Department of Biodiversity, Conservation and Attractions
GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson *et al.* (1994)
Other names:	Swan Coastal Plain community 8 (SCP08). Floristic community type 8 (FCT08).
Description:	The community has been recorded between Bullsbrook and Ludlow, and occurs in low lying flats with a clay impeding layer that facilitates seasonal inundation. The vegetation can be dominated by *Viminaria juncea* (swishbush), *Melaleuca viminea* (mohan), *Melaleuca lateritia* (robin redbreast bush) or *Melaleuca osullivanii* (broombush) but also occasionally by *Eucalyptus wandoo* (wandoo). The occurrence of species such as *Hypocalymma angustifolium* (white myrtle), *Acacia lasiocarpa* var. *bracteolata* (long peduncle form) and *Verticordia huegelii* (variegated feather flower) at moderate frequencies, and aquatic annuals is common. The community is also known as "floristic community type 8" as originally described in Gibson N., Keighery B.J., Keighery G.J., Burbidge A.H. and Lyons M.N. (1994) "A floristic survey of the southern Swan Coastal Plain" (unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc.)).
Nomination for:	Listing under BC Act ☒ Change of status ☐ Delisting ☐

1. *Is the ecological community currently on any conservation list, either in a State or Territory, Australia or Internationally?* 2. *Is it present in an Australian jurisdiction, but not listed?*	*Provide details of the occurrence and listing status for each jurisdiction in the following table*

Jurisdiction	**List or Act name**	**Date listed or assessed (or N/A)**	**Listing category eg. critically endangered (or none)**	**Listing criteria eg. B1ab(iii)+2ab(iii) (or none)**
National	EPBC Act	27/03/2012	Critically Endangered under the umbrella TEC 'Clay pans of the Swan Coastal Plain'	
Western Australia	Current ranking under WA Minister ESA list in policy	6/11/2001	Vulnerable	VU B)
	Priority list		1 ☐ 2 ☐ 3 ☐ 4 ☐	
Other State/Territory				

Nominated conservation status: category and criteria (include recommended status for deleted ecological communities)

Critically endangered (CR) ☐ Endangered (EN) ☒ Vulnerable (VU) ☐ Collapsed (CO) ☐

Priority 1 ☐	Priority 2 ☐	Priority 3 ☐	Priority 4 ☐	None ☐

What criteria support the conservation status category for listing as a threatened ecological community or collapsed ecological community? *Refer to Section 32 of the Biodiversity Act 2016 for definition of 'Collapsed', and Appendix 4 table 'IUCN Red List Criteria for ecosystems version 2.2'.*	EN B1a(iii),b; B2a(iii),b

Eligibility against the criteria		
*Provide justification for the nominated conservation status; is the ecological community eligible or ineligible for listing against the five criteria. For **delisting**, provide details for why the ecological community no longer meets the requirements of the current conservation status.*		
A.	Reduction in geographic distribution *(evidence of decline)*	☐ **A1** ☐ **A2a** ☐ **A2b** ☒ **A3** CR, EN, VU are plausible. VU is most robust
	Justification of assessment under Criterion A.	For criteria A and B, the community is assumed to collapse when the mapped distribution declines to zero (see Appendix 2 for distribution map). • Gibson *et. al* (1994) lists communities that are thought to have declined by >90% based on their analysis of the level of clearing of vegetation on the geomorphologies and landforms that support the community. This clay pan type was included in that group. • The proportion that remains of the pre-1750 extent of the vegetation complexes in which the community occurs is provided in statistical data in Government of Western Australia (2019). • The reduction in extent of native vegetation in the vegetation complexes on the Swan Coastal Plain that support the community is assumed to be indicative of the level of clearing of the community (see Appendix 3 for detailed data on clearing of vegetation complexes). • The following vegetation complexes support the community, with the proportion cleared in brackets: Beermullah (93%). Guildford (95%), Serpentine River (90%), Southern River complex (82%), Yoongarillup complex (64%). • The range of values for the level of clearing of vegetation complexes that support the community is 64-95% (Government of Western Australia 2019). • The timing of the vegetation clearing is not known so is conservatively inferred to be since 1750. • Threshold for level of clearing since 1750 to meet CR is ≥90%, for EN is ≥70%, and for VU is ≥50%. • Community plausibly meets rank for CR, EN or VU under criterion A3.

		• VU under A3 is the most robust and conservative rank as vegetation clearing data are regional and not sufficiently corroborated in relation to this community to support a higher rank.
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*	☒ **B1** (specify at least one of the following): ☐ **a)(i)** ☐**a)(ii)** ☒**a)(iii)** ☒**b)** ☐**c);** ☒ **B2** (specify at least one of the following): ☐ **a)(i)** ☐**a)(ii)** ☒**a)(iii)** ☒**b)** ☐**c);** ☐ **B3 (only for Vulnerable Listing)**
	Justification of assessment under Criterion B.	• B1: EOO is 2991km^2. Community meets the threshold for Endangered as it occupies ≤20,000km^2 (threshold for EN is ≤20,000km^2 and for CR is ≤2,000km^2). • B1aiii) Community is subject to measurable decline from observed and inferred ongoing weed invasion (ie. biotic interactions, see criterion D, and Appendix 1 below). • B1b) Continuing decline observed and inferred from the historic and ongoing impacts of land clearing, hydrological change (alterations to surface water), weed invasion, altered fire regimes, grazing by introduced fauna, and a drying and warming climate that are likely to cause continuing decline in geographic distribution and environmental quality within the next 20 years (see Appendix 1 for details of threats). • B2: AOO is 1400km^2 (occupies 14 10x10 km^2 grid cells). Community meets threshold for endangered with ≤20 cells occupied (threshold for CR is ≤2 grid cells). • B2aiii) Community subject to measurable decline from observed and inferred ongoing weed invasion (as for B1aiii). • B2b): As for B1b, continuing decline observed and inferred from the historic and ongoing impacts of threats likely to cause continuing decline in geographic distribution and environmental quality within the next 20 years. • B1c: Community is considered to occur at 15 threat-defined locations based on clusters of bushland areas subject to similar management, and threats. • Community exists at more than 10 threat-defined locations. Does not meet B1c, B2c or B3. • **Meets criteria for Endangered B1a(iii),b; B2a(iii),b**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• Altered hydrology is a significant abiotic variable affecting the community. Alterations to depths or seasonality of surface water will result in subsequent changes to composition, in particular to the defining herbaceous layer in the community. For criterion C, it is assumed the community will collapse when seasonal inundation with surface water no longer occurs. It is assumed that such severe changes to surface water will results in loss of the defining herbaceous wetland adapted flora in the

		community. Reductions and other changes to seasonal inundation patterns are directly related to rainfall (See Appendix 1 for further details). • There are inadequate quantitative data to link changes to surface water regimes (depths and seasonality) to compositional changes in the community. It is therefore not possible to determine the severity of current or projected declines in rainfall and surface water in relation to the collapse point (also see Appendix 1 for details of threats). • There are inadequate data to determine if community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50 year period, or (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet the criteria for VU. • **Insufficient evidence to determine if the community meets criterion C**
D.	Disruption of biotic processes or interactions *(Evidence of decline over 50-year period)*	☐ **D1** ☒ **D2** ☐ **D3**
	Justification of assessment under Criterion D.	• Weed invasion is a significant biotic threat to the community. • The severity of weed invasion associated with collapse is uncertain, but it is assumed conservatively that the community reaches a collapsed state when only 10% (plausible range 0–20%) of its plant species are native. • Weed data taken from 17 quadrats across 5 occurrences (FL03, BRIX01, BRIX04, MUD02, MUD09, ELLEN01, MEELON01, PM14 and PM28) (representative of 38% of the extent of the community) indicate an increase in the average proportion of exotic species between 1994 to 2017-2018 with an 8% reduction of native taxa. • It is assumed that the increase in introduced taxa as indicated by 17 quadrats is linear and is representative of weed invasion across the occurrences in which the specific quadrats occur. Based on these assumptions, 38% of the extent of the community has a projected 18% decline in native taxa in the next 50 years. This represents a projected reduction to the proportion of native species to 52% (ie. 48% are weed taxa) across 38% of the extent of the community over the next 50 years. This corresponds to a projected 53% severity in relation to the collapse point of ≥90% weeds (ie. 48/90 x100%), within the next 50 years, in the absence of effective weed management. • The community does not fall below the collapse threshold of ≤10% native taxa (ie. ≥90% weeds) within the surveyed 25-year period and is not projected to do so within the next 50 years. • According to available weed monitoring data, the community does not meet the threshold of ≥30% of the extent of the community subject to relative severity of weed invasion of ≥80% to meet VU under criterion D2a. • **Available weed data indicate the community does not meet criterion D.**

E.	Quantitative analysis *(statistical probability of ecosystem collapse)*	• No quantitative estimates of the risk of ecosystem collapse. • Unable to assess

Reasons for change of status

Genuine change ☐ New knowledge ☐ Previous mistake ☐ Review/Other ☒

Provide details: The community was initially ranked as Vulnerable using ranking criteria developed in WA that differ from those in the IUCN Red List Criteria for Ecosystems (version 2.2).

Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*

EOO	2991km^2	AOO	1400 km^2 (14 10x10km grid method).
No. locations	40	Severely fragmented	Yes ☒ No ☐ Unknown ☐
Current known area			Known from 40 occurrences totalling 296ha
Pre-industrialisation extent or its former known extent (if known)			Based on current area of 296ha and decline of between 64-95%, original area is estimated as between 643ha and 5920ha.
Estimated percentage decline			The range of values for the level of clearing of complexes that support the community is 64-95% - assumed to reflect the level of clearing of the community.

Table 1: Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Available data do not indicate community meets criterion
A2a	-	• Available data do not indicate community meets criterion
A2b	-	• Available data do not indicate community meets criterion
A3	CR, EN or VU	• Plausibly meets criteria for CR, EN or VU. VU is most robust
B1a	EN	• Measurable decline due to observed and inferred ongoing weed invasion. • Meets B1a(iii)
B1b	EN	• EOO is ≤20,000km^2 • Known and inferred threats are likely to cause continuing declines in geographic distribution, environmental quality and biotic interactions within the next 20 years. • Meets criterion for EN B1b
B1c	-	• EOO is ≤20,000km^2 • Community exists at more than 10 threat-defined locations. • Does not meet criteria for B1c
B2a	EN	• Measurable decline due to observed and inferred ongoing weed invasion. • Meets criterion for EN B2a(iii)
B2b	EN	• AOO is 14 grid cells • Known and inferred threats are likely to cause continuing declines in geographic distribution, environmental quality and biotic interactions within the next 20 years. • Meets criterion for EN B2b
B2c	-	• Ecosystem exists at more than 10 threat-defined locations. • Does not meet B2c
B3	-	• Known from more than 5 threat-defined locations. • Does not meet criterion
C1	-	• Inadequate data to determine if community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over past 50 years to meet VU.
C2	-	• Inadequate data to determine if community meets the threshold for proportion of the extent (≥30%) for proportional severity (≥30%) over any 50-year period to meet VU under C2b.
C3	-	• Inadequate data to determine if community meets the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet VU.
D1	-	• Available data about weed invasion do not meet minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over past 50 years to meet VU.
D2	-	• Available data about weed invasion do not indicate the community meets minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥80%) over any 50 year period to meet VU.
D3	-	• Inadequate data to determine if community meets minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since 1750 to meet VU.
E	NA	• No quantitative estimates of the risk of ecosystem collapse.
		Plausibly meets CR, EN or VU under A3 but VU under A3 is most robust. Meets criteria for EN under B1a(iii),b; B2a(iii),b. *The highest risk category obtained by any of the assessed criteria will be the overall risk status of the ecosystem'* (IUCN RLE Guidelines V1.1 page 42). **Meets EN under B1a(iii),b; B2a(iii),b.**

Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence	Land tenure	Survey information: date of survey. Note: Survey by DBCA unless otherwise stated.	Condition	Area of occurrence (ha)	Threats *(note if past, present or future)*	Specific management actions
ELLEN01 Occurrence 1	A27620, Conservation and Parks Commission, Fauna Preservation	19/01/1995 19/08/2008 10/10/2005 1/12/2014	Very Good 100% in 2005 and 2014	30.2	Weed invasion Altered fire regimes Grazing (all past, present and future)	
MUD02 Occurrence 2	Reserve C23793 Kargotich Rd, Department of Primary Industries and Regional Development (DPIRD). Road Reserve south of CR23793. Shire of Serpentine – Jarrahdale	21/12/1994 06/11/2014	Very Good 30% Excellent 70% in 1994 and 2014	2.6	Altered fire regimes Vegetation clearing Weed invasion Grazing Recreational activities (all past, present and future)	
FL03 Occurrence 3	C27165 Recreation reserve, City of Armadale	21/04/1995 11/09/2002 28/10/2009 29/09/2011 26/10/2004 1/11/2017 4/12/2018	Excellent 85% Good 15% in 2017	33.31	Altered fire regimes Recreational activities Weed invasion (all past, present and future)	
MEELON01 Occurrence 5	Meelon Nature Reserve 24430 - DBCA, Pinjarra Williams Road, Meelon Road reserve, Shire of Murray	14/11/199 07/10/2005 19/08/2008 08/11/2011 01/12/2011	100% Good in 1995	4.4	Weed invasion Altered fire regimes (all past, present and future)	
PM 28 Occurrence 6	Crown Reserve 46108 South Western Highway Waterloo, Conservation and Parks Commission. Southwest Highway Road Reserve and Dardanup Rail Reserve, Shire of Dardanup	04/05/1995 18/11/2003 11/03/2008 06/09/2013 11/10/2013 17/10/2013	20% Good 80% Pristine in 1995, 100% Degraded in 2013	10.3	Vegetation clearing Altered fire regimes Weed invasion (all past, present and future)	

C5803 Occurrence 7	Reserve 23172, Camping, Shire of Waroona	14/11/1995	Good 20% Excellent 80%	7.1	Vegetation clearing Altered fire regimes Weed invasion (all past, present and future)	
MUD09 Occurrence 8	Reserve 23793 Kargotich Rd, DPIRD, Road reserve Byford, Shire of Serpentine Jarrahdale	21/12/1994 06/11/2014	Very Good 50% and Excellent 50% in 2014	5.0	Altered fire regimes Vegetation clearing Weed invasion Grazing Recreational activities (all past, present and future)	
MYKENW02 Occurrence 9	Brixton St Kenwick, Brixton St Gosnells	08/03/2000 31/01/2013	Good 50% and Very Good 50% in 2013	0.4	Weed invasion Recreational activities Altered fire regimes (all past, present and future)	
ABERNETHY RD PLOT 1 Occurrence 10	LT9000AbernRd, Department of Planning, Development and Lands (DPLH), Shire of Serpentine-Jarrahdale	26/05/2000, 31/06/2006, 31/11/2007	Very Good 20% Excellent 80% in 2007	5.7	Weed invasion Rubbish dumping Recreational activities Altered fire regimes Grazing (all past, present and future)	
NICHOLSON02 Occurrence 11	Loc Nicholson, [redacted] Nicholson, DPLH, City of Gosnells	01/11/2001	Completely Degraded 10%, Excellent 90%,	2.5	Vegetation clearing (past) Altered fire regimes Weed invasion Trampling Rubbish dumping Grazing (balance - past, present and future)	
GOSN10 Occurrence 12	Loc Nicholson DPLH, City of Gosnells	01/11/2001, 21/10/2005, 07/04/2008, 20/10/2011, 06/11/2018	Good 15% Very Good 35% Excellent 50% in 2018	1.5	Vegetation clearing (past) Altered fire regimes Weed invasion Trampling Rubbish dumping Grazing (balance past, present and future)	
PAUL05 Occurrence 14	Site 375/rail reserve, vested with Arc Infrastructure	08/01/2002	Good 25% Pristine 75%	0.1713	Vegetation clearing (past) Altered fire regimes Weed invasion (balance past, present and future)	
myFL04 Occurrence 15	Recreation Reserve C27165 City of Armadale	11/09/2002	Excellent 90% Very Good 10%	1.0439	Altered fire regimes Recreational activities Weed invasion (all past, present and future)	
myFL05 Occurrence 16	Recreation Reserve C27165 City of Armadale	11/09/2002	Excellent 100%	0.2898	Altered fire regimes Recreational activities Grazing Weed invasion	

					(all past, present and future)	
HAY01 Occurrence 17	Hay Park Bunbury, Recreation Reserve, bounded by Bussell Highway, City of Bunbury	16/09/2002, 13/10/2005, 18/11/2003, 09/04/2003, 24/10/2004, 11/03/2008, 06/11/2008	2008 Very Good 40% Excellent 60%	8.6	Weed invasion Altered fire regimes Rubbish dumping Grazing (all past, present and future)	
Mypearce07 Occurrence 18	LOC136TURN, Vested with Commonwealth – Airforce, Dept of Defence, City of Swan	07/11/2002	Excellent 100%	0.04	Vegetation clearing Weed invasion (all past, present and future)	
REHOBOTH01 Occurrence 19	Freehold	25/11/2004, 31/03/2013	Good 20% Very Good 80% in 2013	3.5	Vegetation clearing Weed invasion Hydrological changes Grazing (all past, present and future)	
FORRESTDALE 01 Occurrence 20	National Park Conservation and Parks Commission City of Armadale	10/06/2005, 26/08/2008, 28/10/2015	Completel y Degraded 10% Very good 70% Excellent 20% in 2015	16.0	Vegetation clearing (past) Weed invasion Grazing Hydrological change (balance past, present and future)	
BRIX01 Occurrence 21	Kenwick Wetlands Nature Reserve CR 49200, Vested with Conservation and Parks Commission, City of Gosnells	06/01/1995, 19/08/2008	Excellent 100% in 2008	19.9	Vegetation clearing (past) Altered fire regimes Recreational activities Weed invasion (balance - past, present and future)	
ROSE03 Occurrence 22	Freehold land. Shire of Capel	18/10/2006, 19/06/2009	Very Good 90% Degraded 10% in 2009	3.3	Weed invasion Groundwater decline Road- rail/ maintenance Vegetation clearing Grazing (all past, present and future)	
PM14 Occurrence 23	Reserve 31437 South Western Highway Conservation Park, and Railway, Shire of Waroona	03/05/1995, 01/11/2006, 21/09/2012, 01/10/2013, 16/10/2014, 01/10/2018	Very Good 20% Excellent 80% in 2012	4.5	Vegetation clearing Weed invasion Altered fire regimes (all past, present and future)	
WANAPING01 Occurrence 24	Brixton Street, Freehold Land, City of Gosnells	17/07/2010, 31/03/2013	Very Good 100% in 2010 and in 2013	0.4	Weed invasion Hydrological changes Rubbish dumping Recreational activities (all past, present and future)	

WANAPING03 Occurrence 25	Brixton Street, Freehold Land City of Gosnells	15/07/2010	Excellent 100% in 2010	0.6	Weed invasion Hydrological changes Rubbish dumping Altered fire regimes (all past, present and future)	
WANAPING09 Occurrence 26	Brixton Street, Freehold Land City of Gosnells	15/07/2010	Good 70% Degraded 30%	0.2	Weed invasion Hydrological changes Rubbish dumping Altered fire regimes (all past, present and future)	
BRIX04 Occurrence 28	Conservation and Parks Commission. City of Gosnells	6/01/1995, 14/11/2013	Good 5% Excellent 95% in 2013	3.0	Vegetation clearing Altered fire regimes Recreational activities Weed invasion (all past, present and future)	
BICKLEYRD06 Occurrence 29	Bickley Rd, Freehold, City of Gosnells	27/10/2007, 24/06/2018, 24/10/2007, 27/05/2019	In 2018, Good 33% Very Good 33% and Excellent 34% in 2019	1.8	Vegetation clearing Weed invasion Grazing Nutrient enrichment Drying climate (all past, present and future)	
BRENTWD08 Occurrence 30	Brentwood Road, City of Gosnells	27/10/2008, 23/12/2015	Very Good 100% in 2008	0.7	Vegetation clearing Weed invasion Drying climate (all past, present and future)	
BRENTWD11 Occurrence 31	Brentwood Road, City of Gosnells	27/10/2008, 23/12/2015	Very Good 100%	1.5	Vegetation clearing Weed invasion Drying climate (all past, present and future)	
BRENTWD14 Occurrence 32	Brentwood Road, City of Gosnells	14/05/2008, 09/10/2014	Good, 100% in 2014	0.6	Weed invasion Partial clearing Stock impacts (all past, present and future)	
Kenwick05 Occurrence 37	Bickley Road, Kenwick, City of Gosnells	27/10/2007, 24/10/2007, 24/06/2018, 28/05/2019	Good 50% and Very Good 50% in 2019	0.06	Vegetation clearing Weed invasion Grazing Drying climate (all past, present and future)	
Tonkin01 Occurrence 40	Within Bush Forever site 255, City of Gosnells.	2010	Very Good	4.4	Weed invasion Drying climate (all past, present and future)	
EASTW01 Occurrence 42	Ludlow State Forest, Vested with Conservation and Parks Commission	04/10/2011, 01/11/2011	Excellent 100%	63.23	Weed invasion Drying climate (both past, present and future)	

EASTW02 Occurrence 43	Ludlow State Forest, vested with Conservation and Parks Commission	04/11/2011, 01/11/2011	Excellent in 2011, 100%	39.5	Grazing (past, present and future)	
WATER05_Webb Occurrence 44	Rail Reserve Picton East	27/9/2011, 31/10/2011	Excellent in 2011, 100%	2.3	Weed Invasion (past, present and future)	
PROP06 Occurrence 46	Reserve 40664	01/06/2016	Very Good 70% Degraded 30%	3.9	Recreational activities Grazing Weed invasion (all past, present and future)	
PEEL01 Occurrence 47	Road reserve and private freehold Karnup	12/10/2016 (Emerge Consultants)	Good 100%	3.6	Weed invasion Vegetation clearing Drying climate Hydrological changes (all past, present and future)	
Peel02 Occurrence 48	Crown Reserve 37090 for explosives, forestry. Management Order Minister for Mines and Petroleum, DBCA	12/10/2016 (Emerge Consultants)	Very Good 100%	3.1	Weed invasion Vegetation clearing Drying climate Hydrological change (all past, present and future)	
Peel03 Occurrence 49	Crown Reserve 37090 for explosives, forestry. Management Order Minister for Mines and Petroleum, DBCA	12/10/2016 (Emerge Consultants)	Good 50% Very Good 50%	3.3	Weed invasion Vegetation clearing Drying climate Hydrological change (all past, present and future	
Peel04 Occurrence 50	Crown Reserve 32200 Water Corporation	12/10/2016 (Emerge Consultants)	Good 100%	0.2282	Weed invasion Vegetation clearing Drying climate Hydrological changes (all past, present and future)	

*Vegetation condition categories from Keighery (1994) Vegetation Condition Scale in Bush Forever (Government of Western Australia 2000) are defined below:

Good ('Pristine', 'Excellent', 'Very Good' using Bush Forever (2000) scale): This includes vegetation ranging from 'Pristine' - with no obvious signs of disturbance, to 'Excellent' - Vegetation structure intact, with disturbance only affecting individual species, weeds are non-aggressive species and 'Very Good' - Vegetation structure altered, obvious signs of disturbance eg: from repeated fires, dieback, logging, grazing.

Medium ('Good' using Bush Forever (2000) scale): This includes vegetation categorised as 'Good' - Vegetation structure altered but retains basic vegetation structure or ability to regenerate it, obvious signs of disturbance are present, from activities including partial clearing, dieback and grazing.

Poor ('Degraded', 'Completely degraded' using Bush Forever (2000) scale): This includes vegetation ranging from 'Degraded' Basic vegetation structure severely impacted by disturbance, the vegetation requires intensive management, and disturbance such as partial clearing, dieback, logging and grazing, to 'Completely Degraded' where vegetation structure is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native shrubs and trees.

APPENDIX 1 THREATS

Taken from Department of Parks and Wildlife ((DPAW) 2015)

Vegetation clearing

The seasonal clay-based wetland communities of the south west are amongst the most threatened assemblages in Western Australia. It is estimated that >90% of the original extent of these wetlands has been cleared for agricultural use (Gibson *et al*. 2005). Clay pans in the Perth area have also historically been cleared and quarried for clay for use in manufacturing bricks and tiles.

Weed invasion

Weeds displace native plants, particularly following disturbances such as too frequent fire, grazing or partial clearing, and compete with them for light, nutrients and water. They can also prevent recruitment, cause changes to soil nutrients, and affect abundance of native fauna. They can also impact on other conservation values by harbouring pests and diseases, and increasing the fire risk.

Introduced South African bulbous plants are a particularly serious group of weeds in clay pans. As the taxa occur in similar habitat in South Africa, many have the ability to invade relatively undisturbed clay pan habitat and displace the rich herbaceous flora. *Watsonia meriana*, *Sparaxis bulbifera* (harlequin flower), *Moraea flaccida* (one leafed cape tulip), *Hesperantha falcata* and *Freesia alba* x *lechtlinii* (freesia) are of particular concern. Seed and cormels are spread into undisturbed areas in sheet waterflow across wetlands (Brown and Brooks 2003b; Brown *et al*. 2008). South African perennial grasses are another serious group of weeds that also occur in similar habitat in South Africa and have the ability to invade clay pans in good condition following disturbance events such as fire. *Tribolium uniolae* (haas grass), *Eragrostis curvula* (lovegrass) and *Hyparrhenia hirta* (tambookie grass) are of particular concern and are a priority for control. The impacts of annual weeds are less well known but many move into intact vegetation following a disturbance event and appear to displace the native annual flora. These include *Cyperus hystrix*, *Parentucellia viscosa* (bartsia) and *Hypochaeris glabra* (flat weed).

Sources of weed invasion include adjoining areas of urban and agricultural use, drains, and tracks within and near the clay pans. All these sources increase vulnerability to weed invasion following any type of disturbance. The clay pans may appear reasonably resistant to weed invasions due to seasonal inundation and hardness of soils in the summer and changes to these elements may alter their ability to resist weed invasion (Keighery 1996).

Quadrats established in 1992 in ephemeral claypans during a regional survey of the Swan Coastal Plain (Gibson *et al*. 1994), were resurveyed in 2012 (Gibson *et al*. 2018). A decrease in native species richness, from an average of 38.7 in 1992 to 32.9 per quadrat was indicated after 20 years (Gibson *et al*. 2018). Invasive taxa had increased in richness by 33% from an average of 10.8 taxa to 14.2 taxa per quadrat over the same 20-year period. Six particularly aggressive South African exotic flora had spread into an additional 37% of the previously non-invaded quadrats, with 60% of quadrats containing these taxa at the latter timepoint, an increase of 23%. The increase in exotic taxa could be expected due to the highly fragmented nature of the remnants (Gibson *et al*. 2018). The authors surmise that variability in inundation period in the last decade may be increasingly facilitating a longer period of weed establishment in some years. This indicates that declining rainfall may also be implicated in increased weed invasion in claypans.

Webb (2019) also compared data for proportion of native and weed species in occurrences of the community in 1994, and at a timepoint between 2010 and 2018. Linear projections of a 50-year forecast based on these trends are shown in Figure 1 below. Linear projections have been calculation based on these two timepoints. The projection indicates that if weeds are unmanaged in these occurrences, the proportion of native species will decline to approximately 52% of the total number of species in the community within the next 50 years (ie 48% weeds).

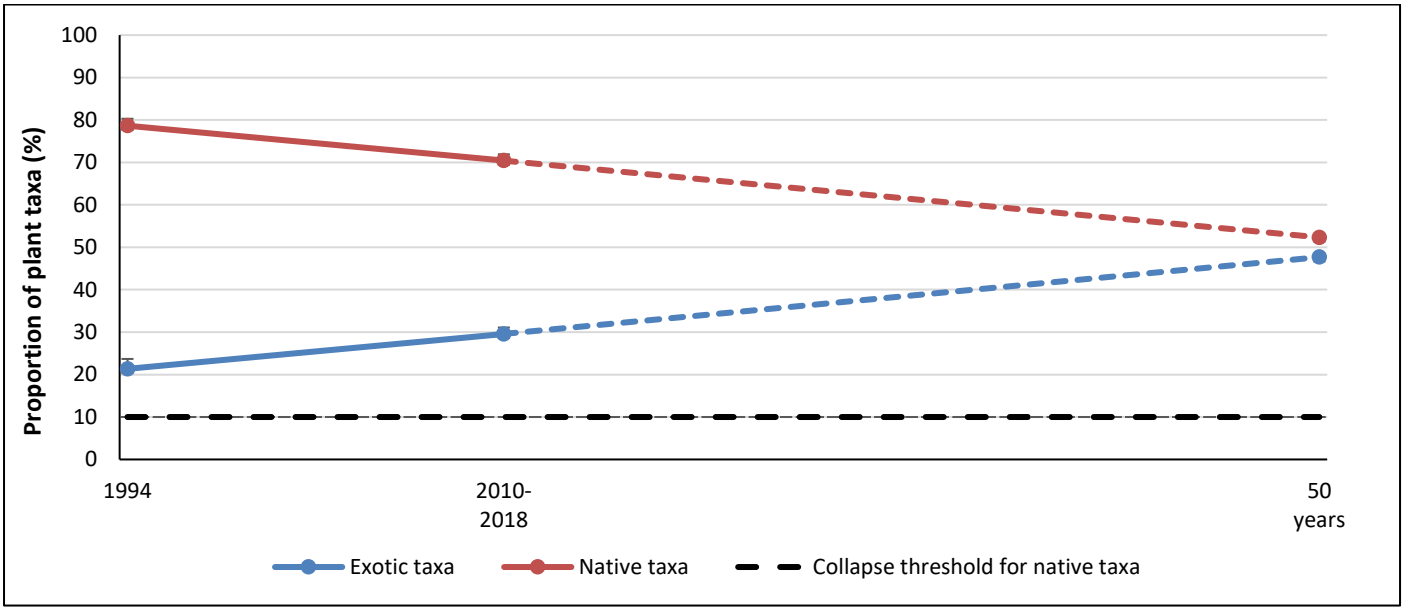

Figure 1. Trend in the proportion of native and exotic plant species based on the mean of 17 sampled sites. 16 sites are located in the Swan region and 1 located in the South-west region (n = 17). A 50-year forecast was calculated using a linear trendline of the proportion of exotic taxa (y=0.3467x+20.971) and the proportion of native taxa (y=-0.3467x+79.029) (Webb 2019).

Hydrological changes

Hydrology is the main driver of the ecological functions of clay pans. The biota associated with low lying areas, including damplands, palusplains and basins, are adapted to, and require, seasonal flooding and shallow water tables for their long-term persistence (Bourke 2017). Variations in depth and timing of inundation influence the suites of flora that occur in a particular location, resulting in variation in the community's composition across its extent (DPaW 2015). Changes in hydrological status will significantly alter the assemblages in the communities (DPaW 2015).

Hope (2015) https://www.climatechangeinaustralia.gov.au/en/publications-library/cluster-reports notes that "There has been a prolonged period of extensive drying from the 1970s in the Southern and South Western Flatlands (SSWF) and from the 1990s to the present in both sub-clusters, particularly in autumn and early winter. Decreases in winter and spring (and annual) rainfall are projected with high confidence. There is strong model agreement and good understanding of the contributing underlying physical mechanisms driving this change (relating to the southward shift of winter storm systems and greater prevalence of high pressure systems). By 2030 winter rainfall may change by -15 to +5 %. By 2090, these ranges are around -30 to -5 % under Representative Concentration Pathways (RCP) RCP4.5 for Southern and South Western Flatlands Western Cluster (SSWFW), and -45 to -15 % under RCP8.5. For Southern and South Western Flatlands Eastern Cluster SSWFE, under RCP4.5 by 2090 the changes are -25 to 0 % while under RCP8.5 the range is -45 to -5 %. For the whole cluster (SSWF), under RCP4.5 by 2090 the range is -25 to -5 % while under RCP8.5 the range is -45 to -15 %." These scenarios are indicative of trends in climatic drying that are likely to affect the depth and seasonality of inundation of the clay pan communities. This has major implications for the future of the clay pan floral assemblages.

Altered hydrology due to anthropogenic causes, in urbanised areas in particular, is likely to be an increasing threat to the clay pans. Drainage to lower watertables, clearing resulting in a decline in evapotranspiration and increased surface runoff, and water quality declines are likely to increasingly impact the hydrologic regimes of the clay pan communities. Altered periods of ponding may affect the timing of growth of herbs in the understorey, and may also affect the species composition of the community by favouring different taxa. Any changes to the natural hydrology of the clay pans can affect composition as they are dependent on the timing of filling and drying at appropriate times of the year. Bourke (2017) suggests it is likely that changes to the hydrological cycle of the occurrence of the claypan community within Greater Brixton Street Wetland area have already occurred or will occur in the future. Also, given the lack of understanding of the current and historical hydrological functioning of this area, the development of a robust conceptual hydrological model for this site is essential.

Increased nutrient levels in surface water in occurrences adjacent to areas such as farm lands and residential areas is likely to favour weeds as they are adapted to higher nutrient levels than native flora.

Fire regimes

Inappropriate fire regimes are a significant threat to the clay pan communities. Historically, fire within the clay pans was probably only very occasional. It is likely that some of the clay pan sub-types such as the Shrublands on dry clay

flats may be adapted to occasional fire as they contain species that will easily carry fire when vegetation is dry, and some component shrubs would reproduce from seed following fire. The fire response of the major types of clay pan vegetation needs to be determined however.

The risk of fire is generally increased by the presence of urban areas nearby. In addition, grassy weeds in the understorey are often more flammable than many of the original native species in the herb layer.

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APPENDIX 2: Distribution of Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson *et al*. (1994))

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APPENDIX 3: Area and proportion remaining for vegetation complexes that support occurrences of Herb rich shrublands in clay pans (floristic community type 8 as originally described in Gibson *et al*. 1994)

Vegetation Complex	Area of vegetation complex in occurrences of SCP08 (ha)	SCP Pre-European Extent (ha) of complex	SCP % Remaining	SCP Pre-European Extent secure for Conservation (EPA definition) (ha)	SCP Current percentage remaining within lands secure for Conservation (EPA definition) (%)
Beermullah complex	5.72	6707.27	6.67	145.38	2.13
Guildford complex	121.18	90513.13	5.09	373.62	0.33
Serpentine River complex	17.43	19855.41	9.77	373.62	2.42
Southern River complex	114.74	58781.48	18.43	1137.82	1.37
Yoongarillup complex	8.63	27977.93	35.81	4539.74	14.14

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APPENDIX 4: IUCN Red List Criteria for ecosystems (version 2.2) (IUCN 2017)

A. Reduction in geographic distribution over ANY of the following time periods:				
		CR	EN	VU
A1	Present (over the past 50 years).	≥ 80%	≥ 50%	≥ 30%
A2a	Future (over the next 50 years).	≥ 80%	≥ 50%	≥ 30%
A2b	Future (over any 50 year period including the present and future).	≥ 80%	≥ 50%	≥ 30%
A3	Historic (since 1750).	≥ 90%	≥ 70%	≥ 50%
B. Restricted geographic distribution indicated by EITHER B1, B2 or B3:				
		CR	EN	VU
B1	Extent of a minimum convex polygon enclosing all occurrences (Extent of Occurrence)	≤ 2,000 km²	≤ 20,000 km²	≤ 50,000 km²
	AND at least one of the following (a-c):			
	(a) An observed or inferred continuing decline in **EITHER**:			
	i. a measure of spatial extent appropriate to the ecosystem; **OR**			
	ii. a measure of environmental quality appropriate to characteristic biota of the ecosystem; **OR**			
	iii. a measure of disruption to biotic interactions appropriate to the characteristic biota of the ecosystem.			
	(b) Observed or inferred threatening processes that are likely to cause continuing declines in geographic distribution, environmental quality or biotic interactions within the next 20 years.			
	(c) Ecosystem exists at …	1 location	≤ 5 locations	≤ 10 locations
B2	The number of 10 × 10 km grid cells occupied (Area of Occupancy)	≤ 2	≤ 20	≤ 50
	AND at least one of a-c above (same sub-criteria as for B1).			
B3	A very small number of locations (generally fewer than 5) **AND** prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and thus capable of collapse or becoming Critically Endangered within a very short time period (B3 can only lead to a listing as VU).			VU

C. Environmental degradation over ANY of the following time periods:

			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
C1	The past 50 years based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
C2	The next 50 years, or any 50-year period including the present and future, based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
C3	Since 1750 based on change in an abiotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		

D. Disruption of biotic processes or interactions over ANY of the following time periods:

			Relative severity (%)		
		Extent (%)	≥ 80	≥ 50	≥ 30
D1	The past 50 years based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 80	≥ 50	≥ 30
D2	(D2a) The next 50 years, or (D2b) any 50-year period including the present and future, based on change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table: OR	≥ 80	CR	EN	VU
		≥ 50	EN	VU	
		≥ 30	VU		
			≥ 90	≥ 70	≥ 50
D3	Since 1750, based on a change in a biotic variable affecting a fraction of the extent of the ecosystem and with relative severity, as indicated by the following table:	≥ 90	CR	EN	VU
		≥ 70	EN	VU	
		≥ 50	VU		

E. Quantitative analysis

	CR	EN	VU
… that estimates the probability of ecosystem collapse to be:	≥ 50% within 50 years	≥ 20% within 50 years	≥ 10% within 100 years

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