Conservation Significance and Management Options for the Vegetation, Floristic and other Conservation Values of the Whicher Scarp

Report of the Expert Panel

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Cover photographs by B J Keighery (clockwise from the top left):

- Mountain Marri (*Corymbia haematoxylon*) and Jarrah (*Eucalyptus marginata*) woodland over *Xanthorrhoea acanthostachya* on sandy laterite.
- Mountain Marri and Jarrah woodland on deep white sand.
- Mountain Marri, Jarrah, *Banksia grandis* and *Banksia attenuata* woodland on deep coloured sands.

Document Control

Custodian:	Director, Forest and Ecosystem Management Division.
Approved by:	Director General, Parks and Wildlife

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1 Executive Summary

This report has been prepared at the request of the Deputy Director General, Parks and Conservation (DEC) to review the relevant issues raised in the report *A Floristic Survey of the Whicher Scarp* (Keighery *et al.* 2008a). The Report of the Expert Panel briefly describes the background to the recognition of the Whicher Scarp landform, the associated ecosystem and vegetation types through a range of studies. The report outlines the progression of mapping and analysis, and highlights that due to incomplete information, the Whicher Scarp was unable to be effectively assessed during the Regional Forest Agreement (RFA) and Forest Management Plan (FMP) deliberations. The Panel considers that the Whicher Scarp qualifies as a forest ecosystem (number 31: Whicher Scarp Vegetation) for inclusion in the FMP 2013 update. This ecosystem is "poorly reserved" under the RFA criteria as are several of its component vegetation complexes (CSc and Yf). Recommendations are made in relation to the protection of flora values of the Whicher Scarp, management of environmental and threatening processes and land use management.

Photograph 1 The Whicher Flannel Flower (*Actinotus whicheranus*) is confined to two very different Whicher Scarp habitats, the wetland habitat of the Gale Road Busselton Ironstones (a TEC) and the rare upland communities on the deep sands in the Whicher forest. This species flowers in the heat of summer and is very difficult to locate at other times. The closest relatives of this species are found on the sandstones in NSW. This species has been recommended for listing as DRF as it is only known from two groups of populations in very different habitats that are subject to a set of threatening processes.

2 Terms of Reference

The purpose is to provide advice to the Deputy Director General, Parks and Conservation, using the expert knowledge within the group, on:

- the vegetation and flora values of the Whicher Scarp;
- the conservation significance of the vegetation and flora values in the regional context of the area covered by the Forest Management Plan 2004-2013;
- other conservation values (fauna, landscape, ecological linkage) of the Whicher Scarp;
- the levels of reservation of these vegetation, flora and other conservation values;
- the threats to the vegetation, flora and other conservation values; and
- options to manage these threats.

The full terms of reference are included as Appendix 1.

Photograph 2 A set of restricted and rare wetland communities are found on Whicher Scarp. Some of these communities occur along the Sabina River (this picture is looking south from the Sabina Road bridge). Populations of a number of rare and restricted taxa are associated with these communities including *Grevillea bronwenae*, *Dryandra formosa* (Whicher Scarp form) and *Lambertia rariflora* subsp. *rariflora*. One of the communities (Table 2 – F1) is a priority ecological community.

3 Introduction

3.1 Background

In the 1970s the Environmental Protection Authority (EPA) recognised the particular flora values of the Whicher Scarp area in the recommendations of the Conservation Through Reserves Committee (CTRC) System 1 (DCE 1976) and System 6 (DCE 1983a and b) reports where the Whicher Scarp is referred to as the Whicher Range. Two areas on the Whicher Scarp were the subject of recommendations being:

- the 'Whicher Range reserve' (Figure 1.5 DCE 1976). In 1978 an area similar to the proposed Whicher Range reserve (DCE 1976) was placed on the register of the National Estate (DEWHA 2008). In 2004 the FMP 2004-2013 (Conservation Commission of Western Australia 2004) identified an area similar to that identified in the System 1 report (DCE 1976) but the majority of the Whicher Scarp slopes to the west of the Sabina River have been omitted. On the 8th December 2004 a similar area was vested as the Whicher National Park (Maps 3 and 5); and
- C86 (Dardanup Management Priority Area) in the System 6 report (Figure 59, DCE 1983b). This recommendation has also been partially implemented with the vesting of the Dardanup Conservation Park at the same time as the Whicher National Park (Maps 3 and 6).

A Whicher Scarp Reserve was also included in the Central Forest Management Plan for 1987 and in the subsequent Forest Management Plan 1994-2003. The Whicher Scarp was shown to be an area of high species richness both during the RFA (Commonwealth of Australia and Western Australian Government 1998, Map 5) and subsequently by Hearn *et al.* (2003). Proposals for a series of Forest Conservation Areas adjacent to Yelverton and Whicher National Parks were made in the Forest Management Plan 2004-2013 (Conservation Commission of Western Australia 2004).

While CTRC System 1 (DCE 1976) recommended further flora survey in the Whicher Scarp area no specific funds available for this work until the mid 2000s, flora survey work was undertaken over the next three decades by officers of the Department of Conservation and Land Management and EPA together with the Wildflower Society of Western Australia's Bushland Survey Program. With Swan Bioplan funding in 2005 this work was able to be progressed more rapidly and a report on the floristics of the Whicher Scarp was released in early 2008 (Keighery *et al.* 2008a). The RFA process allows for such flora information to be used to further contribute to the knowledge and protection of the forests of the RFA area (Conservation Commission of Western Australia 2004).

3.2 Boundaries of the Whicher Scarp

The Whicher Scarp forms a sickle shaped landform unit that extends from near Burekup in the north where it meets the Darling Scarp, to the south-west of Dunsborough where it meets the granites of the Leeuwin-Naturaliste Ridge (Map 1). The coastal side of the Scarp abuts the Swan Coastal Plain, the Scarp forming the 'hills' of the Bunbury/Busselton area.

The boundaries of the Whicher Scarp are defined by soil-landscape mapping (Map 1 after DAFWA 2007) which is a product of a 15-year mapping and data collation program to provide a soil and landscape inventory in the south-west of Western Australia (Schoknecht *et al.* 2004). Regional scale mapping undertaken as part of this 15-year program forms the basis for Mattiske and Havel (1998) vegetation complex mapping.

However, as outlined in Section 4 in the assessment of Forest Ecosystems (Bradshaw and Mattiske 1997) incomplete vegetation complex mapping has failed to show the continuum of Yelverton and Whicher vegetation complexes and as such the Scarp has been largely allocated to the Swan Coastal Plain landform and not considered further in the RFA analysis.

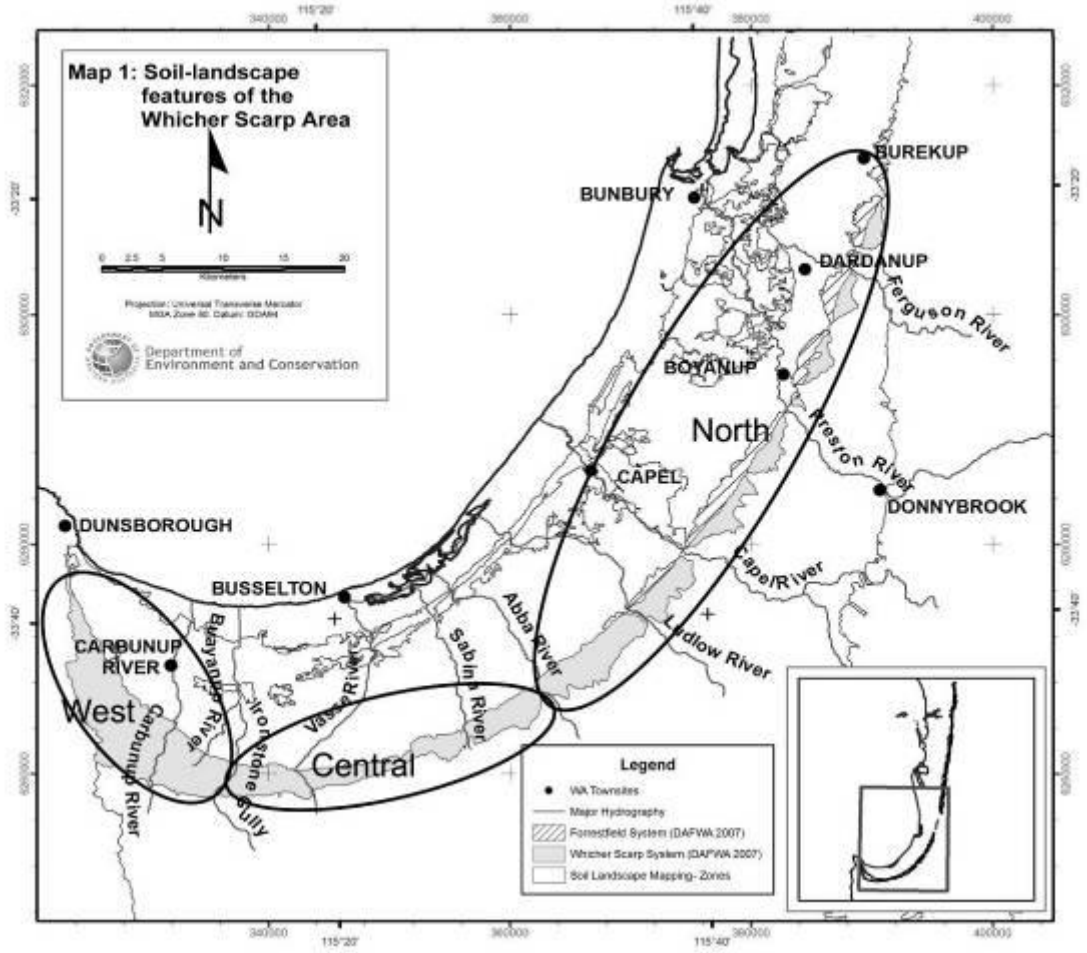
3.3 Location, Geology, Landforms and Soils

The Whicher Scarp is thought to have formed as a result of marine erosion of the Perth Sedimentary Basin around two million years ago (Playford *et al.* 1976). An old shoreline rich in mineral sands, the Yoganup

Formation (Playford *et al.* 1976), is associated with the Swan Coastal Plain / Scarp interface. The Whicher Scarp covers an area of about 23,700 ha, rising to over 100 m in places but with an average height of 50 m and is incised by a series of rivers and creeks. Based on landform and natural values the Whicher Scarp is divided into three sectors, the West, Central and North Whicher Scarp (Map 1).

Broadly, the surfaces of the Whicher Scarp fall into three groups consisting of the widespread sands and laterites and the rare ironstones. Laterite capped rises and slopes are common in the Central and North Whicher Scarp, with exposed laterite being uncommon in the West Whicher Scarp. Shallow rises, slopes and swales of deep sands are found throughout the Scarp. In the Central and North Whicher Scarp these range from white through yellow to orange. In the West Whicher Scarp grey sands predominate, sheet laterite occurring at depth. These sands often occur as a sheet over laterite with varying gravel components.

A series of rivers and creeks incise the Whicher Scarp. Associated with these are a series of flat and basin wetlands as well as rare paluslopes. The ironstones also support wetlands.



Map 1 Soil-landscape features of the Whicher Scarp area.

3.4 Vegetation and Flora

The natural values of the Whicher Scarp in relation to landforms, vegetation and flora are diverse and varied. These values are summarised below after Mattiske and Havel (1998), Keighery *et al.* (2008a) and DEC (2010b). It should be noted that the area figures in this section are based on Keighery *et al.* (2008a); these are comparable but different from those in Section 4.3. These values will be collectively described within this document as 'Whicher Scarp values'.

3.4.1 Significant flora

Significant flora values include high flora species richness, centres of endemic flora, centres of relictual flora, centres of disjunct flora, threatened ecological communities and declared rare flora. The RFA maps (Commonwealth of Australia and Western Australian Government 1998) show the West and Central Whicher in a centre important for flora endemism and species richness. Hearn *et al.* (2003) reviewed the management of significant flora for the Forest Management Plan, 2004-2013, and agreed that the Whicher was a significant area for endemic, relictual and disjunct flora, adding further examples to the RFA data.

These values have been further expanded in the Keighery *et al.* (2008a) study of the Whicher Scarp (see Appendix 2 of this report).

- The area is a species richness centre. The Whicher Scarp contains more than 900 native species of flora, representing species of the jarrah forest, south coast sands and wetlands and Swan Coastal Plain sands as well as a large number of Whicher Scarp centred species.
- A centre of endemic flora with more than 40 species having been recently described in the Whicher Scarp and another 25 being expected to be able to be differentiated genetically and/or morphologically. A highly endemic flora at a national, regional and local scale.
- Several relictual species, including *Actinotus whicheranus*.
- More than 60 species are State listed species, eight being Declared Rare and 53 Priority Species.
- Nine species are Commonwealth listed (DEHWA 2007).
- 49 species are at the northern end of their range and 32 species are at the southern end of their range.
- A centre of disjunct flora with more than 100 species have populations in the Whicher Scarp which are disjunct, sometimes remarkably so, from other populations of the taxon.

3.4.2 Distinctive vegetation

The area described as the Whicher Scarp can be broadly described as consisting of seven unique vegetation complexes, as described by Mattiske and Havel (1998) and listed in Table 1 below. All of these vegetation complexes are woodland plant communities and include the most southern of the species rich Banksia Woodlands allied with those of the Swan Coastal Plain.

Table 1 Summary of Vegetation Complexes of the Whicher Scarp

Vegetation Complex Code	Name
WC	Whicher Scarp
WCv	Whicher Scarp
Y	Yelverton
Yd	Yelverton
Yf	Yelverton
Yw	Yelverton
CSs	Cartis

Previous vegetation mapping and interpretations by DAFWA (2007), Keighery *et al.* (2008a), EPA (2009) and the RFA placed Cartis (CSs) as either part of Whicher Scarp or Swan Coastal Plain. It is the consensus of the Expert Panel that for the purpose of this report that CSs is part of the Whicher Scarp.

A more detailed floristic classification is presented in Table 2. Six distinctive regional floristic community patterns are distinguished in the Whicher Scarp (Table 2 – upland groups A, B, C and wetland groups E, F and G).

A set of restricted woodland communities are associated with the Whicher Scarp. Four of these (Table 2 – A1, B2, C1 and C2) are found on sandy Whicher Scarp surfaces and are listed Priority Ecological Communities (PEC). A highly restricted community is found in the Dardanup Conservation Park (Table 2 - C5), which is also a listed PEC.

Restricted and rare wetland communities (Table 2)

The Whicher Scarp is associated with a series of distinctive wetlands including occurrences of the Busselton Ironstone communities (Table 2 – H). This group is equivalent to the Swan Coastal Plain floristic community type 10b, which is a listed Threatened Ecological Community (TEC). Two other wetland communities are listed PECs (Table 2- F1 and G2).

High degree of intactness of native vegetation

Much of the remaining native vegetation on the Whicher Scarp is in Excellent condition (as per classification used in Keighery 1994), some study sites being free of any weeds. Less than 8 per cent of the flora of the Whicher Scarp are weeds.

A diversity of unusual relictual habitats

The deep sands of the Whicher Scarp with their associated restricted plant communities and flora are relicts of a past landform stretching from Geraldton to Augusta.

Ecological linkages maintained

Within the Central and North Whicher Scarp effective ecological linkage is maintained; however, the West Whicher is mainly private land and is heavily cleared. The Whicher Scarp forms a major regional ecological linkage between the Darling Plateau and the Leeuwin-Naturaliste Ridge.

Photograph 3 A view of a Mountain Marri (*Corymbia haematoxylon*) dominated plant community. Mountain Marri is the distinctive tree species of the Whicher Scarp. In early summer this species is distinguished by its new red foliage. Insets show the cream summer flowers and fruit. This tree is an important food source for Red Tailed Black Cockatoos.

Table 2 **Priority/Threatened Ecological Community (Column 1, after DEC 2010a) listed against Whicher Scarp Floristic Community Types (Column 2, after Keighery *et al.* 2008a), number of quadrats in each WHSFCT group (Column 3), quadrats against vegetation complex and soil –landscape unit (Column 4).**

PEC or TEC	Whicher Scarp Floristic Community Types (WHSFCTs)		No quads	Quadrats followed by Vegetation Complex (after Mattiske and Havel (1998) or Heddle *et al.* (1980)/soil landscape unit (DAFWA 2007)
	A Whicher Scarp woodlands of grey/white sands		**23**	
P1	A1	Central Whicher Scarp Mountain Marri woodland	7	ACTN01(SWA-AB/AB1), SABI07 (WC/WC2), SABI08 (WC/WC2), SABI09 (WC/YLd), SABI12 (T/WC2), WH04 (Y/YL1), WH06 (T/WC2)
	A2	North Whicher Scarp Jarrah and Woody Pear woodland	5	DARP02 (SWA-Gu/CSs), GOOD02 (RO/RO), OATES-1 (SWA-AB/AB1), UCL06 (Y/YL), WONN-2 (SWA-AB/ABw)
	A3	North Whicher Scarp Banksia and Woody Pear woodland	4	DARP06 (CS/CSs), DARP07(CS/WC2), GAV01 (WC/WC2), GWINDR01 (CS/WC2)
	A4	Whicher Scarp *Banksia grandis*, Jarrah and Marri woodland	1	will02 (Yd/YLd)
	A5	Central/North Whicher Scarp Mountain Marri woodland	6	DAVE03 (RO/RO3), UCL01 (Y/YL), UCL02 (Yw/YLvw), UCL03 (Yw/YLvw), WH02 (Y/YLd), will04 (Y/YL)
	B Swan Coastal Plain centred woodlands of grey/white sands		**22**	
	B1	Swan Coastal Plain/North Whicher Scarp *Banksia attenuata* woodland	21	boyan 01 (C/WC2), buffer01 (KI/KI), dard02 (CS/WC2), GAV05 (WC/WC2), gibson01 (YL/YL1), GWINDR02 (CS/WC2), GWINDR03 (CS/WC2), HAPP02 (WC/WC2), kelly02 (WC/WC2)
P1	B2	West Whicher Scarp *Banksia attenuata* woodland	1	CHAM03 (Y/YLd)
	C Whicher Scarp woodlands of coloured sands and laterites		**49**	
P1	C1	Central Whicher Scarp Jarrah woodland	10	ACTN02 (SWA-AB/AB1), GOUL01 (Y/YL1), kemp01 (T/WC2), SABI 10 (T/WC2), SABI11 (T/WC2), smith03 (Yw/YLw), TREE02 (Yw/Ylf), TREE03 (Y/YL2), TREE04 (T/YL1), wicher01 (Y/YL2)
P1	C2	Whicher Scarp Jarrah woodland of deep coloured sands	8	ACTON-1 (SWA-Af/JDf), BOYA01 (CS/WC2), DAVE01 (WC/WC2), DAVE02 (WC/WC2), gibson02 (WC/WC2), HAPP01 (WCv/WCv), smith02 (T/YL1), WONN-1 (CSs/CSs)
	C3	Whicher Scarp Jarrah and Mountain Marri woodland on laterites	11	boyan 02 (KI/RO3), DARP08 (CS/WC2), DAVE04 (RO/RO3), DAVE05 (RO/RO3), DAVE06 (RO/RO3), GAV02 (KI/KI), GOOD03 (RO/RO), GOOD04 (RO/RO), kelly01 (WC/WC2), TREE01 (Y/YL2), WH05 (Y/YL1)
	C4	Whicher Scarp/Blackwood Plateau Jarrah and Marri woodland	17	CHAM01 (Y/YLd), CHAM02 (Y/YLd), DARP01 (JL/JL), DARP03 (JL/RO3), DARP 04 (JL/RO3), DARP05 (JL/JL), GAV03 (WCv/WCv), GAV04 (WCv/WCv), GIBB02 (YL/YL2), GIBB06 (YL/YL2), GOUL02 (Y/YL1), SABI01 (T/KI), SABI02 (RO/PR) , SABI04 (T/Kl), SABI06 (RO/PR), UCL05 (Y/YL), WH03 (Y/YL1)
P1	C5	Dardanup Jarrah and Mountain Marri woodland on laterite	2	dard01 (KI/RO3), dard03 (KI/KI&WC2)
	E Jarrah and Marri woodland wetland type 1		**3**	davies04 (SWA-A/ABw), GOOD01 (RO/RO), WH01 (Y/YLd)
	F Jarrah and Marri woodland wetland type 2		**4**	
P1	F1	Sabina River Jarrah and Marri woodland	2	SABI03 (RO/RO3), SABI05 (RO/PR)
	F2	Miscellaneous Wetlands	2	TAYL01 (SWA-Aw/ABw), UCL04 (Yw/YLvw)
	G West Whicher Scarp wetlands		**2**	
	G1	Creekline Blackbutt *(Eucalyptus patens)* and Marri forest	1	GIBB01 (Yw/YLvw)
P1	G2	Shrublands of near permanent wetlands in creeklines	1	GIBB03 (Yw/YLvw)
TEC	**H Busselton Ironstones**		**11**	iron01 (Tw/Trv), iron02 (Tw/TRv), smith01(Yw/YLw), smith04 (Tw/TRh), will01 (SWA-AB/ABw), will03 (SWA-AB/ABw), WONN-4 (SWA-AB/ABwi), WONN-5 (SWA-AB/ABwi),WONN-6 (SWA-AB/ABwi), YIRON-1 (YW/YLwi), YIRON-2 (YW/YLwi)

4 Status of the Whicher Scarp Forest Ecosystem

4.1 Background

A key attribute in the formulation of Regional Forest Agreement (RFA) between the Commonwealth and State governments was the establishment of a Comprehensive, Adequate and Representative (CAR) reserve system. The biodiversity objectives for a CAR reserve system are outlined by JANIS (1997) along with a suite of biodiversity criteria required to achieve these objectives. The reservation extent of forest ecosystems and vegetation complexes form a significant basis of the criteria.

In order to complete the analysis of the reservation extent for the RFA further mapping of forest ecosystems and vegetation complexes was required. Mapping by Heddle *et al.* (1980) was restricted to the northern extent of the RFA area (Map 2). To recognise forest ecosystems the State mapped forest associations and commissioned further vegetation complex mapping. Forest associations (Bradshaw *et al*. 1997) were derived from work originally undertaken by the Forests Department in the 1950's and 1960's. Information captured over this period for vegetated public land on dominant tree species and crown cover together with broad structural categories for areas of forest vegetation were consolidated into 1:250,000 scale maps.

Vegetation complex mapping is based on landform, soils and climatic zones and their relationship to vegetation (primarily understory vegetation). Mapping of this type was first undertaken for the northern RFA (that part in the Darling System) by Heddle *et al.* (1980) at a scale of 1:250,000. In the development of the RFA the extent of the Heddle *et al.* (1980) mapping within the RFA area (Map 2) was revised to a scale of 1:50,000 and extended to cover the remainder of the RFA area (Mattiske and Havel 1998).

Forest ecosystems where developed through the subdivision of forest associations based on the grouping of like vegetation complexes (Bradshaw and Mattiske 1997).

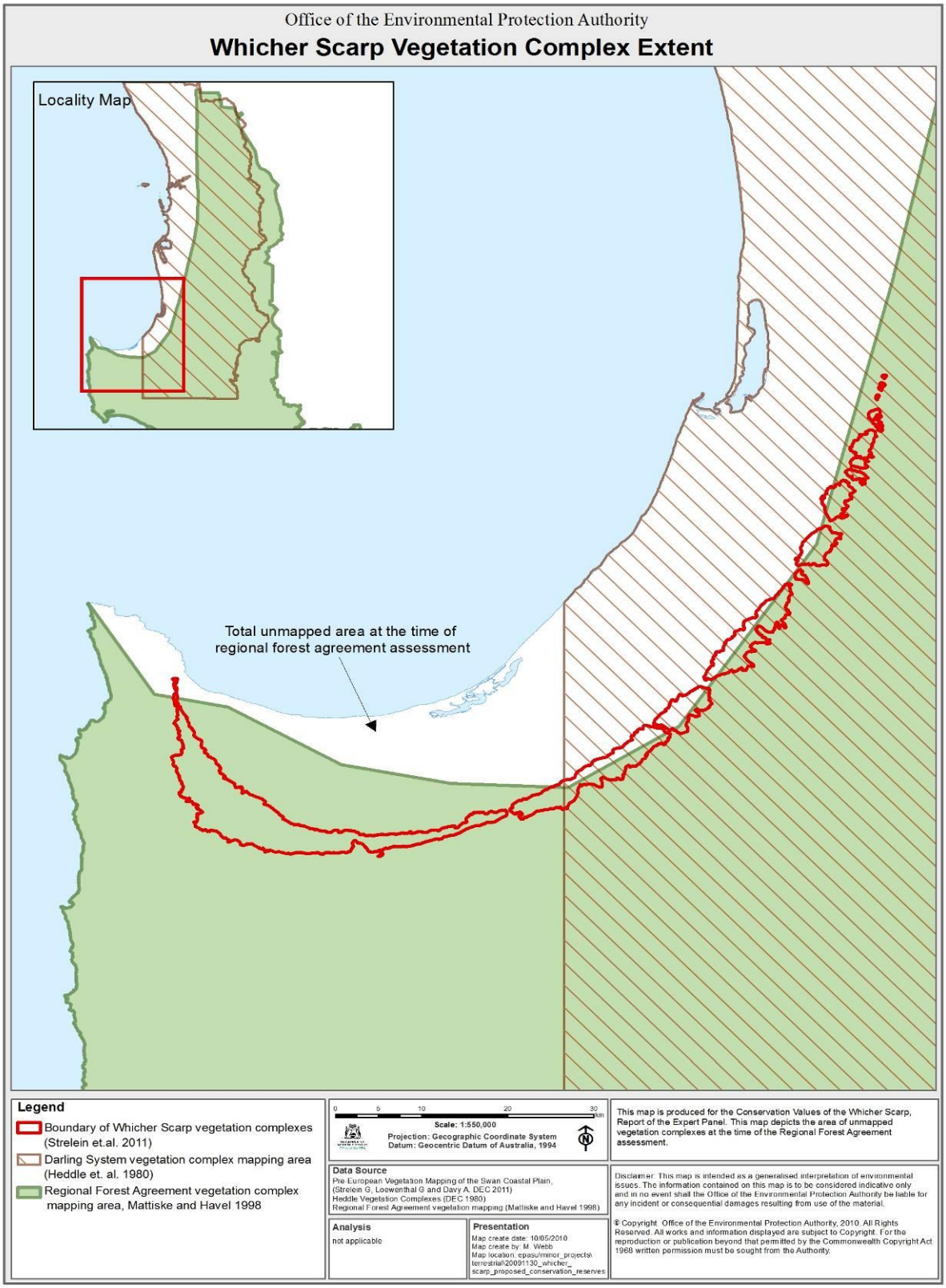
4.2 The Whicher Scarp Forest Ecosystem

At the time of Forest Ecosystem assessment (Bradshaw and Mattiske 1997) the Swan Coastal Plain, the Dandaragan Plateau and the eastern Wheatbelt were only partially covered by vegetation complex mapping (Map 2) (Mattiske and Havel 1998). In the analysis of Forest Ecosystems, these areas were not considered and were only identified to the sub-region level (i.e. Swan Coastal Plain Vegetation, Dandaragan Plateau Vegetation, Wheatbelt Vegetation) (Bradshaw and Mattiske 1997).

The Whicher Scarp was also only partially covered by vegetation complex mapping. The extent of the Scarp mapping was restricted to the Yelverton (Y, Yd, Yf, Yw) vegetation complexes to the west of the Vasse Hwy and the Whicher (WC, WCv) complexes to the east with mid and lower slope areas of the Scarp east of the Vasse Highway remaining largely unmapped (Map 2).

Map 12 of the RFA document (CALM 1998) shows that the mapped extents of the Whicher Scarp to be placed into two different sub-regions. The western extent (Yelverton vegetation complexes) into the Swan Coastal Plain sub-region and the eastern extent (Whicher vegetation complexes) into the Jarrah Forest sub-region (Jarrah Forest-Blackwood Plateau Forest Ecosystem).

The unmapped extent of the Whicher Scarp which supports the interaction of the Yelverton and Whicher vegetation complexes as lower to mid slope sandy soils (Yelverton complexes) and upland laterites (Whicher complexes) is missing which leads to an incomplete picture of the Scarp landform and the sub-regional separation.



Map 2 Comparison of study boundaries and the extent of the Whicher Scarp Landform.

The sub-regional separation has resulted in only the upland lateritic sections (Whicher vegetation complexes) of the Scarp being considered in Forest Ecosystem analysis (Bradshaw and Mattiske 1997). It is understandable that this small area, the apparent lack of a unique Scarp geology and an under-estimation of the dominance of *Corymbia haematoxylon* in vegetation complex mapping (the Scarp vegetation is referred to as Jarrah/Marri dominated open forest) has resulted in the Forest Ecosystem analysis of that small area being placed within the Jarrah Forest-Blackwood Plateau Forest Ecosystem.

Since the RFA, a DEC Forest Management Branch project (Pre-European Vegetation Mapping of the Swan Coastal Plain, Strelein *et al*. (in preparation)) has been able to merge the Mattiske and Havel RFA mapping with a new interpretation of Swan Coastal Plain datasets to create a complimentary Whicher Scarp and Swan Coastal Plain vegetation complex mapping. Other mapping and floristic studies in the area by Mattiske and Keighery have demonstrated that based on complexes and floristics, the Whicher Scarp is not part of either the Blackwood Plateau or the Swan Coastal Plain. Like the Darling Scarp it is a complex interzone that deserves to be listed as a separate Forest Ecosystem, which should become number 31 - Whicher Scarp Vegetation. This ecosystem is detailed below in the format of Bradshaw and Mattiske (1997).

Definition of the Whicher Scarp Forest Ecosystem

31. Whicher Scarp Vegetation

Overstorey

A mosaic of mountain marri *(Corymbia haematoxylon)*, mountain marri/jarrah woodlands to low forest, *Banksia attenuata* woodlands, jarrah woodlands, shrublands dominating landscape on upper and lower slopes. In the western scarp *Banksia attenuata* woodlands predominate and mountain marri is replaced occasionally by peppermint. The complexity and finer scale of the vegetation in this narrow zone more appropriately considered as one ecosystem.

Overstorey very variable in height, but generally lower in height.

Understory/Vegetation

Understorey gradient reflecting mainly soils, sands, laterites and shallow groundwater depth.

Middle story well developed (*Allocasuarina fraseriana*, *Xylomelum occidentale*, *Xanthorrhoea* spp, *Persoonia longifolia* and *Banksia grandis*).

Species in understory are very variable reflecting diverse combination of soils and groundwater.

Climate

Per Humid. Less of an influence due to overriding influence of the soils and landscape.

Soils and Landforms

Soil variability laterite and suites of coloured sands to loamy sands (red, yellow, brown, grey and white) in deep swales and dune slopes as well as at variable depths over laterite and/or with a gravel component. Deep valleys main determining factor.

4.3 Current Extent of Mapped Whicher Scarp Forest Ecosystem and Vegetation Complexes

Approximately 41 per cent (9,783 ha) of the original extent of the Whicher Scarp is covered by native vegetation, which is classified into seven vegetation complexes. Table 3 illustrates the extent and percentage of vegetation complexes that make up the Whicher Scarp Forest Ecosystem as defined by this Expert Panel. The categories of Pre-European area, tenures and reservation status, follow the definitions used for the current Forest Management Plan, as this was the basis for determination of the reserve proposals, against which this Whicher Scarp report has been evaluated.

Table 3 Whicher Scarp Vegetation Complexes as defined by the Regional Forest Agreement by Reserve Status and Forest Management Branch updated vegetation complex mapping (after Mattiske and Havel 1998; Strelein *et al.* 2011)

Vegetation Code	Total pre-1750 extent	Present extent	Proportion of pre-1750 area remaining (%)	Private Property (ha)	Other Public land (ha)	Formal Reserves (ha)	Informal Reserves (ha)	Area Formal and Informal Reserves (ha)	DEC lands outside formal and informal reserves (ha)	Proportion of pre-1750 area in Formal Reserves (%)	area in Formal / Informal Reserves (%)
CSs	2,967	465	16	381	0	31	6	37	47	1	1
WC	4,617	3,145	68	570	97	365	262	627	1,851	8	14
WCv	599	327	55	115	23	0	42	42	147	0	7
Y	9,045	3,475	38	1,259	294	279	270	549	1,373	3	6
Yd	2,215	1,255	57	854	170	38	193	230	0	2	10
Yf	36	6	18	6	0	0	0	0	0	0	0
Yw	4,215	1,110	26	643	99	35	332	368	0	1	9
Whicher Forest Ecosystem	**23,694**	**9,783**	**41**	**3,828**	**683**	**748**	**1105**	**1853**	**3,418**	**3**	**8**

Photograph 4 Wendy's Logania (*Logania wendyae)* is a Whicher Scarp endemic, confined to the North Whicher Scarp (currently only known from Dardanup, Boyanup and Argyle forests) and is listed as Priority 1. This species was first located in the Dardanup Forest Block by G Keighery in the late 1990s during a CALM, DEP and Wildflower Society of WA botanical survey.

4.4 Analysis against Forest Management Plan thresholds

The Whicher Scarp has been clearly defined as a unique forest ecosystem in terms of floristic composition and its position in the landscape. The Expert Panel considers that the Whicher Scarp needs to be recognised as a regional forest ecosystem in the 2013 review of the Forest Management Plan.

Based on the criteria used in the FMP the Whicher Scarp would also be classified as a "poorly reserved forest ecosystem" with less than 15 per cent of its pre-1750 extent in formal and informal reservation (Table 3). In addition to this the Scarp should be given consideration as a 'Vulnerable Forest Ecosystem' (Commonwealth of Australia 1997) given that almost the entire forest ecosystem is subject to continuing and significant threatening processes from current or pending mineral tenements (EPA 2009). Since a significant proportion of the vegetation complexes are outside DEC-managed land there are also concerns for clearing or gradual decline from grazing, inappropriate fire regimes, *Phytophthora* dieback and other threats.

The component vegetation complexes CSs and Yf, when considered individually, also meet the FMP criteria for treatment as "less well reserved vegetation complexes" since the proportions contained in formal and informal reserves is less than 5 per cent of the pre-1750 area (or between 5 per cent and 10 per cent and less than 15 per cent remaining). Current remnant vegetation mapping, if reviewed for intactness or condition, may also mean that vegetation complexes WCv, Y, Yd and Yw qualify as "less well reserved vegetation complexes", as they comprise relatively small areas and are just above the identified thresholds.

Recommendation 1

DEC should:

- recognise the Whicher Scarp as a 'forest ecosystem' in the next Forest Management Plan;
- consider the recognition of the Whicher Scarp forest ecosystem as a vulnerable forest ecosystem in the next Forest Management Plan;
- seek additional reservation of the Whicher Scarp to meet accepted targets for conservation reserves in forests;
- exclude timber harvesting and new BRM removal from the Whicher Scarp for the remainder of the current FMP and considered it for addition as a "poorly reserved forest ecosystem" informal reserve in the next FMP if reservation targets are not met by new reserves; and
- consider the vegetation complexes that comprise Whicher Scarp for recognition as "less well reserved vegetation complexes" and hence informal reserves in the next Forest Management Plan if reservation targets are not met by new reserves.

4.5 Extent of the Whicher Scarp Forest Ecosystem Values

The Whicher Scarp forest ecosystem values are considered to extend beyond the mapped boundaries of the Whicher Scarp forest ecosystem. This is consistent with Keighery *et al.* (2008a) who considered the values to extend approximately a kilometre onto the Blackwood Plateau and half a kilometre onto the Swan Coastal Plain (Map 3). Along watercourses into the Blackwood plateau these values can extend for up two kilometres which is incorporated into the buffer zone indicated on Map 3.

To reflect the above, the eight Whicher Scarp public land Reference Areas (Keighery *et al.* 2008a, EPA 2009) were mapped to include the mapped extent of the Whicher Scarp landform and the buffer. These were named for the Forest Block on which they are centred, being: Yelverton forest, Treeton forest, Whicher forest, Abba forest, Happy Valley forest, Argyle forest, Boyanup forest and Dardanup forest.

5 Conservation of the Whicher Scarp Values

The Whicher Scarp supports a distinctive, often restricted, set of plant communities and an associated rich flora characterised by a significant number of populations of endemic, relictual, disjunct and rare species (Section 3). The Whicher Scarp plant communities are mapped in seven Whicher Scarp vegetation complexes, which are here considered to form the Whicher Scarp forest ecosystem (Section 4).

The Whicher Scarp is represented in four land categories of DEC-managed conservation reserves.

- National Park – A section of the Yelverton forest (West Whicher Scarp) is within the main block of the Yelverton National Park (Map 4). The northern portion of the Whicher National Park contains some of the Whicher Scarp (Central Whicher Scarp) (Map 5).
- Nature Reserves – Two Nature Reserves, Haag Nature Reserve and the unnamed Nature Reserve 45533 on Gale Road (Gale Road Ironstones) are located on the Whicher Scarp. A third reserve Walburra Nature Reserve is found within the Whicher Scarp buffer (Map 4).
- Conservation Park - The northern most extent of the Whicher Scarp is within Dardanup Conservation Park (North Whicher Scarp) (Map 6).
- Forest Conservation Areas – the remaining area of the Yelverton Forest Block outside the National Park (identified as Yelverton FCA, which is ID117 in FMP reserve proposals) (Map 4) and the northern portion of the Whicher Forest Block contiguous with the National Park are Forest Conservation Areas (Map 5).

In addition to these areas there are several other Public conservation reserves supporting Whicher Scarp vegetation of which only one, Gwindinup Reserve (Reserves 2307 and 25500) is managed for conservation of flora and fauna by the Capel Land Conservation District Committee (Table 4).

Table 4 lists DEC-managed estate together with contiguous public reserves and isolated public reserves within the Whicher Scarp reference area that are greater than 20 ha in size. The table provides details on the current purposes of the Scarp's public reserves and an indication of which ones the Panel has identified for conservation consideration.

Table 4 Current and proposed status of public lands

Sector	Public Land area	Current Category	Propose to consider for:
West Whicher	Creekview Rd Res.12492	Landscape Protection	No proposed change
	Yelverton Forest	National Park (FMP ID 116)	No proposed change
	Yelverton Forest	FCA (FMP ID 117)	No proposed change
	Blythe Rd Res.29192	Gravel/Sand	Yelverton FCA
	Blythe Rd Res.36715	Parklands	Yelverton FCA
	Thornton Rd Res.38077	Unknown	No proposed change
	Haag Rd Res.37010	Haag Nature Reserve	No proposed change
	Gale Rd Res.45533	Nature Reserve	No proposed change
	Walburra Res.20258	Walburra Nature Reserve	No proposed change
	Payne Rd Res.25325	Gravel, Recreation	No proposed change
	Payne Rd Res.37348	Unknown	No proposed change
	Gale Rd Res.37063	Unknown	New conservation estate
	Gale Rd UCL loc.2569	Unallocated Crown Land	New conservation estate
	Gale Rd UCL loc.2570	Unallocated Crown Land	New conservation estate
	Gale Rd Unnumbered UCL	Unallocated Crown Land	New conservation estate
Central Whicher	Treeton Forest	State Forest/Timber Reserve	New conservation estate
	Chapman Hill Rd Res.18520	Gravel	No proposed change
	Acton Park South Rd Res.46145	Water retention	No proposed change
	Whicher Forest (WHS 1)	State Forest/Timber Reserve	Whicher N/P
	Whicher Forest	National Park (FMP ID 119)	No proposed change
	Whicher Forest	FCA (FMP ID 117)	No proposed change

Sector	Public Land area	Current Category	Propose to consider for:
	Piggott Rd Res.24564	Gravel	Whicher N/P
	Vasse Hwy Res.22455	Gravel	Whicher FCA
North Whicher	Abba River Res.18915	Timber	New conservation estate
	Abba Forest	State Forest/Timber Reserve	New conservation estate
	Thompsett Rd UCL loc.1783	Unallocated Crown Land	New conservation estate
	Thompsett Rd UCL loc.1784	Unallocated Crown Land	New conservation estate
	Thompsett Rd UCL loc.1793	Unallocated Crown Land	New conservation estate
	Tutunup Rd Res.18047	Unknown	New conservation estate
	Happy Valley Forest	State Forest/Timber Reserve	No proposed change
	Goodwood Rd Res.14076	Timber	No proposed change
	Goodwood Rd Res.21313	Unknown	No proposed change
	Goodwood Rd Res.312188	Unknown	No proposed change
	Argyle Forest	State Forest/Timber Reserve	New conservation area
	Timber Res.177/25	Timber Reserve	New conservation estate
	South West Hwy Res.18237	Unknown	No proposed change
	Gwindinup Res.25500	Conservation flora fauna	No proposed change
	Gwindinup Res.2307	Conservation flora fauna	No proposed change
	Donnybrook Forest	State Forest/Timber Reserve	No proposed change
	Boyanup Forest	State Forest/Timber Reserve	No proposed change
	Dardanup Forest	Conservation Park	No proposed change
	Dardanup Forest (Dard 1)	State Forest/Timber Reserve	Dardanup C/P
	Dardanup Forest (Dard 2)	State Forest/Timber Reserve	Dardanup C/P
	Ferguson Rd Res.8439	Unknown	Dardanup C/P

The following sections outline the strategies recommended for the conservation of the vegetation and flora values of the Whicher Scarp.

5.1 Additional reserves on DEC-managed lands

The DEC reserve system does not adequately represent the Whicher Scarp forest ecosystem. Although 41 per cent of Whicher Scarp remains vegetated, only 3 per cent is located in formal and 8 per cent in formal and informal reserves (Table 3). DEC has scope to increase the protection the Whicher Scarp forest ecosystem in formal reserves. However, due to the fragmented nature of the DEC estate, and the significant areas of the Whicher Scarp occurring on lands that are not vested in the Conservation Commission, this strategy alone will not provide adequate protection of the significant flora values of the Whicher Scarp.

The current extent of reservation of the Whicher Scarp Forest Ecosystem is approximately 1700 ha short of the amount required to achieve a 15 per cent reservation target for a CAR Reserve System. Under the JANIS criteria, no quantitative targets apply for vegetation complexes. However, application of the 'representativeness' principle is designed to ensure that the diversity within each forest ecosystem is represented within the reserve system. Vegetation complexes are a reflection of the diversity within forest ecosystems and all vegetation complexes should be sampled within the reserve system, if possible. The Forest Management Plan 2004-2013 recognised less well reserved vegetation complexes where the proportion contained in formal and informal reserves is less than 5 per cent of the pre-1750 area or between 5 per cent and 10 per cent and less than 15 per cent remaining, and sought to provide additional protection to such vegetation complexes in order to improve representativeness of the conservation reserve system.

The Expert Panel recognises that the decision to change tenure or amend the existing tenure boundaries will not be made on the basis of this report alone. Rather, it will form part of the process for development of the next Forest Management Plan. None-the-less there does appear to be scope to increase the reservation of Whicher Scarp Vegetation Complexes on DEC-managed land, for example the Yelverton (Y) complex.

5.1.1 Design considerations for new reserves

The Panel considered the following criteria to be important in the development of reserve design proposals for additions to or new formal conservation reserves:

- boundaries should facilitate ease of management;
- boundaries should follow tenure boundaries or existing roads, wherever possible;
- boundaries should be appropriately constructed and located to minimise additional areas of un-infested forest at risk of *Phytophthora* dieback;
- boundaries should utilise existing roads where possible, and be located to minimise the amount of new construction required; and
- the location of new boundary roads should not put significant flora and vegetation (DRF, TEC, PEC) at risk of disturbance from disease, soil erosion or deposition.

Further considerations to assist with fire management can include:

- roads should be located on the north side of river and stream zones;
- roads should be located on the western side of river and stream zones; (both these are recommended so that the riparian zone, which is generally the last fuel type to burn, will be excluded from the burn, or will blow into the burn under the influence of a north west / south west wind change. This will assist in reducing the potential for burn escape);
- burn boundaries should be located as much as is practical, in a single fuel type (as this will assist with burn security); and
- roads used as burn boundaries should be reasonably straight (as this will provide for increased burn security, and a safer boundary for fire crews).

5.1.2 Consolidation of existing Conservation lands

Keighery *et al.* (2008a) presented a series of broad recommendation to expand upon existing reserves and proposes new reserves to more securely conserve the conservation values of the West, Central and North Whicher Scarp (Map 1). The Panel reviewed these recommendations and took into account natural values of the Whicher Scarp, the extent of the Whicher Scarp values (Map 3) and management considerations.

As outlined previously there are four formal conservation areas on the Whicher Scarp: Haag Nature Reserve; Yelverton National Park; Whicher National Park; and the Dardanup Conservation Park. Specific flora and vegetation studies into these areas (Keighery *et al.* 1996, 2008b and Keighery *et al.* 2010) have shown that high conservation values exist in public lands outside these formal areas.

West Whicher Scarp: Yelverton National Park

Significant areas of the upland and wetland communities, including the PECs (Table 2 - B2 and G2) associated with the West Whicher Scarp as well as populations and habitat of a series of significant species (Keighery *et al.* 2010) and the interface of the Whicher Scarp and the Margaret River Plateau occur in Yelverton forest outside the boundaries of the Yelverton National Park and on Crown Reserves 29192 and 36715 (Map 4).

Central Whicher Scarp: Whicher National Park

Whicher Scarp plant communities occur on DEC estate and Crown Reserves 24584 and 22455 outside the northern boundary of Whicher National Park. The values include areas of restricted and rare communities and PECs (Table 2 - A1 and C1) associated with sandy slopes north of Sabina Road and populations and habitat of a number of significant species including *Lambertia rariflora* subsp. *rariflora* (P4), *Actinotus whicheranus* (P2, recommended for listing as Declared Rare Flora (DRF)) and *Platythec*a sp. *sabina* (G.J. and B.J. Keighery 295) (recommended for listing as P1). Additional work by Keighery *et al.* 2008a has established that the values attributed to the area in 1974 (CTRC 1974) continue to be demonstrated in the area, and at a higher level than originally shown (Map 5).

North Whicher Scarp: Dardanup Conservation Park

A series of reports/publications have identified very significant flora and vegetation values for the entire area of the Dardanup Forest Block, (Keighery *et al.* 1996, 2008a, 2008b). The values include the largest remaining interface of contiguous vegetation of four major landforms (Swan Coastal Plain, Whicher Scarp,

Blackwood Plateau, Darling Scarp), the only recorded location of the PEC-C5 (Table 2) and a particularly diverse flora of more than 450 native plant taxa with the following particular values:

- contains significant representations of the flora of the four major landforms it encompasses;
- supports large number of significant taxa including at least 11 at the end of their range; and
- contains important populations of Whicher Scarp endemics including *Gastrolobium whicherense*, *Stylidium perplexum* [previously *Stylidium* sp. Dardanup (G.S. McCutcheon 1066)], *Synaphea polypodioides, Lomandra whicherensis* and *Logania wendyae*.

In consideration of these previously documented values, the panel considers that the areas of State forest that are labelled Dard 1 and Dard 2 on Map 6 and have been mapped as containing Whicher Scarp communities (Keighery *et. al* 2008b), be considered for inclusion in a consolidated conservation vesting proposal for Dardanup Block.

5.1.3 Recommendations for new Conservation Lands

The Panel has reviewed the extent of the Whicher Scarp communities outside the conservation reserves and identified the values suitable for conservation reserves, which are not contiguous with existing or proposed conservation estate, and could form the basis for new conservation reserves;

Central Whicher Scarp: Treeton forest

The northern extent of Treeton forest (Map 4) supports substantive Central Whicher Scarp flora and vegetation values of which the most significant is four occurrences of the Critically Endangered Busselton Ironstone TEC (Table 1). Other values of the forest area include:

- Representation of two Whicher Scarp vegetation complexes being Yelverton (Y and Yw).
- Areas of the restricted and rare upland Whicher Scarp floristic community types C1 and C2, both listed as PECs (Table 1).
- Large numbers of significant taxa including at least five taxa at the end of their range and a series of rare taxa including *Daviesia elongata* subsp. *elongata* (DRF), *Lambertia rariflora* subsp. *rariflora* (P4), *Gastrolobium modestum* (DRF) and *Dryandra nivea* subsp. *uliginosa* (DRF).
- Despite pine plantation establishment and historical gravel extraction which has lead to some vegetation fragmentation, the remaining vegetation has a high degree of intactness.

Pine plantations would need to be excluded from any consideration of this area for conservation reservation. Historical gravel pits should be rehabilitated and included in any conservation consideration if this provides an improved management boundary.

North Whicher Scarp: Abba forest

The Abba forest (Map 5) supports substantive North Whicher Scarp flora and vegetation values including a large occurrence of the Critically Endangered Busselton Ironstone TEC that includes the only known populations of three Critically Endangered species (*Lambertia echinata ssp. occidentalis, Darwinia whicherensis, Gastrolobium papilio*). Other values of the forest area include.

- Representation of six Whicher Scarp vegetation complexes, being the Yelverton (Y and Yw and Yd), Whicher (WCv and WC) and Cartis (Cs).
- Four Whicher Scarp floristic community types typical of the restricted sandy north/north-west facing slopes (Table 2 - A2, A3, A4 and C2), one of which is a listed PEC (C2).
- Restricted and rare wetland communities associated with the Whicher Scarp/Swan Coastal Plain Interface and upland Whicher Scarp groundwater seepages, both types of which are listed as PECs (G2 and Swan Coastal Paluslope wetlands).
- The largest area of vegetated Whicher Scarp/Swan Coastal Plain interface through public and private lands, including the only complete transect of the Swan Coastal Plain (south of Shire of Serpentine-Jarrahdale). This transect along Ruabon-Tutunup Road includes a series of listed TECs (Webb *et al.* 2009).
- Supports diversity of the flora of the North Whicher Scarp, a large number of significant taxa including at least 18 at the end of their range, a series of rare taxa such as *Astroloma* sp. Nannup (R.D. Royce 3978) (P4), *Hemigenia rigida* (P1), *Pultenaea skinneri* (P4) and *Acacia flagelliformis* (P4) and many populations of disjunct taxa including *Actinostrobus acuminatus.*

Small areas of pine plantation within this area would need to be excluded from any consideration of this area for conservation reservation.

North Whicher Scarp: Argyle forest

The Argyle forest (Map 6) supports substantive North Whicher Scarp flora and vegetation values in what is considered to be in the least disturbed condition (Keighery *et al.* 2008a). The area includes the largest known examples of the very restricted Whicher coloured sands PEC (C2) (DEC 2010a). Other values of the forest area include:

- Representation of three Whicher Scarp vegetation complexes, being Cartis (CSs) and Whicher (WCv and WC).
- Plant communities of the Whicher Scarp sandy slopes (Table 2 - A3 and C2), a group of communities associated with laterites (Table 2 - C3 and C4) and a group of communities on grey sands that are shared with those of the Swan Coastal Plain (Table 2 - B1).
- Supports the diversity of the flora of the North Whicher Scarp and extensive populations of a large number of significant taxa including at least nine taxa at the end of their range and a series of rare taxa including *Daviesia elongata* subsp. *elongata* (DRF), *Logania wendyae* (P1), *Stenanthemum sublineare* (P2) and the newly recognised taxa, *Lomandra whicherensis* and *Platytheca anasima* (P1).
- A very high degree of intactness of native vegetation in what is considered the least disturbed area of the Whicher Scarp and adjacent Blackwood Plateau.
- The catchments of Camp Gully and Britten Gully that are of particular interest in terms of Whicher Scarp and Swan Coastal Plain plant communities.

Recommendation 2

DEC should incorporate the Whicher Scarp values into future reserve design assessments to ensure that there is adequate representation of values of each of the West, Central and North Whicher sectors in reserve.

5.2 Reserves on Non-DEC public lands

In some cases other public land that are contiguous with the DEC estate or have significant expressions of Whicher Scarp values need to be considered for secure conservation vesting. Many of these reserves are currently being used for Basic Raw Materials (BRM) supply and a variety of other potentially incompatible uses (Table 4). Such reserves contiguous with DEC estate have been highlighted in Table 4. The reserves that are not contiguous also should be considered for secure vesting.

West Whicher Scarp: Gale Road Crown and UCL Reserves

The large body of remnant vegetation comprised of Crown Reserve 37063 and UCL locations 2569, 2570 and an unnumbered UCL reserve south-east of the junction of Gale and South Carbunup Roads (Map 4) supports Whicher Scarp vegetation together with a large transitional area of Whicher Scarp / Blackwood Plateau interface vegetation. This area supports West Whicher Scarp flora and vegetation values including the following;

- representation of the Whicher Scarp Yelverton (Y) vegetation complex;
- provides a significant linkage opportunity between the Central and West Whicher Scarp;
- contains a range of plant communities of wetlands and sands of the Whicher Scarp (Table 2 - E, G2, B, C2) and laterites of the Blackwood Plateau and Leeuwin Block. The occurrence of the Whicher Scarp C2 (PEC listed) community is at its western most extent;
- a high degree of intactness of the remnant vegetation (predominantly of an Excellent condition); and
- the reserves have plant communities representing the interface of the Leeuwin Block, Blackwood Plateau and Whicher Scarp landforms.

The Panel acknowledges the efforts of the Busselton Shire in the implementation of a Biodiversity Incentive Strategy to encourage the voluntary long term preservation of native vegetation. The strategy uses subdivision and rate rebate incentives to support landholders in the protection of high value remnant vegetation. Given the Busselton Shire includes the western, central and some of the northern Whicher Scarp this strategy is of considerable value in assisting the conservation of Scarp vegetation on private property.

Nature Conservation Covenants administered by DEC and National Trust Western Australia and the Land for Wildlife program administered by DEC support the implementation of the Shire strategy by facilitating vegetation protection and conservation management.

Recommendation 3

DEC should seek to:

- work with the relevant LGA to prevent further clearing of intact Whicher Scarp vegetation on Crown reserves within the Whicher Scarp;
- work with the relevant LGA to facilitate the rehabilitation of disturbed lands with a view to possible future incorporation into adjoining proposed conservation reserves; and
- establish a West Whicher Scarp conservation area in the Gale Road area by seeking DEC vesting of Crown Reserve 37063 and UCL Locations 2569, 2570 and the adjoining un-numbered UCL location (Map 4).

6 Environmental and threatening processes and their management

6.1 Weeds, feral animals and pests

The Whicher Scarp is notably free of weeds despite it being in close proximity to a number of rapidly developing communities, notably Busselton and Dunsborough, as well as a number of smaller rural communities such as Dardanup, Boyanup, Capel and Donnybrook. It is the closest area of public forest encountered by people seeking firewood, or who are dumping domestic and garden waste. The impact of these activities is noted to be increasing, particularly within forest blocks such as Treeton, Happy Valley and the southern extent of Argyle. It is likely that such activities are resulting in the introduction of weeds and other degradation, and it is expected that these impacts will increase with increasing local populations.

With its long perimeter with surrounding cleared lands it will be subject to on-going weed invasion threats from agricultural and environmental weeds. Invasion of perennial pasture grasses, such as Veldt Grass along tracks and edges is an ongoing issue. Areas of very high conservation value, such as areas with threatened and priority species and communities should be the priority for control. The relationship between increased cover of these grass weeds and fire (frequent fire increasing weed cover and the contributing to an increased fuel load) needs to be monitored and addressed before irreversible damage occurs. Areas that have been subject to other uses such as settlements and sand and/or gravel mining are nodes for weed invasion and should be targeted for inspection and control. An example of this is the Gwindinup Reserve where there have been numerous activities associated with an old settlement. Sand mining and rubbish dumping has introduced localised infestations of bulbous weeds such as Freesia, *Ferraria crispa* and *Lachenalia aloides* and the shrub *Genista canariensis*.

The Panel considers that there are a number of principles that can be applied to the management of weed flora, and that these are:

- monitoring and control of recognised declared and environmental weeds should focus on high priority areas in the Whicher Scarp to ensure that weed invasion is limited to as low level as practicable;
- monitoring for Alert species (such as bulbous weeds and succulents) which may become a problem under climate change, should focus on old settlements, sand mines and rubbish dumping sites to identify localised infestations and
- operations in the Whicher Scarp should include particular weed hygiene requirements to reduce the risk on weed introduction and spread.

The Whicher Scarp has a number of softwood plantations on DEC-managed land that are managed and harvested by the Forest Products Commission (FPC). The Forest Management Plan 2004-2013 (FMP) Action 18.6 states that:

18.6 The Forest Products Commission will:

18.6.1 monitor for the presence of significant weeds, pests and diseases in plantations, and where reasonable and practicable undertake control measures;

18.6.2 develop and implement weed, pest and disease control programs for identified weeds, pests and diseases;

18.6.3 where there is an identified risk that plantation operations may result in transport of Phytophthora cinnamomi, conduct its operations having regard to the policy and in accordance with the Guidelines referred to in Action 18.2; and

18.6.4 take reasonable and practicable measures to control the spread of plantation species into adjacent native vegetation.

The Panel considers it appropriate for DEC to liaise with FPC to address these issues.

The Whicher Scarp has a number of softwood and hardwood plantations established on land outside DEC-managed land. These plantations are managed and harvested by private individuals and companies and may

have an impact on the adjoining Whicher Scarp. It is appropriate for DEC to work with these private plantation owners and managers to prepare plans to control pine wildings in a similar manner to that used for the FPC.

The main concern for feral animals and pests in the Whicher Scarp are those that will spread plant diseases or contribute to the loss of plant biodiversity. Therefore it is intended that the activities of species such as rabbits, pigs, goats and deer be monitored and control measures implemented as appropriate. In these cases it is appropriate for DEC to work with neighbours to undertake joint or complementary feral animal control where species are found on adjoining lands.

Recommendation 4

DEC should:

- incorporate the Whicher Scarp into areas of "high conservation significance" for the purpose of monitoring and planning of weed, feral and pest species control programmes on DEC-managed land as soon as possible; and
- recognise the Whicher Scarp as a priority area for the control of weeds and wildings in plantations by FPC and adjacent to plantation managed by FPC and other plantation owners.

6.2 *Phytophthora* dieback

Phytophthora dieback is considered widespread and a major threat to the floristic values of the Whicher Scarp. It is important that all activities within the Scarp effectively manage *Phytophthora* dieback to ensure that protectable areas remain free of the pathogen. The Panel considers that an important step to managing the disease is to identify large non-infested areas and assess these areas for their protectability.

DEC currently requires that all disturbance operations on DEC-managed estate are conducted according to a Hygiene Management Plan. The Panel considers that the overall hygiene management across Whicher Scarp would be enhanced by the following requirements:

- proponents be required to quantify risks to uninfested areas, for all disturbance activities in and adjacent to Whicher Scarp;
- that the level of acceptable risk of disease introduction and spread be reduced to the lowest practicable level for all disturbance operations on DEC-managed land in the Whicher Scarp;
- roads should be constructed or upgraded to an appropriate standard to minimise the risk of pathogen spread;
- plantation operations on DEC-managed estate adjoining non-infested Whicher Scarp communities to be conducted with appropriate hygiene and timing to reduce the likelihood of disease introduction or spread;
- DEC should work with adjoining landowners and plantation operations adjoining non-infested Whicher Scarp communities to try to have plantation establishment, tending or harvesting operations conducted with appropriate hygiene and timing (e.g. dry soil access); and
- the appropriate use of amelioration treatments such as phosphite application to protect important values within the Whicher Scarp.

Recommendation 5

DEC should:

- map the *Phytophthora* dieback occurrence within the Whicher Scarp to identify disease free areas as 'Protectable Areas' for management; and
- facilitate the development of a regional Hygiene Management Plan for the Whicher Scarp, to inform decisions regarding acceptable risk, hygiene implementation and the use of amelioration treatments.

6.3 Recreation and tourism

A number of informal and formal recreational activities have historically occurred within the Whicher Scarp and adjoining forest. Informal use of the area by walkers, horse riders, trail and mountain bike riders continues in the Whicher Scarp. These uses have the potential to spread dieback and weeds. Formal events such as endurance horse riding, trail bike and mountain bike events occur within the Whicher Scarp. It is important to continue to manage approved recreation activities, commercial tourism operators and to discourage inappropriate recreation activities.

The Panel considers that:

- the existing network of recreation tracks and trails through Whicher Scarp communities should be reviewed. Those considered to be unnecessary or posing an unacceptable risk to uninfested areas, priority flora or threatened ecological communities within the Whicher Scarp should be closed and rehabilitated or relocated;
- new track and trail construction through the Whicher Scarp be avoided;
- Blackwood and Wellington Districts to work with user groups to monitor impacts of approved trails.

Recommendation 6

DEC should not approve any organised recreational activity or new recreation development within Whicher Scarp that could impact negatively on the conservation values of the Whicher Scarp communities.

6.4 Changing hydrology

The Whicher Scarp has unusual ground water interactions resulting in unique plant communities. The Panel considers that activities such as drainage for agricultural and semi urban development, mine de-watering, the establishment of above-ground water supplies (e.g. dams, water-points) and the establishment of large scale groundwater abstraction for domestic or agricultural purposes, could change the hydrology of TECS, PECS or wetlands.

In addition the Panel notes that changes to the surface hydrology, the drying of inundated areas or the uncovering of some soil types can activate the development of acid sulphate soils. Once activated these processes are very difficult to stop or ameliorate and the best option is seen to be prevention. The Panel considers that the following actions could assist with the management and amelioration of these risks:

- drainage proposals associated with agricultural and subdivision development consider and ameliorate the impact on the floristic communities of the Whicher Scarp;
- impact caused by de-watering during mining on the floristic communities of the Whicher Scarp be monitored and ameliorated;
- no above-ground water supplies be constructed within Whicher Scarp vegetation or in a location that will inundate vegetation of the Whicher Scarp;
- the construction of new water points in areas prone to acid sulphate soil should be avoided; and
- existing DEC water points should be assessed prior to maintenance or upgrading to determine whether they are affecting the hydrology of high priority areas of Whicher Scarp, and considered for relocation and rehabilitation if this is occurring.

The Panel considers the risk to soil values from the activation of acid sulfate soils will be minimised by:

- ensuring that planning identifies the risk zone associated with acid sulphate soils for the operation;
- managing operations in areas identified as having the potential to disturb acid sulphate soil in accordance with DEC Guidelines *Treatment and management of soils and water in acid sulfate soil landscape;*
- ensuring action is taken to mitigate the impact, if acid sulphate soils are activated; and
- ensuring that the scale of any proposed disturbance in susceptible sites is reduced to the smallest possible extent.

Recommendation 7

DEC should:

- provide comment in relation to proposals to impound water or extract large volumes of groundwater within or adjacent to the Whicher Scarp landform with the aim of seeking to minimise the impact of the proposals on the conservation values of the Whicher Scarp, and these should require;
    - appropriate impact modelling;
    - the development of an ongoing monitoring program; and
    - contingency plans should adverse environmental impacts result.
- require that proponents address issues associated with acid sulphate soils, with the intention of preventing or minimising the potential for activation of these soil processes.

6.5 Clearing

Currently there are a number of active and pending mining tenements across the entire extent of the Whicher Scarp. These activities pose a significant threat to the values of the Whicher Scarp and any current or future assessment process should reduce or negate the impact on the values of the Scarp.

Recommendation 8

DEC should ensure that:

- advice on all exploration proposals in the Whicher Scarp includes measures to minimise vegetation clearing and requires the development of a Hygiene Management Plan;
- DEC comments on future mining proposals seeks to minimise impacts on the Whicher Scarp; and
- advice to the EPA on requests to amend or extend current mine plans requires consultation with DEC to identify and protect the floristic values of the Whicher Scarp.

The Whicher Scarp is currently intersected by a range of road types of varying standards. The construction of new roads through the Whicher Scarp, and establishment of new Basic Raw Material (BRM) pits on the Whicher Scarp should be avoided. All road construction and maintenance should use appropriate hygiene practices and existing roads that put non-infested areas under threat from *Phytophthora* dieback should be considered for realignment. Road upgrading through the Whicher Scarp communities should only occur where viable alternatives do not exist and if approved should minimise disturbance to the Whicher Scarp communities. FMP Action 10 requires the Department to progressively rehabilitate redundant roads and the Panel considers that the existing road network through Whicher Scarp communities should be reviewed by Blackwood and Wellington District, and unnecessary roads closed and rehabilitated.

The construction of any new utility infrastructure within the Whicher Scarp should be co-located within existing corridors and/or established on adjacent private land rather than Whicher Scarp vegetation. Maintenance works associated with pipeline and powerlines should be limited to the existing corridor and be conducted with appropriate hygiene. Management and maintenance activities within the Whicher Scarp should be undertaken according to an approved Hygiene Management Plan.

The Panel recognizes that Whicher Scarp communities exist on agricultural land and intact communities should be identified and protected from degradation. The interaction with agriculture is predominately via applications for clearing of native vegetation which should recognize the values of the Whicher Scarp.

The Panel recognizes that Whicher Scarp vegetation communities exist on land proposed for rural and semi-rural subdivision and intact communities should be identified and protected from clearing and degradation. DEC has interaction with the development process via a range of planning processes and should aim to provide information and advice to decision makers to protect the Whicher Scarp.

A number of BRM pits within the Whicher Scarp have been accessed previously by Local Government Authorities and other agencies (e.g. Main Roads Western Australia, Water Corporation) using Notice of

Entry conditions under the Local Government Act (1995). These include gravel pits used primarily for road building purposes, and sand pits used primarily for land fill and construction purposes. The pits vary in their current status of use, completion and rehabilitation. It is envisaged that further pits not be approved, however, the rehabilitation of existing pits will be facilitated. 'Worked out areas' may be revisited with new techniques to facilitate further extraction, landscaping and rehabilitation on a case by case basis.

Recommendation 9

DEC should:

- ensure the determination of clearing requests by Native Vegetation Clearing Section recognises the Whicher Scarp as an area of "high conservation significance";
- require that the species listed in Appendix 2 of this Report be used by botanists as "significant species" for the purpose of flora surveys in association with proposed disturbance activities in and adjacent to the Whicher Scarp Forest Ecosystem; and
- require that for the purpose of flora surveys associated with proposed disturbance activities in/adjacent to the Whicher Scarp that botanists are familiar with and can recognise Priority Ecological Communities of the Whicher Scarp in the field (Table 2).

6.6 Fire management

Fire is an integral part of the natural environment and the Panel does not consider fire as a direct threat to the native plant communities within the Whicher Scarp. On-going prescribed burning is appropriate, however the Panel recognized the importance of maintaining a range of fuel ages.

In order to minimise the unintended impacts of fire management activities on the values of the Whicher Scarp the Panel considers that unnecessary clearing or burn boundary upgrades should be avoided in Whicher Scarp communities. In addition burn boundaries that place non-infested areas of the Whicher Scarp at risk of infestation by *Phytophthora* dieback should be considered for relocation or closure and rehabilitation.

Activities associated with fire suppression and prevention activities (e.g. fire breaks maintenance) have the potential to spread *Phytophthora* dieback and weed species, and should be carried out with appropriate hygiene. It is considered appropriate that fire lines placed through the Whicher Scarp are rehabilitated as soon as possible after the fire is declared safe. The success of post fire rehabilitation should be monitored by District staff to ensure that the alignments are stabilised and revegetated.

Recommendation 10

DEC should:

- ensure that Regional Fire Management Plans provide for a range of understorey ages within Whicher Scarp communities; and
- identify areas of the West, Central and North Whicher Scarp that may be suitable as Fire Reference Areas, and have these incorporated into the Regional Fire Management Plan.

6.7 Other disturbance activities

If the recommendations are accepted that the Whicher Scarp forest ecosystem qualify as a "poorly reserved forest ecosystem" and is managed as if it is an informal reserve, then this will exclude timber harvesting. In this case the on-going impact of timber harvesting on the Whicher Scarp will be a result of the timber harvesting or haulage activities acting on the down slope native plant communities within the same mini-catchment. These impacts are proposed to be ameliorated by the disease management and road management issues identified above.

If the reservation is increased above 15% as a result of the next FMP, so that the Whicher Scarp does not qualify as a "poorly reserved forest ecosystem", then the Panel recognises that the remaining areas may become available for timber harvesting. In this case it is considered that it would prudent to ensure that dieback-free-areas of any available Whicher Scarp are subject to stringent hygiene to retain their dieback-free status.

With respect to the potential impact of plantation harvesting and tending on Whicher Scarp, it is considered that where these plantation operations adjoin Whicher Scarp communities, that they should be conducted within the plantation and existing cleared breaks, and do not involve disturbance of native vegetation areas within or adjoining the plantations.

Apiary sites require clearing of vegetation and the maintenance of roads or tracks for access. The Panel considers that these impacts could be ameliorated by not approving the establishment of new apiary sites within the Whicher Scarp. Further, where a leaseholder indicates that a site within the Whicher Scarp is no longer required the lease should be abolished and not transferred to another owner.

The FMP provides for harvesting of some wildflower species that occur naturally in stream zones or diverse ecotype zones. The Department is able to prepare a list of such species and District Managers may endorse harvesting in informal reserves for these species, where the harvesting would not significantly impact on the values of the informal reserve. The approval of wildflower picking according to this provision is not supported in Whicher Scarp.

The collection of the firewood from the Bunbury and Busselton hinterlands are a major pressure on the surrounding forest. The collection of firewood is currently managed by providing maps of areas approved for firewood collection, installation of signage and enforcement patrols. DEC has recognised the need to improve the management of this activity in accordance with legal requirements. The Panel considers that DEC could reduce the potential impacts from this activity on Whicher Scarp by:

- not designating or gazetting firewood areas within Whicher Scarp;
- requiring the placement of additional signs in and around the Whicher Scarp area to discourage domestic firewood collection; and
- ensuring enforcement patrols are targeted on the Whicher Scarp to reduce the impact of illegal firewood collection on these communities.

Recommendation 11

DEC should review management processes to prevent or minimise the impact of the disturbance activities associated with the production of timber and other forest products on Whicher Scarp communities.

Photograph 5 The Whicher Boronia (*Boronia humifusa*) in the Argyle forest. This is a North Whicher Scarp endemic that is found in Argyle, Happy Valley and Abba forests. While this species can be locally common, it is restricted in its distribution. This species is listed as Priority 1.

6 Appendices

Appendix 1 Terms of Reference

Provision of Advice on the Conservation Significance and Management Options for the Vegetation, Floristic and other Conservation Values of the Whicher Scarp

1. Background

The report *A Floristic Survey of the Whicher Scarp* (Keighery *et al*. 2008a[1]) identified a range of conservation values of the vegetation and flora of the Whicher Scarp in the Bunbury to Dunsborough area.

2. Purpose

The purpose is to provide advice to the Deputy Director General of Parks and Conservation, using the expert knowledge within the group, on:

- The vegetation and flora values of the Whicher Scarp;
- The conservation significance of the vegetation and flora values in the regional context of the area covered by the Forest Management Plan 2004-2013;
- Other conservation values (fauna, landscape, ecological linkage) of the Whicher Scarp;
- The levels of reservation of these vegetation, flora and other conservation values;
- The threats to the vegetation, flora and other conservation values; and
- Options to manage these threats.

3. Expert Panel

The group will be comprised of:

- Greg Keighery, Science Division;
- Chris Dunne, Science Division;
- Greg Strelein, Sustainable Forest Management Division;
- Bob Hagan (Chair), Sustainable Forest Management Division;
- Gary Whisson, Strategic Policy and Programs Division; and
- Caitlin Prowse, Blackwood District.

4. Timing

The group will report to DDG of Parks and Conservation by end of October 2009.

[1] Keighery GJ, Keighery BJ, Webb A, Longman VM, and Griffin EA (2008a). A Floristic Survey of the Whicher Scarp, Department of Environment and Conservation; Western Australia.

Appendix 2 Significant taxa of the Whicher Scarp (after Table 10 Keighery *et al.* 2008a)

KEY

= Additions/changes since 2008 report (Western Australian Herbarium 1998)

Column 1 **Family**
Families are grouped into Ferns, Gymnosperms, Monocotyledons and Dicotyledons

Column 2 **Scientific Name**
Genus + Species + Infra Species Rank + Infra Species Name + Informal Name from Keighery *et al.* (2008a). Some species names may be modified from original sources of information. Some taxa yet to be formally described and named may have a reference collection number from the relevant collector. Taxa (species, sub-species and varieties) are listed alphabetically within genera.

* Weed
subsp. Subspecies
var. Variety
MS A manuscript name yet to be published
PN A phrase name for a taxon yet to be described and published.

Column 3 **Common Name**

Columns 4 - 8 **Significant Taxa**

Column 4 **WA = Western Australian Listed Taxa**
Significant plant taxa (species, sub-species and varieties) listed under the State *Wildlife Conservation Act 1950* and by the Department of Environment and Conservation (Atkins 2006). Priority taxa conservation code listings are current as at January 2008 (Western Australian Herbarium 1998). See Appendix 1 for further descriptions of the categories below.

R Declared Rare Flora: Extant Taxa
X Declared Rare Flora: Presumed Extinct Taxa
1 Priority 1: Poorly Known Taxa
2 Priority 2: Poorly Known Taxa
3 Priority 3: Poorly Known Taxa
4 Priority 4: Rare Taxa

Column 5 **IUCN = Internationally Listed Taxa**
Significant plant taxa (species, sub-species and varieties) listed according to the *IUCN Red List of Threatened Species* as of December 2006. Taxa are listed on the IUCN website (IUCN 2007). See Appendix 1 for further descriptions of the categories below.

CR Taxa that are critically endangered
E Taxa that are endangered
V Taxa that are vulnerable

Column 6 **Com = Commonwealth Listed Taxa**
Significant plant taxa (species, sub-species and varieties) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* as of December 2006. Taxa are listed on the Department of the Environment, Water, Heritage and the Arts website (DEWHA 2007). See Appendix 1 for further descriptions of the categories below.

E Taxa that are endangered
V Taxa that are vulnerable

In some instances, the codes for the Commonwealth and the Internationally listed taxa differ; in these cases, the discrepancy is indicated by an asterisk in the 'Com' column.

Column 7 **OS = Other Categories of Significance**

z Recently recognised taxa

Significant due to geographical location

- **r** Populations at the northern (N) or southern (S) limit of their known geographic range, limit indicated as follows. Example: r (N or S, Locality, Region).
- **d** Populations disjunct from their known geographic range
- **p** Poorly reserved as is known from only a few populations in reserves (applies to all Declared Rare Flora and Priority taxa)
- **s** Significant populations in reference to location, population size, diversity of ages and/or health (applies to all Declared Rare Flora and Priority taxa)
- **u** Uncommon in the area (generally applies to disjunct populations)

Taxa with regional and/or ecological preferences

Endemic taxa

e	Local endemic, less than 100 km range	
e(AREA)	AREA after Map 3 (Biogeographic region or subregion)	
	SWA	Swan Coastal Plain (Swan Coastal Plain)
	SWA(B)	Busselton area of the Swan Coastal Plain (Swan Coastal Plain)
	WHS	Whicher Scarp (Jarrah Forest South)
	BP	Blackwood Plateau (Jarrah Forest South)
	SC	Scott Coastal Plain (Warren)
	MP	Margaret River Plateau (Warren and Jarrah Forest South)
	JF	Jarrah Forest (Jarrah Forest)
Ne	Extends well north from WHS	
Se	Extends well south from WHS (and adjacent Busselton Plain at times)	

Taxa with ecological preferences

- **h** Taxa with distinct habitat preference Example: h (ironstone)
- **a** Relictual species (monotypic genera are annotated)

Taxa with morphological and/or genetic variation

- **v** Morphological variant, unsure of significance at taxonomic level
- **t** Morphological variant, significant taxonomically
- **g** Genetic variant

Column 8 **Endemic (State)**

Taxa (species, sub-species and varieties) endemic to Western Australia (WA) or Australia (AUST; or >AUST = cosmopolitan). No records are given for weeds (see Hussey *et al.* 2007 for country of origin), unless the plant is also native to WA.

Photograph 6 The Whicher Pultenaea (*Pultenaea radiata)* is confined to the Whicher Scarp and near Blackwood Plateau. This is one of the species at the northern extent of its range in the Dardanup Forest Block and is a dominant species in the Central Whicher Scarp.

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
FERNS							
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair				d,p,s,u,h	AUST
Adiantaceae	*Cheilanthes austrotenuifolia*	Rock Fern				d,p,s,u,h	>AUST
GYMNOSPERMS							
Cupressaceae	*Actinostrobus acuminatus*	Creeping Cypress				d,p,s,u,h	WA
MONOCOTYLEDONS							
Anthericaceae	*Hodgsoniola junciformis*	Rush Lily				p,s,u,Se,h	WA
Anthericaceae	*Johnsonia acaulis*	Small Johnsonia				s,h,v	WA
Anthericaceae	*Johnsonia inconspicua*	Hidden Johnsonia	3			z,r(S,Yelverton, WHS),d,p,s,g	WA
Anthericaceae	*Johnsonia lupulina*	Elegant Johnsonia				Se,h	WA
Anthericaceae	*Laxmannia jamesii*	James' Paper Lily	4		V*	r(N,Whicher NP,WHS),d,p,s,u,a	WA
Anthericaceae	*Thysanotus formosus*	Fringed Lily	1			r(N,Boyanup,WHS),p,s,u,eWHS/BP	WA
Anthericaceae	*Thysanotus glaucus*	Fringed Lily	4			d,p,s,u,h	WA
Anthericaceae	*Thysanotus pseudojunceus*	Fringed Lily				r(N,Dardanup,WHS),d,s,u	WA
Cyperaceae	*Caustis dioica*	Caustis				r(S,Treeton,WHS),d,p,s,u,h,g	WA
Cyperaceae	*Caustis* sp. Boyanup (G.S. McCutcheon 1706) PN	Caustis	1			d,p,s,u,h,g	WA
Cyperaceae	*Cyathochaeta avenacea*	Cyathochaeta				v,t,g	WA
Cyperaceae	*Cyathochaeta clandestina*	Cyathochaeta				d,s,h	WA
Cyperaceae	*Cyathochaeta equitans*	Cyathochaeta				d,s,h	WA
Cyperaceae	*Cyathochaeta* sp. Carbunup (G.J. Keighery 14123)	Carbunup River Cyathochaeta				z,d,p,s,u,eSWA(B)/WHS,h	WA
Cyperaceae	*Cyathochaeta* sp. Sabina (SABI03&06)	Sabina River Cyathochaeta				z,p,s,u,eWHS,h	WA
Cyperaceae	*Cyathochaeta teretifolia*	Cyathochaeta	3			d,p,s,u,h	WA
Cyperaceae	*Evandra aristata*	Graceful Evandra				r(N,West WHS),d,s,u,Se,h	WA
Cyperaceae	*Gahnia decomposita*	Swamp Sawsedge				d,s,u,Se,h	WA
Cyperaceae	*Gymnoschoenus anceps*	Western Button Grass				r(N,West WHS),d,s,u,Se,h,a	WA
Cyperaceae	*Lepidosperma* aff. resinosum (A. Webb 10)	Busselton Lepidosperma				s,u,eSWA(B)/WHS	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Cyperaceae	*Lepidosperma obtusum*	Lepidosperma				r(W,Treeton,WHS),d,s,u,h,g	WA
Cyperaceae	*Schoenus pennisetis*	Schoenus	1			r(S,Goodwood Rd,WHS),p,s,u,h	WA
Cyperaceae	*Schoenus* sp. Whicher (G.J. Keighery and B.J. Keighery 901	Whicher Schoenus				z,s,u,eWHS	WA
Dasypogonaceae	*Baxteria australis*	Baxteria				s,Se,h,a	WA
Dasypogonaceae	*Calectasia narragara*	Blue Tinsel Lily				r(S,Whicher NP,WHS),s,u,h	WA
Dasypogonaceae	*Chamaexeros serra*	Little Fringe-leaf				d,s,u	WA
Dasypogonaceae	*Dasypogon hookeri*	Hooker's Pineapple Bush				r(N,Boyanup,WHS),s,Se,h,a	WA
Dasypogonaceae	*Lomandra spartea*	Lomandra				r(S,Whicher NP,WHS),d,s,u,h	WA
Dasypogonaceae	*Lomandra whicherensis*	Whicher Lomandra				z,r(S,Argyle,WHS),p,s,u,e,h,a	WA
Iridaceae	*Patersonia limbata*	Hairy Flag				r(N,Dardanup,WHS),d,p,s,u,Se	WA
Iridaceae	*Patersonia maxwellii*	Maxwell's Flag				r(S,Yelverton,WHS),d,p,s,u	WA
Iridaceae	*Patersonia occidentalis* var. *angustifolia*	Swamp Flag				z,d,s,u,Se,h	WA
Iridaceae	*Patersonia umbrosa* var. *umbrosa*	Purple Flag				r(N,Gwindinup,WHS),d,p,s,u,eSWA(B)/BP,h	WA
Orchidaceae	*Caladenia longicauda* subsp. *clivicola*	Spider Orchid	4			p,s,u,e	WA
Orchidaceae	*Caladenia plicata*	Crab-lipped Spider Orchid	4			p,s,u	WA
Orchidaceae	*Caladenia speciosa*	Sandplain White Spider Orchid	4			z,r(S,Whicher NP,WHS),p,s,u	WA
Restionaceae	*Chordifex isomorphus*	Chordifex	4			p,s,Se	WA
Restionaceae	*Empodisma gracillimum*	Empodisma				d,p,s,u,Se,h,a	WA
Restionaceae	*Hypolaena caespitosa*	Hypolaena				Se	WA
Restionaceae	*Hypolaena exsulca*	Hypolaena				eSWA(B)/WHS,v	WA
Restionaceae	*Hypolaena grandiuscula*	Hypolaena				r(N,Whicher,WHS),d,p,s,u,Se,h,a	WA
Restionaceae	*Lepyrodia heleocharoides*	Lepyrodia	3			r(SW,Yelverton,WHS),d,p,s,u,Se	WA
Restionaceae	*Loxocarya magna*	Loxocarya	3			z,p,s,u,Se,h	WA
Restionaceae	*Loxocarya striata* subsp. *implexa* MS	Loxocarya				z,p,s,u,eSWA(B)/WHS,h	WA
Restionaceae	*Tyrbastes glaucescens*	Tyrbastes	4			z,p,s,u,Se,h	WA
Xanthorrhoeaceae	*Xanthorrhoea acanthostachya*	Prickly Balga				r(S,Abba,WHS),s,u,Ne,h,v,t	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Xyridaceae	*Xyris atrovirida*	Xyris				r(S,Abba,WHS), d,p,s,u,e,h	WA
Xyridaceae	*Xyris lacera*	Xyris				d,s,u,Se,h	WA
Xyridaceae	*Xyris lanata*	Xyris				d,p,s,u,Se,h	WA
Xyridaceae	*Xyris laxiflora*	Xyris				d,s,u,Se,h	WA
DICOTYLEDONS							
Apiaceae	*Actinotus whicheranus*	Whicher Flannel Flower	2			z,p,s,u,eWHS,h	WA
Apiaceae	*Platysace haplosciadia*	Platysace				r(N,Abba,WHS), d,s,u	WA
Apiaceae	*Trachymene grandis*	White Lace Flower				d,s,u	WA
Apiaceae	*Xanthosia atkinsoniana*	Xanthosia				d,s,u	AUST
Apiaceae	*Xanthosia tasmanica*	Xanthosia				r(N,Dardanup,WHS),d,s,u,Se,t	AUST
Asteraceae	*Amblysperma minor*	Claypan Native Gerbera				z,r(N,Dardanup,WHS),d,s,u,h	WA
Asteraceae	*Craspedia variabilis*	Bachelor's Buttons				d,s,u	AUST
Asteraceae	*Hyalosperma demissum*	Hyalosperma				r(S,Abba,WHS), d,s,u	WA
Asteraceae	*Olearia homolepis*	Olearia				d(Kemp Rd),u	WA
Asteraceae	*Olearia strigosa*	Olearia				r(S,Whicher NP,WHS),p,s,u,eSWA(B)/WHS	WA
Casuarinaceae	*Allocasuarina thuyoides*	Horned Sheoak				d,s,u	WA
Cephalotaceae	*Cephalotus follicularis*	Albany Pitcher Plant				r(N,Haag NR,WHS),d,p,s,u,h,a	WA
Dilleniaceae	*Hibbertia acerosa*	Needle-leaved Hibbertia				d,s,u	WA
Dilleniaceae	*Hibbertia aurea*	Hibbertia				d,s,u,v,g	WA
Dilleniaceae	*Hibbertia ferruginea*	Ferruginous Hibbertia				z,s,u,Se	WA
Dilleniaceae	*Hibbertia huegelii*	Huegel's Hibbertia				r(S,West WHS),d,s,u	WA
Dilleniaceae	*Hibbertia lasiopus*	Hibbertia				r(N,Argyle,WHS),d,p,s,u,t	WA
Dilleniaceae	*Hibbertia mylnei*	Hibbertia				d,s,u	WA
Dilleniaceae	*Hibbertia serrata*	Serrate-leaved Hibbertia				d	WA
Droseraceae	*Drosera hyperostigma*	Sundew				d,s,u	WA
Droseraceae	*Drosera myriantha*	Rainbow				r(N,Goodwood Rd,WHS),d,s,u	WA
Epacridaceae	*Andersonia aristata*	Andersonia				r(S,Gale Rd Ironstones,WHS),d,s,u,h	WA
Epacridaceae	*Andersonia barbata*	Andersonia				r(N,Abba,WHS), d,p,s,u,Se	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Epacridaceae	*Andersonia fallax* MS	Andersonia				z,r(N,Whicher NP,WHS),p,s,u,e WHS/BP,h	WA
Epacridaceae	*Andersonia ferricola*	Ironstone Andersonia	1			z,r(S,Treeton,W HS),p,s,u,eSWA(B)/WHS,h	WA
Epacridaceae	*Andersonia heterophylla*	Andersonia				r(S,Whicher NP,WHS),d,s,u,h	WA
Epacridaceae	*Andersonia micrantha*	Andersonia				r(N,Boyanup,W HS),p,s,u,Se	WA
Epacridaceae	*Astroloma* sp. Nannup (R.D. Royce 3978) PN	Nannup Astroloma	4			z,r(N,Abba,WHS),p,s,u,Se	WA
Epacridaceae	*Leucopogon oliganthus*	Beard Heath				r(S,Abba,WHS), d,s,u,a,g	WA
Epacridaceae	*Leucopogon* sp. Whicher Range (G.J. Keighery 11763) PN	Whicher Beard Heath				r(N,Abba,WHS), s,eWHS/BP	WA
Euphorbiaceae	*Amperea micrantha*	Amperea	2			p,s,u	WA
Euphorbiaceae	*Amperea volubilis*	Amperea				r(N,Whicher,WH S),d,p,s,u	WA
Euphorbiaceae	*Ricinocarpos* aff. cyanescens (A. Webb sn 27 October 2003)	Whicher Ricinocarpos				z,p,s,u,eWHS,h	WA
Euphorbiaceae	*Stachystemon vermicularis*	Stachystemon				d,p,s,u,h	WA
Goodeniaceae	*Anthotium junciforme*	Anthotium	4			p,s,u,h	WA
Goodeniaceae	*Dampiera linearis*	Dampiera				v,g	WA
Lamiaceae	*Hemigenia rigida*	Hemigenia	1			p,s,h	WA
Lamiaceae	*Pityrodia bartlingii*	Woolly Foxglove				r(SW,Whicher, WHS),d,p,s,u,Ne ,h,g	WA
Loganiaceae	*Logania wendyae*	Wendy's Logania	1			z,p,s,u,eWHS,h	WA
Mimosaceae	*Acacia browniana* var. *browniana*	Brown's Wattle				r(N,Gwindinup Reserve,WHS)	WA
Mimosaceae	*Acacia flagelliformis*	Rush Wattle	4			p,s,u,eSWA/WH S/BP,h	WA
Mimosaceae	*Acacia inops*	Wattle	3			d,p,s,u,Se,h	WA
Mimosaceae	*Acacia luteola*	Wattle				r(N,Dardanup,W HS),d	WA
Mimosaceae	*Acacia mooreana*	Moore's Wattle				r(N,Dardanup,W HS),s,h	WA
Mimosaceae	*Acacia preissiana*	Preiss's Wattle				r(S,WHS),s	WA
Mimosaceae	*Acacia semitrullata*	Wattle	3			p,s,u,h	WA
Mimosaceae	*Acacia tayloriana*	Taylor's Wattle	4			r(N,Abba,WHS), p,s,u,eWHS/BP	WA
Mimosaceae	*Acacia tetragonocarpa*	Wattle				d,s,u	WA
Mimosaceae	*Acacia uliginosa*	Wattle				r(N,Whicher,WH S),p,s,u,Se	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Myrtaceae	*Actinodium cunninghamii*	Albany Swamp Daisy				p,s,u,h,g	WA
Myrtaceae	*Agonis flexuosa* var. *flexuosa*	Peppermint				s,u,h	WA
Myrtaceae	*Beaufortia sparsa*	Swamp Beaufortia				d,p,s,u,h,g	WA
Myrtaceae	*Beaufortia squarrosa*	Sandplain Beaufortia				r(S,Abba,WHS), d,p,s,u,Ne,h,g	WA
Myrtaceae	*Calothamnus pallidifolius*	Whicher Calothamnus				s,u	WA
Myrtaceae	*Calothamnus schaueri*	Schauer's Calothamnus				d,s,u	WA
Myrtaceae	*Calothamnus* sp. Scott River (R.D. Royce 84) PN	Scott River Calothamnus	2			z,r(N,Treeton,WHS),p,s,u,eWHS/SC,h	WA
Myrtaceae	*Calothamnus* sp. Whicher (B.J. Keighery and N. Gibson 230) PN	Ironstone Calothamnus	4			z,p,s,u,eSWA(B)/WHS,h	WA
Myrtaceae	*Calytrix fraseri*	Pink Summer Starflower				d,s,u,h	WA
Myrtaceae	*Calytrix* sp. Tutunup (G.J. Keighery and N. Gibson 2953) PN	Ironstone Starflower	2			z,p,s,u,eSWA(B)/WHS,h,t	WA
Myrtaceae	*Calytrix tenuiramea*	Starflower				r(W,Whicher NP,WHS),d,s,u,h	WA
Myrtaceae	*Chamelaucium erythrochlorum* MS	Blackwood Wax	4			z,r(N,Dardanup,WHS),p,s,u,eSWA(B)/WHS/BP,h	WA
Myrtaceae	*Darwinia vestita*	Pom-pom Darwinia				r(NW,Dardanup,WHS),p,s,u,Se	WA
Myrtaceae	*Eremaea asterocarpa*	Star-fruited Eremaea				r(S,Argyle,WHS),d,s,u,eSWA/WHS,h	WA
Myrtaceae	*Eremaea pauciflora* var. *pauciflora*	Sandplain Eremaea				d,s,u,h	WA
Myrtaceae	*Eucalyptus decipiens* subsp. *chalara*	Swamp Limestone Marlock				z,r(N,Goodwood Rd,WHS),p,s,u,h	WA
Myrtaceae	*Eucalyptus haematoxylon*	Mountain Marri				r(S,Treeton,WHS),d,s,Ne,g	WA
Myrtaceae	*Eucalyptus megacarpa*	Bullich				d,s,u,h	WA
Myrtaceae	*Eucalyptus relicta*	Whicher Mallee	2			z,p,s,u,eWHS/BP,h,a	WA
Myrtaceae	*Eucalyptus relicta x lane-poolei*	Hybrid Whicher Gum				p,s,u,eWHS	WA
Myrtaceae	*Homalospermum firmum*	Homalospermum				d,s,u,h	WA
Myrtaceae	*Kunzea rostrata*	Orange-fruited Kunzea				r(N,Dardanup,WHS),s,eSWA(B)/WHS/BP	WA
Myrtaceae	*Paragonis grandiflora*	Strange Peppermint				r(S,Whicher NP,WHS),s	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Myrtaceae	*Taxandria fragrans*	Swamp Peppermint				r(N,Argyle,WHS),d,s,u,h	WA
Myrtaceae	*Verticordia densiflora* var. *pedunculata*	Compacted Featherflower	R	E	E	d,p,s,u,eSWA(B)/WHS,h	WA
Papilionaceae	*Aotus cordifolia*	Swamp Aotus	3			p,s,u,h	WA
Papilionaceae	*Bossiaea pulchella*	Beautiful Bossiaea				r(S,Abba,WHS),p,s	WA
Papilionaceae	*Bossiaea* sp. Waroona (B.J. Keighery and N. Gibson 229) PN	Foothills Bossiaea				z,r(S,Goodwood Rd,WHS)	WA
Papilionaceae	*Chorizema reticulatum*	Showy Flame Pea	3			r(N,Argyle,WHS),p,s	WA
Papilionaceae	*Chorizema spathulatum*	Flame Pea				r(N,Whicher NP,WHS),d,Se	WA
Papilionaceae	*Daviesia divaricata* subsp. *divaricata* MS	Daviesia				d,s,u,h	WA
Papilionaceae	*Daviesia elongata* subsp. *elongata*	Spreading Daviesia	R	V	V	p,s,u,eSWA(B)/WHS,h	WA
Papilionaceae	*Daviesia flexuosa*	Flexible Daviesia				r(N,West WHS),d,s,u,Se	WA
Papilionaceae	*Daviesia major*	Daviesia				r(S,Abba,WHS),d	WA
Papilionaceae	*Daviesia nudiflora*	Leafy Daviesia				r(S,Argyle,WHS),d,s,u,h,v	WA
Papilionaceae	*Dillwynia* sp. Capel (P.A. Jurjevich 1771) PN	Capel Dillwynia				z,r(N,WHS),p,s,u,eWHS/BP	WA
Papilionaceae	*Gastrolobium modestum*	Modest Gastrolobium	R	V	V	z,p,s,u,eWHS/BP,h	WA
Papilionaceae	*Gastrolobium whicherense*	Whicher Gastrolobium	2			z,p,s,u,eWHS,h	WA
Papilionaceae	*Gompholobium cyaninum* MS	Blue Gompholobium				s,u,h	WA
Papilionaceae	*Gompholobium villosum*	Hairy Gompholobium				d,s,u	WA
Papilionaceae	*Hovea stricta*	Prickly Hovea				d,s,u,Ne	WA
Papilionaceae	*Jacksonia lehmannii*	Lehmann's Jacksonia				r(S,Whicher,WHS),d,s,u	WA
Papilionaceae	*Jacksonia* sp. Whicher (G.J. Keighery 9953)	Whicher Jacksonia				z,s,eSWA(B)/WHS/BP,h	WA
Papilionaceae	*Pultenaea brachytropis*	Pultenaea				r(N,Abba,WHS),Se	WA
Papilionaceae	*Pultenaea pinifolia*	Tree Pultenaea	3			d,p,s,u,eSWA(B)/WHS/BP,h	WA
Papilionaceae	*Pultenaea radiata*	Whicher Pultenaea				r(N,Dardanup,WHS),s,eWHS/BP,h	WA
Papilionaceae	*Pultenaea skinneri*	Skinner's Pultenaea	4			d,p,s,u,eSWA/WHS/BP,h	WA
Papilionaceae	*Pultenaea verruculosa*	Pultenaea				r(N,WHS)	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Proteaceae	*Adenanthos barbiger* subsp. *barbiger* MS	Hairy Jugflower				z,r(N,Dardanup, WHS),s,Se	WA
Proteaceae	*Banksia meisneri* subsp. *ascendens*	Meisner's Banksia	4			p,s,Se	WA
Proteaceae	*Banksia sphaerocarpa* var. *sphaerocarpa*	Fox Banksia				r(W,Abba,WHS) ,d,s	WA
Proteaceae	*Conospermum acerosum* subsp. *acerosum*	Needle-leaved Smokebush				d,s,u,h	WA
Proteaceae	*Conospermum caeruleum* subsp. *marginatum*	Blue Smokebush				s,u,eSWA(B)/W HS/BP	WA
Proteaceae	*Conospermum paniculatum*	Wiry Smokebush	3			p,s,Se	WA
Proteaceae	*Conospermum teretifolium*	Spider Smokebush				r(N,Argyle,WHS),d,s,u,Se,h	WA
Proteaceae	*Dryandra armata* var. *armata*	Prickly Dryandra				d,s,u,h	WA
Proteaceae	*Dryandra baxteri*	Baxter's Dryandra				r(N,Abba,WHS), d,s,u,h	WA
Proteaceae	*Dryandra formosa*	Showy Dryandra				r(N,Whicher NP,WHS),d,s,u,h ,a,g	WA
Proteaceae	*Dryandra mimica*	Summer Honeypot	R	V	E*	r(S,Whicher NP,WHS),d,p,s,u ,eSWA/WHS,h,a ,g	WA
Proteaceae	*Dryandra nivea* subsp. *uliginosa*	Bush Honeypot	R	E	E	z,d,p,s,u,eSWA/ WHS/SC,h	WA
Proteaceae	*Dryandra sessilis*	Parrotbush				d,u,h	WA
Proteaceae	*Dryandra squarrosa* subsp. *argillacea*	Ironstone Pingle	R	V	V	z,d,p,s,u,eSWA(B)/WHS,h	WA
Proteaceae	*Franklandia fucifolia*	Yellow Franklandia				r(NE,Abba,WHS),d,p,s,u,Se,h,v,g	WA
Proteaceae	*Franklandia triaristata*	Beautiful Franklandia	4			d,p,s,u,Se,h	WA
Proteaceae	*Grevillea bipinnatifida* subsp. *bipinnatifida*	Fuchsia Grevillea				d,s,u	WA
Proteaceae	*Grevillea brachystylis* subsp. *grandis* (=Busselton (G.J. Keighery s.n. 28/8/1985) PN)	Whicher Grevillea	R	CR	*	z,p,s,u,eSWA(B) /WHS	WA
Proteaceae	*Grevillea bronwenae*	Bronwen's Grevillea				p,s,u,eWHS/BP	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Proteaceae	*Grevillea pulchella* subsp. *ascendens* Whicher Scarp Form (G.J.Keighery and B.J.Keighery 938)	Beautiful Grevillea				z,s,u,eWHS,h	WA
Proteaceae	*Hakea cyclocarpa*	Ramshorn Hakea				s,h	WA
Proteaceae	*Hakea falcata*	Forest Hakea				r(N,Whicher NP,WHS),d,s,u, Se,h	WA
Proteaceae	*Hakea lasianthoides*	River Hakea				d,s,h	WA
Proteaceae	*Hakea linearis*	Swamp Hakea				r(N,West WHS),d,s,u,Se,h	WA
Proteaceae	*Hakea oldfieldii*	Oldfield's Hakea	3			d,p,s,u,h,g	WA
Proteaceae	*Hakea stenocarpa*	Narrow-fruited Hakea				d,s,u	WA
Proteaceae	*Isopogon attenuatus*	Coneflower				r(N,Abba,WHS), s	WA
Proteaceae	*Isopogon formosus* subsp. *dasylepis*	Rose Coneflower	3			d,p,s,u,Se,h	WA
Proteaceae	*Lambertia multiflora* var. *darlingensis*	Golden Lambertia				r(S,Abba,WHS), d,p,s,Ne,h	WA
Proteaceae	*Lambertia rariflora* subsp. *rariflora*	Whicher Lambertia	4			d,p,s,u,eWHS/BP,h	WA
Proteaceae	*Petrophile latericola*	Ironstone Petrophile	R	CR	E*	z,d,p,s,u,eSWA(B)/WHS,h	WA
Proteaceae	*Petrophile serruriae*	Petrophile				d,s,u,h,g	WA
Proteaceae	*Petrophile striata*	Petrophile				d,s,u	WA
Proteaceae	*Strangea stenocarpoides*	Strangea				s,Se,h	WA
Proteaceae	*Synaphea hians*	Synaphea	3			z,p,s,u	WA
Proteaceae	*Synaphea petiolaris* subsp. *simplex*	Synaphea	2			p,s,u,eSWA(B)/WHS,h	WA
Proteaceae	*Synaphea polypodioides*	Donnybrook Synaphea	2#			z,p,s,eWHS	WA
Proteaceae	*Synaphea whicherensis*	Whicher Synaphea				z,r(N,Argyle,WHS),s,eSWA(B)/WHS/BP	WA
Rafflesiaceae	*Pilostyles hamiltonii*	Stemflower				s,u	WA
Rhamnaceae	*Stenanthemum sublineare*	Stenanthemum	2			d,p,s,u	WA
Rutaceae	*Boronia capitata* subsp. *gracilis*	Slender Boronia	2			r(SW,Yelverton,WHS),p,s,u,eSWA/WHS,h	WA
Rutaceae	*Boronia humifusa*	Whicher Boronia	1			p,s,u,eWHS,h	WA
Rutaceae	*Boronia purdieana* subsp. *purdieana*	Yellow Boronia				r(S,WHS),d,s,u, Ne,h	WA
Rutaceae	*Boronia tetragona*	Pink Boronia	3			d,p,s,u,Se,h	WA

Family	Scientific Name	Common Name	Significant Taxa				Endemic
			WA	IUCN	Com	OS	
Rutaceae	*Crowea angustifolia* var. *angustifolia*	Crowea				r(N,Whicher NP,WHS),d,s,u, Se,h	WA
Stackhousiaceae	*Tripterococcus paniculatus* MS	Tripterococcus	1			z,r(S,Boyanup,WHS),d,p,s,u,eSWA/WHS,h	WA
Sterculiaceae	*Thomasia laxiflora*	Whicher Thomasia	3			r(N,Boyanup,WHS),p,s,e,h	WA
Sterculiaceae	*Thomasia macrocarpa*	Large-fruited Thomasia				d,s,u,Ne	WA
Stylidiaceae	*Stylidium acuminatum* MS	Sharp-leaved Triggerplant				z,r(S,Argyle,WHS),d,p,s,u,e,h	WA
Stylidiaceae	*Stylidium affine*	Hills Queen Triggerplant				d	WA
Stylidiaceae	*Stylidium barleei*	Tooth-leaved Triggerplant	3			r(N,Acton Park,WHS),p,s,u ,eSWA(B)/WHS /BP,h	WA
Stylidiaceae	*Stylidium caespitosum*	Fly-away Triggerplant				d,p,s,u,Se,h,g	WA
Stylidiaceae	*Stylidium ferricola*	Ironstone Triggerplant	1			p,s,u,eSWA(B)/ WHS,h	WA
Stylidiaceae	*Stylidium lateriticola*	Laterite Triggerplant				r(SW,Whicher NP,WHS),d,p,s,u ,Ne,h,g	WA
Stylidiaceae	*Stylidium perplexum*# *(= S.* sp. Dardanup (G.S. McCutcheon GSM 1066) PN	Dardanup Triggerplant	1			z,p,s,u,eWHS,h	WA
Tremandraceae	*Platytheca anasima*# *(= S.* sp. Argyle (G.J. and B.J. Keighery 281) PN	Argyle Platytheca	1#			z,p,s,u,eWHS,h,a	WA
Tremandraceae	*Platytheca* sp. Sabina (G.J. and B.J. Keighery 295) PN	Sabina River Platytheca	1#			z,p,s,u,eWHS,h,a	WA
Tremandraceae	*Tetratheca parvifolia*	Tetratheca	3			p,s,u,e,h	WA

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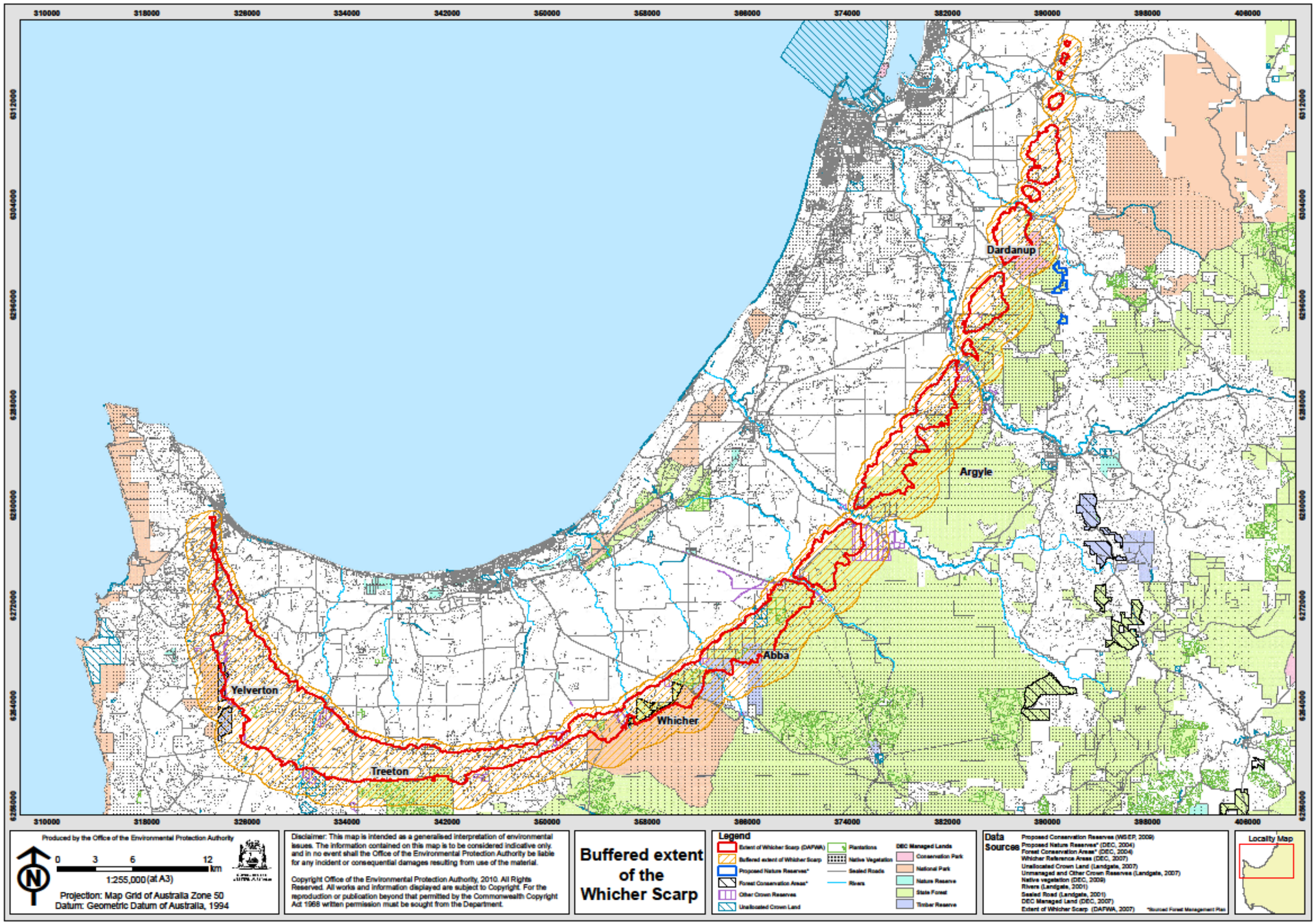
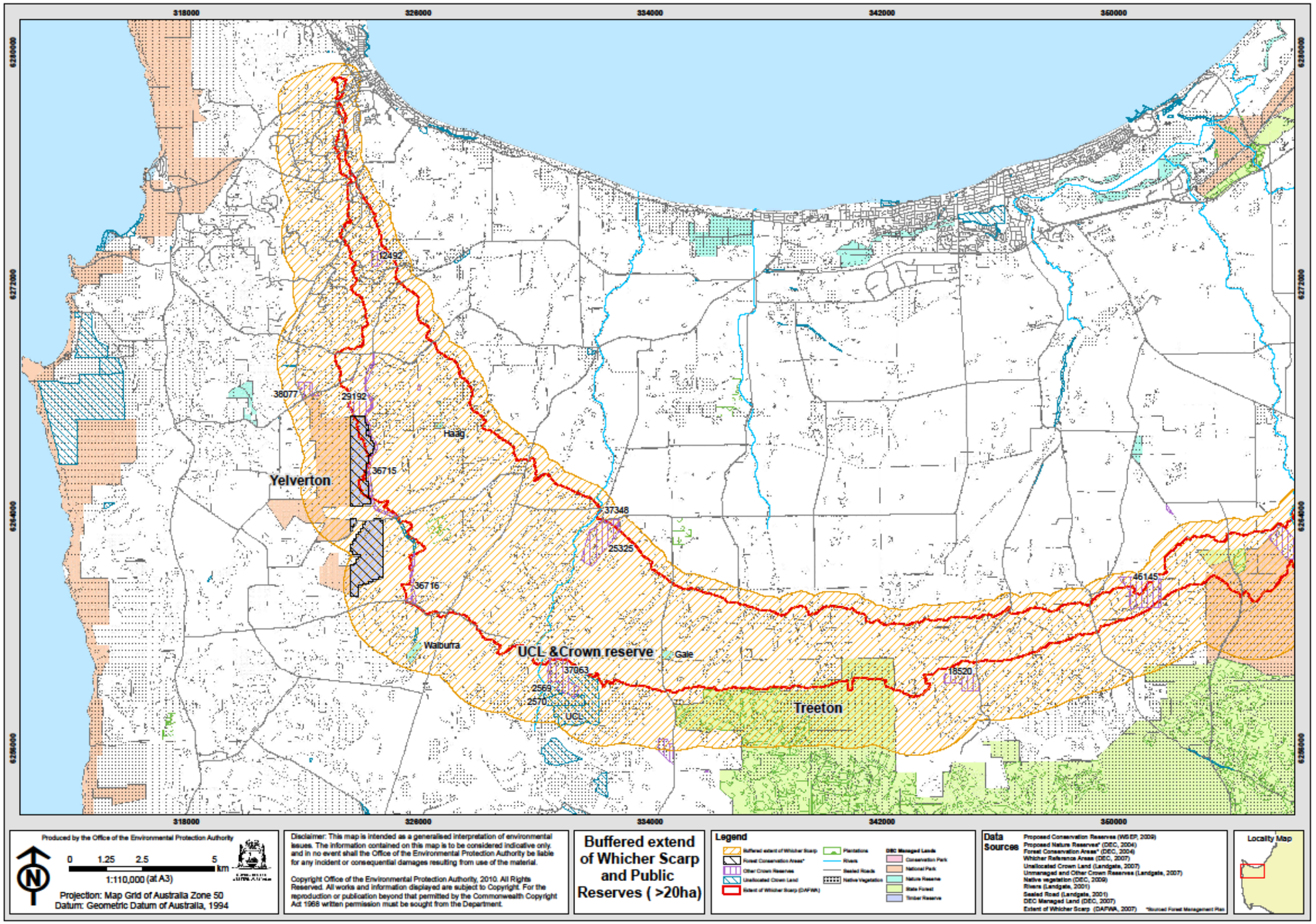
8 Abbreviations

CALM	Department of Conservation and Land Management
CTRC	Conservation Through Reserves Committee
DAFWA	Department of Agriculture and Food, Western Australia
DCE	Department of Conservation and Environment
DEC	Department of Environment and Conservation
DEP–	Department of Environmental Protection
DEWHA	Department of the Environment, Water, Heritage and the Arts
DOE	Department of Environment
DPI	Department for Planning and Infrastructure
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
FMP	Forest Management Plan
FPC	Forest Products Commission
PEC	Priority Ecological Community
RFA	Regional Forest Agreement
SFM	Sustainable Forest Management
TEC	Threatened Ecological Communities

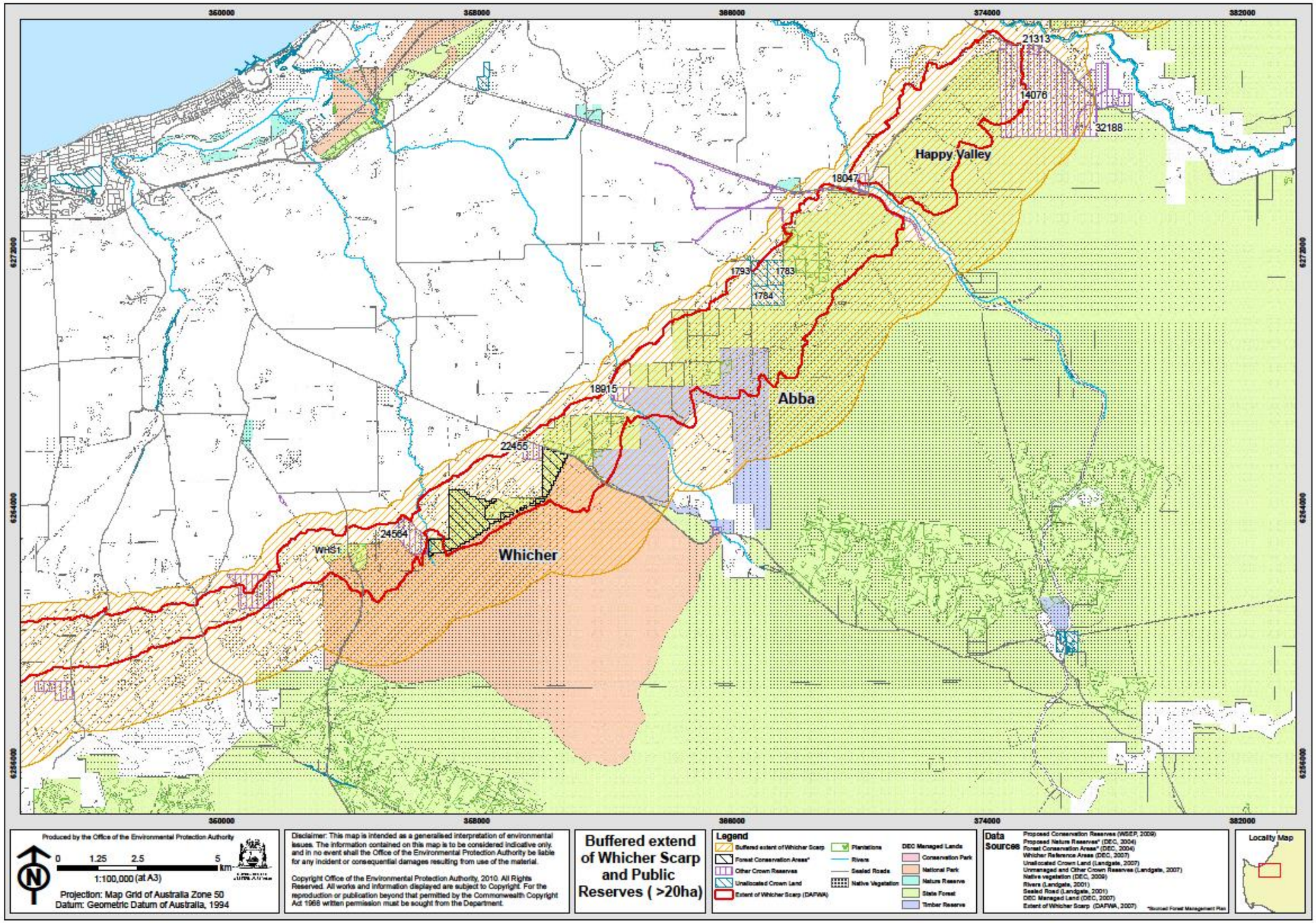
Map 3 – Buffered extent of proposed Whicher Scarp Forest Ecosystem



Map 4 – Whicher Scarp Western Extent



Map 5 – Whicher Scarp Central Extent



Map 6 – Whicher Scarp Northern Extent