



TransGrid

**TransGrid Revenue Proposal
2018/19 – 2022/23**

Appendix D

**Off Easement Risk Management
- Opex Step Change**

Off Easement Risk Management – OPEX Step Change

25/01/17

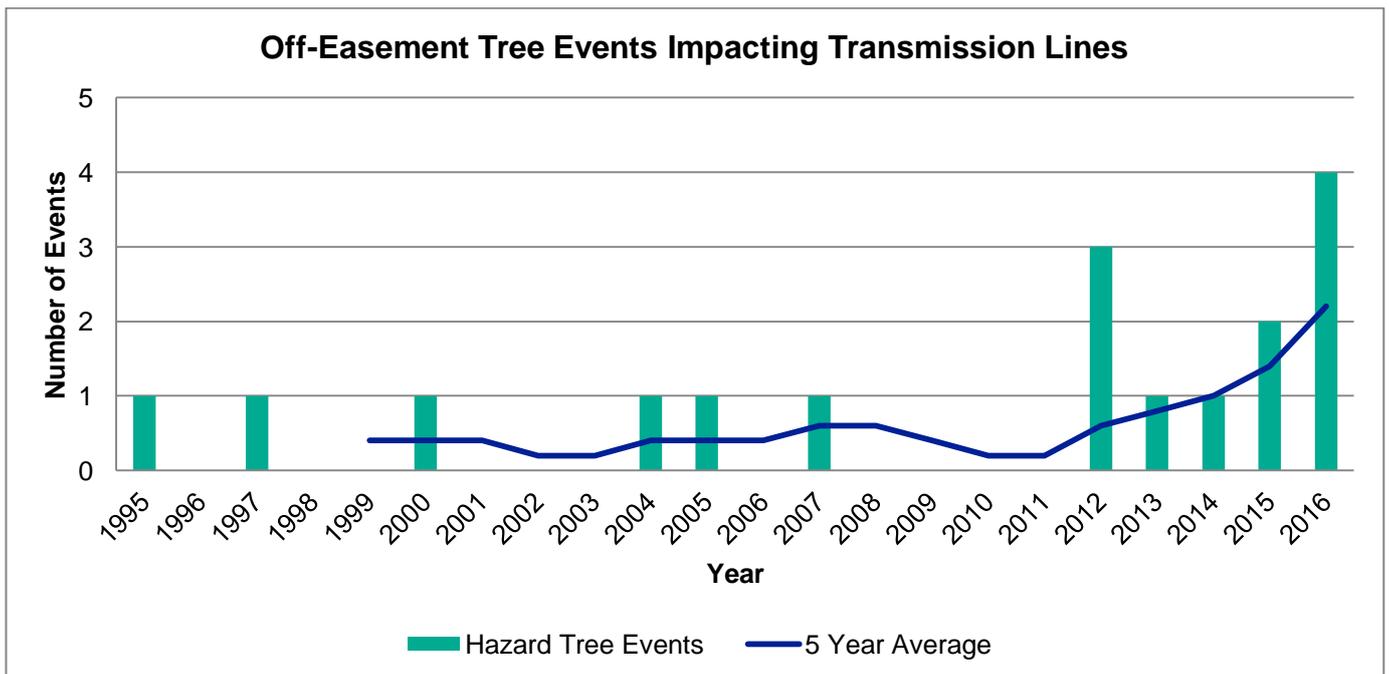
1. Background

TransGrid is committed to the health, welfare and safety of employees, contractors and the public through demonstrated leadership in safety. To help achieve this, TransGrid must ensure its operations are fully compliant with all applicable regulations and guidelines. This includes The Electricity Supply (Safety and Network Management) Regulation 2014 (the regulation), which requires TransGrid to manage the following risks in accordance with AS 5577 electricity network safety management systems:

- > the safety of members of the public;
- > the safety of persons working on networks;
- > the protection of property (whether or not belonging to a network operator);
- > the management of safety risks arising from the protection of the environment (for example, preventing bush fires that may be ignited by network assets); and
- > the management of safety risks arising from loss of electricity supply.

TransGrid’s compliance with the regulation is monitored by IPART through annual compliance reports and independent audits. Recently IPART updated its audit guidelines to provide increased clarity on the requirements of the regulation, which has implications for TransGrid’s approach to vegetation management. Currently TransGrid manages vegetation within easement corridors around its network for the purpose of maximising system reliability, maximising safety of the public and minimising the risk of bush fires. However, TransGrid estimates from historical aerial laser surveys and line modelling of 186 line circuits that some 51,500 trees *outside* TransGrid’s easements could touch conductors if they fell. This year (2016) there have been four separate events where trees from outside TransGrid’s easement area have fallen onto a transmission line; the highest number on record. The historical average during the previous decade was 0.6 events per year as per Figure 1.

Figure 1 – Historical off-easement tree events impacting transmission lines



A significant increase in off-easement tree events is noted in 2012, however the trend of off-easement tree events has continued to increase significantly since 2012 when compared with the previous decade, which saw a relatively steady trend. The recent increase in off-easement tree events may be attributable to:

- > A major bushfire event in the alpine region in 2003 resulting in many dead trees which have not regenerated and rot has established within the dead tree.
- > The decline in the health of trees due to a recent El Nino event over 2015-2016 which resulted in reduced rainfall and warmer temperatures placing stress on trees.
- > Plantations commenced in New South Wales in 1912 for pine and 1939 for eucalypt¹. These trees are now maturing and aging. As trees age, they become more susceptible to dieback (especially in dry seasons), increased attack by insects and pathogens, and rot becomes established within the tree². Each of these factors could result in a tree failing.

The sustained increase in off-easement tree events in the recent years, combined with a new bushfire risk compliance regime and audit guidelines associated with a change in regulator (IPART, previously Department of Trade and Investment) has caused TransGrid to reassess how the off-easement tree risk is managed.

The impact of an off-easement tree touching a conductor can be significant, and has the potential to cause power outages, bush fires and loss of life. For example, residents and business owners sued Endeavour Energy for damages in the NSW Supreme Court regarding a bushfire that took place in October 2013. They claim the energy distributor failed to prune or remove a hazardous tree next to a power pole on a property at Linksvie Road, Springwood. Fanned by wind gusts of up to 100km/h on a hot and dry day, the fire destroyed 194 homes and razed 3600 hectares of bush, although remarkably there was no loss of human life.³The off-easement tree events that occurred in TransGrid's network in 2016 are summarised below:

Table 1: Summary of Off-easement Tree Events in 2016

Date	Transmission Line	Consequence
24/6/2016	9W3 (Coffs Harbour – Raleigh)	Auto-reclose of breaker and a subsequent line patrol.
22/7/2016	97G/3 (Murray – Guthega tee Geehi)	Line out of service for four days.
4/8/2016	96C (Armidale – Coffs Harbour tee Dorrigo)	Line out of service for seven days. Load lost at Dorrigo for 16 hours.
13/11/2016	992 (Tumut – Burrinjuck)	Line out of service for two days.

2. Current Position

Under IPART's new audit guidelines, TransGrid must manage off-easement trees using a four step process to demonstrate that risk to the public, property and environment from bushfires is managed So Far As Reasonably Practicable. The four steps require that:

- > the safety of members of the public;
- > the safety of persons working on networks;
- > the protection of property (whether or not belonging to a network operator);

¹ Forestry Corporation NSW: *History*, November 2016

² Tasmanian Timber: *Eucalypt Forest Life Cycle*

³ Sydney Morning Herald: Louise Hall: *Blue mountains bushfire caused by rotting tree falling on power lines court hears*, February 2016

- > the management of safety risks arising from the protection of the environment (for example, preventing bush fires that may be ignited by network assets); and
- > the management of safety risks arising from loss of electricity supply.

Independent legal advice received by TransGrid has confirmed the risk posed by off-easement trees must be managed to ensure it is As Low As is Reasonably Practical. Whilst it is not deemed 'reasonably practical' to remove all off-easement trees, the advice states that options to address the trees which present the greatest risk must be assessed as part of a regular ongoing programme. An option to address the risk is only deemed to be not 'reasonably practical' when the cost of the option is grossly disproportionate to the benefit gained. TransGrid has identified that more controls are needed to manage the risk associated with off-easement trees and is taking the following steps:

- > Identification of off-easement trees through LIDAR.
- > Assessment of the condition of each off-easement tree by a qualified person.
- > Where an off-easement tree is deemed to be in a condition whereby it is at risk of failure, the tree is to be lopped/pruned, or otherwise reassessed on a routine basis.
- > Planned update of programme scope in 2017 when new data is available.

2.1 Initial Risk Assessment

In order to quantify the risk presented by off-easement trees, TransGrid has:

- > Calculated the risk presented by off-easement trees to each transmission line using the best available data, in accordance with TransGrid's Network Asset Risk Assessment Methodology.
- > Assumed a probability of failure based on the long term rate of off-easement tree failure events that have had an adverse impact on transmission lines. There have been 17 events over the last 21 years across the network, giving a Probability of Failure of $17 \text{ failures} / 51,500 \text{ trees} / 21 \text{ years} = 0.00157\%$ for any off-easement tree.
- > Calculated the Consequence of Failure and Likelihood of Consequence using TransGrid's Network Criticality Framework, which provides consequence values for safety, bushfire and reliability impacts of each transmission line.

The quantified off-easement tree risk has also been used to facilitate the application of the So Far As is Reasonably Practicable (SFAIRP) / As Low As Reasonably Practicable (ALARP) principle, when managing network safety risks. The network safety risks are defined as:

- > The safety risk due to asset failure such as explosive failure or conductor drop.
- > The bushfire risk, which is a subset of the environmental risk.
- > The safety risk to the community.

TransGrid is obliged by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011 to reduce network safety risks SFAIRP/ALARP. In doing so, TransGrid determines whether a risk mitigation is 'reasonably practical' by multiplying the quantified annual network safety risks by a disproportionality factor and comparing this against the proposed annualised risk mitigation cost. Where the annual network safety risk value exceeds the annualised risk mitigation cost, it is deemed 'reasonably practical' to implement the risk control. This calculation is presented in Table 2 and evaluation in Table 4. Further details on SFAIRP/ALARP are included in the Network Asset Risk Assessment Methodology document.

The risk associated with off-easement trees under a Base Case 'run-to-fail' option is \$1.78m per annum, as summarised in the table below and detailed in Attachment One:

Table 2: Risk cost associated with off-easement trees (\$m December 16)

Risk Category	Annual Risk Cost	Annual Risk Reduction	Network Safety Risk Reduction (SFAIRP/ALARP) ⁴
Reliability (System)	\$0.13	\$0.10	\$0.01
Financial	\$0.02	\$0.01	-
Operational/Compliance	-	-	-
People (Safety)	\$0.28	\$0.22	\$1.32
Environment	\$1.36	\$1.09	\$6.54
Reputation	-	-	-
Total	\$1.78	\$1.42	\$7.87

It is anticipated that once planned controls are implemented, the annual risk cost will be reduced by 80%, resulting in a total benefit of \$1.42m per annum. It is not expected that the entire risk can be reduced due to the variable nature of tree failure. Instead, the risk will be reduced progressively over the five year proposed programme, with the largest reductions occurring in the first years (refer Figure 2). This will be achieved by prioritising the transmission lines with the highest calculated risk, taking into account the consequence of possible bushfire using the criticality framework (see Attachment 2).

2.2 Risk Mitigation Strategy

TransGrid has considered the following steps to ensure that its mitigation programme is effectively and efficiently delivered:

Improve information

The current list of off-easement trees is based on LIDAR surveys and analysis that did not capture all transmission lines. An updated off-easement tree survey has been commissioned as part of the 2016-17 LIDAR flights to provide an up to date identification of off-easement trees on all transmission lines on TransGrid's network. The results will allow accurate identification of the individual trees for field staff on the ground to perform assessments.

Engage with affected parties

Following identification of the off-easement trees, approvals will need to be gained to undertake the works off-easement. This will require negotiation with property owners and legal intervention as required. There are also a large number of the trees (approximately 8,500) in National Parks and a similar number in State Forests. Memorandums of Understanding with these bodies will be required before works can be undertaken in these areas. A policy document will then be finalised and the works packaged and issued. It is expected that this will occur over 2017-18.

Prioritise work to minimise risk and maximise efficiency

Due to the large numbers of off-easement trees, 20% of the total quantity per year is to be assessed and actioned over the five years 2019-23 to level the resource requirements, prioritised on risk, as detailed in Attachment 2. This time period will also allow the works to be combined with routine easement inspections

⁴ The Network Safety Risk Reduction is calculated as 6 x Environment (Bushfire) Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

and maintenance (which occur every 1 to 6 years depending upon the easement) wherever possible to increase efficiency of programme delivery.

Following the initial assessments and action, the ongoing assessments of the off-easement trees will be included as part of the scheduled easement inspections from 2023 onwards. It is anticipated that off-easement trees will be assessed every second easement inspection (subject to final policy details) so that synergies with other easement inspections and maintenance are achieved.

Compare practices with other transmission network service providers

By comparison, AusNet Services according to their “Vegetation Management Plan – Electricity Transmission Network” (2015), routinely inspect easements annually and undertake a three yearly pruning cycle to identify off-easement trees and allocate a removal priority as required. They then allocate a reinspection period of 365 days to off-easement trees which have been assessed as not likely to fail but have the potential to fall into the clearance space. Off-easement trees at risk of failure are addressed in a shorter timeframe. Given the quantity of off-easement trees on TransGrid’s network, it is not considered practical to address all trees within one year, hence the work has been broken up to a reasonable level over five years, prioritised on risk.

2.3 Cost and Evaluation

TransGrid will only remove off-easement trees when they have been assessed and display a condition issue. This is because it is not considered reasonably practical to remove all off-easement trees. For the purposes of costing, TransGrid has based its calculations on a research paper prepared in 1984 titled “Native Tree Dieback and Mortality on the New England Tablelands of New South Wales”. This research paper studied a population of native trees and found that 7.7% were dying or dead.

TransGrid has rounded this value down by 10% to 7%, and used this to estimate the number of off-easement trees that will require removal out of the total population. This approach was taken to minimise the risk of over-scoping the programme.

The estimated cost of managing the off-easement tree risk over the five years to 2023 is as per the table below. This includes assessment of all off-easement trees and removal of those which are at risk of failure.

Table 3: Estimated cost of managing off-easement tree risk from 2018/18 to 2022/23 (\$ December 16)

Description	Cost	Unit Cost
Assessment and Removal of 3,600 Trees	\$18,560,849	\$5,156
Assessment Only of 47,900 Trees	\$9,006,681	\$188
Field Services Management and Supervision*	\$3,326,472	\$65
Environmental Approvals	\$780,944	\$217
Scope Allowance*	\$5,107,242	\$99
Project Total	\$36,782,189	-

*Notes:

Field Services Management and Supervision includes costs to issue work packages to contractors, organise land owner approvals (trees off-easement), coordinate legal instructions, arrange access for contractors, prepare and review safety documentation, supervise contractors where required and verify completion of work.

Scope Allowance includes provision for:

1. Additional trees to the 7% requiring removal, noting that:

- a. The study was undertaken in the New England Tablelands region;
 - b. The figure in the study has been rounded down by approximately 10% to avoid over scoping the programme;
 - c. Certain areas of the network, such as the Snowy Mountains region are expected to have a higher proportion of dead and dying trees than the New England Tablelands region due to past bushfires leaving a large number of off-easement trees dead and the winter snows further exacerbating this issue; and
 - d. An additional 32 transmission lines were not included in the original LIDAR used to identify the off-easement trees.
2. The trees are taller than expected. The base estimate takes 64% of the trees requiring removal to be 30m height or less. It is expected that off-easement trees are likely to be a greater height than this, potentially up to 60m and that a greater portion, particularly in National Parks and State Forests will be up towards 60m in height.
 3. Additional environmental approvals or offsets may be required in National Parks, particularly if the tree is deemed of significant value.

This estimate has been taken as \$36 million, or \$7.2 million per year for the five year programme. Details of the estimate components are included in Attachment 3.

In the context of the Network Asset Risk Assessment Methodology, the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) principle is applicable to the following Key Hazardous Events:

- > Structure failure
- > Conductor / earthwire drop
- > Uncontrolled discharge or contact with electricity

Evaluation of the proposed options has been completed against the SFAIRP (So Far As Is Reasonably Practicable)/ALARP (As Low As Reasonably Practical) obligation, as required by the Electricity Supply (Safety and Network Management) Regulation 2014 and the Work Health and Safety Act 2011 in Table 4. The evaluation determines that it is reasonably practical to implement the proposed risk controls.

Table 4 – SFAIRP/ALARP assessment (\$ December 16)

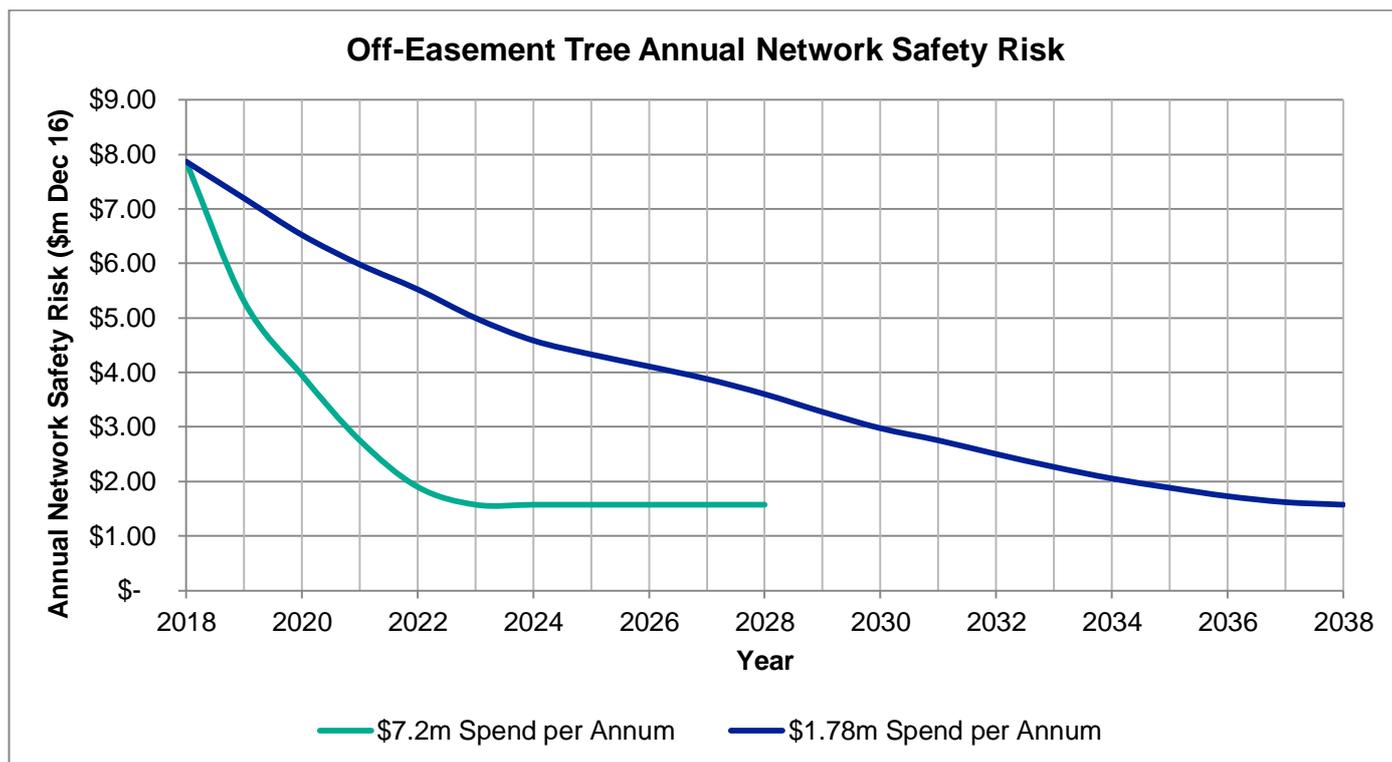
Network Safety Risk Reduction ⁵	Annualised Spend	Reasonably Practicable (Y/N)
\$7.9 million	\$7.2 million	Yes

The proposed risk control programme addresses the off-easement tree risk over a period of five years, reducing the risk to its residual value. Following the proposed programme of works, a reduced programme of monitoring and management is expected to be implemented.

A off-easement tree network safety risk reduction profile has been calculated in Figure 2, showing how the off-easement tree network safety risk reduces over the duration of the proposed \$7.2 million per year five year programme. This is compared with the risk reduction over time associated with implementing a programme of works at a slower rate whereby the annualised spend is reduced to the base annual network risk of \$1.78 million per year.

⁵ The Network Safety Risk Reduction is calculated as 6 x Environment (Bushfire) Risk Reduction + 6 x Safety Risk Reduction + 0.1 x Reliability Risk Reduction.

Figure 2 – Off Easement Tree Annual Network Safety Risk Reduction



While it is ‘reasonably practical’ to implement a off-easement tree risk reduction programme whereby the risk is addressed over a 20 year period, TransGrid would not be meeting its obligations under SFAIRP/ALARP and subsequently the regulations as the five year programme is also ‘reasonably practical’ and addresses the bushfire and safety risk in a much shorter timeframe.

3. Recommendation

From the above evaluation, it is considered that implementation of controls as proposed to manage off easement risk is reasonably practical and required to meet the requirements of the regulation.

Attachment 1 – Off-easement Tree Risk Summary

Current Option Assessment - Risk Summary



Project Name: Hazard Trees

Option Name: 1676 - Option 1

Option Assessment Name: 1676 - Option 1 - Assessment 1

Rev Reset Period: Next (2018-23)

Major Component	No.	Minor Component	Sel. Hazardous Event	LoC x CoF (\$M)	Failure Mechanism	NoxLoC xCoF (\$M)	PoF (Yr 1)	Total Risk (\$M)	Risk (\$M) (Rel)	Risk (\$M) (Op)	Risk (\$M) (Fin)	Risk (\$M) (Peo)	Risk (\$M) (Env)	Risk (\$M) (Rep)
Tree Failure	5E+04	Conductor	Uncontrolled Electrical Contact / Discharge (Tree Failure)	\$2.03	Low Span	104,838.94	0.00%	\$1.65			\$0.01	\$0.28	\$1.36	\$0.00
Tree Failure	5E+04	Insulators	Unplanned Outage - HV (Tree Failure)	\$0.17	Structural Failure	\$8,853.05	0.00%	\$0.14	\$0.13		\$0.01			\$0.00
				\$2.21		113,691.99		\$1.78	\$0.13		\$0.02	\$0.28	\$1.36	\$0.00

Total VCR Risk: \$0.13

Total ENS Risk: \$0.00

Attachment 2 – Transmission Line Risk

Transmission Line	Annual Network Safety Risk	Yearly Portion
964		
963	\$3,378,455	21.7%
97G/1		
89		
966		
96C	\$1,666,931	20.6%
87		
96G		
9W3		
96P		
32		
96L		
96F		
965	\$1,395,866	22.1%
82		
992		
96N		
24		
967		
944		
2		
76		
94M		
77		

Transmission Line	Annual Network Safety Risk	Yearly Portion
26		
27		
96H		
25		
20		
2M		
22		
U1		
74		
31		
968		
11	\$1,020,524	20.3%
947		
14		
21		
86		
73		
97K		
18		
9W2		
72		
970		
U5		
U7		

Transmission Line	Annual Network Safety Risk	Yearly Portion
28		
95N		
6		
97L		
37		
5A2		
96T		
993		
36		
25SP		
95		
94E		
92Z/2		
01		
81		
250		
96R		
94B		
5A1		
959		
097B		
U3		
94X		
99F		
995		

Transmission Line	Annual Network Safety Risk	Yearly Portion
9U2		
35		
94K		
92		
88		
99Z		
29		
10		
39		
84		
99K		
91SP		
30		
13		
94M		
38		
99H		
948		
977/1		
9U3		
97D		
994		
99B		
94U		
976/1		

Transmission Line	Annual Network Safety Risk	Yearly Portion
90SP		
92Z/1		
973		
94P		
94T		
12		
99D		
85		
947/3		
991		
6		
945		
78		
969		
94		
998		
978		
62		
8E		
99P		
8C		
M1		
976/2		
9R5		
996		

Transmission Line	Annual Network Safety Risk	Yearly Portion
97A		
99W		
83		
93		
947/2		
99M		
99A		
99L		
976/1		
23		
99J		
93SP		
5B1		
8L		
39		
97B		
999		
M9		
81SP		
979		
YY		
71		
8M		
9R1		
63		

Transmission Line	Annual Network Safety Risk	Yearly Portion		
X2				
51				
99A/3				
9R2				
5				
976/2				
3C				
977/1				
60			\$411,666	15.4%

Attachment 3 – Cost Estimate

Assessment and Removal of 3,600 Trees

Size of Tree	Qty Weighting	Work Method
25	0.130	Fell
25	0.100	EWP
25	0.060	Climb
30	0.150	Fell
30	0.120	EWP
30	0.080	Climb
40	0.010	Fell
40	0.100	EWP
40	0.070	Climb
50	0.005	Fell
50	0.050	EWP
50	0.060	Climb
60	0.005	Fell
60	0.020	EWP
60	0.040	Climb

1

Assessment Only of 47,900 Trees

Size of Tree	Qty Weighting
25	0.290
30	0.350
40	0.180
50	0.115
60	0.065

1

Field Services Management and Supervision			
Description	Resource	Unit	Qty
Direct Supervision of tree removal (10% of trees)	IL - NSO - Normal Time - Easement Officer (16-28)	HR	3186
	IL - NSO - Travel outside hours - Easement Officer (16-28)	HR	734.4
	IL - Sustenance - Tier 2 Country Centre	DAY	241.2
Management of period order works (12 employees, 30% full time, 5 years)	IL - NSO - Normal Time - Easement Officer (16-28)	HR	30240
	IL - NSO - Travel outside hours - Easement Officer (16-28)	HR	2880
	IL - Sustenance - Tier 2 Country Centre	DAY	1440
Environmental Approvals			
Description	Resource	Unit	Qty
Risk Assessment Checklist - Outside NPWS	IL - CPD - Normal Time - Environmental Officer (24-32)	HR	840
Environmental Inspection - NPWS	IL - CPD - Normal Time - Environmental Officer (24-32)	HR	587
	IL - CPD - Travel outside hours - Environmental Officer (24-32)	HR	2364
	IL - Sustenance - Tier 2 Country Centre	DAY	424
Risk Assessment Checklist - NPWS	IL - CPD - Normal Time - Environmental Officer (24-32)	HR	2364