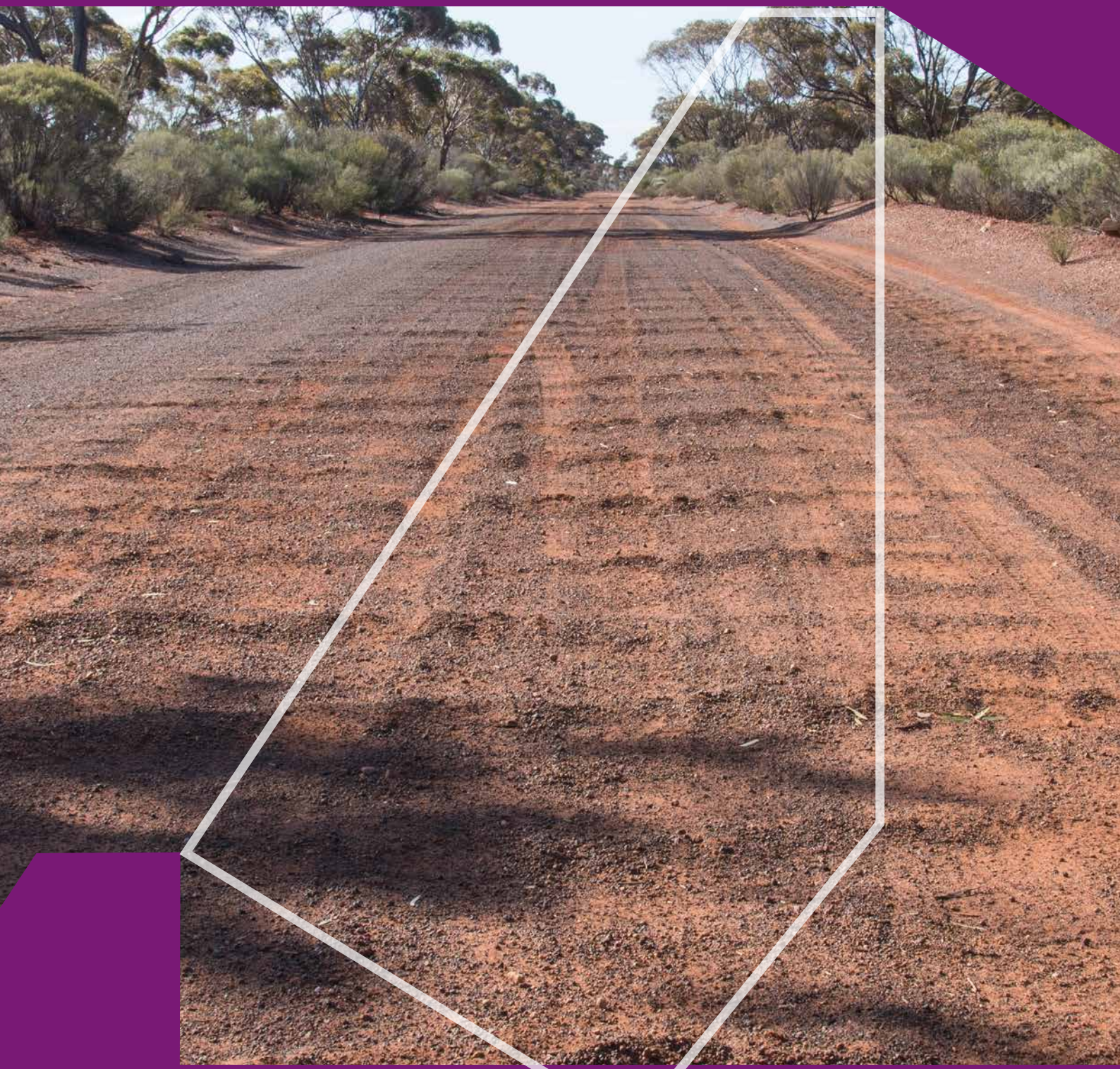

Version 2.0, May 2025

User Guide

Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

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Acknowledgements

Acknowledgement of Traditional Owners

WALGA acknowledges the continuing connection of Aboriginal people to Country, culture and community. We embrace the vast Aboriginal cultural diversity throughout Western Australia, including Boorloo (Perth), on the land of the Whadjuk Nyoongar People, where WALGA is located and we acknowledge and pay respect to Elders past and present.

WALGA is committed to supporting the efforts of WA Local Governments to foster respectful partnerships and strengthen relationships with local Aboriginal communities.

This guideline has been prepared by the Western Australian Local Government Association (WALGA) with the assistance of the National Transport Research Organisation (NTRO).

Disclaimer

Contents

Version	Revision Date	Author	Summary of changes
1	2019	WALGA/ARRB	This version represents the initial Guide
2	2025	WALGA/NTRO	Revised content and Unit rates

Introduction

Western Australian Local Governments face significant costs from road wear as a consequence of unforeseen heavy vehicle traffic triggered by projects, typically in the resources industry. The impacts of additional heavy vehicle traffic on shortening road life and increasing maintenance requirements are greater for roads that were not designed and constructed for this purpose, which is the case for most local government roads. In 2015, WALGA published the *User Guide, Estimating the Incremental Cost Impact on Sealed Roads from Additional Freight Tasks* (WALGA, ARRB 2015). Subsequently many Local Governments requested that WALGA develop a similar tool for unsealed roads leading to the publication of the *User Guide, Estimating the Incremental Cost Impact on Unsealed Local Roads for Additional Freight Tasks* (WALGA, ARRB 2019). Substantial escalation has occurred since 2019, necessitating a review of the unit rates and calculated marginal costs resulting in the publication of this revised Version 2 (2025).

This guide provides Local Governments with a tool to quantify the cost of additional wear and damage to affected unsealed roads for a defined freight task. It can be used as the basis for negotiation of cost recovery from industry, to ensure that the local community does not bear the costs imposed by private businesses, and to adjust long term financial plans. The detailed development of the guide is provided in a separate report, *'Technical Basis for Estimating the Cost of Road Wear on Unsealed Local Government Roads in Western Australia (ARRB 2019)'*, and addendum *'Updates to the Incremental Cost Guides on Sealed and Unsealed Local Roads'* (NTRO 2025), available from the WALGA website.

Users of this guide will require a basic understanding of gravel material properties and unsealed road maintenance treatments. Input parameters required to estimate the cost of road wear include the quantity and the type of heavy vehicles that will be used for the task to be assessed, the length of the affected road segment and the quality of the gravel wearing course. The guide is designed to be applied to unsealed roads only. Estimating the cost of additional heavy vehicle traffic on sealed roads is covered by the separate guideline *'Estimating the Incremental Cost Impact on Sealed Local Roads from Additional Freight Tasks'* (WALGA 2025).

Development background

The guide has been developed using the concept of a marginal cost of road wear. The marginal cost of road wear in this context, is defined as the difference in cost of maintaining a road in a serviceable condition with an increased load of traffic and a base traffic load. The marginal cost is expressed in dollars per axle pass for one kilometre of road. Analysis has shown that the marginal cost for unsealed roads is mostly dependent on:

- the quality of surfacing materials
- climate
- the number of axle passes
- the cost of road maintenance activities.

Using these variables, a catalogue has been developed to represent the spectrum of scenarios that are likely to be encountered on unsealed local government roads across the state.

The marginal cost for each scenario was modelled by using a custom-built spreadsheet developed by the Australian Road Research Board (ARRB). The model generates a life cycle cost analysis of the road based on deterioration curves that predict gravel loss as a function of the time since grading, traffic, precipitation and material properties. The deterioration curves were developed from a long-term monitoring program across Australia and further calibrated to represent the scenarios likely to be encountered in Western Australian. As the defined road deteriorates under specific loading conditions, the model triggers maintenance interventions required to keep the road serviceable. The marginal costs are then calculated by accounting for the difference in costs incurred between the additional load and the normal load cases.

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Deterioration is primarily in terms of gravel loss and therefore an annual asset consumption- based method of costing has been used. Apart from cost escalation, there is no change to the annual task to maintain an unsealed road in the base case.

The scenarios are represented by bar charts which show the marginal cost for a range of granular surfacing material compliance levels in cents per axle pass for one kilometre lengths of road. The user needs to define their relevant scenario in terms of the vehicle type undertaking the task, the number of trips and the quality of the gravel wearing course. The guide will then lead the user to the applicable graph. Detailed information on how to use the guide is provided in the following section.

What are the limitations of the guide?

The marginal costs presented in the guide have been developed by modelling a road network intended to represent the majority of scenarios likely to be encountered in WA. **There are many factors that can influence the cost of road wear and the calculated values are only an estimate**. The local situation and scenario may include factors that render the estimate incorrect.

The guide may be unsuitable when:

- The road is in a very poor or failed condition and requires an initial capital upgrade to support the proposed traffic volumes.
- Sections of the road are subject to unusual conditions, e.g. flooding or very weak subgrades.
- The scenario factors are well beyond the modelled limits.

The limitations of the guide are:

- Associated infrastructure such as bridges, culverts and guardrails are not included.
- The calculations assume that the initial condition is suitable to carry the proposed traffic. Initial capital upgrades would be subject to a separate calculation.
- Where the scenario factors lie between or near the given model values the user will need to interpolate accordingly.
- The guide is only applicable to unsealed local roads.
- The unit rates are current for 2024. Practitioners may need to apply escalation factors in future years and account for any variation to these to ensure consistency with costs in local government. The guide provides an option to enter actual costs if these are available.
- The guide has been developed for the WA local government road network and the catalogue of solutions (and underlying assumptions) may not be valid in other jurisdictions.
- Intersections may be subject to accelerated gravel loss due to turning movements which may warrant a separate assessment.
- Due to the large range of heavy vehicle configurations, users may need to refer to Appendix A to determine the number of axles for the proposed vehicle.

WALGA Road Wear Cost Calculator as an alternative

A calculator has been developed in an Excel spreadsheet that follows the process described in *How to use this guide*. Practitioners are able to download the calculator for free here, and input the variables associated with their loading scenario.

Instructions for accessing and using the calculator are provided in Appendix C.

How to use this guide

The guide is structured around a simple stepped process. Figure 1 presents the nine step procedure to be followed.

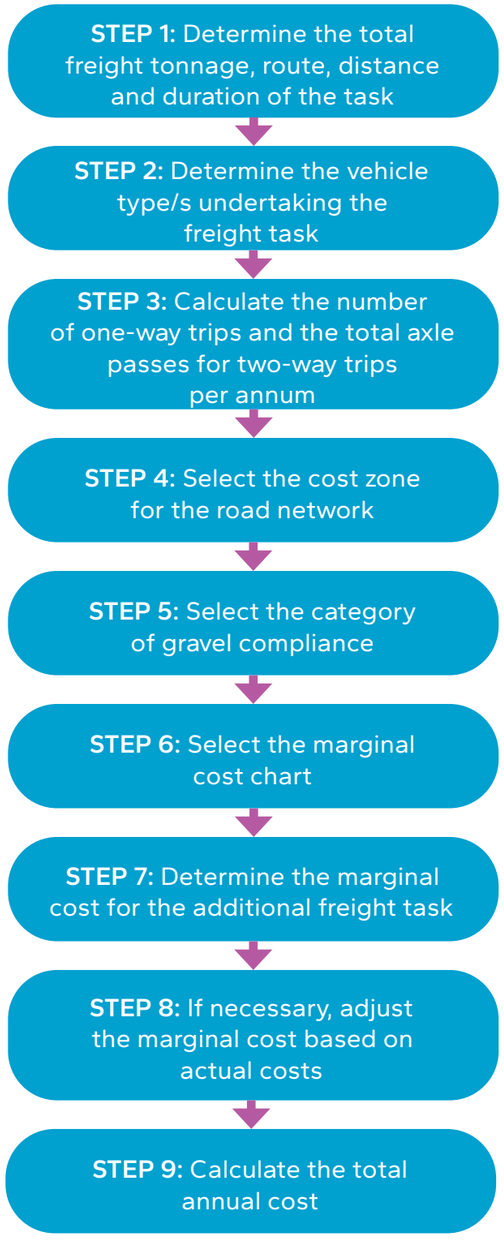

Figure 1: Process for calculating the marginal cost estimate and total annual cost

Details for completing each step are given below. This is followed by a series of typical worked examples.

What information is required?

The user will need the following information:

1. The type of vehicles to be used for the task
2. The annual freight tonnage for the task or the quantity of vehicle passes
3. The duration of the task
4. The task routing and distance
5. The quality of the gravel wearing course.

The following sections detail the sequential steps to determine the cost impact for a defined loading task. Users are able to manually calculate from the guide or use the WALGA Road Wear Cost Calculator tool.

Setup as a downloadable spreadsheet, the WALGA Road Wear Cost Calculator tool follows the steps in the guide and is self-explanatory. The tool is available for download here.

STEP 1: Determine the Tonnage, Distance and Duration

The User will need to gain a good appreciation of the freight task that is being assessed. This will usually involve discussions with the freight generator to determine the duration of the freight task, the total freight tonnage and routing. Typically, these tasks are well structured, with the proponent possibly having a lease on a mine or similar to extract a certain amount of product over a defined period of time.

The modelling has been based on the use of an annual asset consumption-based method of costing. Discounting escalation and duration beyond the first year does not affect the annual marginal cost. Therefore the following steps are all performed based on annual task parameters.

The annual freight tonnage is required to calculate the number of vehicle passes which is the critical input variable.

The distance is defined as the road distance to be traversed on a defined route by the loaded vehicles.

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STEP 2: Determine the Vehicle Type

The next step is to determine the type of vehicle or vehicles that will be used to undertake the task. The vehicle type will typically be supplied by the freight generator. The vehicle type must then be matched to a Main Roads WA restricted access vehicle (RAV) category or corresponding configuration. The RAV types and configurations are provided from Main Roads WA in Appendix A.

STEP 3: Calculate the Number of One-Way Trips and Axle Passes (AP)

The total number of one-way trips may be supplied by the freight generator or it can be calculated by dividing the annual freight tonnage by the vehicle payload to calculate the loaded trips. The vehicle payload will typically be supplied by the freight generator or alternatively it can be estimated using Table 1 that gives typical payload tonnages for a range of vehicles commonly used in WA.

The quantity of axles per vehicle is given in Table 1. For other vehicles, the practitioner must ask the freight generator to supply the number of axles per vehicle. If the RAV category is known, then the number of axles per vehicle can be determined from the diagrams in Appendix A.

Table 1: Estimated payloads and axle quantities for common RAV configurations

Cat.	Configuration	Max. payload RML (t)	Max payload AMMS 3 (t)[1]	Total Axles[2]
1A	Rigid truck, ≤ 12.5 m 	11.6	12.1	3
2A	Prime mover and trailer, ≤ 20.0 m 	25.6	30.1	6
2C	B-Double ≤ 27.5 m 	45.0	47.6	9
3A	A-Double (prime mover, trailer, dog trailer), ≤ 27.5 m 	50.1	59.1	11
4A/6A	A-Double (prime mover, trailer, 6-axle dog trailer), ≤ 27.5 m / 36.5 m 	53.6	65.1	12
7A	AB-Triple (prime mover, trailer, B-Double), ≤ 36.5 m 108.5 t 	67.6	93.0	15
10A	A-Triple (prime mover, trailer, 2 dog trailers), ≤ 53.5 m 	83.6	102.1	18

Source: Values extracted from Main Roads WA 'Vehicle Estimated Equivalent Standard Axles (ESA) Tool' at https://ravrat.au/esa
Note: These figures have been estimated using typical WA vehicle combinations and tare weights. Actual tare weights may vary across vehicle models resulting in slight differences in payload tonnage.
[1]The Accredited Mass Management Scheme (AMMS) allows up to an additional 3.5 tonnes per tri-axle combination and 1.0 tonne per tandem axle combination. The AMMS has three loading levels. If a lower level is applicable then use a proportionate value between regulation mass limit (RML) and AMML L3.
[2]Assumes a single front axle. Adjust total axles for other configurations.

As material loss is similar for both loaded and unloaded trips (ARRB 2019) the AP is calculated for the total two-way trips. An example follows.

The proponent supplies the following information:

Total payload = 300,000 tonnes per annum

Vehicle Type = Prime Mover +semi-trailer + 6 axle dog trailer operating at AMMS L3

From Appendix 1 the vehicle type is a RAV 6A

From Table 1, the payload is 65.1 tonnes and there are 12 axles per vehicle

Therefore, the number of annual loaded one way trips is 300,000 / 65.1 = 4,608

The AP for one-way trips = 4,608 x 12 = 55,296 AP

The total AP for two-way trips = 55,296 x 2 = 110,592 AP

STEP 4: Select the Cost Zone

The appropriate cost zone must be selected from Figure 2.

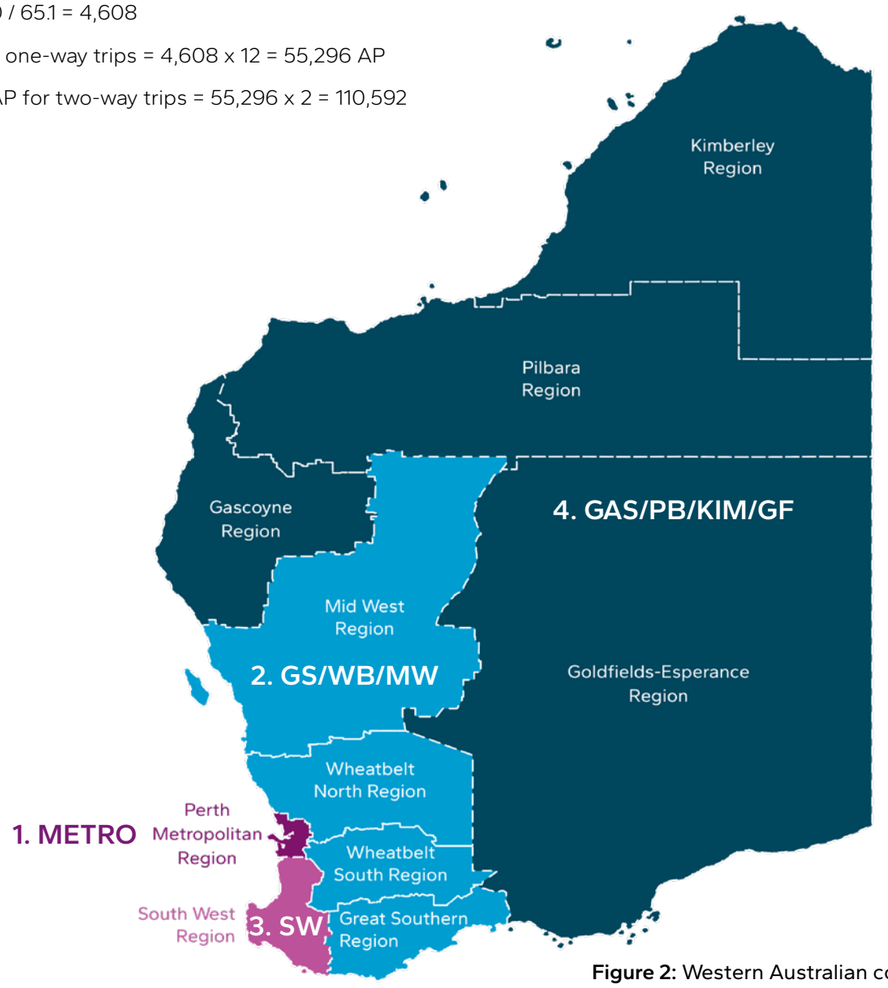

Figure 2: Western Australian cost zones

The cost zones were determined with reference to unit rates collected from a survey conducted by the Department of Local Government in 2011 and 2024.

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STEP 5: Select the Gravel Compliance Level

Gravel compliance refers to the materials characteristics relative to a gravel that has optimum characteristics that minimise gravel loss and deformation under traffic. The **material grading** and **plasticity** are the two most important performance criteria.

Select the appropriate gravel compliance level from Table 2. If there are sections of the road with distinctly different gravel quality characteristics, then it may be appropriate to assess these sections independently. In most cases an experienced practitioner will be able to select the appropriate level from a visual inspection. However if grading and linear shrinkage testing results can be obtained then Table 2 can be used together with Figure 3 to assist in selecting the most appropriate level.

Table 2: Indicative compliance level and performance of unsealed road granular surfacing materials

Indicative compliance level	Materials and performance attributes
Non-compliant below	High rate of material loss (> 20 – 40 mm per year per 100 AADT) with surface ravelling and corrugations under traffic. Shrinkage Product (SP) below 100, whereas the Grading Coefficient (GC) may vary widely. Uniformly graded fine materials with a low GC display low resistance to erosion and coarsely graded higher GC materials tend to ravel badly and are generally unsuitable.
Borderline below	Moderate rate of material loss (10 – 20 mm per year per 100 AADT), with the surface tending to loosen and corrugate under the action of traffic but may remain tolerable to heavy traffic at low to moderate speeds. SP below 200, whereas GC may vary widely. Performance can improve with regular grading/ cushioning operations.
Compliant	Low rate of material loss, typically less than 5 – 10 mm per year per 100 AADT, with a well-knit surface resulting from a mechanically stable particle size distribution with few weak particles and containing a sufficient quantity of plastic fines. Ideal materials typically have a SP greater than 200 with an upper limit of 600 depending on the proportion of heavy traffic and tolerance of dust, and a GC of between 20 and 30. Arm-chair type (or gap) gradings are acceptable with concretionary materials, such as calcretes and laterites.
Borderline above	Moderate rate of material loss (10 – 20 mm per year per 100 AADT), with the surface tending to rut and become slippery in the wet but may remain tolerable to heavy traffic under wet conditions. SP above 600, whereas GC may vary widely. Performance can improve with regular grading/cushioning operations.
Non-compliant above	Moderate to high rate of material loss (> 20 mm per year per 100 AADT) with risk of severe rutting and slipperiness in the wet. SP above 700, whereas GC may vary widely. Uniformly graded fine materials with lower GC display low resistance to erosion and are generally unsuitable, whereas high GC materials tend to be ravel badly leading to extensive potholes.

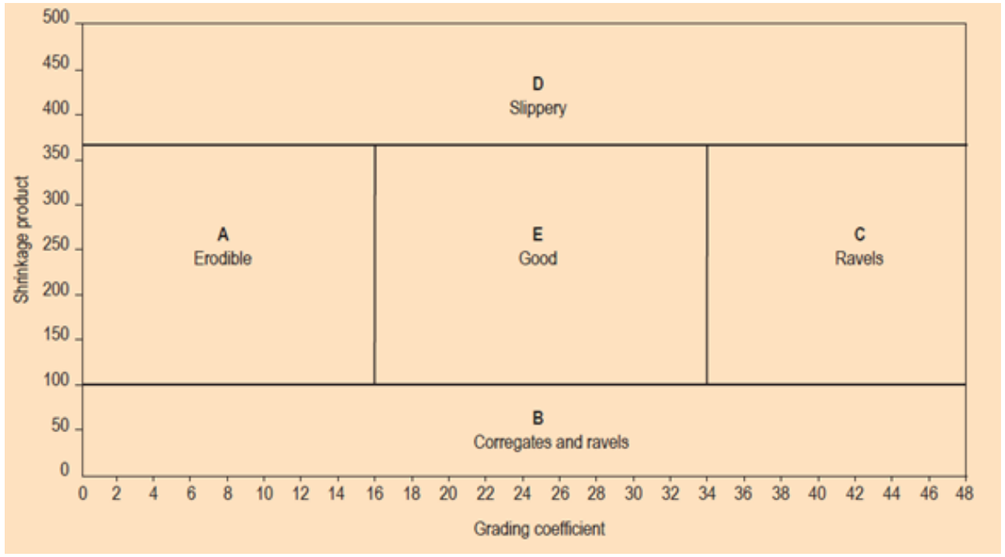

Figure 3: Relationship between gravel wearing surface properties and performance
Source: Jones and Paige-Green 1996
Notes:

1. Shrinkage product = linear shrinkage x % passing the 0.425 mm sieve
2. Grading coefficient = (% passing the 26.5 mm sieve - % passing the 2mm sieve) x % passing the 4.75 mm sieve / 100

STEP 6: Select the Marginal Cost Graph

Using Table 3 input the Cost Zone and the closest AP total for two-way trips and then select the applicable chart.

To continue the example from STEP 3, for cost zone 2 and 110,592 AP, use the nearest value of 100,000 AP and select chart B 4.

STEP 7: Determine the Marginal Cost of the Additional Freight Task

Using the gravel compliance category from STEP 5 and the chart selected in STEP 6, the marginal cost can be determined. An example of how the chart is to be used is presented in Figure 4.

Continuing the example from STEP 6, for a 'Non-compliant below' quality of material in cost zone 2 and at 100,000 axle passes per annum, the marginal cost is 12.7 c per AP.km.

Table 3: Matrix of marginal cost charts

Cost Zone	Additional AP (two-way)	Refer to Chart
2	10,000	Figure B 1
	20,000	Figure B 2
	40,000	Figure B 3
	100,000	Figure B 4
	200,000	Figure B 5
3	10,000	Figure B 6
	20,000	Figure B 7
	40,000	Figure B 8
	100,000	Figure B 9
	200,000	Figure B 10
4	10,000	Figure B 11
	20,000	Figure B 12
	40,000	Figure B 13
	100,000	Figure B 14
	200,000	Figure B 15

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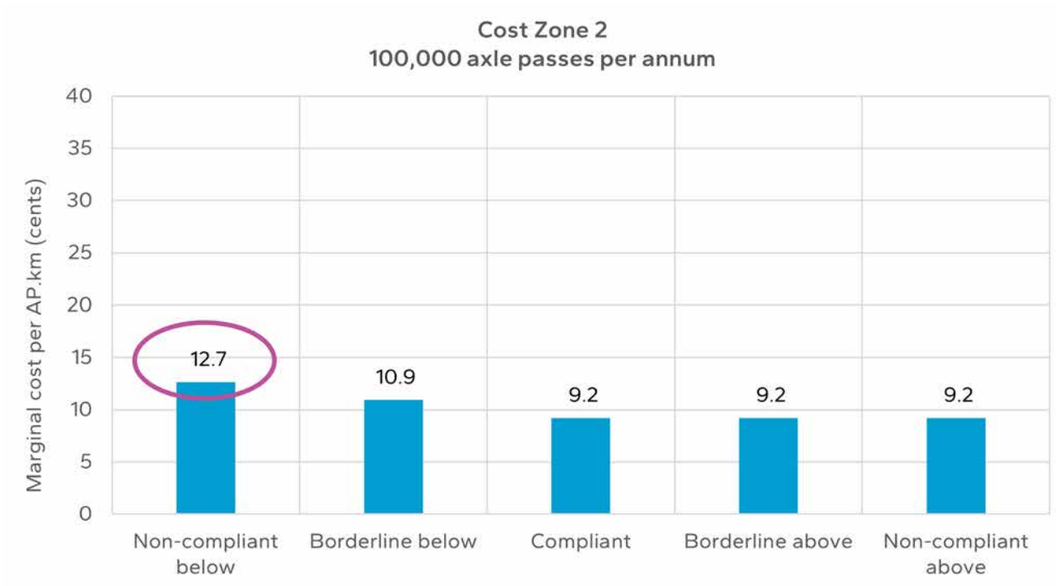


Figure 4: Marginal cost per additional AP in cents per km for zone 2 and 100,000 AP per annum

STEP 8: Adjust the Marginal Cost Based on Actual Costs

The marginal costs were determined with reference to unit rates collected from a survey conducted by ARRB and WALGA in 2017 and the Department of Local Government in 2024. The rates have been reviewed and escalated to be applicable as of 2024. The rates used in the development of the guide are provided in Table 4.

Table 4: Indicative unit cost rate for resheeting used in the guideline

Cost Zone	Average cost rate per Cost Zone ($/km 2024)
2	$68,245
3	$55,623
4	$121,887

If the actual cost of resheeting is known and is different to the indicative costs, then then the marginal cost can be adjusted using the equation:

$$AMC = MC * \frac{a}{b}$$

where

AMC = Adjusted Marginal Cost for specific case study
MC = Marginal Cost
a = Actual cost of resheeting ($/km)
b = Indicative cost of resheeting per Cost Zone ($/km) (see Table 4)

Continuing the example from STEP 6:

If the assessment is in Cost Zone 2, the marginal cost is 12.7 c per AP.km from the chart, and the cost of resheeting is known to be $75,000 per km, then;

AMC = 12.7 x 75,000 / 68,245
AMC =14.0 c per AP.km.

STEP 9: Calculate the Total Annual Cost

The total annual cost is determined by multiplying the marginal cost by the total AP and the route distance.

Continuing the example from STEP 8:

If the adjusted marginal cost is 14.0 c per AP.km, the route distance is 21 km and the total AP is 110,592, then;

Total annual cost = 0.14 x 21 x 110,592 = $325,141 rounded to $325,000

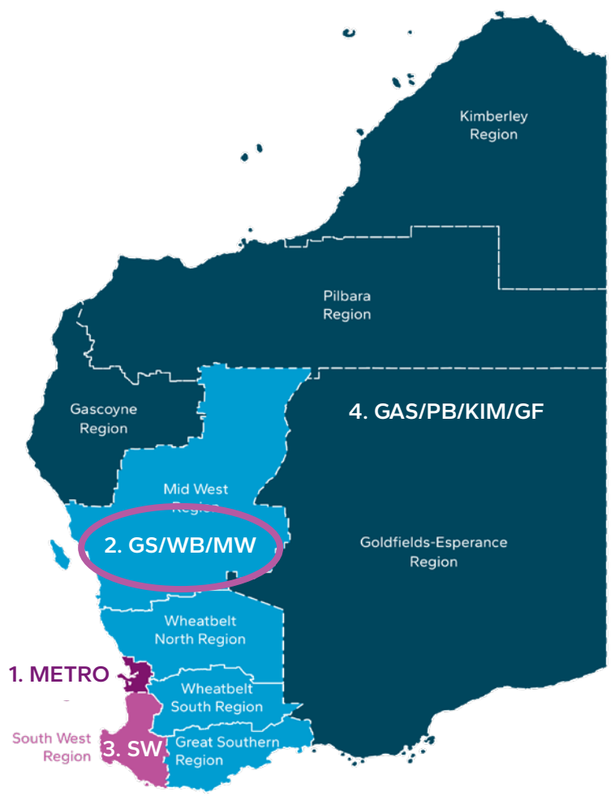
Due to the inherent assumptions and margins of error in the sources of data, the total annual cost should be rounded to the nearest $1,000.

Example Calculations

Worked Example #1

A mining company is developing a mine site in the Mid-West and proposes to transport 300,000 tonnes of iron ore per annum over a five year period along an unsealed Local Government road to access the State road network. They will be using a prime mover towing a semi-trailer and a B double with a concessional loading permit (AMMS Level 3). The road is 58 km long. The Works Manager has reported that the gravel wearing course is coarsely graded and susceptible to ravelling and corrugations, but an acceptable performance can be maintained with regular grading. The cost of resheeting is $75,000 per km

Calculate the annual cost of road wear resulting from this additional freight task.



Solution:

1. **Determine the annual freight tonnage, distance and duration of the task:**

   The annual freight tonnage is given as 300,000 t.

   The route distance is 58 km.

   The duration of the task is 5 years.

2. **Determine the vehicle type undertaking the task:**

   Go to Appendix A and select the applicable RAV Category.

   A prime mover towing a semi-trailer and a B double is known as an AB-Triple, classified as a RAV 7A. Under AMMS L3 it can have a maximum payload of 93.0 t (Table 1).

3. **Calculate the number of one-way trips and convert into axle passes and determine the total AP for two-way trips per annum:**

   The annual tonnage is 300,000 t.

   The maximum payload determined in the previous step is 93.0 t.

   The number of one-way trips = 300,000 / 93.0 = 3,226 per annum.

   From Table 1, the number of axles for a RAV 7A = 15.

   One way AP per annum = 3,226 x 15 = 48,390.

   Therefore two way AP = 96,780 AP per annum.

4. **Select the cost zone:**

   Go to Figure 2 and select cost zone 2 for the Mid West.

   The Mid West falls in Cost Zone 2.

5. **Select the gravel compliance level:**

   The gravel wearing course is described as "coarsely graded and susceptible to ravelling and corrugations but an acceptable performance can be maintained with regular grading".

   From Table 2; the most appropriate gravel compliance level is "Borderline Below".

6. **Select the applicable marginal cost chart:**

   Table 3 is used to select the marginal cost chart.

   Select Cost Zone 2 and 100,000 AP (the closest value to the actual calculated AP of 96,750).

   The applicable marginal cost chart is Figure B 4.

Cost Zone	Additional AP (two-way)	Refer to Chart
2	10,000	Figure B 1
	20,000	Figure B 2
	40,000	Figure B 3
	100,000	Figure B 4
	200,000	Figure B 5
3	10,000	Figure B 6
	20,000	Figure B 7
	40,000	Figure B 8
	100,000	Figure B 9
	200,000	Figure B 10
4	10,000	Figure B 11
	20,000	Figure B 12
	40,000	Figure B 13
	100,000	Figure B 14
	200,000	Figure B 15

7. **Determine the marginal cost:**

   With the appropriate marginal cost chart selected in Step 6, read off the marginal cost for the gravel compliance level of borderline below.

Therefore, from the chart, the marginal cost is 10.9 cents per AP.km/year.

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8. **Adjust the marginal cost based on actual costs:**

   The cost of resheeting is $75,000 per km

   Adjusted Marginal Cost = Marginal Cost x Actual cost of resheeting / indicative cost (Table 4)

   AMC = 10.9 X 75,000 / 68,245 = 12.0 c per AP.km

9. **Calculate the total annual cost:**

   The annual cost can now be calculated from all of the above information.

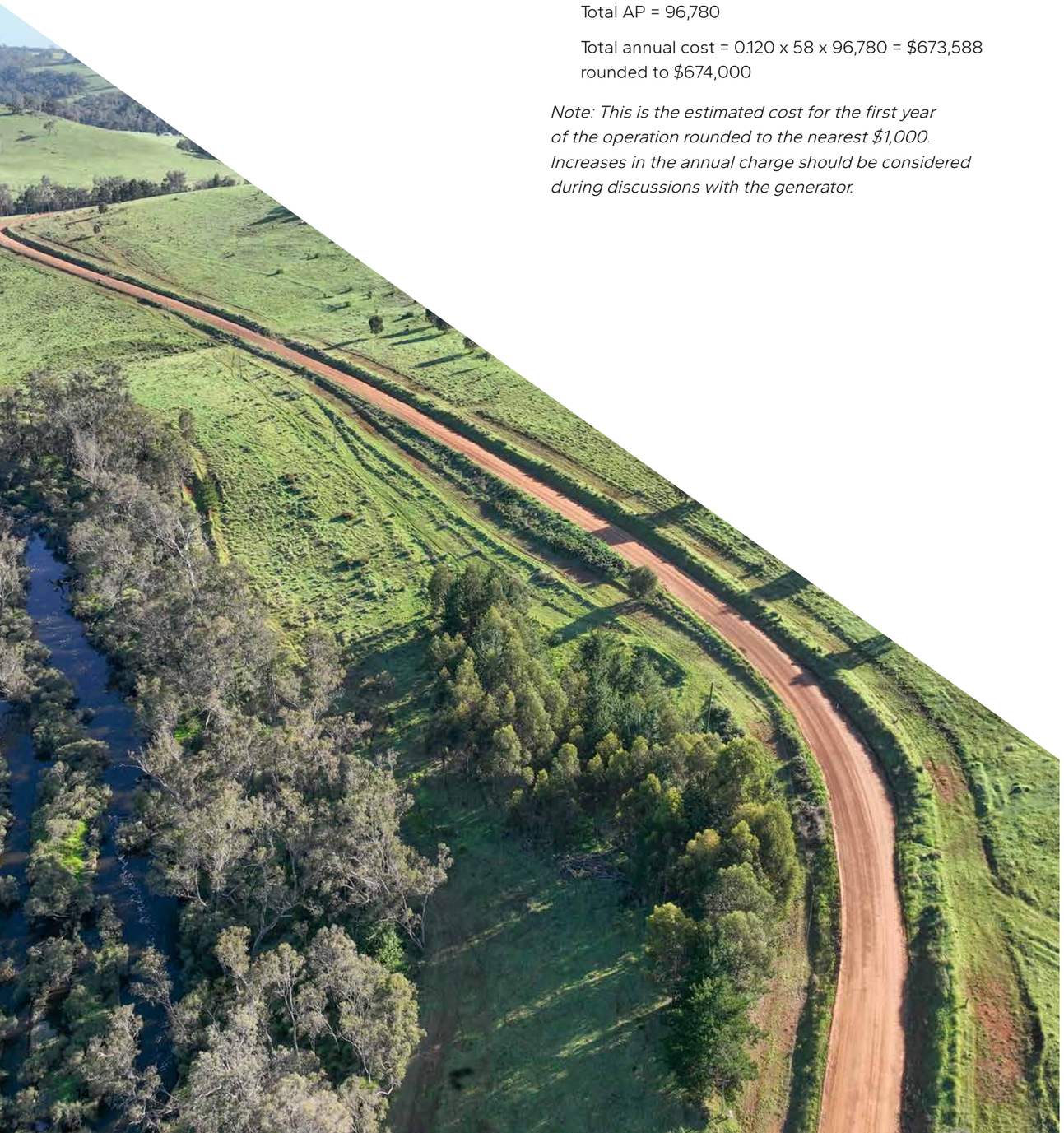
   AMC = 12.0 c per AP.km

   Route distance = 58 km

   Total AP = 96,780

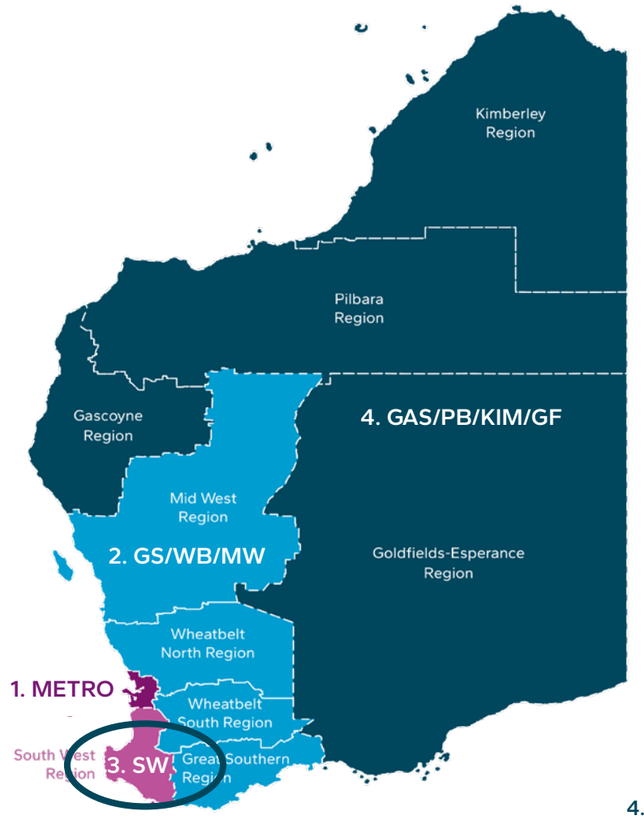
   Total annual cost = 0.120 x 58 x 96,780 = $673,588 rounded to $674,000

Note: This is the estimated cost for the first year of the operation rounded to the nearest $1,000. Increases in the annual charge should be considered during discussions with the generator.



Worked Example #2

A logging company in the South West is proposing to use a Local Government gravel road to transport an estimated 35,000 tonnes per annum of timber to port for chipping. The gravel road is 18 km long and the gravel wearing course is reported as having a high plasticity and prone to becoming very slippery when wet. The company will be using a prime mover and semi-trailer loaded at the regulation mass limit.



Solution:

1. **Determine the annual freight tonnage, distance and duration of the task:**

   The annual freight tonnage is given as 35,000 t

   The route distance is 18 km

   The duration of the task is 1 year

2. **Determine the vehicle type undertaking the task:**

   Go to Appendix A and select the applicable RAV Category.

   A prime mover towing a semi-trailer is classed as a 2A with a maximum payload of 25.6 t @ RML (Table1).

3. **Calculate the number of one-way trips and convert into axle passes and determine total AP for two-way trips per annum:**

   The annual tonnage is 35,000.

   From Table 1, the payload for a Class 2A at RML = 25.6 t.

   The number of one-way trips = 35 000 / 25.6 = 1,367 per annum

   From Table 1, the AP for a class 2A = 6

   Total AP per annum = 1,367 x 6 = 8,202 one way

   Therefore two way AP = 16,404 AP per annum.

   As a reminder, unlike sealed roads that refer to equivalent standard axles, the wear on unsealed roads is primarily affected by vehicle trips. The calculation therefor needs to include the travel in both directions, laden and unladen.

4. **Select the cost zone:**

   Go to Figure 2 and select Cost Zone 3.

   The South West falls in Cost Zone 3.

5. Select the gravel compliance level, select the road class:

The gravel wearing course is described as "having a high plasticity and prone to become very slippery when wet"

From Table 2; the most appropriate gravel compliance level is "Non-compliant above."

6. Select the applicable marginal cost chart:

Table 2 is used to select the marginal cost chart.

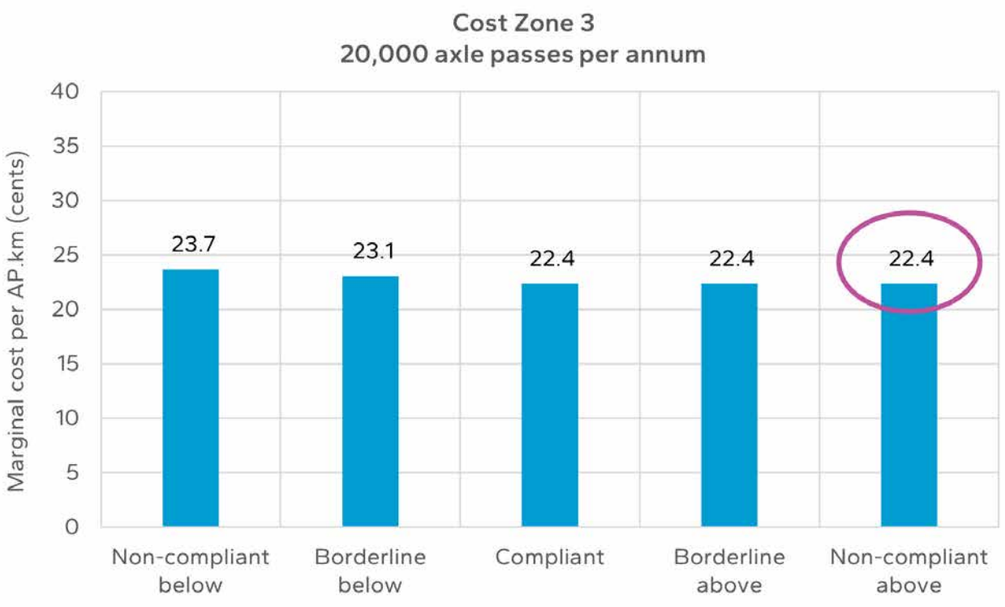
Select Cost Zone 3 and 20,000 AP (the closest value to the actual calculated AP of 16,404).

The applicable marginal cost chart is Figure B7.

Cost Zone	Additional AP (two-way)	Refer to Chart
2	10,000	Figure B 1
	20,000	Figure B 2
	40,000	Figure B 3
	100,000	Figure B 4
	200,000	Figure B 5
3	10,000	Figure B 6
	20,000	Figure B 7
	40,000	Figure B 8
	100,000	Figure B 9
	200,000	Figure B 10
4	10,000	Figure B 11
	20,000	Figure B 12
	40,000	Figure B 13
	100,000	Figure B 14
	200,000	Figure B 15

7. Determine the marginal cost:

With the appropriate marginal cost chart selected in Step 6, read off the marginal cost for the gravel compliance level of "non-compliant above".



Therefore, from the chart, the marginal cost is 22.4 cents per AP.km/year.

8. Adjust the marginal cost based on actual costs:

If no information is available regarding the actual costs of resheeting then no adjustment is applied.

9. Calculate the total annual cost:

The annual cost can now be calculated from all of the above information.

MC = 22.4 c per AP.km

Route distance = 18 km

Total AP = 16,404

Total annual cost = 0.224 x 18 x 16,404 = $66,141 rounded to $66,000.

Note: This is the estimated cost for the first year of the operation, rounded to the nearest $1,000. Increases in the annual charge should be considered during discussions with the generator.

References

ARRB Group 2019, 'Technical Basis for Estimating the Cost of Road Wear on Unsealed Local Government Roads in Western Australia', Project No. PRA16029-2 for Western Australia Local Government Association, Perth, Western Australia.

Paige-Green, P 1987, 'The influence of geotechnical properties on the performance of gravel wearing course materials', PhD thesis, University of Pretoria, South Africa.

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Appendices

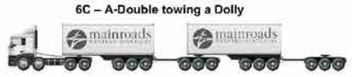
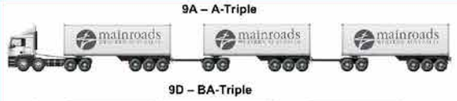
User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix A

Restricted Access Vehicle Classes and Configurations in WA

Heavy Vehicle Services
May 2022

Accredited Mass Management Scheme (AMMS)
Tandem Drive Prime Mover, Trailer Combinations
Restricted Access Vehicle (RAV) Categories

RAV Category	RAV Description		Max. Length	Max. Mass & Approved Network		
				Level 1	Level 2	Level 3
Category 1	1A – Prime Mover & Semi Trailer 		19 m	50 t	-	-
				N1.1	-	-
Category 2	2A – Prime Mover & Semi Trailer  2B - Prime Mover, Semi Trailer & Pig Trailer or Dolly  2C – B-double 	2A	20 m	50.5 t	51.5 t	53 t
		2B	27.5 m	68.5 t	69.5 t	71 t
		2C	27.5 m	72 t	74 t	76.5 t
		All	-	N2.1	N2.2	N2.3
Category 3	3A – A-double 		27.5 m	89 t	91 t	94 t
				N3.1	N3.2	N3.3
Category 4	4A – A-double 		27.5 m	93.5 t	96.5 t	100 t
				N4.1	N4.2	N4.3
Category 5	5A – B-Double towing a Dolly  5B – A-Double  5C – A-Double towing a Dolly  5D – B-Triple 	5A	27.5 m + Dolly	72 t + Dolly	74 t + Dolly	76.5 t + Dolly
		5B / 5D	36.5 m	89 t	91 t	94 t
		5C	27.5 m + Dolly	89 t + Dolly	91 t + Dolly	94 t + Dolly
		All	-	N5.1	N5.2	N5.3
Category 6	6A – A-double  6B – B-Triple  6C – A-Double towing a Dolly 	6A / 6B	36.5 m	93.5 t	96.5 t	100 t
		6C	27.5 m + Dolly	93.5 t + Dolly	96.5 t + Dolly	100 t + Dolly
		All	-	N6.1	N6.2	N6.3
Category 7	7A – AB-Triple  7B – BA-Triple 		36.5 m	115 t	119 t	123.5 t
				N7.1	N7.2	N7.3
Category 8	There are no Category 8 RAVs for AMMS					
Category 9	9A – A-Triple  9B – A-Double towing a Dolly  9C – AB-Triple  9D – BA-Triple 	9A	53.5 m	127.5 t	130.5 t	135 t
		9B	36.5 m + Dolly	89 t + Dolly	91 t + Dolly	94 t + Dolly
		9C / 9D	45 m	115 t	119 t	123.5 t
		All	-	N9.1	N9.2	N9.3
Category 10	10A – A-Triple  10B – A-Double towing a Dolly  10C – Double B-Double  10D – ABB-Quad  10E – AAB-Quad 	10A / 10C / 10D	53.5 m	136.5 t	141.5 t	147 t
		10B	36.5 m + Dolly	93.5 t + Dolly	96.5 t + Dolly	100 t + Dolly
		10E	53.5 m	158 t	164 t	170.5 t
		All	-	N10.1	N10.2	N10.3

Source: Reprinted with permission from Main Roads WA *Accredited Mass Management Scheme Tandem Drive Prime Mover, Trailer Combinations* (2022).

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix A

Restricted Access Vehicle Classes and Configurations in WA

Heavy Vehicle Services
May 2022

Accredited Mass Management Scheme (AMMS)

Tandem Drive Truck, Trailer Combinations

Restricted Access Vehicle (RAV) Categories

RAV Category	RAV Description		Max. Length	Max. Mass & Approved Network		
				Level 1	Level 2	Level 3
Category 1	1A – Rigid Truck  1B – Rigid Truck towing a Pig Trailer or Dolly 	1A	12.5 m	29 t	29 t	-
		1B	20 m	47 t	47 t	-
		All	-	N1.1	N1.1	-
Category 2	2A – Rigid Truck  2B – Rigid Truck towing a 4 or 5 Axle Dog Trailer  2C – Rigid Truck towing a 6 Axle Dog Trailer 	2A	12.5 m	-	-	29.5 t
		2B	25 m	67.5 t	68.5 t	70.5 t
		2C	25 m	72 t	74 t	76.5 t
		All	-	N2.1	N2.2	N2.3
Category 3	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					
Category 4	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					
Category 5	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					
Category 6	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					
Category 7	7A – Rigid Truck Towing two Dog Trailers 		36.5 m	115 t N7.1	119 t N7.2	123.5 t N7.3
Category 8	There are no Category 8 RAVs for AMMS					
Category 9	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					
Category 10	Refer to AMMS Tandem Drive Prime Mover, Trailer Combinations					

Source: Reprinted with permission from Main Roads WA *Accredited Mass Management Scheme Tandem Drive Prime Mover, Trailer Combinations* (2022).

Appendix B
Marginal Cost Charts

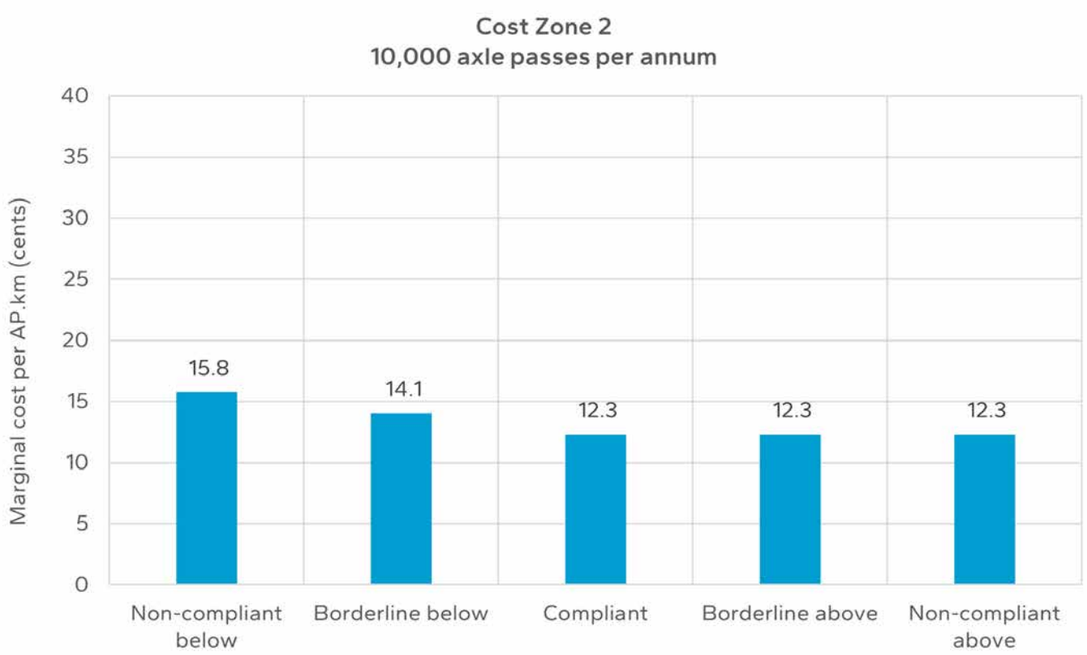


Figure B 1: Marginal cost per additional axle pass (cents per km) for Zone 2 and 10,000 AP per annum

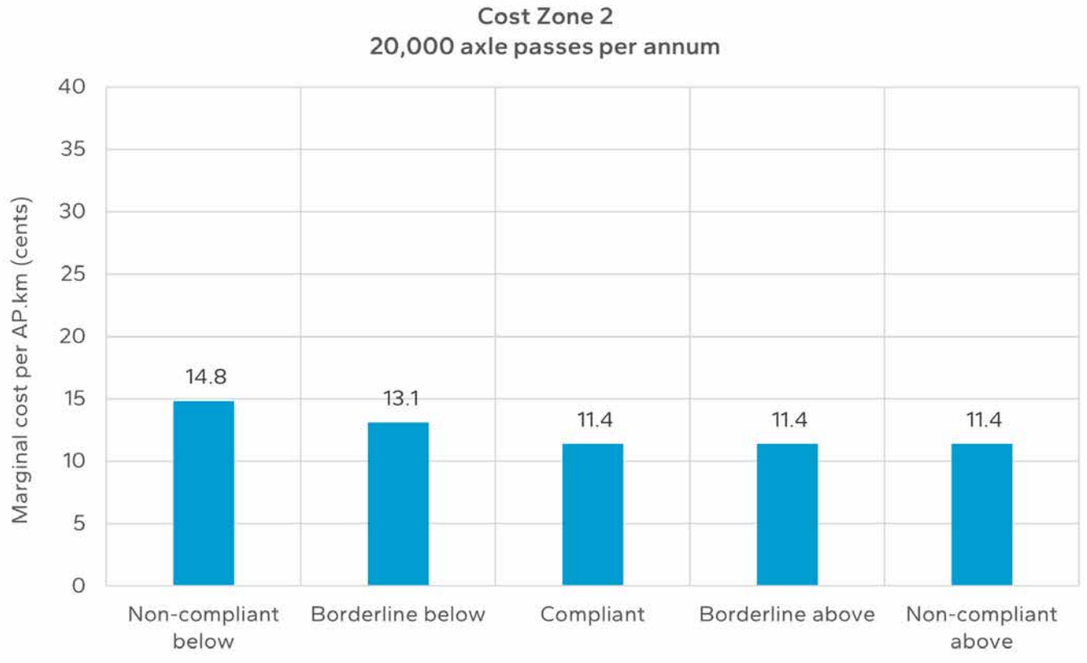


Figure B 2: Marginal cost per additional axle pass (cents per km) for Zone 2 and 20,000 AP per annum

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix B
Marginal Cost Charts

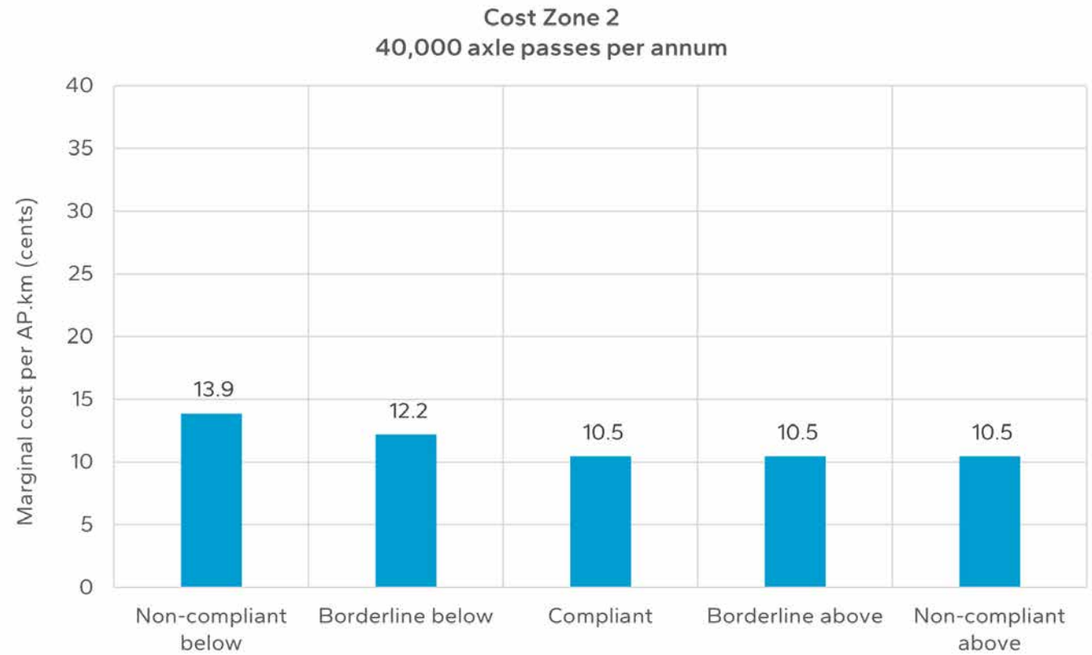


Figure B 3: Marginal cost per additional axle pass (cents per km) for Zone 2 and 40,000 AP per annum

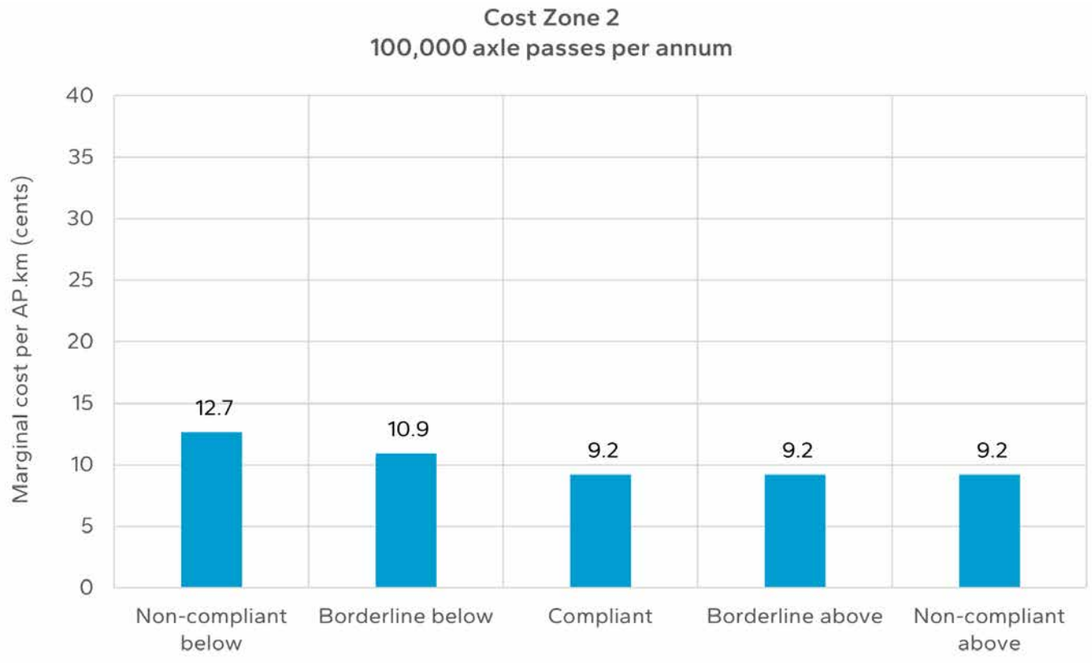


Figure B 4: Marginal cost per additional axle pass (cents per km) for Zone 2 and 100,000 AP per annum

Appendix B
Marginal Cost Charts

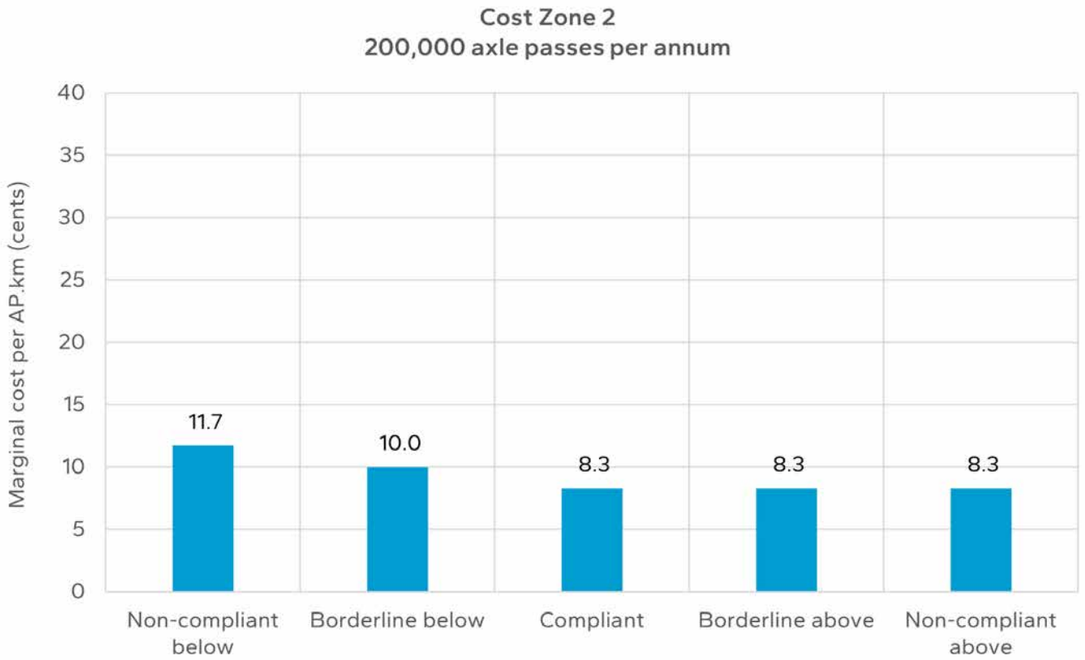


Figure B 5: Marginal cost per additional axle pass (cents per km) for Zone 2 and 200,000 AP per annum

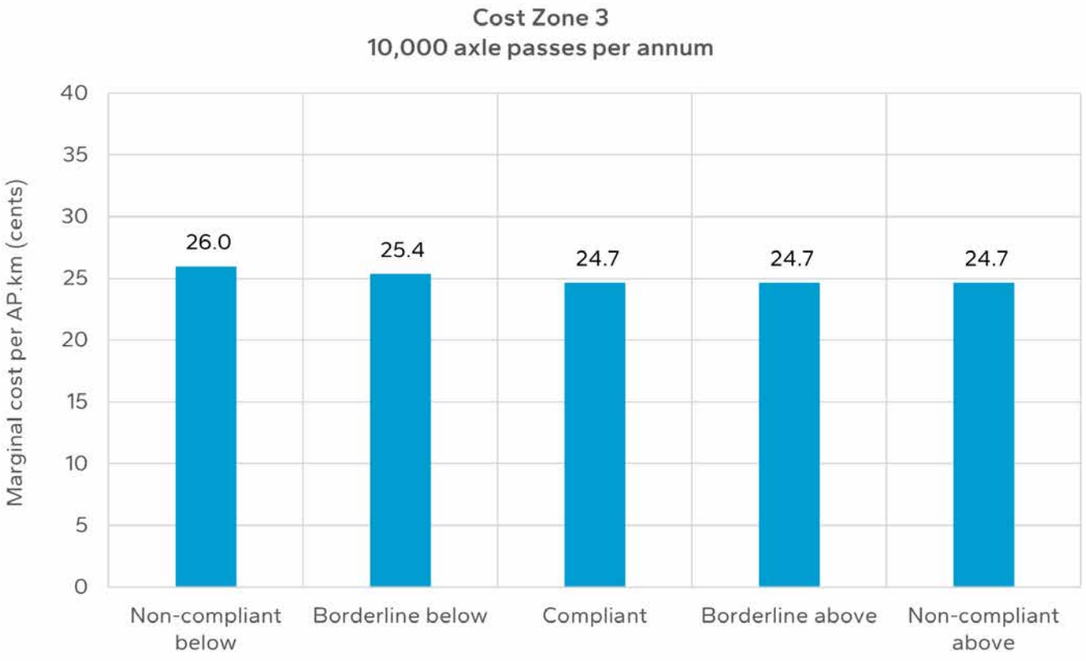


Figure B 6: Marginal cost per additional axle pass (cents per km) for Zone 3 and 10,000 AP per annum

Appendix B
Marginal Cost Charts

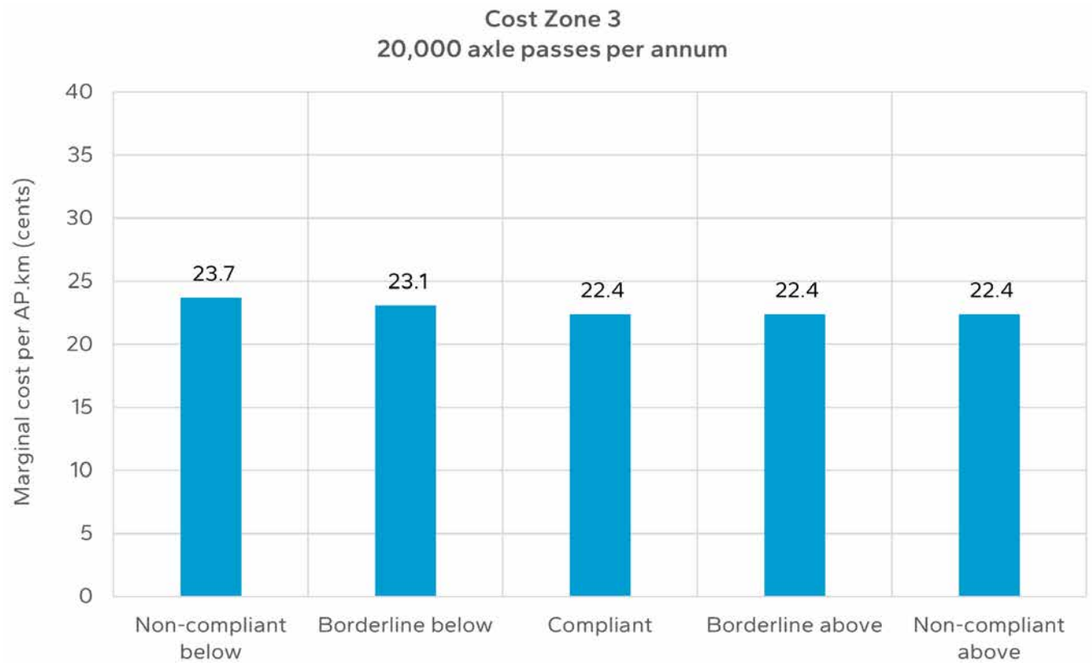


Figure B 7: Marginal cost per additional axle pass (cents per km) for Zone 3 and 20,000 AP per annum

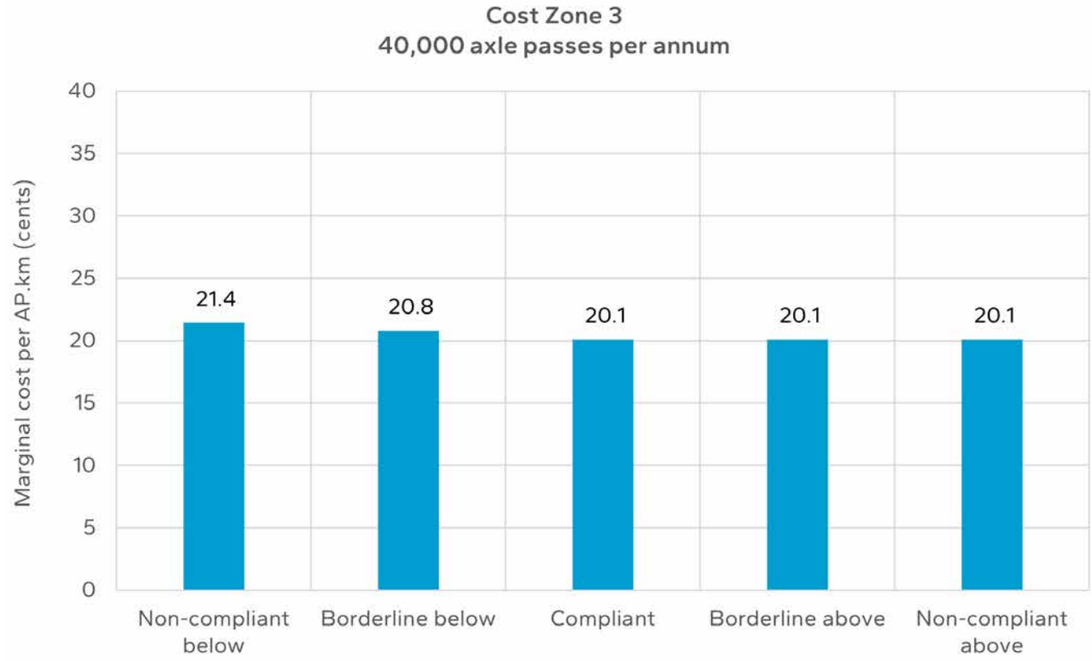


Figure B 8: Marginal cost per additional axle pass (cents per km) for Zone 3 and 40,000 AP per annum

Appendix B
Marginal Cost Charts

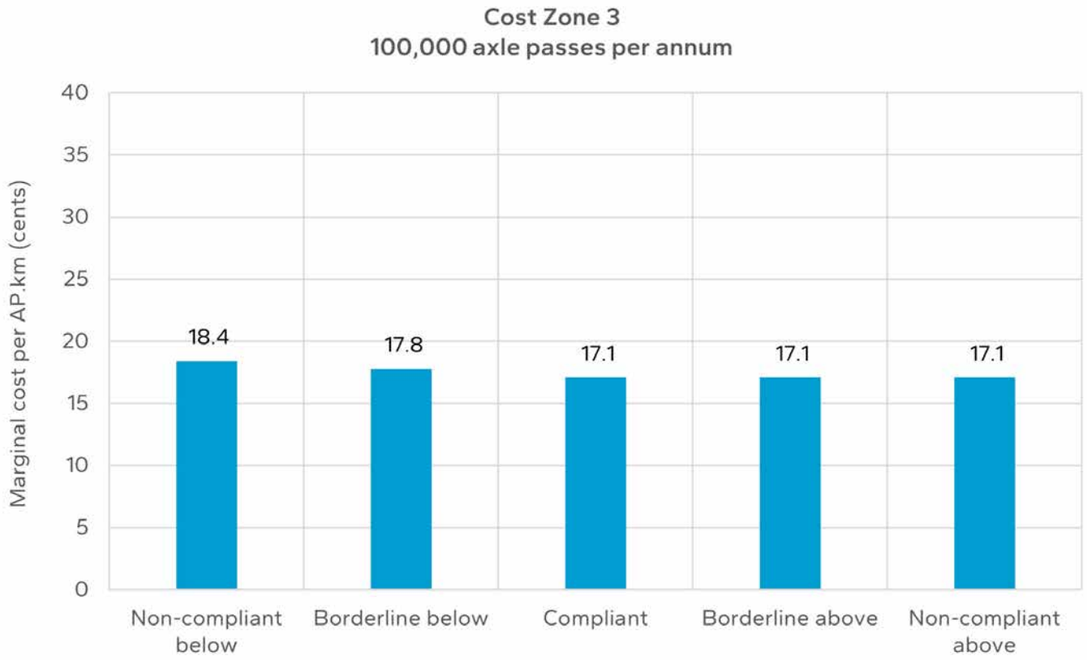


Figure B 9: Marginal cost per additional axle pass (cents per km) for Zone 3 and 100,000 AP per annum

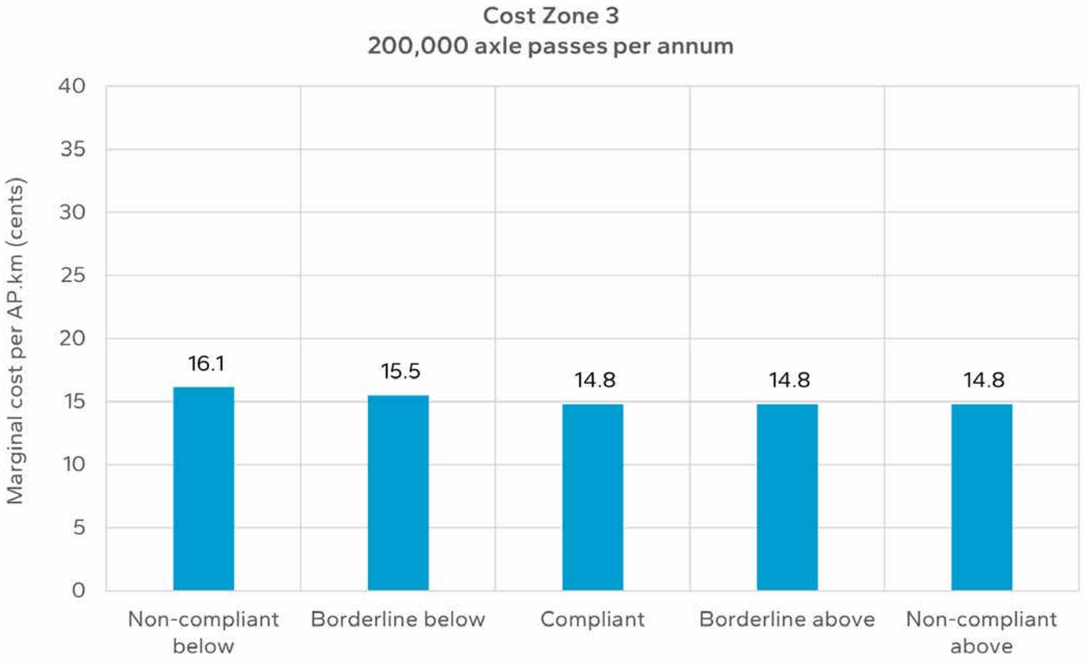


Figure B 10: Marginal cost per additional axle pass (cents per km) for Zone 3 and 200,000 AP per annum

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix B
Marginal Cost Charts

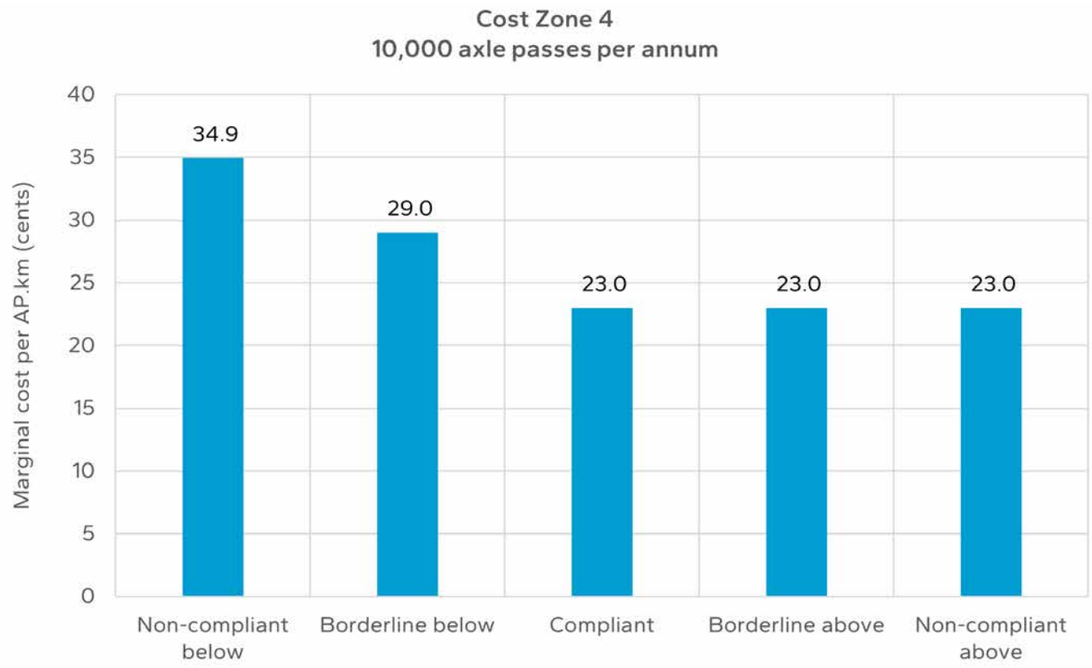


Figure B 11: Marginal cost per additional axle pass (cents per km) for Zone 4 and 10,000 AP per annum

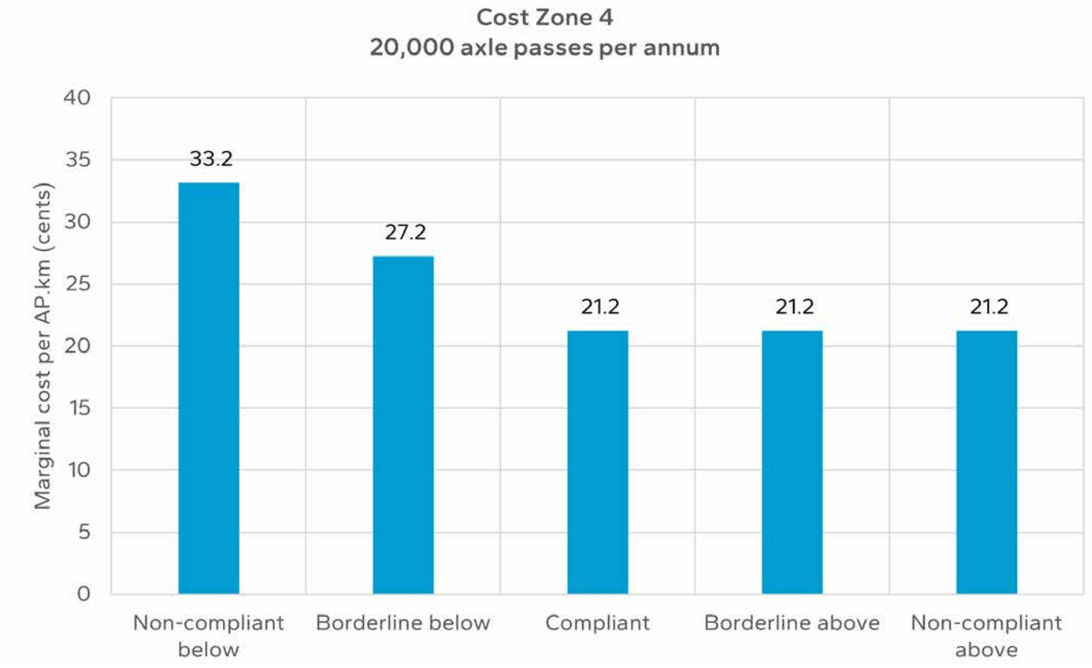


Figure B 12: Marginal cost per additional axle pass (cents per km) for Zone 4 and 20,000 AP per annum

Appendix B
Marginal Cost Charts

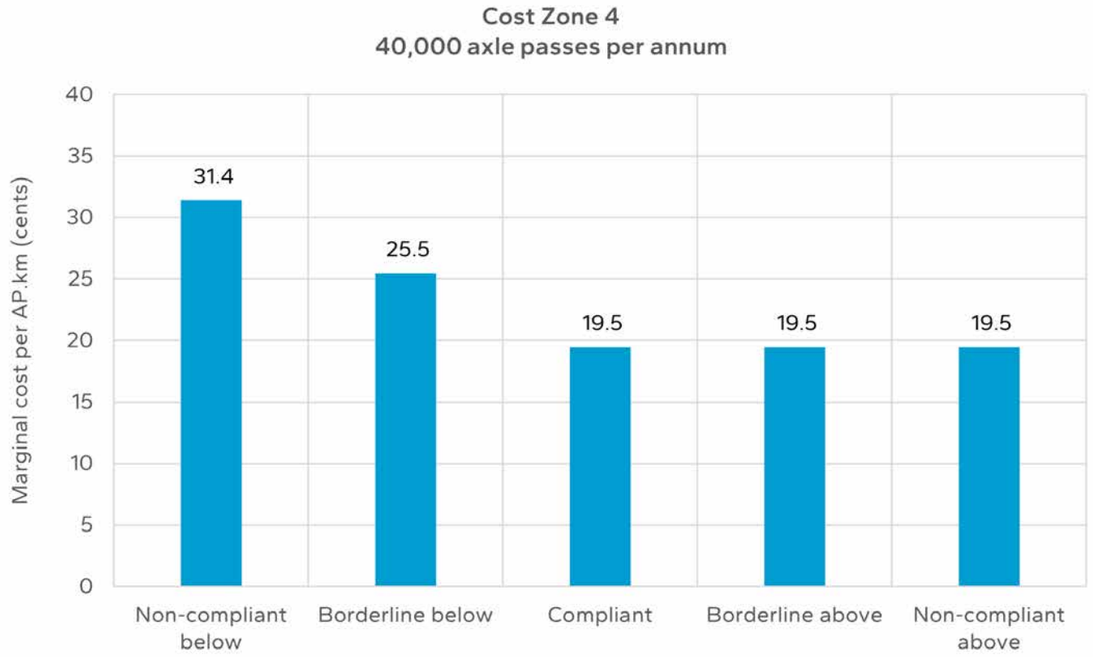


Figure B 13: Marginal cost per additional axle pass (cents per km) for Zone 4 and 40,000 AP per annum

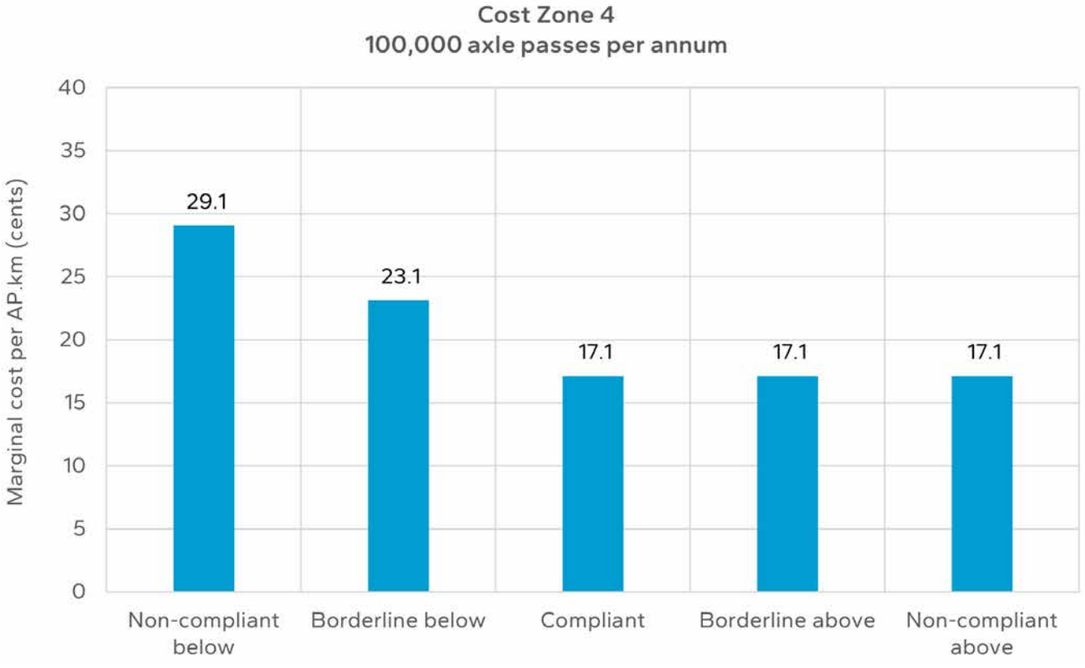


Figure B 14: Marginal cost per additional axle pass (cents per km) for Zone 4 and 100,000 AP per annum

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix B
Marginal Cost Charts

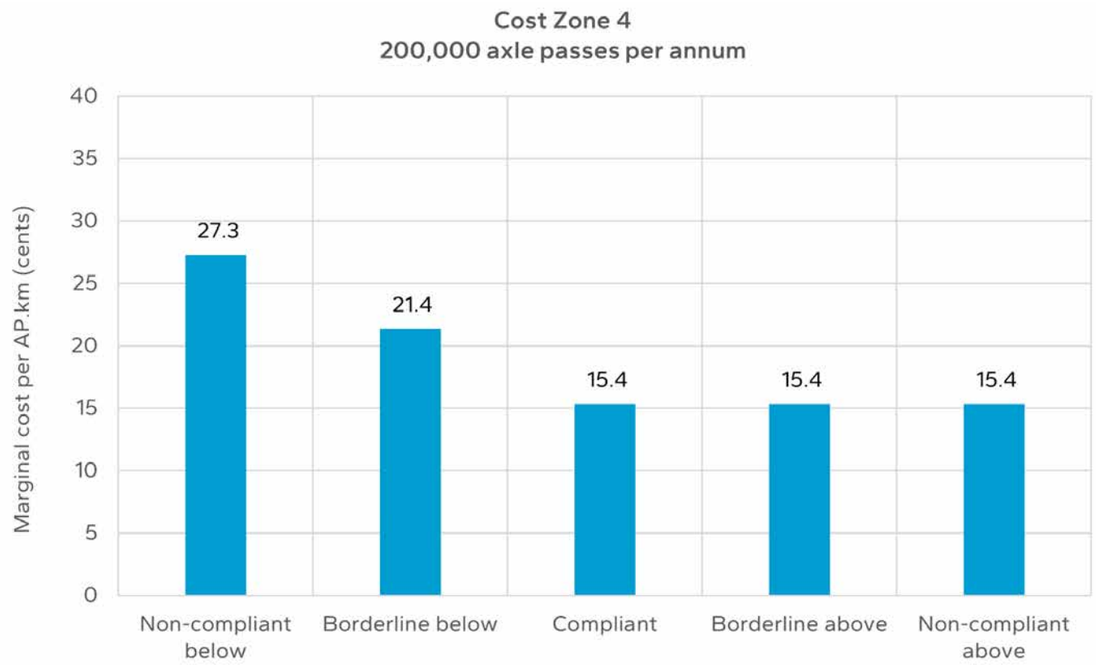


Figure B 15: Marginal cost per additional axle pass (cents per km) for Zone 4 and 200,000 AP per annum

Appendix C

User Guide for the WALGA Road Wear Cost Calculator

C.1 Accessing the Calculator

To effectively use the newly released WALGA Marginal Cost Calculator v1.0, users are recommended to download a copy here.

This file should be saved to a known location, to ensure ready access to the current version of the tool.

C.2 Enabling the Macros

The WALGA MC Calculator consists of some Visual Basic Applications (VBA) code to enable the various functionality and features that are contained within the tool. These need to be **enabled** on the computer for the tool to work correctly.

If the MC Calculator has been sourced from an email or as a download from the WALGA website, based on general IT protocols to protect users, files with Macros may be automatically blocked to prevent malicious software from operating.

When a file sourced from the internet is opened, such as from an email attachment, and that file contains macros, the following message is generally displayed:

The 'Learn More' button will open an article that explains the security risk of enabling Macros, safe practices to prevent any malicious activity and instructions on how to enable these Macros (if it is needed). The article is available through this link:

https://support.microsoft.com/en-us/topic/a-potentially-dangerous-macro-has-been-blocked-0952faa0-37e7-4316-b61d-5b5ed6024216

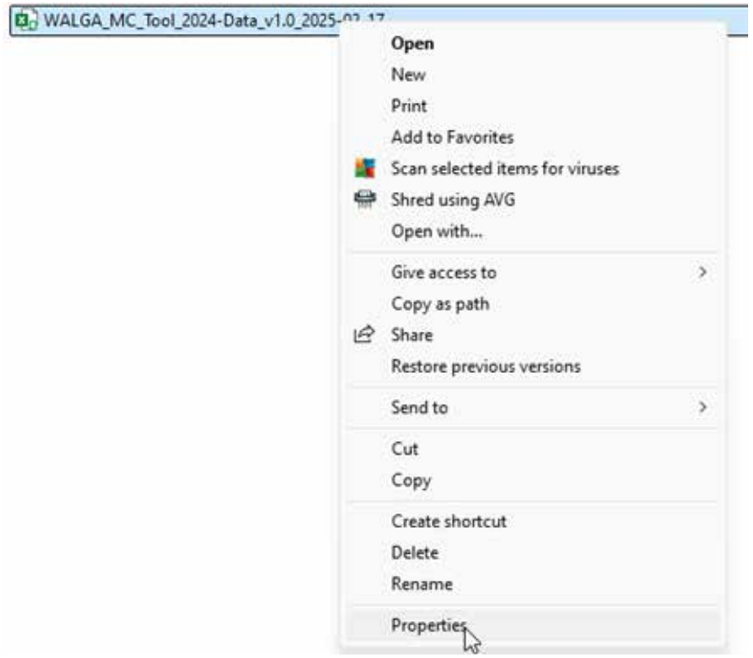
C.3 Unblocking the File

For files that are blocked, the most common way to unblock the file is by modifying the properties of the file as follows:

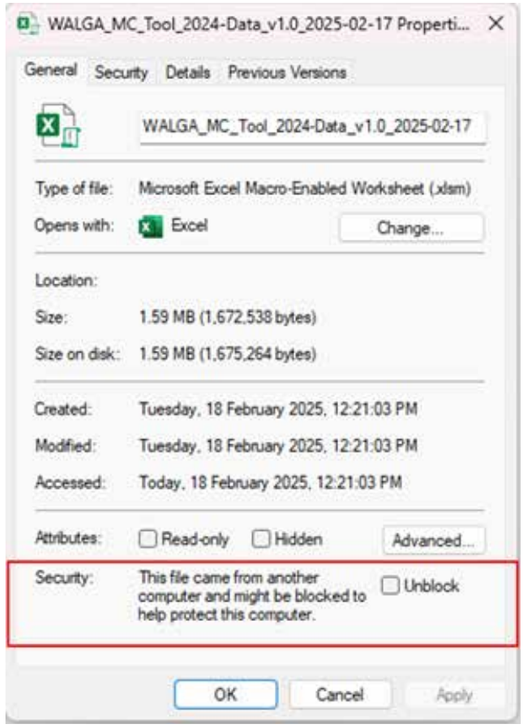
1. Open Windows File Explorer and go to the folder where the file is saved.
2. Right-click the file and choose 'Properties' from the context menu.

Appendix C

User Guide for the WALGA Road Wear Cost Calculator



3. At the bottom of the 'General' tab, select the 'Unblock' checkbox and select 'OK'.



Once the file is unblocked, it will then become a trusted source, and users of the file will not be required to complete this step again.

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

Appendix C

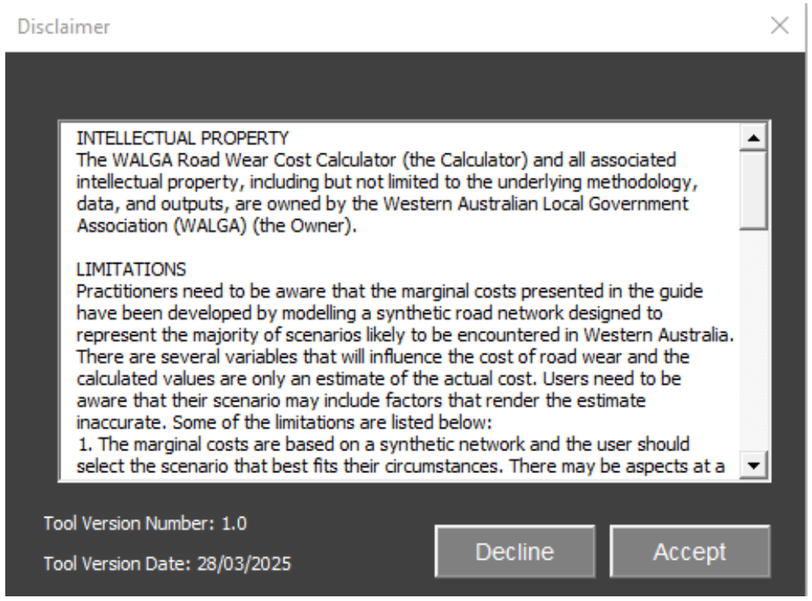
User Guide for the WALGA Road Wear Cost Calculator

C.4 Opening the Tool

With an unblocked file, opening the MC Calculator is like opening any standard Excel file.

If the following message appears below the Excel ribbon, select 'Enable Editing'.

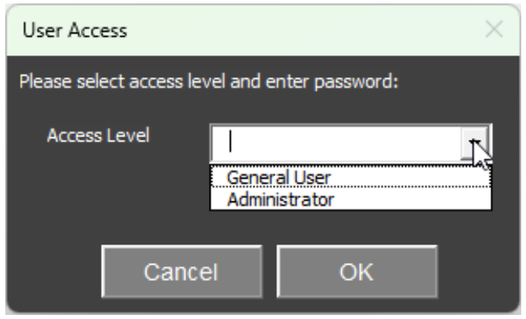
Once the file is opened in Excel, users will be presented with the WALGA Road Wear Cost Calculator disclaimer as shown.



To gain access to the tool, users will need to accept the disclaimer.

Declining the disclaimer will automatically close the Excel application and it will need to be restarted/re-launched to progress to undertake an analysis.

Once accepted, users will be prompted with a 'User Access' interface as shown.

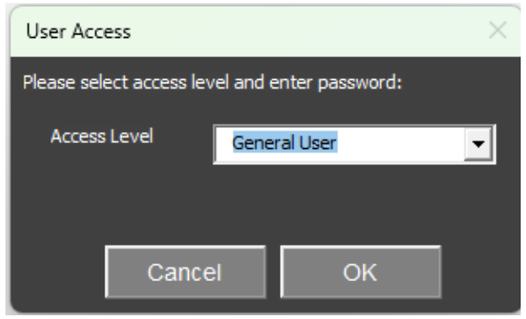


Appendix C

User Guide for the WALGA Road Wear Cost Calculator

Select "General User" from the Access Level drop down menu.

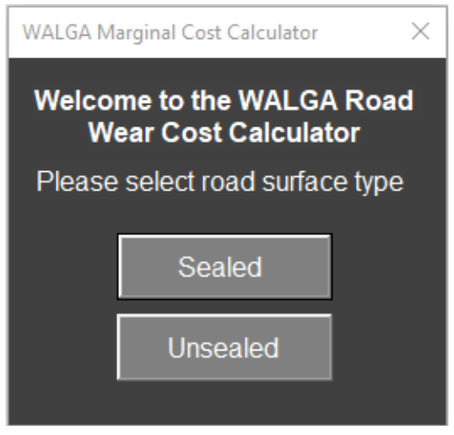
Note that a password is not required to gain access to the tool as as general user.



Once 'General User' is selected, press 'OK' to continue to launch the application.

If 'Cancel' is pressed at this point, users will not be authenticated, and the workbook will close automatically.

To ensure that users can undertake their desired analysis, each time the application is opened, users are prompted to select the type of analysis they are undertaking i.e., either for a sealed road or for an unsealed road analysis as shown.



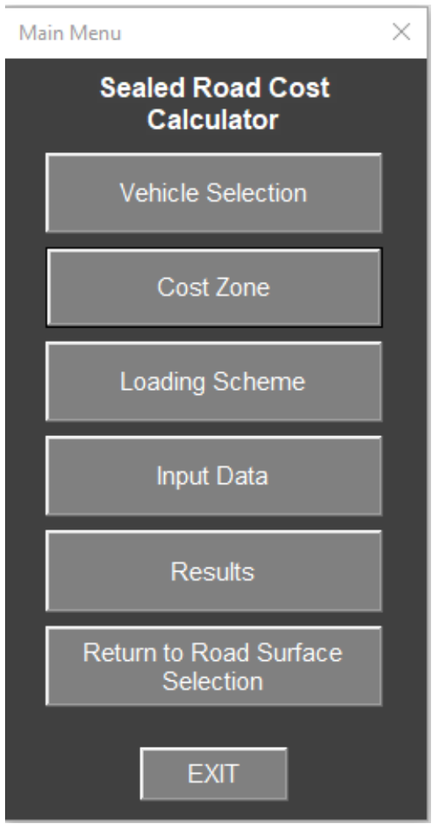
Once the analysis type is selected, the tool will display the appropriate menu to guide the user through the analysis as shown.

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

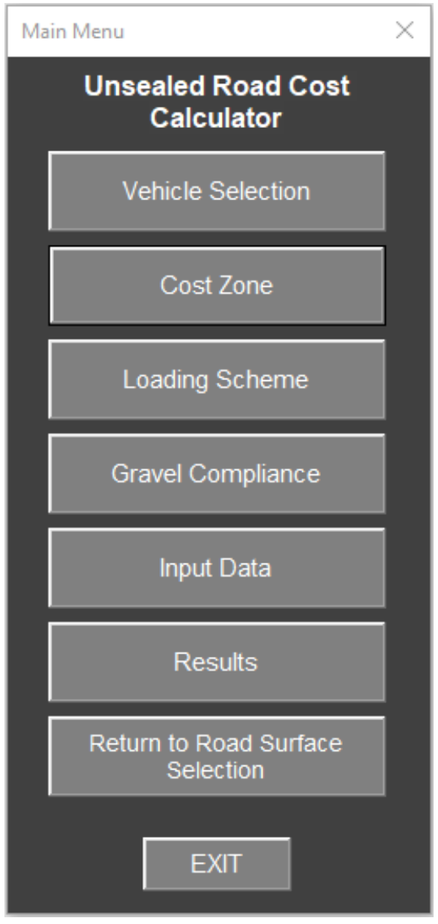
Appendix C

User Guide for the WALGA Road Wear Cost Calculator

Sealed Roads



Unsealed Roads



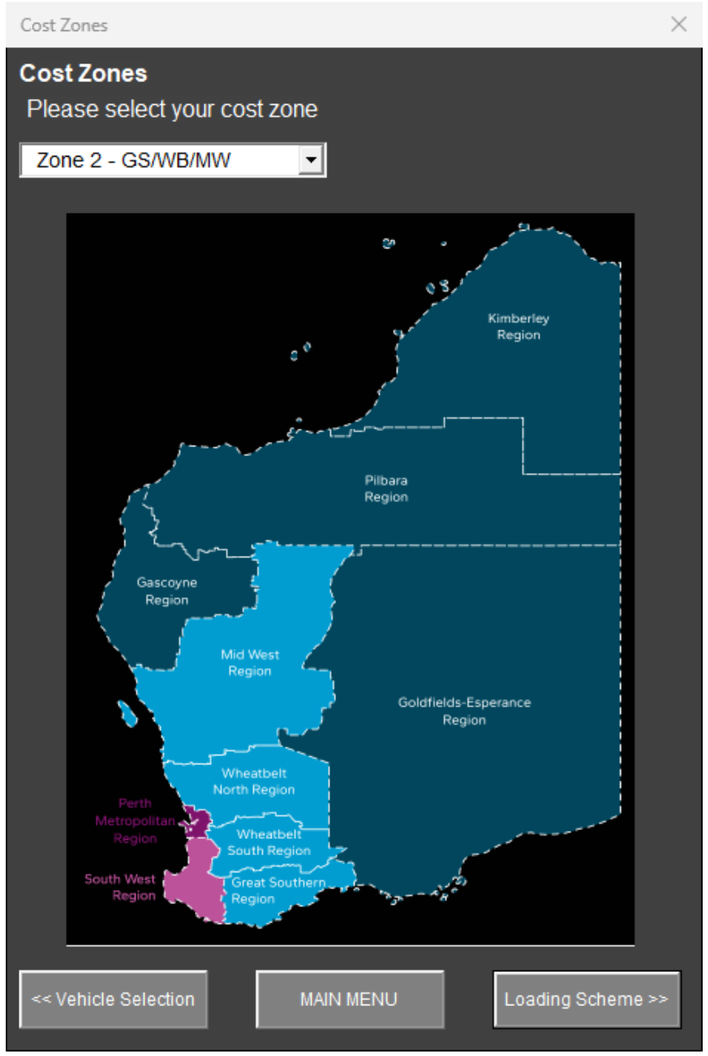
C.5 Running an Analysis

The WALGA MC Calculator has been developed to digitise the hardcopy form of the updated user guides for both sealed roads and unsealed roads, being *Estimating the Incremental Cost Impact on Sealed Local Roads from Additional Freight Tasks* and *Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks*.

The simple user menu created in the tool facilitates logical data entry and user selections that are aligned with the manual processes defined in the relevant User Guide. Navigation through the various menu and data entry forms is facilitated through the easy click buttons provided at the bottom of the form.

Appendix C

User Guide for the WALGA Road Wear Cost Calculator



Users of the WALGA MC Calculator are recommended to familiarise themselves with the appropriate User Guide to confirm data entry and user selection requirements to generate an analysis outcome.

C.6 General Guidance for File Management

The WALGA MC calculator is a standalone Excel Application and so it is recommended that users apply the following good practices in terms of both file management and naming convention, to ensure that multiple analyses undertaken are organised and managed adequately:

1. Always keep a blank tool as a backup.
2. Adopt clear file naming conventions to differentiate between files/analyses.
3. Always use the blank tool to create a new analysis.
4. Ensure to always document the substance of the analysis undertaken in the 'Comments' section provided in the Input Data form of the analysis setup for either sealed or unsealed analyses.

User Guide: Estimating the Incremental Cost Impact on Unsealed Local Roads from Additional Freight Tasks

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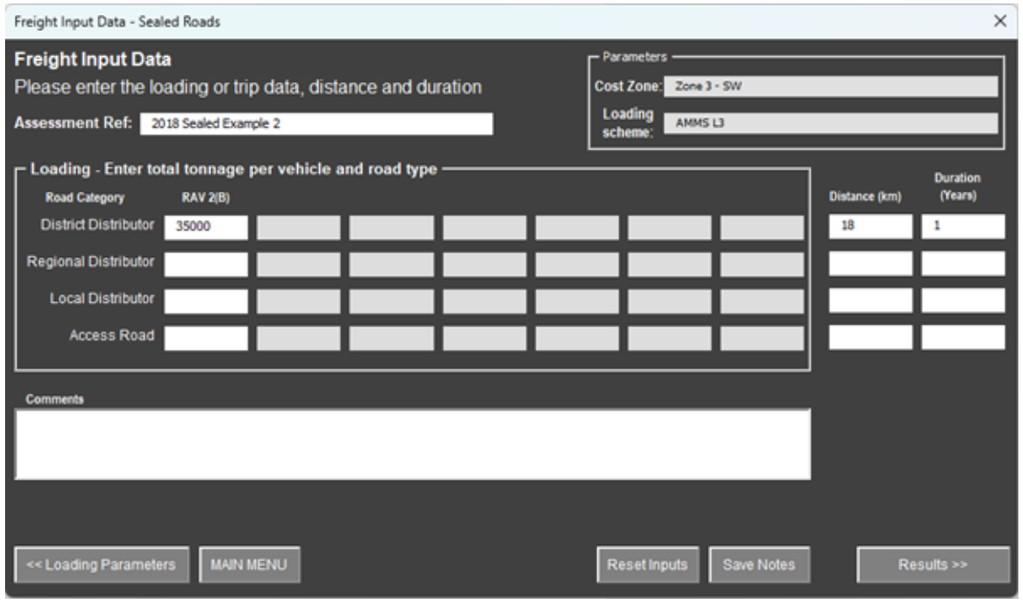
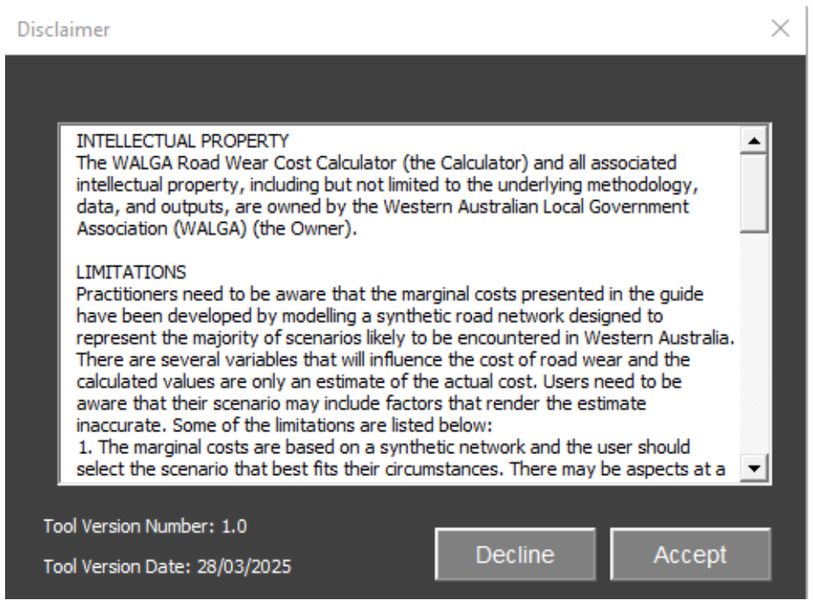
User Guide for the WALGA Road Wear Cost Calculator



5. Always check the currency of the version and release date to ensure that the most up to date tool is being applied (visible on the Disclaimer and the Welcome page).



Appendix C

User Guide for the WALGA Road Wear Cost Calculator

WALGA

Influence. Support. Expertise.

ONE70 Level 1
170 Railway Parade
West Leederville WA 6007

08 9213 2000
infrastructure@walga.asn.au

www.walga.asn.au