User Guide (for users of the SR4D web app)

The figure below illustrates the process used to undertake Star Ratings and Safer Roads Investment Plans, which can be used as part of a systematic, proactive approach to road infrastructure risk assessment and renewal based on research about where severe crashes are likely to occur and how they can be prevented.

The iRAP Star Rating and Safer Roads Investment Plan process
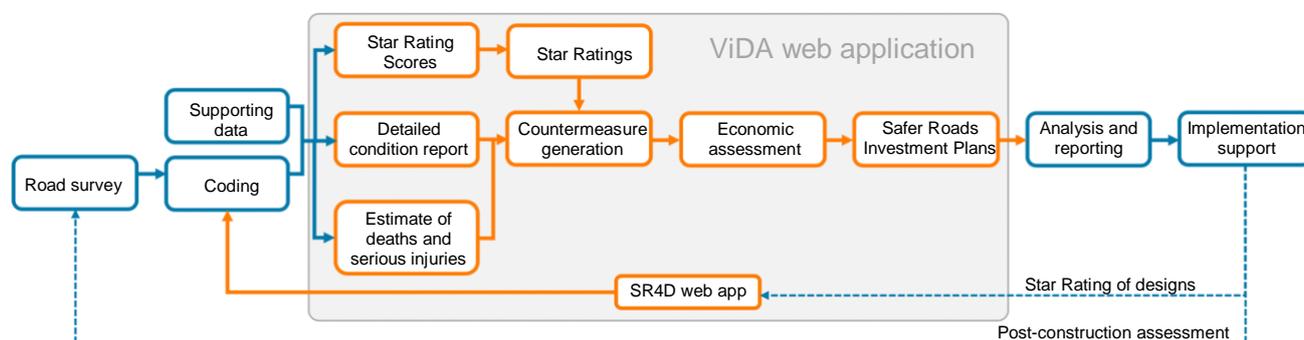
1.1 What are iRAP Star Ratings and Safer Roads Investment Plans?

iRAP Star Ratings and Safer Roads Investment Plans (commonly referred to as a 'SRIP') are the outputs of an iRAP assessment. Star Ratings show the inherent risk of the assessed road network, while an Investment Plan guides future safety upgrades on the road network.

This manual presents guidelines for creating Star Ratings and Investment Plans. Adherence to this guidance will help ensure that:

- Star Ratings and Investment Plans are prepared in a way that meets best practice.

- Poor quality and erroneous data are quickly identified so it can be rectified.

- Assessments are performed in a way that can be repeated for future assessments.

1.2 Training and accreditation

iRAP activities require specialist skills and knowledge. iRAP strongly recommends training for people preparing to undertake an iRAP project. Information about the training courses available can be found on the iRAP website, at https://www.irap.org/training.

iRAP also manages an accredited supplier scheme. There are two categories of iRAP accreditation:

1. Activity accreditation. Suppliers that hold activity accreditation have completed training and successfully completed a test and have demonstrated experience. They have also signed the *iRAP Accredited Supplier Code of Conduct*. Activity accreditation is renewed annually based on demonstrated experience and may include refresher training and consideration of client feedback.

2. Inspection system accreditation, which relates to equipment and software used to perform surveys and coding. Inspection systems that are accredited have met the requirements described in the *iRAP Inspection System Accreditation Specification,* and their manufacturers have signed the *iRAP Accredited Supplier Code of Conduct.* Inspection system accreditation is renewed every three years and may include retesting of the system and consideration of client feedback.

It is beneficial that accredited suppliers and an accredited inspection system are used in iRAP assessments, though it is not mandatory. Information about accreditation can be found on the iRAP website, at https://www.irap.org/accreditation.

If it is decided that accredited suppliers will be used in a Star Rating and Investment Plan project, the following information on the team members should be included in terms of references (TORs) and contracts.

Star Rating and SRIP team members

Name	Email address	Role(s) in project	iRAP accreditation number	iRAP accredited since date	iRAP accreditation renewal due date

2 STAR RATING AND INVESTMENT PLAN PROCESS

The Star Ratings and Investment Plan process draws on survey data (see the _iRAP Survey Manual_), coding data (see the _iRAP Coding Manual_) and additional supporting data and analysis described in this manual. The Star Ratings and Investment Plan process is explained in the diagram below. The process is described in more detail in the following sections.

Star Rating and Investment Plan process

- Analysis and reporting in accordance with _iRAP Star Rating and Investment Plan Manual_

02 Execution

03 Review

- Survey output complies with _iRAP Survey Manual_ and project requirements

- Review _iRAP Star Rating and Investment Plan Manual_
- Review specific project requirements (e.g. Terms of Reference)
- Review _ViDA User Guide_ and iRAP factsheets
- Establish survey team and arrange training if necessary

- Share questions in ViDA Forum
- Internal technical reviews
- Checklist for compliance with manual
- Execute corrections as necessary

Once the road attribute coding is complete, a coding file—or "upload file"—should be ready. There are several stages that now need to be completed to be able to produce Star Ratings and Investment Plans.

The time and effort required to complete these steps will depend on the project requirements and stage of the project. For example, producing Star Ratings alone requires less steps than Investment Plans, as only coding and supporting data is required.

The process summarised in the flowchart below.

CHECK UPLOAD FILE MEETS SPECIFICATION → ADD SUPPORTING DATA → QUALITY CHECK UPLOAD FILE → UPLOAD THE FILE INTO A VIDA DATASET* → PRODUCE STAR RATINGS AND INVESTMENT PLANS
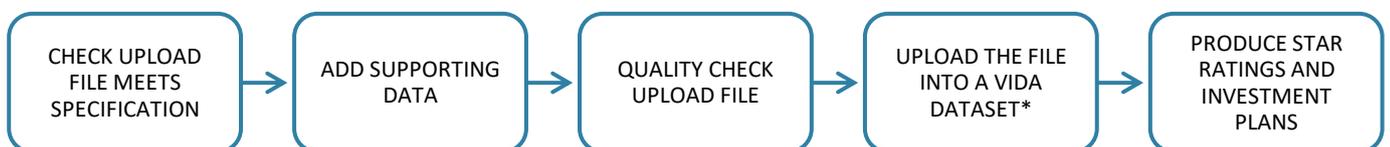
*If a ViDA project and/or dataset does not yet exist, this will have to be created and defined before the upload file can be processed.

These steps are detailed in the section 6. Briefly, they are:

- Select the programme, region, or project in ViDA

- Create and define the dataset and adjust ViDA settings as needed (refer to stages 1-4 in Defining a dataset)

- Calibrate the dataset fatality estimations to produce the Investment Plan (if required; refer to stages 5-6 in Defining a dataset)

- Process the upload file (i.e. coding and supporting data; refer to stage 7 in Defining a dataset)

- Set access permissions for viewing and editing the dataset (refer to stage 8 in Defining a dataset)

- Undertake analysis of Star Rating reports (and Investment Plan if produced).

This manual explains how to complete each of these steps in this process.

It is important that those undertaking Star Rating and Investment Plan analyses have a strong understanding of the iRAP model and the context in which it was developed. The iRAP methodology is described in more detail in section 3 and in the iRAP methodology factsheets available at www.irap.org/methodology.

Reports produced by ViDA are also required for Star Rating and Investment Plan analyses. Please refer to the *ViDA User Guide* for instructions on using ViDA.

2.1 Familiarisation with manual and project requirements

iRAP Star Rating and Investment Plan analyses should begin with a clear understanding of the guidance in this manual and the specific requirements of the project, which are usually set out in a project plan or terms of reference.

A substantial investment of time and resources can be consumed in a project and so it is desirable that all requirements are well understood by all those involved in the analysis. Data and reports that do not comply with the guidelines in this document should not be accepted.

2.2 Types of assessments

Broadly, there are three types of Star Rating and Investment Plan analyses:

1. **Existing road assessments** involve creation of Star Ratings and Investment Plans for roads that are already built. A road may be assessed on multiple occasions to measure changes in Star Ratings over time. For example, assessments performed in 2020 and 2022 could be used to measure the impact of upgrades that were made in 2021.

2. **Design assessments** involve creation of Star Ratings and Investment Plan analyses for roads that are in the design stage. These assessments may be based on coding data compiled entirely from designs (in the case of a greenfield project, for example) or from coding compiled from a combination of designs and surveys of an existing road (in the case of a road upgrade, for example).

3. **Scenario assessments** involve testing of different road attributes and variables for existing and design assessments. For example, testing the impact that a change of speed limit will have on Star Ratings for a design can be tested; or the impact of an Investment Plan with reduced budget can be tested.

These three types of assessments are discussed in more detail later in the manual. It is noted that the Star Ratings may be produced without an Investment Plan, but Star Ratings are prerequisite for Investment Plans to be produced.

2.3   Team

Star Rating and Investment Plan assessments require:

- Expertise in using the iRAP methodology and software

- An ability to manage large and often complex sets of data

- An ability to make reasonable estimates for variables, such as countermeasure costs

- Experience in road engineering safety and an ability to interpret road safety results and data, and

- Excellent written and spoken communications skills.

Depending on the nature of the project, the assessments may be performed by one person or a team of people.

Ideally, people will have experience in road engineering safety activities such as road safety audits. As discussed earlier, iRAP recommends that people preparing to undertake an iRAP project take training and it is beneficial to have accredited suppliers involved in the project.

2.4   Health and safety

This phase of a project may require site visits to project roads and collection of supplementary data. iRAP assessments are typically conducted on high-risk roads. It is especially important that everyone involved in site visits is informed of—and manage—all risks associated with the completion of the activities.

It is good practice to prepare and maintain a health and safety plan that takes into account issues including:

- Operational working hours

- Road travel

- Inspections and data collection

- Vehicle safety details including seat-belts for all passengers

- Air-bags and safe mounting of equipment

- Traffic and personnel management during flow and speed data sampling

- Country specific requirements including immunisations and security arrangements

- Office conditions

- Arrangements for regular check-ins, and

- Insurance and procedures in the event of an incident.

The following is provided as an example only. Survey teams should prepare a plan of their own that reflects the specific project activities and circumstances.

Example health and safety plan

Project Name:			Date:	
Project Description:				
Personnel Details:				
Name	Position	Email	Phone	Emergency contact (name and number)
Health insurance:				
Provider	Member number	Phone	Notes	
Equipment and vehicle description:				
Item	Description			
Key project contacts:				
Name	Position	Email	Phone	Notes
Notes:				
Author name and signature:			Date:	
Supervisor name and signature:			Date:	

Example Risk Assessment

Risk assessment matrix	Common/ repeating occurrence	Known to occur	Could occur	Not likely to occur	Very unlikely to occur
Fatality or permanent disability	High	High	High	Medium-high	Medium-high
Lost time injury or illness	High	High	Medium-high	Medium-high	Medium
Medical treatment	High	High	Medium-high	Medium	Low
First aid treatment	High	Medium-high	Medium	Low	Low
Incident report only	Medium-high	Medium-high	Medium	Low	Low

No.	Job Sequence	Potential Hazard	Probability	Consequence	Risk Rank	Required Hazard Control
1	Road survey	Crash due to fatigue	Known to occur	Fatality or permanent disability	High	The driver shall stop in a safe location and take a break every 2 hours.
2	Manual pedestrian flow counts	Struck by vehicle	Known to occur	Fatality or permanent disability	High	People taking flow counts will wear high visibility vests and shall stand in a location as far a practical from moving traffic.
3	Road survey	Crash due to speeding	Could occur	Fatality or permanent disability	High	The driver shall always comply with official speed limits and drive at speeds that respect safety of themselves and others.

2.5   Managing quality

It is good practice to perform quality and compliance reviews regularly throughout the project. If problems are found and corrected early, then subsequent complications can be minimised and/or the need for re-surveys can be avoided.

These reviews involve checking that each of the guidelines described in this manual have been complied with. The Quality Assurance Checklist may be used as guide for quality assurance checks during the Star Rating and Investment Plan process.

2.6   Standard deliverables

Standard deliverables for an iRAP Star Rating and Investment Plan assessment are:

1. An **inception report** including details on the following:

    a. Work plan

    b. Health and safety plan

    c. Team members, and

    d. Quality and compliance reviews.

2. **Licensed copies of any specialised software** used during the assessment.

3. **Short weekly reports** summarising:

    a. Progress

    b. Health, quality and compliance review processes completed

    c. Health, quality and compliance issues that have been identified and rectifications made

    d. Photos of activities

    e. Planned activities for the next 2 weeks, and

    f. Any issues that may affect performance of the project.

4. An **electronic copy of data** compiled during that assessment and corresponding descriptive information for each sample location in Microsoft Excel format (where collection of this data is required in the project).

5. **Datasets in ViDA**.

6. A **final report** that describes the assessments, supporting data, analysis results and recommendations.

It is good practice to provide a briefing and/or or training on the results and accessing the results in ViDA.

3 UNDERSTANDING STAR RATINGS AND INVESTMENT PLANS

3.1 What are Star Ratings?

iRAP Star Ratings are an objective measure of the likelihood of a road crash occurring and the severity of the outcome. The focus is on identifying and recording the road attributes which influence the most common and severe types of crash, based on scientific evidence-based research.

In this way, the level of risk to a road user on a particular road section or network can be defined without the need for detailed crash data, which is often the case in low- and middle-income countries where data quality is poor. Research shows that a person's risk of death or serious injury is highest on a 1-Star road and lowest on a 5-Star road. Star Ratings are produced for vehicle occupants, motorcyclists, pedestrians and bicyclists.

Star Ratings represent the risk of a fatal injury to an individual road user. For example, for vehicle occupants, Star Ratings equate to the number of deaths and serious injuries per vehicle kilometre travelled on a road. Collective risk, that is the number of fatalities and serious injuries of a road, is a function of individual risk (Star Ratings) and traffic volume.

Star Ratings can be used to objectively quantify the level of risk associated with new road designs (where crash data is not available) to assist in evidence-based decisions on safety improvements. They are also useful where low crash frequency limits the ability of crash analysis to influence performance monitoring and investment prioritisation.

Star Ratings and crash costs

A direct relationship between Star Ratings and the cost of fatalities and serious injuries has been demonstrated in a number of studies. For every incremental increase in Star Ratings, the cost of fatalities and serious injuries are typically halved. More information is available in iRAP methodology factsheet 7, *Star Rating Bands*.

The relationship between Star Ratings and the cost of fatalities and serious injuries

Research shows that a person's risk of death and serious injury is approximately halved for each incremental improvement in Star Rating.
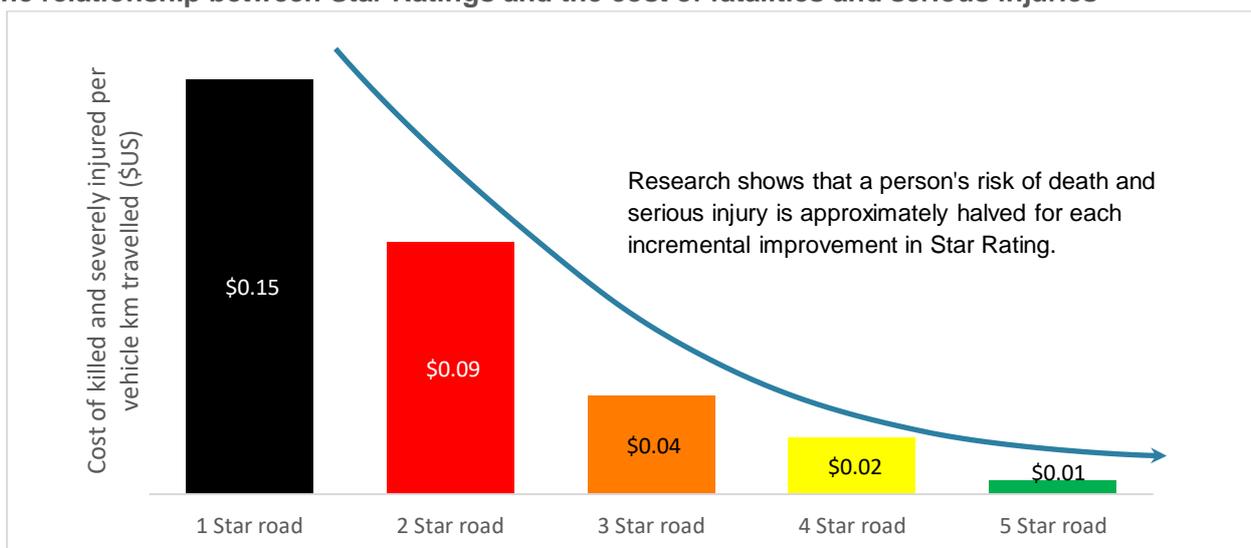
Source: McInerney, R and Fletcher, M (2013). Relationship between Star Ratings and crash cost per kilometre travelled on the Bruce Highway, Australia. Available at: http://www.irap.org.

Calculation of Star Rating Scores

A Star Rating Score (SRS) is calculated for each 100m segment of road for vehicles occupants, motorcyclists, pedestrians and bicyclists.

The SRS—that is, the relative risk of death and serious injury for an individual road user—is calculated using the following equation:

$$\text{crash type score} \quad \text{X} \quad \frac{\begin{array}{c}\text{likelihood} \\ \text{severity} \\ \text{operating speed} \\ \text{external flow influence}\end{array}}{} \quad \text{X} \quad \text{risk factors}$$

Motorised road user scores (vehicle occupants and motorcyclists) are based on head-on, run-off road and intersection crash types. Pedestrian scores are based on walking along- and across-the-road crash types. Bicyclist scores are based on riding along-the-road and intersections crash types.

Risk factors are associated with road attributes, which are recorded during the survey and coding part of the assessment, for different crash types.

More information on the calculation of Star Rating Scores is available in iRAP methodology factsheet 6, *Star Rating Score Equations*.

Star Rating bands

Star Rating Scores are apportioned to Star Rating bands to determine the Star Rating for each 100 metre of road.

Star Rating Bands are not equally distributed. For example, the distribution of SRS into Star Rating bands for vehicle occupants is as follows:

Star Rating band	Star Rating Score (SRS)
★	22.5+
★★	12.5 – <22.5
★★★	5.0 – <12.5
★★★★	2.5 – <5.0
★★★★★	<2.5

Therefore, the lower the Star Rating, the greater the variance between SRS. When SRS are plotted on a chart showing the Star Rating bands (a ViDA Risk Worm), it will be presented in the format of the example below.

Note that bandings are different for each road user type and for pedestrian along risk and crossing risk. For this reason, bandings are not shown for pedestrian risk worms. More information is available in iRAP methodology factsheet 7, *Star Rating Bands*.

Example of ViDA Risk Worm
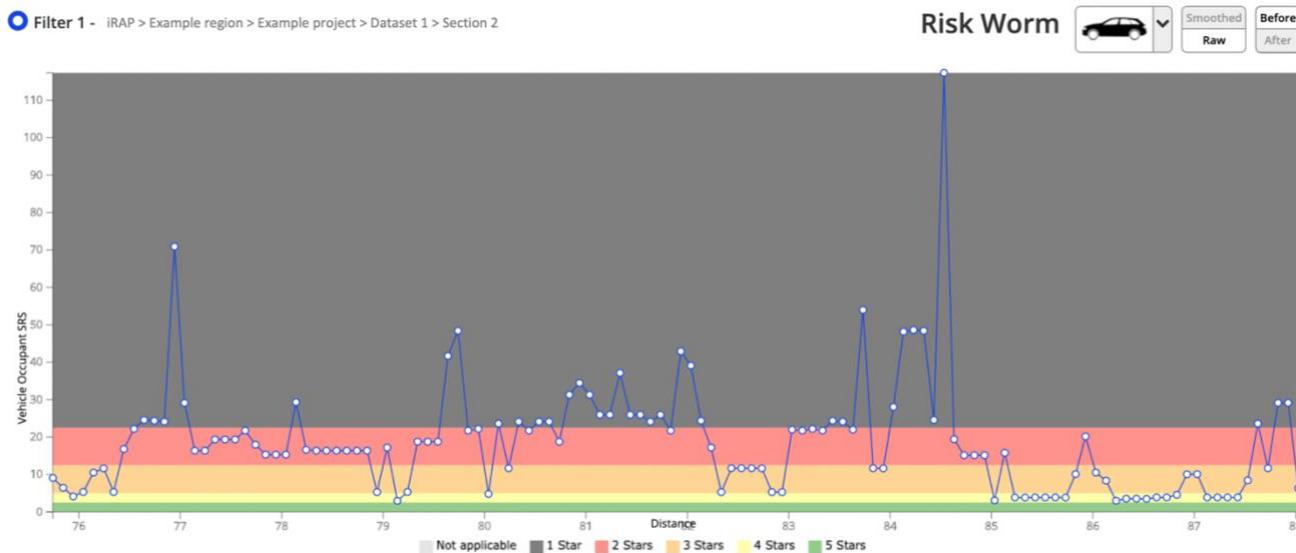
Raw and smoothed Star Ratings

For the purposes of producing a network level map showing Star Ratings, 100 metres is too much detail and makes it difficult to map and analyse. To address this, the 100m segments are combined into longer sections for the calculation of smoothed Star Ratings.

The effect of smoothing is illustrated in the chart below, which shows unsmoothed (raw) SRS in blue and smoothed SRS in white. The target length for smoothing is 3km for roads in rural areas and 1km for roads in urban areas. More information is available in iRAP methodology factsheet 8, *Smoothed Star Ratings*.

Raw (blue) and smoothed (white) Star Rating Scores
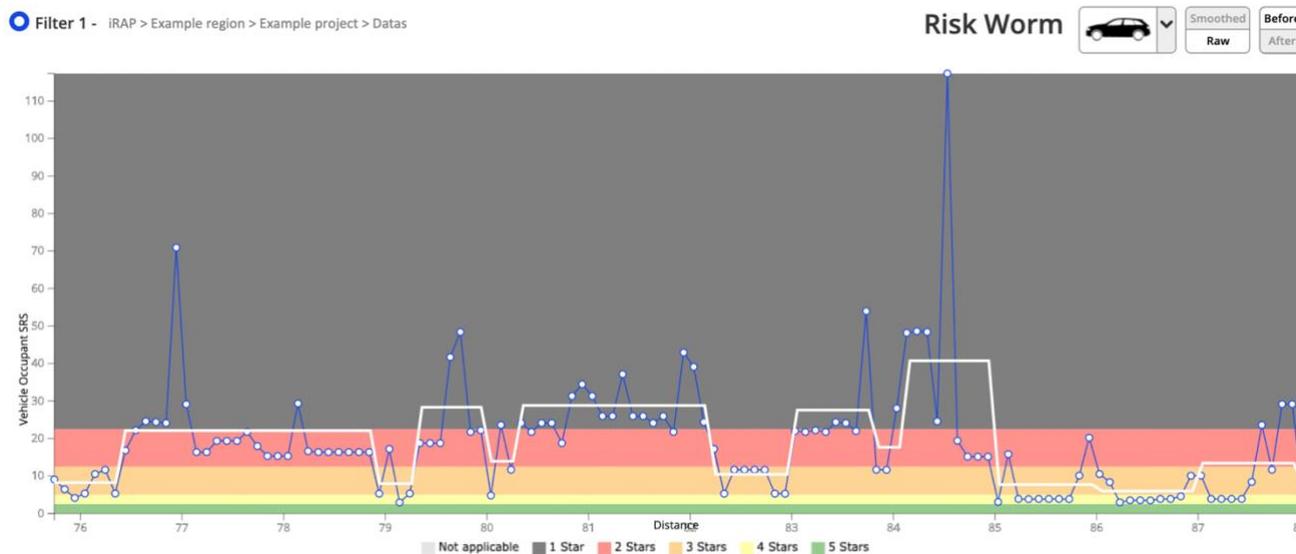
How do Star Ratings improve road safety?

In support of the Sustainable Development Goals (SDGs), the United Nations has adopted 12 global road safety targets to promote the rapid uptake of proven road safety initiatives worldwide. Two of the targets relate specifically to iRAP assessments. They are:

- All new roads are built to a 3-star or better standard for all road users (Target 3)

- More than 75% of travel is on the equivalent of 3-star or better roads for all road users by 2030 (Target 4).

iRAP is committed to helping road agencies to lift the safety performance of road networks and set Star Rating targets.

For road upgrade projects, it suggested that a target is framed in the following way:

> The road shall achieve a smoothed 3-Star Rating for vehicle occupants, motorcyclists, pedestrians and bicyclists, subject to the availability of economically viable infrastructure countermeasures. At locations where it is not economically viable to lift the Star Ratings to at least 3-Stars using infrastructure countermeasures, lowering operating speeds should be considered. Star Ratings should not decrease because of the project.

This aligns with the *United Nations Decade of Action for Road Safety Framework 2011-2020*.

Safe System Approach

Star Ratings are underpinned by four guiding principles central to the Safe System approach. These are:

1. People make mistakes that can lead to road crashes.

2. The human body has a known, limited physical ability to tolerate crash forces before harm occurs.

3. While individuals have a responsibility to act with care and within traffic laws, a shared responsibility exists with those who design, build, manage and use roads and vehicles to prevent crashes resulting in serious injury or death and to provide post-crash care.

4. All parts of the system must be strengthened in combination to multiply their effects, and road users are still protected if one part fails.

While it may not possible to eliminate road crashes, safe roads—those with a high Star Rating—can reduce the likelihood and change the outcome (severity) of the crashes that do occur.

More information on Star Ratings can be found at https://www.irap.org/3-star-or-better/ and in the iRAP methodology factsheets 6-9.

3.2   What are Safer Roads Investment Plans?

An Investment Plan is a prioritised list of countermeasures (safety treatments) that can cost-effectively improve Star Ratings and reduce infrastructure-related risk. More than 90 road improvement options can be analysed by the iRAP model to generate affordable and economically sound investment that improve a road's Star Ratings and, when implemented, can save lives.

Investment Plans are based on an economic analysis of a range of countermeasures, which is undertaken by comparing the cost of implementing the countermeasure with the reduction in crash costs that would result from its implementation. They contain extensive planning and engineering information such as road attribute records, countermeasure proposals and economic assessments for 100 metre segments of a road network.

In interpreting the results of an iRAP assessment, it is important to recognise that an Investment Plan is designed to provide a network-level assessment of risk and cost-effective countermeasures. For this reason, implementation of countermeasures identified in an Investment Plan will ideally include:

1. Local examination of proposed countermeasures (including a 'value engineering' type workshop including all relevant stakeholders)

2. Preliminary scheme investigation studies, and

3. Detailed design and costing, final evaluation and construction.

Research has demonstrated that it is crucial to ensure that local communities have an opportunity to both contribute to road designs but also understand the intended use of various road design features (BRAC, 2009).

Furthermore, significant benefits can often be realised through coordinated targeting of risk factors for road users (such as speeding, seat belt wearing and alcohol) and vehicles (such as seat belt installation and crash performance as measured in GNCAP tests), to complement the upgrades recommended in the Investment Plan. This approach is consistent with the Safe System philosophy. The Road Safety Toolkit (toolkit.irap.org) and United Nations Road Safety Collaboration Good Practice Manuals (WHO, 2009) provide further information on this issue.

More information on Investment Plans can be found in the iRAP methodology factsheets 10-13.

What is FSI calibration?

Calibration factors are used to ensure that the total estimated number of fatalities on the network is equal to the actual number of fatalities on that network. In this way, the iRAP model takes account of factors that influence the number of fatalities on a road other than infrastructure, speed and flows.

If two roads in different countries have exactly the same design, operating speeds and traffic volume, then the vehicle occupant Star Ratings will be the same. However, even if the infrastructure is the same, the road safety context can vary significantly between countries, regions and even cities for the following reasons:

- Vehicle safety features (e.g. airbags, advanced structural design, dynamic stability control)
- Driver behaviour (e.g. education and training, drink driving, seat belts, adherence to road rules), and
- Local laws and enforcement (e.g. mandatory motorcycle helmets and enforcement of road rules).

As a result of these factors, there can be vastly different fatality outcomes. Calibrating datasets according to fatality data adjust for these factors.

There are two steps to calibration:

1. Specifying the number of fatalities on the road network, and
2. Breaking down those fatalities by road user type and crash type.

More information on the way in which this data is used to calibrate the iRAP model is available in the iRAP methodology factsheet 10, *Casualty Estimation & Calibration*.

Fatality estimations

Estimation of fatalities and serious injuries are used in Investment Plans to assess the benefits and costs of implementing infrastructure safety countermeasures on a road. FSI estimates are made for each 100m segment of the existing road under existing conditions.

Where Star Ratings represent the individual risk of a road to a user (i.e. likelihood and severity of a crash), fatality estimations represent collective risk which accounts for exposure (i.e. road user volumes) and actual crash rates.

The FSI Estimation tools allow ViDA users to see this information separate to the Investment Plan. For more information, see the *ViDA User Guide*.

Speed

The issue of speed management is particularly important in road safety. Vehicle operating speeds also have a significant bearing on the iRAP Star Ratings. As such, it warrants special attention in any Star Rating and SRIP assessment.

The risk of death or serious injury is minimised in any crash, where:

1. Vulnerable road users (e.g. motorcyclists, bicyclists and pedestrians) are physically separated from cars and heavier vehicles, or traffic speeds are 30km/h or less.

2. Opposing traffic is physically separated and roadside hazards are well managed.

3. Traffic speeds are 70km/h or less for occupants of cars on roads where opposing traffic is not physically separated.

4. Traffic speeds are 30km/h or less for occupants of cars on roads where roadside hazards are not mitigated.

5. Traffic speeds at intersections are 50km/h or less for occupants of cars where there is a risk of side impact.

Impact speeds for different crash types after which the risk of death escalates

Crash Type		Impact speed
	head on	70 km/h
	side-impact	50 km/h
	side impact with tree	30 km/h
	pedestrian	30 km/h

Source: http://www.towardszerofoundation.org/thesafesystem/

It is not uncommon for there to be a discrepancy between permitted (posted) speeds and the speeds at which vehicles actually travel. In some locations, posted speed limits are set at very low speeds and are unlikely to be complied with in the absence of continuous enforcement or robust traffic calming measures.

Star Ratings are based on the larger of the speed limit and the operating speed (85th percentile speed). This is discussed in more detail later and in an iRAP policy position paper: *Vehicle Speeds and the iRAP Protocols*.

In iRAP results, roads with very low posted speed limits may achieve a relatively high Star Rating (4 or 5-star), even though the road may have high risk features. It is possible to perform the iRAP analyses using speed estimates or data to ensure that Star Rating results reflect the speeds actually travelled and the most appropriate countermeasures are triggered.

The raw data collected as part of the iRAP process can provide a valuable resource to authorities investigating appropriate speed management initiatives. This may include a more detailed analysis of results to investigate where there are lower speed limits without accompanying engineering solutions or may include a review of the speed limits and facilities in place on roads that rate poorly for pedestrian or bicycle safety.

The iRAP results therefore should help enable a professional discussion between police and highway authorities about their goals and respective roles in enforcement and engineering so each can contribute best to ensuring safe speeds.

4 PREPARING AN UPLOAD FILE

To create Star Ratings and Investment Plan using ViDA, the road attribute coding data must be compiled in a .csv file that complies with the *Upload File Specification*. The specification includes example data to assist in illustrating how data may be presented.

At this point in an iRAP project, an *Upload File* should have already been created and most fields populated during the road attribute coding phase (refer to the *iRAP Coding Manual*). The Upload File should now be checked, and the supporting data entered, before the data can be uploaded into ViDA.

Directions for checking and entering supporting data is provided in the next section.

4.1 Upload file validation

It is good practice to regularly perform validation checks of the coding using iRAP tools. The *Coding Validation Tool* is an excel tool that can be used to perform logic checks on iRAP coding data files before they are uploaded to ViDA.

1. Ensure that the Upload File is prepared in accordance with the *Upload File Specification*.

2. Follow the instructions in the *Coding Validation Tool*.

3. If errors are identified, make the necessary corrections. If 'possible errors' are identified, review each possible error and, where necessary, record an explanation of why the coding is deemed to be correct.

Preparing an upload file process

| CHECK THE CODING DATA FILE ('UPLOAD FILE') COMPLIES WITH THE UPLOAD FILE SPECIFICATION | → | IDENTIFY ISSUES WITH THE DATA USING THE CODING VALIDATION TOOL | → | MAKE NECESSARY CORRECTIONS AND RECORD CHANGES | → | ENTER SUPPORTING DATA INTO THE UPLOAD FILE | → | UPLOAD THE FILE INTO VIDA |
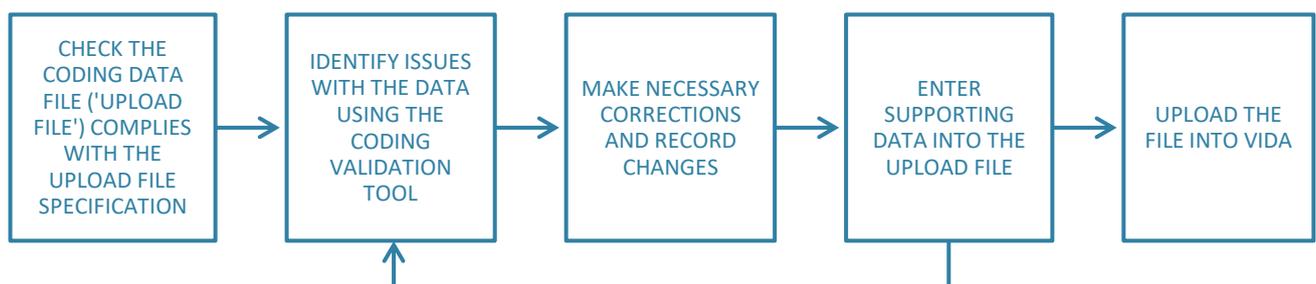
The *Coding Conversion Tool* can also be used to assist with quality checks of coding data. It does so by converting road attribute coding from numerical codes into text.

5 SUPPORTING DATA ATTRIBUTES AND CODES

The following sections provides the coding specification for supporting data. In the following sections:

- Attribute column X / XX, Input: X (e.g. Attribute column 1/A, Input: Text) refers to the column number/letter in the *Upload File Specification* and the type of record to be used for each 100m segment (i.e. text, date, number or code).

- Code X (e.g. Code 6) refers to the code that should be entered into the corresponding field.

5.1   Road details and context

Attribute columns 1-13/A-M.

The road name and section attributes will have been populated during the coding phase. It is good practice to review these as part of the upload file preparation and Star Rating and Investment Plan analyses. Apart from being essential descriptors, these attributes are also used in generating smoothed Star Ratings. This information will also be published online in ViDA to identify the road.

Road name, section name and coding segment

Road attribute data is made up of 100m coding segments. For each segment, the road name and section name are recorded to allow for coding segments to be grouped and analysed.

A road may be divided into a number of sections. Sections are made up of multiple 100m coding segments but are generally not of uniform length.

Roads are comprised of sections and 100m coding segments.

Sections are comprised of 100m coding segments. Sections do not need to be of equal length.

Coding segments are the smallest unit of a road. These are usually 100m in length.
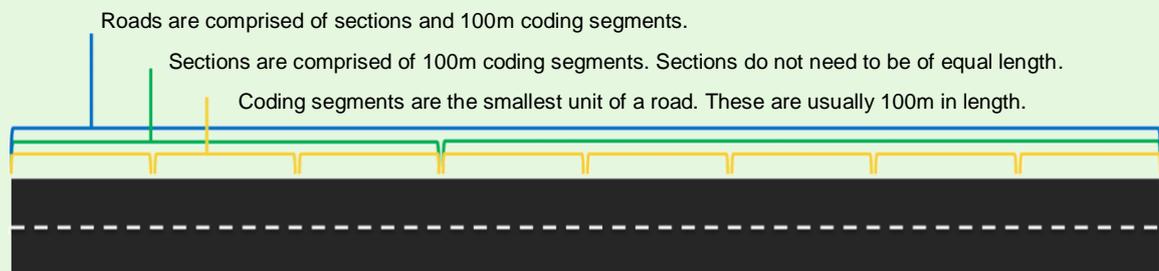
Road name

Attribute column 5/E, Input: Text (must only be in plain Latin characters without accent or tonal marks).

Review the road name identifies road the data refers to.

Road names usually match those that are used by the Road Authority.

Section

Attribute column 6/F, Input: Text (must only be in plain Latin characters without accent or tonal marks).

Review the section name or number to differentiate between sections of road.

The section name should be created to distinguish the section of road from other sections of the same road, or a road authority's own road section system should be used. It is good practice to note the direction of travel.

For example, section names can describe a 'from and to' location (Petersfield to Williamsburg) and the direction such as "eastbound". Alternatively, if the road authority has divided the network up into management or maintenance sections it may be beneficial to use these for the section names.

Sections can be split into smaller sections that reflect changes in road attributes (such as area type, land use, speed limit, carriageway type and number of lanes). Dual carriageways may be given different section names for each of the two carriageways (e.g. 'Road A Section A Northbound' and 'Road A Section A Southbound'). The road name and section may be presented in any format (e.g. 'A24' 'A_24', 'A 24' or 'London Road') though they should not contain any special characters, such as /, \, ë, ú, &.

There is no upper limit for section length. Generally, a section should be no shorter than the Star Rating smoothing length used for its area type (3km for rural and 1km for urban).

Landmark

Attribute column 11/K, Input: Text.

Review key landmarks and chainage markers where they occur.

This allows locations on the road to be referenced relative to the landmarks and is especially beneficial for reporting. Landmarks may be helpful in estimating vehicle flows, pedestrian flows, bicyclist flows and speeds.

Landmarks may be any of the following or other items of interest:
- Town names
- Major intersection number
- Major bridge or toll booth
- Reference point
- Landmarks and chainage markers may either be entered during coding or added from maps or designs at a later stage.

Comments

Attribute column 12/L, Input: Text.

Review key comments to highlight particular road safety issues or special features encountered during the coding process.

Comments may include issues not fully covered by the coding itself or additional location information beneficial to Star Rating analysis and reporting. This may be helpful in estimating vehicle flows, pedestrian flows, bicyclist flows and speeds.

Include any supporting information or notes on assumptions made during the coding of the section. For example:
- High proportion of trucks
- Close proximity to school so pedestrian demand assumed as high
- Poles assumed as frangible
- Bus stop present so pedestrian crossing demand assumed as high.

5.2   Road user flows

Vehicle flow (AADT)

Attribute column 63/BK, Input: Number.

Record the Annual Average Daily Traffic (AADT) for each coding segment.

AADT, the daily motorised traffic flow, is used in the calculation of Star Ratings and to estimate the number of fatalities for each 100m segment of road. Higher traffic flows increase a road user's exposure to certain crash

types, such as a head-on collision. Generally, a larger AADT will result in a lower Star Rating and a higher estimated number of fatalities for a 100m segment of road.

The data must be in Annual Average Daily Traffic (AADT) form – that is, it is the total volume of motorised vehicle traffic for a year divided by 365 days. The data should not be adjusted to passenger car equivalent (PCU) flows.

The AADT should not vary on a 100m to 100m basis. Rather it should remain reasonably stable along homogeneous lengths of road. Changes to AADT will correspond to intersections or major locations (such as airports) where significant flows of traffic joins or leaves the road.

The AADT should reflect the year for which the Star Rating and SRIP analyses is being performed.

> ### Estimating AADT
>
> Ideally, AADT data for the roads being assessed will be supplied by the road authority. If recent data is not available, then flows may be estimated by applying an annual growth factor that reflects historical growth rates and/or forecast population or economic growth along the roads.
>
> In circumstances where reliable traffic flow data are not available, estimates must be made. These estimates should draw on sample data recorded during the road survey phase (refer to the _iRAP Survey Manual_).
>
> If no samples were recorded during the survey, then sampling may be required as part of the Star Rating and Investment Plan analysis phase. Estimates can consider:
>
> - Local knowledge from road authority planners and engineers.
> - Road coding attributes such as carriageway type (divided, undivided), number of lanes, area type and land use.
>
> Estimates may also be performed using innovative methodologies. See for example:
>
> - _Virginia Department of Transportation (DOT) Innovative Procedures in Traffic Volume Estimation_ (https://safety.fhwa.dot.gov/rsdp/downloads/fhwasa17036.pdf).
> - _Using survey videos to perform Moving Vehicle Method of Estimating Traffic Volumes and Speeds_ (http://onlinepubs.trb.org/Onlinepubs/hrbbulletin/156/156-002.pdf).

Motorcycle %

Attribute column 64/BL, Input: Code.

Record an estimate of the motorcycle flow as a percentage of total motorised traffic flow for each coding segment.

A motorcycle is a motorized two or three-wheeled vehicle. This typically includes mopeds, scooters and light three- and four-wheel vehicles capable of speeds over 30km/h.

Motorcycle flow is used to estimate the number of motorcyclist fatalities for a 100m segment of road.

A motorcyclist Star Rating will only be calculated if motorcyclists are present. If the motorcycle % is zero, then no motorcyclist Star Rating will be produced and the estimate of motorcyclist fatalities will be zero.

> **ⓘ** **Estimating motorcycle %**
>
> Ideally, this data will be supplied by the road authority. In circumstances where reliable flow data is not available, estimates must be made. These estimates should draw on:
>
> - Sample data recorded during the road survey phase (refer to the *iRAP Survey Manual*). If no samples were recorded during the survey, then sampling may be required as part of the Star Rating and Investment Plan analysis phase.
>
> - Motorcycle observed flows recorded during the coding phase (refer to the *iRAP Coding Manual* for more information).
>
> - Local knowledge from road authority planners and engineers.
>
> - Road coding attributes such as carriageway type (divided, undivided), number of lanes, area type and land use.

Coding options

% of total flow	100%	81% - 99%	61% - 80%	41% - 60%	21% - 40%	11% - 20%	6% - 10%	1% - 5%	0%	Not recorded
Code	10	9	8	7	6	5	4	3	2	1

Pedestrian peak hour flows

Attribute columns: 65-67/BM-BO, Input: Code.

Record pedestrian peak hour flows.

Pedestrian peak hour flows are recorded individually for flows along the driver-side, along the passenger-side and across the road.

Pedestrians include anyone on foot, operating a push/pull vehicle (street cleaner, pram or rickshaw) or in a wheelchair or other mobility vehicle. Generally, peak hour pedestrian flows along the road should be "smoothed" across road segments that have similar attributes, so they do not significantly fluctuate on a 100m to 100m basis. Ideal smoothing length for pedestrian along flows depends on the local context, but should not be more than a 500m length.

An estimate of the pedestrian peak hour flow on each 100m segment of road is used in the calculation of pedestrian Star Ratings and to estimate the number of pedestrian fatalities for each 100m segment of road.

Changes in pedestrian flows do not affect the Star Ratings, though larger pedestrian flow will result in a lower a higher estimated number of pedestrian fatalities for each 100m segment of road. If pedestrian flow across and along the road is zero, then no corresponding Star Rating will be produced and the estimate of pedestrian fatalities will be zero.

Estimating pedestrian peak hour flow

Ideally, this data will be supplied by the road authority. In circumstances where reliable flow data is not available, estimates must be made. These estimates should draw on:

- Sample data recorded during the road survey phase (refer to the *iRAP Survey Manual*). If no samples were recorded during the survey, then sampling may be required as part of the Star Rating and Investment Plan analysis phase.

- Pedestrian observed flows and other attributes recorded during the coding phase (see below and refer to the *iRAP Coding Manual* for more information).

- Local knowledge from road authority planners and engineers.

As part of the estimation process, it is recommended maps are produced of the estimated flows so that patterns can be reviewed and discussed with those with local knowledge and expertise.

The final peak hour pedestrian flows used in the analysis ultimately need to reflect the specific road environment. Relationships between flows and road attributes can vary significantly between countries and regions. It is therefore good practice to develop a methodology for estimating flows that reflects the specific context of the assessment.

Road attributes that are likely to have a relationship with pedestrian flows

| Attribute	Comment
Pedestrian observed flow across the road	Flows observed during the road coding phase may be an indicator of likely flows during peak hour. However, as these are based on a single point in time they should not be solely relied on.
Pedestrian observed flow along the road driver-side	
Pedestrian observed flow along the road passenger-side	
Land use - driver-side	Land use is a good indicator of likely flows. For example, flows across a road are likely where there is Residential land use on one side of the road and Educational land use on the other side.
Land use - passenger-side	
Area type	This attribute is likely to be highly correlated with the Land Use attributes. Generally, flows will be higher in urban areas.
Intersection type	Intersections might be locations where pedestrian flows, particularly across the road, are more likely to occur.
Pedestrian crossing facilities - inspected road	Pedestrian flows across the road might be higher where there is a crossing facility in place.
Pedestrian crossing facilities - intersecting road	
Pedestrian fencing	Pedestrian flows across the road is reduced to nil where there is a fence in place.
Vehicle parking	Pedestrian flows along and across the road might be higher where there are parked vehicles.
Sidewalk - driver-side	Pedestrian flows might be higher where there are sidewalks in place.
Sidewalk - passenger-side	

Estimating pedestrian peak hour flow (continued)

To support the estimation process, it is good practice to establish tables that define typical relationships between the road attributes. For example, the following table describes a possible relationship between land use and peak hour pedestrian crossing flow for each 100m segment.

Example of a simple relationship between land use and peak hour pedestrian flow

Land use type		Driver side of road					
		Educational	Commercial	Residential	Industrial and manufacturing	Farming and agricultural	Undeveloped areas
Passenger side of road	Educational	100	80	50	10	0	0
	Commercial	80	80	40	20	5	0
	Residential	50	40	30	5	5	0
	Industrial and manufacturing	10	20	5	5	5	0
	Farming and agricultural	0	5	5	5	0	0
	Undeveloped areas	0	0	0	0	0	0

Example of a map illustrating pedestrian peak hour flow along the road passenger-side of a road
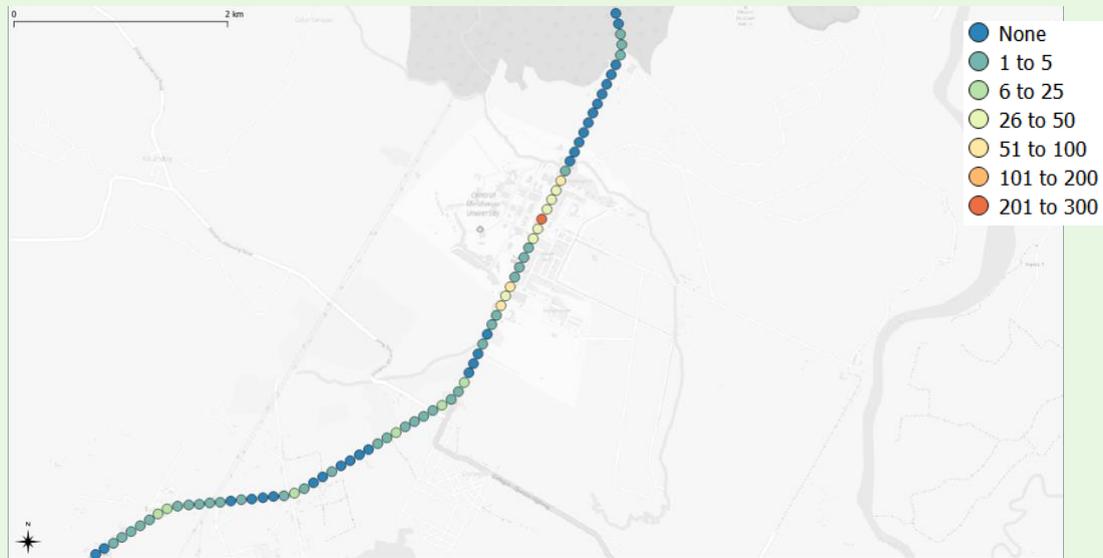
Coding options

Flow type	Attribute columns	Peak hour flow per coding segment										
		900+	501 to 900	401 to 500	301 to 400	201 to 300	101 to 200	51 to 100	26 to 50	6 to 25	1 to 5	0
Pedestrian peak hour flow: Across	65/BM	11	10	9	8	7	6	5	4	3	2	1
Pedestrian flow: Along driver-side	66/BN	11	10	9	8	7	6	5	4	3	2	1
Pedestrian flow: Along passenger-side	67/BO	11	10	9	8	7	6	5	4	3	2	1

Bicycle peak hour flow

Attribute column 68/BP, Input: Code.

Record an estimate of the bicycle peak hour flow for each coding segment.

Bicycle flow is used to estimate the number of bicyclist fatalities for each 100m segment of road.

A bicyclist Star Rating will only be calculated if bicyclists are present. If the bicyclist peak hour flow is zero, then no bicyclist Star Rating will be produced, and the estimate of bicyclist fatalities will be zero.

> **(i) Estimating bicycle flow**
>
> Ideally this data will be supplied by the road authority or other relevant organisation. In circumstances where reliable flow data are not available estimates must be made. The process for estimating bicycle flows should follow a similar methodology as for pedestrian flows. Ideal smoothing length for bicycle flows depends on the local context, but should not be more than a 1km length.

Coding options

% of total flow	900+	501 to 900	401 to 500	301 to 400	201 to 300	101 to 200	51 to 100	26 to 50	6 to 25	1 to 5	0
Code	11	10	9	8	7	6	5	4	3	2	1

5.3   Operating speeds

There are two types of speed attribute used in the assessments:

1. Operating speed – 85th percentile, and

2. Operating speed – mean.

iRAP's policy position paper, Vehicle Speeds and the iRAP Protocols discusses how speeds are used in the iRAP model.

Operating speeds must consider all motorised vehicles. Operating speeds do not typically vary on a 100m to 100m basis but are reasonably stable along homogeneous lengths of road. For example, on a rural highway of consistent design and speed limit with intermittent curves, the operating speed should be stable and not decrease at the curves even though in practice vehicles may slow through the curves.

> **Estimating vehicle operating speeds**
>
> Ideally, this data will be supplied by the road authority. In circumstances where reliable speed data are not available, estimates must be made. These estimates should draw on:
>
> - Sample data recorded during the road survey phase (refer to the *iRAP Survey Manual*). If no samples were recorded during the survey, then sampling may be required as part of the Star Rating and Investment Plan analysis phase.
>
> - Local knowledge from road authority planners and engineers.
>
> - Road coding attributes, for example:
>
>   - Speed limits are often a good indicator of operating speeds. However, sampling may show that operating speeds tend to be higher or lower than speed limits.
>
>   - Attributes associated with increases in traffic flow capacity, such as numbers of lanes and whether the road is divided or undivided, tend to correlate with higher operating speeds.
>
>   - Land use and area type may provide an indication of whether traffic is likely to be faster or slower.
>
> Estimates may also be performed using innovative methodologies, such as *Using survey videos to perform Moving Vehicle Method of Estimating Traffic Volumes and Speeds* (http://onlinepubs.trb.org/Onlinepubs/hrbbulletin/156/156-002.pdf).

Operating Speed – 85th percentile and mean

Attribute column 69-70/BQ-BR, Input: Code.

Record the operating speed – 85th percentile and mean operating speed for the coding segment.

The 85th percentile speed is defined as being the speed at or below which 85% of all vehicles are observed to travel under. Star Ratings are based on the larger of the speed limit and the Operating Speed (85th percentile).

Fatality estimations and Investment Plans are based on the mean operating speed. The mean speed is the average speed at which vehicles travel and should be less than the 85th percentile speed.

Check the correct code is used for the unit of speed (kilometres per hour [km/h] or miles per hour [mph]).

km/h	≥150	145	140	135	130	125	120	115	110	105	100	95	90
Code	25	24	23	22	21	20	19	128	17	16	15	14	13

km/h	85	80	75	70	65	60	55	50	45	40	35	<30
Code	12	11	10	9	8	7	6	5	4	3	2	1

mph	≥90	85	80	75	70	65	60	55
Code	45	44	43	42	41	40	39	38

mph	50	45	40	35	30	25	<20
Code	37	36	35	34	33	32	31

5.4 Roads that cars can read

> Note: The 'roads that cars can read' attribute is not used in Star Rating, fatality estimation or Investment Plan calculations. This attribute is a place-holder for potential assessments of roads autonomous driver technology.

Attribute column 71/BS, Input: Code.

Record if the coding segment meets specifications for autonomous driver technology.

These specifications are yet to be defined. Record as 'does not meet specification'.

Coding options

Does not meet specification

Code: 2

Meets specification

Code: 1

5.5 Star Rating policy targets

> Note: The 'Star Rating policy target' attributes are not used in Star Rating, fatality estimation or Investment Plan calculations. These attributes are descriptive only and may be used for separate analyses and reporting.

Attribute columns 72-75/BT-BW, Input: Code.

Record the Star Rating policy target for each road user group for the coding segment.

In the absence of an official Star Rating policy target, insert '3 Star' for all road user groups.

Coding options

Road user group	Attribute columns	Star Rating policy target					
		★ **1 Star**	★★ **2 Stars**	★★★ **3 Stars**	★★ ★★ **4 Stars**	★★ ★★★ **5 Stars**	★ **Not applicable**
Vehicle occupant	72/BT	1	2	3	4	5	6
Motorcyclist	73/BU	1	2	3	4	5	6
Pedestrian	74/BV	1	2	3	4	5	6
Bicyclist	75/BW	1	2	3	4	5	6

5.6   Annual Fatality Growth Multiplier

Attribute column 76/BX, Input: Number.

Record the annual fatality growth multiplier for each coding segment.

The annual fatality growth multiplier may be used to model annual growth in numbers of fatalities on the road segments. This may be relevant for roads where a marked increase in flows is expected, for example, where new transportation corridors or hubs are opening, or where large residential or commercial developments will significantly increase traffic volumes.

A multiplier of 1 means that the number of fatalities estimated to occur on the segments remain stable.

A multiplier of 1.05, for example, means that the number of fatalities estimated to occur on the segments would grow by 5% each year. This would represent an increase of 271% over a 20 year period.

More information about the fatality estimation process can be found in Stage 5: Fatality estimations.

Unless there is strong evidence to support use of a multiplier greater than 1, it is recommended that the annual fatality growth multiplier is always set to 1.

5.7 Quick coding guide for supporting data

Section	Item	Col No.		Type	Cat ID	Category
Road details and context	Road name	5	E	text	NA	NA
	Section	6	F	text	NA	NA
	Landmark	11	K	text	NA	NA
	Comments	12	L	text	NA	NA
Road user flows	Vehicle flow (AADT)	63	BK	number	NA	NA
	Motorcycle %	64	BL	code	10	100%
					9	81% – 99%
					8	61% – 80%
					7	41% – 60%
					6	21% – 40%
					5	11% – 20%
					4	6% – 10%
					3	1% – 5%
					2	0%
					1	Not recorded
	Pedestrian peak hour flow across the road	65	BM	code	11	900+
					10	501 to 900
					9	401 to 500
					8	301 to 400
					7	201 to 300
					6	101 to 200
					5	51 to 100
					4	26 to 50
					3	6 to 25
					2	1 to 5
					1	0
	Pedestrian peak hour flow along the road driver-side	66	BN	code	11	900+
					10	501 to 900
					9	401 to 500
					8	301 to 400
					7	201 to 300
					6	101 to 200
					5	51 to 100
					4	26 to 50
					3	6 to 25
					2	1 to 5
					1	0
	Pedestrian peak hour flow along the road passenger-side	67	BO	code	11	900+
					10	501 to 900
					9	401 to 500
					8	301 to 400
					7	201 to 300

					6	101 to 200
					5	51 to 100
					4	26 to 50
					3	6 to 25
					2	1 to 5
					1	0
	Bicycle peak hour flows	68	BP	code	11	900+
					10	501 to 900
					9	401 to 500
					8	301 to 400
					7	201 to 300
					6	101 to 200
					5	51 to 100
					4	26 to 50
					3	6 to 25
					2	1 to 5
					1	0
Operating speeds	Operating speed – 85th percentile	69	BQ	code	25	≥150km/h
					24	145km/h
					23	140km/h
					22	135km/h
					21	130km/h
					20	125km/h
					19	120km/h
					18	115km/h
					17	110km/h
					16	105km/h
					15	100km/h
					14	95km/h
					13	90km/h
					12	85km/h
					11	80km/h
					10	75km/h
					9	70km/h
					8	65km/h
					7	60km/h
					6	55km/h
					5	50km/h
					4	45km/h
					3	40km/h
					2	35km/h
					1	<30km/h
					45	≥90mph
					44	85mph
					43	80mph
					42	75mph
					41	70mph
					40	65mph
					39	60mph
					38	55mph
					37	50mph

					36	45mph
					35	40mph
					34	35mph
					33	30mph
					32	25mph
					31	<20mph
	Operating speed – mean	70	BR	code	25	≥150km/h
					24	145km/h
					23	140km/h
					22	135km/h
					21	130km/h
					20	125km/h
					19	120km/h
					18	115km/h
					17	110km/h
					16	105km/h
					15	100km/h
					14	95km/h
					13	90km/h
					12	85km/h
					11	80km/h
					10	75km/h
					9	70km/h
					8	65km/h
					7	60km/h
					6	55km/h
					5	50km/h
					4	45km/h
					3	40km/h
					2	35km/h
					1	<30km/h
					45	≥90mph
					44	85mph
					43	80mph
					42	75mph
					41	70mph
					40	65mph
					39	60mph
					38	55mph
					37	50mph
					36	45mph
					35	40mph
					34	35mph
					33	30mph
					32	25mph
					31	<20mph
Other	Roads that cars can read	71	BS	code	2	Does not meet specification
					1	Meets specification
	Vehicle Occupant Star Rating policy target	72	BT	code	1	1 Star
					2	2 Star
					3	3 Star

					4	4 Star
					5	5 Star
					6	Not applicable
	Motorcyclist Star Rating policy target	73	BU	code	1	1 Star
					2	2 Star
					3	3 Star
					4	4 Star
					5	5 Star
					6	Not applicable
	Pedestrian Star Rating policy target	74	BV	code	1	1 Star
					2	2 Star
					3	3 Star
					4	4 Star
					5	5 Star
					6	Not applicable
	Bicyclist Star Rating policy target	75	BW	code	1	1 Star
					2	2 Star
					3	3 Star
					4	4 Star
					5	5 Star
					6	Not applicable
	Annual fatality growth multiplier	76	BX	number	NA	NA

6 PRODUCING STAR RATINGS AND INVESTMENT PLANS IN VIDA

The ViDA web application is the core of the iRAP suite of online tools. Its function is the calculation, management, analysis and presentation of iRAP Star Ratings and Safer Roads Investment Plans. ViDA provides tools, services and workflows to manage the RAP data lifecycle, from dataset set-up and processing to on-screen reports and downloadable files. ViDA also allows users to drill down through and analyse assessments using filter and search tools.

This section provides instructions on how to upload road coding and supporting data into ViDA to produce Star Ratings and Investment Plans.

6.1 Using ViDA

ViDA can be accessed at https://vida.irap.org. To experience ViDA to its full potential, iRAP recommend using Google Chrome or Mozilla Firefox internet browsers.

The *ViDA User Guide* includes all the information required to access ViDA, set up and manage accounts, changing settings, accessing the ViDA forum and reading and analysing reports. For first time users of ViDA, it is highly recommended the following sections are read in conjunction with the *ViDA User Guide*.

ViDA has three levels of access:

1. Reader: A Reader account is for those who want to look at high-level reports (e.g. public, project stakeholder). This account allows users to view 'final published' reports and request access to 'final unpublished' reports. You can filter Road Data, Star Rating and Investment Plans reports to the dataset level.

2. Analyst: An Analyst account is for those who want to look at detailed reports (e.g. researcher, road authority engineer, project partner). This account is the same as the Reader account, but adds the ability to filter Road Data, Star Rating and Investment Plans reports to the Road and Section levels. Users can also access download files.

3. Creator: A Creator account is for those who want to create reports (e.g. RAP project manager, road designer, road safety auditor). This account is the same as the Analyst account, but adds the ability to create and edit Datasets and produce reports. Note that the creation of a dataset requires the permission of the Project Manager, and the creation of a Project requires the permission of the Region Manager.

All ViDA users start with a 'Reader' account. To be able to add new datasets into ViDA, the user needs to request an account upgrade in ViDA. For further instructions, see 'Upgrade Account' in the *ViDA User Guide*.

Until a ViDA user is accredited, they will be given a Provisional Creator account. Provisional Creator accounts are the same as a regular Creator accounts except that access is limited to the ViDA *Sandbox* where datasets may only be set to *Working* or *Draft* status.

Access to ViDA tools by access type

ViDA access type	Reader	Analyst	Provisional Creator	Creator
Demonstrator	✓	✓	✓	✓
View standard reports	✓	✓	✓	✓
View SRIPs and downloads		✓	✓	✓
Create datasets in the Sandbox			✓	✓
Star Ratings for Designs (SR4D)			✓	✓
Create datasets				✓

6.2   The ViDA Creator Dashboard

The dashboard is the primary page within ViDA. It provides access to the different tools and along with user specific notifications and system announcements.

ViDA Users with Creator access have additional tools which appear on the Dashboard.

These are:

Project Setup & Access enables Creator users to request access to datasets and create/edit projects.

Upload Coding Data enables Creator users to upload data to a Star Rating and Investment Plan project.

For descriptions of other ViDA tools, please see the *ViDA User Guide*.

6.3   Creating and editing programmes, regions, and projects

In ViDA, road coding files—or "upload files"—are uploaded into datasets. A dataset must be allocated to a project. Projects are organised into programmes and regions.

This section explains how to create programmes, regions and projects.

To begin the process, log in to ViDA (http://vida.irap.org) and select the Project Access & Setup button on the Dashboard.

Understanding the Project Setup & Access screen

Permissions

Prior to setting up a programme, region, project or dataset, it is important to understand how 'permissions' for these are managed.

The permissions interface can be found in the 'Edit' pop-up box for each programme, region, project and dataset.

The permissions interface divides users who have been granted access into three lists:

1. Users who have Creator permissions
2. Users who have Analyst permissions
3. Users who have Reader permissions.

Creating, editing and deleting actions can only be done by users with Creator permissions. The only exception is a programme. Programmes may only be created, edited and deleted by ViDA Administrator. To request this, contact support@irap.org.

User managers

Only the manager and user managers may grant access permission to other users.

The manager may assign other users as user managers by clicking on the person icon next to the user's name. Once a user manager, the person icon next to their name turns green. User managers will receive notifications on the ViDA Dashboard when another user requests access to a dataset. Refer to the *ViDA User Guide* for more information.

Granting access permission

To add a user, select '+Add' to search for and add other users to the Readers list. Once a user is added, the user's name, ViDA account level and email suffix is visible.

Added users can then be upgraded to Analysts or Creators by dragging and dropping their name into the respective list. Note that the level of access a user may be assigned depends on their ViDA access. For example, a user with Reader permissions may not be added to the Creator or Analyst lists. When dragging a user between lists, the background colour of each list is displayed in green to indicate which list is permitted.

Users may be removed from the lists by clicking the trash icon to the left of the user's name.

Understanding permissions in the 'Edit' pop-up box

Programmes

Programmes may only be created, edited and deleted by ViDA Administrator. If a programme needs to be created, contact support@irap.org.

The Sandbox programme may be used to create private regions, projects and datasets that can be used for testing. These datasets cannot be set to 'final'. However, it is possible to create a dataset in the Sandbox and later move it to another programme, region or project at a later date.

Regions

Creating a region: Regions may only be created by users with Creator permissions for the programme.

Click on the cog icon next to the programme name and selecting '+ New Region'. A programme may have an unlimited number of regions.

A 'New Region' pop-up box will open which requires a name and selection of the region manager.
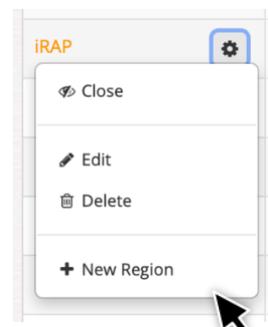
Example 'New Region' pop-up box

Editing and deleting a region: A region may only be edited and deleted by users with Creator permissions for the programme.

Click once on the icon beside the Region name and select 'Edit' to open the Edit Region pop-up box. The region name and permissions for the region can be changed here.
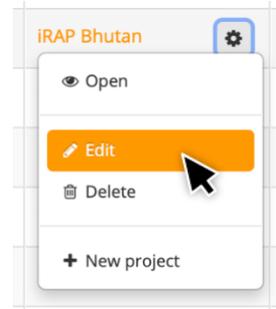
Example 'Edit Region' pop-up box

Projects

Creating a project: Projects may only be created by users with Creator permissions for the region.

Click on the cog icon next to the region name and select '+ New Project'. A region may have an unlimited number of projects.

A New Project pop-up box will open which requires a project name, country, and selection of the project manager.

The project manager may be selected from the drop-down list. If the required name is not in the list, contact the regional manager who may assign manager access to the user.
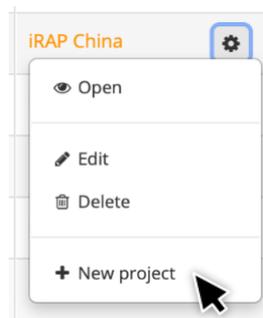
> **ⓘ What model should I use?**
>
> The default iRAP International Star Rating model version is the most up-to-date version available. Other versions of the model are available but should only be used in particular circumstances. Do not change the default version unless clearly instructed to do so by the programme manager or regional manager.

Example New Project pop-up box

Editing and deleting a project: A project may only be edited and deleted by users with Creator permissions for the region via the Project Setup & Access menu.

Click on the cog icon beside the project name and selecting 'Edit' to open the Edit Project pop-up box.

The project name, country and permissions can be changed here. Note that deleting a project will also delete corresponding datasets. This action cannot be undone.
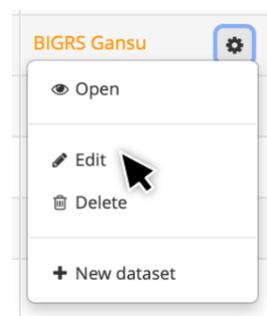
Example Edit Project pop-up box

6.4   Creating and editing datasets

Once a programme, region and project are established, datasets can be created.

Creating a dataset: Open the Project Setup and Access menu and select the programme and the region. Find the correct project and then click on the cog icon and select '+New dataset'.


Note that new design, scenario or post-construction datasets should be saved to the same project as existing datasets which are related (for example, a baseline dataset and design dataset for the same network).

A project may have an unlimited number of datasets. There is no restriction on the type of data within a dataset. For example, datasets within a project may contain:

- Two datasets containing two complete sets of data for a single road network (for example, the baseline dataset and a scenario test dataset)

- Partial duplication of a road (for example, a dataset containing intersection design coding only) or multiple datasets for different parts of a road network.

Creating a new dataset in the Project Setup and Access screen
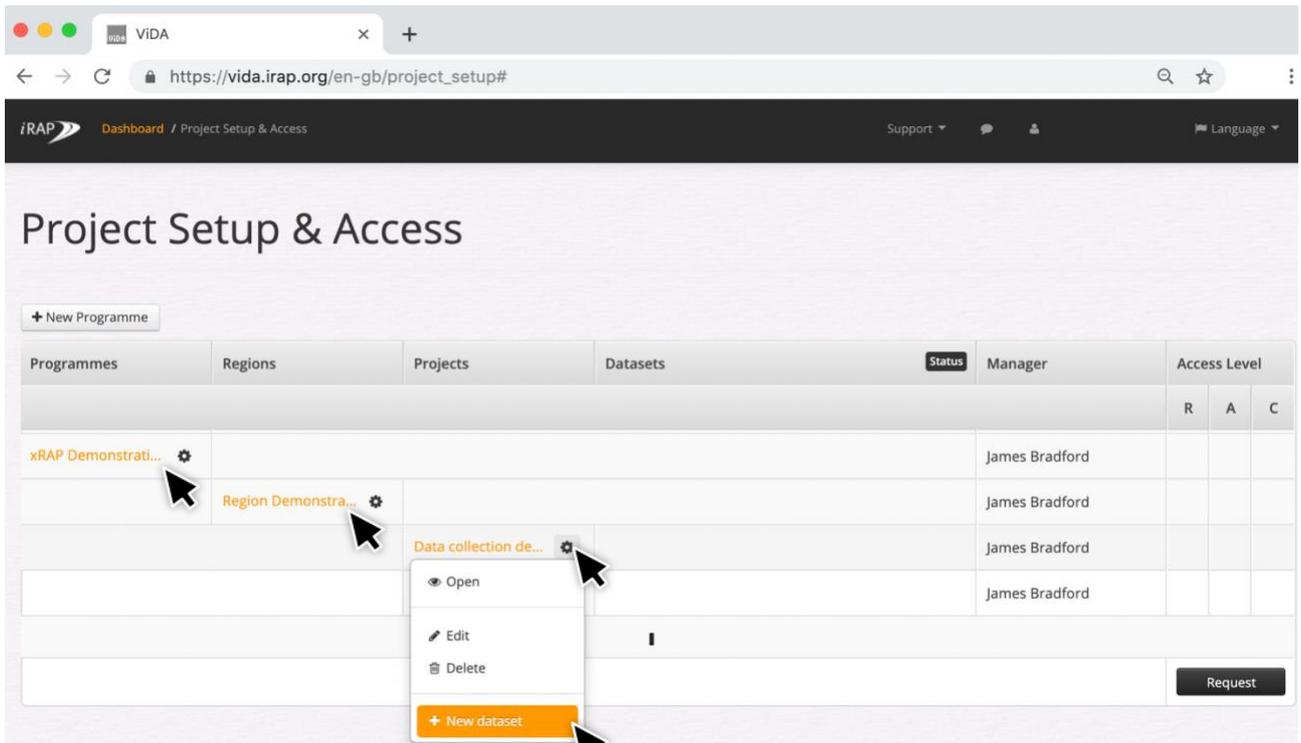
The Create Dataset pop-up box will appear. Enter the dataset name and click 'Create Dataset'.

Create Dataset pop-up box
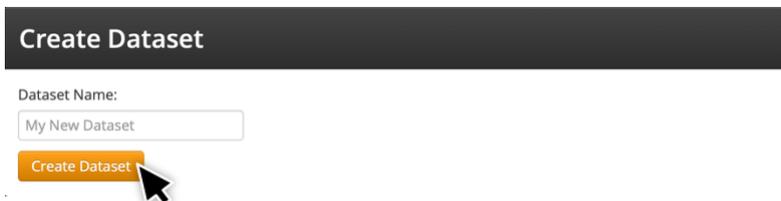
Tips for naming projects and datasets

It is good practice to name new projects and datasets clearly to avoid confusion as the project progresses.

Project names should identify the road network and year. Dataset names should describe the sub-set of the data. For example:

- Project name: Highways England 2019

- Dataset name: Baseline BCR 1

Dataset name should not repeat the project name. It should be easily recognisable to others who might use the dataset. If a road or network name is used, ensure it is applied consistently if multiple datasets are created.

Dataset names should also include one or more descriptor for the type of assessment/analysis. These are:

- 'baseline' or 'existing' – For existing road conditions.

- 'design' – For road designs. Additional descriptors, such as concept, interim, final etc. may be used.

- 'scenario xxx' – For various scenario testing. Always use descriptors to help users understand what the scenario is (e.g. +10kmh).

- 'BCR X' – For different benefit-cost ratios.

- 'post-construction'

Use only plain Latin characters without tonal marks, symbols or special characters. For example: "National Highways 2016 Baseline - BCR 3.0".

How many datasets do I need?

Each dataset can only be calibrated using a single set of fatality data. When setting up datasets, it is good practice to consider the fatality data available and the analysis that need to be performed. For example:

- A network assessment (with multiple roads) may only require a single dataset. In this case, the dataset's calibration can only be done with one set of fatality data.

- If good fatality data is available for each road, road type or area, creating corresponding datasets will allow each to be calibrated using the corresponding fatality data. However, managing multiple datasets with individual fatality data is complex. It is therefore recommended this approach is taken when there is a clear justification or benefit. For example, where two roads with very different FSI profiles have been assessed.

Defining a dataset

Once a dataset has been created, additional information needs to be added to it. This can be done by editing the dataset.

Editing a dataset: Datasets can be edited by clicking on the cog icon next to the dataset name and selecting 'Edit'.
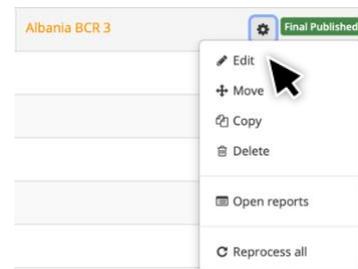
The Edit Dataset screen is used to define the characteristics of a dataset. It is structured into eight stages. These stages follow the progress of generating Star Ratings and Investment Plans.

The content of each stage can be expanded and collapsed by clicking on the name of a stage.

Example Edit Dataset screen
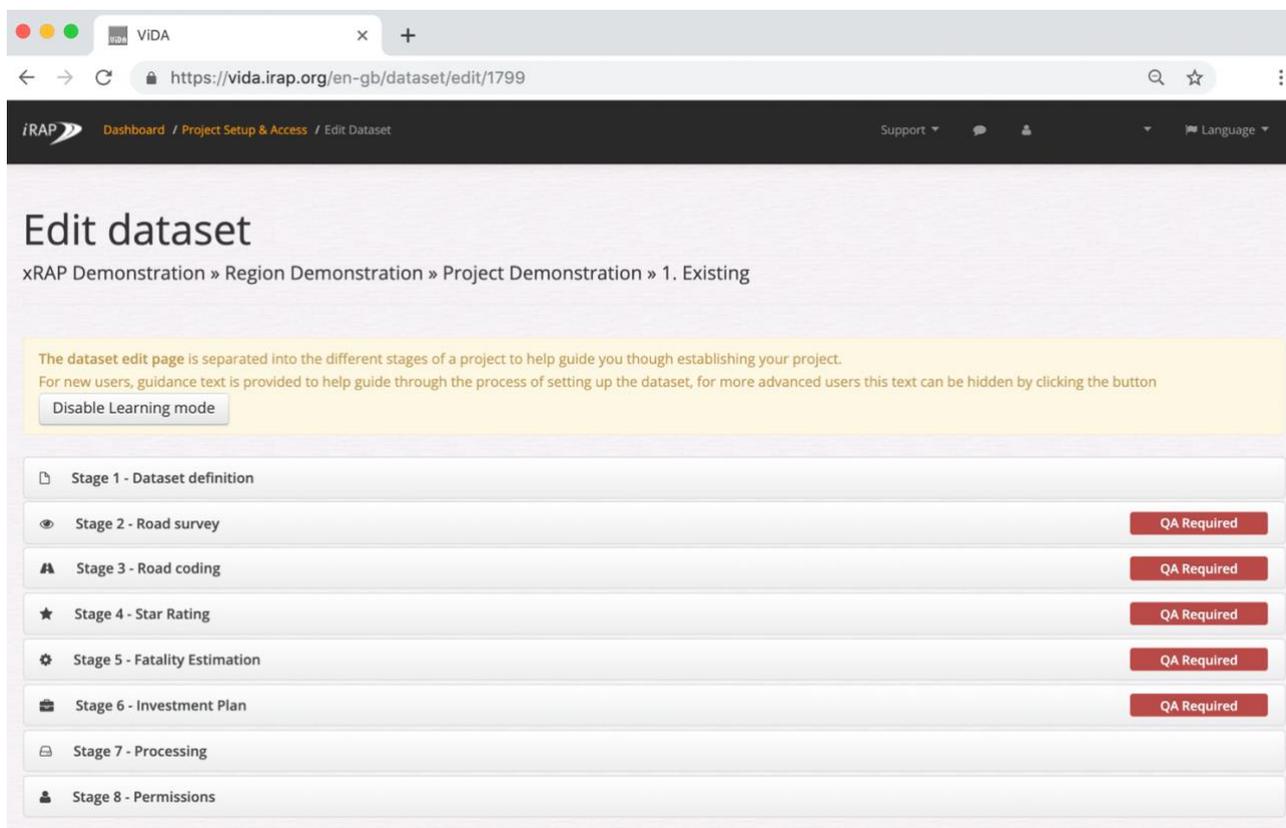
> **(i)** **Learning Mode**
>
> Learning Mode guides the user through the process of setting up a dataset. This text, in the yellow box, can be hidden by clicking the 'Disable Learning Mode' button. The learning text can also be accessed via the help buttons throughout each stage.

Quick guide to editing datasets

Saving changes: After completing or updating fields in a stage, click on 'Save stage' to save changes for the relevant stage. The 'Restore' button will cancel all unsaved changes and revert all fields in that stage to their previously saved values.

Note that uploading the countermeasure cost file in stage 6 automatically saves the changes to the costs.

If a stage has unsaved changes, a small warning will appear next to the stage name, which can be seen when the stages are collapsed.
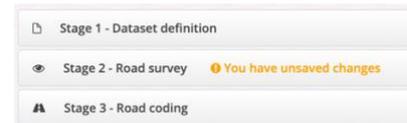
Input help: Some fields provide further explanation or guidance. This can be access by clicking on the small question icon next to the field.

Quality assurance approval: Some stages require quality assurance approval. Labels in each stage heading allow for quick identification of a stage's approval status.

Who approves quality?

Organisations are linked to the stages that they are permitted to quality approve. Personnel from those organisations are authorised to carry out the approval.

The designated quality approver must click 'Assign QA Approval' in order accept that the data is of adequate quality. Clicking this button will cause the red QA Required label will change to a green QA Approved label.

Once a stage is approved, a revoke button allows QA approval to be revoked.

Stage 1 Dataset Definition

This stage requires the information that defines a dataset's key characteristics. It includes:

- Dataset name: This would have already been defined when the dataset was created. The name can be changed at any time.

- Dataset manager: Can be selected from the drop-down menu. The dataset manager is the primary owner of the dataset. To be a dataset manager, the user must have a Creator account. If the required user's name is not listed, contact the project manager who may assign the person Creator permissions to the dataset. The dataset manager can be changed at any time.

- Country: The country is defined during project set-up. It sets the currency used for Investment Plans.

- Side of the road vehicles drive on: Define whether vehicles drive on the left-hand side or right-hand side the road.

- Dataset status: The dataset status defines the status of the data and controls the type of user access.

    - *Working* is for datasets that are currently under construction. The project manager provides access to the data.

- *Draft* is for data that is close to completion but has not been fully quality checked and is not for wider circulation. The project manager provides access to the data.

- *Final Hidden* is for data that is complete and quality assured, but is only visible to users who have access. The project manager provides access to the data.

- *Final Unpublished* is for data that is complete and quality assured. It is visible on the project access page for users to request access.

- *Final Published* is for data that is complete and quality assured. It is publicly available at Reader level and higher levels of access can be requested.

- Dataset ID: This is an automatically generated number which identifies the dataset. It is used for some tasks, such as importing FSI calibration settings from another dataset.

- The version of the model the dataset is using. This is defined at the project level. All datasets within a project use the same model.

To complete the stage, fill out all fields required and click 'Save stage'. To undo any unsaved changes, click 'Restore'.

Dataset status options

Status	Working	Draft	Final Hidden	Final Unpublished	Final published
Description	Dataset in development	Dataset ready for review	Dataset complete		
Results available to all Readers, Analysts and Creators	✘	✘	✘	✘	✔
Readers, Analysts and Creators may request access	✘	✘	✘	✔	✔
Dataset Manager may assign access	✔	✔	✔	✔	✔

Example Stage 1 Dataset Definition

Stage 2 Road Survey

This stage requires the details of the road survey, which is the geo-referenced image data of a road network. This is described in the _iRAP Survey Manual_. It includes:

- Quality assurer: Who will carry out the quality assurance check. All road surveys require quality assurance to confirm that the road image and geolocation data are of sufficient quality. If the required name is not listed, please contact support@irap.org.

- Road survey supplier and inspection system: Select who carried out the survey from the drop-down list. The drop-down list includes accredited survey providers. If the required name is not listed, please contact support@irap.org. If the provider is not accredited, select 'Other – iRAP authorised'. If the project did not have a survey (i.e. it is a design assessment), select 'NA – Star Rating of Design'.

  Select the inspection system used. Accredited inspection systems are linked to survey suppliers. If the required system is not listed or is out of date, please contact support@irap.org. If no inspection system is listed for the survey supplier, leave the field blank.

- Coding segment: Enter the length of the coding segment used in the attribute coding. If the default length was used (100m), set to 0.1km.

To complete the stage, fill out all fields required and click 'Save stage'. To undo unsaved changes, click 'Restore'.

Example Stage 2 Road Survey
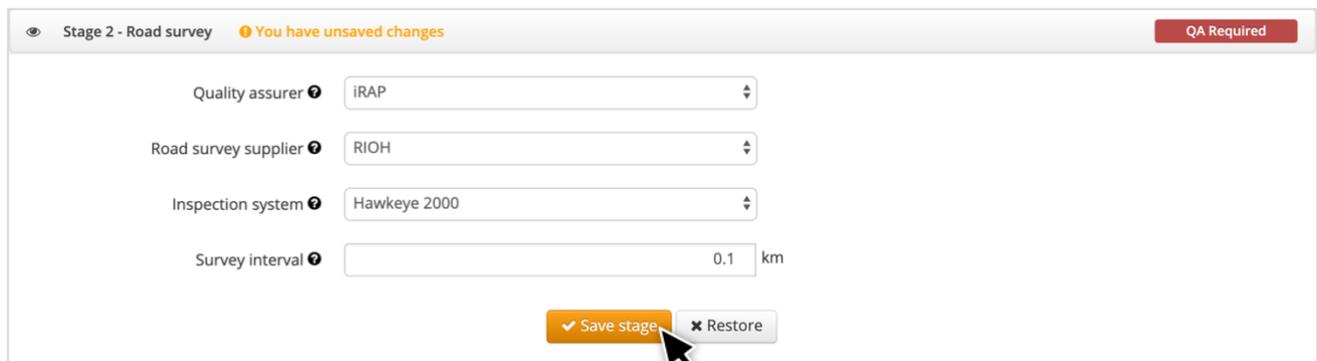
Stage 3 Road Coding

This stage requires the details of the road attribute, which is described in the _iRAP Coding Manual_. It includes:

- Quality assurer: Who will carry out the quality assurance check. All road coding requires a minimum 10% quality assurance check. The _Coding Validation Tool_ is available to assist in carrying out coding quality assurance checks. If the required name is not listed, please contact support@irap.org.

- Road coding supplier: Select who carried out the road attribute coding from the drop-down list. The drop-down list includes accredited coding providers. If the required name is not listed, please contact support@irap.org. If the provider is not accredited, select 'Other – iRAP authorised'.

At this stage, it is recommended to check the upload file meets the _Upload File Specification_ and the delimiter settings are correct.

By default, the delimiter for a .csv file is set to a comma (,) and decimal mark is set to a full stop (.). However, it is common that these are used the opposite way around. The delimiter settings used in ViDA can be changed by selecting 'Change settings' in the second blue box. This will ensure the upload file can be uploaded into ViDA correctly.

To complete the stage, fill out all fields required and click 'Save stage'. To undo unsaved changes, click 'Restore'.

Example Stage 3 Road Coding

Stage 4 Star Ratings

Star Ratings are calculated using the road attributes. This stage requires details for the calculation of Star Ratings. It includes:

- Quality assurer: Who will carry out the quality assurance check. If the required name is not listed, please contact support@irap.org.

- Smoothing method: Select the preferred smoothing method. Star Ratings can be smoothed by length or section.

  - Smoothing by length will create smoothed Star Rating results for 3km lengths in rural areas and 1km lengths in urban areas.

  - Smoothing by section will create average Star Ratings over the road section lengths defined in the upload file or where there is a change in road name or carriageway type.

  For more information on smoothing, see Raw and smoothed Star Ratings. The smoothing method should be consistent for all datasets within a project.

To complete the stage, fill out all fields required and click 'Save stage'. To undo any unsaved changes, click 'Restore'.

Example Stage 4 Star Ratings

Stage 5 Fatality Estimations

> This stage is only required for producing Investment Plans. For assessments to produce Star Ratings only, this stage may be ignored. Proceed to Stage 7: Processing.

Numbers of fatalities by road user and crash type are used to calibrate the dataset and produce the fatality and serious injury (FSI) estimates and Investment Plan reports in ViDA. For more information, see Calibration factors.

This stage requires details for the calculation of FSI for Investment Plans. It includes:

- Quality assurer: Who will carry out the quality assurance check. If the required name is not listed, please contact support@irap.org.

- Total network fatalities: Enter the annual number of fatalities on the network and supporting parameters. See the guidance under 'Total network fatalities' below.

- Distribution of fatalities by road user group and crash type: Distribute the fatalities into user groups and then split them into crash types.

Where do I find fatality data?

Ideally, fatality data for a 3-year period will be supplied by the road authority or another relevant agency, such as police. At times this data will be readily available but at other times additional efforts are needed to gather this data. This can include visits to regional, district or local offices.

It is common for reliable fatality data to not be available at all. When this is the case, estimates must be made. These estimates often require a high degree of expertise and experience in road safety and reliance on professional judgement. Estimates can consider:

- Fatality rates (ideally fatalities per vehicle kilometre travelled) on roads that are of similar design and use to those being assessed. Examples of sources of fatality and crash rates for different road types include:

  o Asian Highway Database: https://www.unescap.org/our-work/transport/asian-highway/database.

  o European Road Safety Atlas: http://atlas.eurorap.org/ (refer to Risk Mapping Technical Specification for information on crash rates for risk bands).

- Safety metrics reported in the World Health Organization (WHO) Global Status Reports on Road Safety. This report includes information about total numbers of fatalities in each country, the distribution of fatalities by road user type and indications about under reporting rates.

- Unofficial sources such as research papers and articles, media reporting, local knowledge of road authority planners and engineers, police, academics and local communities.

Importing settings from another dataset

Fatality estimation settings may be imported from a related dataset, for which the setting have already been defined. For example, a baseline dataset's settings can be used for new design and scenario datasets for the same road network.

Import settings from another dataset
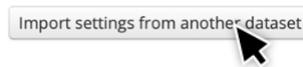
To import fatality estimation settings, click on 'Import settings from another dataset'. A pop-up box will open. Insert the dataset ID and click continue.

Note that if the dataset being imported from has auto calibration enabled, this will need to be disabled within that dataset in order to manually adjust calibration factors in the new dataset.

Importing settings from another dataset pop-up box

Total network fatalities

In the 'Total network fatalities' box:

1. Select the quality assurer.

2. Enter the number of reported deaths. This is the number of deaths for all road users that are reported to have occurred on the roads assessed during the sample period.

3. Enter the start and end year for the reported deaths sample period.

4. Click 'Calculate from years covered' button to generate the sample period in years.

5. Enter the *fatality under-reporting factor*. For example, if the number of reported traffic fatalities is 350, but the World Health Organisation Global Status Report on Road Safety estimates the road traffic fatalities is 490, then the *fatality under-reporting factor* would be 1.4.

6. Click 'Calculate' to calculate the *estimated number of annual fatalities on network*. This is the reported number of deaths, adjusted for under-reporting, divided by the sample period.

7. Enter text into the *fatality data source and assumptions* field. This text enables others to determine the sources of the data and the assumptions made.

Example total network fatalities

Toggle advanced

To explore how trends in fatality growth would affect an investment during the analysis period, the *annual fatality growth exponent* can be used. For example, to explore a 5% annual increase in road fatalities, this value can be set to 1.05 in order to include the projected fatality growth in the analysis.

Enter text into *basis for the growth exponent* to explain sources and assumptions.

This function is recommended for research purposes only.

Annual fatality growth exponent	1
Basis for growth exponent	

Distribution of fatalities by road user category and crash type (%)

The second step of calibration is to distribute the fatalities into user groups and then split them into crash types. If this distribution is not available in the reported data, estimates will need to be made.

There are three calibration tables, which can be selected by clicking on the corresponding button:

Calibration Factors | AADT Multipliers | AADT Power

1. Calibration Factors
2. AADT Multipliers
3. AADT Power

These tables are not required to be individually populated if auto calibration is being used.

Calibration Factors

> ⓘ **Auto or manual calibration?**
>
> The fatality estimation can be automatically calibrated using crash data. To do this, click on 'Enable Auto Calibration'. It is recommended that auto calibration is used except where the *import settings from another dataset* function is being used.
>
> The fatality estimation can be calibrated using crash data (auto calibration) or manually.
> **Auto Calibration** is currently disabled   [Enable Auto Calibration]
>
> Manual calibration requires the entry of fatality calibration factors. These need to be calculated manually, outside of ViDA. Click 'Disable Auto Calibration' to switch to manual calibration.
>
> The fatality estimation can be calibrated using crash data (auto calibration) or manually.
> **Auto Calibration** is currently enabled   [Disable Auto Calibration]

To manually calibrate a dataset, enter the calibration factors. Once the calibration factors have been updated and the dataset is reprocessed (see Stage 7), the latest estimation calculations can be viewed by following the link in the yellow box below the table. This will open the *latest fatality estimation calculations* pop-up box.

Example Calibration Factor table

	Vehicle occupant Calibration Factor	Motorcyclist Calibration Factor	Pedestrian Calibration Factor	Bicyclist Calibration Factor
Run-off LOC driver-side	0.288	2.4000000005		2.1400000032
Run-off LOC passenger-side	0.288	2.4000000004		
Head-on LOC	0.288	2.400000001		
Head-on overtaking	0.288	2.4000000081		
Intersection	0.288	2.4000000001		2.14
Property access	0.2879999992	2.3999999653		
Along		2.4000000003	0.04	2.1400000001
Crossing intersected road			0.04	
Crossing inspected road			0.04	

(top-right tabs: Calibration Factors | AADT Multipliers | AADT Power)

Please note: the last fatality estimation calculations, including any changes made, can be viewed here. Note, if any changes have been made since the dataset was last processed then the dataset will require re-processing

Latest fatality estimation calculations pop-up box

Latest fatality estimation calculations

Please note: the values shown in this table may be truncated. In order to see full values please choose either the *Percentages* or *Fatalities* option from the button group above

(button group: Percentages and Annual Fatalities | Percentages | Fatalities)

Assigned total: 0.275 Calibration total:	Vehicle occupant Percentage (%)	Fatalities	Motorcyclist Percentage (%)	Fatalities	Pedestrian Percentage (%)	Fatalities	Bicyclist Percentage (%)	Fatalities
User group distribution ❗		0.124		0.032		0.018		0.099
Run-off LOC driver-side	27.8	0.0345	25.9	0.0085			0.6	0.0005
Run-off LOC passenger-side	27.2	0.0338	23.1	0.0075				
Head-on LOC	25.4	0.0314	21.7	0.0071				
Head-on overtaking	2.7	0.0033	2.2	0.0007				
Intersection	16.7	0.0207	15	0.0049			31.5	0.0312
Property access	0.2	0.0002	0.2	0.0000				
Along			11.8	0.0038	39.7	0.0072	67.9	0.0674
Crossing intersected road					14.8	0.0026		
Crossing inspected road					45.5	0.0082		
Other	0	0	0	0	0	0	0	0

In the *latest fatality estimation calculations*, the distribution is shown as percentages and as number of fatalities. To see full values, click either 'Percentages' or 'Fatalities'.

(button group: Percentages and Annual Fatalities | Percentages | Fatalities)

Check that the Assigned Total equals the Estimated Number of Annual Fatalities on the Network. If it does not, Assigned Total box will appear red to indicate that there is an error.

The 'Calibration Total' is the number of annual fatalities on the network calculated by the model after processing. Note that until data is processed (in stage 7), this value will be blank.

When the Assigned Total and Calibration Total are the same, the total number of fatalities is correctly calibrated.

The 'User Group Distribution' (top row of numbers) contains the number of fatalities and/or percentage of fatalities by road user type (vehicle occupant, motorcyclist, pedestrian and bicyclist).

In this row, the number of fatalities must sum to match the Assigned Total and the percentages must sum to 100%. If they do not, a red '!' icon will also appear. Hover over this icon to see details about the error.

To complete the stage, fill out all fields required and click 'Save stage'. To undo unsaved changes, click 'Restore'.

Stage 6 Investment Plan

This stage is only required for producing Investment Plans. For assessments to produce Star Ratings only, this stage may be ignored. Proceed to Stage 7: Processing.

This stage requires a series of economics and analysis variables required for an investment plan.

It includes:

Quality assurer: Who will carry out the quality assurance check. All road surveys require quality assurance to confirm that the road image and geolocation data are of sufficient quality. If the required name is not listed, please contact support@irap.org.

Analysis period (years): The number of years over which the economics of the Investment Plan are calculated. Note: this is not the treatment life of individual countermeasures. The default analysis period is 20 years. However, this can be updated to reflect the project requirements as needed.

Discount rate (%): Discount rate is used to estimate net present values of countermeasure costs and benefits. The discount rate is typically set to 4% however this can be adjusted depending on the usual practice in each country.

Minimum attractive rate of return: The lowest internal rate of return (IRR) the road authority would consider to be a good investment. The default provided is the discount rate divided by 100. Click 'Action' to calculate the minimum attractive rate of return.

Example Stage 6 - Investment Plan

GDP per capita (current): Provide a value to be used to estimate a value of life for economic analysis. Gross Domestic Product (GDP) per capita in current prices (local currency) for the country can be attained from the IMF World Economic Outlook Databases.

Value of life multiplier: Enter the official value of life (VoL) multiplier. If no official VoL figure is available, the iRAP research paper *The True Cost of Road Crashes* provides an estimate of the value of life in a country based on a multiple of GDP per capita in current prices.

The recommended value is VoL = 70 x GDP per capita (current prices), though a range of 60 – 100 x GDP per capita (current prices) may also be selected depending on the country and assessment.

Value of life: This figure should reflect the official national or jurisdiction VoL if available. If this is not available, the default value of GDP per capita x VoL multiplier can be used. Click 'Action' to calculate the VoL.

Value of serious injury multiplier: Enter the official value of serious injury (VoSI) multiplier. The iRAP research paper *The True Cost of Road Crashes* provides an estimate of the VoSI in a country based on a multiplier of the VoL recorded above.

The recommended value is VoSI = 0.25 x VoL where an official figure for VoSI is not available.

Serious injury to fatalities ratio: The number of serious injuries for each fatality. Following the guidance in *The True Cost of Road Crashes*, the default value is 10 (that is, 10 serious injuries for each fatality). This may be changed based on strong supporting evidence. However, caution is advised as serious injury data in crash data typically has high underreporting rates.

Countermeasure Qualification criteria: This is fixed to use the Benefit Cost Ratio (BCR).

a. Provide the **Qualification value**: This is the minimum threshold value used for the Investment Plan. For example, if the Qualification criteria is set to BCR and Qualification value is set at ≥5, then only those countermeasures with an isolated BCR of 5 or more will be included in the Investment Plan.

b. **Multiple countermeasure adjustment** may be set to Advanced (recommended), Simple or None. This controls how the fatality estimations of the countermeasures are combined, thus adjusting the effect of each countermeasure.

    i. Advanced calculates the compound effect of all countermeasures within a 100m segment and distributes fatalities to each countermeasure proportionally

    ii. Simple uses a simple multiplier to adjust fatalities when countermeasures are combined

    iii. None considers each countermeasure as if it was built in isolation.

c. If the Simple Multiple countermeasure adjustment was selected, provide the **Multiple countermeasure multiplier**.

d. Provide details of data sources and any assumptions made in the **Basis for economic values** text box.

Countermeasure costs

To generate Investment Plans, the iRAP model requires the input of local countermeasure cost and service life data. In total, up to 94 countermeasures may be included in the investment plan assessment. Each countermeasure is described in the Road Safety Toolkit.

Countermeasure costs need to be in a countermeasure cost upload file that meets requirements. These requirements and how to use an upload file template are described in the sections below.

Example countermeasure costs table

Countermeasure costs

Review Countermeasure Triggers
Countermeasure cost upload file requirements

⊕ Upload costs   ⊕ Download costs

Countermeasure	Service Life	Rural / open area			Urban / rural town or village			Ignore	Edit
		Low	Medium	High	Low	Medium	High	All: ⊘ ⊘	
Improve Delineation	5	80000000	80000000	80	80000000	80000000	80000000	⊘	✎
Bicycle Lane (on-road)	20	177000000	177000000	177	177000000	177000000	177000000	⊘	✎
Bicycle Lane (off-road)	20	1931000000	1931000000	1	1931000000	1931000000	1931000000	⊘	✎
Motorcycle Lane (Painted logos only on-road)	5	159000000	159000000	159	159000000	159000000	159000000	⊘	✎
Motorcycle Lane (Construct on-road)	20	2325000000	2325000000	2	2325000000	2325000000	2325000000	⊘	✎

ⓘ **How do I find countermeasure costs?**

Countermeasure costs and services lives will vary from country to country and can also differ between regions and states within the same country largely due to differences in material costs, construction plant costs, labour costs, use of the roads and the environment.

Ideally, this data will be supplied by the road authority, such as in a published schedule of rates for highway works. If recent data is not available, then costs may be estimated by applying an annual price growth factor that reflects historical growth rates and/or forecast changes in prices.

In circumstances where reliable data are not available, estimates must be made. It is noted that these estimates often require a high degree of expertise and experience in road safety and reliance on professional judgement. Estimates can consider:

- Cost schedules from road upgrade and construction projects that have been completed on similar roads. These may need to be obtained from sources such as consultants, contractors or researchers.

- Countermeasure cost data used in an iRAP assessment in a similar situation. The validity of this data must be considered. It may need to be converted to match the local currency.

- Other sources such as research papers and articles, media reporting, local knowledge of road authority planners and engineers, academics and local communities.

Uploading countermeasure costs into the dataset:

- Click 'Upload Costs' to upload a *countermeasure cost upload file* to the dataset.

- If countermeasure costs have previously been entered, they can be downloaded again in *countermeasure cost upload file* format by clicking 'Download Costs' button. The *countermeasure cost upload file* may be used as a template for uploading countermeasure costs.

- Countermeasures can be ignored by clicking the corresponding icon in the Ignore column. The red icon indicates that a countermeasure is not able included in an investment plan.

- Individual countermeasure costs can be edited by clicking the corresponding icon in the Edit column if the table.
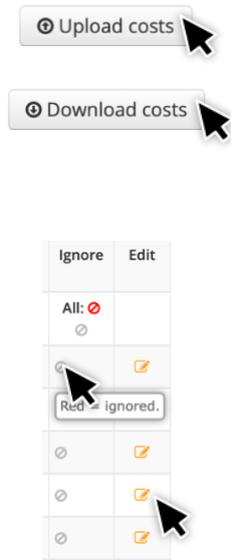
To complete the stage, fill out all fields required and click 'Save stage'. To undo unsaved changes, click 'Restore'.

Review countermeasure triggers

For a countermeasure to be considered for inclusion in an Investment Plan, it needs to be 'triggered'. The triggers may be viewed by clicking 'Review Countermeasure Triggers'. The triggers are based on international good practice.

Note that triggered countermeasures still must pass further checks against a countermeasure hierarchy (to avoid overlapping countermeasures), minimum spacing and economic criteria before they are included in the SRIP.

iRAP methodology factsheet 11, *Countermeasures* describes the triggers methodology in more detail.

Countermeasure cost upload file requirements

The requirements for countermeasure cost data may be viewed by clicking 'Countermeasure cost upload file requirements'.

Using the countermeasure cost upload file (Costs Template)

It is suggested that countermeasure cost data is initially compiled using the *countermeasure cost upload file*. This can be downloaded by clicking 'Costs Template'.

In this file, do not change the following columns:

> (1) ID
>
> (2) Name
>
> (3) Carriageway Code
>
> > − i = countermeasure applied to individual carriageway
> >
> > − m = countermeasure applied to multiple carriageways
> >
> > − u = countermeasure can only be applied to undivided carriageways
>
> (4) Unit of Cost
>
> (12) Divided Carriageway Cost Multiplier

The remaining columns may be updated as needed. This includes:

> (5) Service Life: The service life of each countermeasure is listed in years. The default values in the file may be changed to any number of whole years.
>
> (6-11) Upgrade cost: For each countermeasure, up to six different costs may be entered, depending on two categories:
>
> > 1. Area Type (urban or rural)
> >
> > 2. Upgrade Cost (low, medium or high)
> >
> > These are described in more detail in the *iRAP Coding Manual*.
> >
> > As an example, the countermeasure "Improve Delineation" typically involves improvements to road markings and road signs. This countermeasure is likely to have similar costs regardless of whether it is a rural or urban area type. In this case, similar costs would be entered for all six cost fields.
> >
> > On the other hand, the countermeasure "Additional Lane (2 + 1 road with barrier)" involves significant road widening, which is likely to be more expensive in urban areas than in rural areas. In this case, the countermeasure costs would typically be higher in an urban area type than a rural area type. Furthermore, adding lanes typically requires earthworks which can differ depending on factors such as the density of surrounding development, terrain and so forth. Therefore, countermeasure costs for low, medium and high upgrades would differ.
>
> (13) Hide: The Hide field controls whether a countermeasure is included in reports and download files. There are two options:
>
> > 0. Not hidden. In this case, if a countermeasure is included in an Investment Plan, it will be listed in the reports or download files.
> >
> > 1. Hidden. In this case, even if a countermeasure is included in an Investment Plan, it will not be listed in the reports or download files.
>
> (14) Ignore: The Ignore field controls whether a countermeasure can be included in an Investment Plan (subject to it passing triggers, spacing, hierarchy and economic tests). There are two options:

Please ensure your file meets the following requirements:

- Format: CSV
- Costs are in local currency
- Columns
  1. Countermeasure ID
  2. Name
  3. Carriageway Code
  4. Unit of Cost
  5. Service Life
  6. Rural-Low Upgrade Cost
  7. Rural-Medium Upgrade Cost
  8. Rural-High Upgrade Cost
  9. Urban-Low Upgrade Cost
  10. Urban-Medium Upgrade Cost
  11. Urban-High Upgrade Cost
  12. Divided Carriageway Cost Multiplier
  13. Hide
  14. Ignore

The CSV template is available here: Costs Template

1. Not ignored. In this case, a countermeasure is able included in an Investment Plan.

2. Ignored. In this case, a countermeasure is not able included in an Investment Plan.

Once the *countermeasure cost upload file* is completed, it can be uploaded to the dataset following the instruction for how to upload countermeasure costs into the dataset provided above.

Stage 7 Processing

Now that the dataset set up is complete, the data can be processed. This stage requires the upload file that contains road attribute coding and supporting data to be uploaded for processing.

Example Stage 7 Processing

How to upload data to the dataset

Click 'Upload coding data'.

There is a final opportunity to check the upload file meets the *Upload File Specification* and the delimiter settings are correct. For more information on these, see Stage 3 Road Coding.

Click 'Browse' to select the upload file from the computer, then click the 'Upload Files' button. It is possible to upload a series of files at once. These will be joined together during the processing.

ViDA will then perform a validation test on the data. If there are errors, a notification is given and corrections to upload file are necessary before attempting the upload coding data again.

Once the upload file is error free, a *Validation successful* message will appear. To proceed with processing the dataset, click 'Proceed'. Note that proceeding will overwrite any existing data in the dataset.

Validation successful

Your upload file has successfully validated and is ready for processing.
Click proceed to process your data.

Please note: this will overwrite your existing dataset.

✓ Proceed   ✗ Cancel

The dataset will now commence processing. Progress can be monitored on the ViDA Dashboard.

A notification will appear in the activity feed once processing is complete, after which reports and download files will be available. These can be accessed via the Results button on the ViDA Dashboard or by clicking 'View Results' under Dataset history.

How to reprocess data

If one or more upload files have already been uploaded but require reprocessing, click 'Reprocess all'. This is for when dataset settings have been changed (such as countermeasure costs) but the upload files remain the same.

The dataset will now commence processing. Progress can be monitored on the ViDA Dashboard.

Dataset history

This is a record of when the dataset was processed or reprocess and by whom. To view the results of the last processed dataset, click 'View Results' to go directly to the reports and downloads section of ViDA. Alternatively, results and downloads can be access via the Results button on the ViDA Dashboard.
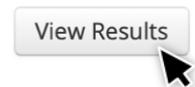
Results from previously processed datasets cannot be viewed or restored.

Stage 8 Permissions

This stage sets up the user access permissions for the dataset.

Dataset permissions operate the same way as those for programme, region and project permissions. Please refer to this section for instructions on how to grant, upgrade and remove access permissions.

It is recommended that only one user should have Creator permissions on a dataset. Granting Creator permissions to additional users could cause the dataset to be overwritten.

To complete the stage, click 'Save stage'. To undo unsaved changes, click 'Restore'.

6.5   Editing coding for a dataset

It is often necessary to edit road attribute coding in a dataset after it has been processed in ViDA. This may occur when, for example, final quality assurance checks of the investment plan reveal errors in the coding.

To update coding, click the Results button on the ViDA Dashboard.
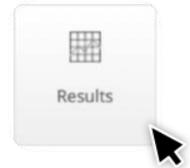
In Filter 1, select the Program, Region, Project and Dataset and click 'Apply'.

Select 'Downloads' in the navigation ribbon.
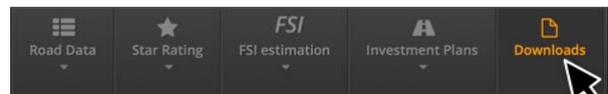
Click the 'Upload Only (zip)' link.
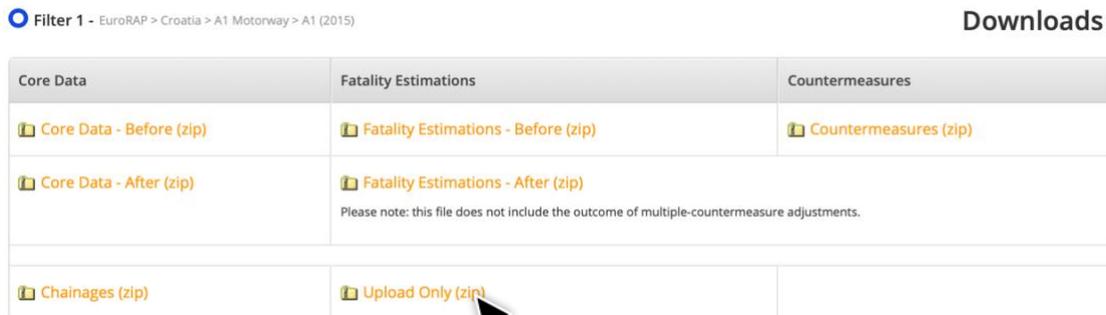
The Upload Only pop-up box will appear. There is an option enter a bespoke name for the file. Click 'Request'.
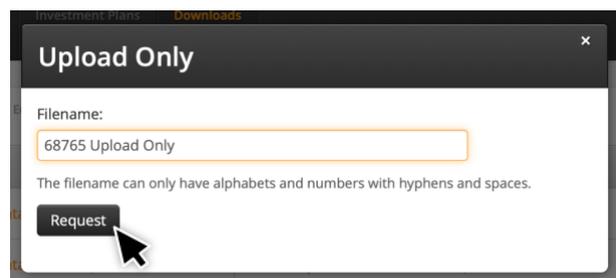
Once the request has been processed, a red notification will appear in the Navigation bar at the top of the screen. Click on the Notification indicator and select the file in the Activity Feed. When prompted, download and save the .csv file.

Coding for the attributes that need to be edited may be updated in Microsoft Excel or other specialised software. Coding must be performed in accordance with the _iRAP Coding Manual_.

When the coding update is complete, re-upload the data following the directions provided in Stage 7 Processing.

6.6   Moving, copying and deleting datasets

Moving or copying a dataset

To move or copy a dataset, click on the cog icon next to the dataset name in the Project Setup & Access menu and select 'Move' or 'Copy'.
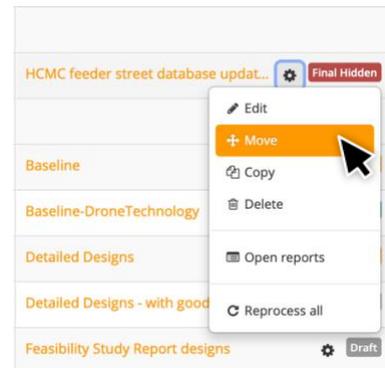

When prompted, select the region and project that the dataset will be moved or copied to.

Note: A dataset may only be moved or copied to a project that has the same country and model version settings.

Moving a dataset removes it from the original location. All information is retained including user permissions.

Copying a dataset replicates all of the original dataset's information. The word "COPY" is added to the end of the dataset name and it is given its own Dataset ID.
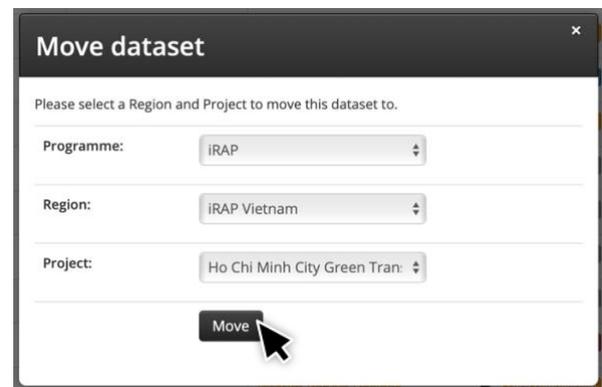
Deleting a dataset

To delete a dataset, click on the cog icon next to the dataset name in the Project Setup & Access menu and select 'Delete'.

Deleting a dataset cannot be undone. A warning box will appear to confirm deletion. Click 'confirm' to proceed.

7 STAR RATING DESIGNS AND SCENARIOS

Designs and scenario Star Ratings are the assessment of hypothetical road conditions which may be used to assist road authorities in understanding the safety implications for proposed road upgrades, speed changes or other changes which could affect the safety of a road.

> **What is the difference between designs and scenarios?**
>
> A road design is a set of proposed changes to the layout of a road's infrastructure. This can be a simple widening of an existing carriageway through to a complete reconfiguration of the road layout (such as building a raised freeway).
>
> Scenarios are alternative outcomes of an existing road or road design. They are most commonly used to model the effect of certain countermeasures or speed limits on the road or design's Star Ratings.

The process of producing Star Ratings for road designs and scenarios is slightly different to that of existing roads. This section will explain these differences and provide guidance on design and scenario coding, Star Ratings and calibration. However, it is important to note that the principles for preparing upload files and setting up datasets in ViDA remain the same. It is highly recommended that users have a solid understanding of the content in previous chapters before attempting to apply this process to road designs and scenario tests.

7.1   Star Rating designs

Rather than road attribute coding being largely drawn from a road survey, road attribute coding has to be derived from design documents such as feasibility plans, concept drawings and detailed designs.

It is likely that design documents alone will not provide all the road attribute information required to produce Star Ratings. Therefore, it is beneficial if Star Ratings for road designs has an existing road dataset to draw this information from.

For example, in a design that involves the addition of a lane, the 'number of lanes' attribute and related attributes (such as 'delineation', 'paved shoulder', roadside objects and distance, 'road condition', 'skid resistance' and 'operating speed') will be updated in the design coding depending on the specific design. Other unrelated attributes will remain the same as the existing road coding.

For Star Rating road designs, it is possible that a design is assessed without a corresponding dataset for an existing road. This can occur when:

- A road upgrade is planned, but no assessment has been performed for the existing road, or
- A 'greenfield' road is being built, where there is no existing road.

If no existing road dataset exists for a design, see Design Star Ratings with no existing dataset.

iRAP's *Star Rating for Designs* (SR4D) tool is a purpose-built application to assist with Star Rating designs. For more information, see *iRAP's SR4D web app*.

7.2   Scenario testing

Scenario testing is to observe the differences between two or more variations in existing conditions or designs. By definition, scenario Star Ratings cannot exist without existing road or design Star Ratings. For example:

- In a scenario to test of the impact of installing safety barriers on existing road, the design/scenario coding will be the same as the existing road, but roadside object and roadside distance attributes will be updated.

- In a scenario to test the impact of a speed limit reduction (with enforcement). In this case the design/scenario coding will be the same as the existing road, but the speed limit and operating speed attributes will be updated (noting that it may be reasonable to assume that, even with enforcement, operating speeds do not reduce by as much as the speed limit reduction).

The complexity of Star Rating scenarios can vary from simple (changing one or two attributes—such as speed—while others remain constant) through to complex, such as comparing entirely different design propositions for a section of road.

Multiple scenario datasets may be created, although it is recommended these are limited according to their intended use.

Design and scenario Star Ratings using an existing road dataset

If there is an existing road dataset (e.g. a completed baseline or design assessment), it can be used as the basis for producing design or scenario Star Ratings.

To do this, download the existing road or design coding using the same method as editing coding for a dataset, but rename the file to identify it as a design or scenario coding file.

Once the file is downloaded, coding for the attributes featured in the design or scenario may be updated in iRAP's *SR4D web app*, Microsoft Excel or other specialised software.

In this case, a design is any information that describes how the road will be built. It can include, for example, feasibility plans, concept drawings and detailed designs.

Coding must be performed in accordance with the *iRAP Coding Manual*. Any assumptions made in the coding of the design should be recorded for future reference. Assumptions can be recorded in the comments field of the coding file.

Once the coding of design or scenario is complete, undertake quality checks, ensure the file meets the *Upload File Specification* and enter supporting data as per Preparing an Upload File and Supporting Data Attributes and Codes.

> **ⓘ Does supporting data change for design or scenario Star Ratings?**
>
> Star Rating designs and scenarios requires a number of assumptions to be made based on the changes to the road that the design or scenario would introduce.
>
> For example, if a new mass transit system were being installed along a road, it would likely result in a significant increase to pedestrian flows in the vicinity of transit stations. The forecast patronage for these stations could be used as an indicator for future pedestrian flows along and across the section of road.
>
> In many cases, the impact of a design of a road on speed and flow is much less clear. Generally, the vehicle flow of a road directly correlates to its size (e.g. number of lanes - refer to the *iRAP Coding Manual* for guidance on this issue). Surrounding development or major new transport links and hubs (such the opening of a sea or airport) may also significantly increase flows without road

widening. It is important to consult with local authorities about the road's context to gain this information.

Road designs should indicate the proposed posted speed of the road. However, it can be harder to gauge the impact of the designs on operating speeds. The features of the design and their connection to vehicle speeds should be considered. Features such as the removal of intersections, smoother road surfaces and wider lanes can result in a significant increase in operating speeds.

In cases where the future speed and flow conditions are unclear, these can be tested for different scenarios. This is where multiple datasets are created with varying flow and speed characteristics. Scenarios should reflect, as best as possible, potential and credible outcomes based on the available facts. Scenario tests can be an important tool in helping decision makers understand the issues and make decisions accordingly.

All assumptions made in the supporting data for a design or scenario Star Rating should be articulated and recorded in the dataset's definitions.

Once the upload file for the design or scenario is ready, upload it to a new dataset within the same project as the existing road (baseline) dataset.

There are two options for creating a new dataset:

1. Set up a new dataset. See Creating a dataset.
2. Copying the existing road dataset. See Moving, copying and deleting datasets.

In both cases, the datasets definitions will need to be completed/adjusted for the new dataset. See Defining a dataset.

If the existing road dataset has been calibrated (that is, where stages 5 and 6 in Defining a dataset have been completed and the resulting fatality estimations and Investment Plan has been produced), these settings can be used for the design/scenario dataset.

- Where a new dataset was set up, select 'import settings from another dataset' in Stage 5 Fatality Estimations and disable auto calibration. This will import all of the calibration factors for the existing road dataset across to the new dataset.

- Where a dataset was a copy of the existing road dataset, calibration factors in stages 5 and 6 will have also been copied across. Check these are the same. If not, follow the instructions to 'import settings from another dataset' above. Note that auto-calibration will need to be switched off.

Design Star Ratings with no existing dataset

If there is no existing road dataset, a new coding file will need to be created.

It is highly recommended a coding file is created for the existing road first. This will provide information about the road which may not be available in the design. That way, it is simply a matter of updating the coding to reflect the design.

Google Streetview, Mapillary or other available street imagery can be used to code the attributes of the existing road.

If this is not available or it is a greenfield site without an existing road, the information will need to be drawn from other sources, such as satellite imagery, typical characteristics from comparable roads and local knowledge from design team.

Any assumptions made in the coding of the design should be recorded for future reference. Assumptions can be recorded in the comments field of the coding file.

To do this, create a new coding file and code the attributes featured in the design using iRAP's *SR4D web app*, Microsoft Excel or other specialised software. Instructions and coding specifications are provided in the *iRAP Coding Manual*.

Record assumptions made in the coding of the design for future reference. Assumptions can be recorded in the comments field of the coding file.

Once the coding of design is complete, undertake quality checks, ensure the file meets the *Upload File Specification* and enter supporting data as per Preparing an Upload File and Supporting Data Attributes and Codes.

After the upload file for the design has been checked, validated and supporting data entered, it is ready to upload to a new dataset in ViDA.

If this is a new project, see Creating and editing programmes, regions, and projects.

As there is no dataset for the existing road, a new dataset will need to be created. See Creating a dataset and Defining a dataset.

7.3 iRAP's SR4D web app

iRAP's SR4D web app is part of the iRAP suite of online tools which can be used to code existing roads and road designs.

The SR4D web app makes a number of key changes to the traditional Star Rating and Investment Plan Process. The most significant difference is that the SR4D web app utilises the VIDA API to transfer coding data directly into ViDA for processing, thus removing the need to create separate upload files. Users can upload their own road designs into the SR4D web app or use Google Streetview and Mapillary to code existing road attributes.

SR4D web app process

The SR4D web app is freely available for ViDA Creator license holders and can be accessed by selecting the Star Rating for Designs button on the ViDA Dashboard.
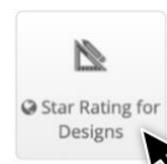
Note that the SR4D web app does not automate coding. All coding must be completed in accordance with the *iRAP Coding Manual*.

The SR4D web app does not automatically define datasets or calibrate them to produce Investment Plans. These steps must be undertaken in ViDA separately. See Defining a dataset for instruction on these steps.

Instruction on how to use the SR4D web app is available in the *Star Ratings for Designs User Guide*.

Example design coding page in the SR4D web app
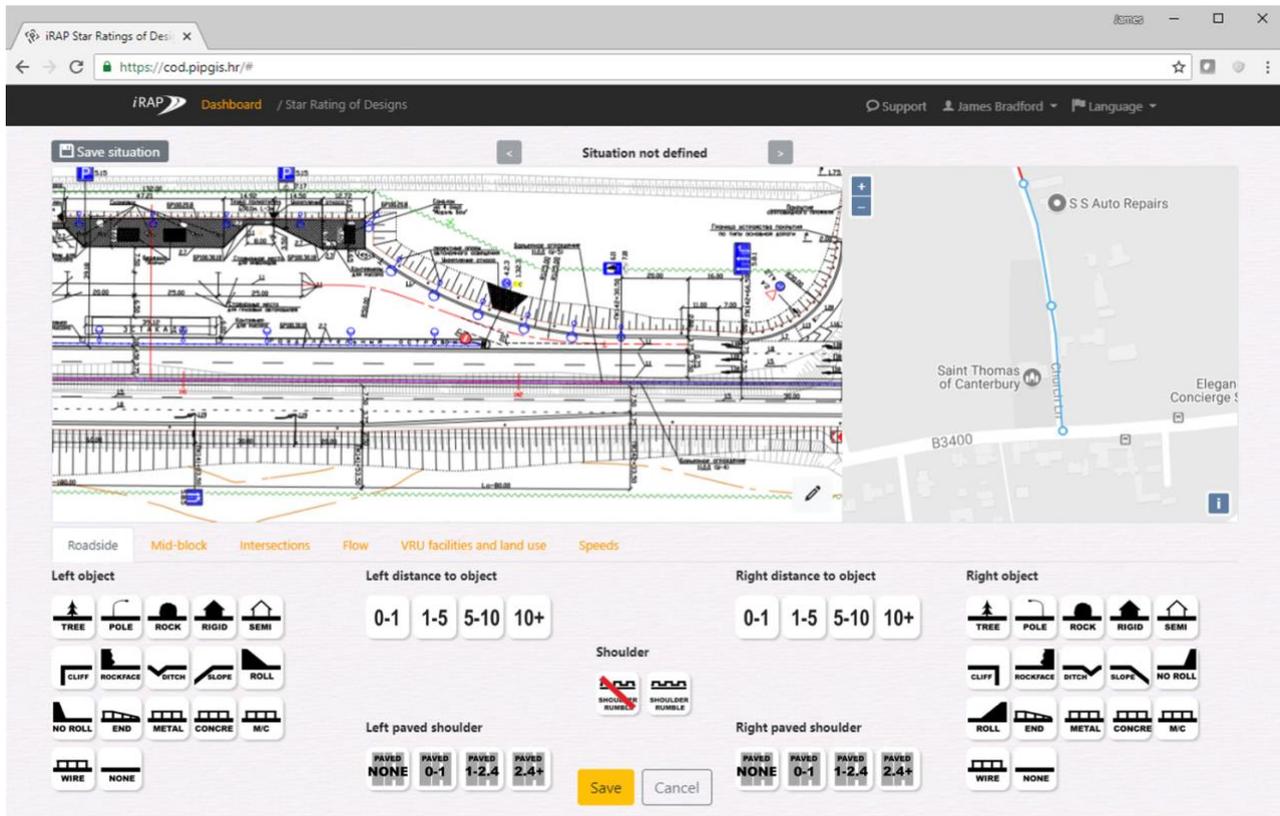
7.4   Fatality estimation and Investment Plans for designs

Fatality estimation and Investment Plans can also be created for design assessments and scenario tests. Fatality estimation for designs may be helpful for comparing the change in fatalities and serious to other scenarios or baseline assessments. Investment Plans for designs provide an opportunity to see what could be done to improve the Star Ratings of the design and thus the potential to reduce fatalities and serious injuries.

Producing fatality estimation and Investment Plans for designs and scenarios can be done easily where there is a calibrated dataset for the existing road (that is, where stages 5 and 6 in Defining a dataset have been completed and the resulting fatality estimations and Investment Plan has been produced).

In this case, calibration factors can be transferred using the two options outlined in Preparing a new design or scenario coding file (with existing upload file). They are:

1. Set up a new dataset. This is where a new dataset is created and defined (see Creating a dataset). Calibration factors can then be imported from the existing road dataset in Stage 5 Fatality Estimations. This option applies to new datasets created in SR4D.

2. Copying the existing road dataset (with auto-calibration switched off). This is where all of the settings and calibration factors are directly copied to the new dataset and the design upload file is processed in Stage 7 Processing.

In both cases, dataset definitions should be checked and adjusted as necessary. Refer to Defining a dataset for more information.

Where there is no existing calibrated dataset for the road, fatality data for the existing road, economic data and countermeasure cost data will be required to calibrate the new dataset. Refer to Defining a dataset for further

information on what is required and instructions on how to input this data. Where appropriate, calibration factors for similar road networks may be used.

8 POST-CONSTRUCTION STAR RATINGS

Post-construction Star Ratings are an assessment of a road after improvements have been made. These may be done for performance tracking.

This process is the same as that which is followed for completing a baseline assessment for a road. A survey of the road is completed, and the survey footage used to code the road attributes.

For information on how to undertake road surveys and attribute coding, please refer to the *iRAP Survey Manual* and the *iRAP Coding Manual* at www.irap.org/specifications.

Some types of road upgrades are relatively simple, that is, they are unlikely to significantly alter vehicle speeds or road user flows. In these cases, the existing coding data (i.e. that used for baseline or design Star Ratings) may be used as a basis for the post-construction coding similar to the method used to Star Rate designs. For example:

- Where safety barriers have been installed, the post-construction coding will be the same as the road previously, but roadside object and roadside distance attributes will be updated.

- Where a lane has been added, the post-construction coding will be the same as the road previous, but the number of lanes attribute will be updated. In this case, other related attributes, such as delineation, paved shoulder, roadside objects, road side distance, road condition, skid resistance and operating speeds might also be updated depending on the specific design (noting that operating speeds should be based on samples taken in the field after the speed limit was changed).

- Where a speed limit has been reduced (and enforced), the post-construction coding will be the same as the road previously, but the speed limit and operating speed attributes will be updated (noting that operating speeds should be based on samples taken in the field after the speed limit was changed).

To use an existing dataset as the basis for post-construction road attribute coding, follow the steps described in Design and scenario Star Ratings using an existing road dataset.

To produce fatality estimations and Investment Plans, refer to Fatality estimation and Investment Plans for designs. Note that if there has been a period between baseline and post-construction assessments during which new fatality and serious injury crash data has become available, calibration factors should be updated.

The SR4D web app may also be used for these types of assessments. Refer to iRAP's *Star Rating for Designs (SR4D) tool* and *Star Ratings for Designs User Guide* for more information.

9 ANALYSIS AND REPORTING

An iRAP assessment, the Star Rating reports and Investment Plans are technical processes that require specialist training and skill set. The function of the analyses and reporting is to make the results of the assessment relevant to all potential audiences—from engineers and road designers working on the road project through to politicians and policy-makers making investment decisions.

In many ways, analysis and reporting is the most important part of an iRAP road assessment. The information contained therein will guide road safety planning and policy and inform decision making about investing in safer roads.

It is critically important the reports, subsequent presentations and implementation support addresses the priorities of the client, highlights critical issues to be addressed which may not have been considered, and provides a realistic and practical way forward.

9.1   Data analysis

Once all of the data is uploaded into ViDA, there is a range of analyses it can be used for, depending on the project and client's needs.

ViDA contains an extensive range of ways to analyse this data, down to the road and section level. Examples include:

- Road data can be analysed and presented using Detailed Condition Reports, and Road Attribute Snapshots and Matrices (allowing two set of attributes to be correlated).

- Star Ratings can be analysed and presented using maps, tables and charts. There is also the Risk Worm, which shows the distribution of Star Rating Scores at the road section level, and Risk Worm by Crash Type which breaks the results down by crash type risk.

- Fatality Estimation can be analysed and presented using maps and tables. Fatality Estimation data can also be used for analysis such as identifying common severe crash types (see Advanced data analysis using download files).

- Predicted Casualty Saving Maps can be used to prioritise road upgrades where high numbers of fatal and serious injury crashes can be avoided.

For more information about ViDA reports and how to use them, please refer to the *ViDA User Guide*.

9.2   Advanced data analysis using download files

The download files can be used for more detailed and specific analysis. Download files contain all the information collected and produced during the assessment. There are three main types:

1. Core Data download files. These contain:

- Location information for each 100m segment of road including road name, section name distance (chainage), longitude and latitude (columns 5-10/E-J)

- Traffic volumes (column 63/BK)

- Pedestrian and bicycle peak hour flows (columns 65-68/BM-BP)

- Road attribute codes (columns 13-62/M-BJ and 77-78/BY-BZ)

- Vehicle operating speeds (columns 69-70/BQ-BR)

- Star Rating Score for each road user crash type (columns 80-85/CB-CG; 90-96/CL-CR; 101-103/CW-CY and 108-110/DD-DF)

- Star Ratings – smoothed and raw (columns 86-89/CH-CK; 97-100/CS-CV; 104-107/CZ-DC and 111-114/DG-DJ).

2. Fatality Estimation download files. These contain:

- Location information for each 100m segment of road (columns 1-6/A-F)

- Estimated (modelled) number of annual deaths for each 100m segment of road given as the rate per km by crash type (columns 8-13/H-M; 15-21/O-U; 23-26/W-Z and 28-30/AB-AD)

- Estimated (modelled) number of annual deaths for each 100m segment of road given as the rate per km by road user (columns 14/N; 22/V; 27/AA and 31/AE)

- Estimated (modelled) total number of annual deaths only for each 100m segment of road (column 35/AI) given as the rate per 100m

- Estimated (modelled) total number of annual deaths and serious injuries for each 100m segment of road (column 36/AJ) given as the rate per 100m. Note that this is also provided in the 'Total' column of the FSI Estimation table in ViDA.

3. Countermeasures download file. This contains:

- Location information for each listed countermeasure (columns 1-8/A-H)

- A list of countermeasures for further investigation (column 11/K)

- Countermeasure service life (column 13/M), analysis period (column 14/N) and discount rate (column 20/T)

- An economic assessment of each countermeasure including initial costs (column 22/V)

- Construction and maintenance costs for the duration of the analysis period (column 23/W)

- FSI saved (columns 17-18/Q-R)

- Economic cost savings and value of safety benefits (columns 19/S and 21/U)

- Benefit cost ratio (BCR) (column 25/Y), and

- Internal rate of return (IRR) (column 26/Z).

Core Data and Fatality Estimation files

The Core Data and Fatality Estimation files are available 'before' implementation of the Investment Plan (showing the existing or baseline conditions) and 'after' (assuming all countermeasures identified within the Investment Plan have been implemented).

To access download files, go to the Results screen in ViDA and select 'Downloads' in the Navigation Bar and select the download file required.

A pop-up box will appear which gives the option to customise the file name. It is recommended that the file name is changed to be easily recognisable.

The file will then be processed. Once it is ready, it will be available as a .csv for download in the Activity Feed.

Once the file is downloaded, it can be opened in Microsoft Excel or similar for analysis. Directions for some common analyses using download files are provided below.

Calculating a reduction in FSI for an Investment Plan

The SRIP Table will provide the number of FSI saved, but not the reduction this represents. To calculate the reduction in FSI, how many fatal and serious injuries are occurring on the assessed road network must first be known.

This can be calculated by using the 'Fatality Estimations – Before' download file and summing the column 'Total Fatal and Serious Injury Estimation per 100m per year' (column 36/AJ) or viewing the 'Total' column in the FSI Estimation table in ViDA. Note that not all crash types are included in the FSI model, this method will only provide the reduction in the FSI modelled. To include all crash types, use the calibration target.

> **How do I calculate an FSI reduction for an Investment Plan?**
>
> If the sum of column 36/AJ (or the 'Total' column in the FSI Estimation table) is 10,150.5, that is how many annual fatal and serious injuries have been distributed (modelled) across the surveyed network. Multiplying this figure by 20 provides the number of FSI on the surveyed network over the next 20 years (the analysis period in the Investment Plan).
>
> For example,
>
> $$10,150.5 \times 20 = 203,010$$
>
> Therefore, the estimated number of FSI on the surveyed network in 20 years is 203,010.
>
> If the SRIP Table reported the number of FSI saved over 20 years was 120,067, the percentage reduction can be calculated by dividing the decrease (120,067) by the original number (203,010) and multiplying the answer by 100. For example,
>
> $$\frac{120,067}{203,010} \times 100 = 59.1\%$$
>
> In this case, the Investment Plan would result in an estimated 59.1% reduction in FSI over a 20 year period.
>
> It is important to ensure that the analysis period is consistent.
>
> The 'Fatality Estimations – After' download file can be used to analyse the projected reduction in FSI by crash type (assuming all cost-effective countermeasures listed in the Investment Plan are to be implemented).

Comparing fatalities or FSI between datasets

Comparing a reduction in FSI between two datasets may be required for comparing a baseline, scenario and design datasets.

If comparing datasets for the same road, for example a baseline dataset and a design dataset, the datasets must have the same calibration factors. See Stage 5 Fatality Estimations for more information.

The FSI Estimation table in ViDA can be used to compare the total FSI for all road users or by road user type. The datasets can be viewed within one filter and viewed by dataset or in two filters.

To compare only fatalities or specific crash types, refer to the relevant columns in the 'Fatality Estimations – Before' files.

> **How do I calculate a percentage reduction or increase in FSI?**
>
> The example below shows FSI estimates for two datasets: a baseline and a detailed design. The example FSI Estimation table below shows a significant difference between annual pedestrian FSI for the assessed road network.
>
>
>
> Therefore, it may be useful for reporting to specify the percentage increase in FSI for pedestrians in the detailed design compared to the baseline.
>
> In this example, the difference between annual pedestrian FSI for the detailed design (70.7) and the baseline (41.8) is 28.9.
>
> Divide the difference by the baseline and multiply by 100 to work out the percentage increase. For example,
>
> $$\frac{28.9}{41.8} \times 100 = 69.14\%$$
>
> In this case, the detailed design would result in an estimated 69.14% increase in pedestrian FSI per year.

Identifying common severe crash types

A detailed analysis of available crash data can be used in order to better understand the safety issues along a section of road.

Where crash data is poor or does not exist, the 'Fatality Estimations – Before' download file can be used to estimate the number of fatalities that occur on the surveyed network by crash type.

For example, the annual number of vehicle occupant run-off road fatalities estimated to occur on a particular corridor can be calculated by using the Filter to select the required road or road section and then summing the total in columns 8/H (run-off road driver side) and 9/I (passenger side) and dividing by 10 (to convert from per km per year to per 100m per year).

Identifying highest risk locations and corridors

The 'Core Data – Before' download file can be used to identify the highest risk locations within the surveyed network.

The sort function in Excel can be used to sort 100m segments in order of risk. For example, by sorting the data by Vehicle SRS Total (column 86/CH) and ordering the data from largest to smallest, the data will be listed in order of vehicle occupant risk with the highest risk segments shown first. The locations can be identified using the Road Name column (5/E), Section Name column (6/F), Distance or chainage column (7/G) and Longitude and Latitude columns (9-10/I-J). Copy the latitude and longitude values of each location into Google Earth or similar to show the location.

In order to identify the highest risk corridors, sort the data by smoothed results, for example, Vehicle SRS Total Smoothed (column 87/CI).

Understanding road user risk

While the Investment Plan provides a list of measures that will reduce the risk of a road and improve the Star Rating, it is important to consider what makes a road section high risk.

The 'Core Data – Before' download file and the iRAP Star Rating Demonstrator can be used together to gain an understanding of the contribution of different road attributes to road user risk.

Identify the highest risk sections by filtering the roads which score 1-Star in column 88/CJ in the 'Core Data – Before' download file (i.e. the raw Star Rating for each 100m segment).

For each 1-Star road segment, feed the recorded road attributes (input data) in columns 13-78/M-BZ into the iRAP Demonstrator using the drop-down lists. The input data in the download file is shown in numerical codes. This can be converted using this tool or refer to the quick code guide in the *iRAP Coding Manual* Coding Quick Guide and in Section 5.7 for supporting data.

Once all the road attributes in the iRAP Demonstrator have been selected to match the row of data from the download file the corresponding Star Rating Score and Star Rating will be shown.

In the following example, road attributes from a 1-Star section of road for pedestrians is shown in the Demonstrator. The crash type risk that contributes to the Star Rating Score for each road user is shown by selecting 'Chart'.

**Example Star Ratings using the Demonstrator**
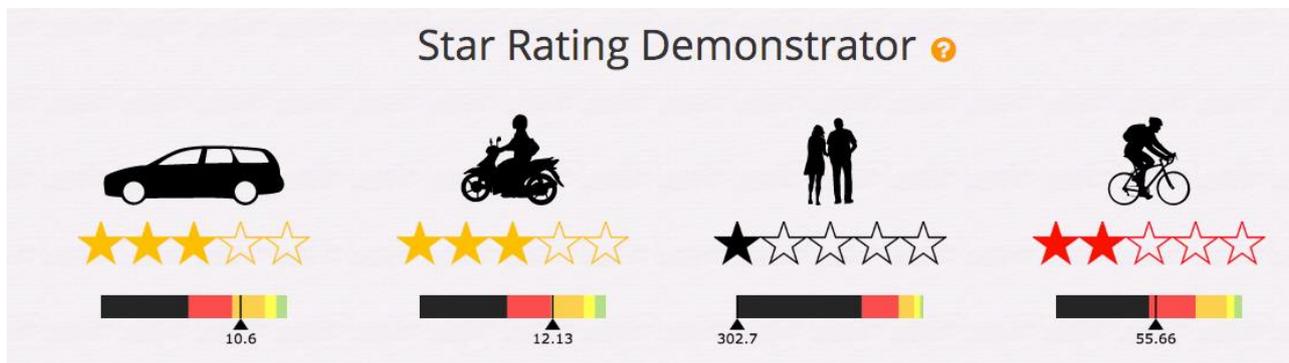
Crash type risk chart using the Demonstrator

The Demonstrator's crash type risk chart shows both Star Ratings and crash type risk. This allows relevant attributes to be quickly scrutinised and tested to see the impact on Star Ratings and crash types instantly. The chart below, for example, shows that for pedestrians, the highest crash type risk is from 'crossing through' (crossing the assessed carriageway).

Not every crash type risk may be shown. In this example, if a crossing is installed to treat the across risk, the along risk appears because of a lack of sidewalks. It is not until both are treated that the improvement can be seen in the Star Rating improve and the crash risk reduce.

The Demonstrator can then be used to test different treatment options, for example in this case, the difference between a signalised and an unsignalised pedestrian crossing.

Example crash type risk chart using the Demonstrator
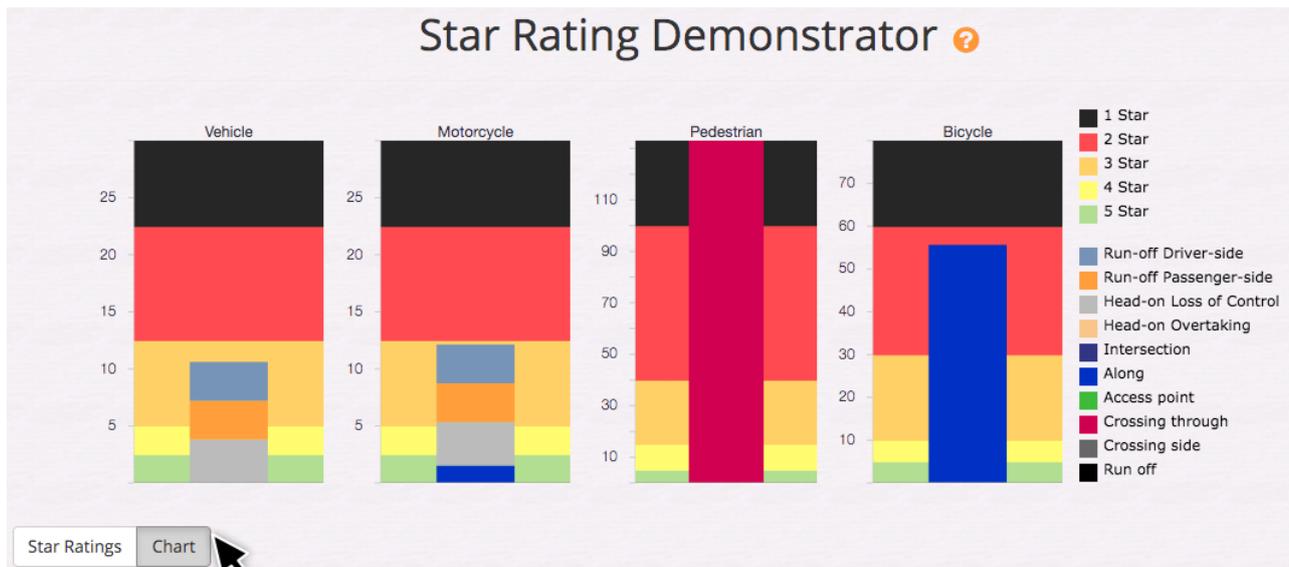
9.3　Tailoring Safer Roads Investment Plans

A standard Investment Plan, or route treatment, includes all viable safety measures along a route (or network) optimised for the highest number of fatalities and serious injuries prevented.

Investment Plans can be customised to meet other requirements of the client or the context of the road assessment. There are many ways to customise Investment Plans. The most common approaches to customising Investment Plans include:

- To meet a defined budget or threshold for economic return. For example, where there is either a specified budget with which to undertake road safety upgrades, a minimum return on investment (in terms of benefit cost ratio or internal rate of return), or both.

- For a mass-action program. This is where an Investment Plan addresses common crash characteristics over a larger area or along a corridor, such as delineation problems or vehicles running off the road.

- Ease of implementation. This is to assist road authorities to stage road upgrades in a way that accounts for construction lead times or budget appropriation. This way, upgrades that can be done immediately are prioritised (such as delineation) and more significant upgrades can be introduced to the planning pipeline for capital works.

- To support a maintenance program. This limits an Investment Plan to those things that can generally be undertaken as part of road maintenance and do not require capital works approval, planning or budget.

- To meet a Star Rating Target. A standard Star Rating target is 3-Star or better (see How do Star Ratings improve road safety?). A Star Rating target may be an official policy target or may be specified by the client for the specific road project. Star Rating targets should be recorded as part of the Supporting Data. See Star Rating policy targets for more information.

The following section provides instruction on how to create these common types of customised Investment Plans.

Reprocessing datasets for customised Investment Plans will not affect the Star Ratings (before) but it will affect the Star Ratings (after). Refer to the *ViDA User Guide* for more information about these reports.

Multiple customised Investment Plans can be created to provide options or comparison. Each dataset in ViDA can only have one Investment Plan. To create new Investment Plan versions, the dataset can be simply copied. See Moving, copying and deleting datasets for more information.

## Tailoring an Investment Plan to meet a defined budget or economic return

To create an Investment Plan to meet a defined budget or economic return, create a copy of the dataset and name it accordingly.

In Stage 6 Investment Plan, adjust the benefit cost ratio (BCR) qualification value.

Select the Countermeasure Qualification criteria. This is used to select type of threshold used for the Investment Plan. - BCR, Benefit Cost Ratio - IRR, Internal Rate of Return - Cost per FSI saved

Qualification criteria   bcr

❓

Qualification value   >=   5
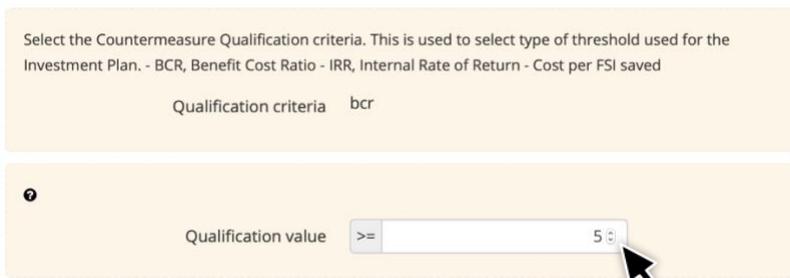
A lower BCR will produce a more expensive Investment Plan with more benefits (as more countermeasures are included in the plan), whereas a higher BCR leads to a less expensive Investment Plan with fewer benefits (as fewer countermeasures are included in the plan). Note that a BCR<0 cannot be used. To produce an Investment Plan irrespective of cost, select a BCR between 0 and1.

This relationship is illustrated in the following chart.

Example of the relationship between BCR and Investment Plan cost and benefits
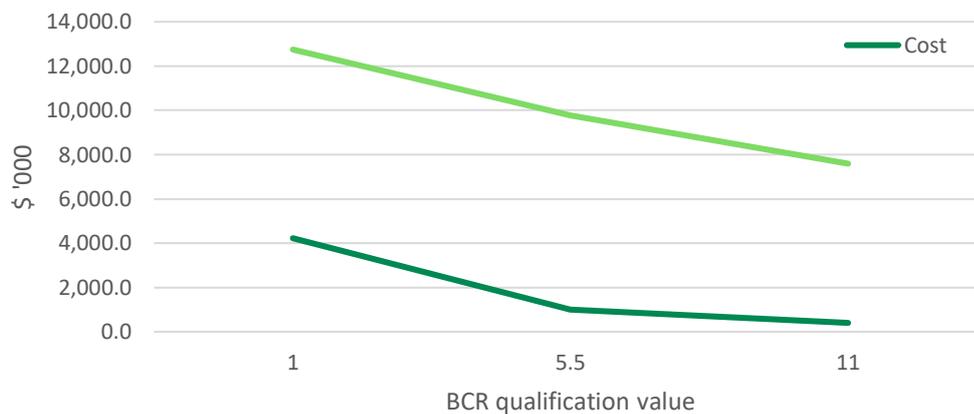
After the qualification value has been adjusted, reprocess the data in Stage 7 Processing. Trial and error may be required to adjust the cost of an Investment Plan to match a specified budget.

Tailoring an Investment Plan for create a mass-action program

To create an Investment Plan to support a mass-action program, all countermeasures will be ignored except those included in the mass-action program. For example, to improve delineation across a network of roads or corridor, all countermeasures except "Improve Delineation", "Improve Curve Delineation" and "Delineation and signing (intersection)" will be set to Ignore.

To do this, create a copy of the dataset (with auto-calibration switched off) and name it accordingly.

In Stage 6 Investment Plan, scroll down to the Countermeasure Cost table. Click the 'Ignore All' icon so that all countermeasures are ignored from subsequent processing. Once all countermeasures are ignored, select the countermeasures to be included in the plan by clicking on the 'Edit' icon in the applicable countermeasure row. This will open the Edit Countermeasure Cost pop-up box. Deselect the 'Ignore' box and click 'Save changes'.

Countermeasure Costs table

Countermeasure costs

Review Countermeasure Triggers

Countermeasure cost upload file requirements

Countermeasure	Service Life	Rural / open area			Urban / rural town or village			Ignore	Edit
		Low	Medium	High	Low	Medium	High	All: ⊘ ⊘	
Improve Delineation	5	65235	65235.01	65235.01	65235.01	65235.01	65235.01	⊘	☑
Bicycle Lane (on-road)	20	94321.5	94321.49	94321.49	94321.49	94321.49	94321.49	⊘	☑
Bicycle Lane (off-road)	20	721009.9	801122.08	881234.28	721009.86	801122.08	881234.28	⊘	☑
Motorcycle Lane (Painted logos only on-road)	5	59571.5	59571.47	59571.47	59571.47	59571.47	59571.47	⊘	☑
Motorcycle Lane (Construct on-road)	20	670179	744643.33	819107.67	670179	744643.33	819107.67	⊘	☑
Motorcycle Lane (Segregated)	20	1608429.6	1787144	1965858.4	1608429.6	1787144	1965858.4	⊘	☑

Edit countermeasure cost screen

Countermeasure	Service Life	Rural / open area			Urban / rural town or village			Ignore
		Low	Medium	High	Low	Medium	High	
Improve Delineation	5	4500	5000	5500	5850	6500	7150	

✔ Save changes   ✖ Close

After the countermeasures have been adjusted, reprocess the data in Stage 7 Processing.

Tailoring an Investment Plan for construction pipelines

To create an Investment Plan to assist road authorities to stage road upgrades in a way that accounts for construction lead times or budget appropriation, countermeasures need to be first categorised according to their lead time or capital cost.

This categorisation will depend on the circumstance of the road authority. The table below is an example how countermeasure could be categorised.

Example of how countermeasures can be categorised for construction pipelines

Category	Description	Lead time	Example countermeasures
A	Countermeasures for immediate implementation by the region/district as part of routine maintenance.	Immediate	Delineation Road surface improvement Pedestrian crossing quality Sight distance
B	Countermeasures that require construction works, do not add capacity and which can be defined by simple diagrams and cross sections and can be funded by annual capital works budget.	1 year	Paved shoulders Sidewalks Pedestrian crossings Bicycle lanes
C	Countermeasures that require construction works, do not add capacity and which require detailed design and/or topographical survey and can be funded by annual capital works budget.	2-5 years	Intersection improvements Horizontal alignment
D	Countermeasures that require construction works, add capacity, require detailed design and topographical survey, coordination with planning and significant financial support.	5-10 years	Duplication Grade separation of intersections

In addition to the standard Investment Plan for all countermeasures combined, a separate set of Investment Plans are created for each category. These sub-Investment Plans will contain only the countermeasures that are included for each specified category.

To do this, make one copy of the dataset for each category (with auto-calibration switched off) and name them accordingly.

In Stage 6 Investment Plan for each dataset, set all countermeasures—except the ones that apply to that category—to Ignore. For instructions on how to do this, see Tailoring an Investment Plan for create a mass-action program.

After the countermeasures have been adjusted, reprocess the data in Stage 7 Processing.

The results of these sub-Investment Plans may then be brought together in the written report. Note that as the datasets will have been processed separately, the estimated reductions in fatalities and serious injuries cannot necessarily be added together. This is related to the multiple countermeasure adjustment, which is explained further in iRAP methodology factsheet 12, *Multiple Countermeasures*.

The original Investment Plan may be used for a more accurate sum of the benefits once all countermeasures are implemented. If countermeasures in the original version were subsequently excluded, then the

countermeasures in the original Investment Plan will need to be adjusted to match the those included in all of the sub-Investment Plans.

Tailoring an Investment Plan to support a maintenance program

There are seven countermeasures in the iRAP model that generally fit in with road maintenance. They are:

1. Improve delineation
2. Improve curve delineation
3. Delineation and signing (intersection)
4. Upgrade pedestrian facility quality
5. Road surface rehabilitation
6. Sight distance (obstruction removal)
7. Skid resistance

To create an Investment Plan that focusses on maintenance-related countermeasures only, create a copy of the dataset and name it accordingly.

In Stage 6 Investment Plan, set all countermeasures—except the ones that apply to road maintenance—to "Ignore". For instructions on how to do this, see Tailoring an Investment Plan for create a mass-action program.

After the countermeasures have been adjusted, reprocess the data in Stage 7 Processing.

Tailoring an Investment Plan to meet a Star Rating target

The recommended approach to creating an Investment Plan to meet a Star Rating target is to combine countermeasures with reduction in speed limits and operating speeds. The latter often requires complementary actions such as targeted enforcement and road safety awareness initiatives.

It is also recommended that the basis of this type of Investment Plan should be one which meets a budget or delivers a specified rate of return (IRR) or BCR. See Tailoring an Investment Plan to meet a defined budget or economic return for more information.

Star Rating targets may be specific to one or more road user types.

The 'Core Data – After' download file can be used to identify sections of the road remain below the Star Rating target for the road user group (i.e. even if the countermeasures identified in the Investment Plan were implemented).

In Excel, use the filter to identify the 100m segment where the smoothed Star Rating is below the Star Rating Target. For example, if the target only relates to vehicle occupants, go to the Vehicle Star Rating Smoothed column (column 89/CK). If the target is 3-Star or better, open the filter and deselect 3, 4 and 5-Star values.

Make a note of the 100m segments of road that do not achieve the target. This can be done by making a note in an empty column (such as column 115/DK).

If the target also applies to other road users, repeat the process of filtering the Smoothed Star Rating columns (column 100/CV for Motorcyclist Star Rating Smoothed; column 107/DC for Pedestrian Star Rating Smoothed; and column 114/DJ for Bicyclist Star Rating Smoothed).

After all the 100m segments which do not achieve the desired Star Rating have been identified and noted, use the filter on the note column (e.g. 115/DK) to select only these 100m segments.

Adjust the coding for speed limits and operating speeds. For example, reduce speed limits and operating speeds by 10km/h. Note that it may be reasonable to assume that, even with enforcement, operating speeds do not reduce by as much as the speed limit reduction.

Save the file as a .csv. This file becomes an upload file for a new scenario dataset.

Create the new scenario dataset by making a copy of the existing dataset (with auto-calibration switched off) and process the new upload file.

After processing, review the smoothed Star Ratings (before). These Star Ratings will reflect the countermeasures in the Investment Plan and the new speed limits and operating speeds. If the roads do not achieve the target, the budget for the Investment Plan and/or the scale of speed limit reductions may be reviewed. Trial and error of the preceding steps is often needed to generate a practical solution.

9.4   Written reports

Star Rating and Investment Plan analysis and reporting is a standard project requirement. What information is reported and how it is presented is largely determined on the assessment being performed and the intended audience.

Any one iRAP assessment may have multiple reports tailored for specific audiences and issues. The most common approach is to produce:

- A summary report that provides an overview of the project, methodology, results, analysis and recommendations, and
- A technical report which is a complete record of all the project's activities, approaches and outcomes.

Elements of a typical iRAP assessment report include:

- Introduction and contextual information, such as:

  i.   An introduction that explains the context of the assessment including key details such as the objectives, roads assessment and stakeholders involved.

  ii.   A general description of the iRAP methodology.

  iii. A description of surveys, coding and data collection activities that were performed.

  iv.   A description of supporting activities performed during the assessment, such as publicity events, training or important briefings.

  v.   A description of supporting data used in the assessment, including fatality and serious injury data, economics data, speed data and countermeasure cost data. This should include an explanation of any methodologies and assumptions used to generate estimates.

- Star Rating reports and analysis. These reports are available in ViDA. For more information on how to access Star Rating reports, see the *ViDA User Guide*. Examples include:

  i.   A detailed condition report, which summarises the road attributes that have been coded.

  ii.   Star Ratings of the roads, including summary tables, maps and images illustrating star ratings and road attributes for different locations. It is recommended that unless the roads assessed are very short, smoothed star ratings are used.

  iii. Risk worms may be used to illustrate specific issues on specific sections of road.

- Investment Plan reports and analysis. These reports are available in ViDA. For more information on how to access Investment Plan reports, see the *ViDA User Guide*. Examples include:

i. Tables summarising investment plan results and examples of specific locations where countermeasures have been suggested. Depending on the requirements of the assessment, multiple investment plans may need to be produced.

ii. A description of what the Star Ratings would be for the roads if the investment plans were implemented and the estimated changes in numbers of fatalities and serious injuries.

iii. A comparison of results of scenario testing (see Scenario testing for more information) or customised Investment Plans (see Tailoring Safer Roads Investment Plans for more information).

iv. Identification, analysis and discussion of specific issues. These are usually issues identified as key priorities by the client but can also be issues identified during the assessment. Examples include safety issues relating to specific road user groups (such as pedestrians), key locations of risk (such as intersections) or general issues affecting a corridor, such as heavy vehicles.

- Recommendations and conclusions including:

  i. Clear recommendations on how the results should be applied to support investment in safer roads. This often includes a recommendation that countermeasures identified in the Investment Plan be subject to detailed review.

  ii. Specific recommendations for identified issues.

  iii. A discussion on any issues that may have had an impact on the assessment results, and which may need to be considered when interpreting the results and implementing recommendations. This might include, for example:

    - The chance that countermeasures in the SRIP that result in an increase in traffic capacity (such as additional lanes) or improvements to pavement (such as improved road condition) might result in an increase in speeds.

    - Assumptions made about operating speeds.

  iv. Details on how survey, coding and assessment data can be accessed, including a list of datasets in ViDA.

While preparing a report, there are several reference materials that can be helpful to cite. These include:

- iRAP's methodology factsheets at www.irap.org/methodology

- iRAP's *Road Safety Toolkit* at toolkit.irap.org

- World Road Association's (PIARC) *Road Safety Manual* at roadsafety.piarc.org

- NACTO Global Designing Cities Initiative's *Global City Design Guide*

- OECD International Transport Forum's Safe System report: *Zero Road Deaths and Serious Injuries*

- OECD International Transport Forum's *Speed and Crash Risk* report

- The World Health Organisation's (WHO) *Global Status Report on Road Safety*.

For specific examples on presenting the results of an iRAP assessment, see the examples of Star Rating and Investment Plan reports available online at www.irap.org/research-and-technical-papers.

## 9.5   Preparing a strip plan in Microsoft Excel

A strip plan can be a useful way of listing the locations of countermeasures included in an Investment Plan. A strip plan is one of the standard reports in ViDA (refer to the *ViDA User Guide* for more information).

It is also possible to create a strip plan in Microsoft Excel. The process is as follows:

1. Click the Results button on the dashboard in ViDA.

2. In Filter 1, select the program, region, project and dataset for the existing road and click the 'Apply' button.

3. Click the Downloads menu.

4. Click the Countermeasures (zip) link and then click the 'Request' button in the dialogue box. You may also change write your own name for the file in the dialogue box.

5. A notification will appear in the activity feed once processing is complete, after which the file will be available for download. Save the file as an Excel Workbook (.xlsx). This is so that you can use multiple sheets and save formulas.

6. After opening the Excel file, select cell A1 in the sheet that contains data and click 'Insert > PivotTable'.

7. In the Create PivotTable dialogue box, ensure that all the countermeasure data is contained in the Table/Range box then click 'OK'.

Screenshot showing the set up of a PivotTable in Excel to create a strip plan
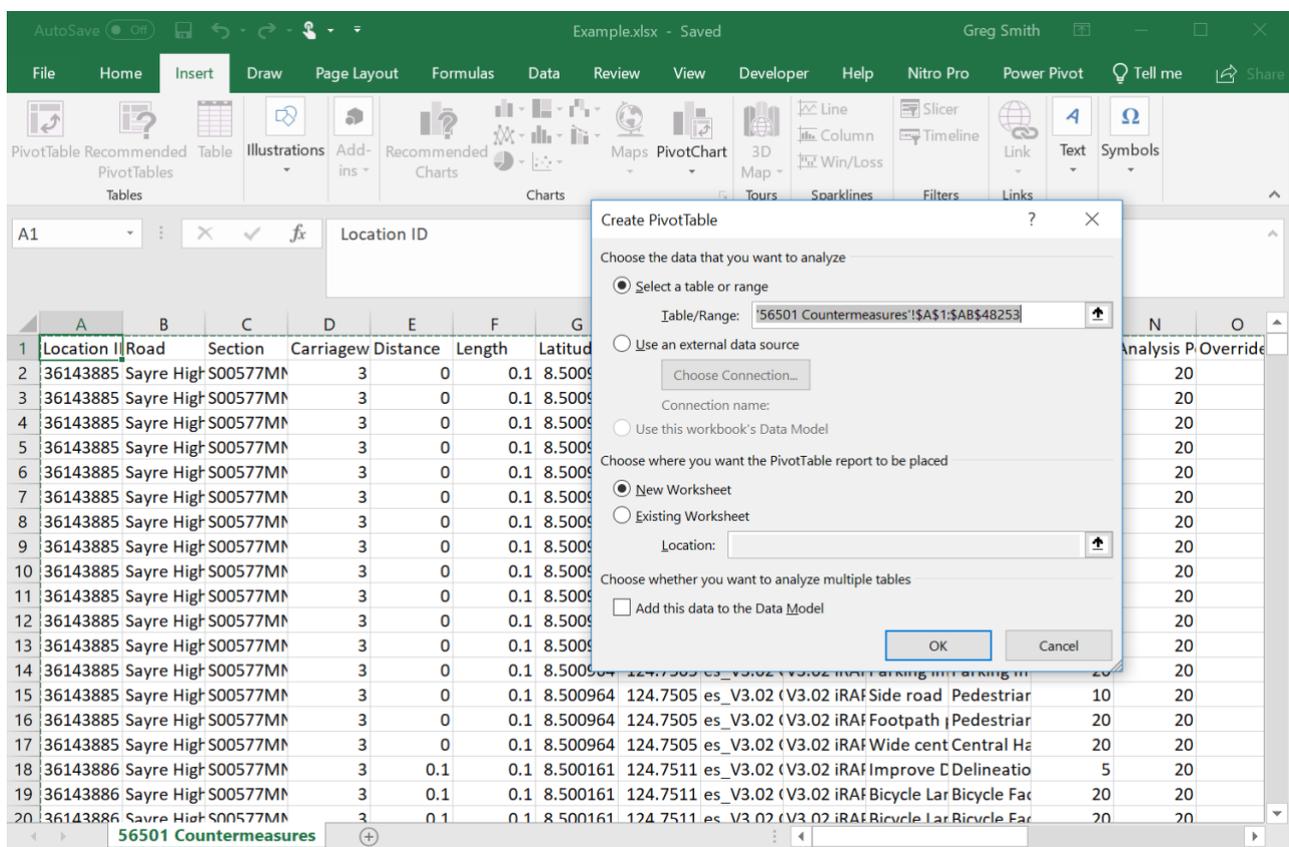
8. In the PivotTable Field menu:

   a. Put the 'Override' field into the Filters box.

   b. Put the 'Road' field into the Rows box.

   c. Put the 'Section' field into the Rows box (below the Road field).

   d. Put the 'Distance' field into the Rows box (below the Section field).

   e. Put the 'Latitude' field in the Rows box (below the Distance field).

   f. Put the 'Longitude' field in the Rows box (below the Latitude field).

   g. Put the 'Countermeasure' field into the Columns box.

   h. Put the 'Length' field into the Values box.

9. In the Values box of the PivotTable Field list, click on 'Sum of Length' to show the options. Click on 'Value Field Settings…' In the 'Summarize Values by' tab, select 'Count' and click 'OK'.

10. Click 'Design > Report Layout > Show in Tabular Form'. Then click 'Design > Report Layout > Repeat All Item Labels'.

11. Click 'Design > Subtotals > Do Not Show Subtotals'.

12. In Cell B1, click on the Override drop down box, select '0' and click 'OK'.

Your pivot table now shows a number 1 at each distance (or chainage) location where it a countermeasure has been suggested for installation.

Only the countermeasures included in the Investment Plan will be provided in the table, so if comparing two strip plans the columns may be different.

You can also use various formatting options to suit your purposes. For example, you can use the Text Direction or Wrap Text functions to make the columns narrower, which helps with printing. You can also use the Condition Formatting function to colour cells/draw icons in cells that contain data.

Screenshot showing the use of a PivotTable in Excel to create a strip plan

10 IMPLEMENTATION SUPPORT

Implementation support on a project is where additional guidance is provided through subsequent road design, planning and construction activities.

This section provides guidance on how to use Star Rating and Investment Plan to inform different stages of the road planning and construction process, including concept plans, site investigations, detailed designs, road safety audit and construction.

It is important to note that the Investment Plan is a guide for which countermeasures to investigate further for the road design or upgrade. Inclusion in the Investment Plan means there is strong evidence they could prevent deaths and serious injuries in a cost-effective way.

The extent of implementation support provided as part of the project should be determined at the outset and reflect the context of the project, client needs and the stage of road planning or capital works.

10.1 Site visits

The site visit is an integral part of any crash investigation or road improvement scheme as it may help to identify additional issues that are not apparent from the Star Rating and Investment Plan results or crash data alone.

iRAP assessment results, such as the strip plan, can be used to assist with site inspections.

If undertaking any site visits or field work during the investigation, concept planning and design stages, it is strongly recommended that a risk assessment that includes the identification of potential hazards and mitigating actions is completed. See Health and safety for more information.

10.2 Concept planning and preliminary design

A preliminary design or concept plan helps to demonstrate the practicalities, suggested locations and estimated costs of a proposed road upgrade for consideration and review.

The complexity of the concept (or feasibility) planning stage can vary depending on the type and location of the scheme and the proposed road infrastructure upgrades. For relatively simple delineation improvements such as line marking or traffic signs a simple plan and reference to the relevant design standards may be sufficient to guide implementation. For more complex treatments such as intersection upgrades or road widening schemes more detailed planning and design is likely to be required.

The function of concept planning is to:

- Identify the problem or problems
- Collect additional information through site visits, surveys and desktop studies
- Test the feasibility of proposed countermeasures through a preliminary design
- Communicate what is proposed to stakeholders including elected officials, senior staff and members of the local community and review feedback
- Provide a basis for generating initial cost estimates.

iRAP outputs such as the Star Rating Scores for each crash type, fatality estimations and strip plans are all useful resources to help build up a picture of the potential hazards and remedial treatments at each location.

Other useful sources of information to be used during the preliminary design stage include:

- Traffic survey data (volumes and speeds) including data on motorcycles and commercial vehicles
- Pedestrian and bicyclist counts

- Detailed crash data (location specific)

- Location of public utility equipment and services apparatus within the highway

- Site visit observations (may include conflict study) and photographs

- Stage 1 Road Safety Audit.

Below is an example of a concept plan completed by a road authority in Australia which uses the details from the Investment Plan for proposed road safety upgrades.

Example concept plan containing details from an Investment Plan
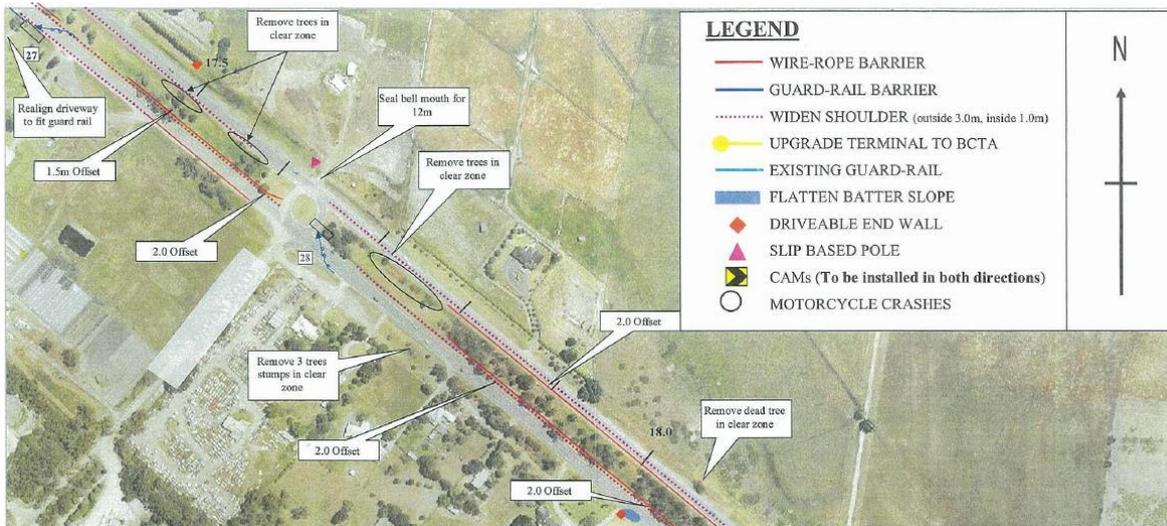
Source: VicRoads

10.3   Detailed designs

Following the review and design options agreed during the preliminary design stage, the detailed design will incorporate all the information required to enable the countermeasures or road safety upgrades to be implemented accurately and safely. This will include details such as traffic sign and road markings schedules, street lighting, landscaping, detailed junction layout and design, standard drawings and cross sections.

Countermeasures and the Road Safety Toolkit

The countermeasures identified in the Investment Plans provide a starting point for an initial investigation. Engineering judgement should be used when selecting and designing appropriate remedial measures. It is also important that the countermeasures selected for implementation are designed and built according to the relevant design standards and best practice.

Countermeasures identified in the iRAP plans are described in more detail in the Road Safety Toolkit (http://toolkit.irap.org). The Toolkit is an online resource which provides free information on the causes and prevention of road crashes that cause death and injury. Building on decades of road safety research, the Toolkit helps engineers, planners and policy makers develop safety plans for vehicle occupants, motorcyclists, pedestrians, bicyclists, heavy vehicles and public transport users.

The iRAP Road Safety Toolkit

10.4 Road Safety Audit

The iRAP results should be used in conjunction with other road safety techniques. Road Safety Audit is a systematic method of checking the safety aspects of new road improvement schemes. The term is generally considered to refer to a formal independent and multi-disciplinary detailed assessment of the safety performance of all new highway and traffic management schemes, including modifications to existing layouts, and are undertaken at different stages during the design, planning and construction process.

The number of countries worldwide adopting Road Safety Audits as a formal procedure is increasing, making a significant contribution to improving highway safety. iRAP recommends that all road improvement schemes that lead to a significant change in the highway features are, as a minimum, subject to Road Safety Audit during design and before being opened to the public.

Road Safety Audits and RAP projects are not mutually exclusive, they can and should be used together to identify road user risk and to improve the safety of road designs. iRAP results are often used to deliver broad network level outcomes that provide road authorities and others with risk assessment data and programme costs for high level planning, budgeting and the setting of road safety policy targets.

Road Safety Audits can provide a very detailed level of scrutiny, identifying particular issues and design failings at specific locations that may conform to relevant design standards but nonetheless increase road user risk. Recommendations are based on the knowledge and experience of the audit team. Both methods can and are being used in conjunction to successfully improve safe road design.

10.5   Safety at road works

Road works can be hazardous for both road users and road workers as temporary changes in road layout can lead to driver error, especially if the road users do not understand what is expected of them.

Road authorities, design consultants, road worker operatives and supervisors all have an important responsibility to ensure that roadwork sites are safe and that operatives and road users—including vulnerable road users such as motorcyclists, pedestrians and bicyclists—are not put at undue risk.

Road users must be warned well in advance of any roadwork sites, informed about the size and nature of any obstruction and directed around the site in a clear and concise manner. Attention should be given to the signing, guarding and lighting of road works to ensure that a safe system of working is in place at all times.

Many jurisdictions have local codes of practice, design guides and manuals for the design, signing requirements and layout of temporary road works that must be followed in order to minimise risk. For example, see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/203669/traffic-signs-manual-chapter-08-part-01.pdf.

APPENDIX 1: QUALITY ASSURANCE CHECKLIST

This Quality Assurance Checklist may be used as guide for quality assurance checks during the Star Rating and Investment Plan process.

For more information, see Managing quality.

This checklist is intended as a guide only. It may not cover all elements of a project and some elements may not apply.

Item	Response	Comment
Upload File		
Road name and section		
Are the road names and sections logical, easy to understand and align with the road authority naming conventions?	Yes / No	
Landmark and comments		
Have the landmark and comments fields been reviewed and do they contain necessary information?	Yes / No	
Vehicle flow (AADT) and Motorcycle %		
How was the data compiled?	Official data / Estimated / Combination	
Is the source of the data adequately described?	Yes / No	
If estimates were made are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Pedestrian peak hour flows		
How was the data compiled	Official data / Estimated / Combination	
Is the source of the data adequately described?	Yes / No	
If estimates were made are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Bicycle peak hour flow		
How was the data compiled?	Official data / Estimated / Combination	
Is the source of the data adequately described?	Yes / No	
If estimates were made are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	

Item	Response	Comment
Operating speeds		
How was the data compiled?	Official data / Estimated / Combination	
Is the source of the data adequately described?	Yes / No	
If estimates were made are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Roads That Cars Can Read and Star Rating Policy Targets		
Have these fields been completed adequately	Yes / No	
Annual Fatality Growth Multiplier		
Is the Annual Fatality Growth Multiplier set to 1 for all segments?	Yes / No	
If the Annual Fatality Growth Multiplier is not set to 1 for all segments is the reasoning explained and appropriate?	Yes / No	
Upload File validation		
Did the Upload File(s) generate errors or possible errors in the iRAP Coding Validation Tool?	Yes / No	
If the Upload File(s) generated errors or possible errors in the iRAP Coding Validation Tool, were these corrected and/or adequately explained?	Yes / No	
Region, Project and Dataset(s) in ViDA		
Region setup		
Has the Region been set up correctly?	Yes / No	
The region name is logical and easily understood?	Yes / No	
Project setup		
Has the Project been set up correctly?	Yes / No	
The project name is logical and easily understood?	Yes / No	
Is the country correct?	Yes / No	
Was the iRAP International Star Rating Model v3.02 used? If not, was the reason adequately explained?	Yes / No	
Dataset set up		
Stage 1: Dataset Definition		
The name of the Dataset(s) is logical and easily understood	Yes / No	

Item	Response	Comment
Is the side driven on correct?	Yes / No	
The Dataset(s) status is appropriate	Yes / No	
Stage 2: Road Survey		
Is the Quality Assurer correctly entered?	Yes / No	
Is the Road Survey Supplier correctly entered?	Yes / No	
Is the Inspection System correctly entered?	Yes / No	
Is the Survey Interval set to 0.1km? If not, is the reason adequately explained?	Yes / No	
Has QA Approval been assigned?	Yes / No	
Stage 3: Road Coding		
Were the Delimiter settings changed? If so, is the reason adequately explained?	Yes / No	
Is the Quality Assurer correctly entered?	Yes / No	
Is the Road Coding Supplier correctly entered?	Yes / No	
Has QA Approval been assigned?	Yes / No	
Stage 4: Star Ratings		
Is the Quality Assurer correctly entered?	Yes / No	
Is the Smoothing type set to Length? If not, is the reason adequately explained?	Yes / No	
Has QA Approval been assigned?	Yes / No	
Stage 5: Fatality Estimations		
How was the data compiled?	Official data / Estimated / Combination	
Is the source of the data adequately described?	Yes / No	
If estimates were made are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Is the Quality Assurer correctly entered?	Yes / No	
Has QA Approval been assigned?	Yes / No	
Investment Plan		
How were the economic variables compiled?	Official data / Estimated / Combination	

Item	Response	Comment
If estimates were made for the economic variables are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Is the source of the economic variables adequately described?	Yes / No	
How were the countermeasure costs and services lives compiled?	Official data / Estimated / Combination	
If estimates were made for the countermeasure costs and services lives compiled are the methodology and assumptions clearly explained and are the results reasonable?	Yes / No	
Is the source of the countermeasure costs and services lives compiled adequately described?	Yes / No	
Is the Quality Assurer correctly entered?	Yes / No	
Has QA Approval been assigned?	Yes / No	
Permissions		
Have permissions for access to the Region, Project and Dataset(s) been set up?	Yes / No	
Have User Managers been assigned to the Region, Project and Dataset(s)?		
Written report		
The report is clear and concise	Yes / No / N/A	
The report includes Star Rating tables and the explanation about their meaning is accurate and clear	Yes / No / N/A	
The report includes maps and the explanation about their meaning is accurate and clear	Yes / No / N/A	
The report includes example of road images showing star ratings, key road attributes and their explanation is accurate and clear	Yes / No / N/A	
The report includes Safer Roads Investment Plan and its explanation is accurate and clear	Yes / No / N/A	
Is the estimated number of fatalities and serious injuries prevented in the SRIP reasonable?	Yes / No / N/A	
Does the economic benefit exceed the estimated cost (that is, there is a BCR greater than 1) for all countermeasures in the SRIP?	Yes / No / N/A	
Do countermeasures at specific locations make sense (e.g. countermeasures have been reviewed against road images at sample of locations)	Yes / No / N/A	

Item	Response	Comment
The report explains why some countermeasures were not included in the investment plan	Yes / No / N/A	
The report includes the Star Ratings after SRIP is implemented and the explanation is accurate and clear	Yes / No / N/A	
The report accurately and clearly explains the impact that scenario has on the Star Ratings	Yes / No / N/A	
The report accurately and clearly explains the impact that scenario has on the number of fatalities and serious injuries	Yes / No / N/A	
The report includes actionable recommendations	Yes / No / N/A	
The report reflects the project requirements (for example, includes the correct roads and specific requests such as SRIP scenarios and strip plans)	Yes / No / N/A	
Deliverables		
Have all requested deliverables been completed?	Yes / No / N/A	

Document version

Version	Update
August 2019 – BETA edition release	The *iRAP Star Rating and Investment Plan Manual – Version 1.0* covers all topics relating to producing Star Ratings and Safer Roads Investment Plans in one document, including the collection of supporting data, uploading data into ViDA, quality assurance, analysis and reporting and implementation guidance. It combines information from the following previous documents: *Coding Manual, Supporting Data Template*, *Data Analysis and Reporting Specification*, *Quality Assurance Guide* and *Implementation Support Guide, and the ViDA User Guide – Creator Edition*.