# User Guide

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

WALGA
WORKING FOR LOCAL GOVERNMENT

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GROUP

# CONTENTS

# 1  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.

This guide provides Local Governments with a tool to quantify the cost of additional wear and damage to affected 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.

Methods previously used to estimate the cost impact often required detailed input data, specialised engineering evaluation and modelling skills which are not readily available to Local Government. This user guide presents a method for estimating the cost of road wear using simple input parameters. The technical basis is provided in a separate report, *'Estimating the Incremental Cost Impact on Sealed Local Roads from Additional Freight Tasks' (ARRB 2015).*

Users of this guide will require a basic understanding of the Western Australian road classification system and will be assisted to select appropriate parameters based on the situation and freight task. The guide is designed to be applied to sealed roads only. Estimating the cost of additional heavy vehicle traffic on unsealed roads is outside the scope of this guide.

## 1.1 DEVELOPMENT BACKGROUND

The guide has been developed around 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, between an increased load of traffic and a base traffic load. Analysis has shown that the marginal cost is mostly dependent on the magnitude and duration of the additional load, the structural strength of the road and the cost of road maintenance activities.

Using these critical variables, a catalogue of charts has been developed to represent the spectrum of scenarios that are likely to be encountered on Local Government roads across the state. The marginal cost for each scenario was modelled by using a custom software tool developed by ARRB called the Freight Axle Mass Limit Tool (FAMLIT). FAMLIT models the life of the road based on deterioration curves that were developed by monitoring numerous different types of roads over many years. As the defined road structure deteriorates under specific loading conditions, the model triggers maintenance interventions that are required to keep the road serviceable. FAMLIT then calculates the difference in costs incurred between the additional load and the normal load.

The scenarios are presented by graphs showing marginal cost versus load duration. The user needs to define their scenario in terms of the vehicle type undertaking the task, annual tonnage and road category and the guide will then lead the user to the applicable graph. Detailed information on how to use the guide is provided in section 2.
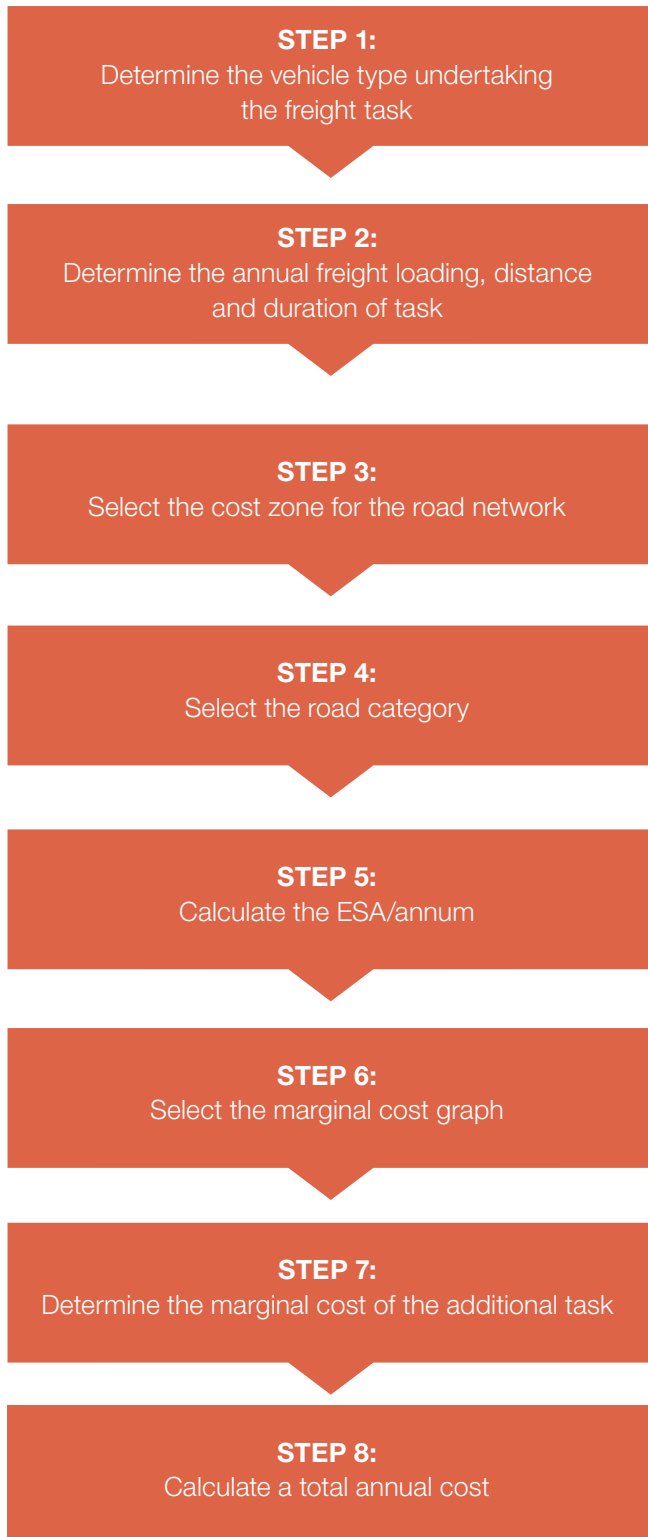
## 1.2 WHAT ARE THE LIMITATIONS OF THE GUIDE?

Practitioners need to be aware that the marginal costs presented in the guide have been developed by modelling a synthetic road network designed to represent the majority of scenarios likely to be encountered in Western Australia. There are a multitude of variables that will influence the cost of road wear and the calculated values are only an estimate of the actual cost. Users need to be aware that their scenario may include factors that render the estimate inaccurate.

Some of the limitations are listed below:

1. The marginal cost graphs are based on a synthetic network and the user should select the scenario that best fits their circumstances. There may be aspects at a project level that require a review of the calculated cost. Possible examples are:

   • The road has been constructed to a level that is markedly different to the road class design assumptions employed (see Table C.1)

   • The road is in a very poor or failed condition.

   • Sections of the road are subject to unusual conditions, e.g. flooding or very weak subgrades.

2. The method does not calculate the costs for associated infrastructure, e.g. bridges, culverts and guardrails.

3. The actual loading values and durations may lie between or outside of the given values. The user will need to interpolate or extrapolate accordingly. The guide may not be valid for scenarios that lie well beyond the modelled limits.

4. The guide has been developed for sealed local roads only, and does not apply to unsealed roads.

5. The unit rates are current for 2015. Escalation factors should be applied for future years.

6. 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.

# 2  HOW TO USE THIS GUIDE

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

**STEP 1:**
Determine the vehicle type undertaking
the freight task

**STEP 2:**
Determine the annual freight loading, distance
and duration of task

**STEP 3:**
Select the cost zone for the road network

**STEP 4:**
Select the road category

**STEP 5:**
Calculate the ESA/annum

**STEP 6:**
Select the marginal cost graph

**STEP 7:**
Determine the marginal cost of the additional task

**STEP 8:**
Calculate a total annual cost

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

Details for completing each step are shown on the left. 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

3. The duration of the task

4. The task routing and distance

The following sections outline the sequential steps to determine a marginal cost for a particular additional loading task.

## STEP 1: Determine the vehicle type undertaking the task

The first 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 operator. The vehicle type must then be converted to a MRWA RAV designation. The user must select the appropriate RAV designation from Appendix A.

## STEP 2: Determine the annual freight loading, distance and duration

To determine the annual freight loading, a good appreciation of the total freight task needs to be gained. This will usually involve discussions with the freight operator to determine the duration of the additional loading and the total loading to be applied. Typically such requests 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.

An example of a typical total load and duration is shown below:

Iron ore extraction – 600,000 tonnes over 3 years.

In this case, the annual tonnage is determined by dividing the total freight tonnage by the duration:

600,000/3 = 200,000 tonnes per year.

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

## STEP 3: Select the cost zone

The appropriate cost zone must be selected from one of the four cost zones shown in Figure 2.
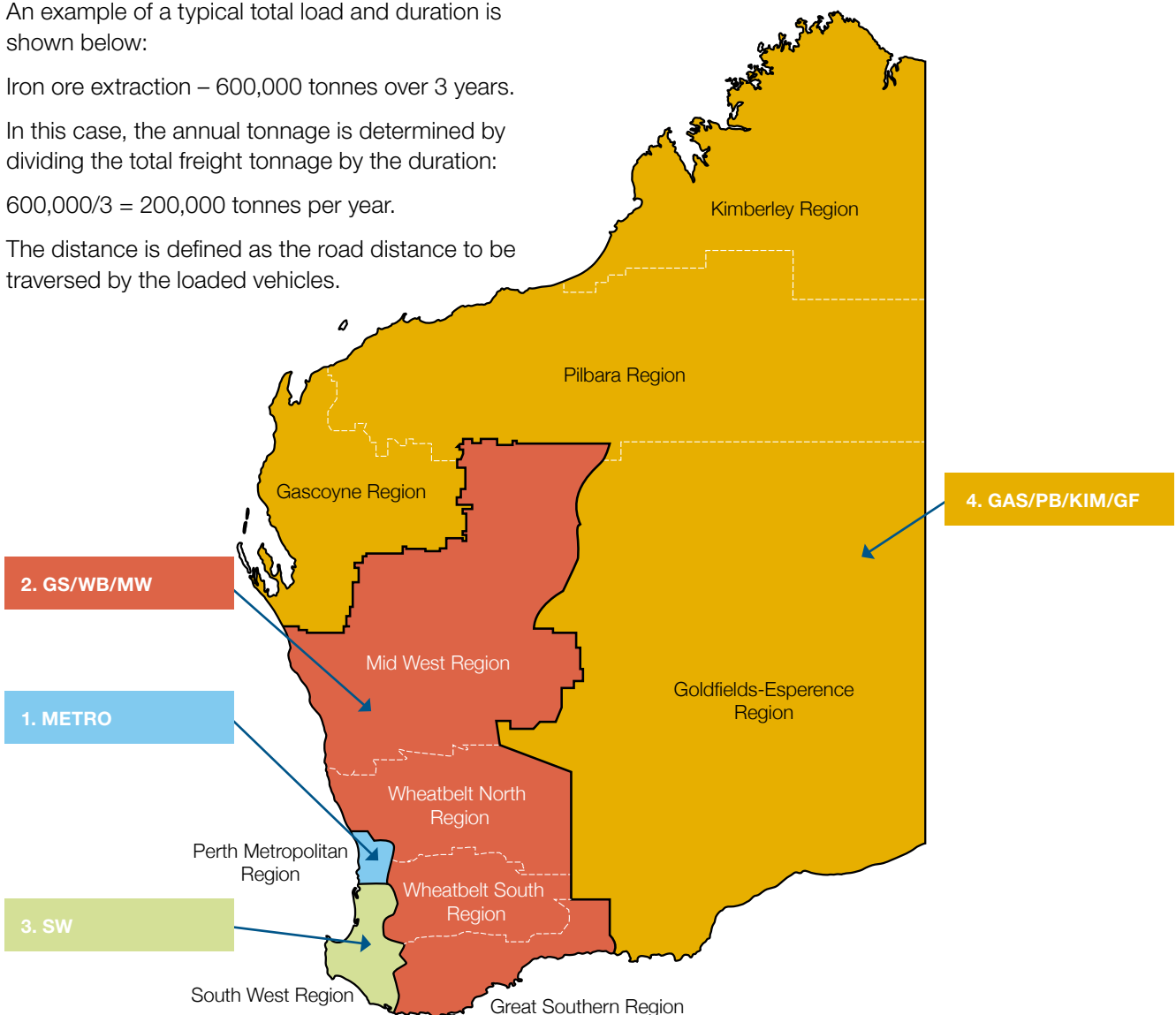
Kimberley Region

Pilbara Region

Gascoyne Region

**4. GAS/PB/KIM/GF**

**2. GS/WB/MW**

Mid West Region

Goldfields-Esperence Region

**1. METRO**

Wheatbelt North Region

Perth Metropolitan Region

Wheatbelt South Region

**3. SW**

South West Region

Great Southern Region

*Figure 2: Western Australian cost zones*

The cost zones were determined using the unit rates collected from the survey conducted by the Department of Local Government in 2011. The rates have been escalated to 2015 for use in the analysis tool.

## STEP 4: Select the road category

The user must select the road category from the list below:

• access road

• local distributor

• regional distributor

• district distributor

The road categories are based on the Main Roads classification system and every local road will fall into one of these categories.

Because of the variability in performance of these four road categories, users need to determine the exact route associated with the task. Where the designated route is well-defined and constrained to only one road category, the analysis outcomes are simply associated with the one cost estimate (see Section 3, Example 1). If the task traverses multiple road categories then these sections of road must be assessed separately (see Section 3, Example 2).

Appendix C.3 provides details of the design traffic that was assigned to each of these categories for model development. Some roads may be constructed to levels that are markedly different to the road category design assumptions and users must adjust their choice accordingly.

## STEP 5: Calculate Equivalent Standard Axles

The road wear caused by the movement of a quantity of freight will differ depending on the types of heavy vehicles that are used for the task. That is why the load equivalencies of all heavy vehicles need to be expressed in a common measure that is related to the amount of road wear.

The road wear caused by the passing of a heavy vehicle is proportional to the number and type of axle groupings (e.g. single, double or tri-axle) and the load carried by each of the axle groups. The allowable load on an axle group is strictly controlled in Western Australia and is termed the Regulation Mass Limit (RML). Some vehicles may operate under the Accredited Mass Management Scheme (AMMS) which allows for up to an additional 3.5 tonnes per tri-axle combination and 1.0 tonne per tandem axle combination. The damage caused per payload tonne will therefore differ depending on the type of vehicle that is used and the loading scheme that is applied. For consistency, all heavy vehicles are therefore converted to a common standard termed 'Equivalent Standard Axles' (ESA).

Figure 3 gives the ESA per payload tonne for different vehicle types and loading schemes. Figure 4 gives the ESA per vehicle for increasing loads. These charts have been developed using typical WA vehicle combinations and tare weights and provide reasonable estimates of ESA for most typical combinations. Actual tare weights may vary across vehicle models resulting in slight differences in ESA calculations.

In this step the user must determine the ESA per payload tonne from Figure 3 and then multiply this figure by the annual tonnage to determine the ESA per year. Alternatively the user can determine the ESA per vehicle from Figure 4 and multiply this by the annual number of vehicle movements to obtain the ESA per year.

For instance, a RAV 7(A) operating at RML, has an ESA per payload tonne of 0.14. If the RAV designation is not provided on the charts below then choose the closest match. A full list of RAV descriptions is given in Appendix A.
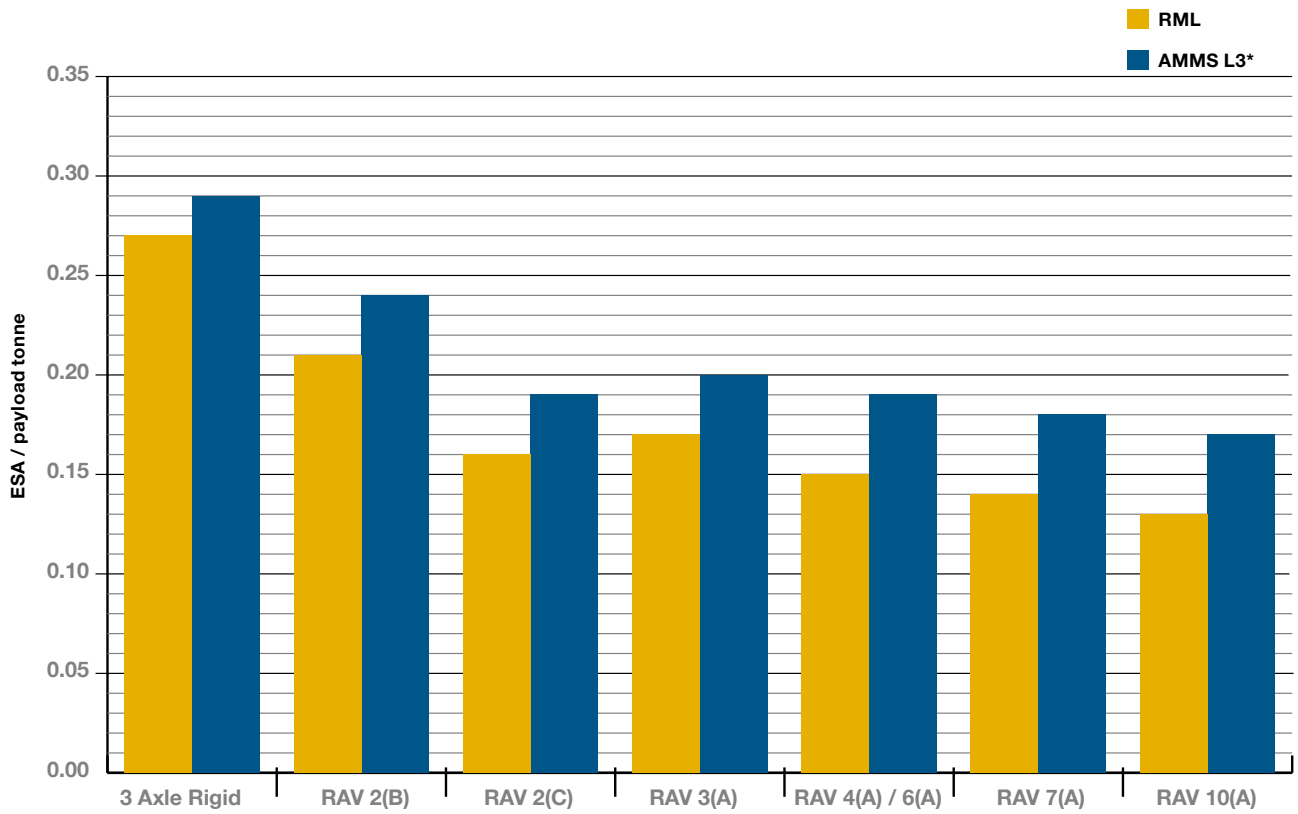
Figure 3: ESA per payload tonne for different vehicle types and loading schemes.

*Note: The AMMS has three levels. The displayed values are for Level 3. If the vehicle is operating at a lower level then select a proportionate value between the RML value and the AMMS L3 value
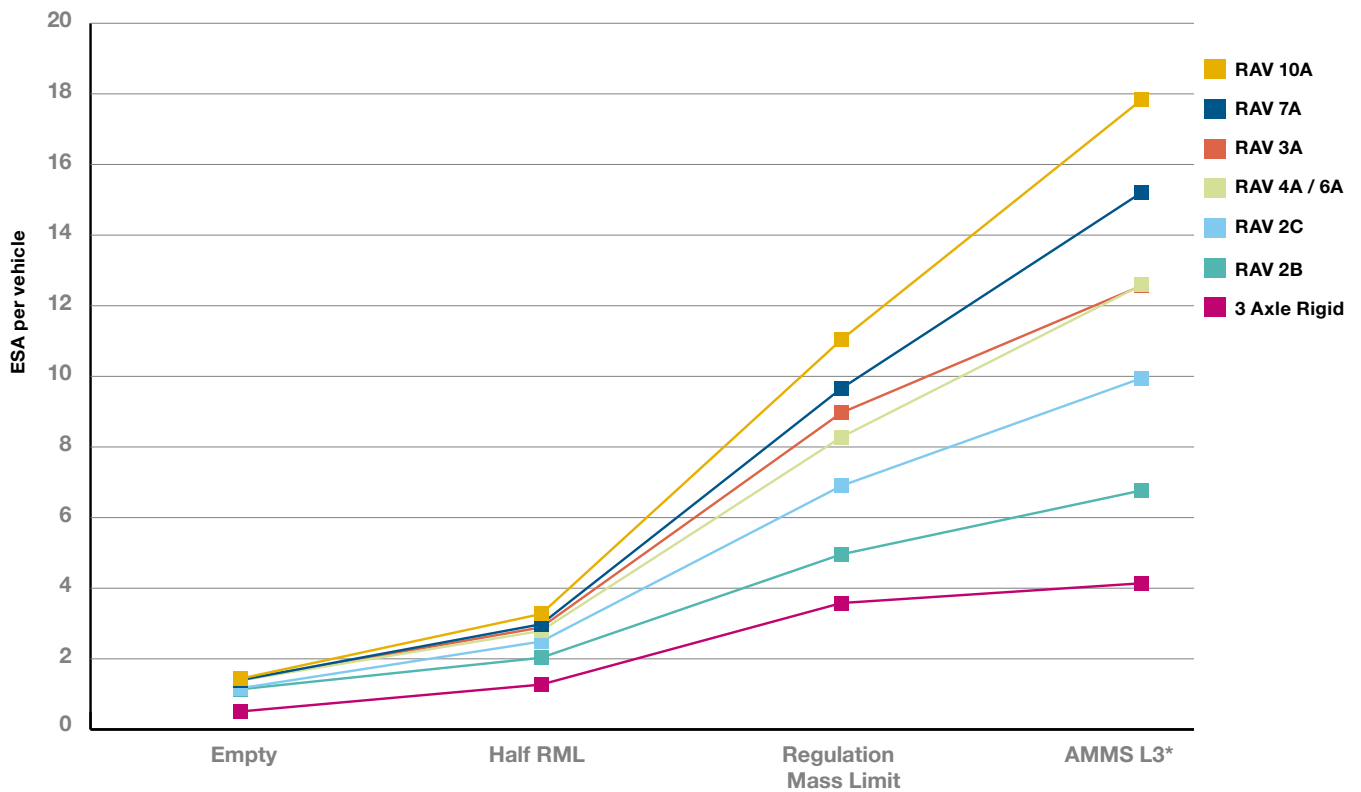


Figure 4: ESA per vehicle for increasing payload

*Note: The AMMS has three levels. The displayed values are for Level 3. If the vehicle is operating at a lower level then select a proportionate value between the RML value and the AMMS L3 value.

## STEP 6: Select the marginal cost graph

There are 64 output charts representing four cost zones, four road categories and four loading scenarios. Users must select the chart or charts that are relevant to the scenario that is being assessed.

The charts are structured in order of cost zone, then by road category and finally by the modelled loading scenarios. Table 1 facilitates easy access to the generated charts with a series of links to each of the relevant figures. The user must select the loading scenario that is closest to their actual scenario.

| From STEP 3<br>Cost zone | From STEP 4<br>Road class | From STEP 5<br>Loading scenario (ESA/year) | Figure link |
|---|---|---|---|
| 1 | Access road | 20,000 | Figure B 1.1 |
| | | 60,000 | Figure B 1.2 |
| | | 100,000 | Figure B 1.3 |
| | | 200,000 | Figure B 1.4 |
| | Local distributor | 20,000 | Figure B 2.1 |
| | | 60,000 | Figure B 2.2 |
| | | 100,000 | Figure B 2.3 |
| | | 200,000 | Figure B 2.4 |
| | Regional distributor | 20,000 | Figure B 3.1 |
| | | 60,000 | Figure B 3.2 |
| | | 100,000 | Figure B 3.3 |
| | | 200,000 | Figure B 3.4 |
| | District distributor | 20,000 | Figure B 4.1 |
| | | 60,000 | Figure B 4.2 |
| | | 100,000 | Figure B 4.3 |
| | | 200,000 | Figure B 4.4 |
| 2 | Access road | 20,000 | Figure B 5.1 |
| | | 60,000 | Figure B 5.2 |
| | | 100,000 | Figure B 5.3 |
| | | 200,000 | Figure B 5.4 |
| | Local distributor | 20,000 | Figure B 6.1 |
| | | 60,000 | Figure B 6.2 |
| | | 100,000 | Figure B 6.3 |
| | | 200,000 | Figure B 6.4 |
| | Regional distributor | 20,000 | Figure B 7.1 |
| | | 60,000 | Figure B 7.2 |
| | | 100,000 | Figure B 7.3 |
| | | 200,000 | Figure B 7.4 |
| | District distributor | 20,000 | Figure B 8.1 |
| | | 60,000 | Figure B 8.2 |
| | | 100,000 | Figure B 8.3 |
| | | 200,000 | Figure B 8.4 |

| From STEP 3<br>Cost zone | From STEP 4<br>Road class | From STEP 5<br>Loading scenario (ESA/year) | Figure link |
|---|---|---|---|
| 3 | Access road | 20,000 | Figure B 9.1 |
| | | 60,000 | Figure B 9.2 |
| | | 100,000 | Figure B 9.3 |
| | | 200,000 | Figure B 9.4 |
| | Local distributor | 20,000 | Figure B 10.1 |
| | | 60,000 | Figure B 10.2 |
| | | 100,000 | Figure B 10.3 |
| | | 200,000 | Figure B 10.4 |
| | Regional distributor | 20,000 | Figure B 11.1 |
| | | 60,000 | Figure B 11.2 |
| | | 100,000 | Figure B 11.3 |
| | | 200,000 | Figure B 11.4 |
| | District distributor | 20,000 | Figure B 12.1 |
| | | 60,000 | Figure B 12.2 |
| | | 100,000 | Figure B 12.3 |
| | | 200,000 | Figure B 12.4 |
| 4 | Access road | 20,000 | Figure B 13.1 |
| | | 60,000 | Figure B 13.2 |
| | | 100,000 | Figure B 13.3 |
| | | 200,000 | Figure B 13.4 |
| | Local distributor | 20,000 | Figure B 14.1 |
| | | 60,000 | Figure B 14.2 |
| | | 100,000 | Figure B 14.3 |
| | | 200,000 | Figure B 14.4 |
| | Regional distributor | 20,000 | Figure B 15.1 |
| | | 60,000 | Figure B 15.2 |
| | | 100,000 | Figure B 15.3 |
| | | 200,000 | Figure B 15.4 |
| | District distributor | 20,000 | Figure B 16.1 |
| | | 60,000 | Figure B 16.2 |
| | | 100,000 | Figure B 16.3 |
| | | 200,000 | Figure B 16.4 |

*Figure B 1.1 to Figure B 16.4 are located in Appendix B. An example is presented in Figure 5.*

Cost zone 1
Access road
60,000 ESA/year
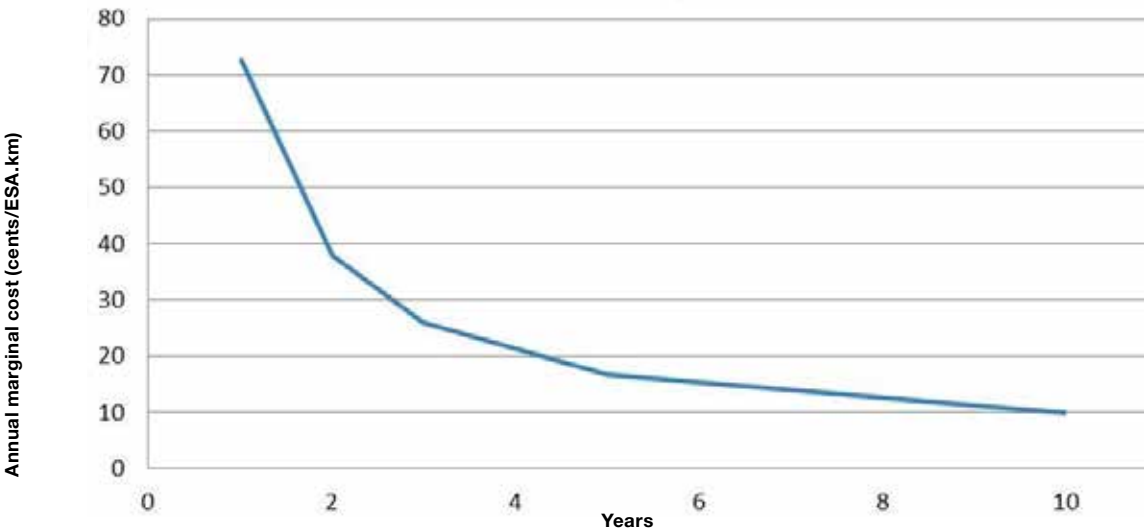


*Figure 5: Example chart of estimated marginal costs*

It is likely that the requested additional loading calculated in Step 5 will not match one of the four loading scenarios presented in this guide. The user must select the loading scenario that is closest to their calculated value.

For instance, a calculated value of 15,000 ESA/year would result in the selection of a loading scenario of 20,000 ESA/year from Table 1 as this is the closest matching available scenario.

## STEP 7: Determine the annual marginal cost of the additional task

Using the chart selected in STEP 6, the marginal cost of the additional loading can be determined. An example of how the chart is to be used is presented in Figure 6, which has been selected for a district distributor in cost zone 1 with an additional loading of 20,000 ESA/year.

Cost zone 1
District distributor
20,000 ESA/year
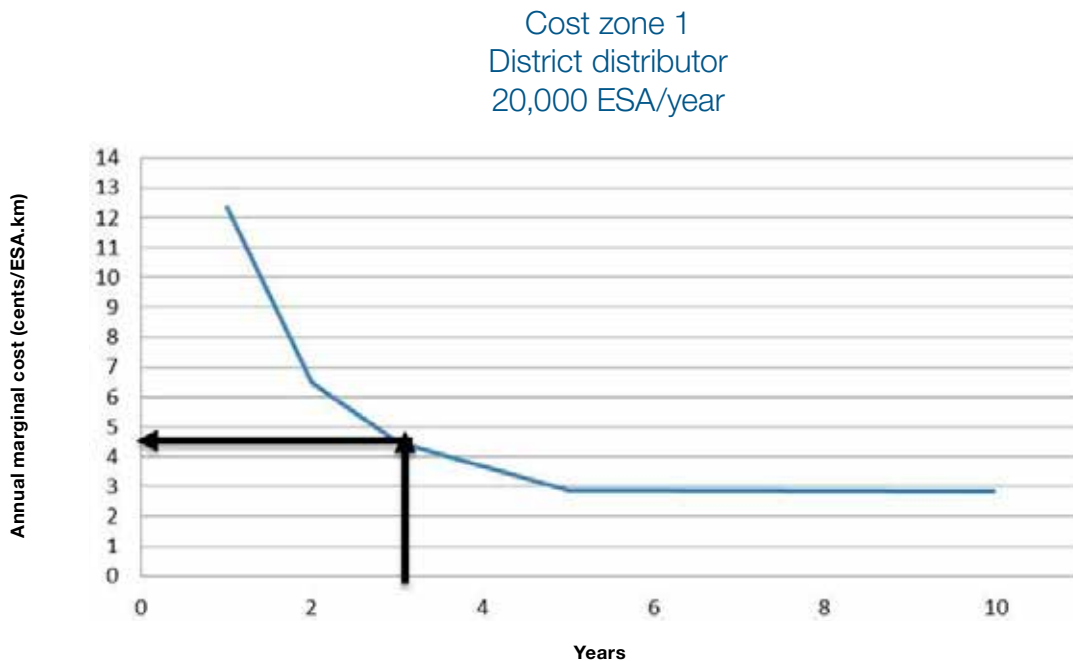


*Figure 6: Marginal cost chart of a district distributor in cost zone 1 with an additional 20,000 ESA/year*

To evaluate the marginal cost of a particular task, the duration of the task is required. For example in Figure 6, a loading duration of 3 years has been selected, and therefore the annual marginal cost is 4.5 cents per ESA. km/year or represented in dollars as $0.045 per ESA. km/year.

## STEP 8: Calculate an annual cost

The annual total cost is calculated using the annual marginal cost. The relevant equations are as follows:

**Annual Cost = Annual Marginal Cost x ESA per year x Distance**

Annual Marginal Cost in cents/ ESA.km is determined from Step 7

ESA per year is the actual ESA per year from Step 5.

Distance is the road distance in kilometres

This can converted back to a cost per tonne as follows:

**Cost per tonne = Annual Cost / (Annual Tonnage x Distance)**

The calculated costs are only valid for 2015 as ongoing years will need to have an escalation factor applied to accommodate for the increases in costs. Relevant factors will need to be obtained by users of the guide from appropriate sources to suit their particular study.

# 3   EXAMPLE CALCULATIONS

## 3.1 Worked Example #1

A mining company is developing a mine site in the Mid-West and proposes to transport 2 million tonnes of iron ore over a five year period along a Local Government road to access the State road network. They will be using a prime mover and semi-trailer towing two six axle dog trailers with a concessional loading permit (AMMS Level 3). The road is a local distributor and is 64 km long.

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

**Solution:**

### 1. Determine the vehicle type:

Go to Appendix A and select the applicable RAV Category.

A prime mover and semi-trailer towing two six axle dog trailers is a RAV 10 (A).

### 2. Determine the annual tonnage, distance and duration:

The annual tonnage is 2 000,000/5 = 400,000 tonnes per year.

The distance is 64km.

The duration is 5 years.

### 3. Select the cost zone:

Go to Figure 2 and select cost zone 2.
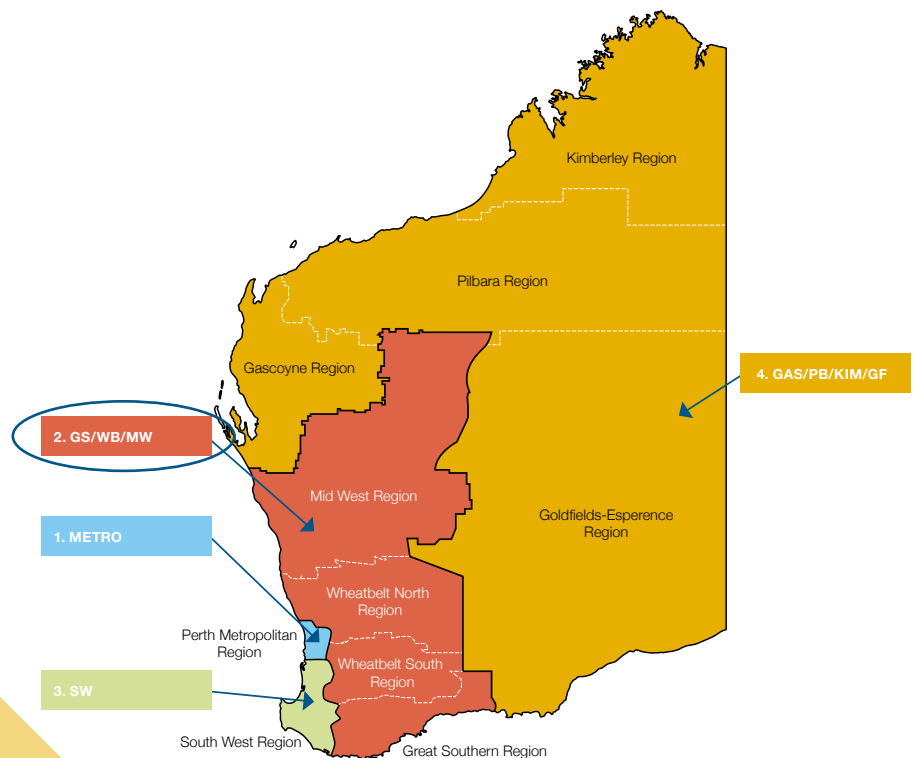


### 4. Select the road class:

As stated above, the task is to be undertaken on a local distributor.

## 5. Calculate the ESA per year:

Go to Figure 3, the ESA per payload tonne for a RAV 10(A) with a concessional load is 0.17.

The total ESA per year is therefore 0.17 x 400,000 = 68,000 ESA/year
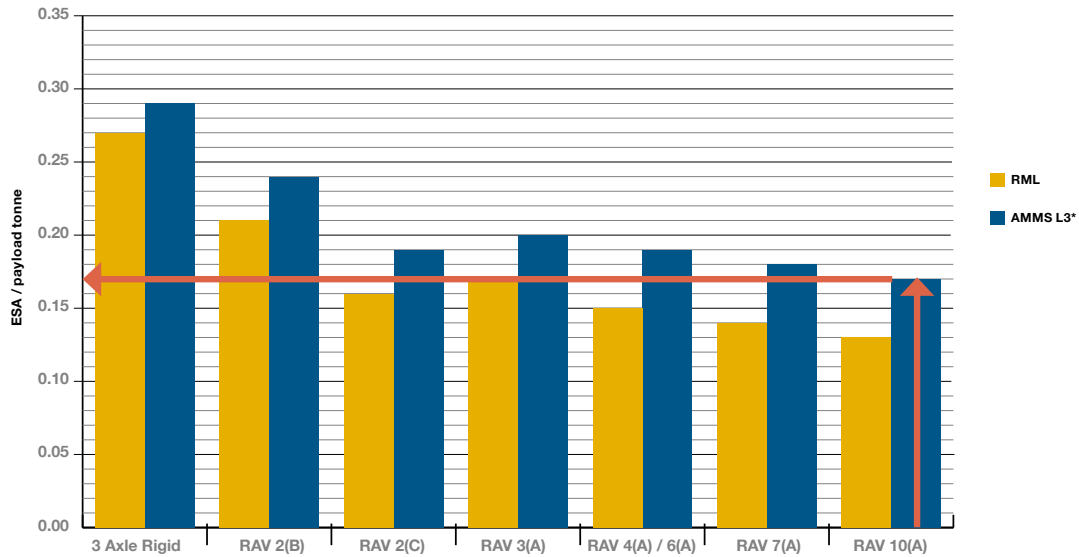


## 6. Select the marginal cost graph:

Based on the calculated task of 68,000 ESA/year as outlined Step 5 above, the 60,000 ESA/year loading scenario is the closest available value to be applied in this calculation. Therefore all of the required parameters to select a marginal cost graph are available, including:

Cost zone = 2, road class = local distributor, applicable load = 60,000 ESA/year and specified period of additional loading = 5 years

Using these values, Table 1 will lead you to the applicable marginal cost graph.

With all of the required criteria determined, select the required marginal cost chart from Appendix B. For this example, this is Figure B 6.2 and is shown in Step 7.

## 7. Determine the marginal cost:

With the appropriate marginal cost graph selected in Step 6, read off the marginal cost for the task duration.

### Cost zone 2
### Local distributor
### 60,000 ESA/year



Therefore, from the graph, the marginal cost is 10.7 cents per ESA.km/year or $0.107 per ESA.km/year.

## 8. Calculate annual cost:

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

The total loading task is 68,000 ESA/ year being applied over 64 km, so the total annual cost can be determined by multiplying these together:

Total Annual Cost = 0.107 x 68,000 x 64 = $465,664 per year

The cost per tonne, converted into cents per tonne.km can be calculated:

Cost per tonne = $465,664 x 100 / (400,000 x 64) = 1.82 cents per tonne.km.

Note: This is the estimated cost for the first year of the operation. Increases in the annual charge should be considered during discussions with the operator.

## 3.2 Worked Example #2

A mining company has decided to open up a mine site in the Kimberley region and wishes to transport 3.5 million tonnes of ore over a 5 year period along a Local Government road to access the state road network. Accessing the state road network consists of travelling along a district distributor for 40 km and a regional distributor for another 15 km. They are to use a truck towing two six axle dog trailers operating under the Accredited Mass Management Scheme Level 3 (AMMS L3).

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

**Solution:**

**1. Determine the vehicle type:**

Refer to Appendix A for an outline of all defined vehicles in WA.

A truck towing two six axle dog trailers is a RAV 7(A).

**2. Determine annual tonnage, distance and duration:**

The annual tonnage is 3,500,000/5 = 700,000 tonnes per year.

The distances are 40km and 15km.

The duration is 5 years.

**3. Select the cost zone:**

Go to Figure 2 and select cost zone 4.
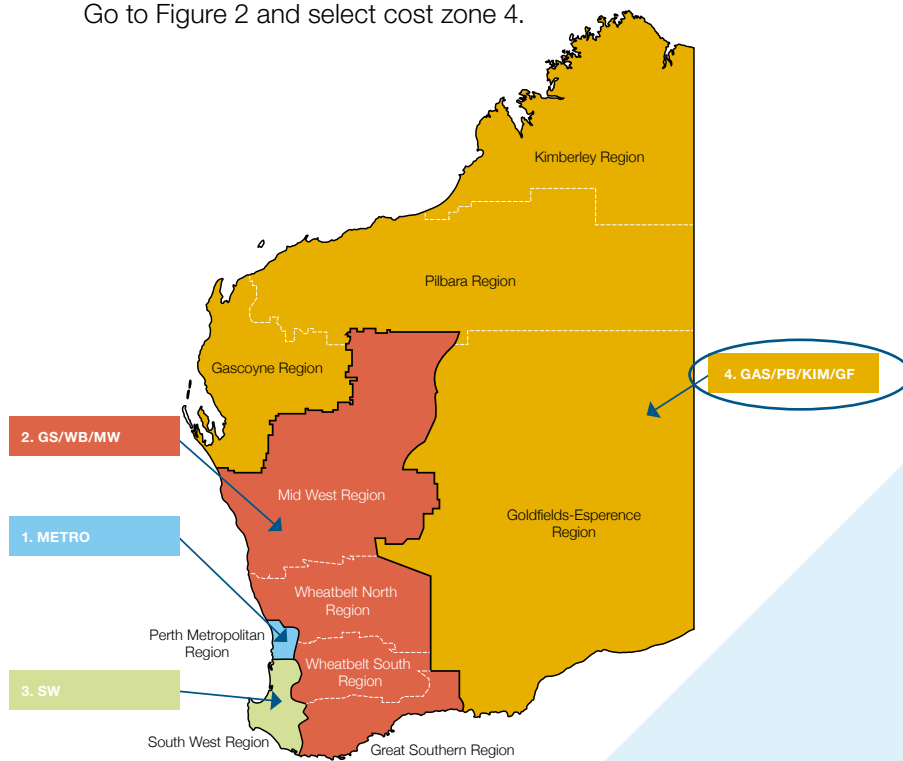


**4. Select the road class:**

As outlined above, both district distributor and regional distributor roads are selected.

## 5. Calculate the ESA per year:

Go to Figure 3, the ESA per payload tonne for a RAV 7(A) with a regulation load is 0.18.

The total ESA per year is therefore 0.18 x 700,000 = 126,000 ESA/year
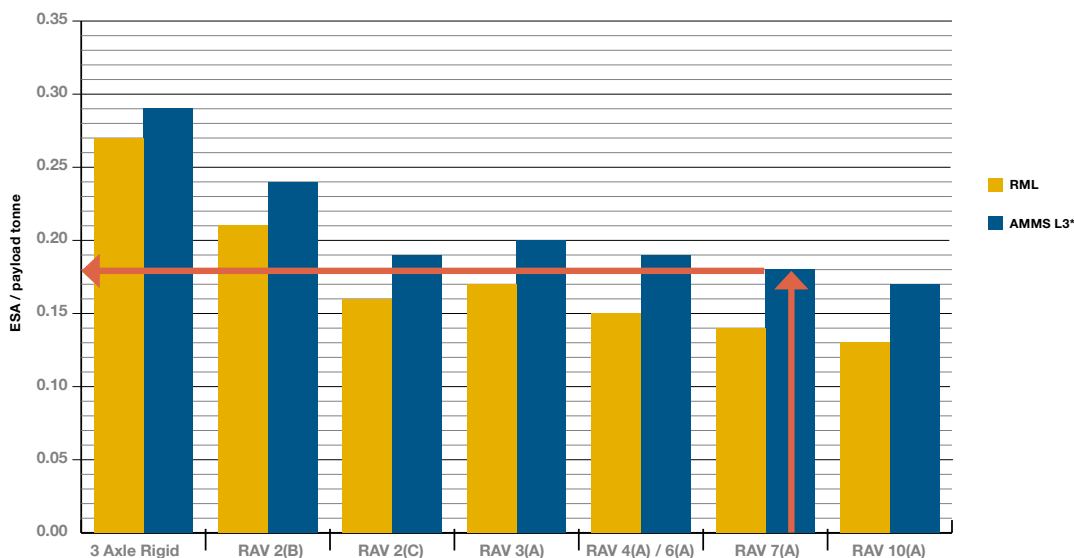


## 6. Select the marginal cost graph:

Using the calculated task of 126,000 ESA/year as outlined in Step 5, the 100,000 ESA/year loading scenario is the closest value to be applied in this calculation. Therefore all of the required parameters to select a marginal cost graph are available, including:

Cost zone = 4, road classes = district distributor and regional distributor, applicable load = 100,000 ESA/year and specified period of additional loading = 5 years

Using these values, Table 1 will lead you to the applicable marginal cost graph.

With all of the required criteria determined, select the required marginal cost chart from Appendix B. For this example, this is Figure B 16.3 for the district distributor and Figure B 15.3 for the regional distributor, as shown in Step 7 respectively.

| | | | |
|---|---|---|---|
| | | 100,000 | Figure B 13.3 |
| | | 200,000 | Figure B 13.4 |
| | Local distributor | 20,000 | Figure B 14.1 |
| | | 60,000 | Figure B 14.2 |
| | | 100,000 | Figure B 14.3 |
| | | 200,000 | Figure B 14.4 |
| 4 | | 20,000 | Figure B 15.1 |
| | Regional distributor | 60,000 | Figure B 15.2 |
| | | 100,000 | Figure B 15.3 |
| | | 200,000 | Figure B 15.4 |
| | | 20,000 | Figure B 16.1 |
| | District distributor | 60,000 | Figure B 16.2 |
| | | 100,000 | Figure B 16.3 |
| | | 200,000 | Figure B 16.4 |

### 7. Determine the marginal cost:

With the appropriate marginal cost graphs selected in Step 6, read off the marginal cost for the task duration.

**Cost zone 4**
**District distributor**
**100,000 ESA/year**



**Cost zone 4**
**Regional distributor**
**100,000 ESA/year**
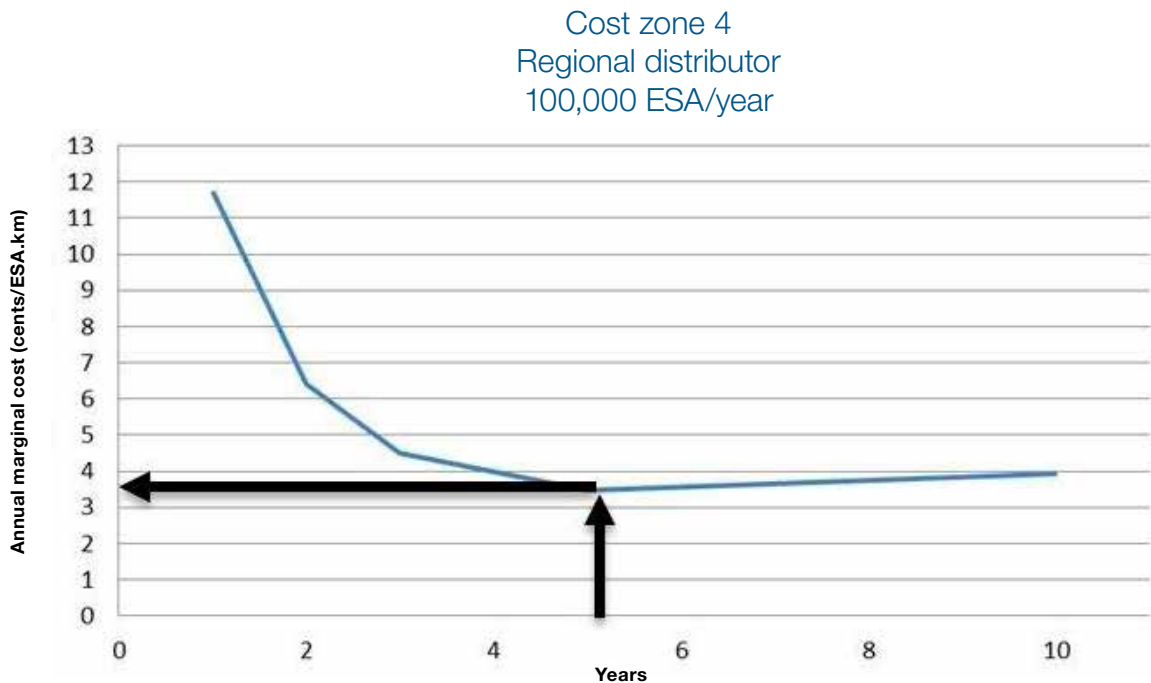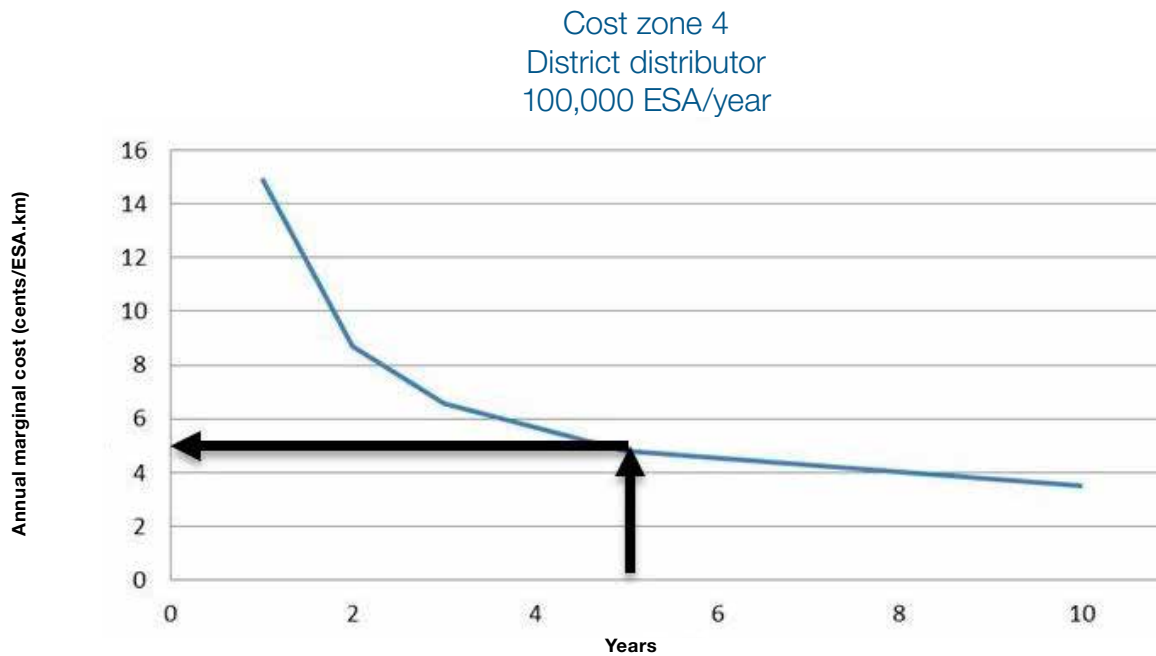


From the graphs, the marginal cost is 4.9 cents per ESA.km/year for the district distributor and 3.5 cents per ESA.km/year for the Regional distributor.

**8. Calculate an annual cost:**

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

The total loading task of 126,000 ESA/year will be applied to the district distributor for 40 km and then to the regional distributor for another 15 km, therefore the total annual cost can be determined as follows:

0.049 x 126,000 x 40 = $246,960 per year (for the district distributor)

0.035 x 126,000 x 15 = $66,150 per year (for the regional distributor)

The total annual cost is therefore $313,110 per year.

The total annual can be converted into cents per tonne. km as follows:

Cost per tonne =

$246,960 x 100/ (700,000 x 40) = 0.88 cents per tonne. km (for the district distributor)

$66,150 x100 / (700,000 x 15) = 0.63 cents per tonne. km (for the regional distributor)

*Note: These are the estimated costs for the first year of the operation. Increases in the annual charge should be considered during discussions with the operator.*

## 3.3 Worked Example #3

A sand quarry in the Metropolitan area is applying to transport an estimated 75,000 tonnes per year using a prime mover and semi-trailer operating under the regulation mass limit (RML). The task route will follow an access road for 1.3 km and then a regional distributor for 2.5 km to access the state road network. The quarry will operate for five years.

**Task:**

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

**Solution:**

**1. Determine the vehicle type:**

Refer to Appendix A for an outline of all defined vehicles in WA.

A prime mover and semi-trailer is a RAV 2(B).

**2. Determine the annual tonnage, distance and duration:**

The annual tonnage is 75,000 tonnes per year as given above.

The distances are 1.3km and 2.5km.

The duration is 5 years.

**3. Select the cost zone:**

Go to Figure 2 and select cost zone 1.



**4. GAS/PB/KIM/GF**

**2. GS/WB/MW**

**1. METRO**

**3. SW**

Kimberley Region

Pilbara Region

Gascoyne Region

Mid West Region

Goldfields-Esperence Region

Wheatbelt North Region

Perth Metropolitan Region

Wheatbelt South Region

South West Region

Great Southern Region
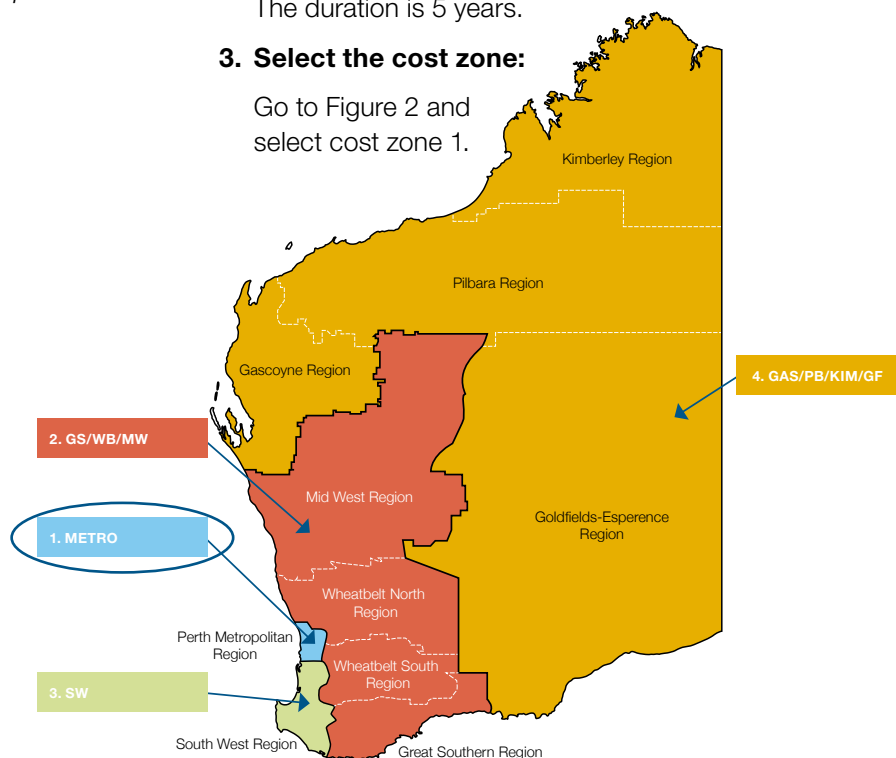
**4. Select the road class:**

As given, both an access road and a regional distributor are to be used in the calculation.

## 5. Calculate the ESA per year:

Go to Figure 3, the ESA per payload tonne for a RAV 2(B) at RML is 0.21.

The total ESA per year is therefore 0.21 x 75,000 = 15,750 ESA/year
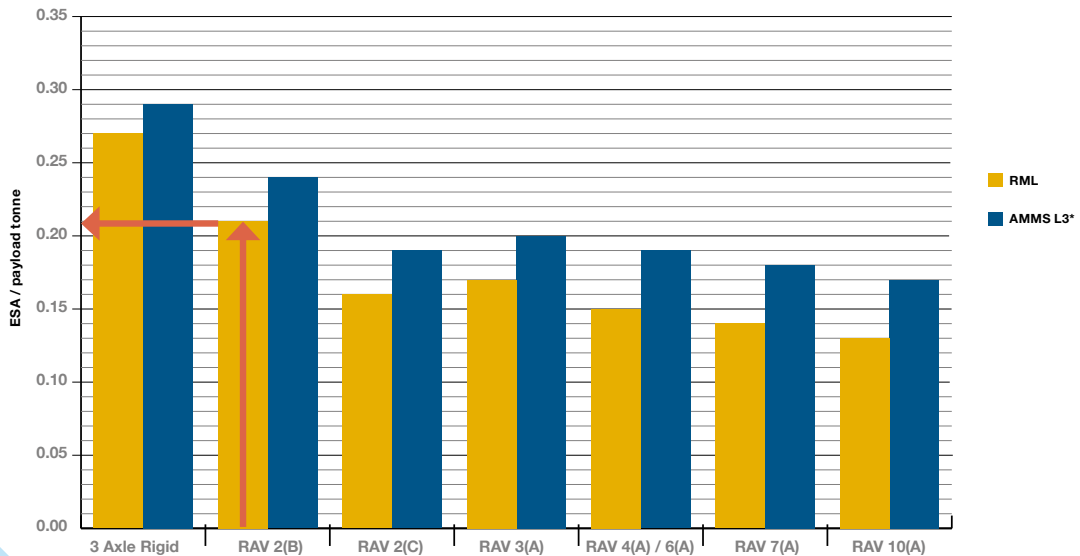


## 6. Select the marginal cost graph:

Based on the calculated task of 15,750 ESA/year, the 20,000 ESA/year loading scenario is the closest value to be applied in this calculation. Therefore all of the required parameters to select a marginal cost graph are available, including:

Cost zone = 1, road classes = access road and
regional distributor, applicable load = 20,000 ESA/year and specified period of additional loading = 5 years

Using these values, Table 1 will lead you to the applicable marginal cost graphs.

With all of the required criteria determined, select the required graphs from Appendix B. For this example, this is Figure B 1.1 for the access road and Figure B 3.1 for the regional distributor, as shown in Step 7 respectively.

| From STEP 3 Cost zone | From STEP 4 Road class | From STEP 5 Loading scenario (ESA/year) | Figure link |
|---|---|---|---|
| | Access road | 20,000 | Figure B 1.1 |
| | | 60,000 | Figure B 1.2 |
| | | 100,000 | Figure B 1.3 |
| | | 200,000 | Figure B 1.4 |
| | Local distributor | 20,000 | Figure B 2.1 |
| | | 60,000 | Figure B 2.2 |
| | | 100,000 | Figure B 2.3 |
| | | 200,000 | Figure B 2.4 |
| 1 | Regional distributor | 20,000 | Figure B 3.1 |
| | | 60,000 | Figure B 3.2 |
| | | 100,000 | Figure B 3.3 |
| | | 200,000 | Figure B 3.4 |
| | District distributor | 20,000 | Figure B 4.1 |
| | | 60,000 | Figure B 4.2 |
| | | 100,000 | Figure B 4.3 |
| | | 200,000 | Figure B 4.4 |
| | Access road | 20 000 | Figure B 5.1 |
| | | 60 000 | Figure B 5.2 |
| | | 100 000 | Figure B 5.3 |
| | | 200 000 | Figure B 5.4 |
| | | 20 000 | Figure B 6.1 |

### 7. Determine the marginal cost:

With the appropriate marginal cost graphs selected in Step 6, read off the marginal cost for the task duration.

**Cost zone 1**
**Access road**
**20,000 ESA/year**



**Cost zone 1**
**Regional distributor**
**20,000 ESA/year**
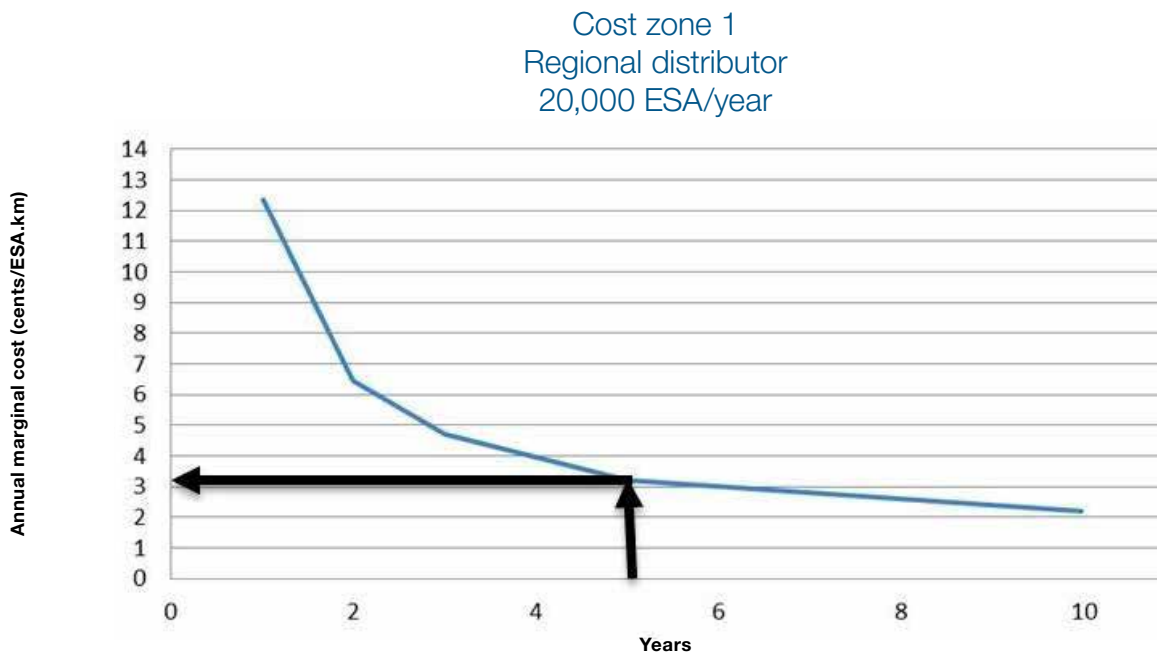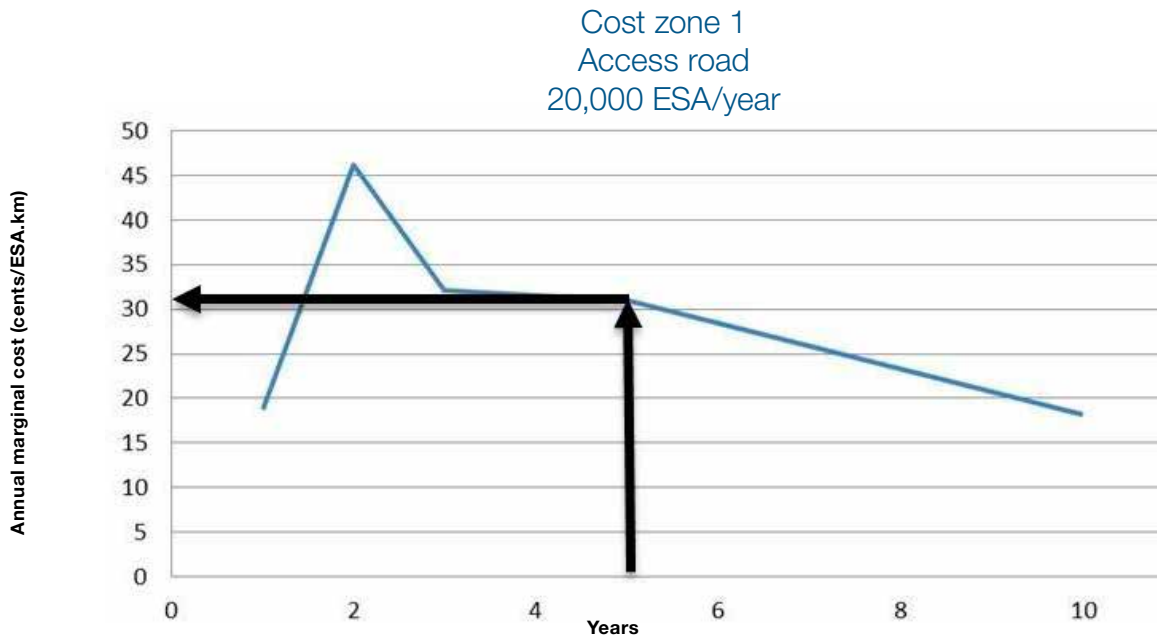


From the graphs, the marginal cost is 30.8 cents per ESA.km/year for the access road and 3.1 cents per ESA.km/year for the regional distributor.

## 8. Calculate an annual cost:

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

The total loading task is 15,750 ESA/year being applied to the access road for 1.3 km and then to the regional distributor for 2.5 km, so the annual cost can be determined as follows:

0.308 x 15,750 x 1.3 = $6306 per year (for the access road)

0.031 x 15,750 x 2.5 = $1221 per year (for the regional distributor)

The total annual cost is therefore $7527 per year

Using the total annual cost, the cost per tonne, converted into cents per tonne.km can be calculated as follows:

Cost per tonne =

$6306 x 100/ (75,000 x 1.3) = 6.5 cents per tonne.km (for the access road)

$1221 x 100 / (75,000 x 2.5) = 0.65 cents per tonne.km (for the regional distributor)

*Note: These are the estimated costs for the first year of the operation. Increases in the annual charge should be considered during discussions with the operator.*

## 3.4 Worked Example #4

A new mining company has decided to open up a mine site in the Gascoyne region. In this case however they are constrained by the number of vehicles they have at their disposal and have calculated that within a year they can deliver 10,000 trips to the site while using only prime movers with a semi-trailer towing two six axle dog trailers. The company is operating their vehicles under the Accredited Mass Management Scheme Level 3. The life of the mine is forecast as 6 years. The company would like access to a 30 km long regional distributor that is managed by the Local Government.

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

**Solution:**

**1. Determine the vehicle type:**

Refer to Appendix A for an outline of all defined vehicles in WA.

A prime mover and semi-trailer towing two six axle dog trailers is a RAV 10(A).

**2. Determine the annual tonnage, distance and duration:**

As outlined above, the annual freight loading is unknown but the number of trips with a RAV 10(A) is estimated to be 10,000 per year.

The distance is 30km.

The duration is 6 years.

**3. Select the cost zone:**

Go to Figure 2 and select cost zone 4.
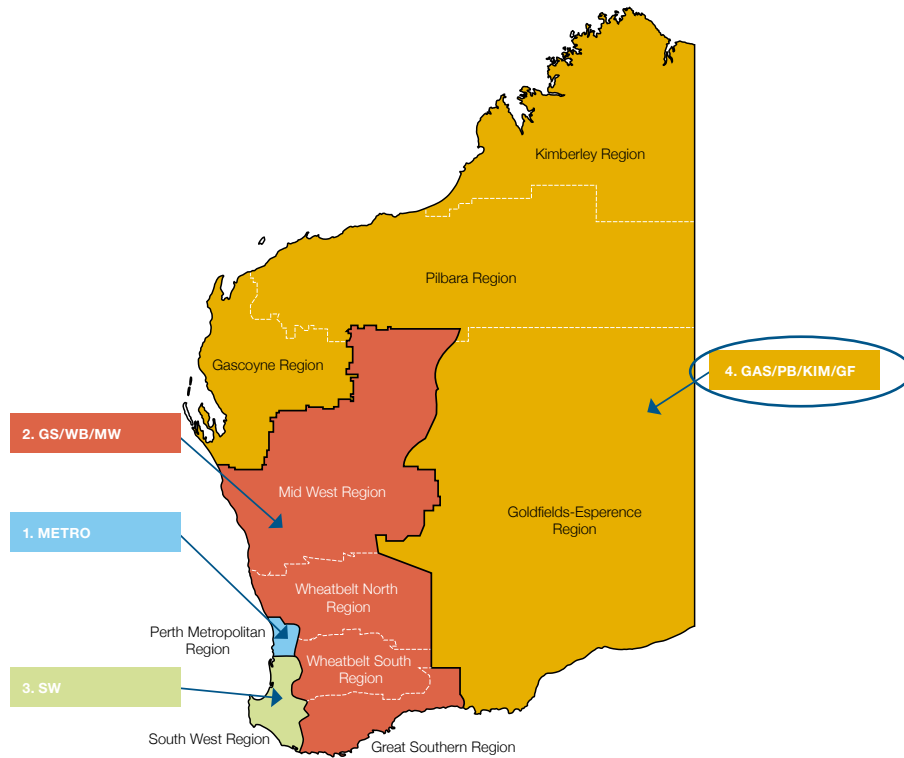
## 4. Select the road class:

As outlined above, the task is to operate on a regional distributor.

## 5. Calculate the ESA per year:
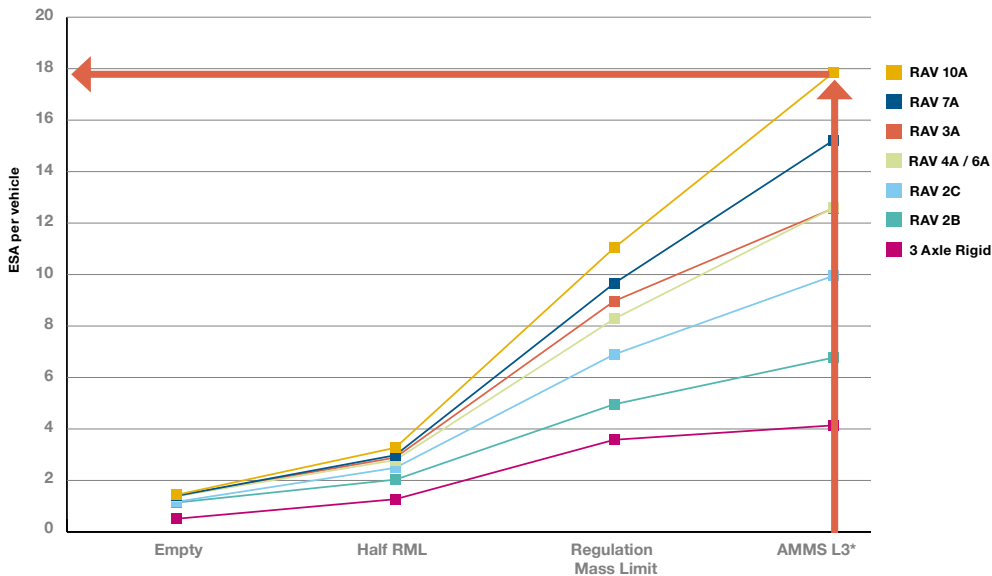


Go to Figure 3, the ESA per vehicle for a RAV 10(A) with concessional mass limit is approximately 18.

The total ESA per year is therefore 18 x 10,000 trips = 180,000 ESA/year

## 6. Select the marginal cost graph:

Based on the calculated task of 180,000 ESA/year as outlined Step 5, the 200,000 ESA/year loading scenario is the closest value to be applied in this calculation. Therefore all of the required parameters to select a marginal cost graph are available, including:

Cost zone = 4, road class = regional distributor, applicable load = 200,000 ESA/year and specified period of additional loading = 6 years.

Using these values, Table 1 will lead you to the applicable marginal cost graph as follows:

With all of the required criteria determined, select Figure B 15.4 from Appendix B.

| | | 100,000 | Figure B 13.3 |
|---|---|---|---|
| | | 200,000 | Figure B 13.4 |
| 4 | Local distributor | 20,000 | Figure B 14.1 |
| | | 60,000 | Figure B 14.2 |
| | | 100,000 | Figure B 14.3 |
| | | 200,000 | Figure B 14.4 |
| | Regional distributor | 20,000 | Figure B 15.1 |
| | | 60,000 | Figure B 15.2 |
| | | 100,000 | Figure B 15.3 |
| | | 200,000 | Figure B 15.4 |
| | District distributor | 20,000 | Figure B 16.1 |
| | | 60,000 | Figure B 16.2 |
| | | 100,000 | Figure B 16.3 |
| | | 200,000 | Figure B 16.4 |

## 7. Determine the marginal cost:

With the appropriate marginal cost graph selected in Step 6, read off the marginal cost for the task duration.

### Cost zone 4
### Regional distributor
### 200,000 ESA/year
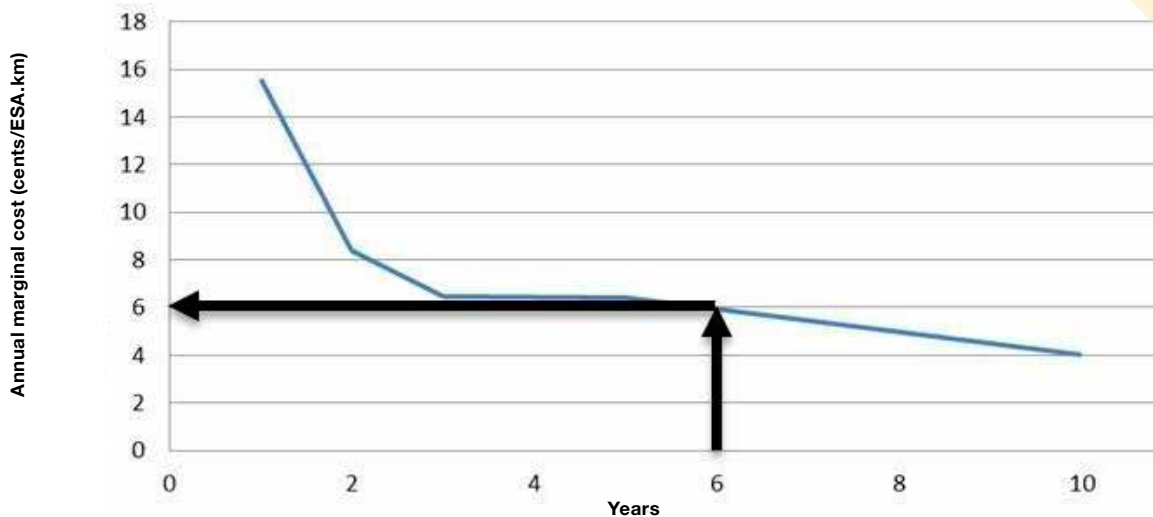


From the graph, the annual marginal cost is 6 cents per ESA.km/year.

## 8. Calculate an annual cost:

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

The total loading task was 180,000 ESA/year being applied over 30 km, so the total marginal cost can be determined by multiplying these together:

0.06 x 180,000 x 30 = $324,000 per year

With the total marginal cost determined, the cost per trip can be calculated:

Cost per trip = $324,000/ 10,000 = $32.40 per trip.

*Note: These are the estimated costs for one year of operation. Increases in the cost per trip charge should be considered during discussions with the operator for each year of operation.*

# 4 REFERENCES

ARRB Group 2015, 'Estimating the Incremental Cost Impact on Sealed Local Roads from Additional Freight Tasks', ARRB Group Contract Report 009335 for Western Australia Local Government Association, Perth, Western Australia.

Austroads 2010, 'Guide to Pavement Technology, Part 2: Pavement Structural Design', Austroads, Sydney, New South Wales.

# APPENDIX A - DEFINED VEHICLE TYPES IN WESTERN AUSTRALIA

## RAV 2015
### Heavy Vehicle Operations

# Prime Mover, Trailer Combinations

## VEHICLE DESCRIPTION AND CONFIGURATION CHART (RAV) – PRIME MOVER, TRAILER COMBINATIONS EXAMPLES

**Category 1**
- (A) PRIME MOVER, SEMI TRAILER TOWING A PIG TRAILER
- (B) PRIME MOVER TOWING AN OVERHEIGHT SEMI TRAILER
- (C) SHORT B-DOUBLE
- (D) TWINSTEER PRIME MOVER TOWING SEMI TRAILER

**Category 2**
- (A) PRIME MOVER, SEMI TRAILER TOWING A PIG TRAILER
- (B) PRIME MOVER TOWING SEMI TRAILER
- (C) B-DOUBLE
- (D) SHORT B TRIPLE
- (E) CAR CARRIER SEMI TRAILER

**Category 3**
- (A) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER

**Category 4**
- (A) PRIME MOVER, SEMI TRAILER TOWING 6 AXLE DOG TRAILER

**Category 5**
- (A) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER
- (B) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER AND CONVERTER DOLLY
- (C) B-DOUBLE TOWING A CONVERTER DOLLY
- (D) B-TRIPLE

**Category 6**
- (A) PRIME MOVER, SEMI TRAILER TOWING 6 AXLE DOG TRAILER
- (B) B-TRIPLE
- (C) PRIME MOVER SEMI TRAILER TOWING A 6 AXLE TRAILER & CONVERTER DOLLY

**Category 7**
- (A) PRIME MOVER, TOWING SEMI TRAILER AND B DOUBLE
- (B) B-DOUBLE TOWING A DOG TRAILER

**Category 9**
- (A) PRIME MOVER, SEMI TRAILER TOWING 2 X DOG TRAILERS
- (B) PRIME MOVER, SEMI TRAILER TOWING A DOG TRAILER AND CONVERTER DOLLY
- (C) B DOUBLE TOWING A DOG TRAILER
- (D) PRIME MOVER, SEMI TRAILER TOWING A B-DOUBLE

**Category 10**
- (A) PRIME MOVER, SEMI TRAILER TOWING 2 X 6 AXLE DOG TRAILERS
- (B) B-DOUBLE TOWING A CONVERTER DOLLY CONNECTED TO 2 SEMI TRAILERS
- (C) PRIME MOVER, SEMI TRAILER TOWING B TRIPLE
- (D) B-DOUBLE TOWING 2 DOG TRAILERS
- (E) DOUBLE ROAD TRAIN TOWING B-DOUBLE TRAILERS
- (F) PRIME MOVER, SEMI TRAILER TOWING A 6 AXLE DOG TRAILER AND CONVERTER DOLLY

Example of Axle Groups

Example of Axle Group with An Optional Axle — Optional Axle

| Cat | Config | Axle Spacing Table | Length (m) | Mass (T) Maximum Permitted Mass | Height (m) () = see NOTES | Axle Groups | RAV Network |
|---|---|---|---|---|---|---|---|
| 1 | (A) | A | ≤20 | 50 | ≤4.6 (4) | 4 | Network 1 |
| | (B) | A | ≤19 | 42.5 | ≤3.5 (5) | 3 | |
| | (C) | A | ≤20 | 50 | ≤4.6 (4) | 4 | |
| | (D) | A | ≤19 | 47.5 | ≤4.6 (4) | 3 | |
| 2 | (A) | A | ≤27.5 | 65.5 | ≤4.6 (4) | 4 | Network 2 |
| | (B) | A | ≤20 | 42.5 | ≤3.5 (5) | 3 | |
| | (C) | A | ≤27.5 | 67.5 | ≤4.6 (4) | 4 | |
| | (D) | A | ≤27.5 | 87.5 | ≤4.6 (4) | 5 | |
| | (E) | A | ≤25 | 42.5 | ≤4.6 (4) | 3 | |
| 3 | (A) | B | ≤27.5 | 84 | ≤4.6 (4) | 5 | Network 3 |
| 4 | (A) | A | ≤27.5 | 87.5 | ≤4.6 (4) | 5 | Network 4 |
| 5 | (A) | B | >27.5,≤36.5 | 84 | ≤4.6 (4) | 5 | Network 5 |
| | (B) | B | >27.5,≤36.5 | 84+d | ≤4.6 (4) | 6 | |
| | (C) | A | >27.5,≤36.5 | 67.5+d | ≤4.6 (4) | 5 | |
| | (D) | A | >27.5,≤36.5 | 84 | ≤4.6 (4) | 5 | |
| 6 | (A) | A | >27.5,≤36.5 | 87.5 | ≤4.6 (4) | 5 | Network 6 |
| | (B) | A | >27.5,≤36.5 | 87.5 | ≤4.6 (4) | 5 | |
| | (C) | A | >27.5,≤36.5 | 87.5+d | ≤4.6 (4) | 6 | |
| 7 | (A) | A | >27.5,≤36.5 | 107.5 | ≤4.6 (4) | 6 | Network 7 |
| | (B) | A | >27.5,≤36.5 | 107.5 | ≤4.6 (4) | 6 | |
| 9 | (A) | B | >36.5,≤53.5 | 120.5 | ≤4.6 (4) | 7 | Network 9 |
| | (B) | B | >36.5,≤53.5 | 84+d | ≤4.6 (4) | 6 | |
| | (C) | A | >36.5,≤45 | 107.5 | ≤4.6 (4) | 6 | |
| | (D) | A | >36.5,≤45 | 107.5 | ≤4.6 (4) | 6 | |
| 10 | (A) | A | >36.5,≤53.5 | 127.5 | ≤4.6 (4) | 7 | Network 10 |
| | (B) | A | >36.5,≤53.5 | 127.5 | ≤4.6 (4) | 7 | |
| | (C) | A | >36.5,≤53.5 | 127.5 | ≤4.6 (4) | 7 | |
| | (D) | A | >36.5,≤53.5 | 147.5 | ≤4.6 (4) | 8 | |
| | (E) | A | >36.5,≤53.5 | 147.5 | ≤4.6 (4) | 8 | |
| | (F) | A | >36.5,≤53.5 | 87.5+d | ≤4.6 (4) | 6 | |

### NOTES

1. Operators using a category of RAV outlined in this document must operate that RAV in accordance with the OPERATING CONDITIONS and only on the network specified.
2. These diagrams are a visual indication of the vehicle only.
3. Operators must refer to the OPERATING CONDITIONS for the full vehicle description.
4. The height of the vehicle can exceed 4.3m but MUST NOT exceed 4.6m when it is:
   (i) built to carry livestock or; (ii) carrying a crate to carry livestock or; (iii) carrying vehicles on more than one deck or;
   (iv) carrying a multi modal container or; (v) carrying a large indivisible item or; (vi) When operating with an appropriately licenced over height curtain side or pantechnicon Trailer.
5. Maximum height of Pig Trailer only.

**Heavy Vehicle Operations**
Tel: **138 HVO (138 486)**
Email: hvo@mainroads.wa.gov.au
Website: www.mainroads.wa.gov.au

**mainroads** WESTERN AUSTRALIA

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# RAV 2015
## Heavy Vehicle Operations

# Truck, Trailer Combinations

## VEHICLE DESCRIPTION AND CONFIGURATION CHART    (RAV) – TRUCK, TRAILER COMBINATIONS EXAMPLES

| Category | Vehicle | | Axle Spacing Table | Length (m) | Mass (T) Maximum Permitted Mass | Height (m) (* = see note) | Axle Groups | RAV Network |
|---|---|---|---|---|---|---|---|---|
| **1** | (A) TRUCK LIVESTOCK OR VEHICLE CARRIER | (A) | A | <12.5 | 27.5 | ≤4.6 (4) | 2 | Network 1 |
| | (B) TRUCK TOWING A PIG TRAILER | (B) | B | ≤20 | 45.5 | ≤4.6 (4) | 3 | |
| | (C) TRUCK TOWING A DOG TRAILER | (C) | B | ≤20 | 50 | ≤4.6 (4) | 4 | |
| | (D) TRUCK TOWING A CAR CARRIER TRAILER | (D) | A | ≤20 | 42.5 | ≤4.6 (4) | 3 | |
| **2** | (A) TRUCK TOWING A 6 AXLE DOG TRAILER | (A) | A | ≤25 | 67.5 | ≤4.6 (4) | 4 | Network 2 |
| | (B) TRUCK TOWING A CAR CARRIER TRAILER | (B) | A | ≤25 | 42.5 | ≤4.6 (4) | 3 | |
| | (C) TRUCK TOWING A 2,3,4 OR 5 AXLE DOG TRAILER | (C) | B | ≤25 | 64.0 | ≤4.6 (4) | 4 | |
| **7** | (A) TRUCK TOWING 2 X 5 OR 6 AXLE DOG TRAILERS | (A) | A | >27.5, ≤36.5 | 107.5 | ≤4.3 | 6 | Network 7 |
| **8** | (A) TRUCK TOWING 2 DOG TRAILERS | (A) | A | >27.5, ≤36.5 | 107.5 | ≤4.3 | 6 | Network 8 |

**Example of Axle Groups**

**Example of Axle Group with An Optional Axle**

Optional Axle

**NOTES**

1. Operators using a category of RAV outlined in this document must operate that RAV in accordance with the OPERATING CONDITIONS and only on the network specified.
2. These diagrams are a visual indication of the vehicle only.
3. Operators must refer to the OPERATING CONDITIONS for the full vehicle description.

4. The height of the vehicle can exceed 4.3 m but MUST NOT exceed 4.6 m when it is:
   (i) built to carry livestock or; (ii) carrying a crate to carry livestock or; (iii) carrying vehicles on more than one deck or;
   (iv) carrying a multi modal container or; (v) carrying a large indivisible item or; (vi) When operating with an appropriately licenced over height curtain side or pantechnicon Trailer.
5. Maximum height of Pig Trailer only.

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# APPENDIX B – MARGINAL COST CHARTS

## B.1 Cost zone 1 – Access roads

**Figure B 1.1**

Cost zone 1
Access road
20,000 ESA/year
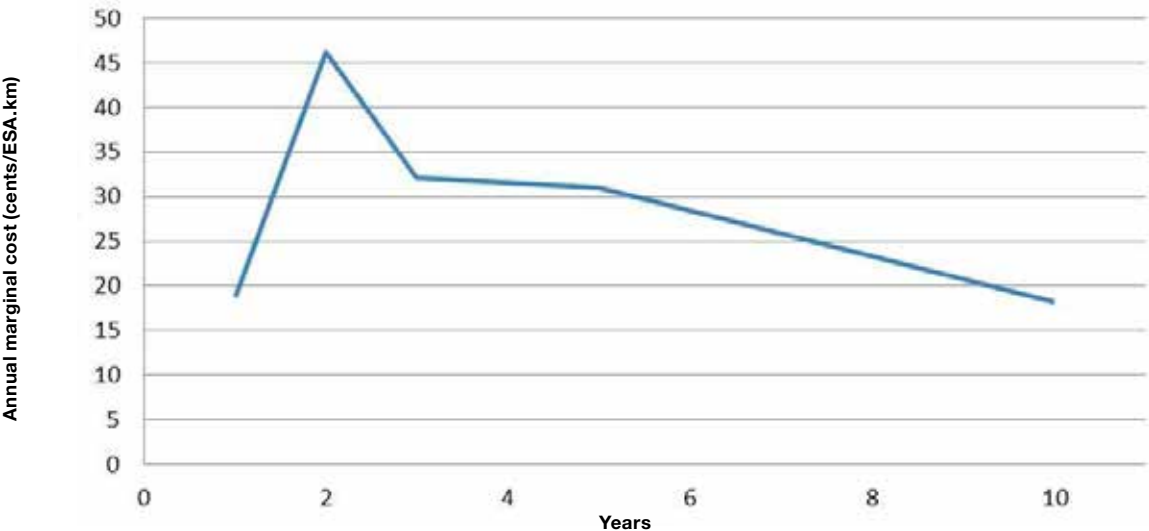


**Figure B 1.2**

Cost zone 1
Access road
60,000 ESA/year
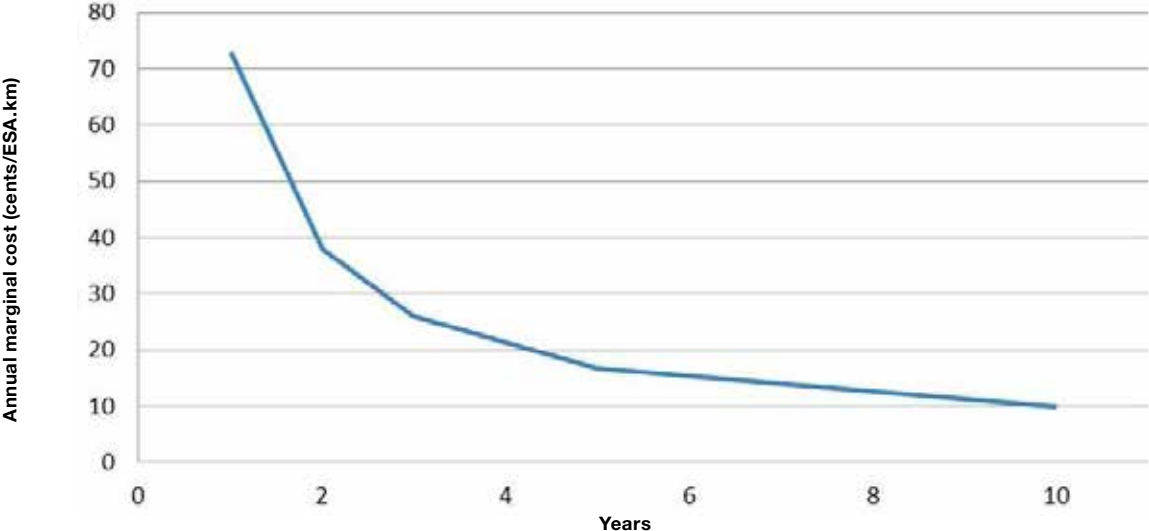
**Figure B 1.3**

Cost zone 1
Access road
100,000 ESA/year
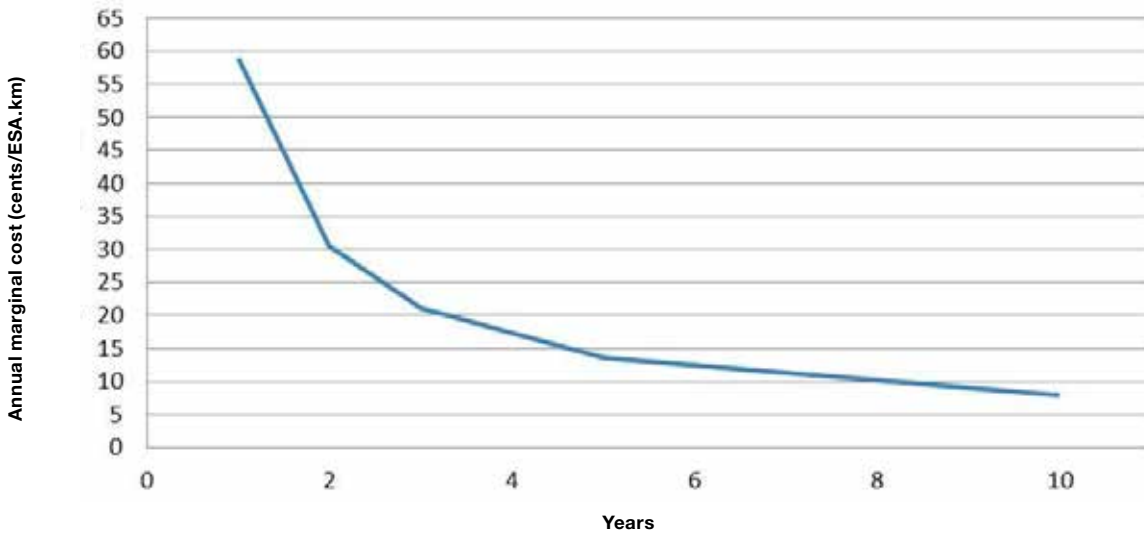


**Figure B 1.4**

Cost zone 1
Access road
200,000 ESA/year
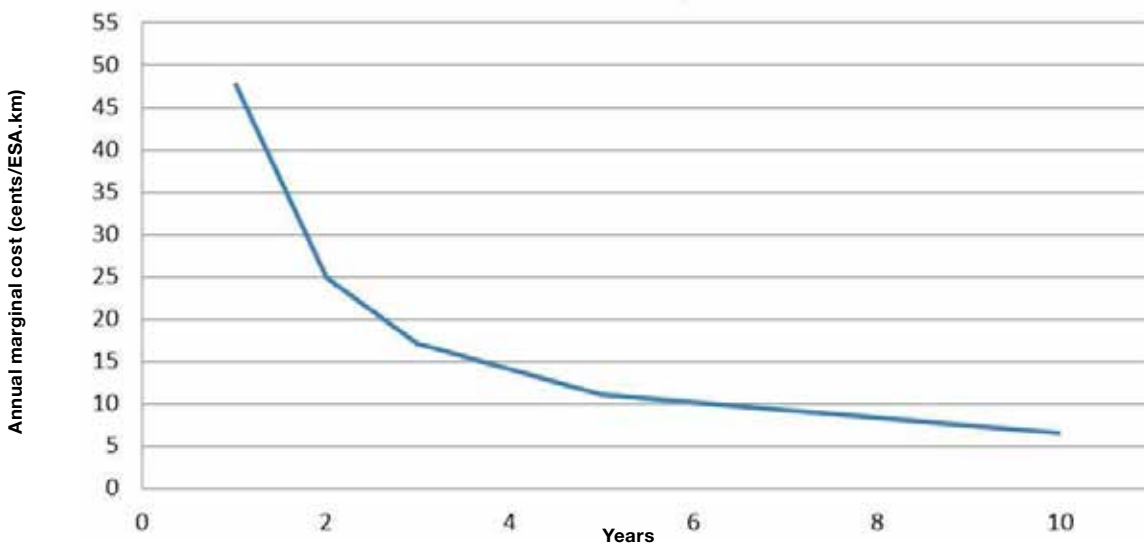
## B.2 Cost zone 1 – Local distributor

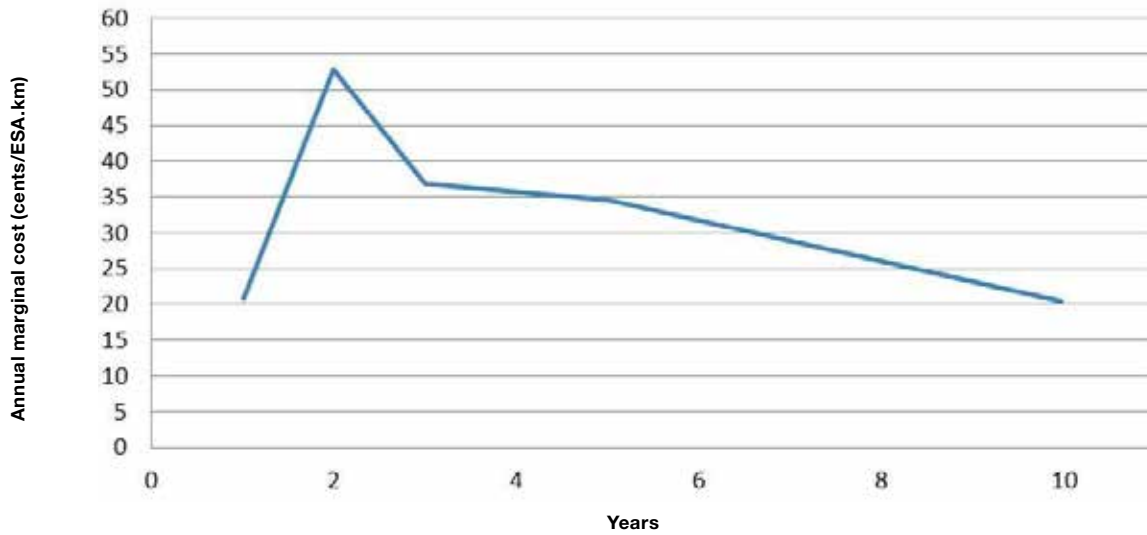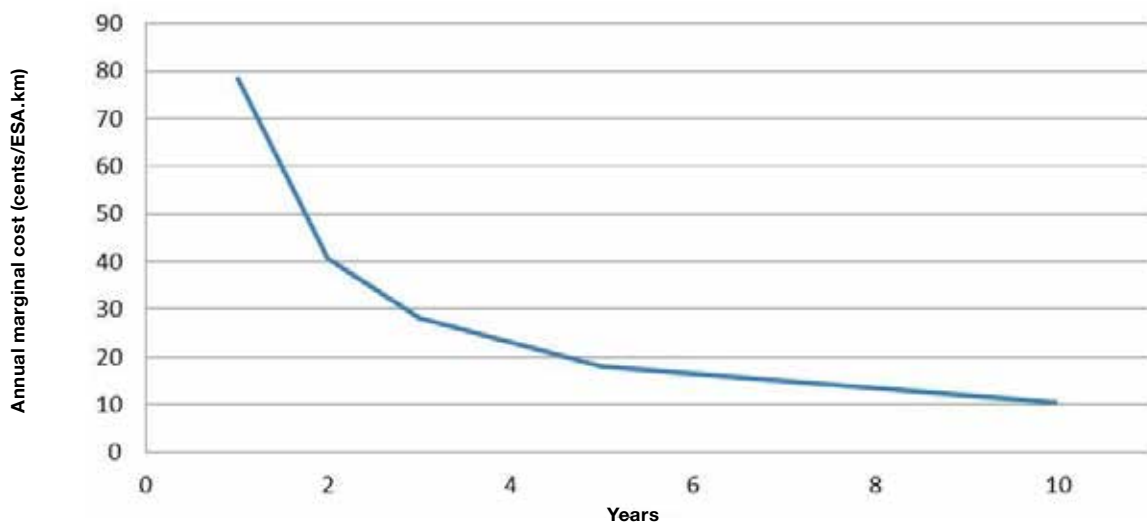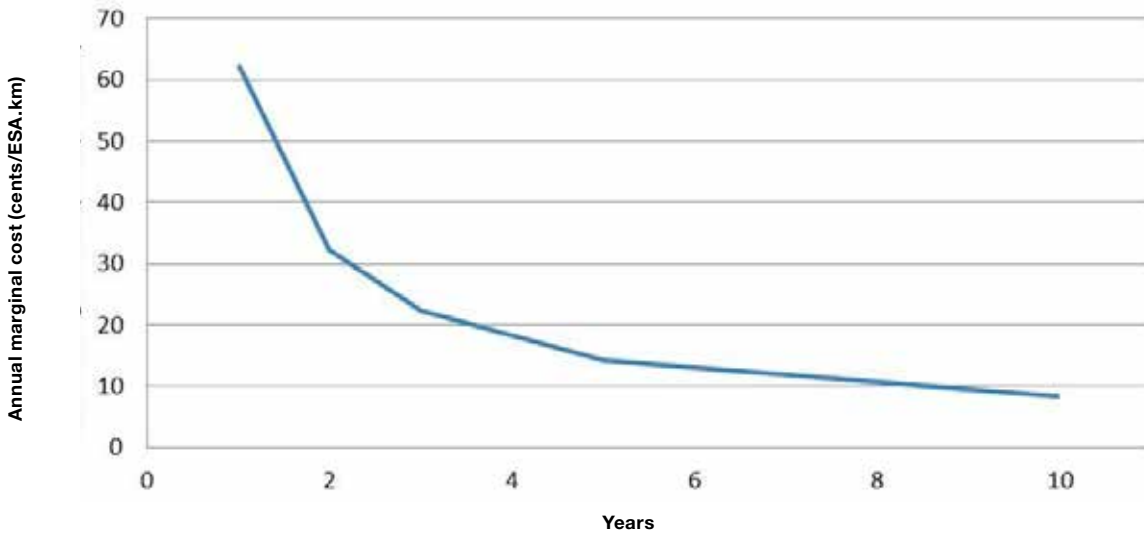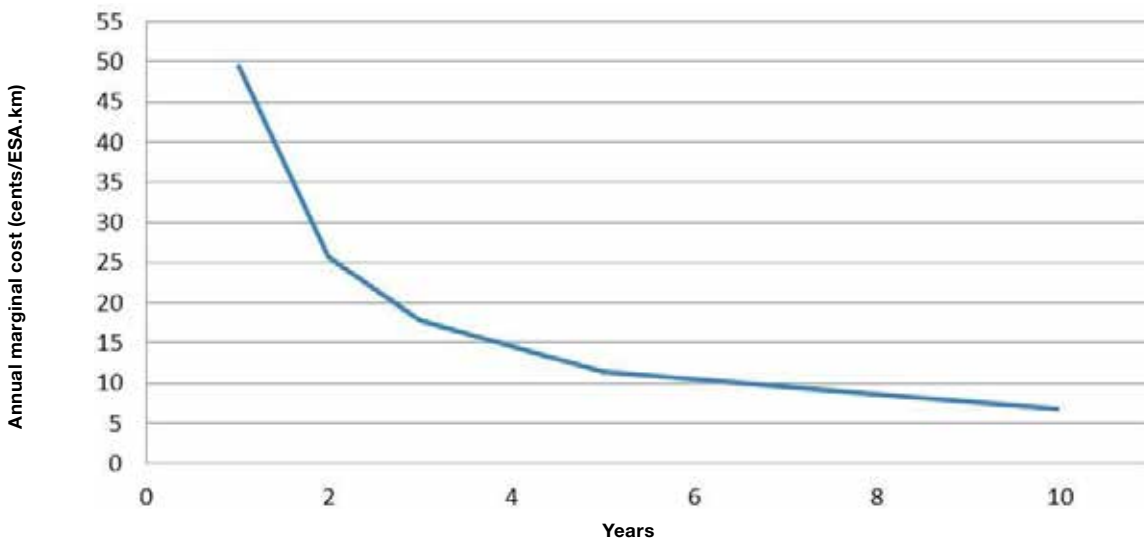**Figure B 2.1**

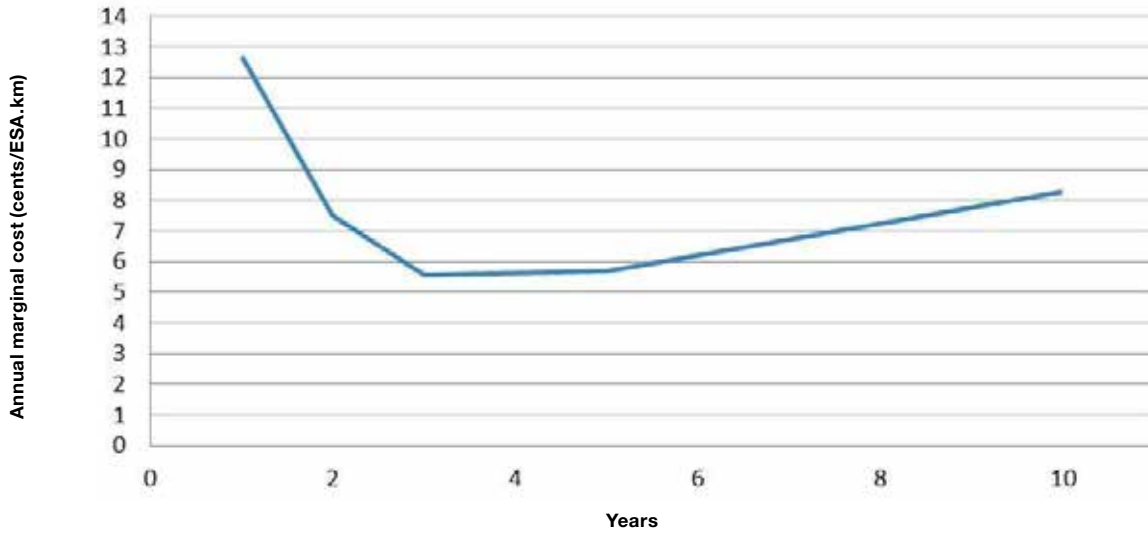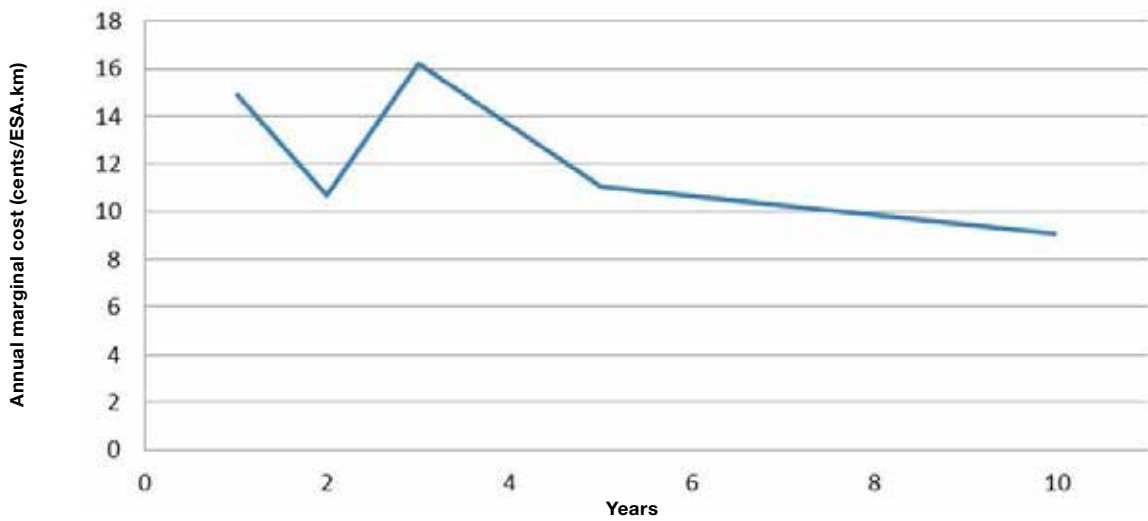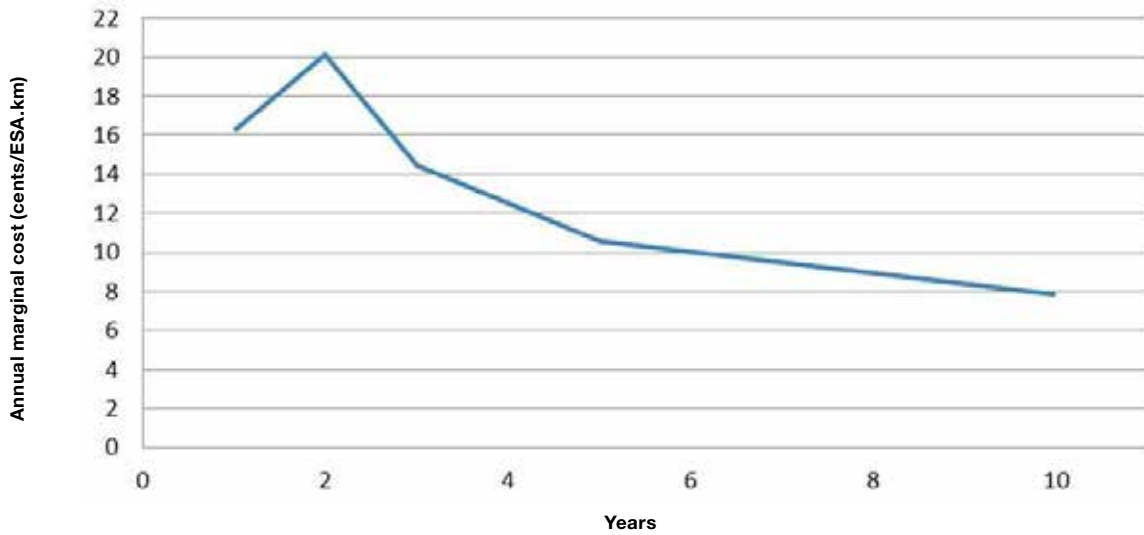Cost zone 1
Local distributor
20,000 ESA/year
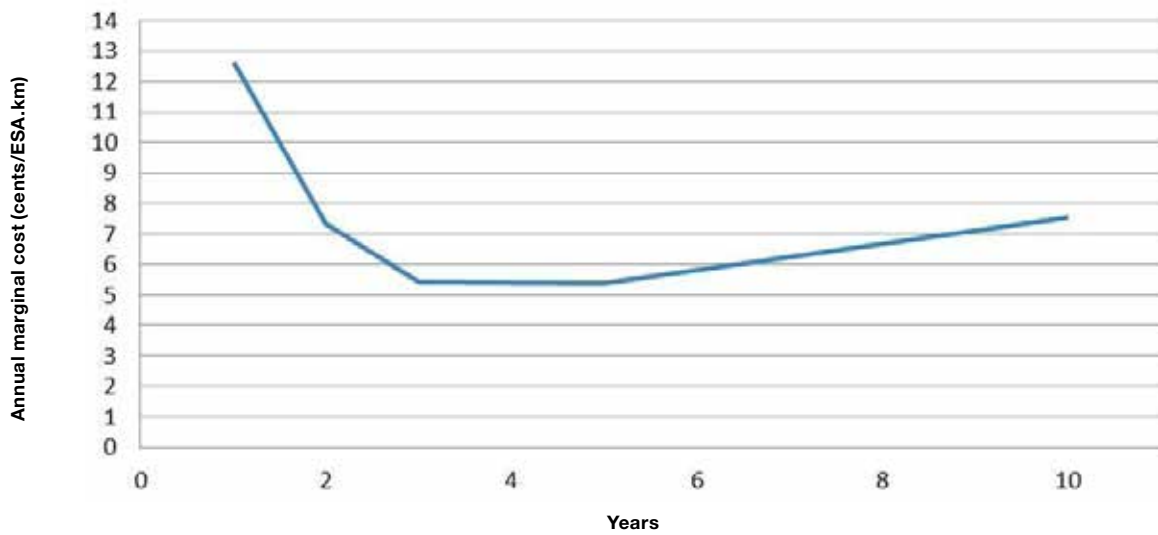


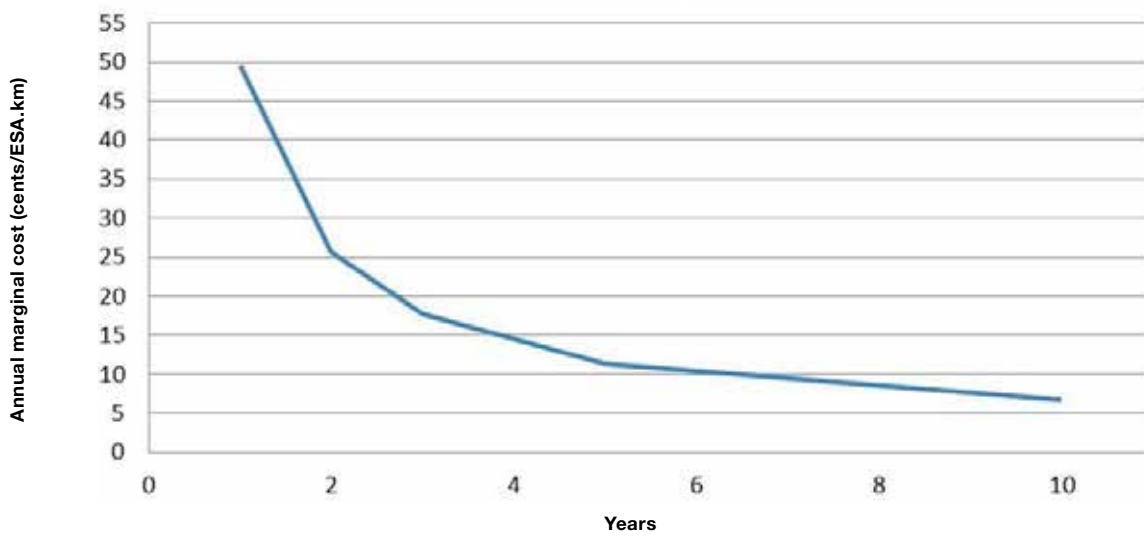**Figure B 2.2**

Cost zone 1
Local distributor
60,000 ESA/year
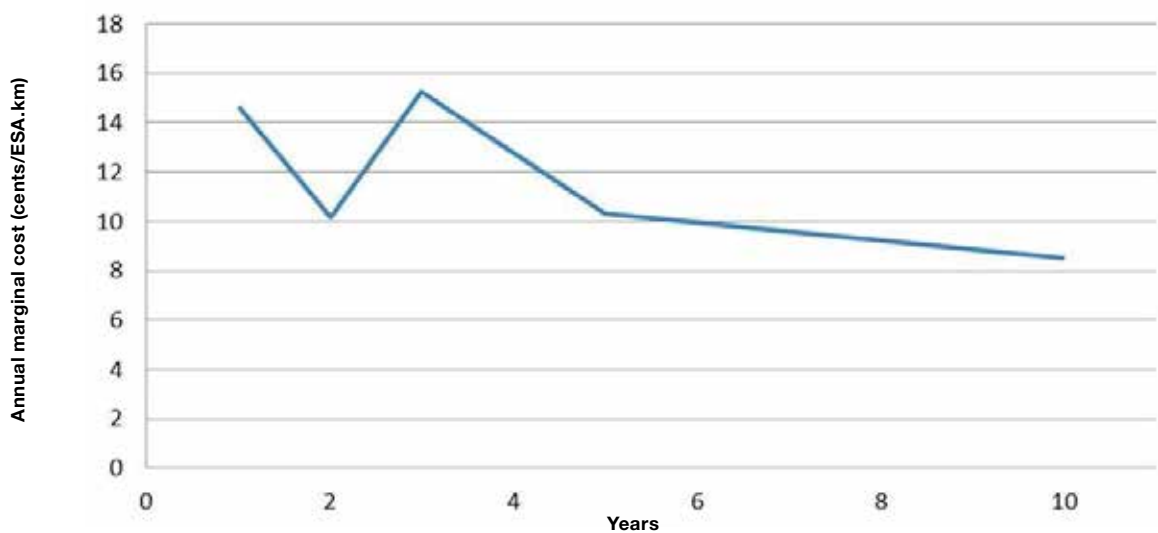
**Figure B 2.3**

Cost zone 1
Local distributor
100,000 ESA/year
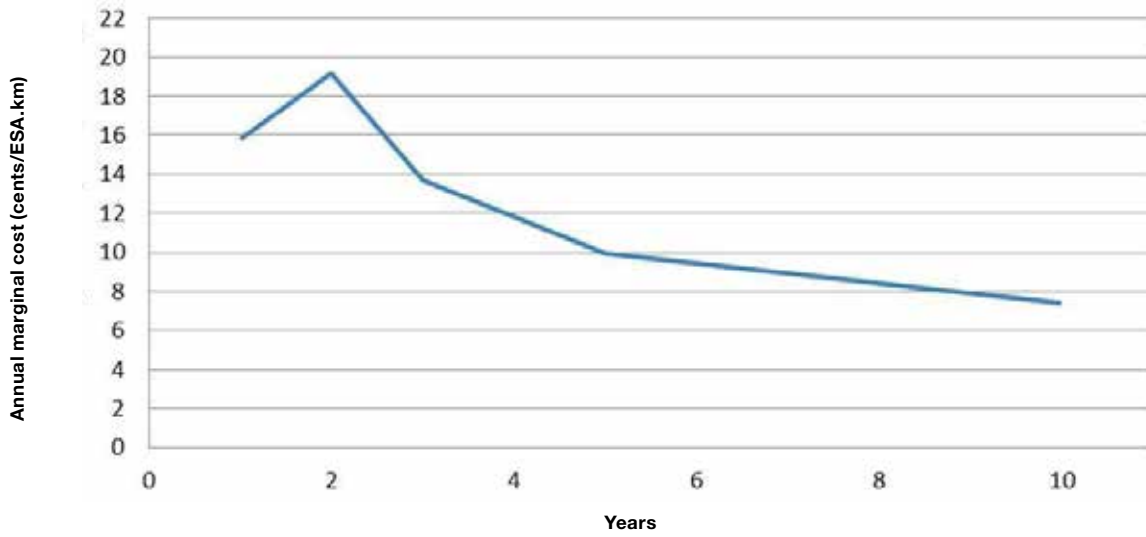


**Figure B 2.4**

Cost zone 1
Local distributor
200,000 ESA/year
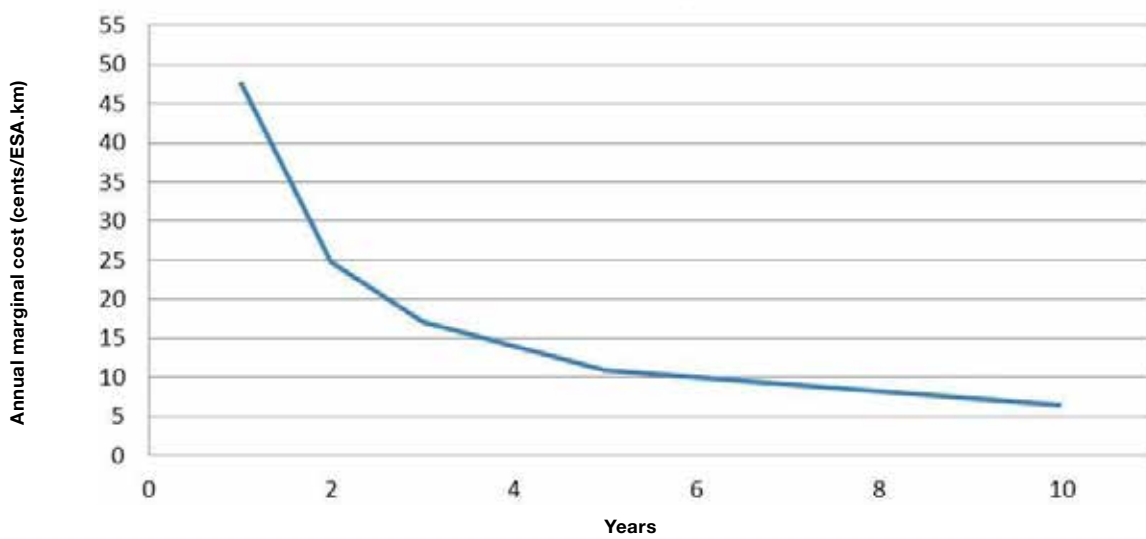
## B.3 Cost zone 1 – Regional distributor

**Figure B 3.1**

Cost zone 1
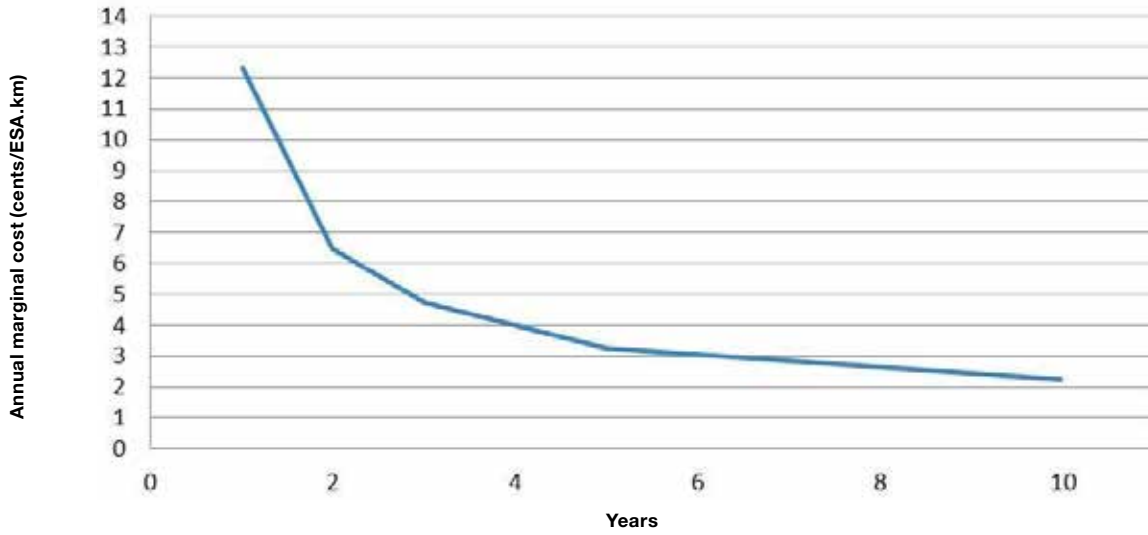Regional distributor
20,000 ESA/year
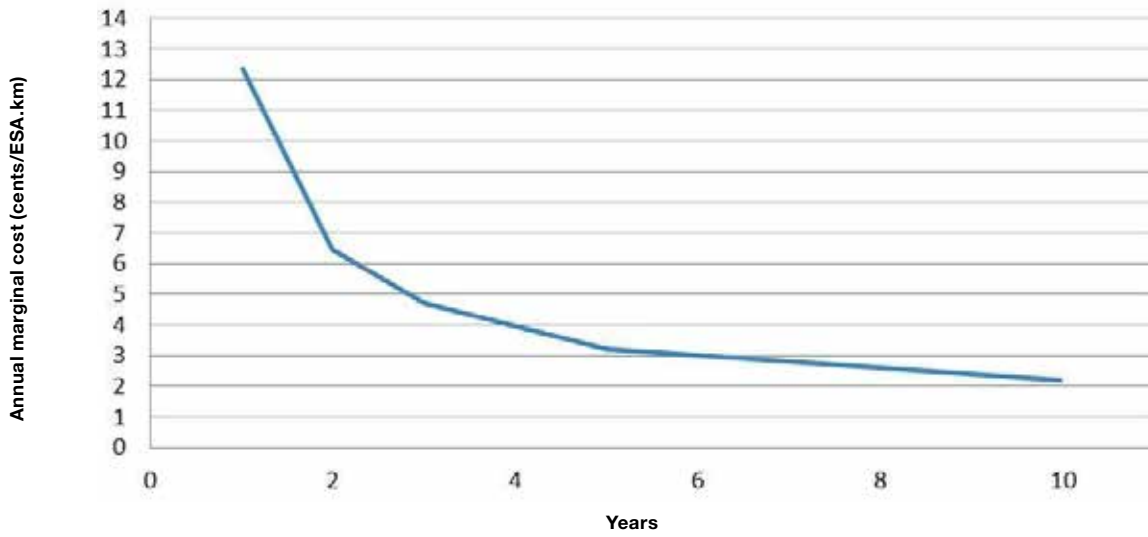


**Figure B 3.2**

Cost zone 1
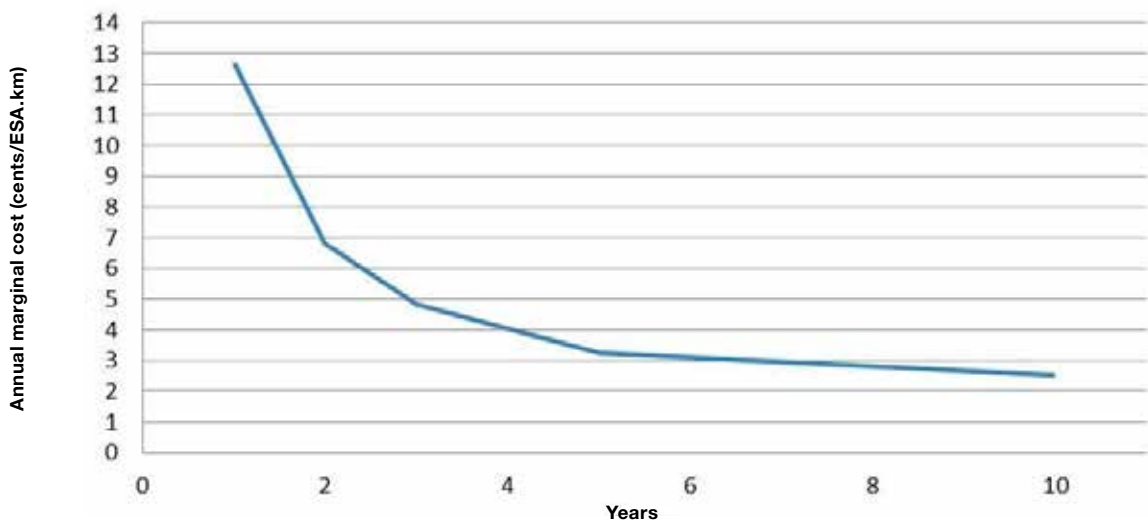Regional distributor
60,000 ESA/year
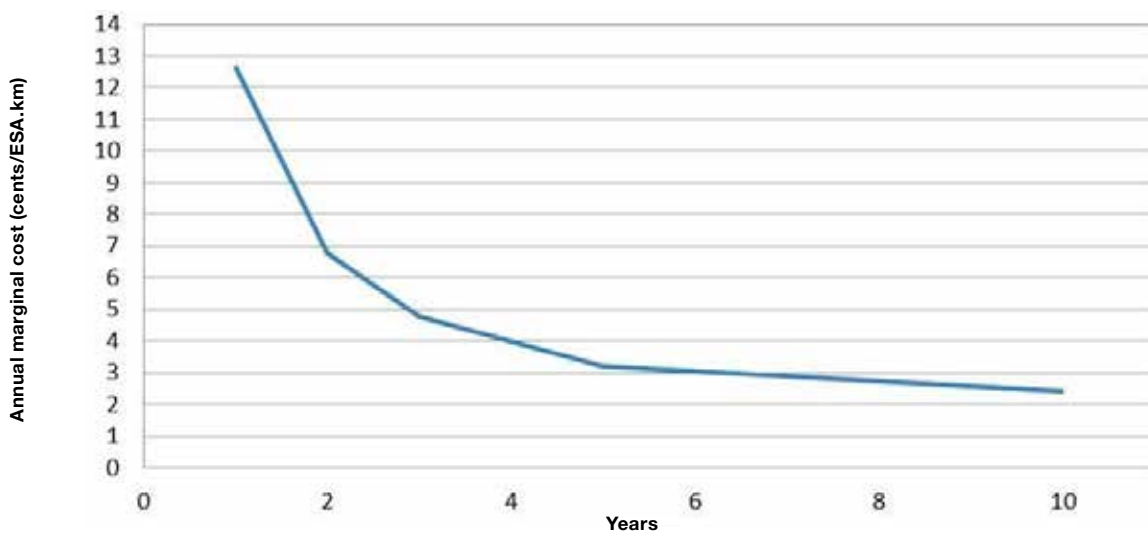
**Figure B 3.3**

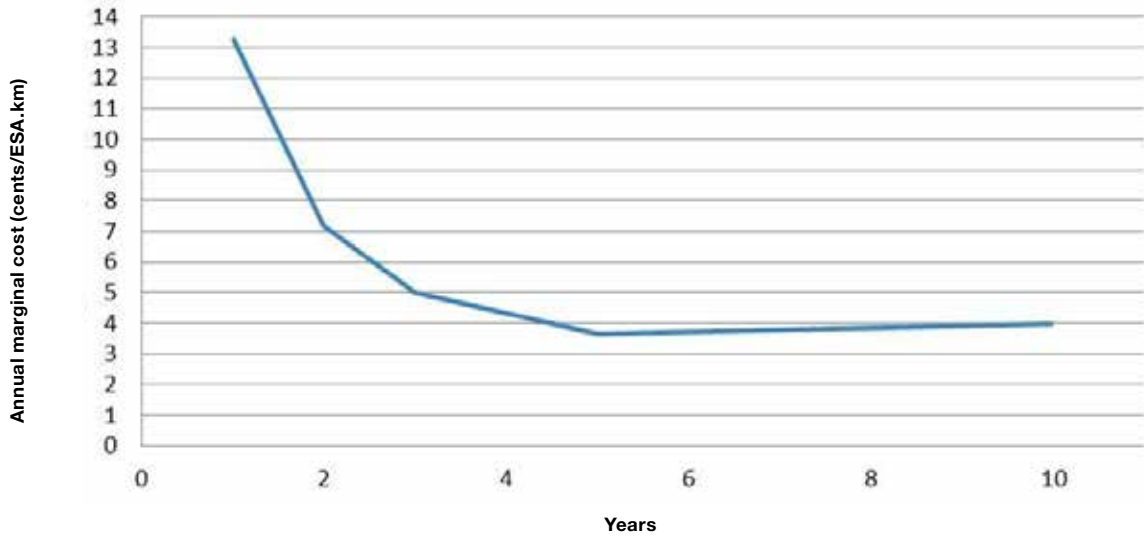Cost zone 1
Regional distributor
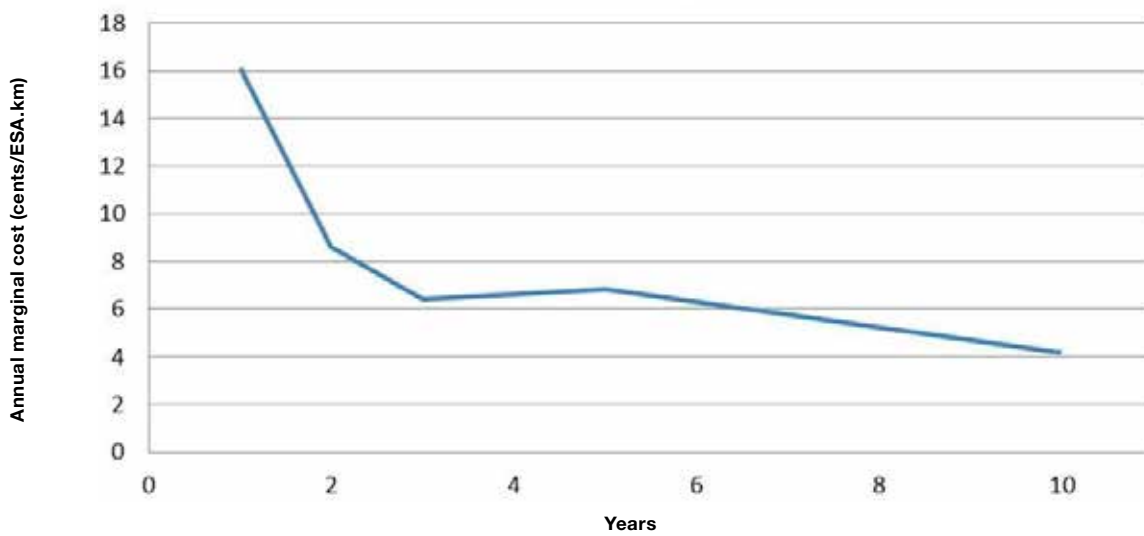100,000 ESA/year
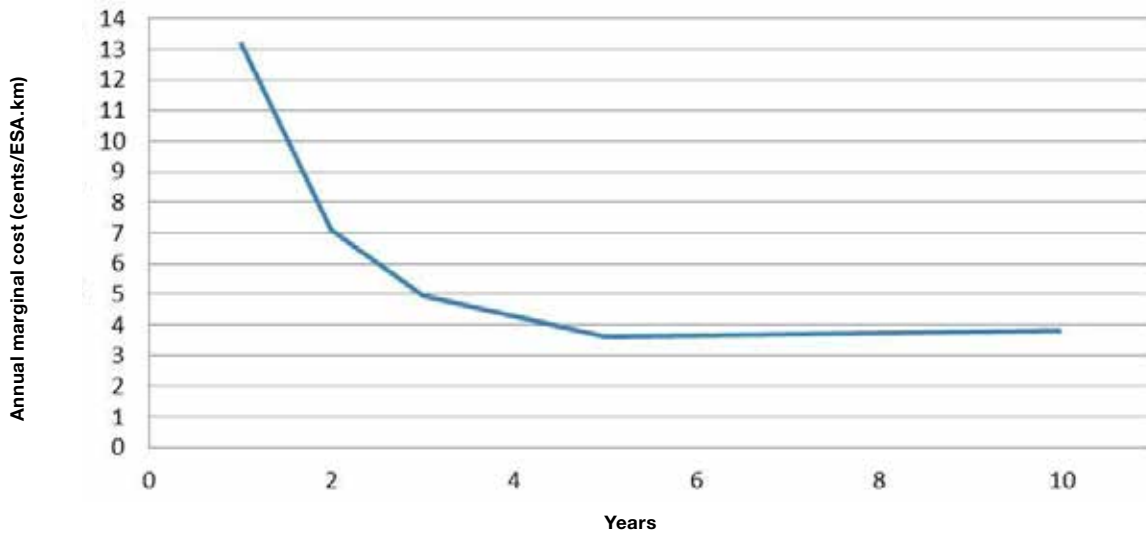


**Figure B 3.4**

Cost zone 1
Regional distributor
200,000 ESA/year
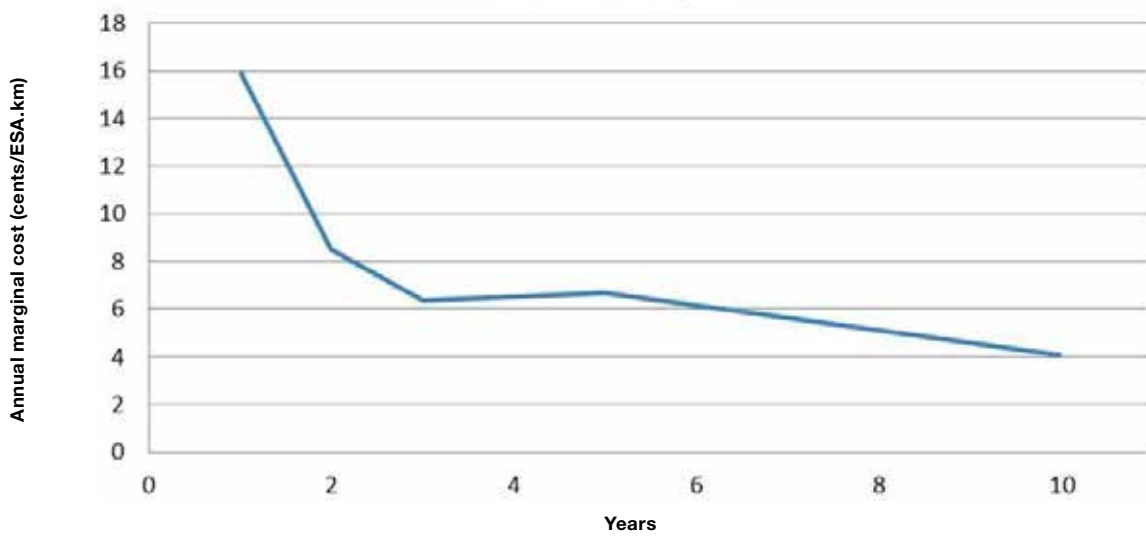
## B.4    Cost zone 1 – District distributor

**Figure B 4.1**

Cost zone 1
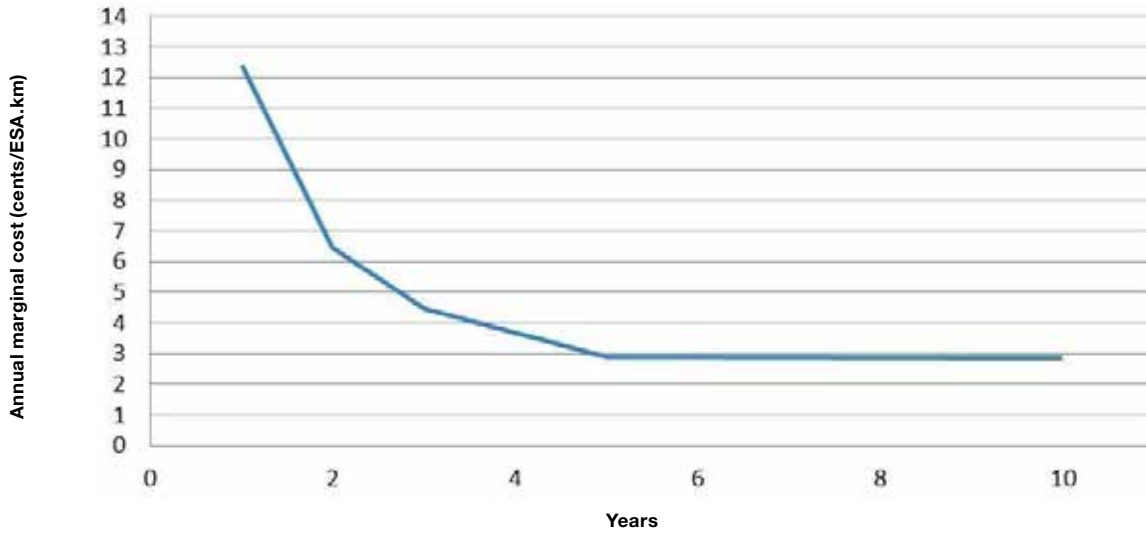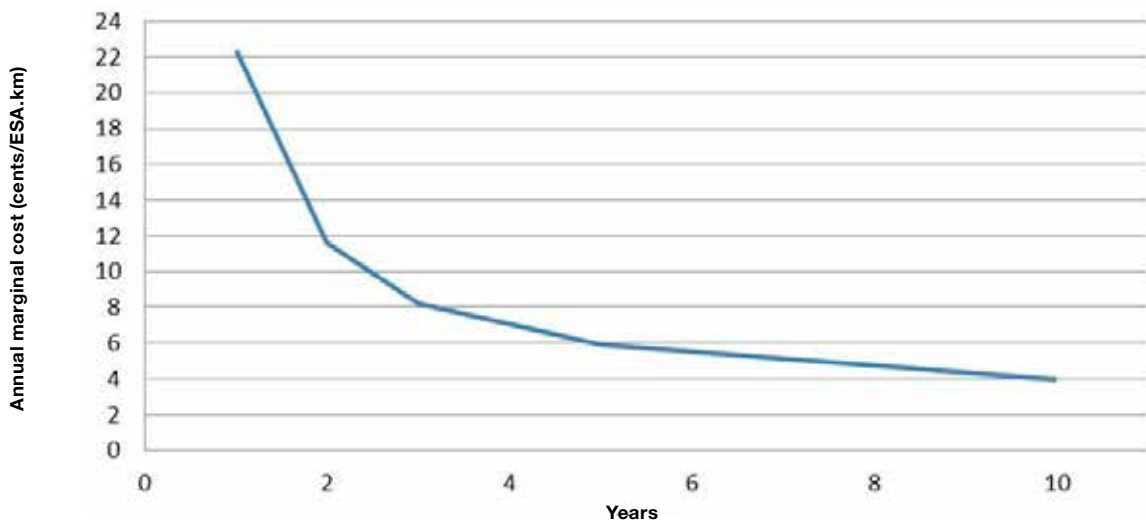District distributor
20,000 ESA/year
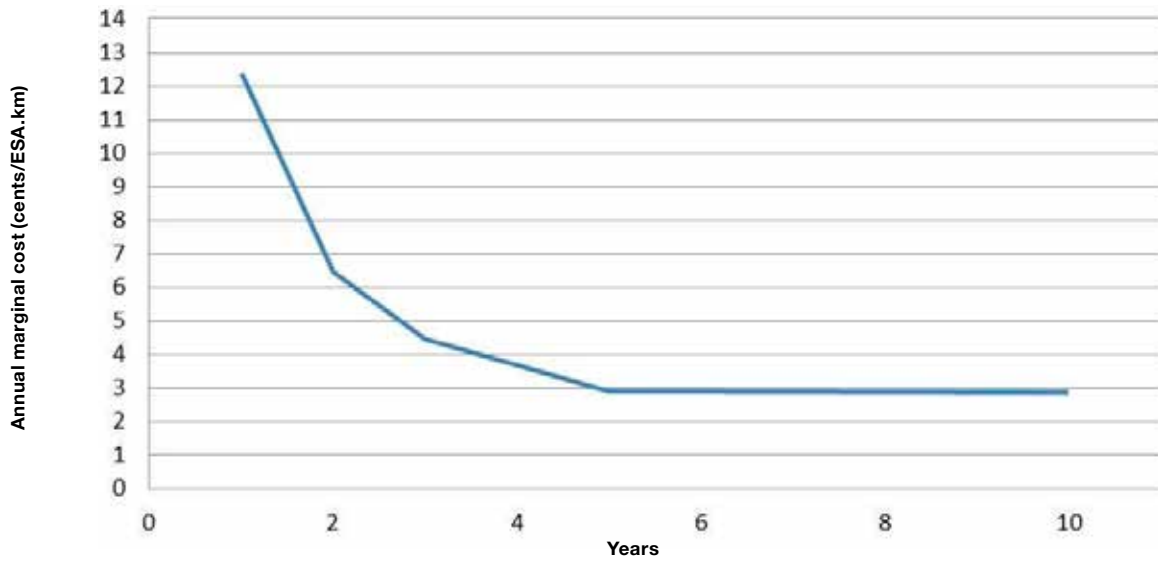


**Figure B 4.2**

Cost zone 1
District distributor
60,000 ESA/year
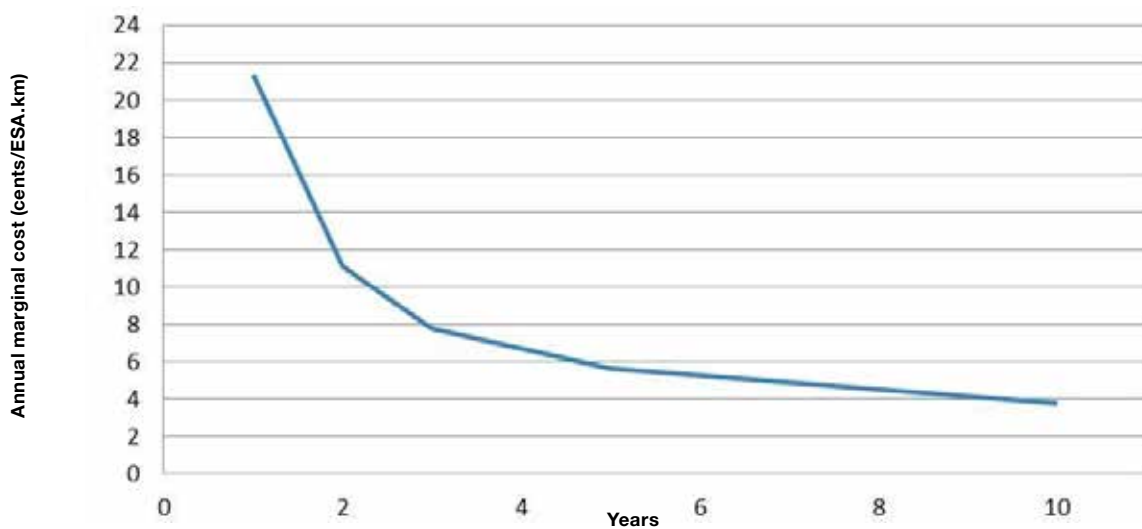
**Figure B 4.3**

Cost zone 1
District distributor
100,000 ESA/year
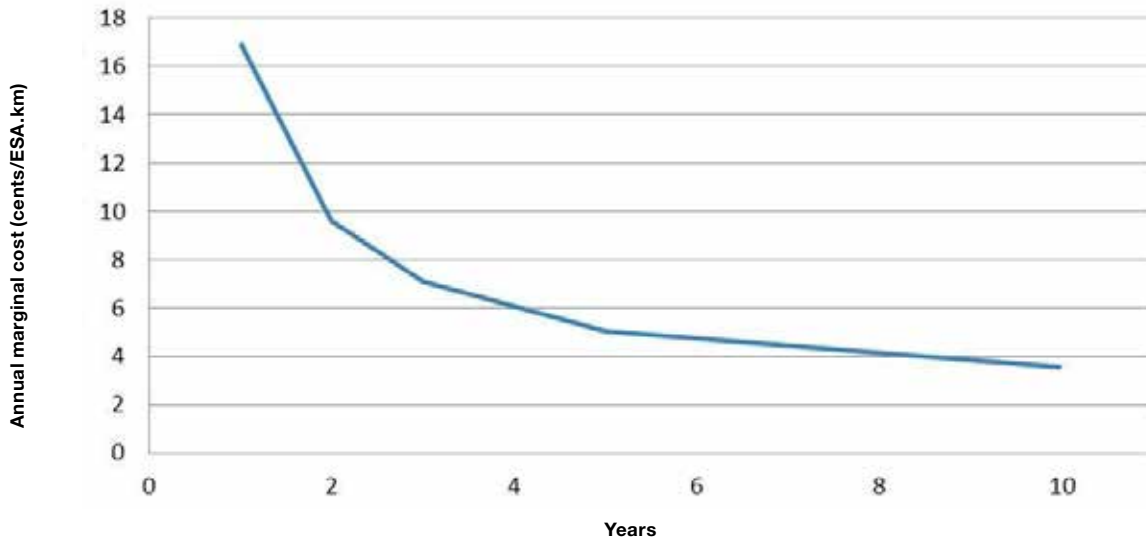


**Figure B 4.4**

Cost zone 1
District distributor
200,000 ESA/year
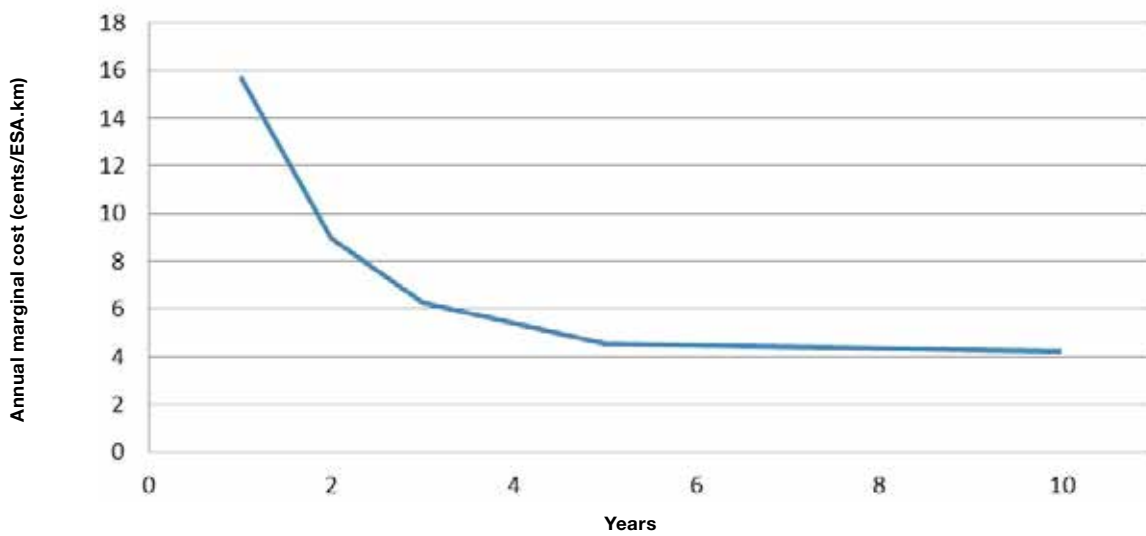
## B.5 Cost zone 2 – Access roads

**Figure B 5.1**

Cost zone 2
Access road
20,000 ESA/year



**Figure B 5.2**

Cost zone 2
Access road
60,000 ESA/year
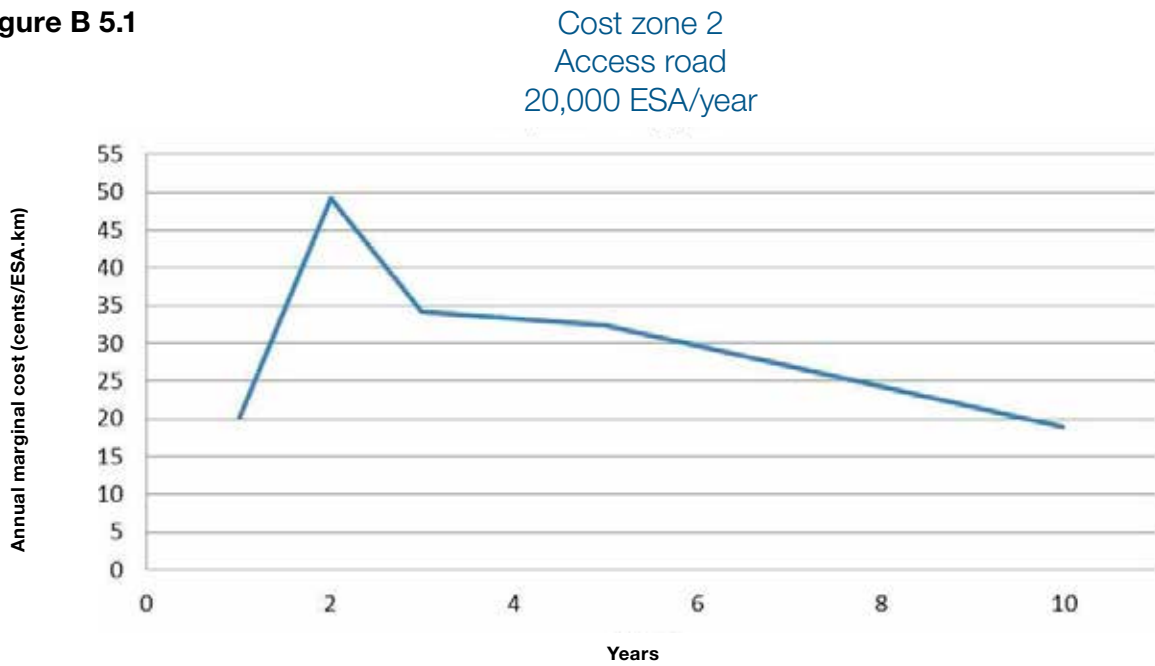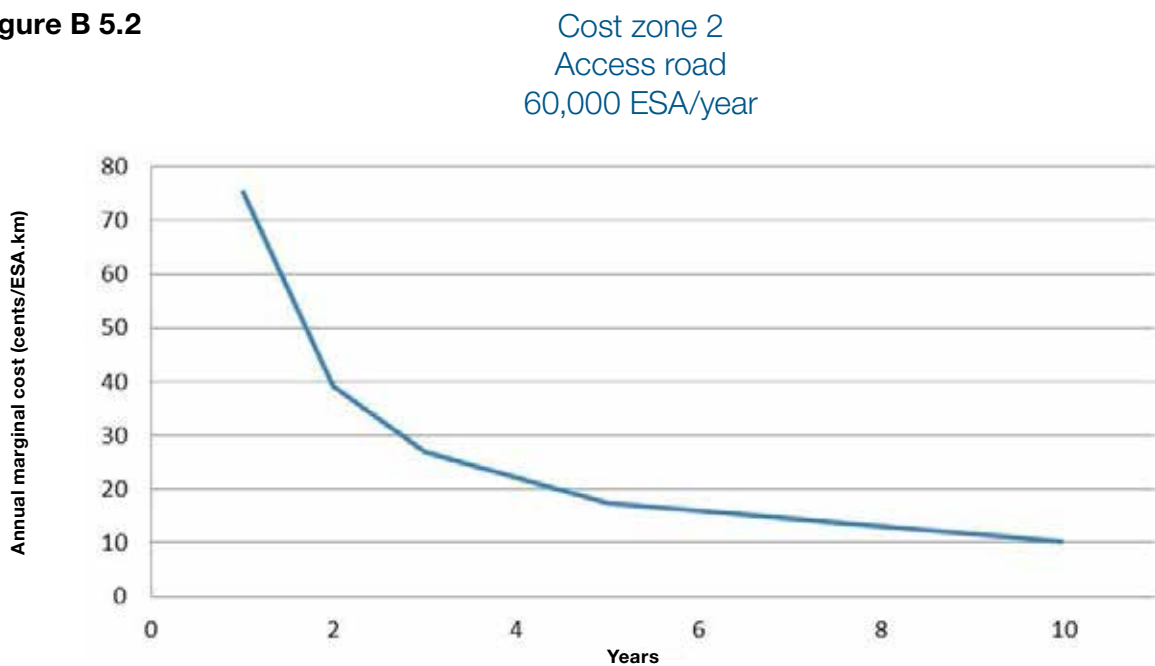
**Figure B 5.3**

Cost zone 2
Access road
100,000 ESA/year
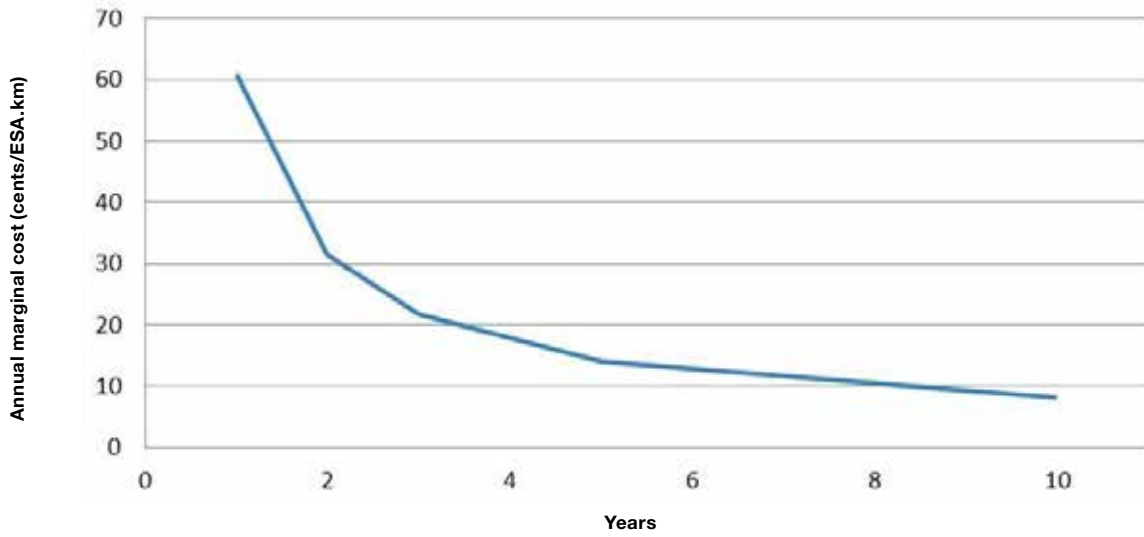


**Figure B 5.4**

Cost zone 2
Access road
200,000 ESA/year
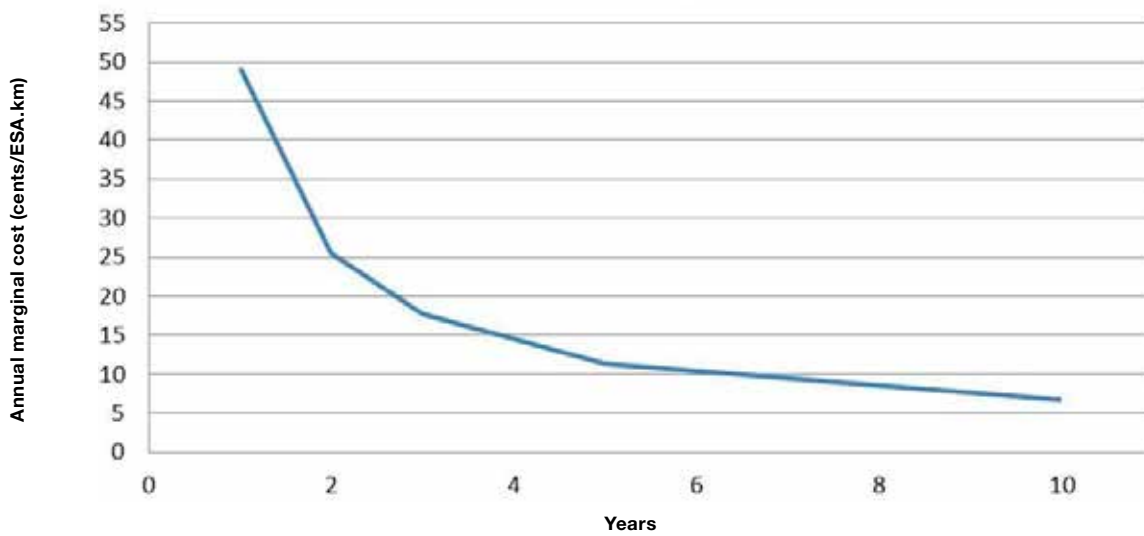
## B.6    Cost zone 2 – Local distributor

**Figure B 6.1**

Cost zone 2
Local distributor
20,000 ESA/year
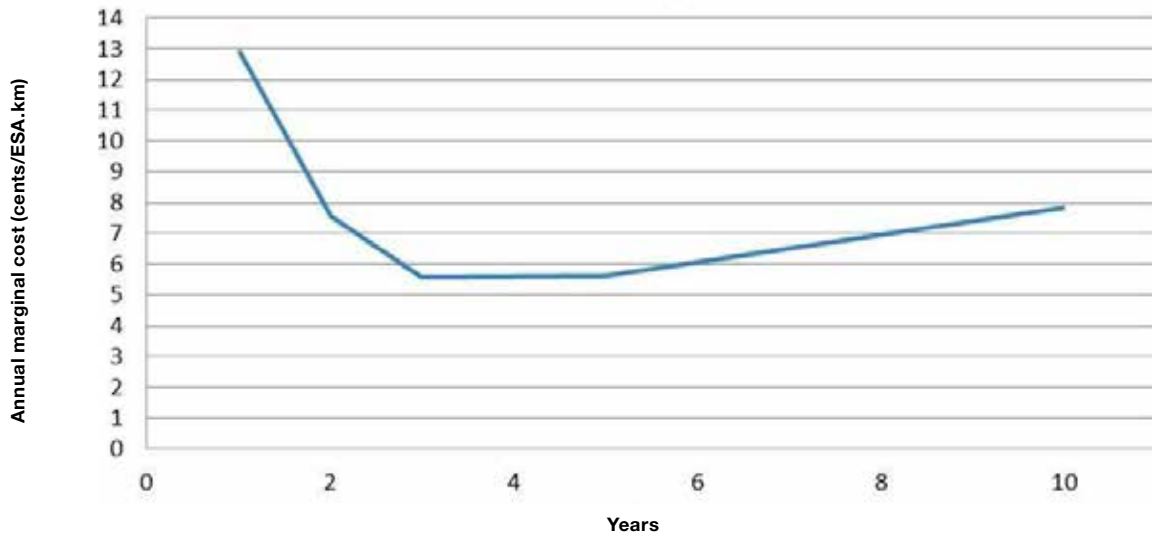


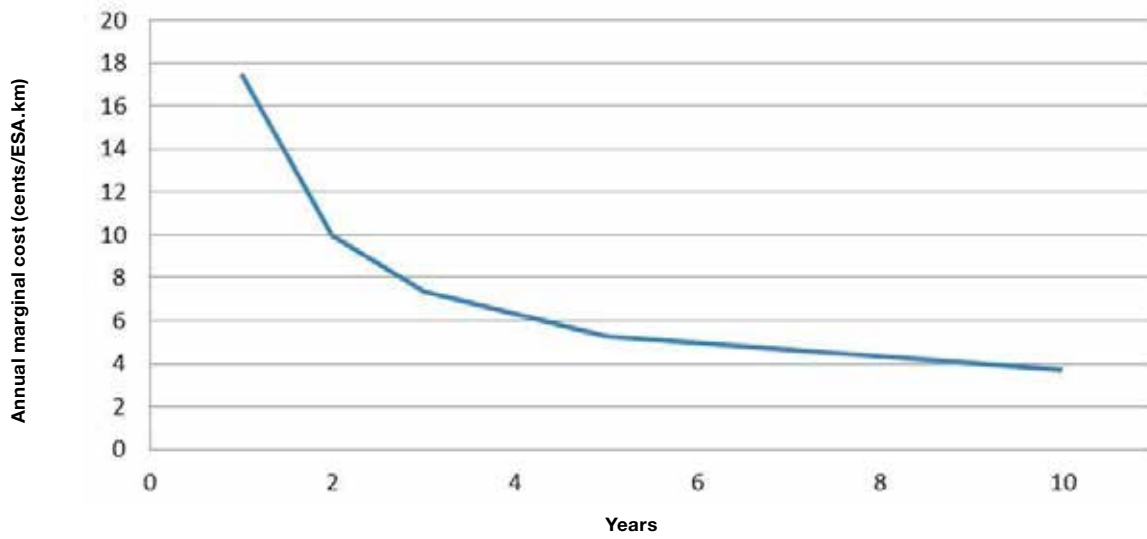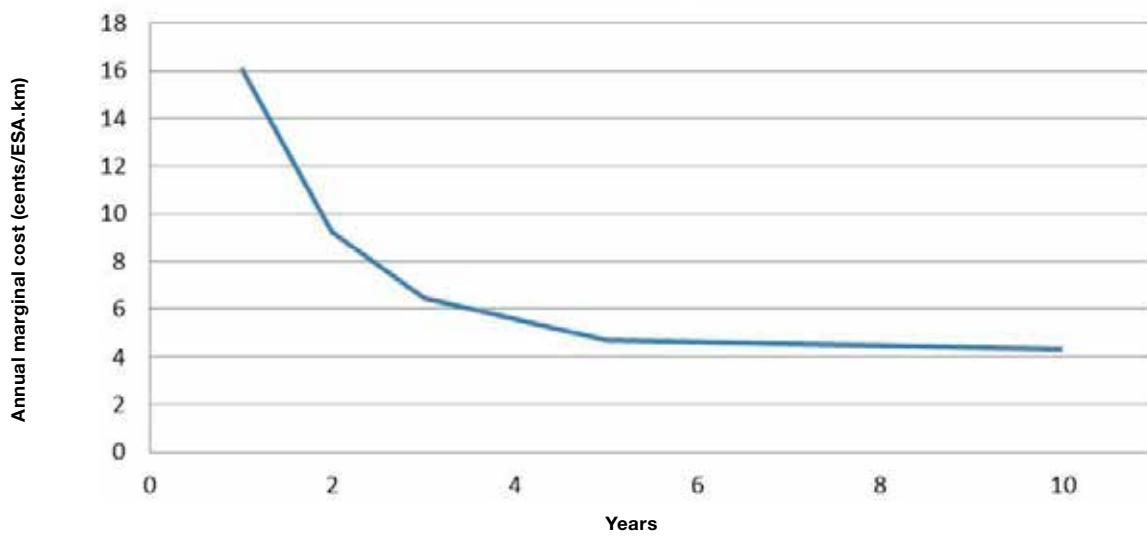**Figure B 6.2**

Cost zone 2
Local distributor
60,000 ESA/year
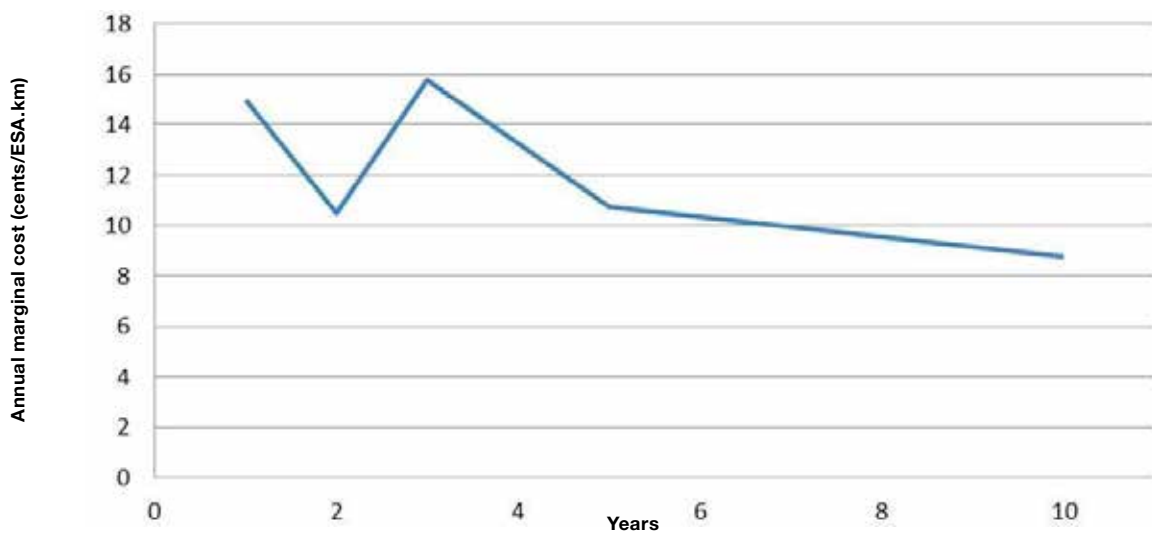
**Figure B 6.3**

Cost zone 2
Local distributor
100,000 ESA/year
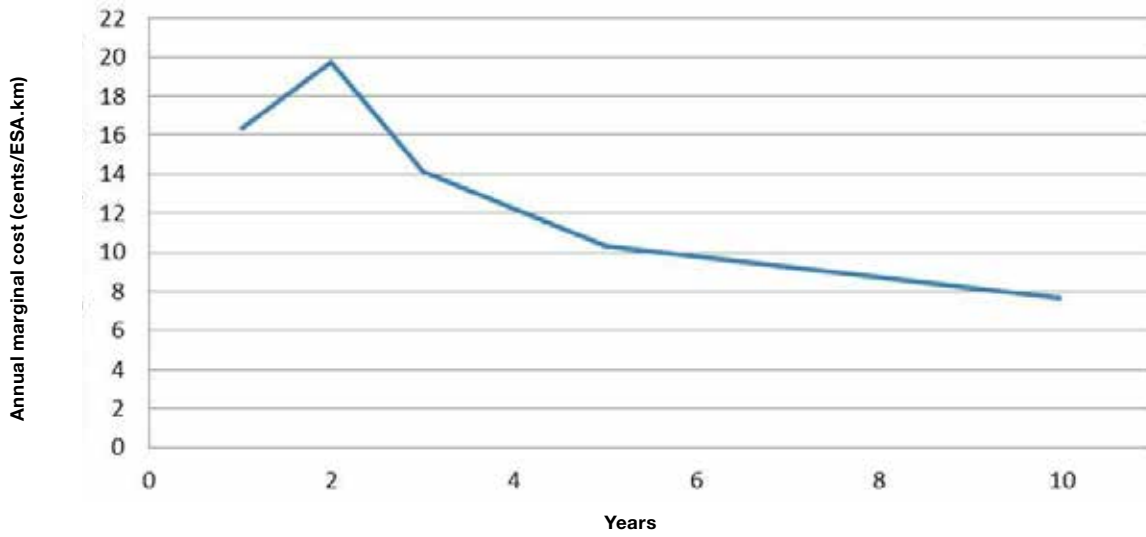


**Figure B 6.4**

Cost zone 2
Local distributor
200,000 ESA/year

## B.7    Cost zone 2 – Regional distributor

**Figure B 7.1**

Cost zone 2
Regional distributor
20,000 ESA/year
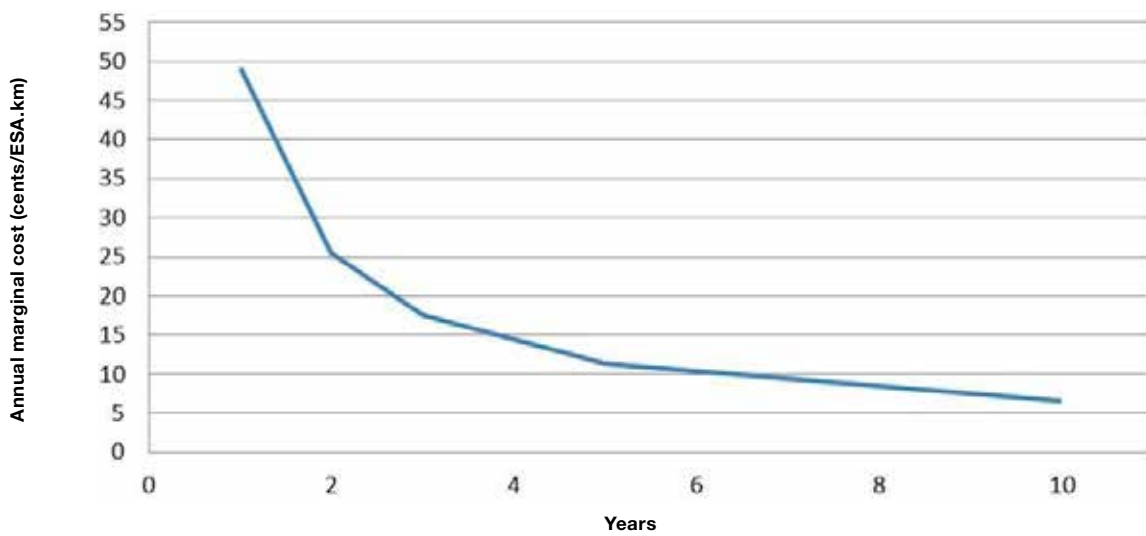


**Figure B 7.2**

Cost zone 2
Regional distributor
60,000 ESA/year
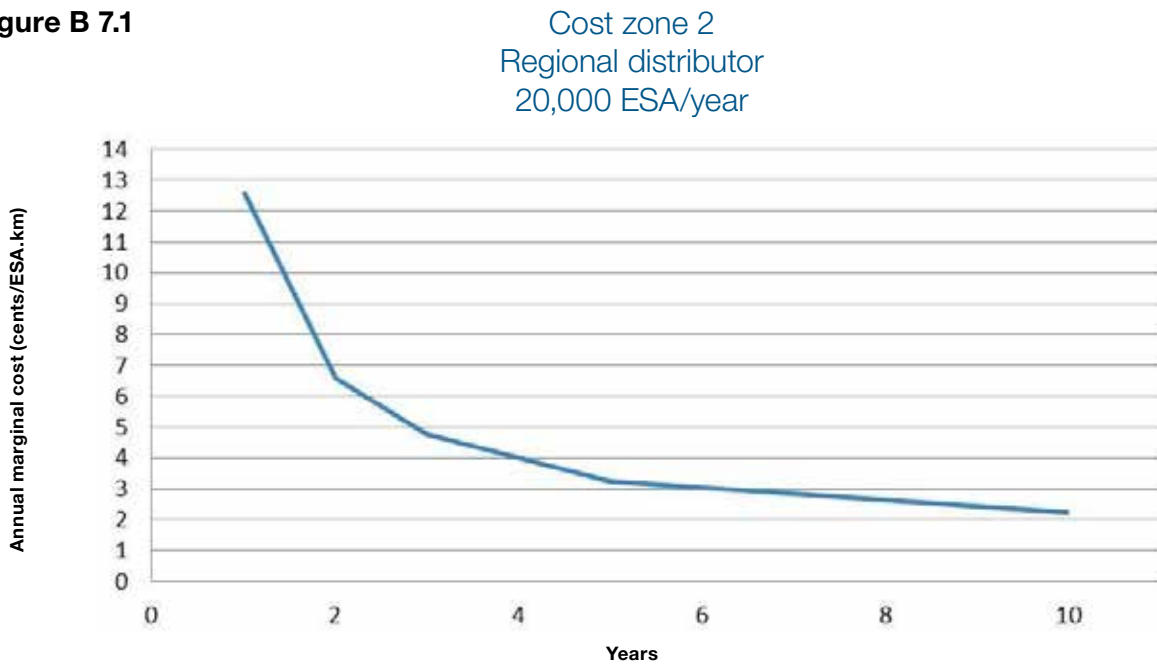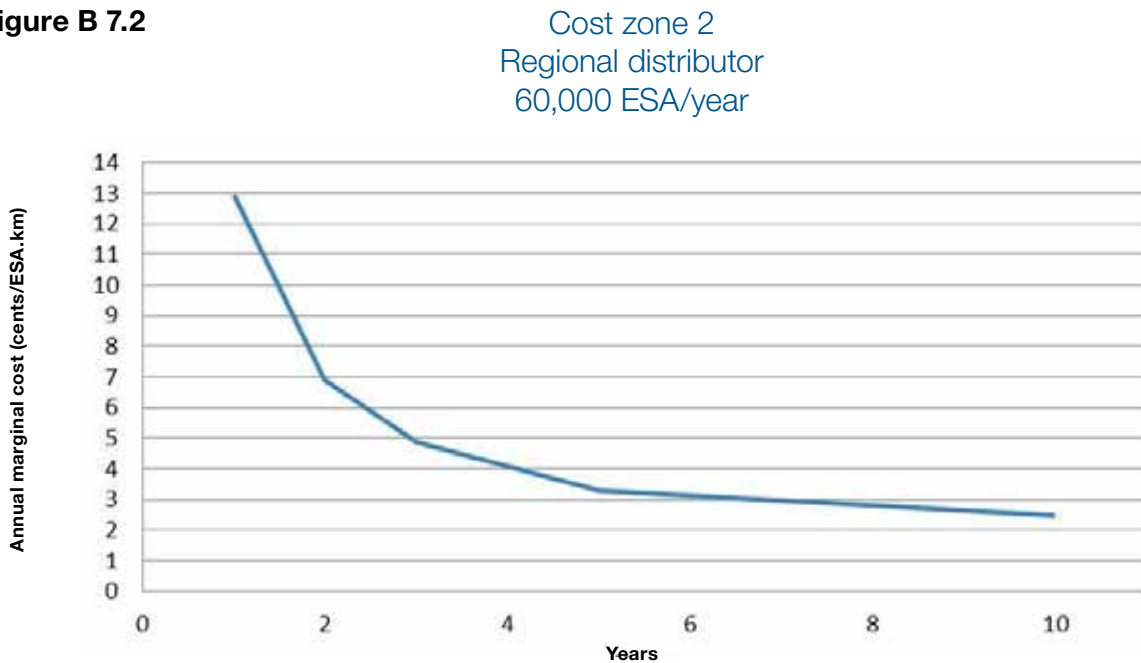
**Figure B 7.3**

Cost zone 2
Regional distributor
100,000 ESA/year
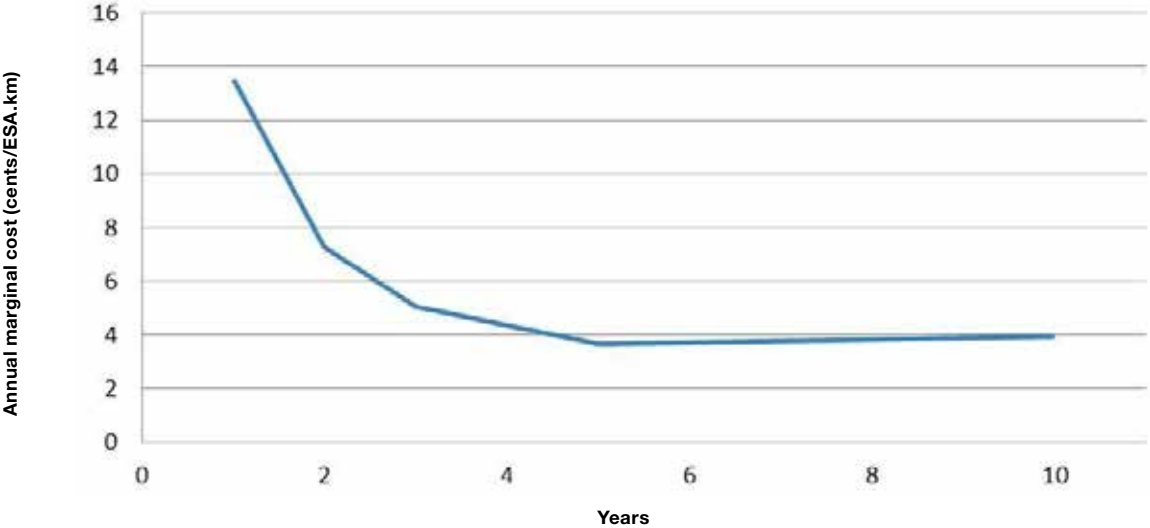


**Figure B 7.4**

Cost zone 2
Regional distributor
200,000 ESA/year
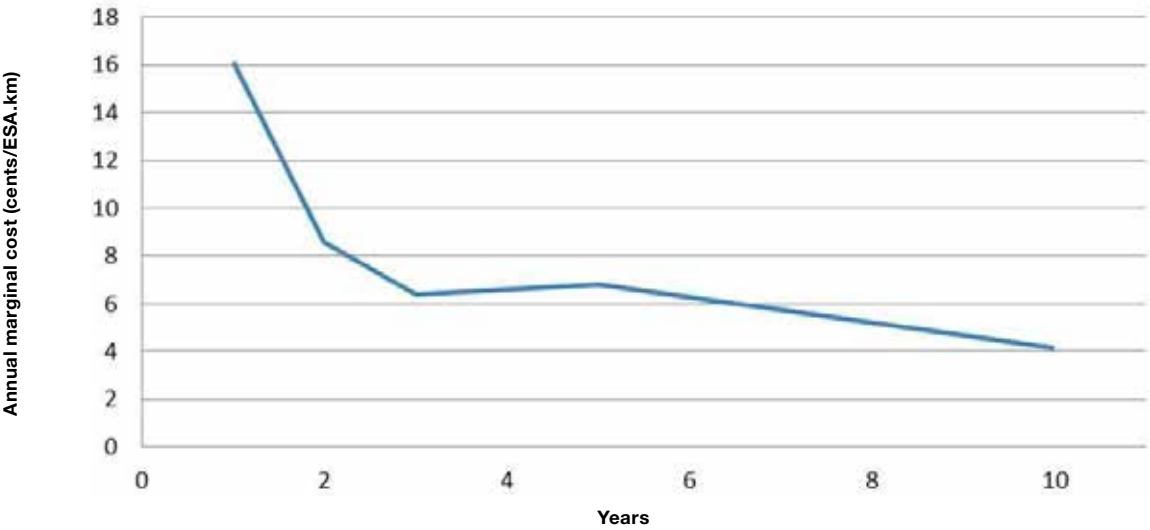
## B.8 Cost zone 2 – District distributor

**Figure B 8.1**

Cost zone 2
District distributor
20,000 ESA/year
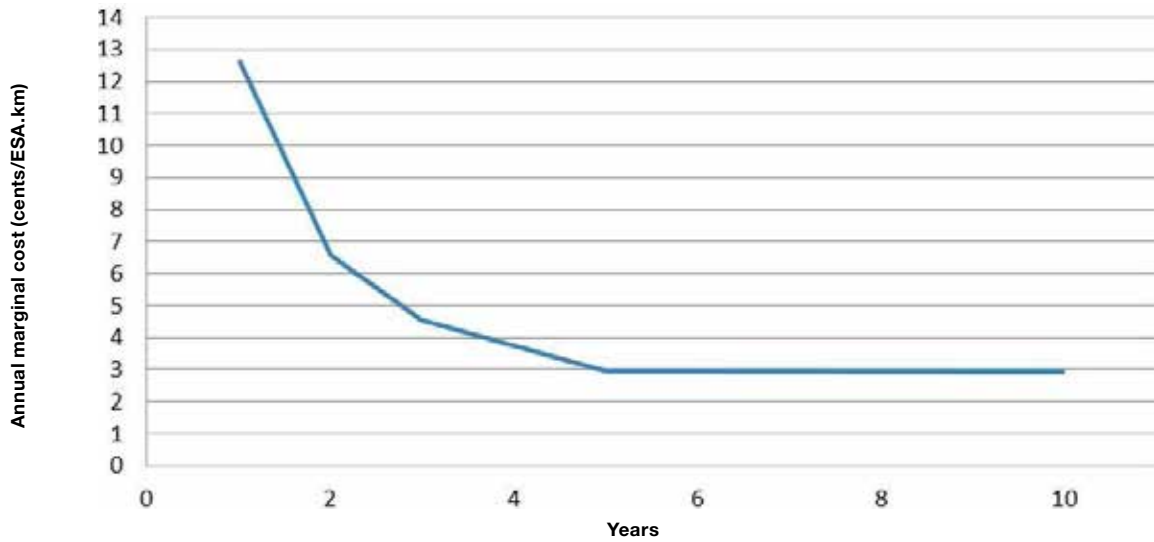


**Figure B 8.2**

Cost zone 2
District distributor
60,000 ESA/year
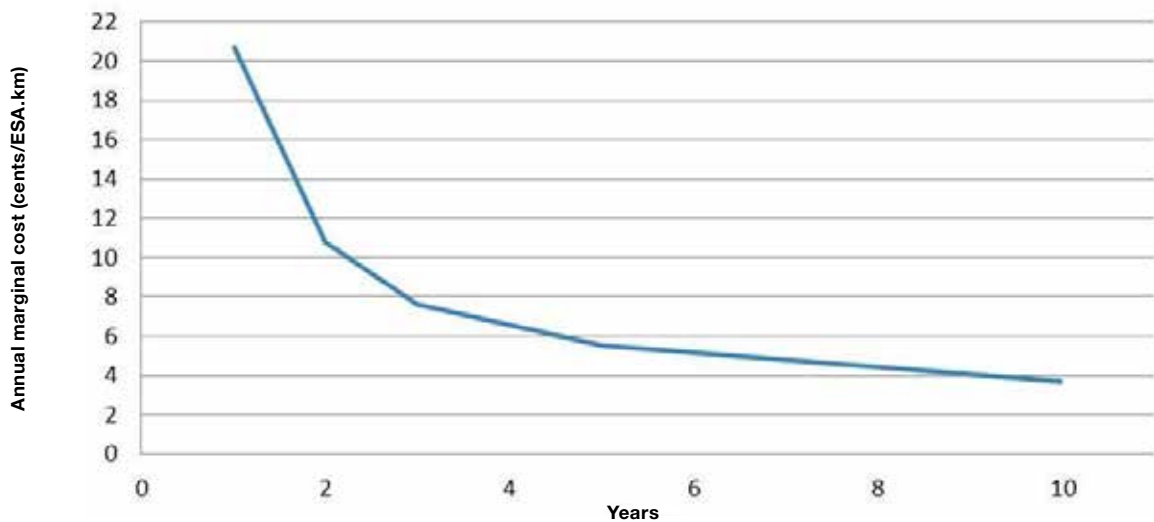
**Figure B 8.3**

Cost zone 2
District distributor
100,000 ESA/year
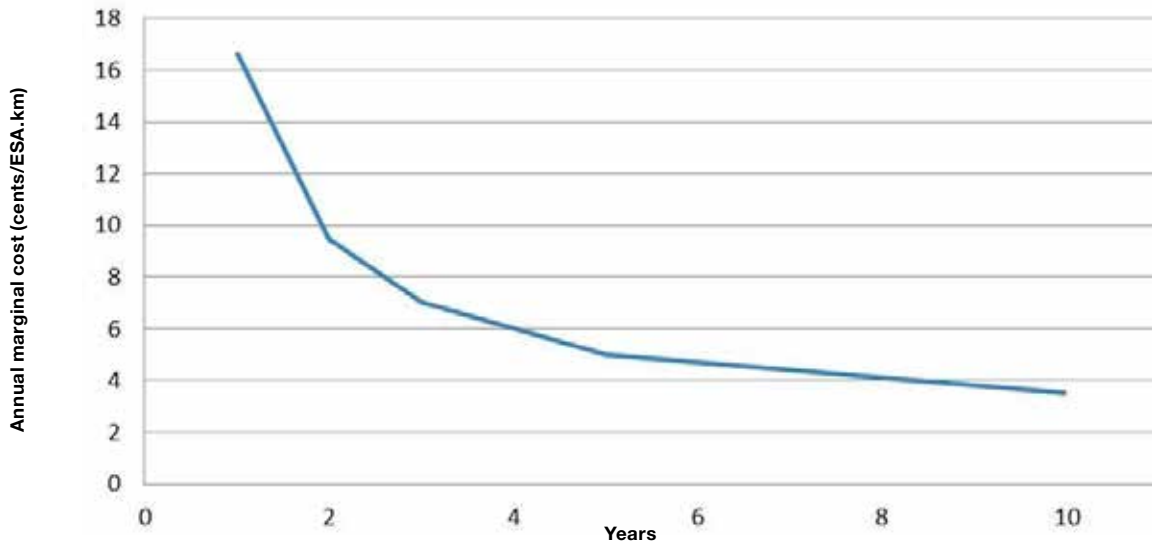


**Figure B 8.4**

Cost zone 2
District distributor
200,000 ESA/year
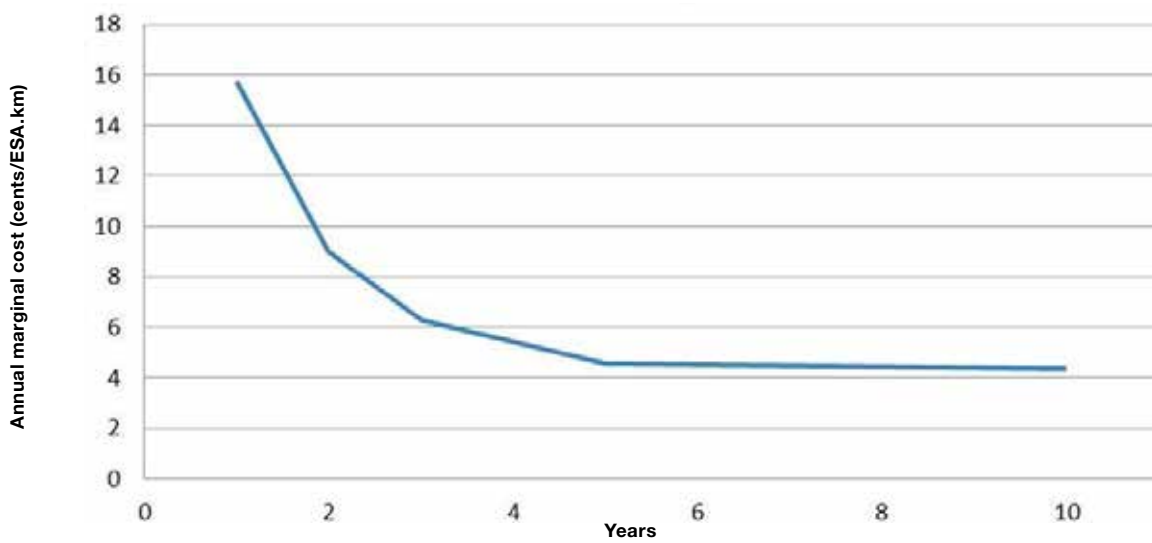
## B.9 Cost zone 3 – Access roads

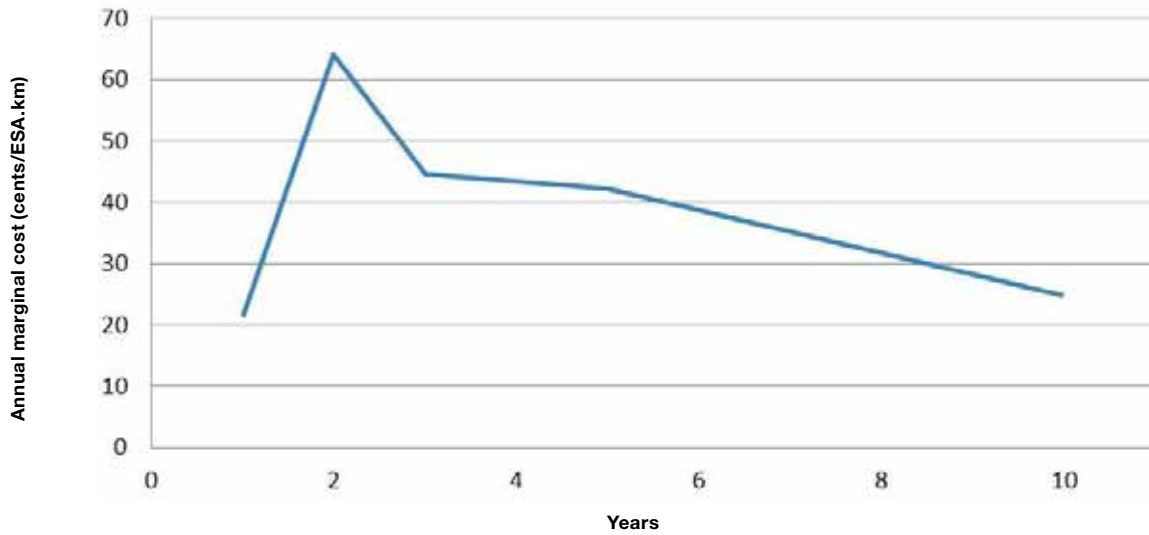**Figure B 9.1**
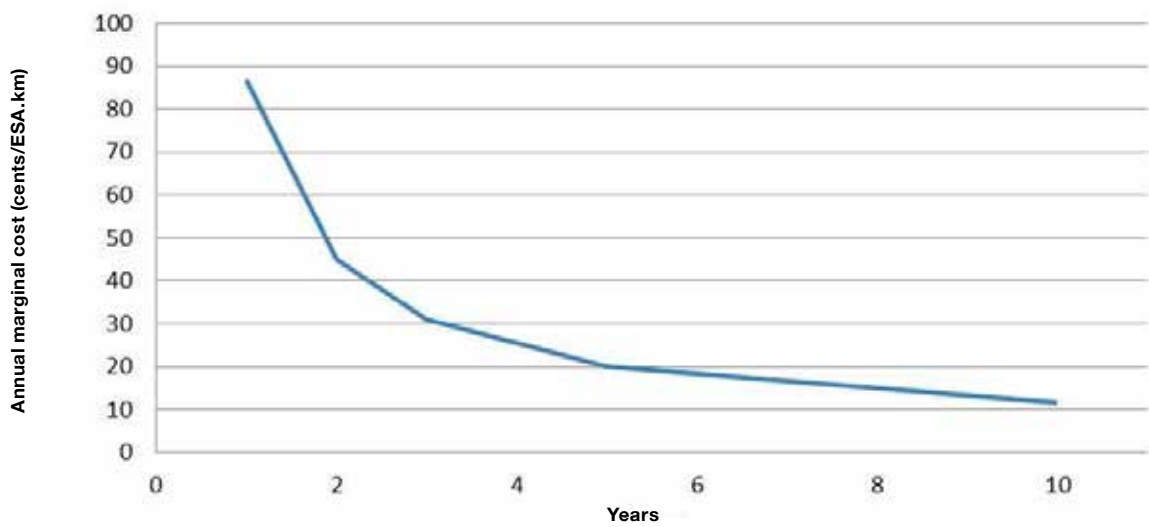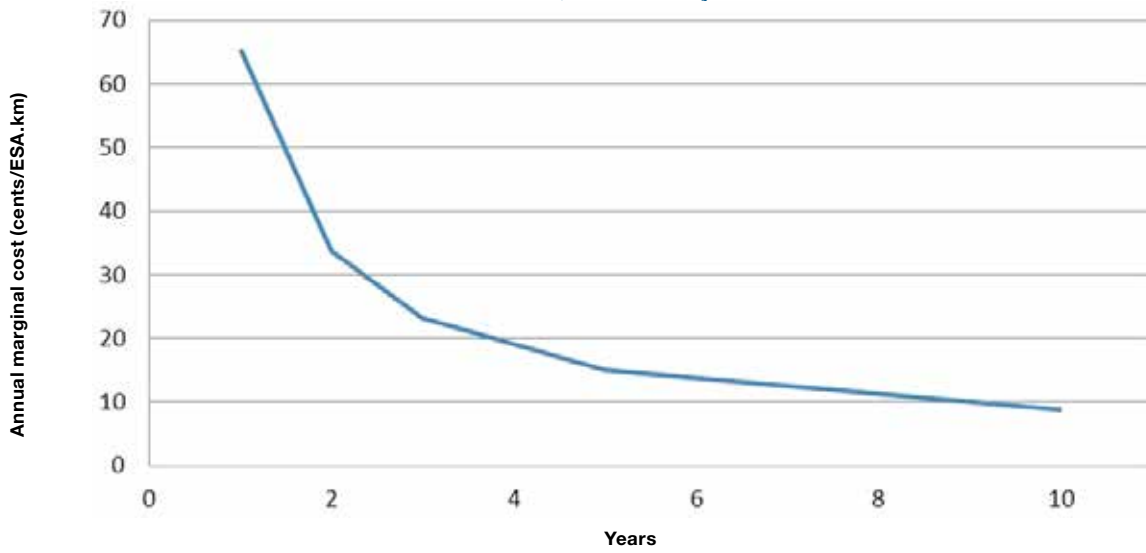
Cost zone 3
Access road
20,000 ESA/year



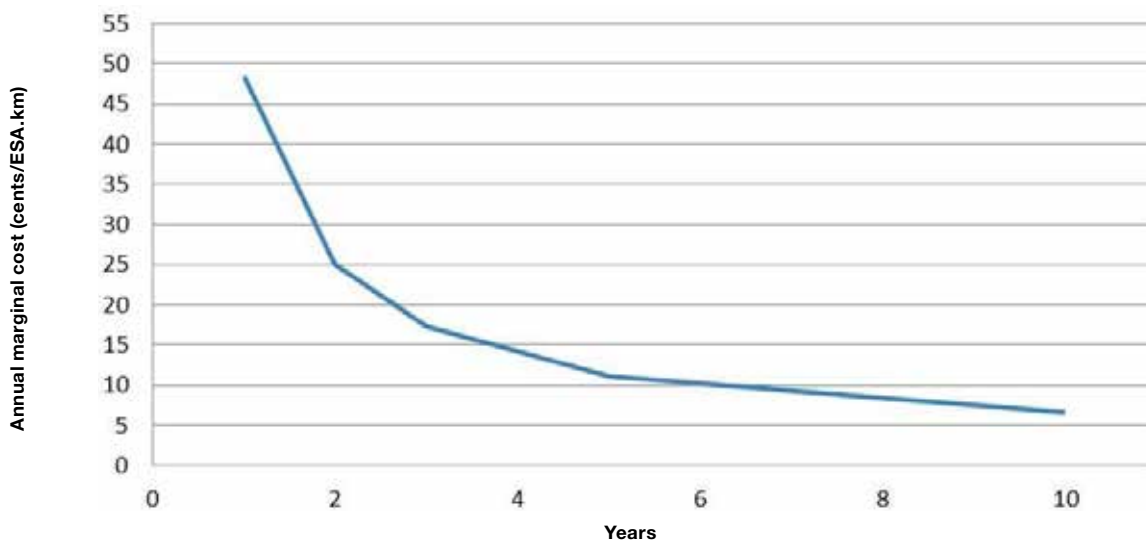**Figure B 9.2**

Cost zone 3
Access road
60,000 ESA/year

**Figure B 9.3**

Cost zone 3
Access road
100,000 ESA/year



**Figure B 9.4**

Cost zone 3
Access road
200,000 ESA/year

## B.10   Cost zone 3 – Local distributor
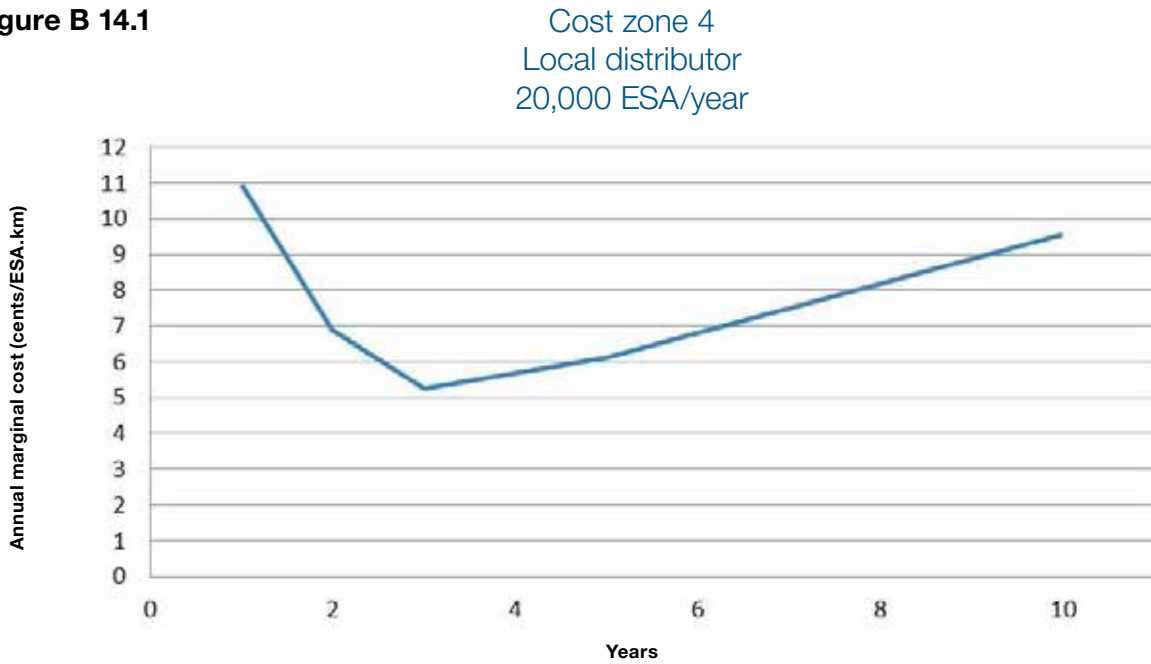
**Figure B 10.1**

### Cost zone 3
### Local distributor
### 20,000 ESA/year



**Figure B 10.2**

### Cost zone 3
### Local distributor
### 60,000 ESA/year

**Figure B 10.3**

Cost zone 3
Local distributor
100,000 ESA/year



**Figure B 10.4**

Cost zone 3
Local distributor
200,000 ESA/year

## B.11   Cost zone 3 – Regional distributor

**Figure B 11.1**

### Cost zone 3
### Regional distributor
### 20,000 ESA/year



**Figure B 11.2**

### Cost zone 3
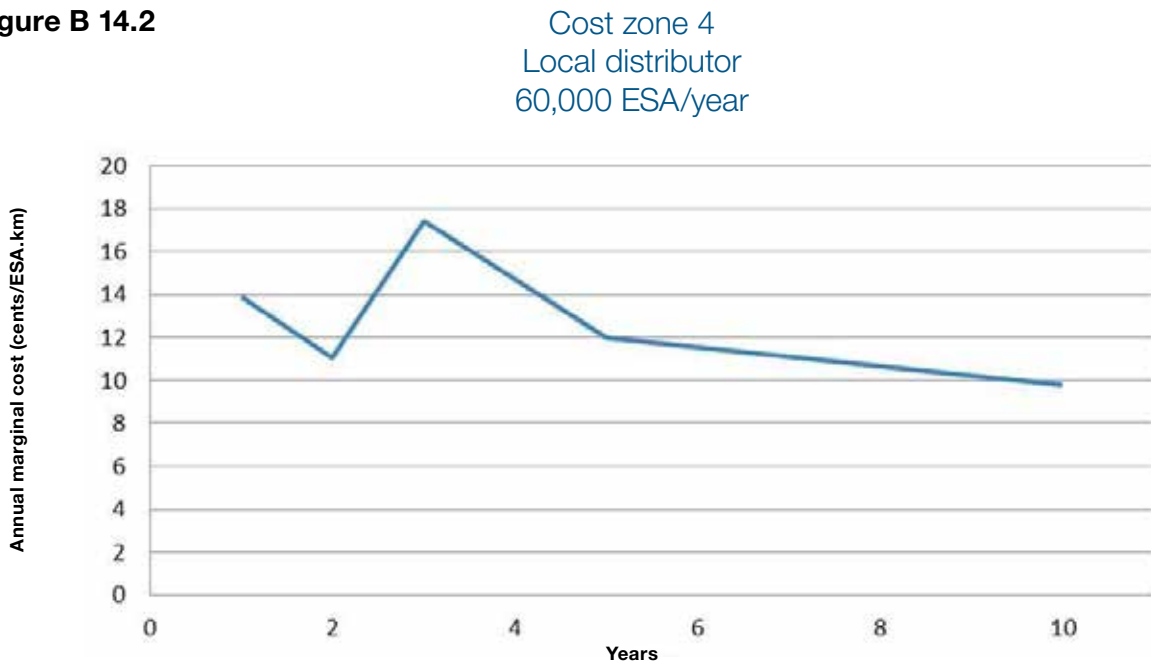### Regional distributor
### 60,000 ESA/year

**Figure B 11.3**
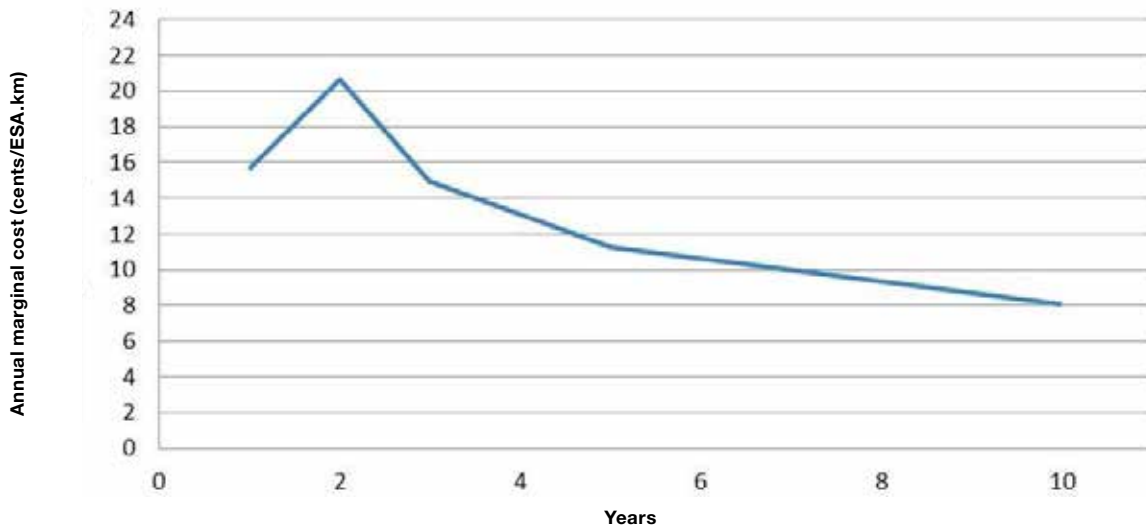
Cost zone 3
Regional distributor
100,000 ESA/year



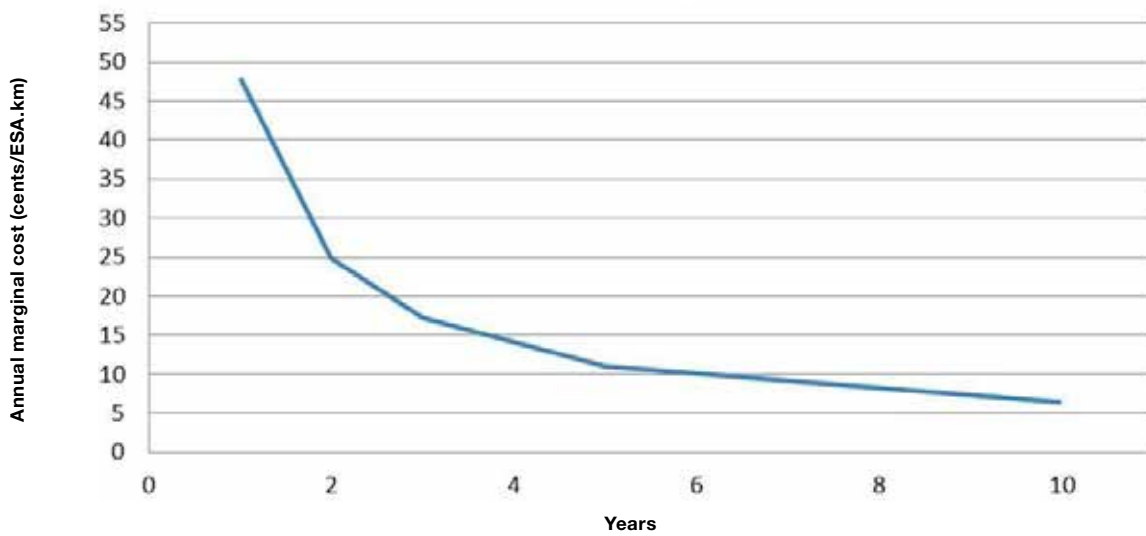**Figure B 11.4**

Cost zone 3
Local distributor
200,000 ESA/year

## B.12   Cost zone 3 – District distributor

**Figure B 12.1**

Cost zone 3
District distributor
20,000 ESA/year



**Figure B 12.2**

Cost zone 3
District distributor
60,000 ESA/year

**Figure B 12.3**

**Figure B 12.4**

Cost zone 3
District distributor
200,000 ESA/year

## B.13   Cost zone 4 – Access roads

**Figure B 13.1**

Cost zone 4
Access road
20,000 ESA/year



**Figure B 13.2**

Cost zone 4
Access road
60,000 ESA/year

**Figure B 13.3**

Cost zone 4
Access road
100,000 ESA/year



**Figure B 13.4**

Cost zone 4
Access road
200,000 ESA/year

## B.14 Cost zone 4 – Local distributor

**Figure B 14.1**

Cost zone 4
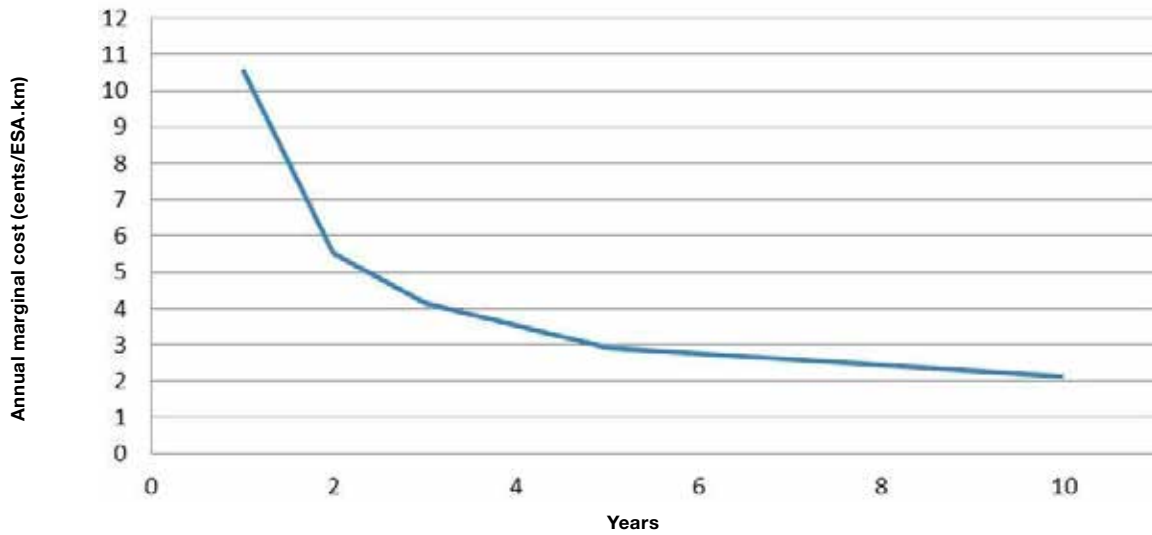Local distributor
20,000 ESA/year



**Figure B 14.2**

Cost zone 4
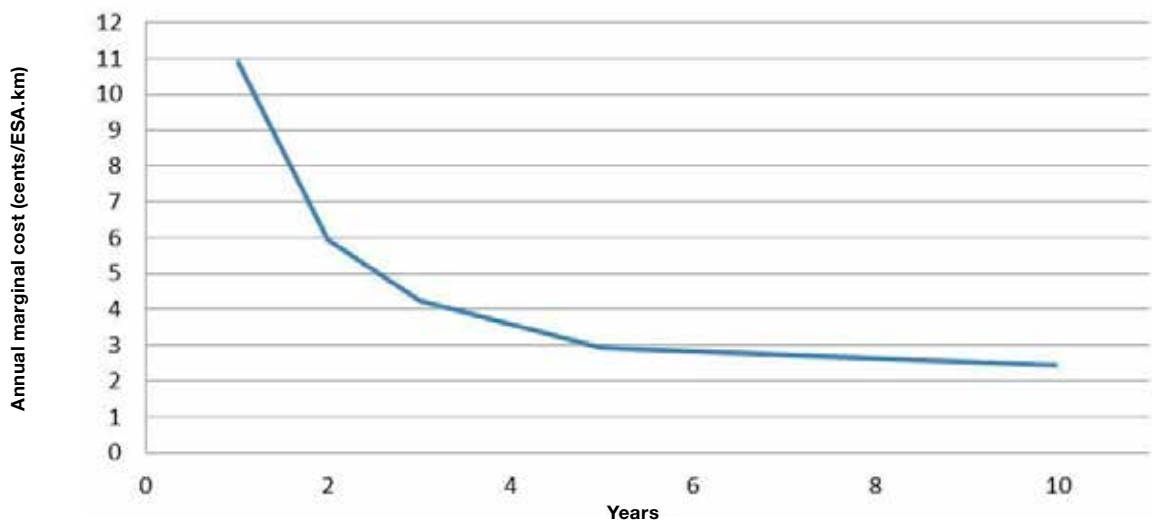Local distributor
60,000 ESA/year

**Figure B 14.3**

Cost zone 4
Local distributor
100,000 ESA/year



**Figure B 14.4**

Cost zone 4
Local distributor
200,000 ESA/year

## B.15   Cost zone 4 – Regional distributor

**Figure B 15.1**

Cost zone 4
Regional distributor
20,000 ESA/year



**Figure B 15.2**

Cost zone 4
Regional distributor
60,000 ESA/year

**Figure B 15.3**

Cost zone 4
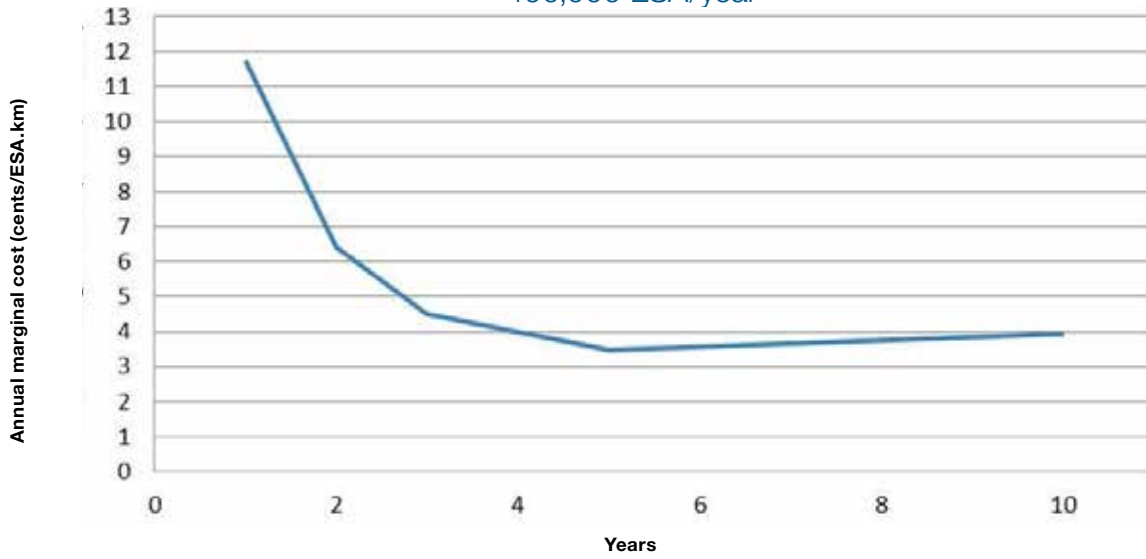Regional distributor
100,000 ESA/year



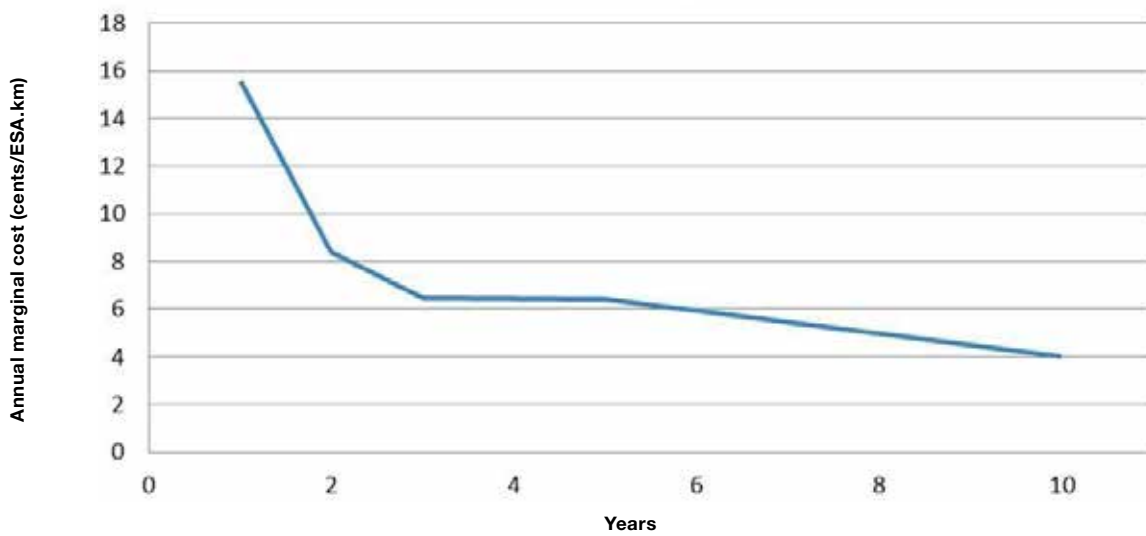Annual marginal cost (cents/ESA.km)

Years

**Figure B 15.4**

Cost zone 4
Regional distributor
200,000 ESA/year



Annual marginal cost (cents/ESA.km)

Years

## B.15  Cost zone 4 – District distributor

**Figure B 16.1**
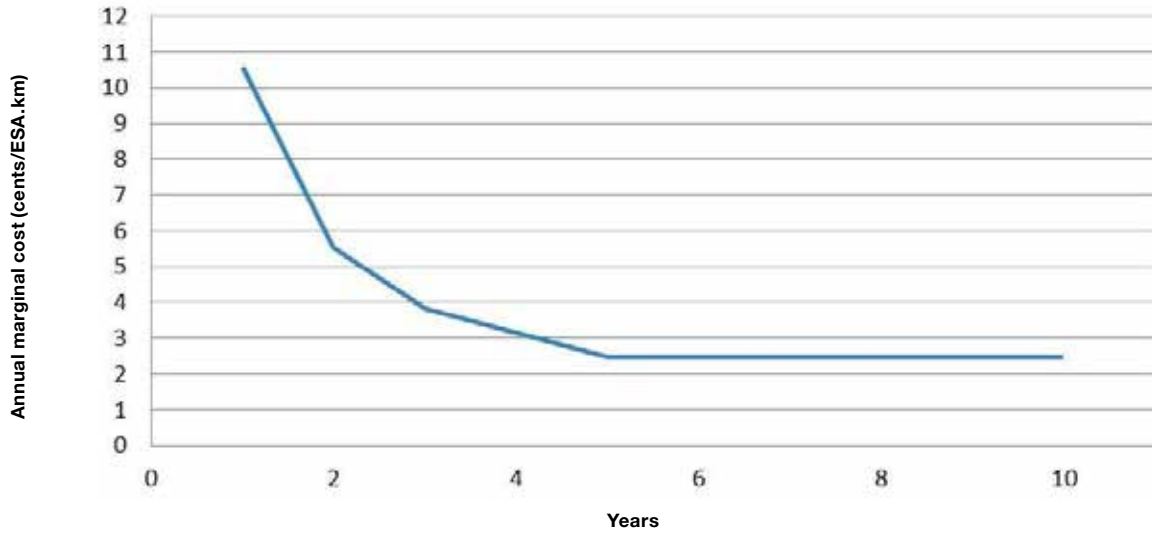
Cost zone 4
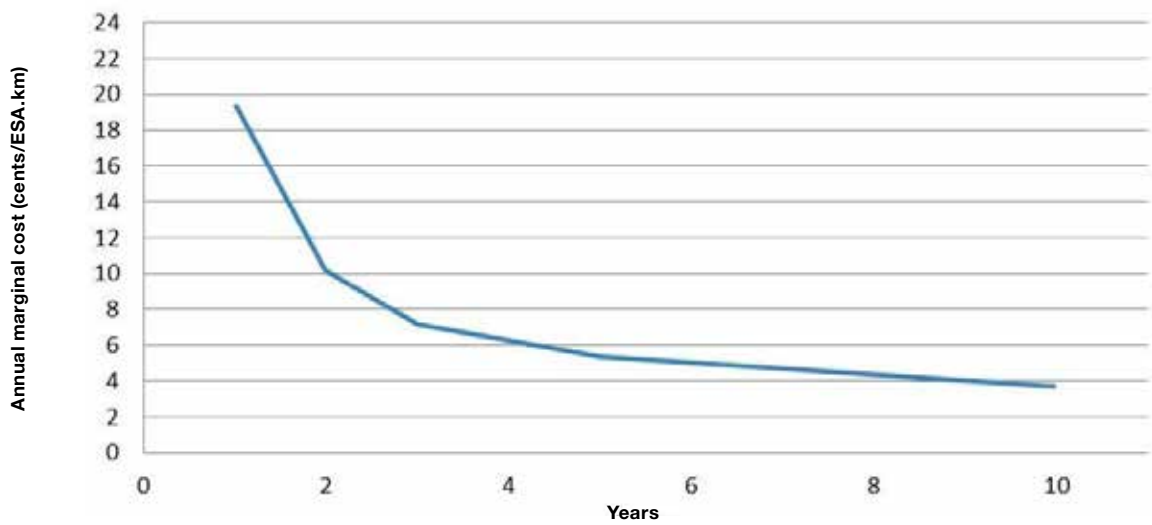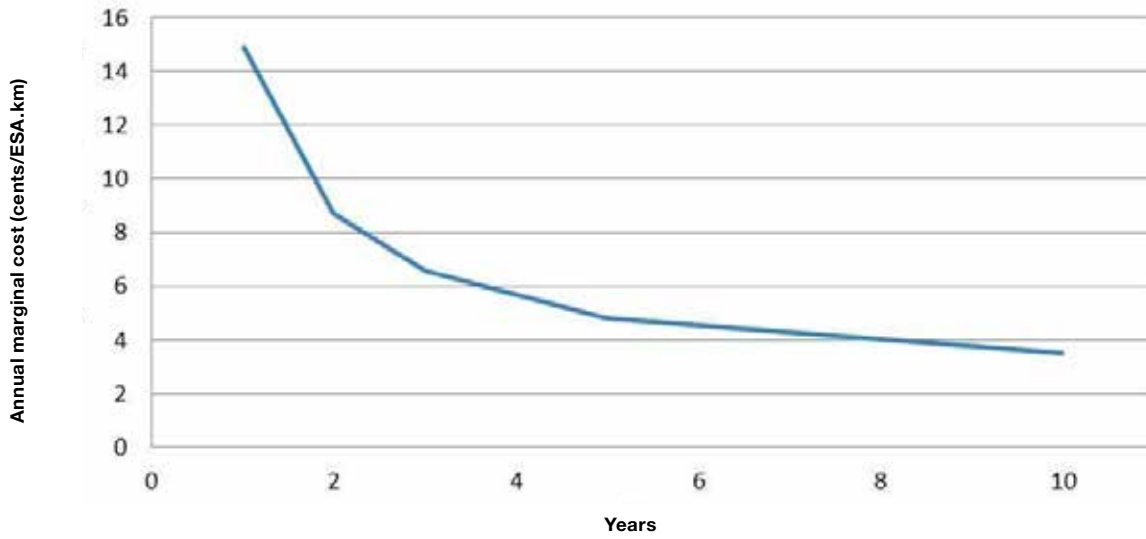District distributor
20,000 ESA/year



**Figure B 16.2**

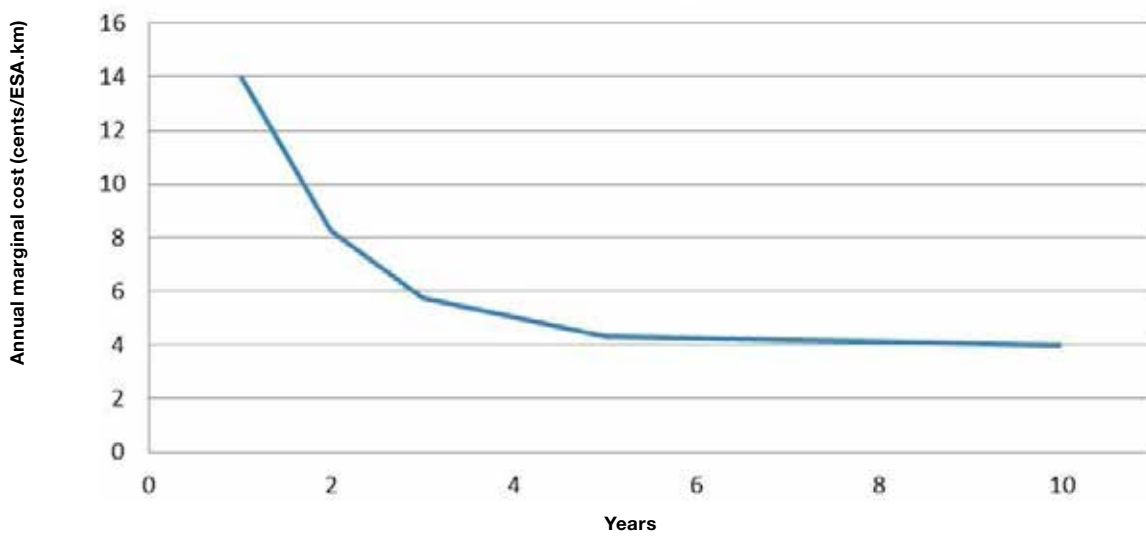Cost zone 4
Local distributor
60,000 ESA/year

**Figure B 16.3**

Cost zone 4
district distributor
100,000 ESA/year



**Figure B 16.4**

Cost zone 4
district distributor
200,000 ESA/year

# APPENDIX C - RELEVANT TECHNICAL BACKGROUND AND EXPLANATIONS

This appendix outlines some of the more relevant technical background that is associated with the development of the content presented in this user guide.

## C.1 What is an ESA?

An Equivalent Standard Axle (ESA) is a measure which standardises the damage done to a road pavement by an axle group of a heavy vehicle.

For simplicity, design traffic loading is often described as the number of Standard Axle Repetitions (SAR) that a pavement structure will carry.  To calculate the design SAR for a pavement, the damage associated with each axle group of each vehicle configuration is estimated in terms of Standard Axle Repetitions.

A standard axle is a single axle with dual tyres (referred to as SADT) applying an axle load of 80 kN (approximately 8.16 tonne) to the pavement.  The number of SARs that an axle group with a certain load applies to a pavement can be determined using Equation 1:

$$SARm_{ij} = \left[\frac{L_{ij}}{SL_i}\right]^m \tag{1}$$

**where**

$SARm_{ij}$ =     number of Standard Axle Repetitions (or passages of the Standard Axle) which causes the same amount of damage as a single passage of axle group type i with load Lij, where the load damage exponent is m

$SL_i$     =     Standard Load for axle group type i

$L_{ij}$     =     jth load magnitude on the axle group type i

$m$     =     load damage exponent for the damage type.

The SAR calculated with a load damage exponent of 4 is commonly referred to as an Equivalent Standard Axles (ESA) and is applied to granular pavements with a thin bituminous surfacing designed using an empirical methodology, which forms the basis for the examples in this guide.  Throughout this guide ESA are used, but if the type of pavements differs from that used in this guide the SAR should be determined using an alternative load exponent of 5 for asphalt surfaced pavements and 12 for cement stabilised pavements.  It is evident therefore that, axle mass applications in excess of standard axle masses have an exponentially increasing effect on pavement wear.

For different axle configurations, the Austroads *Guide to Pavement Technology Part 2: Pavement Structural Design* shows how to convert the different loadings into a unit that is equivalent across all axle groups.

## C.2 What is a marginal cost?

Marginal costs are associated with the difference in expenditure required to maintain a pavement under different loading. The base traffic represents a traffic volume that would consume the structural capacity of the selected pavement structures over a 50 year period, i.e. the pavement's service life. A road may be subjected to a defined period of additional loading (see Figure C.1.). This user guide has been developed by modelling the effect of four typical additional loading scenarios.

The effects of this additional loading on costs to the agency to meet and deliver the same levels of services as determined for the base traffic are estimated by modelling the structural performance of the road over time. The costs included provision for routine maintenance, resurfacing, and pavement rehabilitation and reconstruction activities to be undertaken by the road agency to deliver these levels of service.
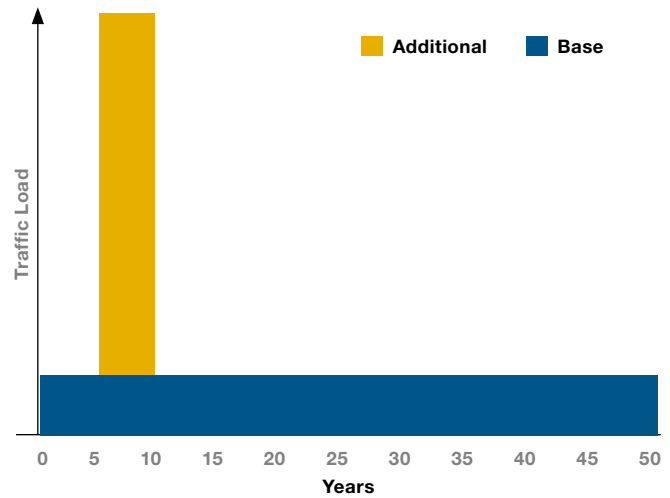


*Figure C. 1: Traffic load versus time showing a typical additional load for a set duration*

The marginal cost of road wear in this context, is defined as the difference in cost of maintaining a road in a serviceable condition, between an increased load of traffic and a base traffic load.

## C.3 Road category definitions

The road categories applied in this analysis have been nominally designed to accommodate a range of traffic loadings relative to their different service levels. Therefore, the higher order roads should be capable of accommodating larger cumulative loading than the lower order road types. Figure C. 1Table C.1 shows the different design traffic ranges anticipated on these road categories and the midpoint cumulative design ESA for each of the road types that were selected for inclusion in the analyses.

**Table C. 1: Design ESA and adopted mid-point ESA**

| Road category | Design traffic (ESA x $10^6$) | Adopted design traffic (ESA x $10^6$) |
|---|---|---|
| Access road | < 0.08 | 0.04 |
| Local distributor | 0.08 – 0.4 | 0.2 |
| Regional distributor | 0.4 – 2.0 | 1.2 |
| District distributor | 2.0 – 6.0 | 4.0 |

In some cases, a road may have been designed and constructed to a level that is different to the adopted design traffic and the user should then adjust the selected category accordingly.