

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
418	March 2020	385481.5	6477567.4	Jarrah ( <i>Eucalyptus marginata</i> )	750	14	No	0	n/a	
419	March 2020	385476.1	6477575.7	Jarrah ( <i>Eucalyptus marginata</i> )	620	13	No	0	n/a	
420	March 2020	385472.2	6477587.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	1200	10	No	0	n/a	
421	March 2020	385440.0	6477616.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	900	17	No	0	n/a	
422	March 2020	385421.1	6477648.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	540	12	No	0	n/a	
423	March 2020	385408.7	6477690.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	810	15	No	0	n/a	
424	March 2020	385398.8	6477702.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	1700	21	No	1	Small (<10 cm entrance)	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
425	March 2020	385475.0	6477645.0	Jarrah ( <i>Eucalyptus marginata</i> )	620	10	No	0	n/a	
426	March 2020	385481.0	6477654.2	Jarrah ( <i>Eucalyptus marginata</i> )	1200	6	No	0	n/a	
427	March 2020	385457.1	6477651.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	850	15	No	0	n/a	
428	March 2020	385458.9	6477667.4	Tuart ( <i>Eucalyptus gomphocephala</i> )	1200	14	No	0	n/a	
429	March 2020	385476.6	6477668.1	Jarrah ( <i>Eucalyptus marginata</i> )	680	9	No	0	n/a	
430	March 2020	385469.0	6477707.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	1020	16	No	0	n/a	
431	March 2020	385450.5	6477701.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	1030	16	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
432	March 2020	385460.1	6477733.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	680	20	No	0	n/a	
433	March 2020	385460.1	6477741.4	Tuart ( <i>Eucalyptus gomphocephala</i> )	810	21	No	0	n/a	
434	March 2020	385452.4	6477751.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	920	12	No	0	n/a	
435	March 2020	385446.3	6477745.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	820	15	No	0	n/a	
436	March 2020	385432.1	6477746.5	Tuart ( <i>Eucalyptus gomphocephala</i> )	900	15	No	0	n/a	
437	March 2020	385419.0	6477737.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	1300	15	No	0	n/a	
438	March 2020	385434.1	6477722.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	1100	14	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
439	March 2020	385364.0	6477759.1	Jarrah ( <i>Eucalyptus marginata</i> )	530	10	No	0	n/a	
440	March 2020	385345.0	6477796.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	560	12	No	0	n/a	
441	March 2020	385351.1	6477797.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	10	No	0	n/a	
442	March 2020	385336.1	6477801.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	12	No	0	n/a	
443	March 2020	385326.5	6477825.9	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	12	No	0	n/a	
444	March 2020	385338.4	6477833.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	620	13	No	0	n/a	
445	March 2020	385309.7	6477855.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	920	16	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
446	March 2020	385303.5	6477886.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	920	12	No	0	n/a	
447	March 2020	385288.3	6477910.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	1010	18	No	0	n/a	
448	March 2020	385253.4	6477955.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	850	13	No	0	n/a	
449	March 2020	385227.2	6478006.5	Tuart ( <i>Eucalyptus gomphocephala</i> )	590	8	No	0	n/a	
450	March 2020	385226.9	6478011.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	530	8	No	0	n/a	
451	March 2020	385224.8	6478016.6	Marri ( <i>Corymbia calophylla</i> )	500	10	Yes	0	n/a	
452	March 2020	385211.7	6478028.1	Marri ( <i>Corymbia calophylla</i> )	560	7	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
453	March 2020	385214.2	6478031.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	530	7	No	0	n/a	
454	March 2020	385216.6	6478018.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	580	9	No	0	n/a	
455	March 2020	384981.4	6478776.4	Dead Stag	520	7	No	0	n/a	
456	March 2020	384979.5	6478781.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	1000	14	No	0	n/a	
457	March 2020	384974.3	6478794.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	510	11	No	0	n/a	
458	March 2020	384980.2	6478804.9	Dead Stag	940	10	No	0	n/a	
459	March 2020	384986.1	6478807.9	Tuart ( <i>Eucalyptus gomphocephala</i> )	1000	21	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
460	March 2020	384993.8	6478798.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	600	19	No	0	n/a	
461	March 2020	385005.8	6478809.6	Marri ( <i>Corymbia calophylla</i> )	520	15	No	0	n/a	
462	March 2020	385016.3	6478823.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	1100	14	No	1	Large (>20 cm entrance)	
463	March 2020	385003.5	6478835.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	540	10	No	0	n/a	
464	March 2020	385006.7	6478849.1	Jarraah ( <i>Eucalyptus marginata</i> )	520	9	No	0	n/a	
465	March 2020	385011.1	6478857.5	Jarraah ( <i>Eucalyptus marginata</i> )	700	18	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
466	March 2020	384979.2	6478840.6	Dead Stag	850	8	No	1	Medium (10-20 cm entrance)	
467	March 2020	384985.8	6478855.7	Dead Stag	870	10	No	2	Medium (10-20 cm entrance)	
468	March 2020	384978.9	6478859.4	Tuart ( <i>Eucalyptus gomphocephala</i> )	560	12	No	0	n/a	
469	March 2020	384987.2	6478883.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	740	11	No	0	n/a	
470	March 2020	384993.5	6478885.6	Jarrah ( <i>Eucalyptus marginata</i> )	1050	9	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
471	March 2020	385000.8	6478887.4	Jarrah ( <i>Eucalyptus marginata</i> )	900	14	No	0	n/a	
472	March 2020	384998.5	6478896.6	Marri ( <i>Corymbia calophylla</i> )	520	13	No	0	n/a	
473	March 2020	385014.4	6478892.5	Jarrah ( <i>Eucalyptus marginata</i> )	700	11	No	0	n/a	
474	March 2020	385013.6	6478894.4	Jarrah ( <i>Eucalyptus marginata</i> )	650	10	No	0	n/a	
475	March 2020	385019.1	6478921.9	Tuart ( <i>Eucalyptus gomphocephala</i> )	950	11	No	0	n/a	
476	March 2020	384992.3	6478924.5	Marri ( <i>Corymbia calophylla</i> )	520	15	No	0	n/a	
477	March 2020	385004.1	6478940.3	Jarrah ( <i>Eucalyptus marginata</i> )	820	11	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
478	March 2020	385023.3	6478939.9	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	15	No	0	n/a	
479	March 2020	384993.9	6479022.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	620	14	No	0	n/a	
480	March 2020	384996.5	6479036.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	580	14	No	0	n/a	
481	March 2020	385025.3	6479040.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	640	15	No	0	n/a	
482	March 2020	385025.3	6479041.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	550	15	No	0	n/a	
483	March 2020	385028.2	6479043.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	520	15	No	0	n/a	
484	March 2020	385046.2	6479045.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	15	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
485	March 2020	385047.1	6479045.1	Tuart ( <i>Eucalyptus gomphocephala</i> )	620	14	No	0	n/a	
486	March 2020	385056.7	6479045.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	520	13	No	0	n/a	
487	March 2020	385061.3	6479048.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	530	13	No	0	n/a	
488	March 2020	385077.5	6479061.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	540	15	No	0	n/a	
489	March 2020	385086.1	6479061.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	540	12	No	0	n/a	
490	March 2020	385012.2	6479165.4	Tuart ( <i>Eucalyptus gomphocephala</i> )	620	18	No	0	n/a	
491	March 2020	385027.0	6479160.4	Tuart ( <i>Eucalyptus gomphocephala</i> )	1190	23	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
492	March 2020	385029.1	6479157.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	1530	17	No	0	n/a	
493	March 2020	385059.1	6479145.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	550	10	No	0	n/a	
494	March 2020	385056.9	6479134.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	520	7	No	0	n/a	
495	March 2020	385073.5	6479142.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	1000	18	No	0	n/a	
496	March 2020	385083.1	6479135.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	820	16	No	0	n/a	
497	March 2020	385086.9	6479136.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	15	No	0	n/a	
498	March 2020	385078.7	6479133.9	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	12	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
499	March 2020	385079.6	6479129.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	12	No	0	n/a	
500	March 2020	385094.4	6479135.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	610	18	No	0	n/a	
501	March 2020	385103.6	6479130.5	Tuart ( <i>Eucalyptus gomphocephala</i> )	920	15	No	0	n/a	
502	March 2020	385105.6	6479113.5	Tuart ( <i>Eucalyptus gomphocephala</i> )	700	14	No	0	n/a	
503	March 2020	385165.4	6479097.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	650	13	No	0	n/a	
504	March 2020	385162.4	6479096.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	700	11	No	0	n/a	
505	March 2020	385175.5	6479102.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	590	18	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
506	March 2020	385183.1	6479097.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	950	15	No	0	n/a	
507	March 2020	385198.5	6479091.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	710	14	No	0	n/a	
508	March 2020	385212.7	6479083.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	610	15	No	0	n/a	
509	March 2020	385216.7	6479083.3	Tuart ( <i>Eucalyptus gomphocephala</i> )	820	15	No	0	n/a	
510	March 2020	385230.9	6479069.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	520	16	No	0	n/a	
511	March 2020	385165.5	6479014.5	Jarrah ( <i>Eucalyptus marginata</i> )	1440	19	No	0	n/a	
512	March 2020	385130.6	6479030.7	Jarrah ( <i>Eucalyptus marginata</i> )	620	10	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
513	March 2020	385118.3	6479019.3	Jarrah ( <i>Eucalyptus marginata</i> )	900	11	No	0	n/a	
514	March 2020	385110.1	6479035.6	Jarrah ( <i>Eucalyptus marginata</i> )	800	10	No	1	Large (>20 cm entrance)	 
515	March 2020	385068.1	6479022.3	Jarrah ( <i>Eucalyptus marginata</i> )	900	14	No	0	n/a	
516	March 2020	385076.5	6479034.6	Jarrah ( <i>Eucalyptus marginata</i> )	920	10	No	2	Large (>20 cm entrance)	 
517	March 2020	385061.8	6479035.8	Jarrah ( <i>Eucalyptus marginata</i> )	920	12	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
518	March 2020	385043.6	6478987.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	530	12	No	0	n/a	
519	March 2020	385036.9	6478978.8	Tuart ( <i>Eucalyptus gomphocephala</i> )	520	15	No	0	n/a	
520	March 2020	385035.8	6478977.2	Tuart ( <i>Eucalyptus gomphocephala</i> )	550	10	No	0	n/a	
521	March 2020	385055.6	6478971.9	Dead Stag	720	11	No	0	n/a	
522	March 2020	385045.6	6478964.0	Jarrah ( <i>Eucalyptus marginata</i> )	520	8	No	0	n/a	
523	March 2020	385042.2	6478959.7	Tuart ( <i>Eucalyptus gomphocephala</i> )	500	12	No	0	n/a	
524	March 2020	385057.7	6478940.7	Marri ( <i>Corymbia calophylla</i> )	510	7	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
525	March 2020	385056.9	6478913.4	Jarrah ( <i>Eucalyptus marginata</i> )	820	14	No	0	n/a	
526	March 2020	385061.2	6478906.5	Jarrah ( <i>Eucalyptus marginata</i> )	500	12	No	0	n/a	
527	March 2020	385052.9	6478900.4	Jarrah ( <i>Eucalyptus marginata</i> )	850	13	No	0	n/a	
528	March 2020	385059.6	6478896.2	Jarrah ( <i>Eucalyptus marginata</i> )	820	12	No	0	n/a	
529	March 2020	385035.9	6478870.7	Marri ( <i>Corymbia calophylla</i> )	540	12	No	0	n/a	
530	March 2020	385031.3	6478849.6	Marri ( <i>Corymbia calophylla</i> )	500	12	No	0	n/a	
531	March 2020	385028.9	6478839.6	Tuart ( <i>Eucalyptus gomphocephala</i> )	650	14	No	0	n/a	

Tree No.	Survey date	Easting (mE)	Northing (mN)	Tree species	DBH (mm)	Height (m)	Foraging evidence	Number of hollows	Minimum width of hollow entrance (cm) and hollow height (m)	Photograph
532	March 2020	385029.6	6478826.0	Tuart ( <i>Eucalyptus gomphocephala</i> )	640	13	No	0	n/a	
533	March 2020	385029.5	6478811.9	Jarrah ( <i>Eucalyptus marginata</i> )	800	12	No	0	n/a	

\*Tree was not marked using differential GPS as they were unable to be safely accessed. An approximate GPS coordinate was taken in the field and then the point was manually moved to closest tree identified using aerial photography.

Table O.2: Locations of vertebrate conservation listed species recorded during the survey.

Species name (common name)	Status	MGA Zone 50 J		Date	Observation type (number of records)	Photograph
		Easting (mE)	Northing (mN)			
<i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo)	EN; EN	383753	6485064	26/09/2019	One individual observed foraging on <i>Banksia prionotes</i>	
		384772	6481653	27/09/2019	One individual observed perching on concrete wall and foraging in <i>Eucalyptus marginata</i> tree	
		386000	6476651	26/03/2020	Feeding evidence (Marri nuts)	
		385220	6478020	27/03/2020	Seven individuals heard	No photo available

Species name (common name)	Status	MGA Zone 50 J		Date	Observation type (number of records)	Photograph
		Easting (mE)	Northing (mN)			
<i>Calyptorhynchus latirostris</i> (Carnaby's cockatoo)	EN; EN	385224	6478025	27/03/2020	Feeding evidence (Marri nuts)	
<i>Calyptorhynchus banksii naso</i> (forest red-tailed black cockatoo)	VU; VU	385886	6476969	26/03/2020	Two individuals sighted	
		386232	6475615	10/04/2019*	Feeding evidence (Marri nuts)	

Species name (common name)	Status	MGA Zone 50 J		Date	Observation type (number of records)	Photograph
		Easting (mE)	Northing (mN)			
<i>Calyptorhynchus banksii naso</i> (forest red-tailed black cockatoo)	VU; VU	386069	6476416	26/03/2020	Feeding evidence (Marri nuts)	
		386024	6476624	26/03/2020	Feeding evidence (Marri nuts)	
		385847	6477038	26/03/2020	Feeding evidence (She-oak fruit)	

Species name (common name)	Status	MGA Zone 50 J		Date	Observation type (number of records)	Photograph
		Easting (mE)	Northing (mN)			
<i>Isoodon fusciventer</i> (quenda)	P4	384702	6482394	27/09/19	Individual sighting of roadkill. Diggings present in adjacent vegetation.	No photo available
		385492	6477549	26/03/2020	Secondary sign {Diggings}	
		385855	6477016	26/03/2020	Secondary sign {Diggings}	

\*Recorded during previous April 2019 survey (Astron Environmental Services 2019).

## **References**

Astron Environmental Services. 2019. PSP Mitchell Freeway Gaps: Hodges Drive to Reid Highway Targeted Black Cockatoo Assessment. unpublished report prepared for Main Roads Western Australia, Perth, WA.

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## **Appendix P: Threatened Fauna Species Report Forms**

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# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/09/2019	<b>TIME:</b> 1400 am/pm
<b>OBSERVER NAME/S:</b> Alexandra Sleep	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> alexandra.sleep@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Mitchell Freeway southbound road reserve approximately 230 m from where Eddystone Avenue crosses over the freeway and adjacent to The Gateway and Treetop Avenue to the east in the City of Joondalup, suburb of Edgewater.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6485064.09	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 383753.49	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input checked="" type="checkbox"/> Photo <input checked="" type="checkbox"/>	<b>Number of Adults:</b> Male _____ Female _____ Unknown 1
Moderately certain <input type="checkbox"/> Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b> Male _____ Female _____ Unknown _____
Not sure <input type="checkbox"/> Identified by expert <input type="checkbox"/>	<b>Number of Pouch Young:</b> Male _____ Female _____ Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Observed foraging on Banksia prionotes.

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input checked="" type="checkbox"/> Translocation <input type="checkbox"/>	Dawn sighting <input type="checkbox"/> Caught/Trapped <input type="checkbox"/> Taken into care <input type="checkbox"/>
Survey <input type="checkbox"/> Historical (Written) <input type="checkbox"/>	Day sighting <input checked="" type="checkbox"/> Spotlighting <input type="checkbox"/> Released <input type="checkbox"/>
Monitoring <input type="checkbox"/> Historical (Oral) <input type="checkbox"/>	Dusk sighting <input type="checkbox"/> Remote camera <input type="checkbox"/> Other (specify):
Other (specify):	Night sighting <input type="checkbox"/> Remote sensing <input type="checkbox"/>
Survey/monitoring type (specify): observed while carrying out botanical survey	Dead (fresh) <input type="checkbox"/> Acoustic recorder <input type="checkbox"/>
	Dead (degenerated) <input type="checkbox"/> Subfossil/Fossil <input type="checkbox"/>

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):**HABITAT INFORMATION:** (Select as many as applicable)**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |   |   |   |                                       |                                 |
|---|---|---|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>               | Scrubland <input checked="" type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>  | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>             | Grassland <input type="checkbox"/>            | Rock Community <input type="checkbox"/>     | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input checked="" type="checkbox"/> | Spinifex <input type="checkbox"/>             | Wetland/Riparian <input type="checkbox"/>   | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>               | Sedgeland <input type="checkbox"/>            | Remnant Vegetation <input type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Planted vegetation along freeway road reserve dominated by *Acacia rostellifera*, *Melaleuca systema* with scattered *Banksia prionotes*

**FIRE HISTORY:**

Last fire (season and year, or estimate time passed): \_\_\_\_\_ Fire Intensity: High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

Submitter of record: Alexandra Sleep Organisation and Role: Astron - Environmental Scientist  
 Contact Details: alexandra.sleep@astron.com.au Date Submitted: 04/12/2019





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 27/09/2019	<b>TIME:</b> 1500 am/pm
<b>OBSERVER NAME/S:</b> Alexandra Sleep	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> alexandra.sleep@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Mitchell Freeway southbound road reserve, near the location where the principal shared pathway joins with Trailwood Drive, approximately 350 m north of Whitfords Avenue in the suburb of Woodvale.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6481653	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 384772	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input checked="" type="checkbox"/> Photo <input checked="" type="checkbox"/>	<b>Number of Adults:</b> Male _____ Female _____ Unknown 1
Moderately certain <input type="checkbox"/> Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b> Male _____ Female _____ Unknown _____
Not sure <input type="checkbox"/> Identified by expert <input type="checkbox"/>	<b>Number of Pouch Young:</b> Male _____ Female _____ Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Observed perching on concrete wall and then foraging in jarrah tree.

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input checked="" type="checkbox"/> Translocation <input type="checkbox"/>	Dawn sighting <input type="checkbox"/> Caught/Trapped <input type="checkbox"/> Taken into care <input type="checkbox"/>
Survey <input type="checkbox"/> Historical (Written) <input type="checkbox"/>	Day sighting <input checked="" type="checkbox"/> Spotlighting <input type="checkbox"/> Released <input type="checkbox"/>
Monitoring <input type="checkbox"/> Historical (Oral) <input type="checkbox"/>	Dusk sighting <input type="checkbox"/> Remote camera <input type="checkbox"/> Other (specify):
Other (specify):	Night sighting <input type="checkbox"/> Remote sensing <input type="checkbox"/>
Survey/monitoring type (specify): observed while carrying out botanical survey	Dead (fresh) <input type="checkbox"/> Acoustic recorder <input type="checkbox"/>
	Dead (degenerated) <input type="checkbox"/> Subfossil/Fossil <input type="checkbox"/>

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

## REPRODUCTIVE STATE:

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

## SPECIMEN: (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

## Specimen location and catalogue number:

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

## Specimen identified by (name, affiliation):

## HABITAT INFORMATION: (Select as many as applicable)

### Landform:

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify): top of road verge batter              |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> | (original ground level)                                |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

### Vegetation Type:

- |  |                                    |   |                                       |                                 |
|--|------------------------------------|---|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>              | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>  | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input checked="" type="checkbox"/> | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>     | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/>           | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>   | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>              | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

## Associated flora species, ecological communities, and other habitat information:

Eucalyptus gomphocephala and Eucalyptus marginata woodland over mixed planted shrubs of Acacia iteaphylla, Chamalaucium uncinatum over scattered remnant Xanthorrhoea preissii over a closed grassland of Ehrharta calycina.

## FIRE HISTORY:

Last fire (season and year, or estimate time passed): \_\_\_\_\_ Fire Intensity: High  Medium  Low  No signs of fire

## OTHER COMMENTS:

Empty box for other comments.

Submitter of record: Alexandra Sleep Organisation and Role: Astron - Environmental Scientist  
 Contact Details: alexandra.sleep@astron.com.au Date Submitted: 04/12/19





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )		<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020		<b>TIME:</b> 9:09 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser		
Organisation/Company and Role/Job Title: Astron- Environmental Scientist		
<b>EMAIL:</b> David.Keirle@astron.com.au		<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6476651	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 386000	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):			

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): feeding evidence	Spotlighting <input type="checkbox"/>
observed while carrying out suitable Black Cockatoo	Remote camera <input type="checkbox"/>
tree assessment	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):**HABITAT INFORMATION:** (Select as many as applicable)**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty text area for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	<b>NUMBER SEEN:</b> 7
<b>OBSERVATION DATE:</b> 27/03/2020	<b>TIME:</b> 6:54 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6478020	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385220	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input checked="" type="checkbox"/> Photo <input type="checkbox"/>	<b>Number of Adults:</b> Male _____ Female _____ Unknown 7
Moderately certain <input type="checkbox"/> Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b> Male _____ Female _____ Unknown _____
Not sure <input type="checkbox"/> Identified by expert <input checked="" type="checkbox"/>	<b>Number of Pouch Young:</b> Male _____ Female _____ Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Seven individuals observed calling

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/> Translocation <input type="checkbox"/>	Dawn sighting <input type="checkbox"/> Caught/Trapped <input type="checkbox"/> Taken into care <input type="checkbox"/>
Survey <input checked="" type="checkbox"/> Historical (Written) <input type="checkbox"/>	Day sighting <input checked="" type="checkbox"/> Spotlighting <input type="checkbox"/> Released <input type="checkbox"/>
Monitoring <input type="checkbox"/> Historical (Oral) <input type="checkbox"/>	Dusk sighting <input type="checkbox"/> Remote camera <input type="checkbox"/> Other (specify):
Other (specify):	Night sighting <input type="checkbox"/> Remote sensing <input type="checkbox"/>
Survey/monitoring type (specify): observed calling while carrying out suitable Black Cockatoo tree assessment	Dead (fresh) <input type="checkbox"/> Acoustic recorder <input type="checkbox"/>
	Dead (degenerated) <input type="checkbox"/> Subfossil/Fossil <input type="checkbox"/>

**SECONDARY SIGNS:**

Heard <input checked="" type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020



# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 27/03/2020	<b>TIME:</b> 6:47 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6478025	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385224	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Evidence of birds feeding on marri tree

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): feeding evidence	Spotlighting <input type="checkbox"/>
observed while carrying out suitable Black Cockatoo	Remote camera <input type="checkbox"/>
tree assessment	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii</i> )	<b>NUMBER SEEN:</b> 2
<b>OBSERVATION DATE:</b> 26/03/2020	<b>TIME:</b> 10:03 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6476969	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385886	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input checked="" type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input type="checkbox"/>	Male 1
Not sure <input type="checkbox"/>	Female 1
Photo <input checked="" type="checkbox"/>	Unknown
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Observed foraging on Cape Lilac Tree.

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input checked="" type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): observed while carrying out suitable Black Cockatoo tree assessment	Spotlighting <input type="checkbox"/>
	Remote camera <input type="checkbox"/>
	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify):

**SECONDARY SIGNS:**

Heard <input checked="" type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):**HABITAT INFORMATION:** (Select as many as applicable)**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

**Submitter of record:** Kady Grosser **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** kady.grosser@astron.com.au **Date Submitted:** 09/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020	<b>TIME:</b> 8:16 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6476416	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 386069	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):		GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): feeding evidence	Spotlighting <input type="checkbox"/>
observed while carrying out suitable Black Cockatoo	Remote camera <input type="checkbox"/>
tree assessment	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii</i> )		<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020		<b>TIME:</b> 9:01 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser		
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist		
<b>EMAIL:</b> David.Keirle@astron.com.au		<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6476624	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 386024	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):			

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): feeding evidence	Spotlighting <input type="checkbox"/>
observed while carrying out suitable Black Cockatoo	Remote camera <input type="checkbox"/>
tree assessment	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Red-tailed Black-Cockatoo ( <i>Calyptorhynchus banksii</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020	<b>TIME:</b> 10:19 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
<b>Organisation/Company and Role/Job Title:</b> Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6477038	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385847	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):			

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): feeding evidence	Spotlighting <input type="checkbox"/>
observed while carrying out suitable Black Cockatoo	Remote camera <input type="checkbox"/>
tree assessment	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input checked="" type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Southern Brown Bandicoot ( <i>Isodon fusciventer</i> )		<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020		<b>TIME:</b> 13:38 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser		
Organisation/Company and Role/Job Title: Astron- Environmental Scientist		
<b>EMAIL:</b> David.Keirle@astron.com.au		<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6477549	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385492	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
Other (specify):			

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>		
Certain <input type="checkbox"/>	Photo <input checked="" type="checkbox"/>	<b>Number of Adults:</b>	<b>Number of Juveniles:</b>
Moderately certain <input checked="" type="checkbox"/>	Specimen <input type="checkbox"/>	Male _____	Male _____
Not sure <input type="checkbox"/>	Identified by expert <input type="checkbox"/>	Female _____	Female _____
		Unknown 1	Unknown
Expert name, affiliation:			

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Bandicoot diggings sighted opportunistically while carrying out a Black Cockatoo survey

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>	
Opportunistic <input type="checkbox"/>	Translocation <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Historical (Written) <input type="checkbox"/>	Caught/Trapped <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Historical (Oral) <input type="checkbox"/>	Spotlighting <input type="checkbox"/>
Other (specify):		Remote camera <input type="checkbox"/>
Survey/monitoring type (specify): Bandicoot diggings observed while carrying out suitable Black Cockatoo tree assessment		Remote sensing <input type="checkbox"/>
		Acoustic recorder <input type="checkbox"/>
		Subfossil/Fossil <input type="checkbox"/>
		Taken into care <input type="checkbox"/>
		Released <input type="checkbox"/>
		Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input checked="" type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):**HABITAT INFORMATION:** (Select as many as applicable)**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty box for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020





# Fauna Report Form

Database No: \_\_\_\_\_

<b>SPECIES NAME:</b> Southern Brown Bandicoot ( <i>Isodon fusciventer</i> )	<b>NUMBER SEEN:</b> 1
<b>OBSERVATION DATE:</b> 26/03/2020	<b>TIME:</b> 10:14 am/pm
<b>OBSERVER NAME/S:</b> David Keirle Kady Grosser	
Organisation/Company and Role/Job Title: Astron- Environmental Scientist	
<b>EMAIL:</b> David.Keirle@astron.com.au	<b>PHONE:</b> 9421 9600

**OBSERVATION LOCATION:** (i.e. property address, street and suburb, distance to nearest intersection, reserve name/number etc.)

Between Mitchell Freeway and Oronsay Road, Warwick 100m north of Warwick Road overpass.

<b>COORDINATES:</b>	<b>DATUM:</b>	<b>SOURCE:</b>	<b>COORDINATE ACCURACY:</b>
Latitude/Northing: 6477016	GDA94 <input checked="" type="checkbox"/>	GPS <input checked="" type="checkbox"/>	30m <input checked="" type="checkbox"/> 10km <input type="checkbox"/>
Longitude/Easting: 385855	WGS84 <input type="checkbox"/>	Map <input type="checkbox"/>	300m <input type="checkbox"/> 50km <input type="checkbox"/>
Zone (required for UTM's): 50 J	Unknown <input type="checkbox"/>	Google Earth <input type="checkbox"/>	1km <input type="checkbox"/> 100km <input type="checkbox"/>
	Other (specify):	GIS <input type="checkbox"/>	

**LAND TENURE:**

Nature Reserve <input type="checkbox"/>	State Forest <input type="checkbox"/>	Private Property <input type="checkbox"/>	Rail Reserve <input type="checkbox"/>	Aboriginal Reserve <input type="checkbox"/>	Shire Reserve <input type="checkbox"/>
National Park <input type="checkbox"/>	Timber Reserve <input type="checkbox"/>	Pastoral Lease <input type="checkbox"/>	Main Road Reserve <input checked="" type="checkbox"/>	State Waters <5.4km <input type="checkbox"/>	Other (specify):
Conservation Park <input type="checkbox"/>	Water Reserve <input type="checkbox"/>	UCL <input type="checkbox"/>	Shire Road Reserve <input type="checkbox"/>	Marine Park <input type="checkbox"/>	

<b>CERTAINTY OF ANIMAL IDENTIFICATION:</b>	<b>AGE AND SEX:</b>
Certain <input type="checkbox"/>	<b>Number of Adults:</b>
Moderately certain <input checked="" type="checkbox"/>	Male _____
Not sure <input type="checkbox"/>	Female _____
Photo <input checked="" type="checkbox"/>	Unknown 1
Specimen <input type="checkbox"/>	<b>Number of Juveniles:</b>
Identified by expert <input type="checkbox"/>	Male _____
	Female _____
	Unknown _____
	<b>Number of Pouch Young:</b>
	Male _____
	Female _____
	Unknown _____

Expert name, affiliation:

**DISTINGUISHING FEATURES/DESCRIPTION OF OBSERVED ANIMAL:** (required to confirm identification or attach photo)

Photo attached

**OBSERVATION:** (animal activity and other relevant details)

Bandicoot diggings sighted opportunistically while carrying out a Black Cockatoo survey

**OBSERVATION DETAILS:** (select as many as applicable)

<b>METHOD:</b>	<b>TYPE:</b>
Opportunistic <input type="checkbox"/>	Dawn sighting <input type="checkbox"/>
Survey <input checked="" type="checkbox"/>	Day sighting <input type="checkbox"/>
Monitoring <input type="checkbox"/>	Dusk sighting <input type="checkbox"/>
Translocation <input type="checkbox"/>	Night sighting <input type="checkbox"/>
Historical (Written) <input type="checkbox"/>	Dead (fresh) <input type="checkbox"/>
Historical (Oral) <input type="checkbox"/>	Dead (degenerated) <input type="checkbox"/>
Other (specify):	Caught/Trapped <input type="checkbox"/>
Survey/monitoring type (specify): Bandicoot diggings observed while carrying out suitable Black Cockatoo tree assessment	Spotlighting <input type="checkbox"/>
	Remote camera <input type="checkbox"/>
	Remote sensing <input type="checkbox"/>
	Acoustic recorder <input type="checkbox"/>
	Subfossil/Fossil <input type="checkbox"/>
	Taken into care <input type="checkbox"/>
	Released <input type="checkbox"/>
	Other (specify): secondary sign

**SECONDARY SIGNS:**

Heard <input type="checkbox"/>	Nest/Mound <input type="checkbox"/>	Feathers/Hair/Fur/Skin <input type="checkbox"/>	Feeding residue <input type="checkbox"/>
Scats <input type="checkbox"/>	Natural Hollow <input type="checkbox"/>	Bones <input type="checkbox"/>	Fauna run <input type="checkbox"/>
Tracks <input type="checkbox"/>	Artificial Hollow <input type="checkbox"/>	Eggs/eggshell <input type="checkbox"/>	Other (specify):
Diggings <input checked="" type="checkbox"/>	Burrow <input type="checkbox"/>	Shell <input type="checkbox"/>	

**CAUSE OF DEATH:**

Roadkill <input type="checkbox"/>	Found drowned <input type="checkbox"/>	Predation by native animal <input type="checkbox"/>	Unknown <input type="checkbox"/>
Found shot <input type="checkbox"/>	Stranded on beach <input type="checkbox"/>	Predation by cat/fox/dog <input type="checkbox"/>	Other (specify):
Found poisoned <input type="checkbox"/>	Annual die off <input type="checkbox"/>	Starvation/malnutrition <input type="checkbox"/>	



# Fauna Report Form

Database No: \_\_\_\_\_

**REPRODUCTIVE STATE:**

- |   |   |  |   |
|---|---|--|---|
| Non-breeding <input type="checkbox"/>         | Pregnant <input type="checkbox"/>       | Nesting <input type="checkbox"/>             | Unknown <input checked="" type="checkbox"/> |
| Mating <input type="checkbox"/>               | Lactating <input type="checkbox"/>      | Eggs in nest <input type="checkbox"/>        | Other(specify):                             |
| Breeding colours <input type="checkbox"/>     | Young in pouch <input type="checkbox"/> | Young in nest <input type="checkbox"/>       |   |
| Breeding/Mating call <input type="checkbox"/> | Young at heel <input type="checkbox"/>  | Fledgling emergence <input type="checkbox"/> |   |

**SPECIMEN:** (Select as many as applicable)

- |  |  |  |  |
|--|--|--|--|
| Fresh carcass <input type="checkbox"/>       | Partial carcass <input type="checkbox"/> | Skull/bones <input type="checkbox"/>           | Not retained <input checked="" type="checkbox"/> |
| Frozen carcass <input type="checkbox"/>      | DNA sample <input type="checkbox"/>      | Hair/Fur/Skin/feather <input type="checkbox"/> | Other (specify):                                 |
| Degenerated carcass <input type="checkbox"/> | Spirit specimen <input type="checkbox"/> | Scats <input type="checkbox"/>                 |  |

**Specimen location and catalogue number:**

- |                                    |  |  |  |
|------------------------------------|--|--|--|
| WA Museum <input type="checkbox"/> | Other Museum/Collection <input type="checkbox"/> | Given to the Department <input type="checkbox"/> | Retained by collector <input type="checkbox"/> |
| Catalogue No:                      | Museum/Collection name:                          | Office location:                                 | Collectors Reference No.                       |
|                                    | Catalogue No.                                    | Contact name:                                    |  |

**Specimen identified by** (name, affiliation):

**HABITAT INFORMATION:** (Select as many as applicable)

**Landform:**

- |  |  |  |                                  |  |
|--|--|--|----------------------------------|--|
| Cave <input type="checkbox"/>          | Hill/Mountain <input type="checkbox"/>     | Open Depression <input type="checkbox"/> | Lake <input type="checkbox"/>    | Ocean <input type="checkbox"/>                         |
| Cliff <input type="checkbox"/>         | Slope <input type="checkbox"/>             | Drainage line <input type="checkbox"/>   | Wetland <input type="checkbox"/> | Artificial surface <input checked="" type="checkbox"/> |
| Rocky outcrop <input type="checkbox"/> | Sand dune <input type="checkbox"/>         | River <input type="checkbox"/>           | Swamp <input type="checkbox"/>   | Other (specify):                                       |
| Gully/Gorge <input type="checkbox"/>   | Flat <input type="checkbox"/>              | Creek <input type="checkbox"/>           | Aquifer <input type="checkbox"/> |  |
| Ridge <input type="checkbox"/>         | Plain <input type="checkbox"/>             | Seepage <input type="checkbox"/>         | Estuary <input type="checkbox"/> |  |
| Crest/Summit <input type="checkbox"/>  | Closed Depression <input type="checkbox"/> | Pool <input type="checkbox"/>            | Beach <input type="checkbox"/>   |  |

**Vegetation Type:**

- |                                    |                                    |  |                                       |                                 |
|------------------------------------|------------------------------------|--|---------------------------------------|---------------------------------|
| Forest <input type="checkbox"/>    | Scrubland <input type="checkbox"/> | Saltbush/Samphire <input type="checkbox"/>             | Revegetation <input type="checkbox"/> | Park <input type="checkbox"/>   |
| Woodland <input type="checkbox"/>  | Grassland <input type="checkbox"/> | Rock Community <input type="checkbox"/>                | Farmland <input type="checkbox"/>     | Garden <input type="checkbox"/> |
| Shrubland <input type="checkbox"/> | Spinifex <input type="checkbox"/>  | Wetland/Riparian <input type="checkbox"/>              | Orchard <input type="checkbox"/>      | Other (specify):                |
| Mallee <input type="checkbox"/>    | Sedgeland <input type="checkbox"/> | Remnant Vegetation <input checked="" type="checkbox"/> | Plantation <input type="checkbox"/>   |                                 |

**Associated flora species, ecological communities, and other habitat information:**

Remnant vegetation along freeway road reserve dominated by Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*).

**FIRE HISTORY:**

**Last fire** (season and year, or estimate time passed): \_\_\_\_\_ **Fire Intensity:** High  Medium  Low  No signs of fire

**OTHER COMMENTS:**

Empty text area for other comments.

**Submitter of record:** Brittany Osborn **Organisation and Role:** Astron - Environmental Scientist  
**Contact Details:** brittany.osborn@astron.com.au **Date Submitted:** 14/04/2020



## **Appendix D. Kirkby (2020) Black Cockatoo Targeted Assessment**

GENERAL FINDINGS OF BLACK COCKATOO SURVEY, EASTERN ROAD RESERVE BETWEEN HODGES  
DRIVE AND WARWICK ROAD.

Black cockatoos known from the survey area are Carnaby's Cockatoo *Calyptorhynchus latirostris*, Forest Red tailed Black Cockatoo (FRTBC) *Calyptorhynchus banksii naso*. Baudin's Cockatoo *Calyptorhynchus baudinii* also occurs in the Perth region, but is unlikely to occur at so far west on the Swan Coastal Plain other than as a possible vagrant.

Carnaby's Cockatoo is known to breed at the Edith Cowan University Campus approximately 1 km from the north section of the survey area at Joondalup Drive. 8-9 pairs breed each year in a mix of natural and artificial hollows (Simon Cherriman pers comm. Link to ECU news coverage provided).

The nearest known breeding area for FRTBC is approximately 30 km to the SE in the Darling Range.

Methods and timing

All trees above 500mm diameter at breast height (DBH) located in a previous survey (Astron 2019-2020) were inspected for the presence of black cockatoo breeding hollows. Species include Jarrah *E. marginata*, Tuart *E. gomphocephala* and Marri *Corymbia calophylla*. Hollows of the correct size and angle were inspected for signs of use such as chewing and wear around the entrance indicating past use. All trees were inspected from ground level using binoculars and if deemed necessary inspected using a pole camera.

The survey took place between June 15<sup>th</sup> and June 27<sup>th</sup> 2020.

Breeding habitat

A total of 329 trees were inspected. The majority of trees, though above 500mm DBH, appear to be relatively young and have not yet reached sufficient age to form hollows large enough for black cockatoos.

Of interest were trees number (numbers from Astron report) 103, 190, 230 and 290.

Tree 103 (Tuart) has a small hollow with a chewed entrance and was located on a previous survey (T. Kirkby 2019. Documents supplied) and is probably not a black cockatoo breeding hollow.

Tree 190 (dead stag) has a top entry hollow with chewing at the entrance (photograph supplied) Although the top section of the hollow is in poor condition it may still be deep enough to provide a black cockatoo breeding hollow.

Tree 230 (dead Tuart stag) has a hollow (photograph supplied) which has an entrance large enough for a black cockatoo but which shows no signs of use around the rim or internally and is unlikely to be a breeding hollow. The hollow is probably too shallow.

Tree 290 (Tuart) has a hollow with a suitable entrance for a black cockatoo and which shows chewing at the entrance. Feral bees are present in a nearby hollow preventing closer inspection with a pole camera. Photograph from ground level supplied.

### Foraging habitat.

The quality of the understorey foraging habitat throughout the survey varies between poor and completely degraded. For the complete list of foraging species see Astron 2019-2020. The more relevant species utilised by black cockatoos in the remaining understorey are *Banksia sessilis*, *B. nivea*, *Hakea lissocarpha*, *H. prostrata*, *H. trifurcata*, *Xanthorrhoea priessi*. All are food sources for Carnaby's Cockatoo.

Though most understorey vegetation in the survey is rated as degraded much of the overstorey has good canopy condition, particularly Jarrah, Marri, Tuart, Sheoak *Allocasuarina fraseriana* and to a limited extent *Banksia spp.* The overstorey species are particularly relevant to FRTBC (apart from *banksia spp*) which feed on seeds from Jarrah, Marri, Sheoak and to a lesser extent Tuart and very rarely do they feed below the canopy level. Jarrah, Marri and particularly *banksia spp.* are also utilised by Carnaby's Cockatoos as are Tuart and sheoak, though to a much lesser extent.

Foraging residues from Carnaby's Cockatoos at the survey area were noted from Marri and banksia. They were also observed feeding on Jarrah (Astron 2019-2020). Given the presence of breeding Carnaby's Cockatoos to the north within 1 km of the survey area, the vegetation, though not in pristine condition may provide foraging habitat for these breeding birds.

### Roosting sites.

No roosting sites are known from the survey area and no signs of black cockatoos roosting were noted.

Tony Kirkby

Black cockatoo researcher

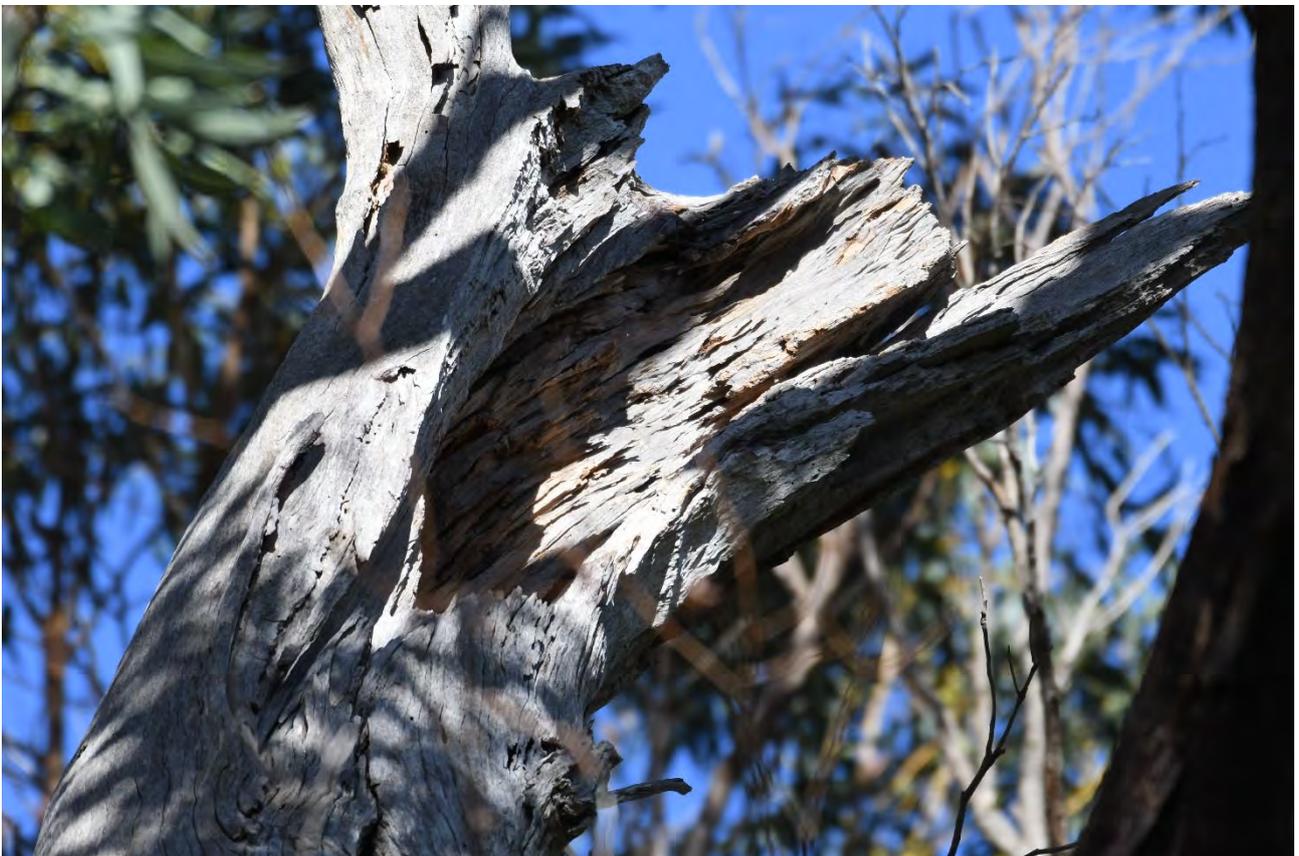
28<sup>th</sup> June 2020

## **Appendix E. Kirkby (2020) Photos of Potential Suitable Hollows for Black Cockatoos in the DE**

**Tree 190 – Dead Stag (E 384627.5 N 6482991.7):**

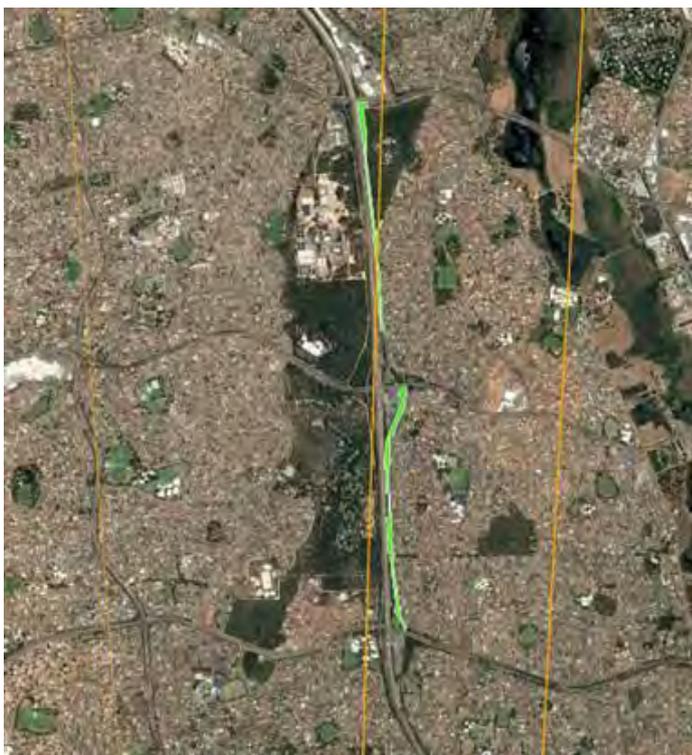


**Tree 290 – Tuart (*Eucalyptus gomphocephala*) (E 384887.5 N 6479559.4):**



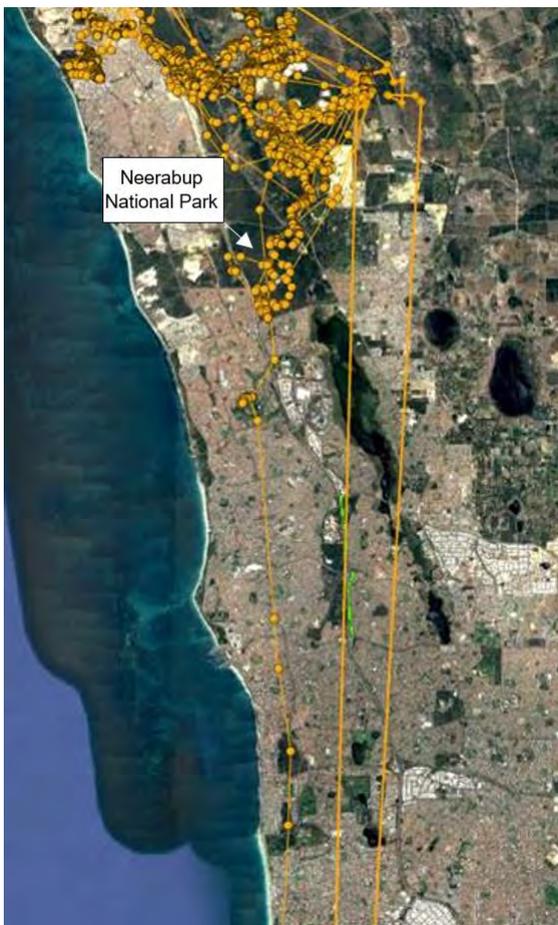
# Appendix F. Murdoch University Black Cockatoo Tracking Research Data

### Murdoch University Black Cockatoo Satellite Tracking Data



Source: Data and images supplied by Murdoch University (2020)

**Plate 1.** Carnaby’s Cockatoo GPS satellite tracks (yellow), showing movement north and south, indicating that the general area surrounding the DE (green polygon) is a transit corridor for the species.



Source: Data and images supplied by Murdoch University (2020)

**Plate 2.** Wider view of the area showing the Carnaby’s Cockatoo satellite tracks and utilisation of habitat in Neerabup National Park.

## Appendix G. Terratree (2020) Dieback Assessment

***Phytophthora* Dieback Assessment of Mitchell Freeway**

Prepared for Main Roads Western Australia

*Ref: T20023*

## Document Control

Revision	Details	Date	Author	Reviewer
Rev 0	Draft for Internal Review	26/06/2020	A. Caubo	J. Grehan
Rev A	Draft for Submission to Client	29/06/2020	A. Caubo	J. Braid
Rev B	Draft for Submission to Client	06/07/2020	A. Caubo	J. Braid



Joseph Grehan  
Principal Ecologist

## DISCLAIMER

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Telephone: (08) 9250 1163 / Mobile: 0400 003 688

Email: joeg@terratree.com.au

Website: www.terratree.com.au

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*Terratree Pty Ltd*

## Abbreviations and Acronyms

\*this is a usual list for Dieback reports. Only leave in abbreviations actually used in report and add any new ones as needed (see template list in Z:\Report Templates for some extras) \*

<b>BoM</b>	Bureau of Meteorology
<b>CALM</b>	former Department of Conservation and Land Management (now DBCA)
<b>DAFWA</b>	former Department of Agriculture and Food Western Australia (now DPIRD), WA Government
<b>DAWE</b>	Department of Agriculture, Water and the Environment, Australian Government
<b>DBCA</b>	Department of Biodiversity, Conservation and Attractions, WA Government
<b>DotE</b>	former Department of the Environment, Australian Government (now DAWE)
<b>DEE</b>	former Department of the Environment and Energy, Australian Government (now DAWE)
<b>DIDMS</b>	Dieback Information Data Management System
<b>Dieback Interpreter's Manual</b>	<i>FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department</i>
<b>DPIRD</b>	Department of Primary Industries and Regional Development, WA Government
<b>EPA</b>	Environmental Protection Authority
<b>FEMD</b>	Forest and Ecosystem Management Division of DBCA, WA Government
<b>GDA94</b>	Geocentric Datum Australia 1994
<b>GPS</b>	Global Positioning System

## Executive Summary

Main Roads Western Australia commissioned Terratree Pty Ltd to undertake a Comprehensive *Phytophthora* Dieback assessment along a portion of the Mitchell Freeway.

The portion of Mitchell Freeway which was assessed is located approximately 12.7 km north of the Perth CBD, 5.2 km east of the coast and 3.5 km south of the centre of Joondalup (**Figure 1**). The assessment area is primarily focused on the vegetation on the eastern side of the Mitchell Freeway. Small vegetated areas were also assessed along the west of the freeway as well as along Hepburn Avenue and Whitfords Avenue.

The desktop review utilized the Dieback Information Data Management System (DIDMS) database, and this identified no positive sample results for any *Phytophthora* species within the assessment area. Two soil and tissue samples were taken during the Dieback assessment. Both samples returned negative results for any *Phytophthora* species. Mapping categorised 0.6 ha (1.8%) of the assessed area as Infested and a further 0.9 ha was mapped as Uninfested. The majority of the assessment area was excluded from being assessed as the vegetation was classified as Degraded or Completely Degraded in accordance with Keighery classification (Keighery, 1994).

Terratree makes the following recommendations to manage the Mitchell Freeway Assessment area:

- All vehicles and machinery must be clean on exit from the assessment area. This is to prevent the spread of *Phytophthora* spp. from spreading to other areas within and outside of the assessment area. This is especially important when operating around the Infested stormwater sump.
- All vehicles and machinery must be clean on entry into the Uninfested areas between Hepburn Avenue and Warwick Road.

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# 1 Introduction

## 1.1 Background

Main Roads Western Australia commissioned Terratree Pty Ltd (Terratree) to undertake a Comprehensive Phytophthora Dieback (Dieback) assessment along a portion of the Mitchell Freeway. The objective of the Dieback assessment was to map the extent of disease occurrence caused by the plant pathogen *Phytophthora cinnamomi*. This will inform disease management practices before, during and after construction in this area.

## 1.2 Project Location and Size

Mitchell Freeway (hereafter referred to as 'the assessment area') is located approximately 12.7 km north of the Perth CBD, 5.2 km east of the coast and 3.5 km south of the centre of Joondalup (**Figure 1**). The assessment area is primarily focused on the vegetation on the eastern side of the Mitchell Freeway. Small vegetated areas were also assessed along the west of the freeway as well as along Hepburn Avenue and Whitfords Avenue.

The assessment area is 33.5 ha in total area. However, due to the degraded nature of most of the assessment area only 1.5 ha was able to be assessed.

## 1.3 *Phytophthora* Dieback

Phytophthora Dieback (or Dieback) is a disease caused by the introduced soil-borne pathogen *Phytophthora cinnamomi*. While some plant species are resistant, others are susceptible to the disease caused by the pathogen, which can result in chlorosis, dieback and usually death (Wills and Keighery 1994). The pathogen has a range of hosts in Southwest WA, predominantly from the Ericaceae, Fabaceae, Myrtaceae, Proteaceae, and Xanthorrhoeaceae plant families.

Although several *Phytophthora* species occur in Western Australia, the most virulent and pathogenic is *P. cinnamomi*. References to Phytophthora Dieback refer to the disease caused by this species unless otherwise specified.

The most recent Western Australian State of the Environment Report lists Dieback as a Priority 1 threat to biodiversity (EPA 2007). A recent review of threats to species listed as threatened under the Federal *Environment Protection and Biodiversity Conservation Act 1999* shows that *P. cinnamomi* is the second greatest invasive species threat in Australia after rabbits (Kearney *et al.* 2019).

Dieback has a significant effect in WA for the following reasons:

- 40 % of native plant species in Southwest WA (over 2,200 species), including almost half the endangered species, are susceptible to the pathogen (Shearer *et al.* 2004). This includes 49 % of WA's threatened flora (EPA 2007).
- Changes in the composition and structure of floral communities resulting from the spread of Dieback have flow-on impacts throughout the ecosystem, including habitat alteration negatively affecting indigenous fauna populations.
- Dieback can lead to significant soil erosion through the loss of susceptible vegetation.

Disease expression caused by *Phytophthora* species occurs in native vegetation when the following variables and environmental conditions are present:

- **Host** - plant species are present that are susceptible to *Phytophthora* spp. (i.e. *Banksia*, *Hakea*, *Leucopogon* and *Daviesia* spp.).
- **Pathogen** - a *Phytophthora* spp. pathogen must be present, either residing in susceptible or resistant species.
- **Environment** - soil temperatures of 15-30 °C and pH 5-6 (acidic) are required for *P. cinnamomi* survival and activity. Some *Phytophthora* species, including *P. multivora*, can survive in alkaline soils (pH 7+).

Dieback is widespread in areas with greater than 800 mm of annual rainfall, less extensive in areas that receive between 600 and 800 mm, and mainly restricted to water-gaining sites in areas that receive 400–600 mm. The pathogen rarely occurs in areas receiving less than 400 mm annual rainfall. In WA, Dieback is a significant environmental issue for projects between Geraldton in the Midwest and Esperance on the South Coast, and it is widespread in the Southwest region.

Dieback is spread through the movement of water and soil within the landscape. Major vectors of Dieback include, but are not limited to, wet soil adhering to vehicle tyres/tracks and earthmoving equipment. Therefore, quarantine management procedures are an effective tool in reducing the spread of Dieback associated with any earthmoving activity.

## 1.4 Regulatory Context

Phytophthora Dieback management is required under several regulatory mechanisms including:

- The Federal *Environment Protection and Biodiversity Conservation Act 1999*, which lists Phytophthora Dieback as a Key Threatening Process.
- Projects being assessed under the Western Australian *Environmental Protection Act 1986*, which requires the Department of Biodiversity, Conservation and Attractions (DBCA) and/or Department of Mines, Industry Regulation and Safety to comment on Dieback management and provides these agencies with the right to impose conditions on new approvals.

- The *Environmental Protection Act 1986* Part V S.50A “Serious Environmental Harm” provisions.

## 2 Existing Environment

### 2.1 Biogeography

The Interim Biogeographic Regionalisation for Australia (IBRA) has defined 89 bioregions and 419 subregions across Australia, based on climate, geology, landforms, native vegetation and species (DEE 2012). These provide a useful method for reporting biodiversity patterns and categorising assessment areas. The assessment area is located within the Perth Swan Coastal Plain 2 (SWA02) IBRA subregion.

A biodiversity audit of Western Australia's subregions classified this subregion as follows:

Swan Coastal Plain 2: A low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia and Tuart on sandy soils. *Casuarina obesa* on outwash plains and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *Casuarina obesa*-marri woodlands and *Melaleuca* shrublands, are extensive only in the south (Mitchell, Williams and Anthony, 2002)

### 2.2 Regional Vegetation

The assessment area lies in the Drummond Botanical Subdistrict within the Swan Coastal Plain Subregion (Beard 1990). The Drummond Botanical Subdistrict is described as 'Mainly Banksia low woodland on leached sands with Melaleuca swamps where ill-drained; woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) on less leached soils. The climate is described as 'warm Mediterranean', with winter precipitation of 600-1000mm and 5 - 6 dry months per year.

Detailed 1:250,000 vegetation mapping of the Swan Coastal Plain, based on mapping conducted by Heddle *et al.* (1980), identifies two vegetation complexes within the assessment area. The Karrakatta complex dominates the majority of the assessment area with the Cottesloe Complex only occurring at the far north of the assessment area. Characteristics of these vegetation complexes are listed in **Table 1**.

**Table 1: Vegetation Complexes within Mitchell Freeway Assessment Area**

Vegetation Complex	Karrakatta Complex – Central and South
System 6 Region Code	49
Landform Description	Swan Coastal Plain – Aeolian Deposits
Structure	Open Forest and Woodland

<b>Vegetation Description</b>	Predominantly open forest of <i>Eucalyptus gomphocephala</i> (Tuart) - <i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri) and woodland of <i>Eucalyptus marginata</i> (Jarrah) - <i>Banksia</i> species. <i>Agonis flexuosa</i> (Peppermint) is co-dominant south of the Capel River.
<b>Interpretability for Dieback Assessment</b>	Low to Medium interpretability, dependent on understorey composition.
<b>Vegetation Complex</b>	<b>Cottesloe Complex – Central and South</b>
<b>System 6 Region Code</b>	52
<b>Landform Description</b>	Swan Coastal Plain – Aeolian Deposits
<b>Structure</b>	Woodland, Open Forest and Closed Heath
<b>Vegetation Description</b>	Mosaic of woodland of <i>Eucalyptus gomphocephala</i> (Tuart) and open forest of <i>Eucalyptus gomphocephala</i> (Tuart) - <i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri); closed heath on the Limestone outcrops.
<b>Interpretability for Dieback Assessment</b>	Low to Medium interpretability, dependent on understorey composition.

### 2.3 Soils

At the Western Australian level, the soil type of the Swan Coastal Plain is Deep Sandy Soils of a non-calcareous (siliceous) type. Soil mapping of the Perth area based on Churchward and MacArthur (1980) categorizes soils within the assessment area as Swan Coastal Plain Aeolian Deposits, specifically Karrakatta Sands. These are characterised as “undulating landscape and deep yellow sands over limestone” (DAFWA 2003).

Department of Primary Industries and Regional Development (DPIRD 2018) detailed soil mapping for Western Australia shows one main soil Zone within the assessment area. Purdie *et al.* (2004) defines these as within the Perth Coastal Zone 211. Within this zone there are four systems with Sp-Ky dominating most of the assessment area, Sp-KIs is isolated to a small patch of Hepburn Avenue, Sp-S7 and Sp-LS1 have a mosaic occurrence in the southern portion of the assessment area. Characteristics of these soil types are listed in order of dominance in **Table 2**.

**Table 2: Soil subsystems within Mitchell Freeway**

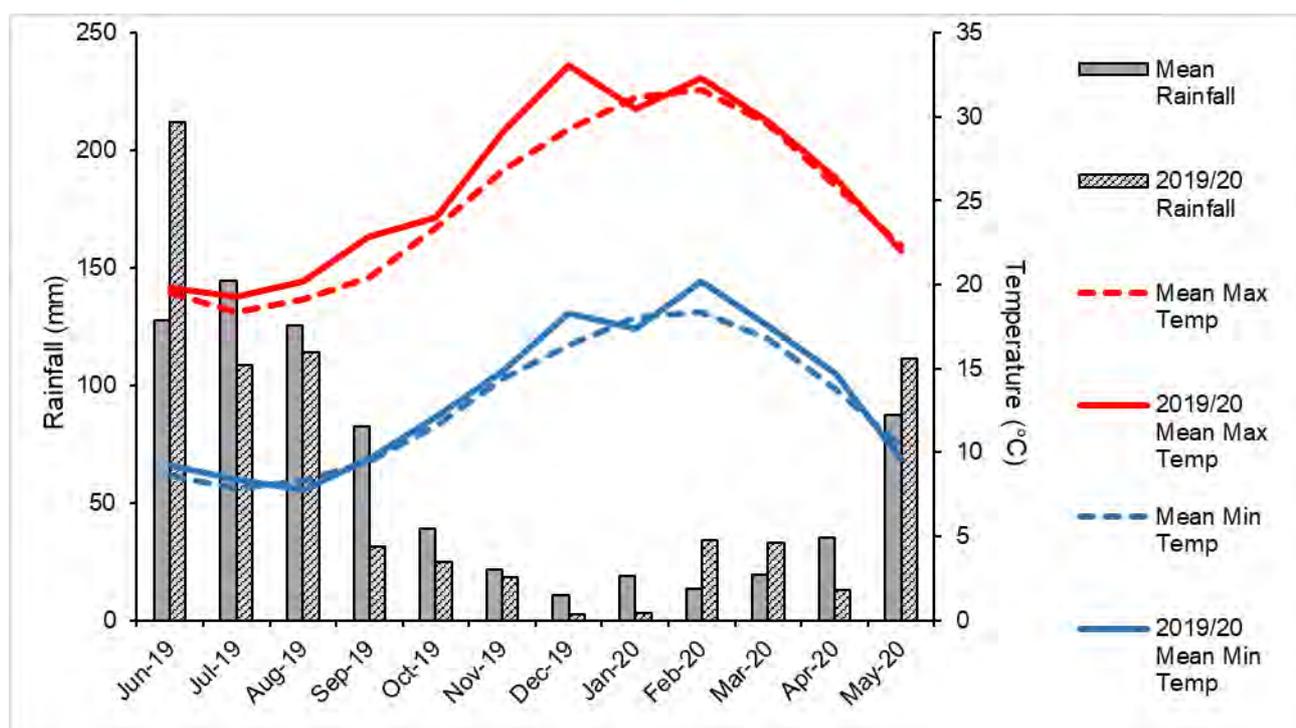
<b>Province</b>	Swan
<b>Soil Zone</b>	Perth Coastal Zone 211
<b>Zone Description</b> (Purdie <i>et al.</i> 2004)	Coastal sand dunes and calcarenite. Late Pleistocene to Recent (Quindalup and Spearwood Systems). Calcareous and siliceous sands and calcarenite.
<b>System Symbol (DPIRD 2018)</b>	211Sp__Ky
<b>System Description</b> (DPIRD 2018)	Low hilly to gently undulating terrain. Yellow sand over limestone at 1-2 m
<b>Location within assessment area</b>	Dominates the majority of the assessment area, north of Warwick Road.
<b>Province</b>	Swan
<b>Soil Zone</b>	Perth Coastal Zone 211
<b>Zone Description</b> (Purdie <i>et al.</i> 2004)	Coastal sand dunes and calcarenite. Late Pleistocene to Recent (Quindalup and Spearwood Systems). Calcareous and siliceous sands and calcarenite.
<b>System Symbol (DPIRD 2018)</b>	211Sp__S7
<b>System Description</b> (DPIRD 2018)	SAND - pale and olive yellow, medium to coarse-grained, sub-angular to sub-rounded quartz, trace of feldspar, moderately sorted, of residual origin
<b>Location within assessment area</b>	Mosaic occurrence in the southern portion of the assessment area. Just north of Warwick Road.
<b>Province</b>	Swan
<b>Soil Zone</b>	Perth Coastal Zone 211
<b>Zone Description</b> (Purdie <i>et al.</i> 2004)	Coastal sand dunes and calcarenite. Late Pleistocene to Recent (Quindalup and Spearwood Systems). Calcareous and siliceous sands and calcarenite.
<b>System Symbol (DPIRD 2018)</b>	211Sp__LS1
<b>System Description</b> (DPIRD 2018)	LIMESTONE - light, yellowish brown, fine to coarse-grained, sub-angular to well rounded, quartz, trace of feldspar, shell debris, variably lithified, surface kankar, of eolian origin. Minor heavy minerals.
<b>Location within assessment area</b>	Mosaic occurrence in the southern portion of the assessment area. Just north of Warwick Road.
<b>Province</b>	Swan

<b>Soil Zone</b>	Perth Coastal Zone 211
<b>Zone Description (Purdie et al. 2004)</b>	Coastal sand dunes and calcarenite. Late Pleistocene to Recent (Quindalup and Spearwood Systems). Calcareous and siliceous sands and calcarenite.
<b>System Symbol (DPIRD 2018)</b>	211Sp_Kls
<b>System Description (DPIRD 2018)</b>	Low hills and ridges. Bare limestone or shallow siliceous or calcareous sand over limestone.
<b>Location within assessment area</b>	Isolated to small area east of the Mitchell Freeway along Hepburn Avenue.

## 2.5 Climate

The climate of the assessment area is Mediterranean, characterised by warm to hot, dry summers and cool, wet winters. On average, the locality of the assessment area experiences 5-6 dry months per year, with most rain falling between June and September (Beard 1990). Bureau of Meteorology (BoM) weather station Perth Metro (#9225) receives an average annual rainfall of 726.80mm, with the majority of rainfall occurring between May and September (**Graph 1**).

The mean maximum temperature in December in 2019 was 3.8°C hotter than the long-term mean maximum temperature for December. Mean minimum temperature was also warmer for this month in 2019. Recorded rainfall for nine of the past 12 months is lower than average. However, a much wetter than average June and a wetter than average February and March would still be sufficient for the pathogenic activity to have occurred. This rainfall, when combined with the recent warm soil temperatures, is expected to result in suitable conditions for pathogen activity, and therefore for the observation and diagnosis of disease symptoms.



**Graph 1:** Rainfall and temperature data for Perth Metro weather station #9225 (BoM 2020b). The October 2019 Rainfall data is from Subiaco Treatment Plant weather station (8.3 km from Yokine) due to no data for that month at Perth Metro weather station being available.

## 2.6 Historical Land Use and Disturbance

The Swan Coastal Plain has been subject to intensive historical land use and disturbance. However, there remain significant areas of remnant native vegetation, predominately in the north of the Swan Coastal Plain.

Dominant land uses in the Swan Coastal Plain include cultivation in the form of dryland agriculture and horticulture, conservation and crown reserves, and small areas of infrastructure, mining and forestry (Mitchell *et al.* 2002). Significant urban and rural residential development has also occurred on the Swan Coastal Plain, and this is the dominant land use in the area surrounding the Mitchell Freeway Assessment Area.

## **3 Methods**

### **3.1 Comprehensive Dieback Assessment**

The Comprehensive Dieback assessment is conducted in a two-stage process:

- A desktop review of relevant, available information regarding site characteristics plus previous Dieback mapping and sample results.
- A field assessment to observe disease symptoms, record Dieback occurrence category data and collect soil and tissue samples for diagnostic testing.

The Dieback Interpreter's Manual requires a Comprehensive Dieback assessment every three years where ground disturbance activities are planned (FEMD 2015). Recheck assessments can be completed annually for up to three years to update Dieback occurrence maps. While this only applies to DBCA-managed lands, it is recommended that all land managers follow this guidance where ground disturbance activities are planned in areas of native vegetation.

### **3.2 Desktop Assessment**

A desktop assessment was completed to collect information about the assessment area, surrounding landscape, and any previous history of Dieback mapping.

The Dieback Information Data Management System (DIDMS; Project Dieback 2014) was used to obtain data from the Vegetation Health Services (VHS) laboratory on Dieback occurrence mapping and sample results from previous assessments in the area.

### **3.3 Field Assessment**

#### **3.3.1 Survey Strategy**

Field assessment requires visually assessing native vegetation within the assessment area, recording Dieback occurrence category data, and collecting soil and tissue samples from recently dead disease indicator species for diagnostic testing.

The Linear Dieback field assessment was conducted on 09/06/2020 and was completed by DBCA-registered Dieback Interpreter Joseph Grehan, along with Trainee Interpreter Aaron Caubo.

The assessment was conducted according to the *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the Department produced by the Forest and Ecosystem Management Division* (FEMD 2015; hereafter referred to as 'the Dieback Interpreter's Manual').

The assessment areas were investigated on foot and within vehicles to determine the accessibility of the vegetation communities. In the areas which contained assessable vegetation the areas were traversed to map their extent and where possible samples were taken.

Spatial data, including disease evidence points and sample locations and photographs, were recorded using handheld Global Positioning System (GPS) units.

### 3.3.2 Assessability

The Keighery vegetation disturbance scale in the Dieback Interpreter’s Manual (**Table 3**) was used to determine the assessability of vegetated areas within the assessment area.

Areas with a vegetation condition rating of 1-3 (Pristine - Very Good) and enough disease indicator species present to enable a diagnosis of the disease status are considered assessable.

Other areas of vegetation may be categorised as Possibly Assessable based on a condition rating of 4 (Good). In these areas, significant impacts to vegetation, including grazing, forestry harvesting, weed incursion and frequent fire events, have altered vegetation composition and structure so that it is unlikely to recover in the medium- to long-term. Assessability of these areas is at the discretion of the Interpreter.

Areas where native vegetation is significantly degraded or cleared are given a condition rating of 5 (Degraded) or 6 (Completely Degraded) and classified as Excluded from assessment. Non-vegetated areas are also Excluded from assessment, including pasture, pits (including gravel pits), large roads (sealed and unsealed), permanently flooded areas and parkland tree stands.

**Table 3: Keighery vegetation disturbance scale and assessability (Keighery 1994, as defined in FEMD 2015)**

Assessability	Scale		Condition
Assessable	1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
	2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
	3	Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Possibly assessable, discretion required	4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, Dieback and grazing.

Assessability	Scale		Condition
Not assessable or excluded from assessment	5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, Dieback and grazing.
	6	Completely Degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs.

### 3.3.3 Vegetation Community Descriptions

Vegetation communities encountered within the assessment area are described in accordance with the Scheme for Description of Vegetation Structure in the *Native Vegetation Condition Assessment and Monitoring Manual for Western Australia* (DEC, 2009) (**Table 4**). The scheme uses the dominant species in each stratum, combined with projected foliage cover to describe the vegetation units.

**Table 4: Scheme for Description of Vegetation Structure in the *Native Vegetation Condition Assessment and Monitoring Manual for Western Australia* (DEC 2009) as adapted from Muir (1977) and via Alpin (1979) and Keighery (1994)**

Growth Form/ Height Class	Canopy Cover			
	100% to 70%	70% to 30%	30% to 10%	10% to 2%
Trees over 30 m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10 m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Mallee over 8 m (Tree Mallee)	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee under 8 m (Shrub Mallee)	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub
Shrubs over 2 m	Closed Tall Scrub	Tall Open Scrub	Tall Shrubland	Tall Open Shrubland
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland
Shrubs under 1 m	Closed Low Heath	Open Low Heath	Low Shrubland	Very Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

### 3.3.4 Dieback Occurrence Categories

The assessability of vegetated and non-vegetated areas and associated *Phytophthora* Dieback occurrence categories can be determined using **Table 5**.

Uninfested vegetation exhibits the following characteristics:

- No positive sample results received for *P. cinnamomi*.
- An acceptable diversity of healthy disease indicator species is present, including some of the following genera: *Banksia*, *Persoonia*, *Xanthorrhoea*, *Leucopogon*, *Hakea* and *Adenanthos*.
- Vegetation condition is in Pristine-Very Good (1-3) condition according to the Keighery scale with a good density of vegetation cover and no obvious reduction in biomass or masking by resistant species.
- No evidence found of disease pattern or chronology.

Infested vegetation is identified and characterised by the following features:

- Positive sample results for *P. cinnamomi* are found either in the immediate area, upslope or upstream of the Infested area.
- Multiple disease indicator species deaths (ISDs) are occurring.
- Disease pattern and chronology are visible.
- Vegetation structure and composition are obviously altered.

Uninterpretable vegetation exhibits the following characteristics:

- Insufficient amounts of disease indicator species are present, including the following genera: *Banksia*, *Persoonia*, *Xanthorrhoea*, *Leucopogon*, *Hakea* and *Adenanthos*.
- Vegetation condition is in Pristine-Very Good (1-3) condition according to the Keighery scale with a good density of vegetation cover, possible masking by resistant species and no obvious reduction in biomass.
- Environmental conditions occur that discourage the pathogen, such as highly fertile soils, fewer host species or a dominating resistant host.

Uninterpretable areas may contain Dieback (e.g. in very low levels as an endemic or incipient disease) without showing signs of its presence and determining the presence of the pathogen is not possible using interpretation methods (FEMD 2015). Uninterpretable areas that meet the protocols for identifying Protectable Areas are managed as being both Infested and Uninfested so that the pathogen is neither imported into, nor exported from, these areas.

The Temporarily Uninterpretable category is allocated to areas of native vegetation that have been disturbed but will recover over time and become interpretable and mappable in the future (i.e. within five years). Examples of Temporarily Uninterpretable areas include vegetation that has been impacted by fire, timber harvesting, grazing, flooding or mining with subsequent rehabilitation (FEMD 2015).

Excluded areas (see **Section 3.3.2**) are distinguished from Temporarily Uninterpretable areas in that they cannot normally regenerate naturally and become mappable for Dieback occurrence in the future. Excluded areas were mapped from both field data and, where applicable, aerial imagery.

**Table 5: Assessability of vegetated and non-vegetated areas (adapted from FEMD 2015)**

	<i>Phytophthora</i> occurrence category	Typically present	May be present
<p><b>Naturally vegetated areas</b> Keighery disturbance rating of 3 or less. <i>Phytophthora</i> occurrence categorisation is possible. Small unvegetated areas can exist and may be included in the assessment area considering total environmental context.</p>	<b>INFESTED</b>	Dead and dying reliable indicator species	Healthy reliable indicator species Indicator Species Deaths (ISDs) that have been killed by other agents
	<b>UNINFESTED</b>	Healthy reliable indicator species	ISDs that have been killed by other agents
	<b>UNINTERPRETABLE</b>	Very few reliable indicator species	Occasional reliable indicators, but too few for <i>Phytophthora</i> Dieback interpretation
	<b>NOT YET RESOLVED</b>	Usually reliable indicator species in an environment not favourable to disease development	Negative sample results for all <i>Phytophthora</i> species
<p><b>Vegetation structure temporarily altered</b> Phytophthora occurrence assessment will be possible when vegetation structure recovers. Recovery times will be variable depending on severity and type of disturbance.</p>	<b>TEMPORARILY UNINTERPRETABLE</b>	Indicator species masked by disturbance typically from fire, harvesting, temporary flooding, poisoning	Occasional reliable indicator species, but disturbance prevents accurate placement of <i>Phytophthora</i> occurrence
<p><b>Road disturbance area</b></p>	<b>DISEASE RISK ROAD (DRR)</b>	Unformed track with shoulders of interpretable vegetation	Shoulders and batters with regenerated vegetation Incipient infestation
<p><b>Vegetation structure severely altered</b> Keighery disturbance rating 5 or greater. <i>Phytophthora</i> occurrence assessment is not possible. Can be determined by desktop assessment (aerial photo). Small vegetated areas can exist and may be excluded from the assessment area considering total environmental context.</p>	<b>EXCLUDED</b>	Pasture, pits, easements, infrastructure, large roads (sealed and unsealed) permanent flooding, plantations, parkland tree stands	Sporadic reliable indicator species

### 3.3.5 Hypothesis

Linear Dieback assessment of Mitchell Freeway is testing the hypothesis that “disease indicator species deaths and changes in vegetation community composition and structure are the result of infestation by *Phytophthora Dieback*”.

### 3.3.6 Sampling Strategy and Methods

Sampling strategies for the assessment of Dieback aim to resolve the following scenarios:

- Sampling to support an Infested diagnosis - recently dead and dying indicator species are sampled to support an Interpreter’s diagnosis of an area as Infested.
- Sampling to support an Uninfested diagnosis - recently dead and dying indicator species are sampled to support an Interpreter’s diagnosis of an area as Uninfested.

To test the hypothesis in **Section 3.3.5**, potential sample locations were selected throughout the assessment area. Potential sample locations were allocated a rating from 1-5 as defined in **Table 6**. Final sample locations were selected by geographic location, ensuring samples were spread throughout the assessment area and in areas that would adequately test the hypothesis. This includes sampling ISDs that would support either an Uninfested or Infested diagnosis.

**Table 6: Sample requirement rating and description (adapted from FEMD 2015)**

Rating	Importance	Description
1	Very Low	The result is not expected to alter the assessment outcome, e.g. area that is obviously Infested with multiple observable factors.
2	Low	The result is not expected to alter the assessment outcome, but the site may have value for training purposes.
3	Moderate	The results may add extra evidence to a particular strategy. Soil and tissue samples may be taken from these sites where Interpreters are required to provide extra evidence for sensitive or difficult areas or where further proof is needed to support field diagnosis. Sites rated ‘3’ may be left not sampled.
4	High	The results of these samples will be critical to the assessment outcome; however, occasional sample sites with this rating may not be sampled at the completion of the assessment.
5	Very High	The results of these samples will be critical to the assessment outcome. All sites rated ‘5’ will be sampled.

The following sampling strategy for assessment area was used:

- Take samples of indicator species deaths (ISDs) in assessable areas to test the hypothesis.
- Retest samples (through rebaiting or DNA test) where a positive result was expected but not returned.
- Reformulate the hypothesis if the second test returned the same unexpected result to test for other factors causing ISDs and changes to community composition and structure (e.g. drought, *Armillaria luteobubalina*, fire).

Samples must be collected of soil and tissue from recently dead or dying disease indicator species to confirm the presence, or indicate the possible absence, of Dieback and to inform interpretation of the assessment area. Caution must be applied to interpreting the results of sampling and claiming that an area is Uninfested. Prolonged unfavourable conditions for *Phytophthora cinnamomi* can lead to false negative results due to low levels of inoculum present in a sample. Sample results should be considered within the context of other field evidence, including disease vectors, pattern, chronology, biomass reduction and changes in vegetation structure.

All sampling strictly adhered to the following procedures:

- All tools used in sampling were thoroughly sterilised with a 70:30 mixture of methylated spirits and water before samples were taken. Tools were dry prior to sampling so that the results were not compromised.
- The plant sampled was excavated to a depth that ensured adequate plant tissue material could be obtained from the roots and cambium layer around the collar of the plant being sampled (not more than 150 mm depth).
- Material from all around the plant was taken in addition to any obvious lesions to avoid missing any infected material. Plant tissue material plus soil from around the roots and other places in the soil profile were placed in a polythene bag.
- All relevant information pertaining to the plant sampled and sample location was recorded on the Sample Information Sheet.
- Two aluminium tags that provided the date, project name, sample number, species sampled and the name of the Interpreter were prepared. One tag was placed in the sample bag and the other was tied near the sample site, which was also demarcated with fluorescent pink flagging tape.
- The sample hole was backfilled to prevent fauna from becoming trapped.
- All tools were brushed off to remove excess soil and sterilised to prevent contamination of the next sample site and sample.

All soil and tissue samples were lodged with the VHS laboratory, where diagnostic baiting was conducted. All sample point locations were recorded using a hand-held GPS unit.

Dieback assessment is conducted in a manner to ensure it does not spread Dieback within the assessment area. The following procedures are followed:

- Start all field assessments with a clean vehicle and footwear free of soil and vegetative material.
- Only work in dry conditions (i.e. when soil is not adhering) to reduce spreading of soil from footwear and vehicle movement.
- In wet conditions on more exposed soils, carry a small cleaning brush and spray bottle with a 70:30 solution methylated spirits/water to remove soil and mud from footwear when moving from Infested to Uninfested areas.
- In wet conditions:
  - Aim to work from Uninfested into Infested or Uninterpretable or Excluded areas.
  - Drive vehicle only on well-formed tracks avoiding muddy and wet areas.
  - If Uninfested areas need to be entered, complete an in-field vehicle inspection and clean down if required.
- If a water-crossing or muddy area must be driven through, drive through slowly to reduce mud-spraying and complete an in-field vehicle inspection and clean down if required.

In-field vehicle cleaning can be difficult to achieve. An in-field vehicle inspection and clean down involves the following process:

- Before entering an Uninfested area or after completing a water/mud-crossing, stop at an appropriate site as soon as possible. This should be a dry and sandy or hard-pan location in the Infested area, draining onto or into the Infested area.
- Remove soil and mud from tyres, bumper, wheel arches, steps and under vehicle.
- Spray down the undercarriage and wheels of vehicle with 70:30 solution methylated spirits/water.
- Spray all equipment used to clean the vehicle and footwear with 70:30 solution methylated spirits/water.

### **3.4 Mapping**

Spatial data, including tracks and waypoints recorded on hand-held GPS units, were downloaded into a Geographic Information System (GIS) program. The GIS software used for the project was QGIS 3.4 (QGIS Development Team 2019).

Field evidence and observations plus spatial data were used to prepare a Dieback occurrence map for the assessment area. *Phytophthora* occurrence categories were mapped using the categories defined in

For operational purposes, Dieback occurrence mapping is only valid for 12 months after the assessment is completed to counter for autonomous spread of the pathogen (FEMD 2015).

### **3.5 Limitations**

The following limitations were encountered during the Phytophthora Dieback assessment:

- The lack of previous Dieback assessments in assessment area was a limiting factor for the desktop assessment.
- Large portions of the assessment area were in a Degraded condition and as such could not be assessed.

## 4 Results

### 4.1 Desktop Review

The desktop review utilised the DDIMS database and this identified no positive sample results for any *Phytophthora* species within the assessment area. However, several positive samples were found in the area surrounding the assessment area. Both a *Phytophthora cinnamomi* and *P. multivora* sample were found along Reid Highway just to the east of the assessment area. Additionally, two *P. multivora* and three *P. nicotianae* were found to the west of the assessment area between Whitfords Avenue and Ocean Reef Road which marks the northern extend of the assessment area.

### 4.2 Disease Indicator Species

Disease indicator species observed within the assessment area include, but are not limited to, representatives of the Casuarinaceae, Proteaceae and Xanthorrhoeaceae families. Disease indicator species observed during the field survey are listed in **Table 7**. *Banksia attenuata*, *B. menziesii* and *Xanthorrhoea preissii* were the most reliable primary indicator species in the assessment area. Secondary indicators, including *Banksia sessilis*, *Allocasuarina fraseriana* and *A. humilis* were also used to inform interpretation.

**Table 7: Disease indicator species within the Mitchell Freeway**

Family	Species	Primary Indicator	Secondary Indicator
Casuarinaceae	<i>Allocasuarina fraseriana</i>		•
	<i>Allocasuarina humilis</i>		•
Proteaceae	<i>Banksia attenuata</i>	•	
	<i>Banksia menziesii</i>	•	
	<i>Banksia sessilis</i>	•	
Xanthorrhoeaceae	<i>Xanthorrhoea preissii</i>	•	

### 4.3 Vegetation Communities

Vegetation community descriptions within the assessment area are described in accordance with **Table 4** from the *Native Vegetation Condition Assessment and Monitoring Manual for Western Australia* (DEC 2009). Two native vegetation types were identified within the assessment area (**Table 8**). A large percentage of the assessment area contained planted vegetation which does not reflect the vegetation that naturally grows in the area. As such these areas are classified as Degraded and were excluded from assessment. The Tuart Forest Community (C2) was the most dominant vegetation community present and occurred from just north of Whitfords Avenue to the southern extent of the assessment area. The Jarrah (C1) woodland community was

the only other natural vegetation community within the assessment area, and this occurred in the areas north of Whitfords Avenue to the northern end of the assessment area.

**Table 8: Vegetation communities observed within the assessment area (DEC, 2009).**

<b>C1 (Jarrah Woodland)</b>
Tall Open Woodland of <i>Eucalyptus gamphocephala</i> over Open Woodland of <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> and <i>Allocasuarina fraseriana</i> ) over Tall Open Shrubland <i>Acacia rostelifera</i> <i>Calothamnus quadrifidus</i> and <i>Melaleuca nesophila</i> over Open Shrubland of <i>Xanthorrhoea preissii</i> over Closed Grassland of Introduced grasses ( <b>Photo 1</b> ).
<b>C2 (Tuart Forest)</b>
Closed Forest of <i>Eucalyptus gomphocephala</i> over Low Woodland of <i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> , <i>Allocasuarina fraseriana</i> and <i>Corymbia calophylla</i> over Shrubland of <i>Xanthorrhoea preissii</i> , <i>Acacia rostelifera</i> , <i>Jacksonia sternbergiana</i> and <i>Allocasuarina humilis</i> over Open Sedgeland of <i>Mesomelaena pseudostygia</i> and <i>Lepidosperma calcicole</i> over Open Grassland of Introduced grasses ( <b>Photo 2</b> ).

#### 4.4 Sample Results

Two soil and tissue samples were taken during the Dieback assessment. Both samples returned negative results for any *Phytophthora* species. All sample results are presented in **Table 9**. The VHS laboratory *Phytophthora* testing results are provided in **Appendix A**. The individual sample sheets are provided in **Appendix B**.

**Table 9: Sample results from Mitchell Freeway**

Sample	Species	Easting	Northing	Result	Retest
MFS01	<i>Xanthorrhoea preissii</i>	0385398	6477712	Negative	NA
MFS02	<i>Banksia attenuata</i>	0385750	6477135	Negative	NA

#### 4.5 Dieback Occurrence

**Figure 2** presents the Dieback occurrence maps for the assessment area. In total, 1.5 ha of bushland was assessed for Dieback occurrence. **Table 10** provides a breakdown of the Dieback occurrence area calculations. Mapping categorised 0.6 ha (1.8%) of the assessed area is Infested and a further 0.9 ha was mapped as Uninfested. The majority of the assessment area was Excluded from being assessed as the vegetation was classified as Degraded or Completely Degraded in accordance with Keighery classification (1994) (**Table 3**).

**Table 10: Dieback occurrence area statement for Mitchell Freeway**

<b>Occurrence Category</b>	<b>Area (ha)</b>	<b>% of Assessment Area</b>
Infested	0.6	1.8
Uninfested	0.9	2.7
Excluded	32.0	95.5
<b>Total</b>	<b>33.5</b>	<b>100</b>

## 5 Discussion

### 5.1 Dieback Occurrence at Mitchell Freeway.

Most of the assessment area (32ha (95.5%)) was had to be categorised as Excluded from assessment, primarily due to these areas being Degraded or Completely Degraded in accordance with Keighery vegetation disturbance scale (Keighery 1994). Degraded areas were generally characterised by being dominated with invasive exotic species, or planted vegetation which does not occur within the natural vegetation communities (**Photo 4**). Completely Degraded vegetation is generally cleared of native vegetation and dominated by invasive exotic species (**Photo 3**). These areas also lacked disease indicator species to enable assessment. The Excluded areas within the assessment area should be treated as Infested for management purposes due to the long history of disturbance.

The only Infested area is immediately north of Whitfords Avenue and is only 0.6 ha or 1.8% of the assessment area. Dead disease indicator species present included *Banksia attenuata* and *Xanthorrhoea preissii*, which were found upslope and downslope of a large stormwater sump (**Photo 5 & Photo 6**). No samples were taken in this area as the disease expression was sufficient to determine that this area is Infested.

Three small areas totaling 0.9 ha (2.7%) were found between Hepburn Avenue and Warwick Road within the Tuart Forest vegetation community (**Photo 7**). Two samples (MFS01 and MFS02) were taken in the larger two of the areas, both of which returned negative results for *Phytophthora* species, which supports the determination that these areas are Uninfested.

### 5.2 Other Potential Impacts to Vegetation

#### 5.2.1 Drought

Impacts to vegetation through prolonged drought are distinguished from impacts caused by *P. cinnamomi* by the following characteristics:

- No disease pattern or chronology is seen in the surrounding vegetation.
- Phytophthora-resistant species are exhibiting evidence of stress and mortality.
- The plant senesced gradually, rather than succumbing quickly as is usually the case with deaths attributed to *P. cinnamomi*.
- No visible lesions or mycelium on the roots of the dead or dying plant. Re-shooting or epicormic growth is visible on dying plants.
- The presence of single or multiple dead branches with the remainder of the plant appearing to be healthy may be attributed to drought or pathogenic fungi.

## 6 Conclusion and Recommendations

The Linear Dieback assessment conducted by Terratree on 9 June 2020, found that 0.6 ha (1.8%) of the Mitchell Freeway assessment area was determined to be Infested with Dieback. Only 0.9 ha (2.7%) of the assessment area was determined to be Uninfested and the remaining 32.0 ha (95.5%) of the assessment area was excluded from the assessment. These areas were excluded because they were classified as Degraded or Completely Degraded in accordance with Keighery vegetation condition scale (Keighery 1994).

Terratree makes the following recommendations to manage the Mitchell Freeway Assessment area:

- All vehicles and machinery must be clean on exit from the assessment area. This is to prevent the spread of *Phytophthora* spp. from spreading to other areas within and outside of the assessment area. This is especially important when operating around the Infested stormwater sump.
- All vehicles and machinery must be clean on entry into the Uninfested areas between Hepburn Avenue and Warwick Road.

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## Glossary of Terms (adapted from FEMD 2015)

**Assessment** - (Phytophthora occurrence) any combination of activities including detection, diagnosis (interpretation), mapping and demarcation of Phytophthora Dieback disease in natural ecosystems.

**Assessment Area** - an area where Phytophthora occurrence assessment is possible or will be possible in the short to medium term. This area may be larger or smaller than the proponent's project area.

**Diagnosis** - a determining or analysis of the cause or nature of a problem or situation.

**Dieback (Phytophthora)** - in the south-west of Western Australia, a disease of plants caused by infection by the soil-borne organisms of the genus *Phytophthora*, of which *P. cinnamomi* is the most widespread.

**Dieback (Phytophthora) Interpreter** - a registered person who conducts Phytophthora Dieback interpretation.

**Dieback (Phytophthora) Interpretation** - the method of determining Phytophthora Dieback infestation using procedures in the Dieback Interpreter's Manual (Forest and Ecosystem Management Division (2015). FEM047 Phytophthora Dieback Interpreter's manual for lands managed by the department. Version 1.0. Department of Parks and Wildlife, Perth, Western Australia).

**Disease** - the combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

**Environment** - the sum of all external factors that act on an individual organism during its lifetime.

**Excluded Area** - an area that has been disturbed to an extent that it is not assessable and therefore excluded from Dieback interpretation.

**Host** - the plant that is invaded by a pathogen and from which the pathogen derives its energy.

**Indicator species** – a plant species that is more susceptible to Phytophthora disease and reliably shows symptoms earlier than other species.

**Infection** - the invasion of a host organism's bodily tissue by disease-causing organisms. In relation to Dieback, this refers to an individual plant and not the population.

**Infested Area** - an area that an accredited Dieback Interpreter has determined has plant disease symptoms consistent with the presence of the pathogen *Phytophthora cinnamomi*.

**Pathogen** - any organism or factor causing disease within a host.

**Pathogenic** - causing or capable of causing disease.

**Phytophthora Dieback** - a term referring to the disease symptoms caused by *Phytophthora* species in susceptible vegetation.

**Susceptible** - influenced or able to be harmed by Phytophthora Dieback.

**Sporulation** - a type of reproduction that occurs in fungi, algae and protozoa and involves the formation of spores by the spontaneous division of a cell into four or more daughter cells, each of which contains a part of the original nucleus.

**Symptom** - a phenomenon that arises from and accompanies a particular disease or disorder and serves as an indication of it.

**Uninfested Area** - an area that an accredited Dieback Interpreter has determined to be free of plant disease symptoms that indicate the presence of Phytophthora Dieback.

**Uninterpretable Area** - an area situated in locations receiving >600 mm rainfall per year or are water-gaining sites (e.g. granite outcrops, impeded drainage or engineering works that aggregate rainfall) in the 400-600 mm per year rainfall zone where indicator plants are absent or too few to determine the presence or absence of disease caused by Phytophthora Dieback.

**Unprotectable Area** - a disease-free area that is likely to become infested within a given time.

**Vector** - any agent that acts as a carrier or transporter.

## Photos



**Photo 1: Jarrah Woodland Vegetation Unit (C1)**



**Photo 2: Tuart Forest Vegetation Unit (C2)**



**Photo 3: Introduced Vegetation (Completely Degraded)**



**Photo 4: Example of Degraded Vegetation which was excluded from Assessment**



**Photo 5: Infested vegetation upslope of stormwater sump with recently dead *Banksia* sp.**



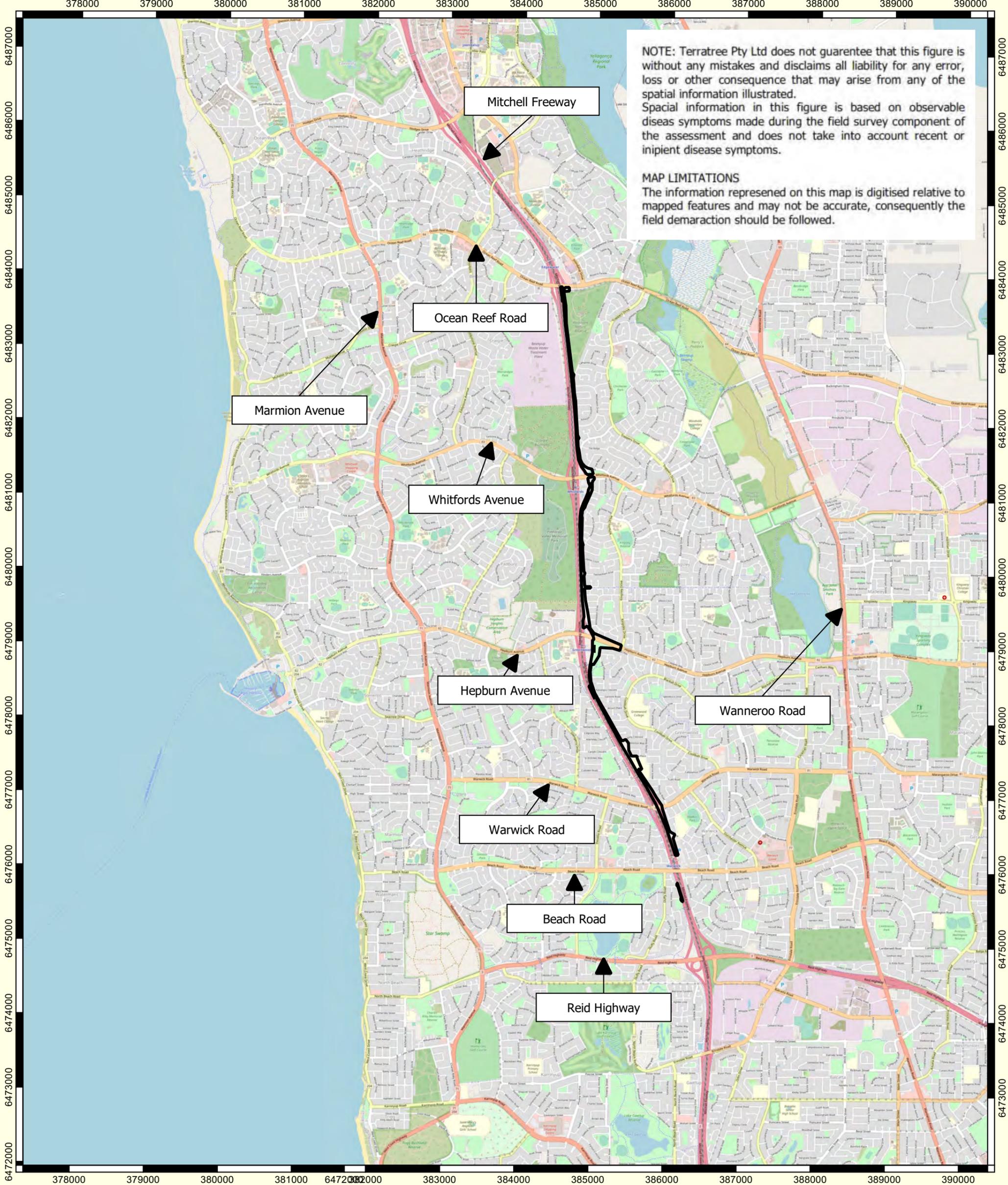
**Photo 6: Infested vegetation downslope of stormwater sump with recently dead *Banksia* sp. and *Xanthorrhoea preissii*.**



**Photo 7: Uninfested vegetation between Hepburn Avenue and Warwick Road**

## Figures

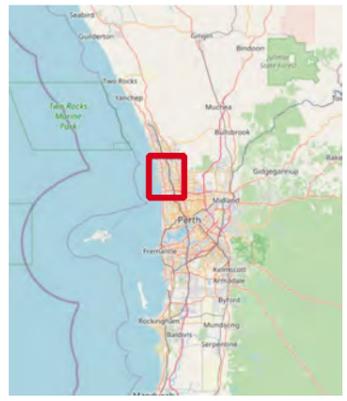
**Figure 1: Project location map**



**NOTE:** Terratree Pty Ltd does not guarantee that this figure is without any mistakes and disclaims all liability for any error, loss or other consequence that may arise from any of the spatial information illustrated. Spatial information in this figure is based on observable dieback symptoms made during the field survey component of the assessment and does not take into account recent or inipient dieback symptoms.

**MAP LIMITATIONS**  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.

**Legend**  
 Assessment Area



Project Location

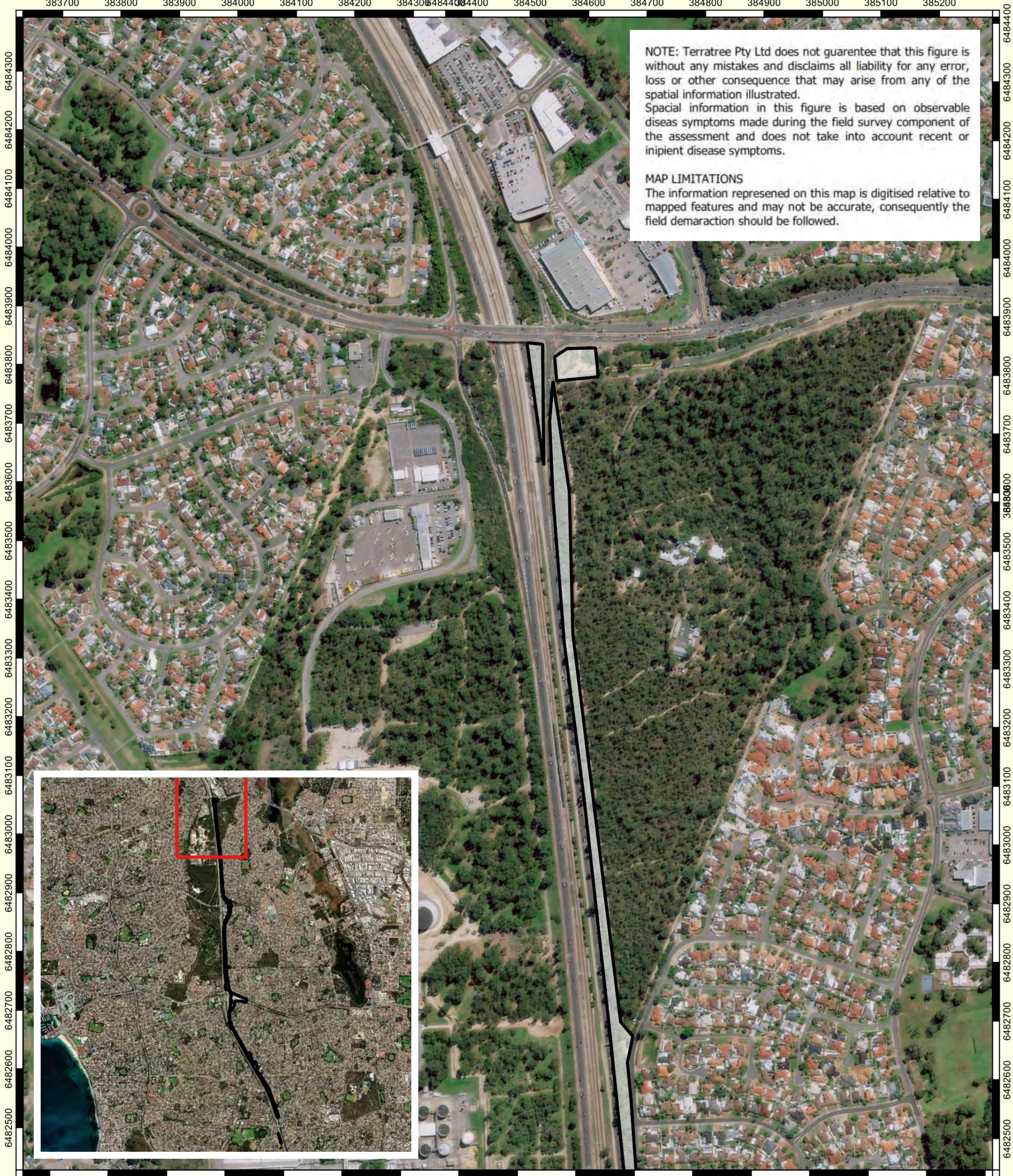
Project Location Map		
2020 Main Roads Mitchell Freeway Dieback Assessment		
		
		Datum: GDA 1994 Projection: MGA Zone 50 Scale: 1: 55000 at A3
Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry:	Checked: A. Caubo	
<b>Figure 1</b>	Revision: J. Grehan	
	Review:	

**Figure 2: *Phytophthora cinnamomi* Dieback occurrence maps**

383700 383800 383900 384000 384100 384200 384300 384400 384500 384600 384700 384800 384900 385000 385100 385200

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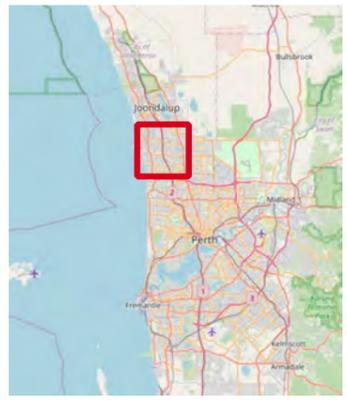
**MAP LIMITATIONS**  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.



**Legend**

- Assessment Area
- Main Roads Dieback Occurance**
- Excluded

Occurrence Category	Area (ha)	Unprotectable (ha)	% of Assessment Area
Infested	0.6	-	1.8
Uninfested	0.9	-	2.7
Excluded	32.0	-	95.5
<b>Total</b>	<b>33.5</b>	-	<b>100</b>



Project Location

**Dieback Occurance Map**

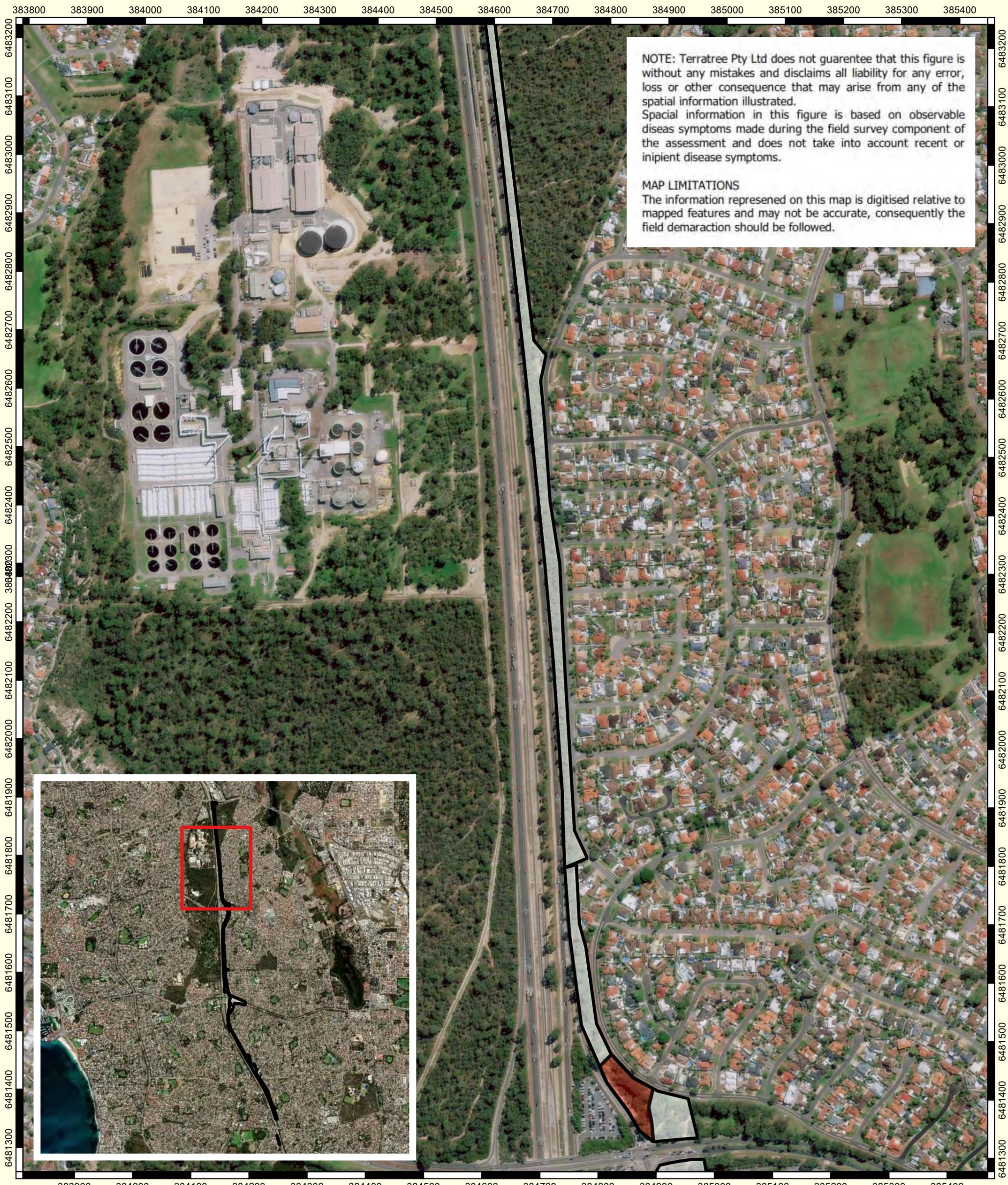
**2020 Main Roads Mitchell Freeway Dieback Assessment**

0 100 200 300 400 m

N

Datum: GDA 1994  
Projection: MGA Zone 50  
Scale: 1: 7000 at A3

Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry: 07/07/2021	Checked: A. Caubo	
<b>Figure 2.1</b>	Revision: J. Grehan	
	Review:	



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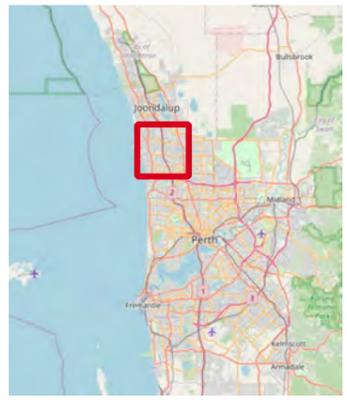
**MAP LIMITATIONS**  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.



**Legend**

- Assessment Area
- Main Roads Dieback Occurance**
- Excluded
- Infested

Occurance Category	Area (ha)	Unprotectable (ha)	% of Assessment Area
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Uninfested	0.9	-	2.7
Excluded	32.0	-	95.5
<b>Total</b>	<b>33.5</b>	<b>-</b>	<b>100</b>



Project Location

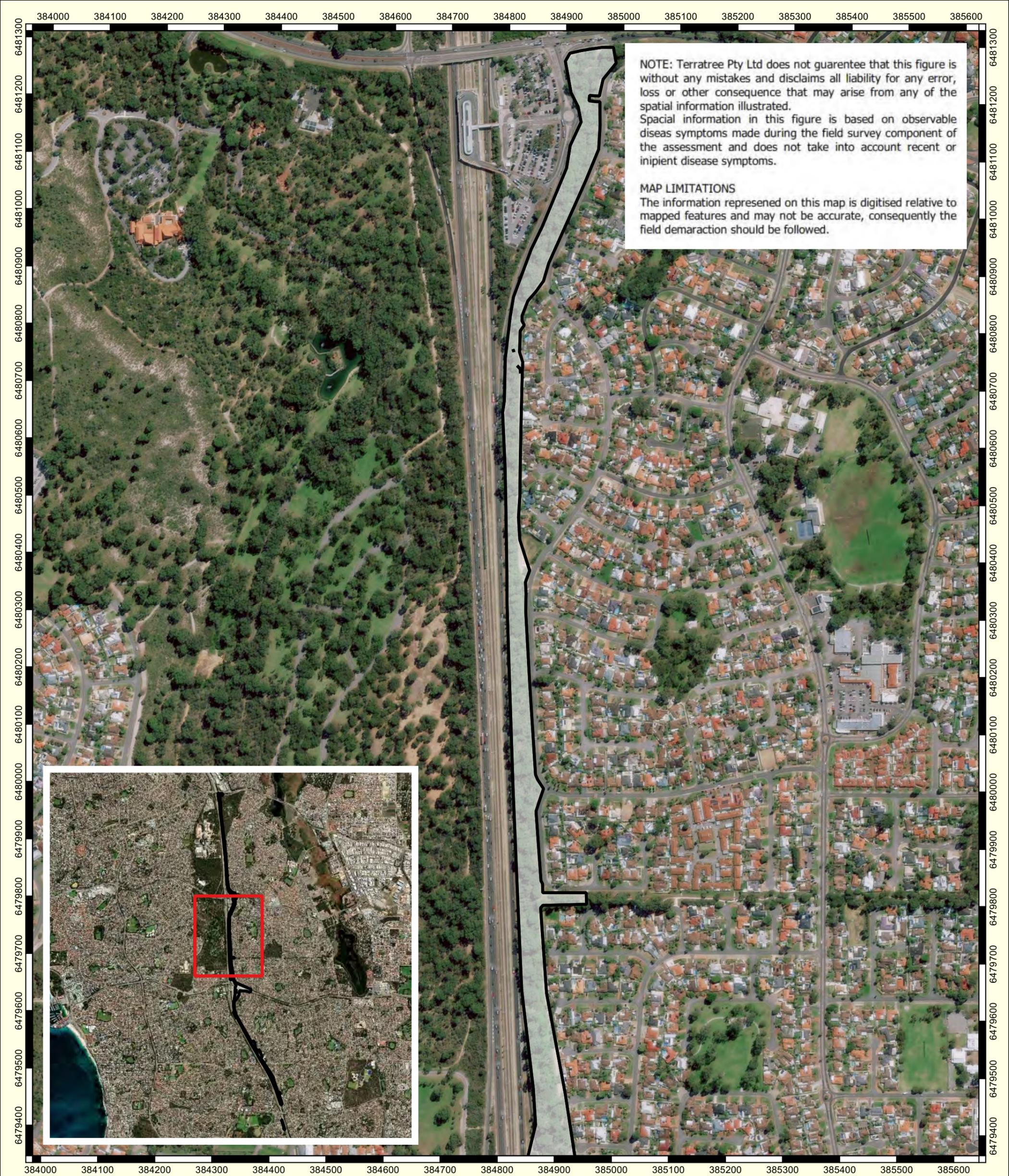
**Dieback Occurance Map**  
**2020 Main Roads Mitchell Freeway Dieback Assessment**

Datum: GDA 1994  
Projection: MGA Zone 50

Scale: 1: 7000 at A3

Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry: 07/07/2021	Checked: A. Caubo	
	Revision: J. Grehan	
	Review:	

**Figure 2.2**



NOTE: Terratree Pty Ltd does not guarantee that this figure is without any mistakes and disclaims all liability for any error, loss or other consequence that may arise from any of the spatial information illustrated. Spatial information in this figure is based on observable dieback symptoms made during the field survey component of the assessment and does not take into account recent or inipient dieback symptoms.

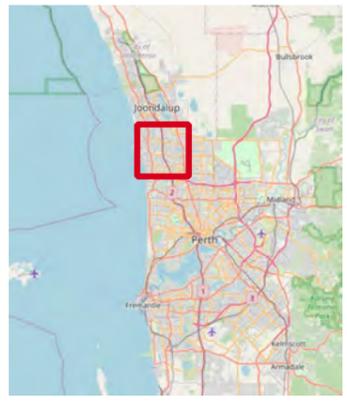
MAP LIMITATIONS  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.



**Legend**

- Assessment Area
- Dieback Occurance**
- Excluded

Occurance Category	Area (ha)	Unprotectable (ha)	% of Assessment Area
Infested	0.6	-	1.8
Uninfested	0.9	-	2.7
Excluded	32.0	-	95.5
<b>Total</b>	<b>33.5</b>	<b>-</b>	<b>100</b>



Project Location

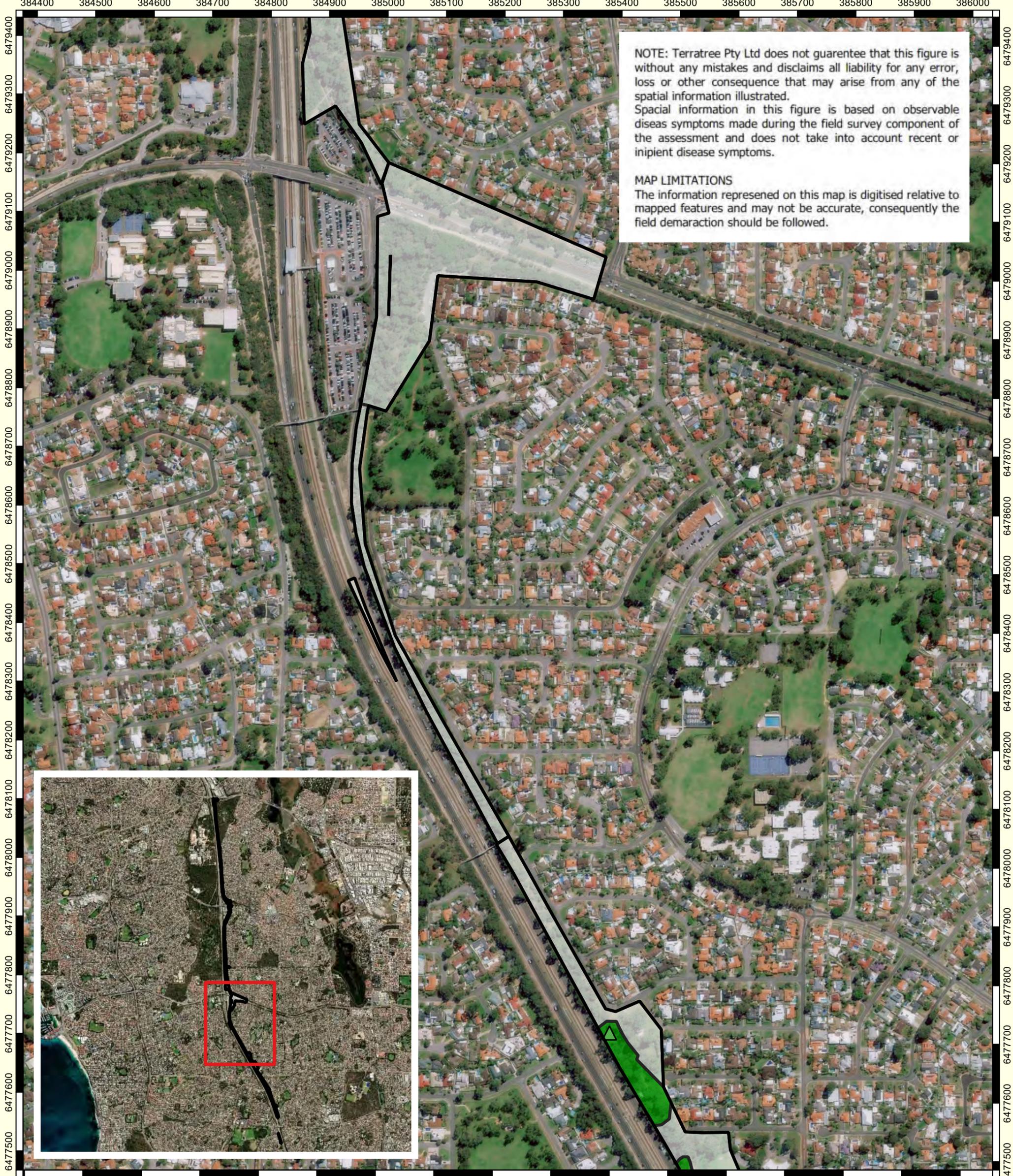
**Dieback Occurance Map**

**2020 Main Roads Mitchell Freeway Dieback Assessment**

0 100 200 300 400 m

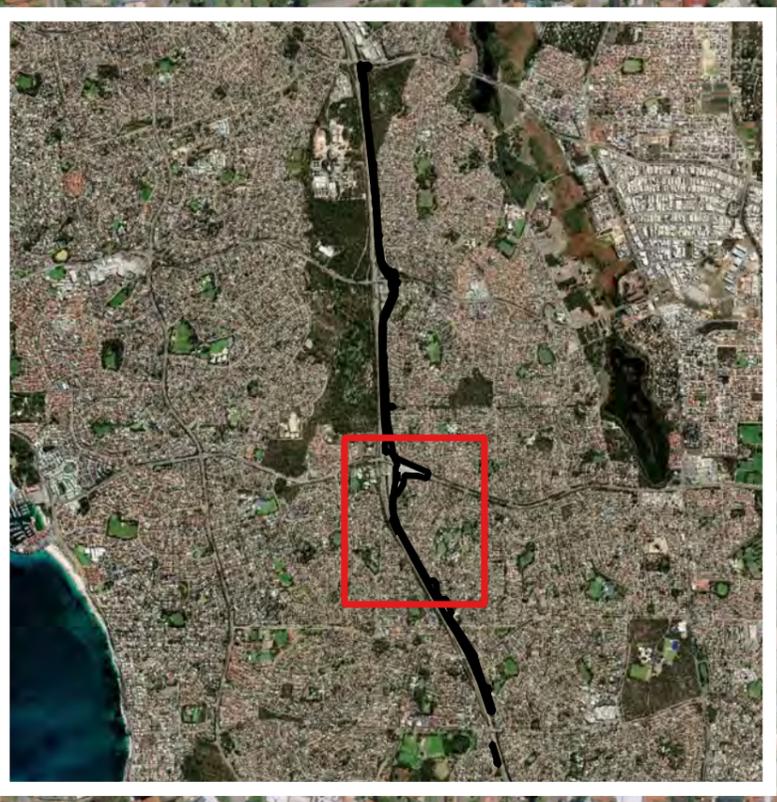
Datum: GDA 1994  
Projection: MGA Zone 50  
Scale: 1: 7000 at A3

Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry: 07/07/2021	Checked: A. Caubo	
<p><b>Figure 2.3</b></p> <p>Revision: J. Grehan</p> <p>Review:</p>		



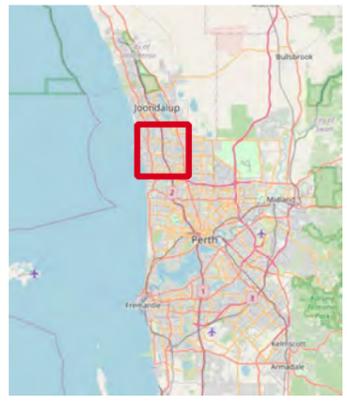
**NOTE:** Terratree Pty Ltd does not guarantee that this figure is without any mistakes and disclaims all liability for any error, loss or other consequence that may arise from any of the spatial information illustrated. Spatial information in this figure is based on observable dieback symptoms made during the field survey component of the assessment and does not take into account recent or inipient dieback symptoms.

**MAP LIMITATIONS**  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.



- Legend**
- Assessment Area
  - Sample Locations**
  - ▲ Negative
  - Dieback Occurance**
  - Excluded
  - Uninfested

Occurrence Category	Area (ha)	Unprotectable (ha)	% of Assessment Area
Infested	0.6	--	1.8
Uninfested	0.9	--	2.7
Excluded	32.0	--	95.5
<b>Total</b>	<b>33.5</b>	<b>--</b>	<b>100</b>



Project Location

**Dieback Occurance Map**

**2020 Main Roads Mitchell Freeway Dieback Assessment**

0 100 200 300 400 m

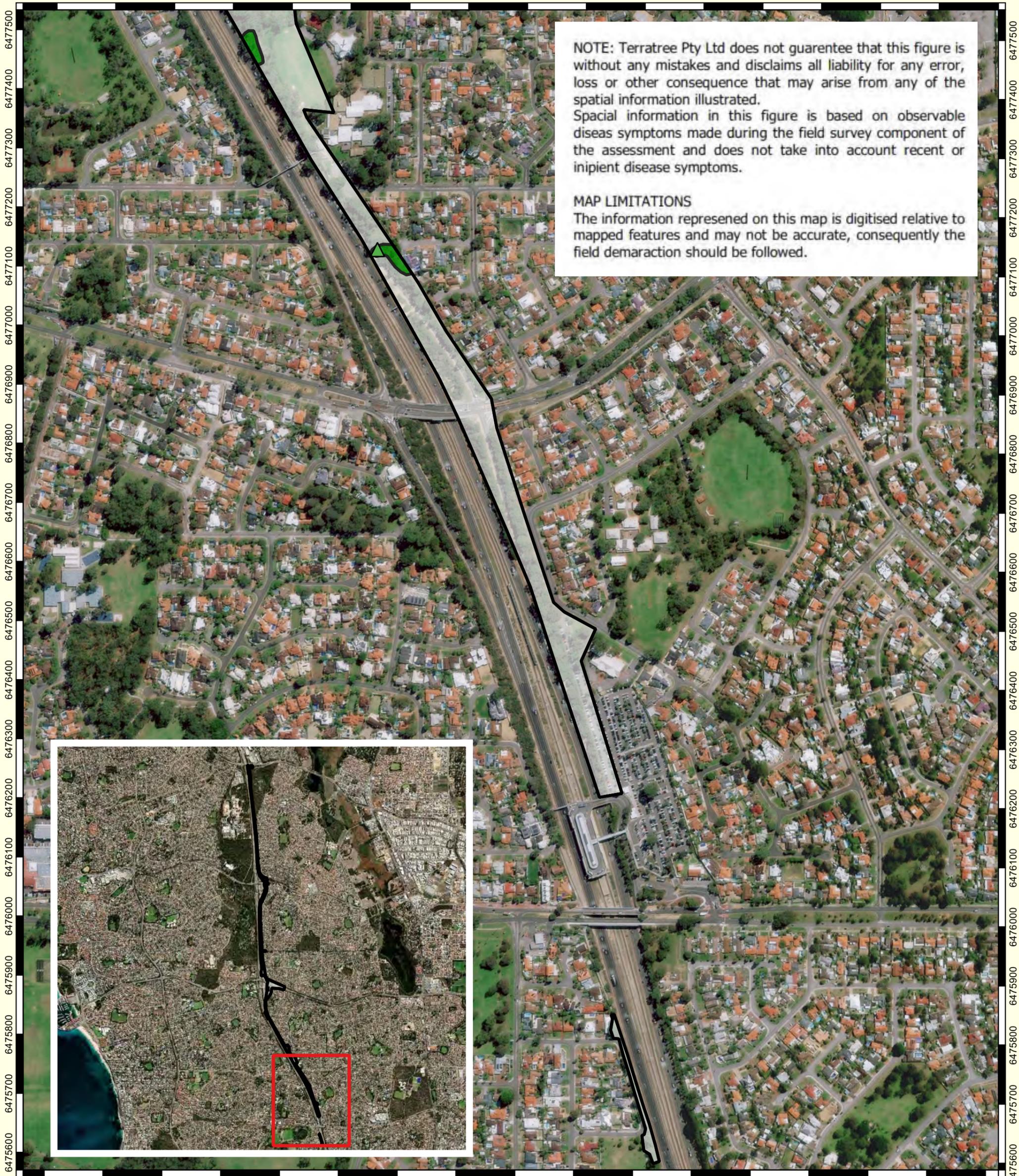
N

Datum: GDA 1994  
Projection: MGA Zone 50  
Scale: 1: 7000 at A3

Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry: 07/07/2021	Checked: A. Caubo	
	Revision: J. Grehan	
	Review:	

**Figure 2.4**

385200 385300 385400 385500 385600 385700 385800 385900 386000 386100 386200 386300 386400 386500 386600 386700 386800



**NOTE:** Terratree Pty Ltd does not guarantee that this figure is without any mistakes and disclaims all liability for any error, loss or other consequence that may arise from any of the spatial information illustrated. Spatial information in this figure is based on observable dieback symptoms made during the field survey component of the assessment and does not take into account recent or inipient dieback symptoms.

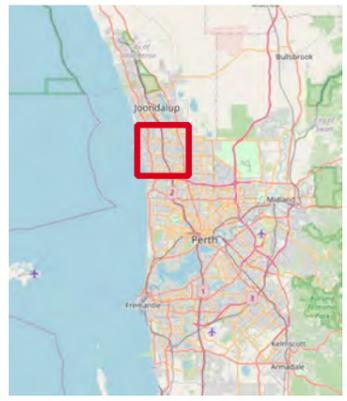
**MAP LIMITATIONS**  
The information represented on this map is digitised relative to mapped features and may not be accurate, consequently the field demarcation should be followed.

385200 385300 385400 385500 385600 385700 385800 385900 386000 386100 386200 386300 386400 386500 386600 386700 386800

**Legend**

- Assessment Area
- Sample Locations**
- Negative
- Dieback Occurrence**
- Excluded
- Uninfested

Occurrence Category	Area (ha)	Unprotectable (ha)	% of Assessment Area
Infested	0.6	-	1.8
Uninfested	0.9	-	2.7
Excluded	32.0	-	95.5
<b>Total</b>	<b>33.5</b>	<b>-</b>	<b>100</b>



Project Location

**Dieback Occurrence Map**

**2020 Main Roads Mitchell Freeway Dieback Assessment**

0 100 200 300 400 m

Datum: GDA 1994  
Projection: MGA Zone 50  
Scale: 1: 7000 at A3

Date: 07/07/2020	Prepared: A. Caubo	Project No: T20023
Expiry: 07/07/2021	Checked: A. Caubo	
<b>Figure 2.5</b>	Revision: J. Grehan	
	Review:	

## Appendices

## Appendix A: VHS Laboratory Sample Result Sheet

**VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET**

**SEND TO:** VHS Lab, Forest and Ecosystem Management Div - DPaw, 17 Dick Perry Ave KENSINGTON 6151 **Phone:** (08) 9334 0317 **Fax:** (08) 9334 0114

**CONTACT DETAILS of sender**

Name: Joe Grehan (Terratree)  
 Fax No. \_\_\_\_\_ Phone No.: 0892501163  
 DPaw Office or Company Name: Terratree Pty Ltd

**GDA**  
 (1)  
 GDA 94

**Job Type (Please Indicate)**  
 DPaw (C) \_\_\_\_\_  
 Recoup (R) \_\_\_\_\_  
 Private (P) \_\_\_\_\_

**VHS USE ONLY**  
 Date received 11.6.20  
 Date faxed 25.6.20

**NOTIFY DFWA?**  
 \_\_\_\_\_

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg: Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS 41174      ■■■■■ ■■■■ ■■■■ ■■■■	09/06/20	MFS01	Xanthorrhoea preissi	L	50	E 0385398 N 6477712	P		NEG
VHS 41175      ■■■■■ ■■■■ ■■■■ ■■■■	09/06/20	MFS02	Banksia attenuata	L	50	E 0385750 N 6477135	P		NEG

**NOTES:**

- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
- Site Impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
- An MGA map reference with prefixes **must** be supplied for all samples.
- Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
- Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryplogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, ALT = *P. alticola*, NEG = negative, SUB = subcultured for further tests

Please Note: a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

**COMMENTS: MF = Mitchell Freeway**



## Appendix B: Sample Information

Sample ID	MFS01	
Plant Sampled	<i>Xanthorrhoea preissii</i>	
Coordinates (GDA 94)	E: 0385398	
	N: 6477712	
Vegetation Type	Tuart Forest	
Aspect (N, S, E, W)	SW	
Slope (°)	5	
Soil Type	Sandy	
Site Disturbance	Roading & Public Access	
ISD Class	Isolated	
Vector	Yes	
Topographical Position	Mid-slope	
Disease Expression	Subtle	
Chronological Pattern	Low	
Spatial Pattern	Low	
Drought Effect	Medium	
<i>Armillaria</i> evidence	No	
Fire Effects	No	
Current Dieback Impact	Low	
Biomass Reduction	Low	
Drainage	Average	
Other ISDs	NA	
Comments	Sample taken to support Uninfested diagnosis. Weeds Present.	
Photo		

Sample ID	MFS02
Plant Sampled	<i>Banksia attenuata</i>
Coordinates (GDA 94)	E: 0385750
	N: 6477135
Vegetation Type	Jarrah Woodland
Aspect (N, S, E, W)	SW
Slope (°)	10
Soil Type	Yellow Sand
Site Disturbance	Roading and Public Access
ISD Class	Isolated
Vector	Yes
Topographical Position	Mid-slope
Disease Expression	Low
Chronological Pattern	Low
Spatial Pattern	Low
Drought Effect	Medium
<i>Armillaria</i> evidence	No
Fire Effects	No
Current Dieback Impact	Low
Biomass Reduction	Low
Drainage	Average
Other ISDs	Nil
Comments	Sample taken to support Uninfested diagnosis. Weeds present
Photo	

# Appendix H. Tuart TEC Action Management Plan



## Main Roads Western Australia

Mitchell Freeway Principal Shared Path Gaps Project Ocean  
Reef Road to Hepburn Avenue, WA  
Tuart Woodlands TEC Action Management Plan

March 2021

## **GHD scope and limitations**

Main Roads Western Australia (Main Roads) commissioned GHD Pty Ltd (GHD) to develop a Tuart Woodlands TEC Action Management Plan (AMP) in accordance with the Department of Agriculture, Water and the Environment (DAWE) request for additional information for EPBC 2020/8833 Mitchell Freeway Principal Shared Path Gaps Project Ocean Reef Road to Hepburn Avenue, WA. This AMP forms part of that request for additional information.

This AMP has been prepared by GHD for Main Roads and may only be used and relied on by Main Roads for the purpose agreed between GHD and the Main Roads. GHD otherwise disclaims responsibility to any person other than Main Roads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

GHD has prepared this report on the basis of information provided by Main Roads and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report, and conditions encountered and information reviewed at the date of preparation of the report. GHD disclaims liability arising from any of the assumptions being incorrect, and has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

# Glossary

Abbreviation/Term	Definition
AMP	Action Management Plan
CALM	Department of Conservation and Land Management
CoE	Clean on Entry/Exit
Cth	Commonwealth
DBCA	Department of Biodiversity, Conservation and Attractions
DE	Development Envelope
DFES	Department of Fire and Emergency Services
DAWE	Department of Agriculture, Water and the Environment
DPIRD	Department of Primary Industries and Regional Development
EPA	Environmental Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPBC Regulations	Environment Protection and Biodiversity Conservation Regulations 2000
LGA	Local Government Authority
Main Roads	Main Roads Western Australia
MNES	Matters of National Environmental Significance
n/a	Not Applicable
PSP	Principal Shared Path
SMART performance standards	Specific, Measurable, Achievable, Relevant and Time-bound performance standards
Suitably qualified person	A person who has professional qualifications and at least three years of relevant work experience surveying for the relevant MNES and who can give authoritative assessment, advice and analysis on performance relative to the subject matter using relevant protocols, standards, methods or literature. If the person does not have appropriate professional qualifications, the person must have at least five years of work experience related to the subject matter and can give an authoritative assessment, advice and analysis on performance relative to the subject matter using relevant protocols, standards, methods or literature.
Tuart TEC	Tuart ( <i>Eucalyptus gomphocephala</i> ) woodlands and forests of the Swan Coastal Plain ecological community
TEC	Threatened Ecological Community
TSSC	Threatened Species Scientific Community
WA	Western Australia
WoNS	Weeds of National Significance

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# 1. Declaration of Accuracy

I declare that to the best of my knowledge, all the information contained in, or accompanying this document is complete, current and correct. I am duly authorised to sign this declaration on behalf of the proponent/approval holder. I am aware that:

- a. giving false or misleading information is a serious offence under section 137.1 of the Criminal Code Act 1995 (Cth)
- b. section 137.2 of the Criminal Code Act 1995 (Cth) makes it an offence for a person to produce a document to another person in compliance or purported compliance with a law of the Commonwealth where the person knows that the document is false or misleading
- c. section 490 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence for an approval holder to provide information in response to an approval condition where the person is reckless as to whether the information is false or misleading
- d. section 491 of the EPBC Act makes it an offence for a person to provide information or documents to specified persons who are known by the person to be performing a duty or carrying out a function under the EPBC Act or the Environment Protection and Biodiversity Conservation Regulations 2000 (Cth) (EPBC Regulations) where the person knows the information or document is false or misleading.

Signed: \_\_\_\_\_

Full name: John Braid, Principal Environment Officer

Organisation: Main Roads Western Australia

EPBC Referral Number: EPBC 2020/8833

Name of Action Management Plan this document and declaration refers to: Mitchell Freeway Principal Shared Path Gaps Project Ocean Reef Road to Hepburn Avenue, WA - Tuart Woodlands TEC Action Management Plan

Date: \_\_\_\_\_

## 2. Purpose and context

### 2.1 Purpose

This Action Management Plan (AMP) has been prepared as part of Preliminary Documentation to support assessment of the Mitchell Freeway Principal Shared Path Gaps Project Ocean Reef Road to Hepburn Avenue, WA (EPBC 2020/8833, the Proposed Action) under the EPBC Act.

The Preliminary Documentation has been prepared in response to a request by Department of Agriculture, Water, and Environment (DAWE) on 17 December 2020, for additional information to inform the assessment of the relevant impacts of the Proposed Action on Matters of National Environmental Significance (MNES).

The structure and content of this AMP has been prepared in accordance with Attachment C of DAWE's request for additional information.

### 2.2 Location and nature of relevant action activities

The Proposed Action involves the Commissioner of Main Roads Western Australia (Main Roads) installing a Principal Shared Path (PSP) and noise walls along the Mitchell Freeway at various sections between Hepburn Avenue and Ocean Reef Road, in the northern suburbs of Perth, Western Australia (WA). Figure 1 presents the Proposed Action location (referred to from hereon as the Development Envelope (DE)). The DE comprises an area of 13.68 hectares (ha) and extends for more than four kilometres (km) in a generally north south direction.

The Proposed Action includes the installation of a new PSP along the Mitchell Freeway, and the upgrading of existing PSPs to current design standards. The Proposed Action also includes the construction of noise walls to mitigate noise on nearby residential areas, stretching from Hepburn Avenue to Ocean Reef Road, verge side emergency stopping bays and the modification of on-ramps, Intelligent Transport Systems works and drainage on the Mitchell Freeway to accommodate the works. These works are required to improve the safe and efficient use of this route.

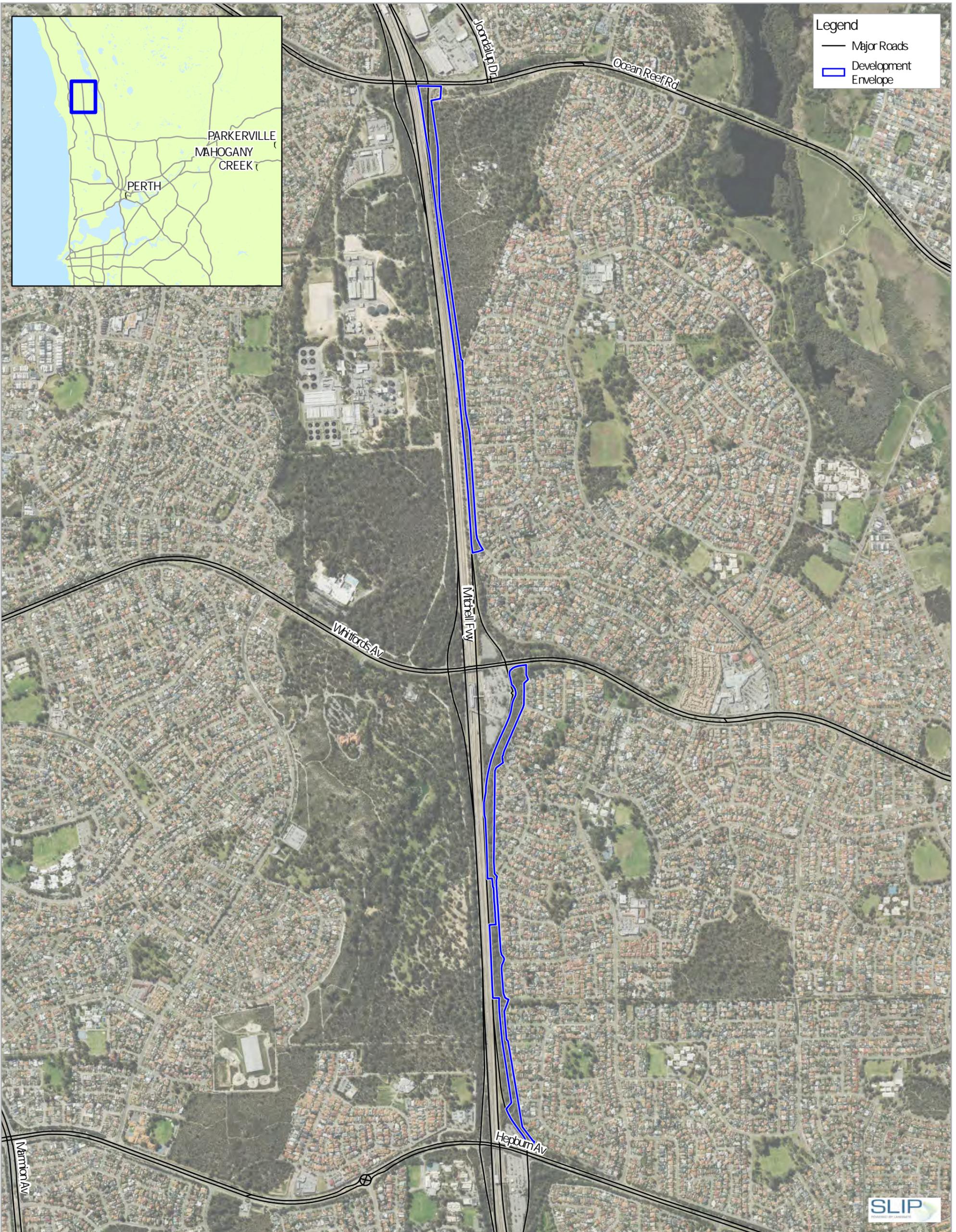
### 2.3 Schedule of action phases

#### 2.3.1 Pre-construction

The concept design has been developed to provide sustainable and innovative transport solutions. The key constraint on the design is mitigation of environmental impacts as the Proposed Action is located in a constrained urban environment, within a narrow road verge between the existing freeway and residential properties.

The concept design has been developed to minimise environmental impacts as far as practicable. Due to the early stages of design for the Proposed Action, a layout plan has not yet been created.

The design of the Proposed Action is at the concept stage (concept design). Detailed design during delivery will address key constraints, which may result in further amendments to the concept design.



**Legend**  
 — Major Roads  
 Development Envelope

Paper Size ISO A3  
 0 100 200 300 400  
 Metres

Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50



Main Roads Western Australia  
 PC107-16 SR518 Tuart Woodlands  
 TEC Management Plan

Project No. 12546061  
 Revision No. 0  
 Date 16/03/2021

Proposed Action location and  
 Development Envelope

FIGURE 1

### 2.3.2 Construction

Construction of the Proposed Action is planned to commence in Quarter 3, 2021 and is expected to continue for a period of up to two years.

Construction of the PSP will be undertaken using standard earth moving equipment and construction techniques. Excavated material suitable for use as fill material will be placed directly into the fill location by trucks and spread using loaders, graders or compactors. In order to facilitate widening of the existing PSP, an existing embankment will be excavated and a retaining wall constructed to achieve the required clearance.

Construction fencing will be installed to prevent inadvertent access by members of the public. Main Roads will also install a new permanent fence along the edge of Woodvale Nature Reserve, adjacent to the PSP.

Lay down areas for materials will be established by the Contractor in consultation with Main Roads and the Local Government Authority. All laydown areas, stockpiles and access tracks will be constructed within existing cleared areas or within the permanent footprint of the works. No native vegetation will be cleared for temporary works outside the permanent footprint.

### 2.3.3 Operation

The Proposed Action will operate as a dual lane PSP. The Proposed Action will be subject to normal routine, recurrent and periodic maintenance during operation of the PSP. The operation will be confined to the road corridor for on-ramps, emergency stopping bays, noisewalls and the PSP itself, typically including vegetation pruning, and drainage, lighting, signs and pavement maintenance.

## 2.4 Protected Matters

### 2.4.1 Information on MNES

The DE comprises and lies adjacent to land that supports the following MNES:

- Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community (Tuart TEC) – Critically Endangered
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable.

Consistent with the DAWE request for additional information, this AMP focuses on the management of biotic and abiotic indirect threats to the remaining Tuart TEC in the vicinity.

#### **Tuart TEC**

The Tuart TEC occurs as woodlands or forests with the canopy dominated by the eucalypt *Eucalyptus gomphocephala* (Tuart) trees in the uppermost canopy layer. The Tuart TEC includes the assemblage of plants and animals that occur in association with the tuart canopy (Threatened Species Scientific Community (TSSC) 2019).

Tuart woodlands and forests occur on the Swan Coastal Plain in Western Australia, from Jurien, approximately 200 km north of Perth, to the Sabina River, near Busselton, 225 km south of Perth. The distribution was historically almost continuous from the Sabina River to Lancelin, with the woodlands and forests being most prominent in the southern part of the range. The ecological community further north, near Cervantes is more sparse and isolated, which is likely to have been a long-term characteristic (TSSC 2019).

Tuart woodlands and forests are strongly associated with calcareous soils of the western part of the plain, including those very close to the coast. While it mainly occurs where soils are sandy

and well drained, it can also occur in other areas such as on protected swales, saline and freshwater wetlands, close to river banks and on limestone slopes (Keighery *et al.* 2002; Keighery 2002).

The Tuart TEC occurs within a landscape that has mixed uses, including agriculture, industrial use and housing. Many of the current and future threats to the ecological community are associated with the decreased condition and remaining impacts of the historical disturbance of prolonged grazing and clearing for agriculture (Keighery *et al.* 2002), with urban development and associated infrastructure increasing in its effect on the ecological community in recent decades. With changes in landscape and its management, fire regimes have also changed, while additional biological threats include invasive species, disease and 'Tuart decline' as well as a general lack of recruitment of both canopy and understorey plants.

The Tuart TEC has been identified as particularly susceptible to threatening processes such as land clearing, climate variability, changes in vegetation structure resulting from altered fire regimes and past grazing, hydrological factors and weed invasion (TSSC 2019). The primary known threats to the ecological community are listed here in categories, but these threats often interact, rather than act independently (TSSC 2019):

- Clearing and fragmentation of vegetation associated with:
  - Agriculture and grazing
  - Logging and timber removal
  - Urban development and infrastructure
  - Mining and Quarrying
- Invasive flora and fauna:
  - Weeds
  - Invasive vertebrate animals
  - Invasive invertebrate animals
- Tree dieback (*Phytophthora cinnamomi*) and pathogens
- Altered fire regimes
- Climate change
- Water extraction and other hydrological change
- Loss of fauna supporting key ecological processes.

#### 2.4.2 Location and baseline condition

##### **Biological surveys**

The location and baseline condition of the Tuart TEC and other environmental considerations within the DE and on adjacent land has been determined through biological surveys. These include:

1. Astron (2020) biological survey, which incorporated a 49.6 ha Survey Area comprising the DE and surrounding land. The survey included a detailed flora and vegetation assessment and significant vegetation survey (including of the Tuart TEC). The methods adopted for the flora and vegetation survey were formulated in accordance with the following regulatory guidance:
  - Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority (EPA) 2016a)
  - Environmental Factor Guideline – Flora and Vegetation (EPA 2016b)

- Approved Conservation Advice (incorporating listing advice) for the Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain ecological community (TSSC 2019).
2. Terratree (2020) dieback survey for a 32 ha assessment area, which involved a desktop review of the Dieback Information Data Management System database and field survey that involved the testing of soils and tissue samples. The field assessment was conducted in accordance with the FEM047 Phytophthora Dieback Interpreter’s Manual for lands managed by the Department produced by the Forest and Ecosystem Management Division (Forest and Ecosystem Management Division 2015).

### Tuart TEC

Two Tuart TEC patches (TP12 and TP20) were identified by Astron (2020) within their Survey Area. These patches were inferred to represent the EPBC Act listed Tuart TEC as they are >5 ha in size irrespective of understorey condition. No other areas of Tuart woodlands met the key diagnostic characteristics, condition and patch size thresholds to represent the Tuart TEC. Both identified Tuart TEC patches (TP12 and TP20) intersect the DE.

Figure 2 and Table 1 present the extent of patches of Tuart TEC within the Survey Area and DE (Astron 2020). Figure 3 presents the condition of the vegetation, which includes Tuart TEC, within the DE.

Implementation of the Proposed Action will result in the removal of up to 8.75 ha of Tuart TEC. As shown in Table 1, the remaining occurrence of patch TP20 will no longer meet the 5 ha threshold for Poor TEC condition category post clearing, as per the TEC criteria in the Conservation Advice (TSSC 2019). Therefore, an indirect impact of 3.43 ha will also be associated with patch TP20. This brings the combined direct and indirect impacts to Tuart TEC to 12.16 ha.

Table 1 Tuart TEC patches recorded by Astron (2020)

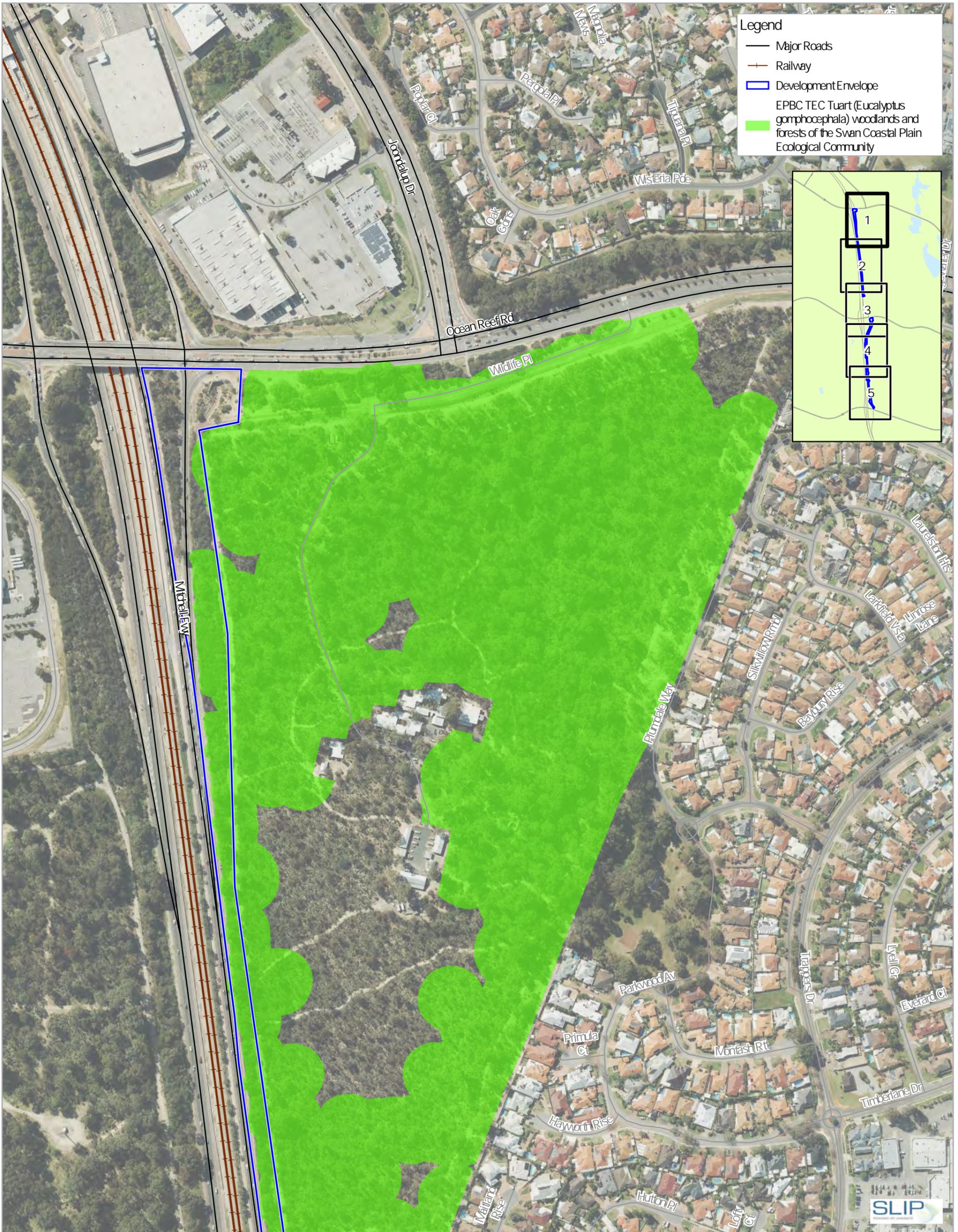
Patch number	Total patch size (ha)	Patch extent within DE (ha)	Extent of patch retained (ha)	Meets TEC criteria after clearing	Comments
TP12	35.2	2.76	32.44	Yes	This patch is located south of Ocean Reef Road, and has a TEC condition category of Poor to Very High. The majority of this TEC patch is located within the Woodvale Nature Reserve outside the DE. Areas of this TEC patch within the Woodvale Nature Reserve are mostly in High to Very High condition.
TP20	9.4	5.97	3.43	No	This patch is located between Whitfords Avenue and Hepburn Avenue. This patch has a TEC condition category of Poor to Moderate. The majority of this patch is located within the DE in a long linear strip adjacent to Mitchell Freeway.

### **Significant weeds**

Seventy-two (72) introduced taxa, including four taxa that are listed as Declared Pests under the Western Australian *Biosecurity and Management Act 2007* and/or Weed of National Significance (WoNS) were recorded during the survey (Astron 2020). Three of the Declared Pests, of which two are also WoNS were recorded from the DE:

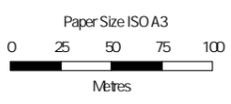
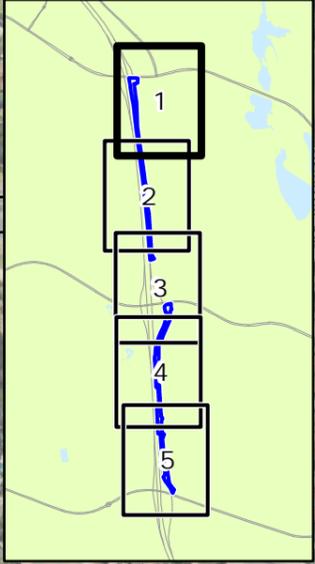
- \**Asparagus asparagoides* (bridal creeper) – Declared Pest and WoNS
- \**Lantana camara* (lantana) – Declared Pest and WoNS
- \**Moraea flaccida* (one-leaf cape tulip) – Declared Pest.

Figure 3 presents the locations of Declared Pests and/or WoNS recorded within the DE.



**Legend**

- Major Roads
- Railway
- ▭ Development Envelope
- EPBC TEC Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain Ecological Community



Paper Size ISO A3  
 Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50



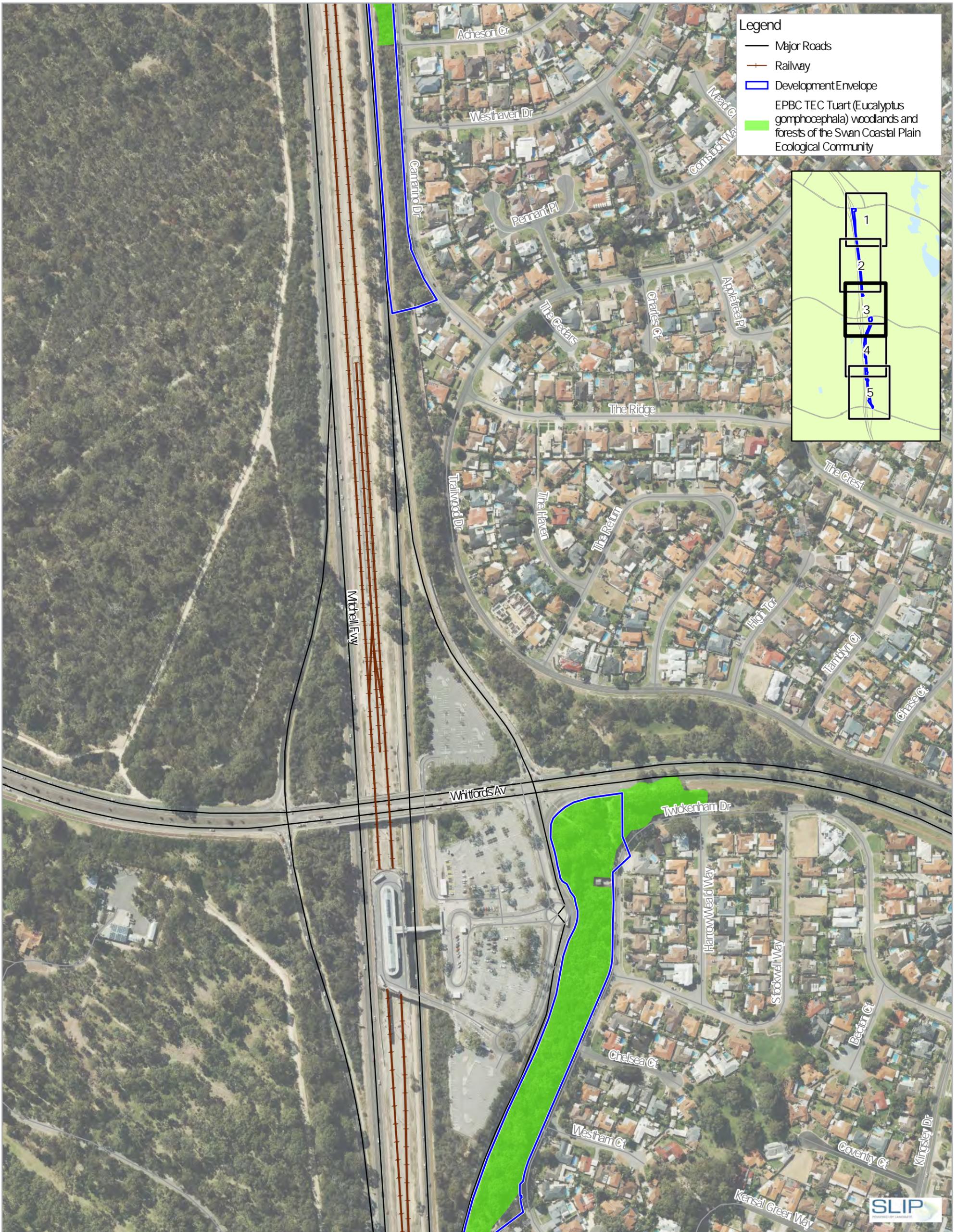
Main Roads Western Australia  
 PC107-16 SR518 Tuart Woodlands  
 TEC Management Plan

Project No. 12546051  
 Revision No. 0  
 Date 16/03/2021

Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC

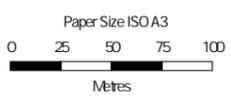
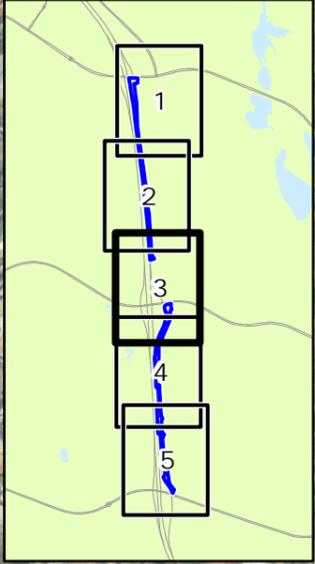
**FIGURE 2**





**Legend**

- Major Roads
- +— Railway
- ▭ Development Envelope
- EPBC TEC Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain Ecological Community



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

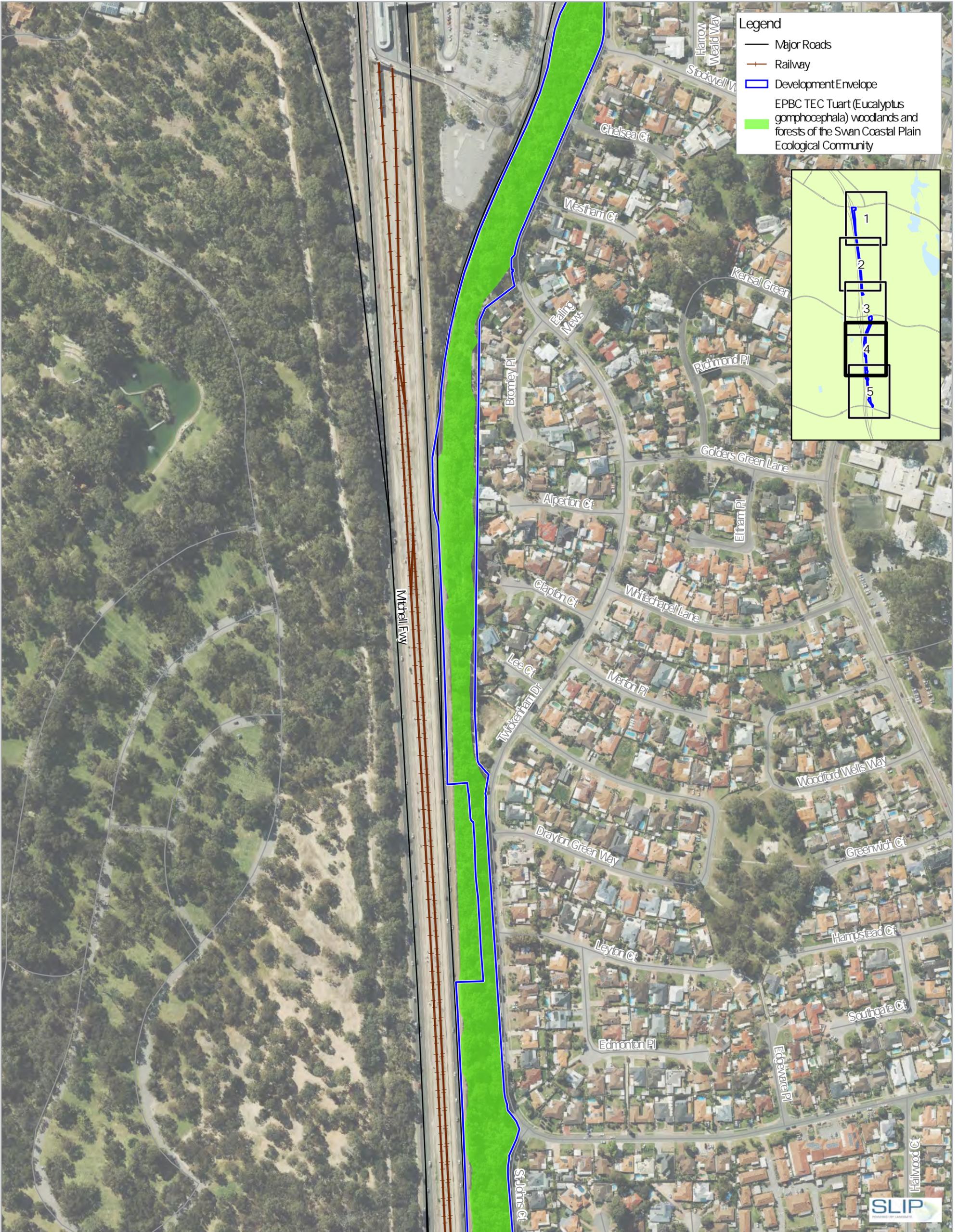


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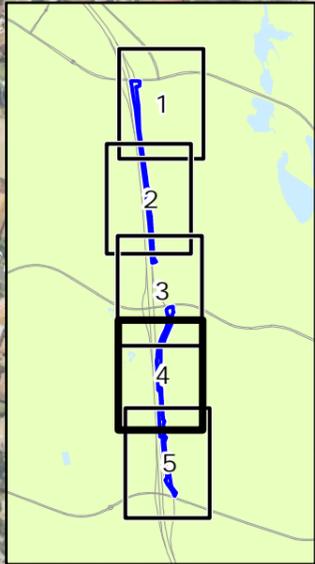
Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC

FIGURE 2



**Legend**

- Major Roads
- Railway
- ▭ Development Envelope
- EPBC TEC Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain Ecological Community



Paper Size ISO A3  
 0 25 50 75 100  
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Map Projection: Transverse Mercator  
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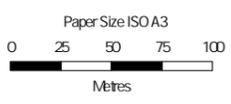
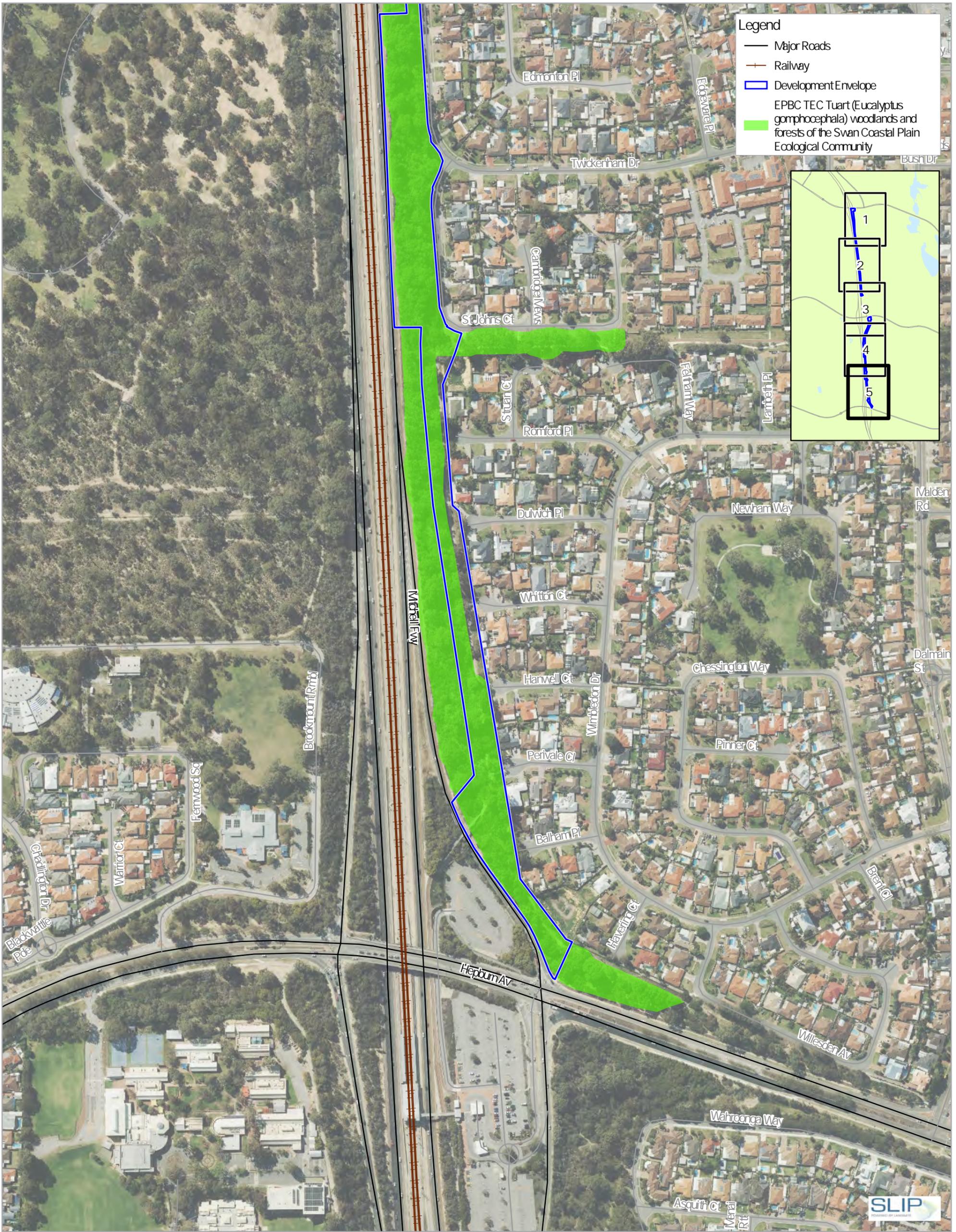


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Tuart (*Eucalyptus gomphocephala*) woodlands  
 and forests of the Swan Coastal Plain TEC

FIGURE 2



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 50

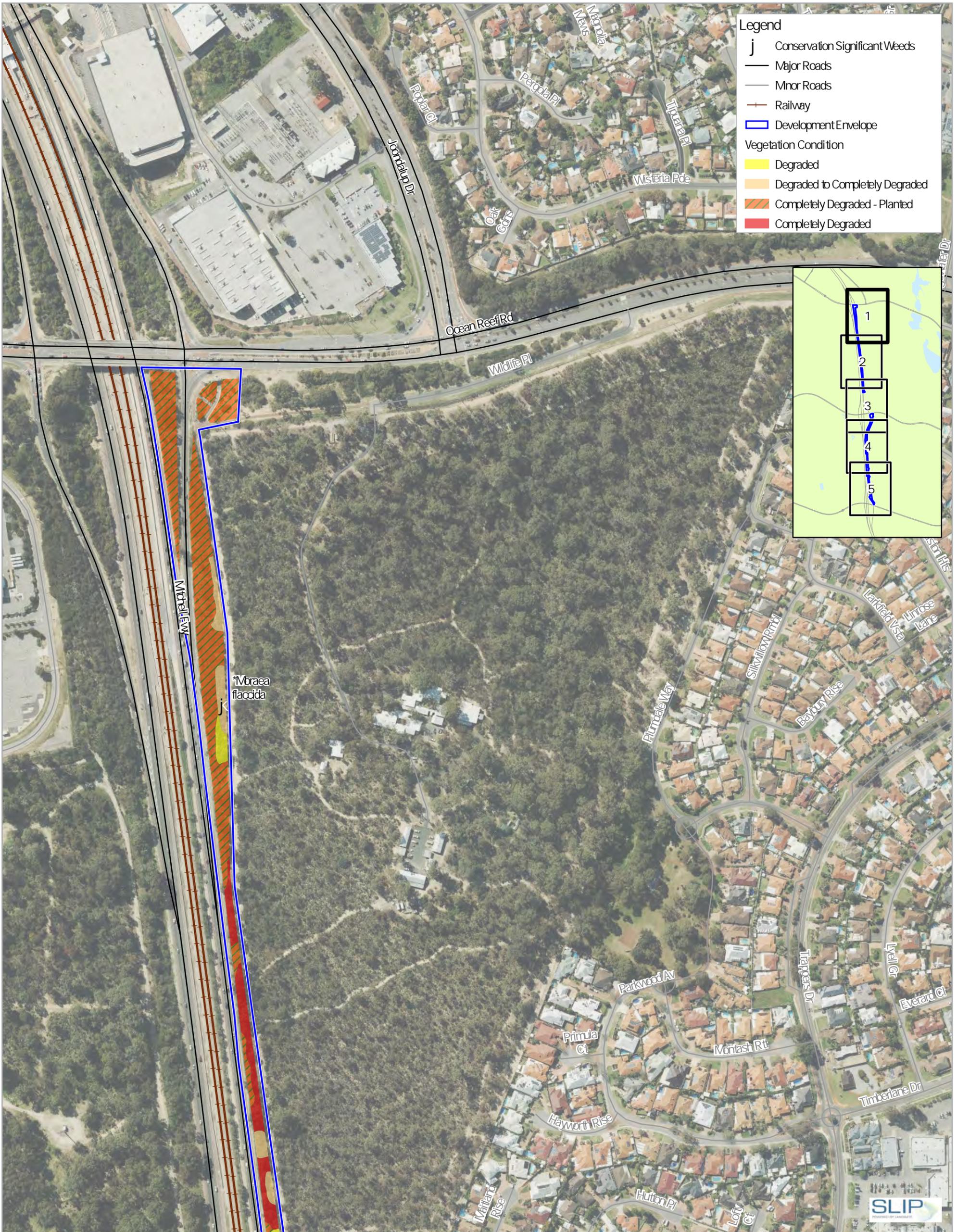


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Tuart (*Eucalyptus gomphocephala*) woodlands  
and forests of the Swan Coastal Plain TEC

FIGURE 2

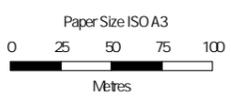
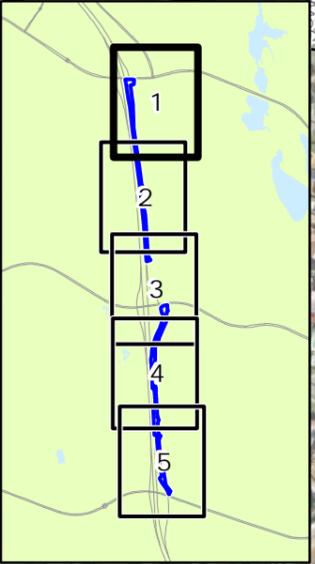


**Legend**

- j** Conservation Significant Weeds
- Major Roads
- Minor Roads
- Railway
- Development Envelope

**Vegetation Condition**

- Degraded
- Degraded to Completely Degraded
- Completely Degraded - Planted
- Completely Degraded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

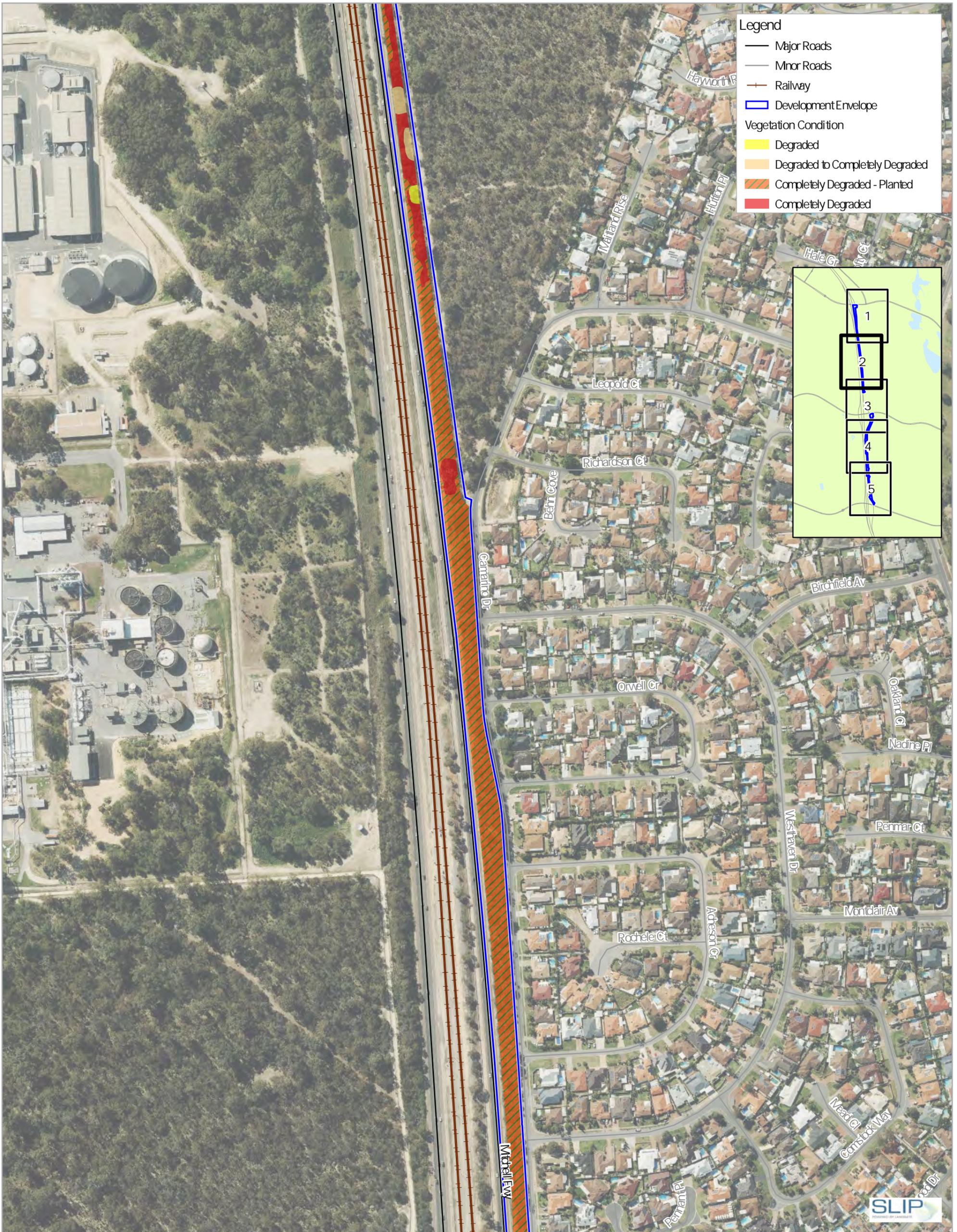


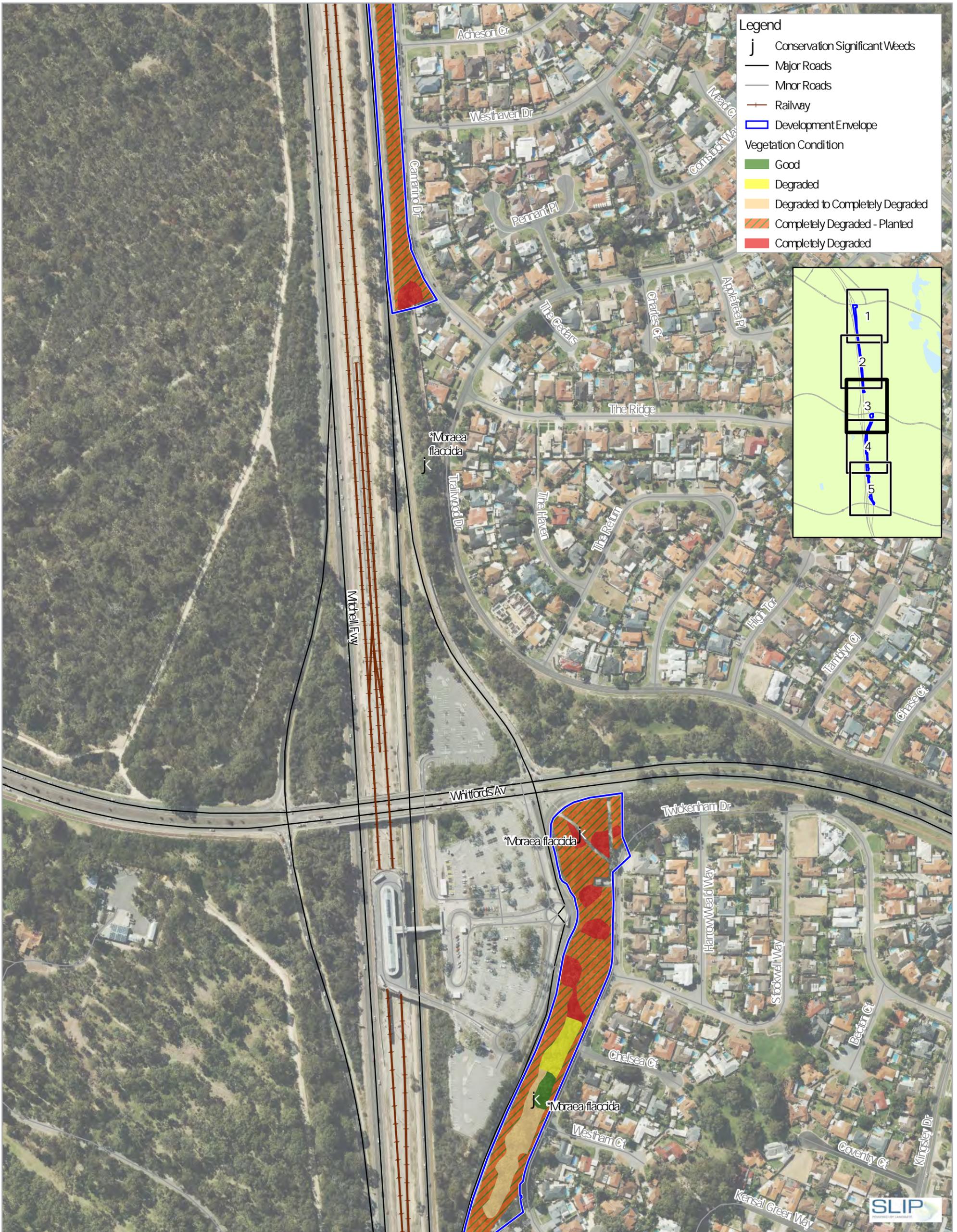
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 TEC Management Plan

**Significant Weeds and  
 Vegetation Condition**

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**FIGURE 3**



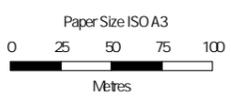
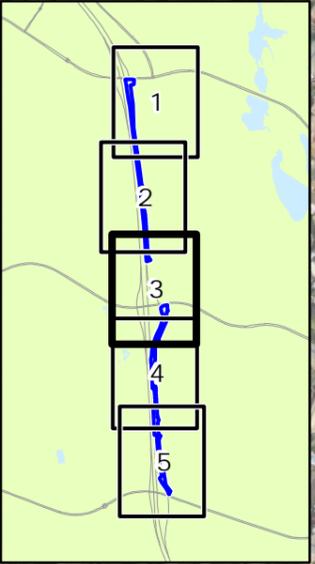


**Legend**

- j Conservation Significant Weeds
- Major Roads
- Minor Roads
- Railway
- Development Envelope

**Vegetation Condition**

- Good
- Degraded
- Degraded to Completely Degraded
- Completely Degraded - Planted
- Completely Degraded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

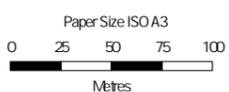
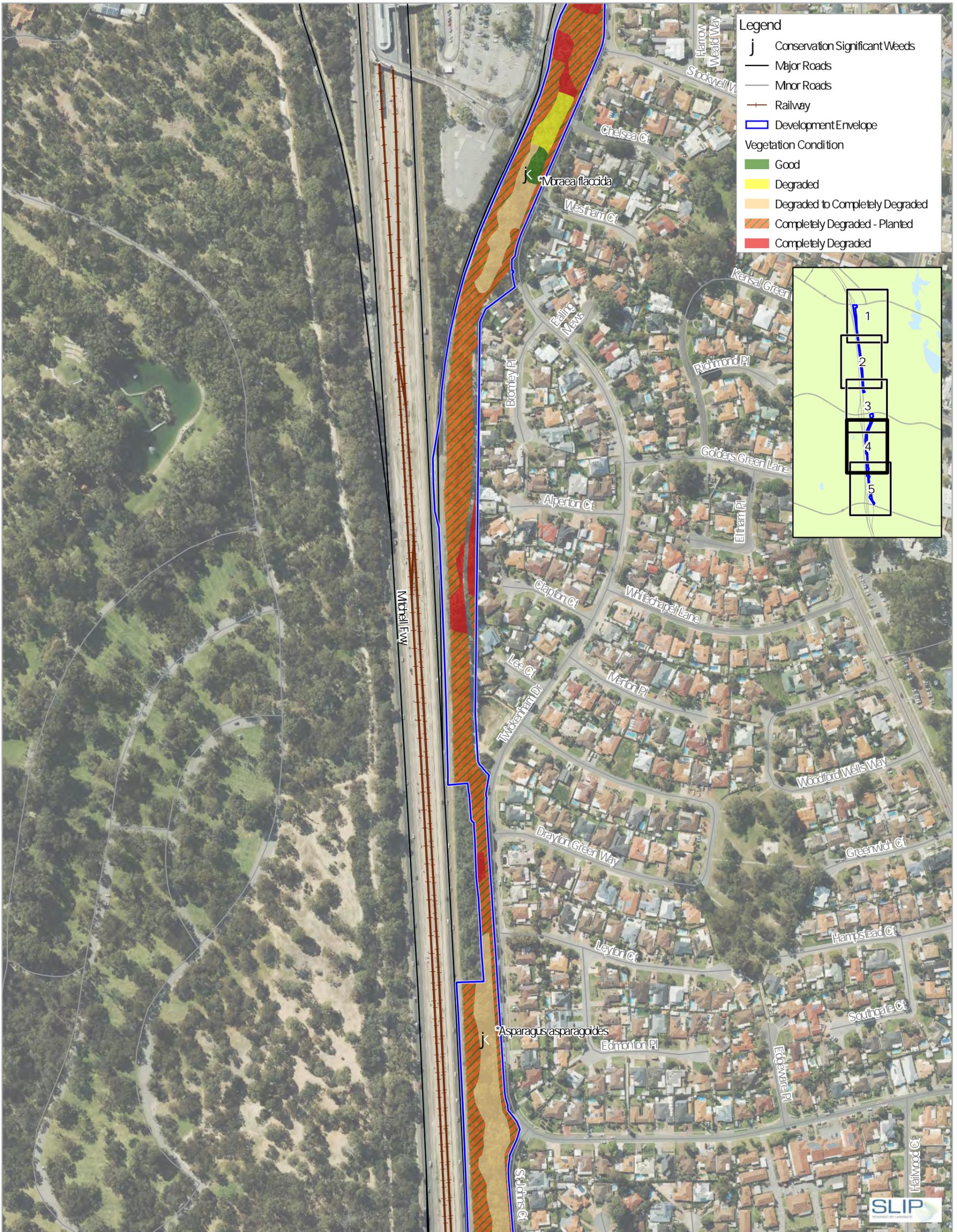


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Significant Weeds and  
 Vegetation Condition

FIGURE 3



Map Projection: Transverse Mercator  
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 Grid: GDA 1994 MGA Zone 50

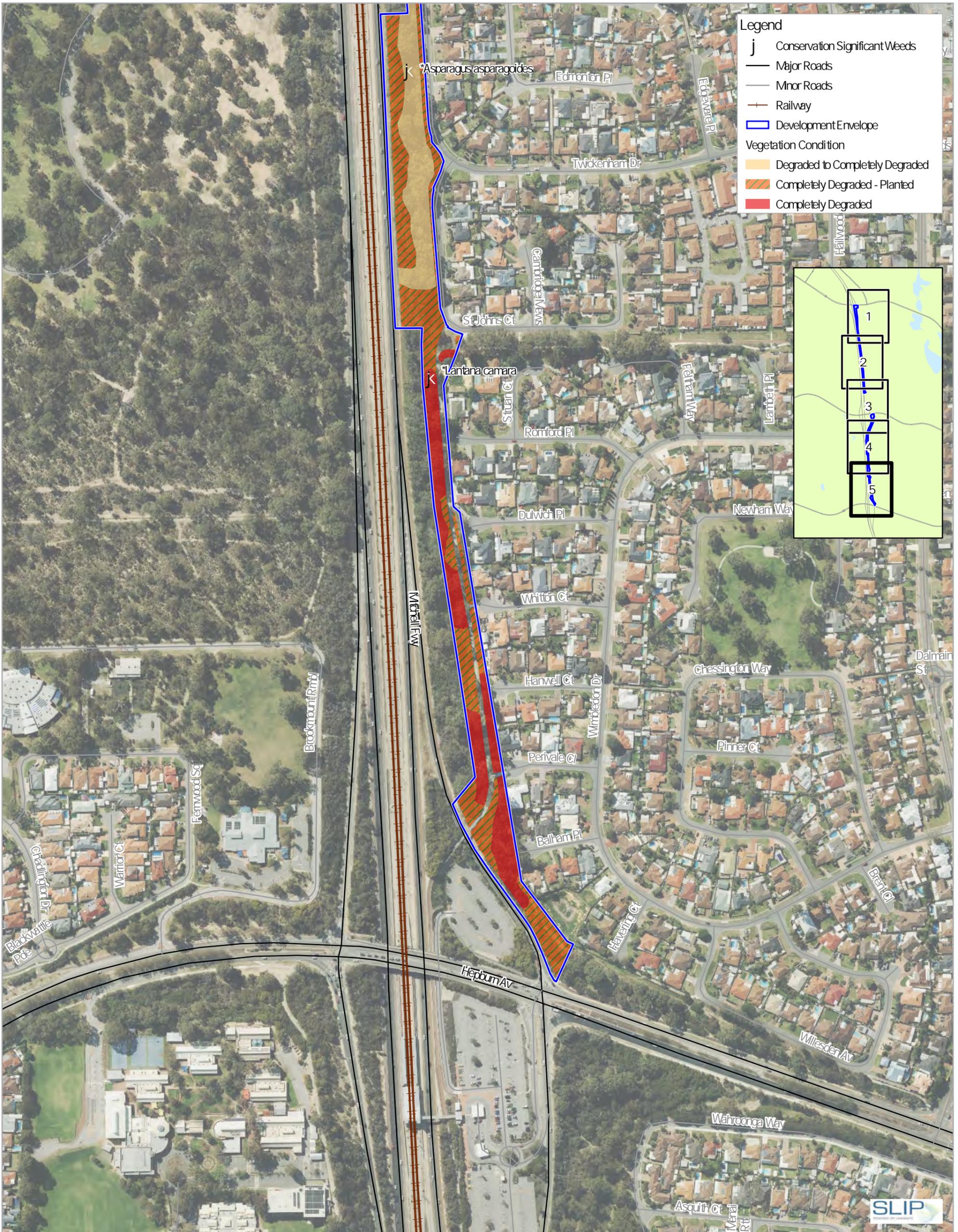


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Significant Weeds and  
 Vegetation Condition

FIGURE 3

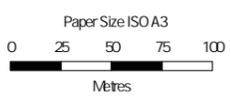
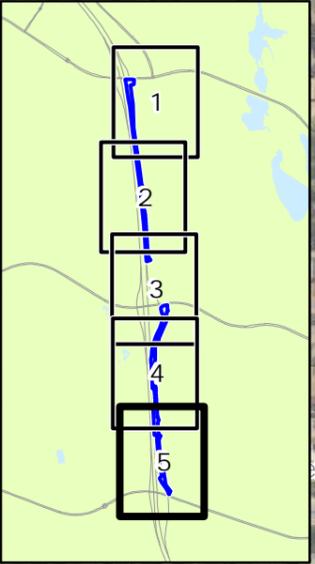


**Legend**

- j Conservation Significant Weeds
- Major Roads
- Minor Roads
- Railway
- Development Envelope

**Vegetation Condition**

- Degraded to Completely Degraded
- Completely Degraded - Planted
- Completely Degraded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
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 Vegetation Condition

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FIGURE 3

### *Phytophthora cinnamomi* dieback

The majority of the 32 ha assessment area was mapped as Excluded primarily due to these areas being Degraded or Completely Degraded in accordance with Keighery (1994) vegetation disturbance scale (Terratree 2020).

Figure 4 presents the dieback mapping for the DE. The DE lacked disease indicator species to enable assessment; however, should be treated as Infested for management purposes due to the long history of disturbance (Terratree 2020). It is important to note Tuart is not susceptible to dieback. *Phytophthora cinnamomi* is therefore unlikely to affect the Tuart component of the Tuart TEC. However, dieback may impact on other native species present within the TEC, reducing the overall diversity and condition.

Main Roads will undertake a dieback assessment in Woodvale Nature Reserve prior to the implementation of the Proposed Action to provide a baseline before vegetation clearing occurs.

#### 2.4.3 Management objectives

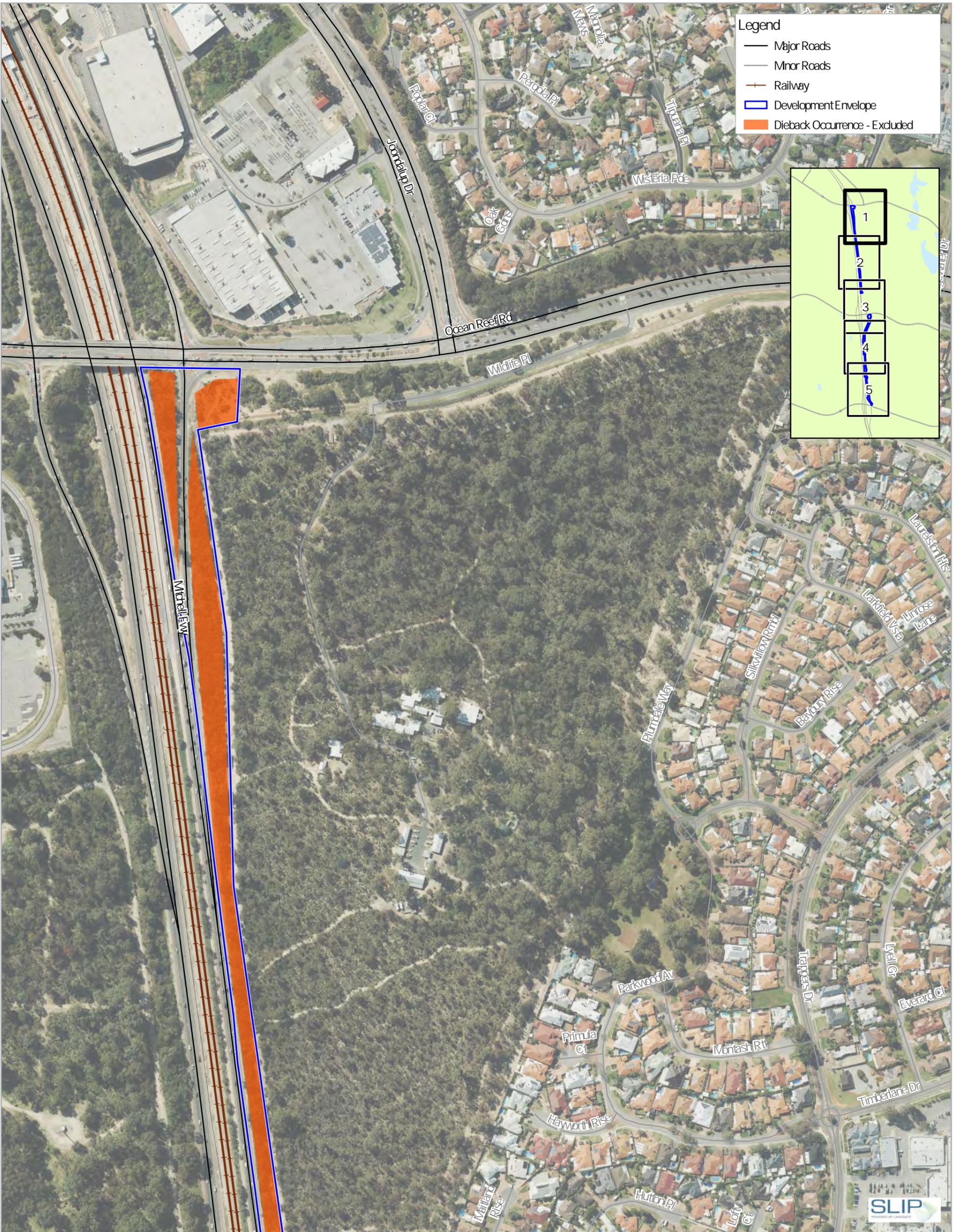
Indirect impacts to the Tuart TEC potentially resulting from implementation of the Proposed Action are expected to be restricted to the introduction and / or spread of weeds and dieback and damage through the accidental generation of a bushfire during construction. Some indirect impacts would be temporary if managed appropriately, while others can be permanent in nature. The introduction and spread of weeds would result in a localised potential impact, but with a possible likelihood of occurrence. This will be managed through implementation of the proposed active management actions in accordance with Main Roads standards, as detailed in Section 5. The consequence of dieback and fire are potentially more significant, with the potential to affect the remaining Tuart TEC patches adjacent to the DE. Main Roads' standard construction practices combined with the management actions detailed in Section 5 will effectively mitigate the potential for these indirect impacts to occur. As such, the potential for dieback and fire to adversely impact retained Tuart TEC are not anticipated to result from Proposal implementation.

This AMP has been prepared with the objective that potential impacts of the Proposed Action to the Tuart TEC are acceptable, minimised and managed. It is a 'management-based' AMP to document actions required during construction and operation of the Proposed Action. Management measures within this AMP are specific to the Proposed Action.

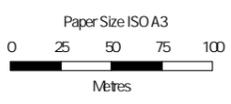
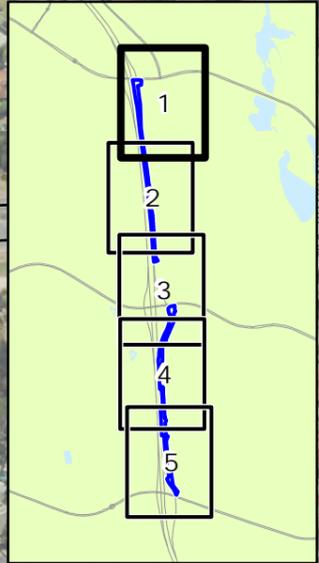
Objectives to manage potential indirect impacts to the Tuart TEC directly adjacent to the DE during construction include:

1. Prevent clearing of Tuart TEC outside the DE
2. Prevent and treat the introduction and/or spread of introduced flora taxa (weeds)
3. Prevent the introduction and/or spread of dieback
4. Prevent illegal rubbish dumping and litter
5. Avoid fire impacts.

Edge effects in ecology are identifiable as any difference in environment between the edge and the interior of a particular vegetation patch (Murcia 1995). Edge effects tend to occur from a combination of inter-related direct and indirect impacts. For the purpose of this AMP, objectives 2 to 5 are considered to cumulatively manage potential impacts to the Tuart TEC adjacent to the DE during construction from edge effects which are a combination of these indirect threats.



- Legend**
- Major Roads
  - Minor Roads
  - Railway
  - ▭ Development Envelope
  - ▭ Dieback Occurrence - Excluded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

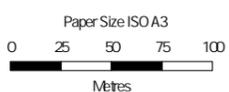
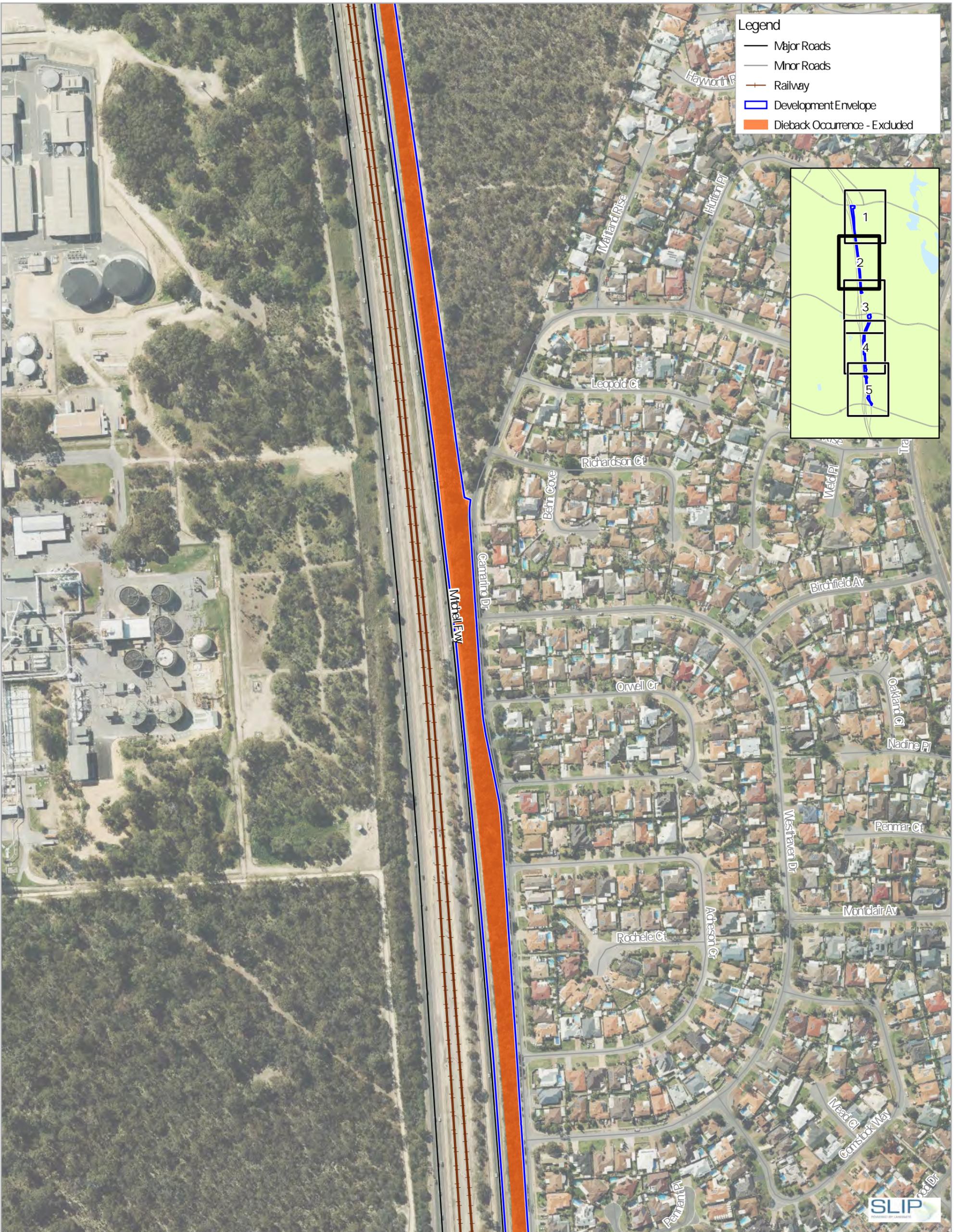


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Phytophthora Dieback Occurrence

FIGURE 4



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 50

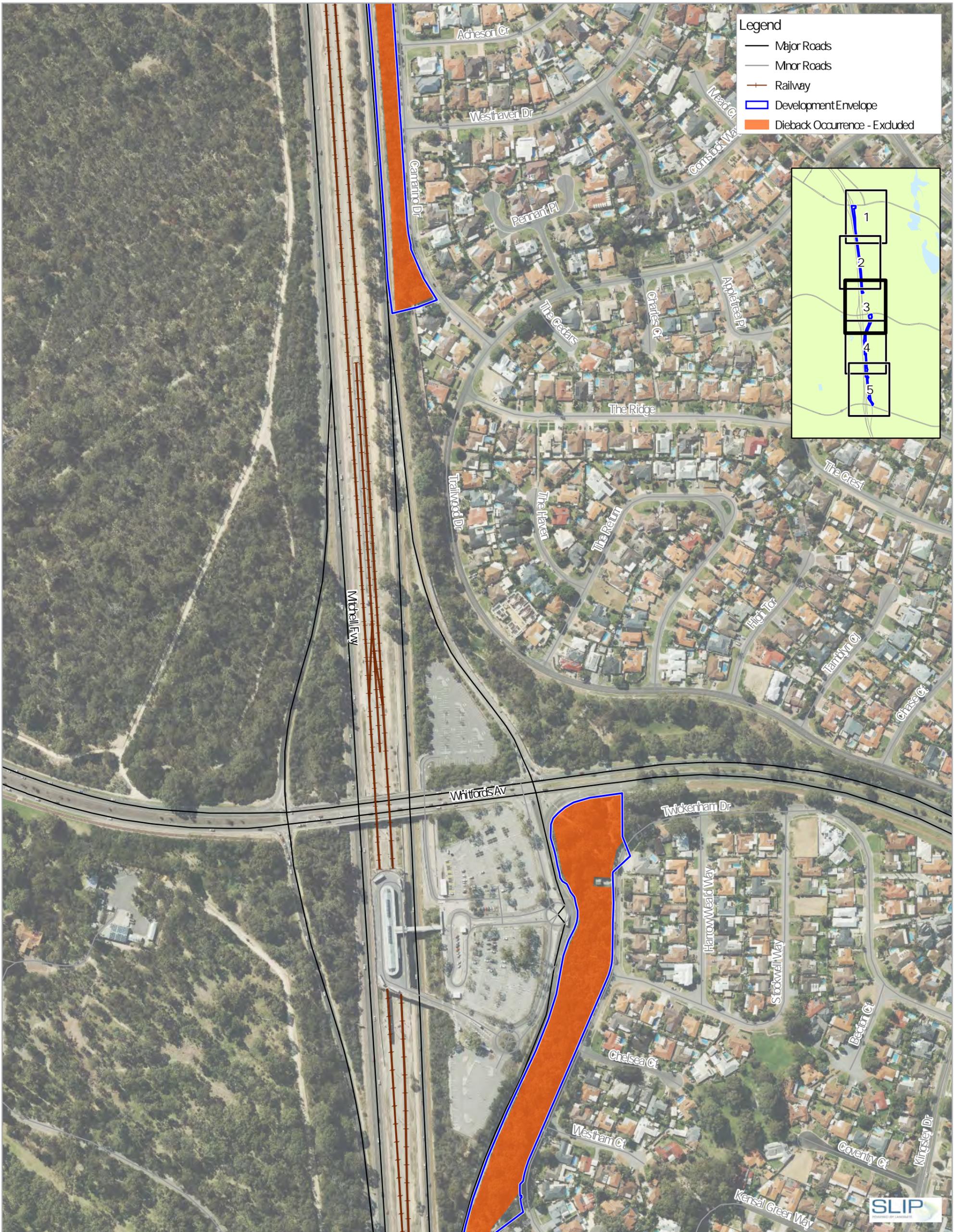


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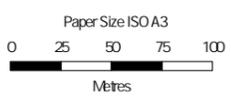
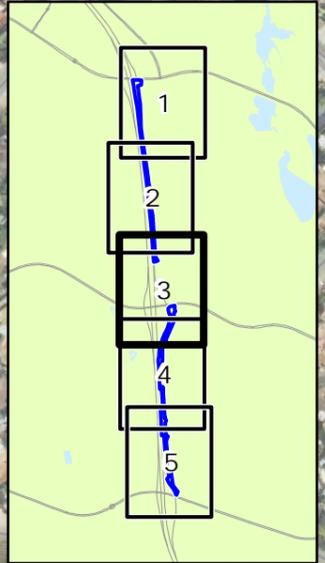
Phythophthora Dieback Occurrence

FIGURE 4



**Legend**

- Major Roads
- Minor Roads
- Railway
- Development Envelope
- Dieback Occurrence - Excluded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
 Grid: GDA 1994 MGA Zone 50

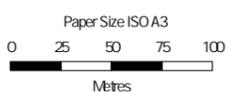


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Phytophthora Dieback Occurrence

FIGURE 4



Map Projection: Transverse Mercator  
Horizontal Datum: GDA 1994  
Grid: GDA 1994 MGA Zone 50

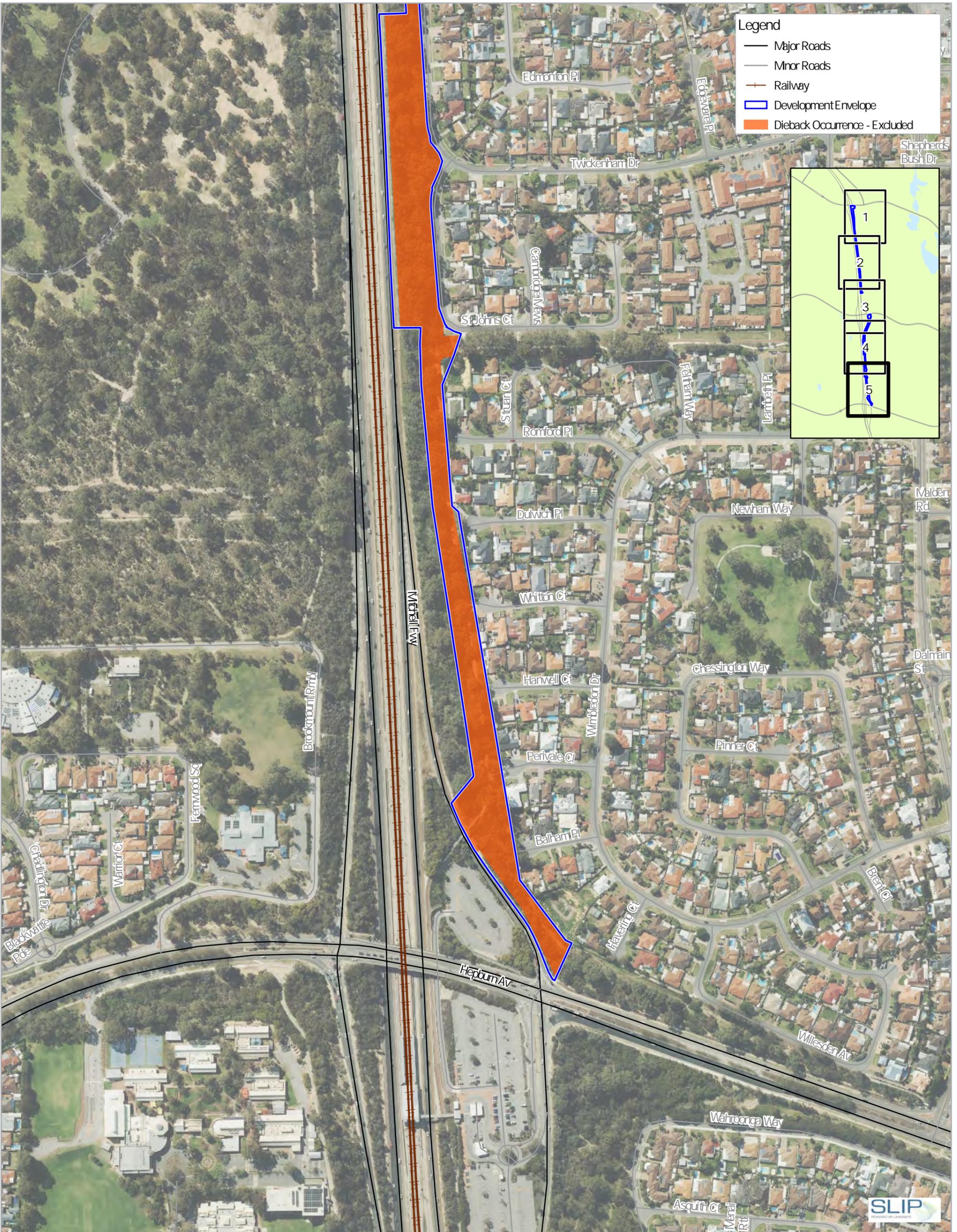


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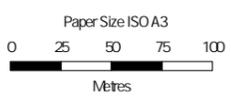
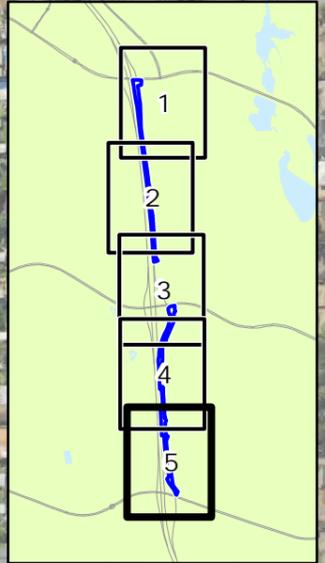
Project No. 12546061  
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Date 16/03/2021

Phythophthora Dieback Occurrence

FIGURE 4



- Legend**
- Major Roads
  - Minor Roads
  - Railway
  - ▭ Development Envelope
  - Dieback Occurrence - Excluded



Map Projection: Transverse Mercator  
 Horizontal Datum: GDA 1994  
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Phytophthora Dieback Occurrence

FIGURE 4

### 3. Performance standards

#### 3.1 SMART performance standards

The DAWE request for additional information (Attachment C) identifies the application of ‘SMART’ (specific, measurable, achievable, relevant and time-bound) performance standards to be applied to AMPs.

SMART performance standards are intended to relate to measurable (numerical) values which can be applied to a Proposal (rather than qualitatively measured management/monitoring actions), and may include measurements such as ‘threshold criteria’, ‘performance indicators’, ‘corrective actions’ and ‘completion criteria’.

Table 2 identifies the SMART performance standards related to the measurable impacts of the Proposed Action. These SMART performance standards complement the management actions and performance targets identified in Table 7, the monitoring actions identified in Table 10, and the corrective actions identified in Table 7.

The ‘threshold criteria’ and ‘completion criteria’ are considered to be achievable, with the risk potential of not achieving the proposed SMART performance standards captured by the risk assessment presented in Table 6.

As the proposed SMART performance standards for ‘threshold criteria’ and ‘completion criteria’ relate to physical measures which can be readily controlled through standard construction management processes, it is considered the proposed SMART performance standards have a low level of uncertainty, with additional margins for safety not required.

The SMART performance standards do not require detailed statistical analysis to determine if the ‘threshold criteria’ and ‘completion criteria’ have been met, nor require statistical power to detect change (for example, seasonal or climatic variability), nor control or reference sites (for comparative purposes).

Table 2 SMART performance standards

Threshold criteria	Performance indicators	Corrective actions	Completion criteria
No clearing of the Tuart TEC outside the DE	Area of Tuart TEC cleared	Refer to Table 7, Section 5	No more than 8.75 ha of Tuart TEC cleared
Evidence of new WoNS or Declared Plants identified in TEC vegetation outside the DE	No new WoNS or Declared Plants identified in TEC vegetation as a result of the Proposed Action		Baseline condition of Tuart TEC vegetation adjacent to the DE is maintained
Evidence of new dieback infestation identified in TEC vegetation outside the DE	No new dieback infestations identified in TEC vegetation as a result of the Proposed Action		
Evidence of rubbish dumping and litter in identified TEC vegetation outside the DE	No new rubbish or litter identified in TEC vegetation as a result of the Proposed Action construction		
Sparks or unplanned fire in the of DE moving into TEC vegetation outside the DE	No unplanned fire as a result of the Proposed Action construction		

## 4. Risk assessment

A risk assessment has been undertaken of the potential impacts identified for the Proposed Action construction and operational phases. The risk assessment adopts likelihood and consequence criteria and a risk matrix presented in Table 3, Table 4 and Table 5, consistent with the AMP Criteria (Attachment C to DAWE request for additional information).

Table 6 presents the risk assessment results, incorporating a summary of mitigation measures to generate a residual risk outcome for each identified risk. Details of mitigation measures including monitoring and corrective actions are presented in the Section 5.

Table 3 Likelihood criteria

Likelihood	Criteria
Highly likely	Is expected to occur during the construction/operation period
Likely	Will probably occur during the construction/operation period
Possible	Might occur during the construction/operation period
Unlikely	Could occur during construction/operation but considered unlikely or doubtful
Rare	May occur in exceptional circumstances

Table 4 Consequence criteria

Consequence	Criteria
Minor	Minor environmental impact that can be reversed
Moderate	Isolated but substantial environmental impact that could be reversed with intensive efforts
High	Substantial environmental impact that could be reversed with intensive efforts
Major	Major loss of environmental value and real danger of continuing
Critical	Severe widespread loss of environmental value and irrecoverable environmental damage

Table 5 Risk ranking matrix

Likelihood	Consequence				
	Minor	Moderate	High	Major	Critical
Highly likely	Medium	High	High	Severe	Severe
Likely	Low	Medium	High	High	Severe
Possible	Low	Medium	Medium	High	Severe
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

Table 6 Risk assessment of Proposed Action to Tuart TEC

Management objective	Impact	Cause	Level of uncertainty	Summary of mitigation	Residual risk		
					Likelihood	Consequence	Risk rating
Prevent clearing of Tuart TEC outside the DE.	Clearing exceeding 8.75 ha of Tuart TEC.	Unauthorised clearing of vegetation, which represents the Tuart TEC outside of DE.	<ul style="list-style-type: none"> <li>The nature of potential impact is known and predictable based on surveys in land adjacent to the DE, undertaken in accordance with EPA and Commonwealth guidance</li> <li>The scale of potential impacts is unpredictable as it relates to unauthorised clearing, however should it occur, it is only likely to be isolated and of a much smaller scale than authorised clearing.</li> </ul>	<ul style="list-style-type: none"> <li>The final design will be assessed against the DE to ensure the required clearing area is no more than the approved area</li> <li>Site induction will include vegetation (including Tuart TEC) clearing requirements and procedures</li> <li>A ground disturbance permit process will be developed by the Contractor and signed off by the Main Roads Superintendent or delegate</li> <li>Tuart TEC not required to be cleared will be marked and identified as no-go areas, demarcated on relevant drawings and provided to the Construction Contractor Representative</li> <li>Vegetation to be retained will be clearly marked with flagging on site</li> <li>Additional areas required for construction such as laydown areas, stockpile areas and vehicle turn around, will be located in areas cleared for permanent works or areas that do not contain Tuart TEC</li> <li>Clearing will be avoided for any temporary construction activities.</li> </ul>	Unlikely	Moderate	Low
Prevent and treat the introduction and/or spread of Declared Plants and WoNS in the Tuart TEC adjacent to the DE during construction works.	Indirect impacts to condition of Tuart TEC adjacent to the DE through introduction and/or spread of weeds.	<p>Construction plant, equipment and soil movement introducing or spreading weeds.</p> <p>Unauthorised site access introducing or spreading weeds.</p>	<ul style="list-style-type: none"> <li>The nature of potential impact is known and predictable based on identified weed infested areas and vulnerable vegetation in surveys undertaken in the DE and adjacent land</li> <li>The scale of potential impacts is likely to occur at a localised scale, which may progressively spread from the DE boundary into adjacent Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>Site induction will include information on Declared Plants and WoNS identification and reporting requirements</li> <li>Declared Plants within the DE will be treated prior to clearing according to their Control Codes and advice from Department of Primary Industries and Regional Development (DPIRD), with the aim of eradication where possible but as a minimum prevent off site movement</li> <li>WoNS within the DE will be treated prior to clearing according to the weed control management outlined by Weeds Australia (<a href="http://weeds.ala.org.au/">http://weeds.ala.org.au/</a>) with the aim of controlling off-site movement</li> <li>Topsoil containing Declared Pests or WoNS will not be reused in landscaping or revegetation</li> <li>All heavy plant and machinery will be inspected by the contractor prior to entry at the work site and be confirmed to be clean and free of vegetation and soil material</li> <li>Movement of machines and other vehicles will be restricted to the limits of the areas cleared with the DE or on designated tracks outside the DE.</li> </ul>	Possible	Minor	Low
Prevent the introduction and/or spread of dieback in the Tuart TEC adjacent to the DE during construction work.	Indirect impacts to condition of Tuart TEC adjacent to the DE through introduction and/or spread of dieback.	<p>Construction plant, equipment and soil movement introducing or spreading dieback.</p> <p>Unauthorised site access introducing or</p>	<ul style="list-style-type: none"> <li>The nature of potential impact is known and predictable based on identified dieback infested areas and vegetation in surveys undertaken in the DE and adjacent land</li> <li>The scale of potential impacts is unpredictable as it relates to dieback which may progressively spread from the DE boundary into adjacent vegetation, including the Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>Site induction will include information on dieback management requirements</li> <li>The entire DE will be assumed Infested and managed in accordance with DBCA Management Guidelines (CALM 2003) including the establishment of a Clean on Entry/Exit (CoE) points</li> <li>Construction site drainage will be directed away from adjacent Tuart TEC.</li> </ul>	Unlikely	Moderate	Low

Management objective	Impact	Cause	Level of uncertainty	Summary of mitigation	Residual risk		
					Likelihood	Consequence	Risk rating
		spreading dieback.		<ul style="list-style-type: none"> <li>• Movement of machines and other vehicles will be restricted to the limits of the areas cleared within the DE or on designated tracks outside the DE.</li> </ul>			
Prevent illegal rubbish dumping and litter in the Tuart TEC adjacent to the DE during construction work.	Indirect impacts to condition of Tuart TEC adjacent to the DE through presence of rubbish and litter.	Poor waste management practices by contractor during construction.	<ul style="list-style-type: none"> <li>• The nature of potential impact is known and predictable based on the type of material required during construction</li> <li>• The scale of potential impacts is likely to occur at a localised scale, as the DE is within a thin strip of vegetation between the Mitchell Freeway and residential areas. Rubbish and litter is unlikely to spread from dumped areas into adjacent Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>• Site induction will include information on waste management</li> <li>• Construction wastes will be appropriately stored and handled to minimise discharge, spills or leaks</li> <li>• All construction wastes will be disposed off-site at an appropriately licensed waste facility.</li> </ul>	Unlikely	Minor	Low
Avoid fire impacting the Tuart TEC adjacent to the DE during construction work.	Loss of Tuart TEC from fire.	Unplanned fire from an ignition source associated with the construction of the Proposed Action.	<ul style="list-style-type: none"> <li>• The nature of potential impact is known and predictable based the type of construction activities required and the location of the DE in relation to adjacent vegetation</li> <li>• The scale of potential impacts is unpredictable as it relates to an unplanned incident, with the potential to quickly spread beyond the DE boundary into adjacent vegetation, including the Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>• Site induction will include information on hot works requirements</li> <li>• Movement of machines and other vehicles will be restricted to the limits of the areas cleared with the DE or on designated tracks outside the DE</li> <li>• Hot work (e.g. grinding, welding) will be undertaken in accordance with Contractor's hot work procedure</li> <li>• Compliance with Department of Fire and Emergency Services and Local Government Authority restrictions to reduce fire risks (e.g. restricted vehicle movements and hot works)</li> <li>• Vehicles and large plant/equipment will be fitted with fire extinguishers and restricted to designated cleared areas unless involved in clearing operations.</li> </ul>	Unlikely	Moderate	Low

## 5. **Environmental management actions**

In order to comply with relevant environmental legislation and manage impacts to the local environment, Main Roads has defined objectives, outcomes and management based provisions to ensure that impacts to Tuart TEC are avoided and minimised as far as practicable during the implementation of the Proposed Action (Table 7).

Table 7 Management measures to mitigate impacts to Tuart TEC

Management objective	Management measures	Performance target/Completion criteria	Timing	Monitoring/Reporting activity	Corrective action Trigger(s)	Corrective action	Corrective action responsibility
Prevent clearing of Tuart TEC outside the DE.	The final design will be assessed against the DE to ensure the required clearing area is no more than the approved area.	Detailed drawings limit clearing of Tuart TEC to 8.75 ha and show environmental no-go areas.	During design phase	Detailed design drawings limit clearing of Tuart TEC to 8.75 ha and show environmental no-go areas.	Detailed design will clear more than 8.75 ha of Tuart TEC	Design reviewed and corrected	Main Roads Superintendent
	Site induction will include vegetation (including Tuart TEC) clearing requirements and procedures.	Induction material contains vegetation (including Tuart TEC) clearing requirements and procedures.	Prior to staff/contractors commencing on site.	<ul style="list-style-type: none"> <li>Environmental audits.</li> </ul>	Induction material does not contain information on management requirements and/or procedures.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Induction material revised.</li> </ul>	Construction Contractor Environmental Management Representative
	A ground disturbance permit process will be developed by the Contractor and signed off by the Main Roads Superintendent or delegate.	Project ground disturbance permit process developed and approved by Main Roads.	Prior to commencement of clearing.	<ul style="list-style-type: none"> <li>Contract correspondence</li> <li>Environmental audits.</li> </ul>	Non conformance with ground disturbance permit process.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Review induction procedure.</li> </ul>	<ul style="list-style-type: none"> <li>Construction Contractor Environmental Management Representative</li> <li>Main Roads Superintendent</li> </ul>
	Tuart TEC not required to be cleared will be marked and identified as no-go areas, demarcated on relevant drawings and provided to the Construction Contractor Representative.	Drawings showing environmental no-go areas provided to the Construction Contractor Representative.	Prior to commencement of clearing.	<ul style="list-style-type: none"> <li>Record of provision of drawings showing environmental no-go areas.</li> <li>Incident reporting</li> <li>Monthly site inspections</li> <li>Site inspection by Construction Contractor Environmental Management Representative prior to and following clearing to confirm no-go areas are appropriately flagged / demarcated, and that clearing remains within limits.</li> </ul>	Clearing more than 8.75 ha of Tuart TEC.	<ul style="list-style-type: none"> <li>Clearing in the direct vicinity will cease immediately if trigger is met. Clearing will not recommence until no-go areas have been reviewed and confirmed to be in place correctly, and Main Roads Superintendent provides approval to recommence</li> <li>Environmental incident will be recorded and the cause investigated</li> <li>Incident will be reported to DAWE along with the cause identified from an investigation</li> <li>Incorrectly cleared areas outside of the DE will be assessed for potential remediation (in consultation with DAWE). Areas for remediation will be included in the Landscape and Revegetation Plan</li> <li>Refresher or updated training will be conducted (if appropriate).</li> </ul>	<ul style="list-style-type: none"> <li>Construction Contractor Environmental Management Representative</li> <li>Main Roads Superintendent.</li> </ul>
	Vegetation to be retained will be clearly marked with flagging on site.	All vegetation to be retained will be marked with flagging on site.					
	Clearing will be avoided for temporary construction activities. Areas required for construction such as laydown areas, stockpile areas and vehicle turn around, will be located in existing cleared areas or areas cleared for permanent works or areas that do not contain Tuart TEC.	Areas for ancillary services located in existing cleared areas or areas cleared for permanent works.	During construction	<ul style="list-style-type: none"> <li>Construction site plan showing all ancillary areas not located on land containing Tuart TEC outside of areas to be cleared for permanent works</li> <li>Monthly site inspections.</li> </ul>	Areas required for construction such as laydown areas etc are located on land containing Tuart TEC outside of the areas cleared for permanent works.		
Prevent and treat the introduction and/or spread of Declared Plants and WoNS in the Tuart TEC	Site induction will include information on Declared Plants and WoNS	Induction material contains information on Declared Plants and WoNS	Prior to staff/contractors commencing on site.	<ul style="list-style-type: none"> <li>Environmental audits.</li> </ul>	Induction material does not contain information on management requirements and/or procedures.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> </ul>	Construction Contractor Environmental Management Representative

Management objective	Management measures	Performance target/Completion criteria	Timing	Monitoring/Reporting activity	Corrective action Trigger(s)	Corrective action	Corrective action responsibility
adjacent to the DE during construction works.	identification and reporting requirements.	identification and reporting requirements.				<ul style="list-style-type: none"> <li>• Induction material revised.</li> </ul>	
	Declared Plants within the DE will be treated prior to clearing according to their Control Codes and advice from DPIRD, with the aim of eradication where possible but as a minimum prevent off site movement.	No new occurrence or spread of Declared Plants within the construction site boundary or immediately adjacent areas during construction activities.	During construction.	<ul style="list-style-type: none"> <li>• Monthly site inspections</li> <li>• Weed survey at completion of construction works.</li> </ul>	Evidence of new Declared Plants identified in TEC vegetation.	<ul style="list-style-type: none"> <li>• Application of weed eradication techniques for the weed species</li> <li>• Review CoE process.</li> </ul>	Construction Contractor Environmental Management Representative
	WoNS within the DE will be treated prior to clearing according to the weed control management outlined by Weeds Australia ( <a href="http://weeds.ala.org.au/">http://weeds.ala.org.au/</a> ) with the aim of controlling off-site movement.	No new occurrence or spread of WoNS through construction activities.			Evidence of new WoNS identified in TEC vegetation.		
	Topsoil containing Declared Pests or WoNS will not be reused in landscaping or revegetation.	All topsoil from Declared Pest or WoNS infested areas to be buried at a depth of at least 300 mm or disposed off-site at a landfill.	During construction.	Records of topsoil segregation and burial or licensed waste facilities.	Topsoil from infested areas used in landscaping or revegetation.	<ul style="list-style-type: none"> <li>• Topsoil removed from landscaping/revegetation areas and replaced with clean topsoil</li> <li>• Infested topsoil buried at depth of at least 300 mm or disposed at a licensed waste facility.</li> </ul>	
	All heavy plant and machinery will be inspected by the contractor prior to entry at the work site and be confirmed to be clean and free of vegetation and soil material.	All plant and machinery will be verified clean on arrival at site.	All construction activities.	Records verifying plant and machinery arriving on site is clean.	Plant and machinery arriving on site without verification that it is clean of soil and vegetative matter.	<ul style="list-style-type: none"> <li>• Refresher training will be conducted</li> <li>• Plant and machinery sent off site and cleaned prior to re-entry to site.</li> </ul>	
	Movement of machines and other vehicles will be restricted to the limits of the areas cleared with the DE or on designated tracks outside the DE.	No evidence of unauthorised vehicle access.	All construction activities.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Monthly site inspections.</li> </ul>	Evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>• Environmental incident will be recorded and the cause investigated</li> <li>• Review induction procedure</li> </ul>	
Prevent the introduction and/or spread of dieback in the Tuart TEC adjacent to the DE during construction work.	Site induction will include information on dieback management requirements.	Induction material contains information on dieback management requirements.	Prior to staff/contractors commencing on site.	<ul style="list-style-type: none"> <li>• Environmental audits.</li> </ul>	Induction material does not contain information on management requirements and/or procedures.	<ul style="list-style-type: none"> <li>• Environmental incident will be recorded and the cause investigated</li> <li>• Induction material revised.</li> </ul>	
	<ul style="list-style-type: none"> <li>• The entire DE will be assumed Infested and managed in accordance with DBCA Management Guidelines (CALM 2003) including the establishment of CoE points</li> </ul>	<ul style="list-style-type: none"> <li>• CoE points established and signposted</li> <li>• Temporary construction drainage established.</li> </ul>	All construction activities	<ul style="list-style-type: none"> <li>• Site inspection by Construction Contractor Environmental Management Representative to confirm CoE points established and signposted</li> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• No CoE points established or signposted</li> <li>• Construction site drainage discharging into adjacent Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental incident will be recorded and the cause investigated</li> <li>• Potentially infested areas arising from access or drainage will be sampled for Phytophthora</li> <li>• Phosphite will be applied to dieback susceptible</li> </ul>	Construction Contractor Environmental Management Representative

Management objective	Management measures	Performance target/Completion criteria	Timing	Monitoring/Reporting activity	Corrective action Trigger(s)	Corrective action	Corrective action responsibility
	<ul style="list-style-type: none"> <li>Construction site drainage will be directed away from adjacent Tuart TEC.</li> </ul>					<ul style="list-style-type: none"> <li>species within 30 m of potentially infested areas, in accordance with DBCA guidance.</li> <li>Review CoE process.</li> <li>Refresher or updated training will be conducted (if appropriate).</li> </ul>	
	Movement of machines and other vehicles will be restricted to the limits of the areas cleared within the DE or on designated tracks outside the DE.	No evidence of unauthorised vehicle access.	All construction activities.	<ul style="list-style-type: none"> <li>Visual inspection opportunistically</li> <li>Monthly site inspections.</li> </ul>	Evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Review induction procedure</li> </ul>	<ul style="list-style-type: none"> <li>Construction Contractor Environmental Management Representative</li> </ul>
Prevent illegal rubbish dumping and litter in the Tuart TEC adjacent to the DE during construction work.	Site induction will include information on waste management.	Induction material contains information on waste management.	Prior to staff/contractors commencing on site.	<ul style="list-style-type: none"> <li>Environmental audits.</li> </ul>	Induction material does not contain information on management requirements and/or procedures.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Induction material revised.</li> </ul>	Construction Contractor Environmental Management Representative
	Construction wastes will be appropriately stored and handled to minimise discharge, spills or leaks.	No evidence of discharges, spills or leaks from construction wastes.	All construction activities.	<ul style="list-style-type: none"> <li>Visual inspection opportunistically</li> <li>Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>Evidence of discharge, spill or leak of construction wastes into adjacent Tuart TEC.</li> </ul>	<ul style="list-style-type: none"> <li>Investigate cause and raise an incident report</li> <li>Implement waste clean-up / CEMP</li> </ul>	Construction Contractor Environmental Management Representative
	All construction wastes will be disposed off-site at an appropriately licensed waste facility	No evidence of illegal rubbish or dumping.	At conclusion of construction activities.	<ul style="list-style-type: none"> <li>Visual inspection at completion of construction works</li> <li>Waste disposal records.</li> </ul>	Evidence of construction wastes identified in TEC vegetation.	<ul style="list-style-type: none"> <li>Investigate cause and raise an incident report</li> <li>Implement waste clean-up / CEMP</li> </ul>	Construction Contractor Environmental Management Representative
Avoid fire impacting the Tuart TEC adjacent to the DE during construction work.	Site induction will include information on hot works requirements.	Induction material contains information on hot works requirements.	Prior to staff/contractors commencing on site.	<ul style="list-style-type: none"> <li>Environmental audits.</li> </ul>	Induction material does not contain information on management requirements and/or procedures.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Induction material revised.</li> </ul>	Construction Contractor Environmental Management Representative
	Movement of machines and other vehicles will be restricted to the limits of the areas cleared within the DE or on designated tracks outside the DE.	No evidence of unauthorised vehicle access.	All construction activities.	<ul style="list-style-type: none"> <li>Visual inspection opportunistically</li> <li>Monthly site inspections.</li> </ul>	Evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>Environmental incident will be recorded and the cause investigated</li> <li>Review induction procedure</li> </ul>	Construction Contractor Environmental Management Representative
	Hot work (e.g. grinding, welding) will be undertaken in accordance with Contractor's hot work procedure.	No fires started as a result of hot works.	All construction activities.	<ul style="list-style-type: none"> <li>Visual inspection opportunistically</li> <li>Hot work procedure records.</li> </ul>	Ignition / fire started as a result of hot works.	<ul style="list-style-type: none"> <li>Implement emergency evacuation and response plans</li> <li>Investigate cause and raise an incident report</li> <li>Review management procedures</li> </ul>	<ul style="list-style-type: none"> <li>Construction Contractor Environmental Management Representative</li> <li>Main Roads Superintendent.</li> </ul>
	Compliance with Department of Fire and Emergency Services (DFES) and Local Government Authority (LGA) restrictions to reduce fire risks (e.g. restricted vehicle	No fires started as a result of DFES or LGA restricted activities.	All construction activities.	<ul style="list-style-type: none"> <li>DFES and LGA fire restriction notices</li> <li>Restricted activity notification records.</li> </ul>	Ignition / fire started as a result of DFES or LGA restricted activities.	<ul style="list-style-type: none"> <li>Implement emergency evacuation and response plans</li> <li>Investigate cause and raise an incident report</li> <li>Review management procedures</li> </ul>	<ul style="list-style-type: none"> <li>Construction Contractor Environmental Management Representative</li> <li>Main Roads Superintendent.</li> </ul>

Management objective	Management measures	Performance target/Completion criteria	Timing	Monitoring/Reporting activity	Corrective action Trigger(s)	Corrective action	Corrective action responsibility
	movements and hot works).						
	Vehicles and large plant/equipment will be fitted with fire extinguishers and restricted to designated cleared areas unless involved in clearing operations.	<ul style="list-style-type: none"> <li>• Vehicles and large plant/equipment fitted with fire extinguisher</li> <li>• No fires started as a result of construction vehicles or equipment.</li> </ul>	All construction activities.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Vehicle inspection.</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicles and large plant/equipment not fitted with fire extinguisher</li> <li>• Evidence of unauthorised vehicle access</li> <li>• Ignition / fire started as a result of construction vehicles or equipment.</li> </ul>	<ul style="list-style-type: none"> <li>• Environmental non-conformance will be recorded in incident register and the cause investigated</li> <li>• Review induction procedure</li> <li>• Implement emergency evacuation and response plans (where there is an ignition/fire)</li> <li>• Review management procedures.</li> </ul>	<ul style="list-style-type: none"> <li>• Construction Contractor Environmental Management Representative</li> <li>• Main Roads Superintendent.</li> </ul>

## 6. Adaptive management

This AMP adopts an ‘adaptive management’ approach which seeks to embed a cycle of monitoring, reporting and implementing change, where required. Accordingly, it is intended that this AMP may be updated (as required) over the life of the Proposed Action to reflect changes in monitoring and management practices, subject to the results of the monitoring to identify that the environmental objectives are being achieved. The AMP may also be revised to address learnings from the implementation of corrective actions, should this occur.

In addition, auditing and review schedules are necessary to embed a formal process to identify and consider any need to update the AMP in order to achieve improved environmental performance (which may not otherwise be triggered by management or monitoring outcomes).

### 6.1 Environmental auditing

This AMP will be audited annually by Main Roads during construction of the Proposed Action to ensure the implementation of the management and monitoring measures, and to confirm the management measures specified are achieving the environmental outcomes.

The proposed auditing schedule for this AMP is identified in Table 8.

Table 8 Environmental audit schedule

Timing	Action	Schedule
Pre-construction	Review of construction procedures to ensure AMP management / monitoring actions are incorporated within works procedures	Prior to construction (single event)
Construction	Inspections by site environmental personnel to identify compliance with AMP	Periodic (monthly)
	Annual audit for assessment of compliance with AMP	Annually (once per calendar year)

The results of the construction and post construction independent ‘third-party’ audit findings will be reported to DAWE as part of annual compliance reporting as outlined within Section 8.

### 6.2 Management review program

Main Roads proposes to review this AMP on an as required basis in order to consider:

- Management and monitoring actions
- Opportunities for improvement in environmental performance (for example, changes to construction methodology or timing)
- Identify a need to update this AMP to capture changes to the management and/or monitoring actions
- Identify any general need to update this AMP (for example, to capture new information on relevant MNES knowledge or management, or updates to the EPBC Act or Policy Statements).

Main Roads acknowledge that a revision to this AMP may trigger a need for additional approval by DAWE prior to implementing any changes to the specified management or monitoring actions.

The proposed AMP review schedule for the Proposed Action is identified in Table 9. The proposed review will be undertaken by a suitably qualified ecologist or relevant expert.

Table 9 AMP Review schedule

Timing	Action	Schedule
<ul style="list-style-type: none"> <li>• Detailed design</li> <li>• Pre-construction</li> <li>• Construction.</li> </ul>	<ul style="list-style-type: none"> <li>• Review of AMP management and monitoring actions</li> <li>• Review of opportunities for an improvement in environmental performance</li> <li>• Address learnings from corrective actions</li> <li>• Revise AMP (if appropriate) and seek approval of DAWE for revised AMP.</li> </ul>	<p>As required, or when:</p> <ul style="list-style-type: none"> <li>• Non-compliance with AMP detected</li> <li>• Material changes to the risk ratings for the hazards identified in the risk assessment for the Proposed Action.</li> </ul>

## 7. Monitoring program and data management

### 7.1 Monitoring program

Key actions and processes have been identified to monitor the potential impacts of the Proposed Action to Tuart TEC during the detailed design and all construction activities. Monitoring will be undertaken by suitably qualified individuals for the methodology type specified. The proposed monitoring program for the Proposed Action is identified in Table 10.

### 7.2 Data management

Main Roads will maintain records on the implementation of this AMP in accordance with Main Roads' corporate standard document control procedures. The retention of records held by Main Roads will be maintained and managed in accordance with the *State Records Act 2000* (WA).

### 7.3 Baseline data

Appendix A presents baseline data relevant to the Tuart TEC (including Tuart TEC extent and condition), developed from on-ground surveys, namely:

- Figure 2 Tuart (*Eucalyptus gomphocephala*) woodlands and forests of the Swan Coastal Plain TEC
- Figure 3 Significant weeds and vegetation condition
- Figure 4 *Phytophthora* dieback occurrence.

Table 10 Proposed monitoring program

Management Objective / Desired Outcome	Performance Target/Completion Criteria	Monitoring/Reporting Activity	Monitoring Method	Monitoring Area	Frequency
Prevent clearing of Tuart TEC outside the DE.	Detailed drawings limit clearing of Tuart TEC to 8.75 ha and show environmental no-go areas.	Detailed design drawings limit clearing of Tuart TEC to 8.75 ha and show environmental no-go areas.	Spatial analysis of drawings.	n/a	Whenever the detailed design is revised.
	Induction material contains vegetation (including Tuart TEC) clearing requirements and procedures.	<ul style="list-style-type: none"> <li>• Environmental audits.</li> </ul>	Review induction material.	n/a	<ul style="list-style-type: none"> <li>• Prior to construction (single event)</li> <li>• Annually.</li> </ul>
	Project ground disturbance permit process developed and approved by Main Roads.	<ul style="list-style-type: none"> <li>• Contract correspondence</li> <li>• Environmental audits.</li> </ul>	<ul style="list-style-type: none"> <li>• Review of written records</li> <li>• Ground disturbance permit evidence.</li> </ul>	n/a	Once, prior to commencement of clearing.
	Drawings showing environmental no-go areas provided to the Construction Contractor Representative.	Record of provision of drawings showing environmental no-go areas.	Review of written records.	n/a	Once, prior to commencement of clearing.
	All vegetation to be retained will be marked with flagging on site.	<ul style="list-style-type: none"> <li>• Incident reporting</li> <li>• Monthly site inspections</li> <li>• Site inspection by Construction Contractor Environmental Management Representative prior to and following clearing to confirm</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection of flagging / demarcation</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	Environmental no-go areas.	<ul style="list-style-type: none"> <li>• Prior to commencement of clearing</li> <li>• Monthly.</li> </ul>

Management Objective / Desired Outcome	Performance Target/Completion Criteria	Monitoring/Reporting Activity	Monitoring Method	Monitoring Area	Frequency
		no-go areas are appropriately flagged / demarcated, and that clearing remains within limits.			
	Areas for ancillary services located in existing cleared areas or areas cleared for permanent works.	<ul style="list-style-type: none"> <li>• Construction site plan showing all ancillary areas not located on land containing Tuart TEC outside of areas to be cleared for permanent works</li> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Written record</li> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	<ul style="list-style-type: none"> <li>• n/a</li> <li>• Ancillary service areas.</li> </ul>	<ul style="list-style-type: none"> <li>• Prior to development of ancillary areas</li> <li>• Monthly.</li> </ul>
Prevent and treat the introduction and/or spread of Declared Plants and WoNS in the Tuart TEC adjacent to the DE during construction works.	Induction material contains information on Declared Plants and WoNS identification and reporting requirements.	<ul style="list-style-type: none"> <li>• Induction records</li> <li>• Environmental audits.</li> </ul>	Review induction material.	n/a	<ul style="list-style-type: none"> <li>• Prior to construction (single event)</li> <li>• Annually.</li> </ul>
	No new occurrence or spread of Declared Plants or WoNS within the construction site boundary or immediately adjacent areas during construction activities.	<ul style="list-style-type: none"> <li>• Monthly site inspections</li> <li>• Weed survey at completion of construction works.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	<ul style="list-style-type: none"> <li>• Construction site area</li> <li>• Construction site boundary.</li> </ul>	<ul style="list-style-type: none"> <li>• Monthly</li> <li>• At completion of construction works.</li> </ul>
	All topsoil from Declared Pest or WoNS infested areas to be buried at a depth of at least 300 mm or	Records of topsoil segregation and burial or licensed waste facilities.	Review of written records.	n/a	Monthly.

Management Objective / Desired Outcome	Performance Target/Completion Criteria	Monitoring/Reporting Activity	Monitoring Method	Monitoring Area	Frequency
	disposed off-site at a landfill.				
	All plant and machinery will be verified clean on arrival at site.	Records verifying plant and machinery arriving on site is clean.	Review of written records.	n/a	When plant and machinery arrive at site.
	No evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	DE site and immediate surrounds.	Monthly.
Prevent the introduction and/or spread of dieback in the Tuart TEC adjacent to the DE during construction work.	Induction material contains information on dieback management requirements.	<ul style="list-style-type: none"> <li>• Induction records</li> <li>• Environmental audits.</li> </ul>	Review induction material.	n/a	<ul style="list-style-type: none"> <li>• Prior to construction (single event)</li> <li>• Annually.</li> </ul>
	CoE points established and signposted.	<ul style="list-style-type: none"> <li>• Site inspection by Construction Contractor Environmental Management Representative to confirm CoE points established and signposted.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	CoE points.	<ul style="list-style-type: none"> <li>• Prior to commencement of clearing</li> <li>• Monthly.</li> </ul>
	Temporary construction drainage established.	Monthly site inspections	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	Temporary drainage area(s).	Monthly
	No evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> </ul>	DE site and immediate surrounds.	Monthly.

Management Objective / Desired Outcome	Performance Target/Completion Criteria	Monitoring/Reporting Activity	Monitoring Method	Monitoring Area	Frequency
		<ul style="list-style-type: none"> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Photographic record, GPS of non-conformance.</li> </ul>		
Prevent illegal rubbish dumping and litter in the Tuart TEC adjacent to the DE during construction work	Induction material contains information on waste management.	<ul style="list-style-type: none"> <li>• Induction records</li> <li>• Environmental audits.</li> </ul>	Review induction material.	n/a	<ul style="list-style-type: none"> <li>• Prior to construction (single event)</li> <li>• Annually.</li> </ul>
	No evidence of spills or leaks from construction wastes.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	DE site and immediate surrounds.	Monthly.
	No evidence of illegal rubbish or dumping.	<ul style="list-style-type: none"> <li>• Visual inspection at completion of construction works</li> <li>• Waste disposal records.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Review of written records.</li> </ul>	DE site and immediate surrounds.	At conclusion of construction works.
Avoid fire impacting the Tuart TEC adjacent to the DE during construction work.	Induction material contains information on hot works requirements.	<ul style="list-style-type: none"> <li>• Induction records</li> <li>• Environmental audits.</li> </ul>	Review induction material.	n/a	<ul style="list-style-type: none"> <li>• Prior to construction (single event)</li> <li>• Annually.</li> </ul>
	No evidence of unauthorised vehicle access.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Monthly site inspections.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Photographic record, GPS of non-conformance.</li> </ul>	DE site and immediate surrounds.	Monthly.
	No fires started as a result of hot works.	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Hot work procedure records.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Review of written records.</li> </ul>	n/a	Monthly.
	No fires started as a result of DFES or LGA restricted activities.	<ul style="list-style-type: none"> <li>• DFES and LGA fire restriction notices</li> <li>• Restricted activity notification records.</li> </ul>	Review of written records.	n/a	Monthly.

Management Objective / Desired Outcome	Performance Target/Completion Criteria	Monitoring/Reporting Activity	Monitoring Method	Monitoring Area	Frequency
	Vehicles and large plant/equipment fitted with fire extinguisher	<ul style="list-style-type: none"> <li>• Visual inspection opportunistically</li> <li>• Vehicle inspection.</li> </ul>	<ul style="list-style-type: none"> <li>• Visual inspection</li> <li>• Review of written records.</li> </ul>	n/a	Monthly.

## 8. Reporting

Main Roads will report to DAWE on the implementation of this AMP as part of annual compliance reporting under the conditions of approval for the Proposed Action.

Where compliance audits undertaken by Main Roads identify the environmental management actions and/or the environmental objectives are not being achieved (i.e. non-compliance or an environmental incident), Main Roads will notify DAWE in accordance with the EPBC approval condition requirements. Consistent with standard document control procedures, Main Roads will maintain copies of all reports submitted to DAWE. The reporting requirements for this AMP are identified in Table 11.

Table 11 Reporting requirements

Aspect	Report from	Report to	Reporting Frequency
Implementation of AMP.	Main Roads Manager Environment	DAWE	Annually (as part of annual compliance reporting).
Non-compliance with AMP or Environmental Incident that adversely impacts the Tuart TEC.	Main Roads Manager Environment	DAWE	In accordance with EPBC approval timeframes.

The format and content of annual reporting will be in accordance with the requirements of the annual reporting conditions. The format and content of reporting of a non-compliance event or an environmental incident will be subject to the nature of the non-compliance/incident and will include all requested information from DAWE.

## 9. **Roles and responsibilities**

This AMP identifies the environmental management of activities to be undertaken by Main Roads in implementation of the Proposed Action. Main Roads acknowledges the environmental management actions contained within this AMP are legal requirements to be met.

The Manager Environment at Main Roads will maintain responsibility for implementation of the management actions outlined within this AMP, on behalf of Main Roads' Managing Director. Management actions may be undertaken by employees and/or contractors of Main Roads on behalf of Managing Director.

Where management actions are undertaken by employees and/or contractors of Main Roads, these will be communicated and documented to the relevant personnel through relevant environmental training and contract documentation (where relevant).

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# Appendix I. Offset Strategy



**mainroads**  
WESTERN AUSTRALIA

# EPBC 2020/8833 Offset Strategy

*We're working for  
Western Australia.*

**Mitchell Freeway Principal Shared  
Path Gaps Project (Ocean Reef  
Road to Hepburn Avenue)**

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# Amendments

Report Compilation & Review	Name and Position	Document Revision	Date
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Author:	A. Dalton	Rev B	15/02/2021
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Author:	A. Dalton	Rev C	22/03/2021
Author:	A. Dalton	Rev D	12/04/2021
Author:	C. Bennison	Rev E	28/05/2021

# 1 INTRODUCTION

## 1.1 Proposal background

Main Roads Western Australia (Main Roads) proposes to install a Principal Shared Path (PSP) and noise walls along the eastern side of the Mitchell Freeway at various sections between Ocean Reef Road and Hepburn Avenue, in the northern suburbs of Perth, Western Australia (Proposal). The Proposed Action occurs within a 13.68 ha Development Envelope (DE) fully within the road reserve.

The Proposal includes:

- The installation of a new continuous PSP along the eastern side of the Mitchell Freeway, including the upgrading of existing PSPs to current design standards.
- The construction of noise walls to mitigate freeway noise on nearby residential areas, stretching from Hepburn Avenue to Ocean Reef Road.
- Verge side emergency stopping bays.
- The modification of freeway on-ramps to accommodate Intelligent Transport Systems (ITS) works.
- Drainage works on the Mitchell Freeway.

The Proposal involves the construction of a continuous PSP along Mitchell Freeway between Ocean Reef Road and Hepburn Avenue in order to improve the efficiency of the Perth bicycle network with the aim to increase the uptake of cycling as a method of commuting. Noise walls will also be constructed in order to improve the amenity of the adjacent residential properties as there is currently no noise mitigation from the traffic noise of the Mitchell Freeway. Works will also include the upgrade of Ocean Reef Road and Whitfords Avenue on-ramps to the Mitchell Freeway and the construction of new emergency stopping bays, which is required to improve the safe and efficient use of the freeway. These works are required to improve the safety and efficient use of this route.

## 1.2 Purpose of this strategy

Environmental offsets are conservation actions that provide environmental benefits intended to counterbalance the significant residual environmental impacts associated with a proposal (GoWA, 2014). Main Roads intend to counterbalance the residual impact of the Proposed Action through implementation of an environmental offset. The offset strategy has been prepared in accordance with the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Environmental Offset Policy (DSEWPaC 2012). The offset will be proportionate to the level of impact and significance of the environmental impact.

Main Roads operates on a hierarchy of avoid, minimise, reduce, rehabilitate and offset environmental impacts. This hierarchy is achieved primarily through changes in scope and design, development and implementation of avoidance and mitigation measures and finally, an offset proposal.

## 1.3 Proposed action location

The Proposed Action is located along Mitchell Freeway between Ocean Reef Road and Hepburn Avenue, in the northern suburbs of Perth, Western Australia (Figure 1). The Proposed Action area is 13.68 ha in size, with 3.02 ha of native vegetation.

## 1.4 Residual impact

Residual impacts associated with the Proposed Action have been determined through application of the significant impact guidelines 1.1 (DEWHA 2013). Residual impacts to Black Cockatoos and Tuart TEC for which Main Roads proposes environmental offsets are detailed in Table 1-1. Whilst Main Roads does not usually provide an offset for indirect impacts, in this instance up to 3.41 ha of indirect impacts to the Tuart TEC have been included as a residual impact noting that one patch will no longer be considered Tuart TEC following implementation of the Proposed Action.

**Table 1-1 Residual environmental impacts requiring offset**

ENVIRONMENTAL ATTRIBUTE	RESIDUAL IMPACT
Black Cockatoo (Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo habitat)	3.02 ha and 177 Suitable DBH Trees (DBH >500mm) with two trees containing Suitable Hollows
Tuart TEC	12.16 ha (8.75 ha direct impact and 3.41 ha indirect impact)

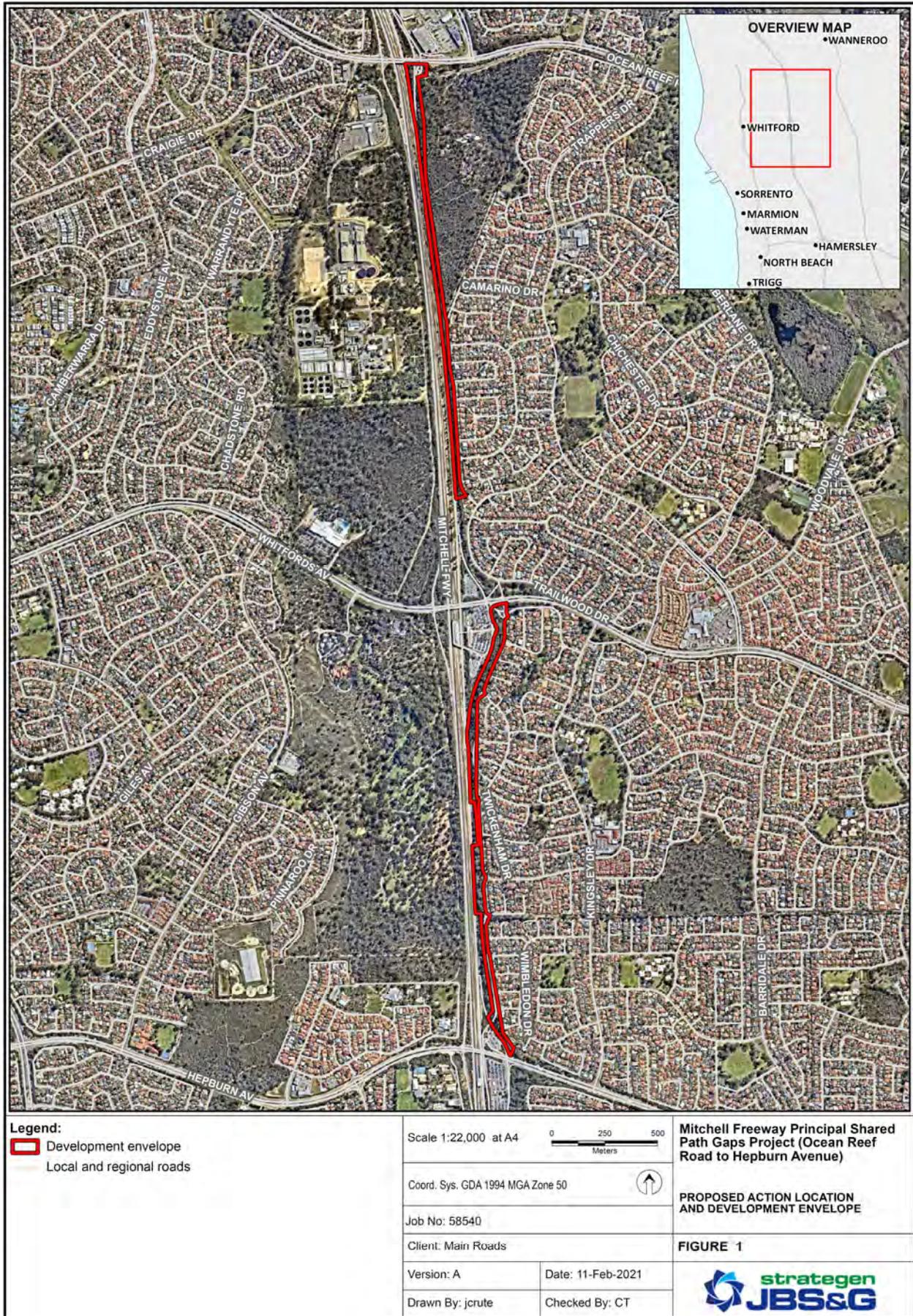


Figure 1. Proposed Action Location

## 2 PROPOSED OFFSET STRATEGY

Main Roads has pursued a number of options in developing a package of offsets to counterbalance residual impacts. The options investigated have comprised acquisition of land and the installation of artificial Black Cockatoo breeding hollows. The proposed offset site will address the requirement for more than one offset attribute, including provision of Tuart TEC and habitat for Black Cockatoos.

Table 2-1 provides an overview of the offset package under consideration, with the offset property location (Offset 1) presented in

**Table 2-1 Overview of proposed offset package**

NO.	OFFSET TYPE	OFFSET SUMMARY	PROPERTY LOCATION	EXISTING TENURE
1	Land Acquisition	31.9 ha of existing native vegetation providing: <ul style="list-style-type: none"> <li>• Tuart TEC</li> <li>• Black Cockatoo habitat</li> </ul>	Preston Beach Road, Lake Clifton	DBCA managed freehold land owned by the State of WA
2	Installation of Artificial Hollows	Six artificial hollows providing nesting habitat for Black Cockatoos	To be determined in consultation with DBCA	TBD

### 2.1 Offset guide inputs and justification

The EPBC offset calculator tool was used to evaluate impacts from the Proposed Action to MNES. Appendix A provides a summary of the calculations used to offset impacts to Tuart TEC and Black Cockatoos and the offset calculator inputs are provided in Appendix B. The offsets calculation has determined that 28 ha of land is required to offset the residual impacts from the Proposed Action to Tuart TEC.

## 2.2 Description of offsets

### Offset 1 – Lake Clifton Property Acquisition

The primary offset for the Proposed Action relates to mitigating the significant residual impacts to the Tuart TEC and Black Cockatoo Habitat. The offsets calculation has determined that 29 ha of land is required to offset the residual impacts from the Proposed Action.

For the purposes of providing an offset for the Proposed Action, a portion of previously acquired land within a 1000 ha property located on Preston Beach Road, Lake Clifton (Lake Clifton site) will be used to offset impacts from the Proposed Action (Figure 2). This land parcel has already been transferred to the Department of Biodiversity, Conservation and Attractions (DBCA), with DBCA now responsible for ongoing land management. Not all of the land within the Lake Clifton site has been utilised as an offset, with approximately 380 ha banked for future offsets. Main Roads proposes to use 31.9 ha of vegetation within the Lake Clifton site (Proposed offset area) to offset impacts from the Proposed Action for impacts to MNES. The approximate cost for the land purchase of the Proposed offset area was \$353,800 with \$18,700 paid to DBCA for ongoing land management, as per DBCA's *Corporate Guideline No. 14 - Environmental Offsets – Proponent Land Management Contributions* (DBCA 2015).

The AECOM (2016) assessment mapped seven vegetation communities within the proposed offset area (Table 2-2). Most of the proposed offset site comprises vegetation community EgXpTd, which is characterised by *Eucalyptus gomphocephala*, *Agonis flexuosa* and *Banksia attenuata* tall open forest. The AECOM (2020) survey confirmed the 31.9 ha of vegetation within the proposed offset site is representative of the Tuart TEC.

Vegetation condition ranged from Excellent to Completely Degraded based on the Keighery (1994) scale (AECOM, 2016). Vegetation was mostly in Excellent (11.96 ha; 37.5%) or Very Good (14.21 ha; 44.6%) condition. The remaining vegetation was in Good (5.68 ha; 17.8%) or Completely Degraded (0.02 ha; 0.07%) condition. AECOM (2020) determined this patch of Tuart TEC has High condition according to Tuart Woodlands conservation advice (DoEE, 2019).

The proposed offset site also contains foraging habitat suitable for Black Cockatoos (Table 2-3). 27.9 ha of the proposed offset site is representative Carnaby's Cockatoo foraging habitat. The quality of foraging habitat ranges from Low to High, however, most of the proposed offset site represented High quality or Valued foraging habitat. FRTBC habitat comprised 1.2 ha of vegetation community MsTDm, which contained up to 10% of *Hakea* species, a foraging species for FRTBC (Johnstone 2011).

The proposed offset site contains 22.4 ha of potential breeding habitat suitable for Black Cockatoos (Table 2-4). The quality of potential breeding habitat ranged from Low to High. The majority of breeding habitat was characterised by vegetation community EgXpTd and comprised High Quality potential breeding habitat. AECOM (2016) estimated that Black Cockatoo habitat in the Lake Clifton survey area comprised up to 3,900 suitable DBH trees (Table 2-4). Based on the amount of habitat present, approximately 700 suitable DBH trees would occur in the proposed offset area. AECOM (2016) also noted that there is a confirmed Carnaby's Cockatoo breeding site approximately 3 km to east of the Lake Clifton site.

**Table 2-2 Vegetation Communities in the Proposed Offset Site (AECOM, 2016)**

Vegetation Community .	Description	Area in Proposed Offset Site (ha)
<b>EgXpTd</b>	<i>Eucalyptus gomphocephala</i> , <i>Agonis flexuosa</i> and <i>Banksia attenuata</i> tall open forest over <i>Xanthorrhoea preissii</i> , <i>Macrozamia riedlei</i> and <i>Hibbertia cuneiformis</i> mid to tall shrubland over <i>*Trachyandra divaricata</i> , <i>*Solanum nigrum</i> and <i>*Geranium molle</i> low isolated forbs.	16.81
<b>ArMsTd</b>	<i>Acacia rostelifera</i> , <i>Spyridium globulosum</i> and <i>Clematis linearifolia</i> tall shrubland over <i>Melaleuca systema</i> , <i>Phyllanthus calycinus</i> and <i>Acanthocarpus preissii</i> mid heathland to open heathland over low sparse to closed forbland of <i>*Trachyandra divaricata</i> , <i>*Solanum nigrum</i> and <i>*Geranium molle</i> .	4.03
<b>AfXpHh</b>	Low to mid open to closed forest of <i>Agonis flexuosa</i> , <i>Eucalyptus gomphocephala</i> and occasional <i>Banksia grandis</i> over <i>Xanthorrhoea preissii</i> , <i>Templetonia retusa</i> and occasional <i>Banksia sessilis</i> var. <i>cygnorum</i> tall open shrubland over <i>Hibbertia hypericoides</i> and <i>Macrozamia riedlei</i> sparse to open low shrubland.	5.54
<b>AfHcEp</b>	<i>Agonis flexuosa</i> mid open forest with emergent <i>Eucalyptus gomphocephala</i> over <i>Hibbertia cuneiformis</i> , <i>Xanthorrhoea preissii</i> and <i>Clematis linearifolia</i> mid sparse shrubland over <i>*Euphorbia peplus</i> , <i>*Geranium molle</i> , <i>*</i> and <i>*Trachyandra divaricata</i> low sparse forbland.	0.02
<b>Xp</b>	<i>Xanthorrhoea preissii</i> tall shrubland over common weeds.	0.92
<b>MrGtTd</b>	<i>Melaleuca raphiophylla</i> and <i>Melaleuca cuticularis</i> low closed forest over <i>Gahnia trifida</i> , <i>Juncus kraussii</i> subsp. <i>australiensis</i> and <i>Lepyrodia drummondiana</i> mid to tall sedgeland over <i>*Trachyandra divaricata</i> , <i>*Geranium molle</i> and <i>*Lysimachia arvensis</i> low isolated forbs.	3.33
<b>MsTd</b>	Mid to tall heathland to closed heathland of <i>Melaleuca systema</i> , <i>Hibbertia cuneiformis</i> and <i>Templetonia retusa</i> over <i>*Trachyandra divaricata</i> , <i>*Hypochaeris glabra</i> and <i>*Arctotheca calendula</i> low forbland.	1.20

**Table 2-3 Black Cockatoo Foraging Habitat in the Proposed Offset Site (AECOM, 2016)**

Species	Quality	Area in Proposed Offset Site (ha)
<b>Carnaby's Black Cockatoo</b>	High	16.81
	Valued	5.51
	Low	5.56
<b>Forest Red-tailed Black Cockatoo</b>	Low	1.20
<b>Baudin's Black Cockatoo</b>	Valued	16.81

**Table 2-4 Black Cockatoo Breeding Habitat in the Proposed Offset Site (AECOM, 2016)**

Quality	Vegetation Community	Habitat Area in Survey Area (ha)	Habitat Area in Proposed Offset Site (ha)	Proportion in Proposed Offset Site (%)	Approximate Number of Trees in Survey Area	Approximate Number of Trees in Offset Area
<b>High</b>	EgXpTd	39.3	16.81	43	1,400	600
<b>Valued</b>	AfXpHh	116.4	5.54	4.8	2,100	100
<b>Low</b>	AfHcEp	138.6	0.02	0.02	400	0

To offset 12.16 ha of impact (including 8.75 ha of direct impacts and 3.41 ha of indirect impacts) to the Tuart TEC and 3.02 ha of impact to Black Cockatoos, Main Roads proposes an allocation of 31.9 ha of land containing:

- 31.9 ha of Tuart TEC
- 27.9 ha of Carnaby's Cockatoo foraging habitat
- 1.2 ha of FRTBC foraging habitat
- 22.4 ha of Black Cockatoo breeding habitat containing approximately 700 suitable DBH trees.

## **Offset 2 – Installation of Artificial Hollows**

Main Roads proposes to install six artificial hollows to offset the significant residual impact to two suitable hollows for Black Cockatoo nesting. The hollows will be installed at a site suitable for Black Cockatoo breeding, on land vested with DBCA, with the location determined in consultation with DBCA. Initial consultation with DBCA has commenced and DBCA is currently proposing a site in the Moora district, in proximity to an existing breed site. DBCA has advised that it does not support the installation of artificial hollows in the Metropolitan region. The design and placement of the artificial hollows will be based on DBCA's guidelines for installing Black Cockatoo hollows (DPaW 2015). Main Roads will monitor and maintain the installed artificial hollows for a period of ten years.

### Installation

Main Roads is intending to procure and install artificial hollows known as Cockatubes. These are constructed by Landcare and the current design has been developed over a period of 10 years with the assistance of DBCA and the Western Australian Museum. Cockatubes are used extensively throughout the south west of Western Australia, including ones that have been installed by Main Roads along the Great Northern Highway in the Bindoon area. Recent monitoring of these hollows show they have been used successfully for breeding (Johnstone et al 2010; Phoenix Environmental Sciences 2020).

Appropriate trees will be identified by taking in to consideration the following parameters:

- Trees should be within DBCA-managed land to facilitate ease of access for monitoring and maintenance
- Located in proximity to an existing nesting hollow
- Located within or adjacent to foraging habitat
- Located in proximity to water
- Trees should be mature and well shaded
- Trees should be accessible with a cherry picker, without requiring additional disturbance, to allow installation of the artificial hollows.

### Monitoring

The artificial hollows will be surveyed in September/October each year to coincide with the peak breeding season for Carnaby's Cockatoos. The first survey will occur during the breeding season following the installation of artificial hollows. Surveys will be undertaken by a suitably qualified person. Surveys will identify:

- If hollows are currently in use or show evidence of previous use
- Maintenance requirements for artificial hollows
- If hollows are no longer to be used by Carnaby's Cockatoos, for example if they have been invaded by feral bees.

The results of the monitoring surveys will be provided to DBCA in order to contribute to broader research into the species.

Maintenance

Maintenance of artificial hollows will be scheduled outside of the breeding season. Maintenance may include:

- Replacement of sacrificial chewing post
- Replacement/repair of attachment points
- Repairs to the base of hollows
- Repairs of cracks in the artificial hollow. If cracks form that are too large to be repaired, the hollow may need to be replaced.
- Removal of pest species, such as feral bees.

**2.3 Mitigation of significant residual impacts**

The EPBC Offset Calculator Tool was used to evaluate the Proposed Actions impacts to Tuart TEC and Black Cockatoos. Table 2-5 provides a summary of the offset package calculations which counterbalance the significant impacts to Tuart TEC and Black Cockatoos.

As presented in Table 2-5, the offset package is expected to provide adequate compensation for significant residual impacts to Tuart TEC and Black Cockatoos. While Main Roads is only proposing to have a permanent residual impact to 8.75 ha of Tuart TEC, Main Roads is offsetting 12.16 ha, which includes an offset for the entire TP20 patch including indirect impacts in this instance.

**Table 2-5 Summary of offset package compensation for potential significant residual impacts**

NO.	OFFSET	MNES VALUES CONFIRMED	BLACK COCKATOO RESIDUAL IMPACT: 3.02 HA X QUALITY 4 = 12 HA OFFSET TOTAL		TUART TEC RESIDUAL IMPACT: 12.16 HA X QUALITY 2 = 28 HA OFFSET TOTAL	
			OFFSET AREA (HA)	% OF IMPACT OFFSET	OFFSET AREA (HA)	% OF IMPACT OFFSET
1.	Lake Clifton offset site	Confirmed: surveyed	27.88 ha	238.37%	31.87 ha	114.71%
2.	Installation of artificial hollows	n/a	Installation of hollows for Black Cockatoo breeding will be installed at a 3 to 1 ratio for Proposed Action impacts to potential Black Cockatoo hollows		n/a	n/a
<b>Total</b>			238.37%		114.71%	

### **Extent to which offset package compensates potential significant residual impacts**

As presented in Table 2-5, the offset package will provide adequate compensation for potential significant residual impacts to Tuart TEC, Carnaby's Cockatoo and FRTBC.

Offset 1 involves the acquisition of land which has been transferred to DBCA's conservation estate. This offset will provide at least 114.71% direct offset for significant residual impacts to Tuart TEC. The offset will also provide at least 238.37% direct offset for significant residual impacts to Black Cockatoos.

### **Suitability of potential offset sites for Tuart TEC and Black Cockatoos**

Offset 1 involves the transfer of land to DBCA, with conservation gain through protection against loss and land management to maintain MNES value. The time to achieve conservation gain will be effective immediately upon land transfer and the level of certainty is high (90%).

AECOM (2020) identified Tuart TEC in High condition within the offsite site. FRTBC and Carnaby's Cockatoo habitat was also identified in the site, including foraging and breeding habitat. There is a confirmed Carnaby's Cockatoo breeding site within 6 km of the Lake Clifton site as shown in the AECOM (2016) report. The proposed offset site also contains approximately 700 potential breeding trees, which will sufficiently offset impacts to 177 Suitable DBH trees in the DE.

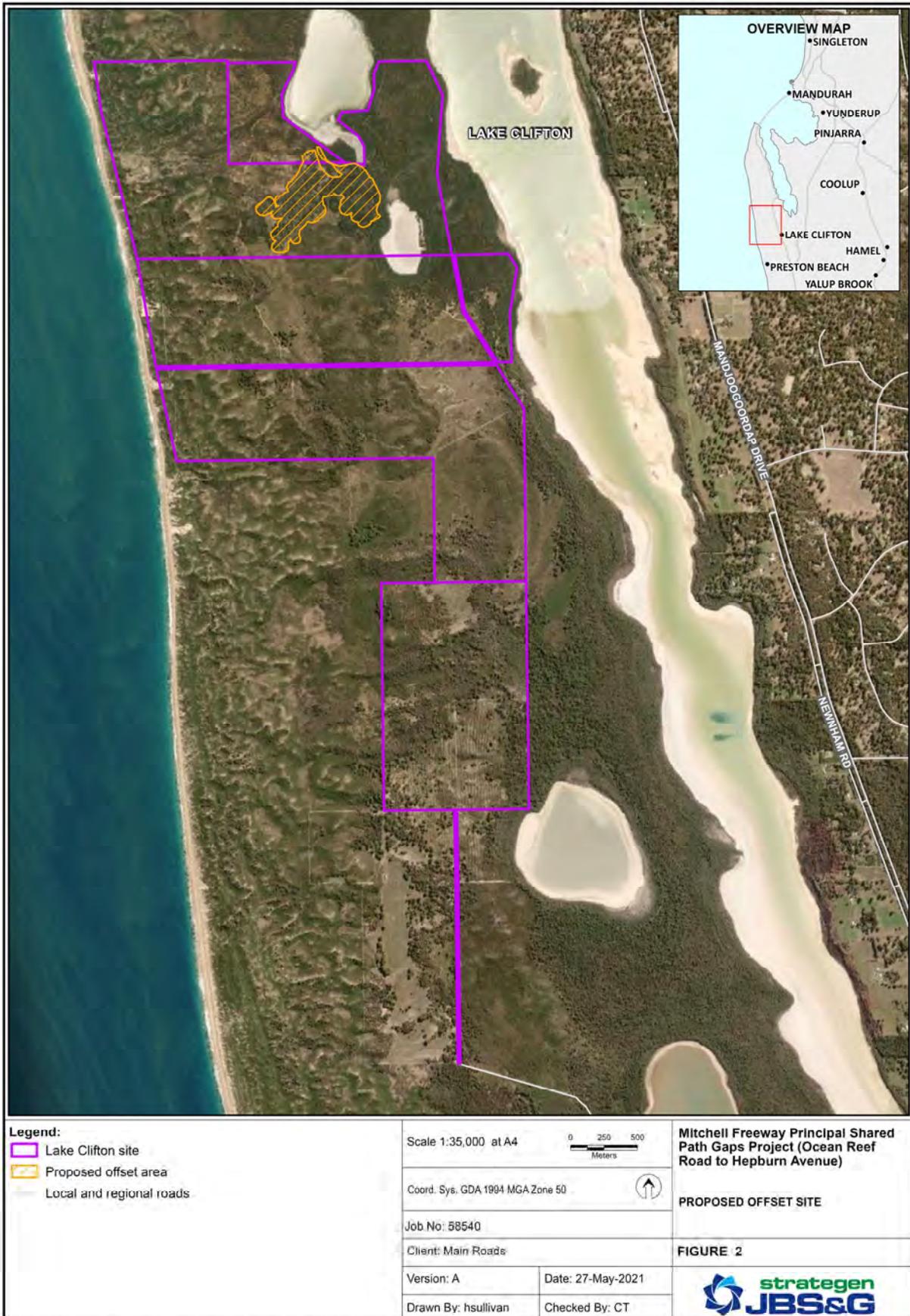


Figure 2. Lake Clifton Offset Site

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## 4 APPENDICES

Appendix	Title
<b>Appendix A</b>	Offset Calculation Values
<b>Appendix B</b>	EPBC Offset Calculator Tool Worksheets
<b>Appendix C</b>	AECOM (2016) Lake Clifton Biological Survey
<b>Appendix D</b>	AECOM (2020) Lake Clifton Tuart TEC Assessment

## Appendix A: Offset Calculations

### Values that were input into the EPBC Calculator Tool – Tuart TEC:

ATTRIBUTE	VALUE	JUSTIFICATION
Area of community/habitat impacted	12.16 ha	Total amount of Tuart TEC clearing required for the Proposed Action.
Vegetation/Habitat quality of the impacted area	2	<p>An overall quality score was obtained by weighting the vegetation condition across the DE:</p> <ul style="list-style-type: none"> <li>• Pristine: score 10 – 0% of TEC area</li> <li>• Excellent: score 9 – 0% of TEC area</li> <li>• Excellent – Very Good: score 8 – 0% of the TEC area</li> <li>• Very Good: score 7 – 0% of TEC</li> <li>• Very Good - Good: score 6 – 0% of the TEC area</li> <li>• Good: score 5 - 0.6% of the TEC area</li> <li>• Good – Degraded: score 4 – 12.67% of the TEC area</li> <li>• Degraded: score 3 – 2.04% of the TEC area</li> <li>• Degraded – Completely Degraded: score 2 – 12.67% of the TEC area</li> <li>• Completely Degraded: score 1 – 84.65% of the TEC area</li> </ul> <p>The TEC ranges from Completely Degraded to Good condition. The majority of the TEC impacted is in Completely Degraded condition. A weighted score of 2 was identified.</p>
Start quality Vegetation/habitat Quality of the offset area (takes into account the regional context and stocking rate)	8	<p>Vegetation condition ranges from Completely Degraded to Excellent based using the Keighery scale (1994). Tuart TEC is High condition based on methods in the Tuart TEC conservation advice (DoEE, 2019).</p> <p>The proposed offset site forms part of a contiguous patch of Tuart Woodland TEC that extends for 81.18<sup>o</sup>ha. The surrounding area is dominated by Yalgorup National Park and Boundary Lake to the north, Lake Clifton to the east, and native vegetation conservation offset reserve elsewhere (AECOM, 2020).</p> <p>The Yalgorup National Park has been recognised by DBCA as one of only three locations to contain most of the Tuart Woodlands, with approximately 67% of the existing Tuarts located in freehold land (DPaW, 2014). Protection of the offset site in conservation estate will therefore add to the amount of contiguous Tuart Woodland habitat protected in conservation estate in the Yalgorup region.</p>
Future Quality without offset	7	Historically, this land was used for cattle grazing and was proposed for development as rural lots. If the site was not purchased for use as an environmental offset, these land uses would have persisted, resulting in further degradation and potential loss of environmental values.
Future Quality with Offset	8	Quality will be maintained by DBCA. For the first seven years of ownership, management will be in accordance with a Memorandum of Understanding (MoU) between MRWA and DBCA that includes funding for management of declared weeds and infrastructure maintenance such as fire breaks and

ATTRIBUTE	VALUE	JUSTIFICATION
		fencing. At the conclusions of the first seven years the site will be incorporated into the conservation estate for Western Australia that is managed by DBCA. Management of the land will then continue for perpetuity in accordance with DBCA management strategies for conservation estate.
Time Horizon over which loss is averted (security of land tenure)	20 years	Land purchased with financial contributions has been added to the conservation estate so long term protection is afforded. Twenty years is the maximum value that can be input.
Time until ecological benefit	1 year	Short time frame as land has already been purchased and is being managed for conservation.
Risk of loss without offset	3%	Low risk of loss. Site may degrade from weed incursion and further impacts from ongoing grazing. Given the patch of Tuart TEC is >5 ha the vegetation, it is likely to be more resilient than smaller patches of the TEC and as long as the vegetation meets the diagnostic criteria for the Tuart TEC it will continue to represent the Tuart TEC, regardless of condition.
Risk of loss with offset	0%	Offset placed into secure tenure managed by the State (i.e. conservation estate) and therefore loss of the Tuart TEC/PEC is unlikely.
Confidence in result	90%	High degree of confidence. Land purchased has been added to the conservation estate through a State guaranteed scheme.
Hectares of offset required	28 ha	Offset required to achieve 100% offset based on calculations.
Hectares of offset proposed	31.87 ha	Offset proposed.
Percentage of impact offset proposed	114.71%	Percentage of offset achieved based on offset calculations.

**Values that were input into the EPBC Calculator Tool – Black Cockatoos:**

ATTRIBUTE	VALUE	JUSTIFICATION
Area of community/habitat impacted	3.02 ha	3.02 ha of foraging habitat for Black Cockatoos was applied to this factor. It is assumed that Black Cockatoo habitat is also representative of habitat for other conservation significant species.
Vegetation/Habitat quality of the impacted area	4	<p>An overall quality score was obtained by considering habitat quality across the DE, taking into account site condition, site context and species stocking rate.</p> <p><b>Site condition</b></p> <ul style="list-style-type: none"> <li>• Pristine: score 10 – 0% of Black Cockatoo habitat area</li> <li>• Excellent: score 9 – 0% of Black Cockatoo habitat area</li> <li>• Excellent – Very Good: score 8 – 0% of Black Cockatoo habitat area</li> <li>• Very Good: score 7 – 0% of Black Cockatoo habitat area</li> <li>• Very Good - Good: score 6 – 0% of the Black Cockatoo habitat area</li> <li>• Good: score 5 - 2% of Black Cockatoo habitat area</li> <li>• Good – Degraded: score 4 – 0% of Black Cockatoo habitat area</li> <li>• Degraded: score 3 – 6% of Black Cockatoo habitat area</li> <li>• Degraded – Completely Degraded: score 2 – 37% of Black Cockatoo habitat area</li> <li>• Completely Degraded: score 1 – 56% of Black Cockatoo habitat area</li> </ul> <p>A weighted score of 4 was identified.</p> <p><b>Site context</b></p> <p>A moderate score was applied to reflect the location of the DE, along the edge of the road within a road reserve. The DE has been subject to degradation through edge effects and large areas of the habitat were historically cleared as part of the Mitchell Freeway construction in the 1980's. Astron (2020) identified that the natural flora assemblage in the DE has been altered to an extent that there is a reduced number and quality of foraging species for Black Cockatoos. Higher quality habitat exists adjacent to the DE in reserves such as Woodvale Nature Reserve.</p> <p>The Proposed Action represents approximately 0.19% of Black Cockatoo habitat remaining within 6 km of the DE (estimated to be 1,511 ha).</p> <p>A Carnaby's Cockatoo breeding site exists approximately 1 km north of the DE.</p> <p>A score of 4 was applied to reflect this context.</p> <p><b>Stocking rate</b></p> <p>A moderate score is provided as the DE is known to support foraging and occupation by the species, but has an absence of actual breeding and roosting evidence. While a Carnaby's</p>

ATTRIBUTE	VALUE	JUSTIFICATION
		<p>Cockatoo breeding site exists approximately 1 km north of the DE, the Proposed Action is expected to have a minor role in sustaining the overall species population viability as the species forages and migrates across the Swan Coastal Plain each year.</p> <p>The score reflects the presence of 3.02 ha of foraging habitat and 107 trees with two potentially suitable hollows.</p> <p>A Carnaby's Cockatoo breeding site exists approximately 1 km north of the DE. However these birds are more likely to forage in Neerabup National Park than within the DE – this is supported by tracking data obtained by Murdoch University. A score of 4 was applied.</p> <p>An average score of 3 was obtained for habitat quality.</p>
<p>Start quality Vegetation/habitat Quality of the offset area (takes into account the regional context and stocking rate)</p>	8	<p>The proposed offset site contains 27.9 ha of foraging habitat suitable for Carnaby's Cockatoos and 1.2 FRTBC habitat. FRTBC habitat was characterised by vegetation community MSTDm, which contained up to 10% of Hakea species, a foraging species for FRTBC.</p> <p>The proposed offset site contains 22.4 ha of potential breeding habitat suitable for Black Cockatoos. The quality of potential breeding habitat ranged from Low to High quality. The majority of breeding habitat was characterised by comprised High quality potential breeding habitat associated with vegetation community EgXpTd. Approximately 700 suitable DBH trees would occur in the proposed offset area.</p> <p>The proposed offset site forms part of an important and ecologically valuable linkage that creates a regional ecological linkage between the north and south portions of the Yalgorup National Park. Extensive areas of Black Cockatoo breeding and foraging habitat are located throughout the offset site and adjacent areas. This includes a confirmed Carnaby's Cockatoo roosting site less than 12 km from the offset site.</p>
<p>Future Quality without offset</p>	7	<p>Historically, this land was used for cattle grazing and was proposed for development as rural lots. If the site was not purchased for use as an environmental offset, these land uses would have persisted, resulting in further degradation and potential loss of environmental values.</p>
<p>Future Quality with Offset</p>	8	<p>Quality of vegetation at the offset site will be maintained by DBCA. For the first seven years of ownership, management will be in accordance with a Memorandum of Understanding (MoU) between MRWA and DBCA that includes funding for management of declared weeds and infrastructure maintenance such as fire breaks and fencing. At the conclusions of the first seven years the site will be incorporated into the conservation estate for Western Australia that is managed by DBCA. Management of the land</p>

ATTRIBUTE	VALUE	JUSTIFICATION
		will then continue for perpetuity in accordance with DBCA management strategies for conservation estate.
Time Horizon over which loss is averted (security of land tenure)	20 years	Land purchased with financial contributions has been added to the conservation estate so long term protection is afforded. Twenty years is the maximum value that can be input.
Time until ecological benefit	1 year	Short time frame as land has already been purchased and is being managed for conservation.
Risk of loss without offset	3%	Without offset, the site may degrade from grazing impacts such as weed incursion and dieback. However, black cockatoo loss of black cockatoo habitat from weed incursion is low.
Risk of loss with offset	0%	Offset placed into secure tenure managed by the State (i.e. conservation estate). Management as conservation estate in similar condition through DBCA's conservation strategies.
Confidence in result	90%	High degree of confidence. Land purchased has been added to the conservation estate through a State guaranteed scheme.
Hectares of offset required	12 ha	Offset required to achieve 100% offset based on offset calculations.
Hectares of offset proposed	27.88	Offset proposed comprises 31.87 ha of native vegetation containing 27.88 ha of black cockatoo habitat.
Percentage of impact offset proposed	238.37%	Percentage of offset achieved based on offset calculations.

## **Appendix B: EPBC Offset Calculator Tool Worksheets**