Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Nomination *(to be completed by nominator)*

Current conservation status	
Name of ecological community:	Assemblages of the organic springs and mound springs of the Mandora Marsh area
Other names:	
Description:	The community occurs in the Mandora Marsh area, which is located 140km south west of Broome, and approximately 40 to 100km inland from Eighty-Mile Beach. Plant assemblages associated with the springs include paperbark *Melaleuca leucadendra* or *Melaleuca cajuputi* forest with or without an understorey of *Acrostichum speciosum* (mangrove fern), and *Sesbania formosa* (white dragon tree) woodland with or without an understorey of mangrove ferns. Stands of the bulrush *Typha domingensis* and sedgelands dominated by *Schoenoplectus* spp. with *Fimbristylis* spp., along with patches of the grass *Sporobolus virginicus* also occur. In addition, a few *Avicennia marina* (white mangroves) occur on the more brackish springs. *Acacia ampliceps* is often present in the mid-storey but is not abundant. *Typha domingensis* and sedges with a few emergent trees or mangroves dominate the vegetation on some of the small mound springs. The dominant vegetation of the springs varies between occurrences and over time due to damage by cyclonic winds. Invertebrate fauna from mound springs of the Mandora Marsh area are much richer than in springs further north in the Kimberley, and very few species are common to both areas. The permanent water and dense vegetation of the springs provide a refuge for these invertebrate fauna in an otherwise arid desert landscape.
Nomination for:	Listing ☐ 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			
Western Australia	Threatened list; under WA Minister ESA list in policy	8/05/2002	Endangered	B) iii)
	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 3 table 'IUCN Red List Criteria for ecosystems version 2.2'.*			B1b
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**
	Justification of assessment under Criterion A.		For criteria A and B, the ecosystem was assumed to collapse when the mapped distribution declines to zero. • A: Based on aerial photography and some on ground verification, up to 7 small occurrences have been destroyed where cattle yards occurred historically. These total <1ha (1 ÷53.5ha total x100 = <2% of the total area of the community mapped). There is no evidence to support the inference that a significant reduction in geographic distribution has occurred over any identified of the 50-year periods (A1, A2). The community does not meet the ≥30% minimum threshold to meet criteria A1 and A2 (or for ≥50% historical decline as required for A3). • **Does not meet criterion A**
B.	Restricted geographic distribution *(EOO and AOO, number of locations and evidence of decline)*		☒ **B1** (specify at least one of the following): CR ☐ **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 178km^2 (≤2,000km^2, which is the threshold for CR). • B2: AOO is three 10x10 km grid cells (threshold for EN is 20, and for CR is two grid cells).

		• a): Broad-scale data from remote sensing assessment from 2002 to 2014 indicates vegetation cover in all the mound springs was generally stable. Only Stockyard springs showed a major loss of vegetation cover (22%), which is likely attributable to introduced herbivores . • b): Continuing decline observed from introduced herbivores, weed invasion (buffel grass) and inappropriate fire regimes; and inferred future decline in environmental quality or biotic interactions from hydrological changes (see Appendix 1 for further information on threats). • c) Ecosystem exists at two threat-defined locations based on their broad dependence on particular groundwater aquifers; the deeper Wallal aquifer, or the shallower Broome aquifer; and the inferred impacts of changes to the hydrologic regime. The assumption is that the occurrences of the community are mainly dependent on one of two aquifers that are subject to different levels of threat from extraction, and therefore different levels of decline (threshold for CR is one and for EN is five threat-defined locations). • B3: Community is known from two threat-defined locations and is at high risk of high-level impacts of changes in hydrology, drying climate, and impacts of feral animals. The current level of threat is considered non-trivial and the community is prone to effects of human activities or stochastic events within a very short time period in an uncertain future and thus capable of collapse or becoming CR within a very short time period (meets VU as <5 threat defined locations). • **Meets criteria for critically endangered B1b**
C.	Environmental degradation of abiotic variable *(Evidence of decline over 50-year period)*	☐ **C1** ☐ **C2** ☐ **C3**
	Justification of assessment under Criterion C.	• C1, C2: The most significant abiotic threat affecting the community is water table decline due to nearby landuses. This will likely result in a continuing decline in environmental quality in the next 50 years. Modelling by Department of Environmental Regulation (refer Appendix 1, Figure 2) predicts that some springs may be subject to 0.9m change in head pressure over 20 years of extraction. There is risk of anisotropy (heterogeneity) that may result in increased drawdown (above 0.9m) along the margins of geological faults that may result in groundwater drawdown exceeding 0.9m at some springs. Current understanding of the actual level and consequence of future drawdown are inadequate to indicate future relative decline and whether this meets the minimum thresholds for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period. • C3: Does not meet the minimum thresholds for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750.

		• **Inadequate data to indicate 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.	• D1, D2: The most significant biotic variable affecting the community is grazing. The assumption is made that impacts of grazing are measured by changes in vegetation condition. Broad-scale data from remote sensing assessment from 2002 to 2014 indicated vegetation cover in all but one mound spring (Stockyard spring) remained relatively stable. Huntley (2016) indicates a maximum of <25% of the vegetation in the most heavily affected area (Stockyard Gully) suffered a major loss of cover (2002-2014). This is below the minimum threshold (30%) proportional severity and only relates to a very small proportion of the total extent of the spring area (0.63ha/52.5ha total spring area X 100% = 1.2%) • D3: Does not meet the minimum proportion of the extent (≥50%) or proportional severity of disruption of biotic processes (≥50%) since 1750. • **Available data do not indicate community meets 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 Endangered using ranking criteria developed in WA that differ to those in the IUCN Red List Criteria for Ecosystems (version 2.2). The community is also subject to new and potentially significant threats from hydrological change.
Summary of assessment information *(provide detailed information in the relevant sections of the nomination form)*

EOO	178km^2	AOO	Three 10x10 km grid cells (actual measured AOO 0.524km^2)
No. occurrences	17	Severely fragmented	Yes ☒ No ☐ Unknown ☐
Justification	The community is naturally fragmented as the springs only occur along a small section within Walyarta Conservation Park, where continuous water discharges or seeps occur. There is intact native vegetation between the springs.		
Current known area			52.5 ha
Pre-industrialisation extent or its former known extent (if known)			Occupies most of its former extent.
Estimated percentage decline			

Summary assessment against IUCN RLE Criteria

Criterion	Rank indicated	Overall conclusion
A1	-	• Does not meet
A2a	-	• Does not meet
A2b	-	• Does not meet
A3	-	• Does not meet
B1a	-	• EOO is ≤2,000km^2 • Remote sensing assessment from 2002 to 2014 indicates vegetation cover in most of the mound springs remained stable. Therefore, the community does not meet minimum thresholds of the criterion (VU). • Does not meet criterion
B1b	CR	• EOO is ≤2,000km^2 • Observed continuing decline from impacts from introduced herbivores; weeds; fire; and inferred future changes to hydrology that are considered 'non-trivial' threats. • Meets CR B1b
B1c	EN	• EOO is ≤2,000km^2 • Ecosystem exists at two threat-defined locations. • Meets rank EN
B2a	-	• AOO is three grid cells • Remote sensing assessment from 2002 to 2014 indicates vegetation cover in the majority of the mound springs remained stable. • Does not meet criterion
B2b	EN	• AOO is three grid cells • Observed continuing decline from impacts of introduced herbivores, weeds and fire; inferred decline in hydrology.
B2c	EN	• AOO is three grid cells • Ecosystem exists at two threat-defined locations.
B3	VU	• Known from two threat-defined locations • Prone to effects resulting from hydrological change, introduced herbivores. • Meets criterion for VU
C1	-	• Inadequate evidence to indicate the community meets the minimum threshold for decline in proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over the past 50 years to meet VU.
C2	-	• Inadequate evidence to indicate the community meets the minimum threshold for proportion of the extent (≥30%) or proportional severity of degradation (≥30%) over any 50-year period to meet VU.
C3	-	• Inadequate evidence to indicate that community meets the minimum threshold for proportion of the extent (≥50%) or proportional severity of disruption of abiotic processes (≥50%) since 1750 to meet VU.
D1	-	• Inadequate evidence to indicate the community meets the minimum threshold for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over the past 50 years to meet VU.
D2	-	• Inadequate evidence to indicate the community meets the minimum threshold for proportion of the extent (≥30%) or proportional severity of disruption of biotic processes (≥30%) over any 50-year period to meet VU.
D3	-	• Does not meet the minimum threshold 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.

		Meets CR under B1b. Plausibly meets EN under B1c, B2b,c, and VU under B3 *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 CR under B1b.**

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Summary of location (occurrence) information *(provide detailed information in the relevant sections of the nomination form)*						
Occurrence	Land tenure	Survey information: date of survey	Condition*	Area of occurrence (ha)	Threats *(note if past, present or future)*	Specific management actions
Saunders01 Saunders02 Saunders03 Saunders04 Saunders05	Conservation Park	2015	50% very good 50% excellent	6.9	Introduced herbivores (cattle), weed invasion, too intense fires, hydrological change, (*past, present, future*)# Disease (*past*) (only an actual threat in this occurrence) *#Threats broadly apply to all occurrences*	Install fencing, control weeds, remove introduced herbivores, establish hydrological monitoring *#Actions to be undertaken at the majority of occurrences.* *(Saunders and Grants Springs already fenced)*
Grants01	Conservation Park	2015	100% good	4.7		
EilEil01	Conservation Park	2015	50% good 50% excellent	11.9		
LittleEilEil01	Conservation Park	2015	100% very good	5.1		
Stockyard Mounds Stockyard02 Stockyard03 Stockyard04 Stockyard05 Stockyard07	Conservation Park	2015	40% good 60% degraded	1.1		
Fern Spring	Conservation Park	2015	80% pristine 20% very good	2.9		
Melaleuca Spring	Conservation Park	2015	85% pristine 15% good	1.1		

Linear Spring Linear Spring01	Conservation Park	2018	50% very good 40% good 10% degraded	2.6		
Top Springs01 Top Springs02 Top/Sump Spring	Conservation Park	2018	15% pristine 20% excellent 25% very good 30% good 10% degraded	4.4		
Sporobolus Spring	Conservation Park	2018	30% good 70% degraded	2.1		
Spring 1	Conservation Park		Not recorded	4.1		
Spring 2	Conservation Park	2018	80% excellent 5% very good 5% good 10% degraded	1.63		
Spring 3	Conservation Park		Not recorded	2.35		
Spring 4	Conservation Park		Not recorded	0.77		
Spring 5	Conservation Park		Not recorded	0.49		
Camp01	Conservation Park	2015	100% good	1.14		
Dingo01	Conservation Park	2016	50% good 50% degraded	0.42		

*For the purposes of relating condition to IUCN Criteria, condition categories from (Keighery (1994) Vegetation Condition Scale (Government of WA 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’ using Bush Forever (2000) scale): Basic vegetation structure severely impacted by disturbance such as partial clearing, dieback, logging and grazing. Scope for regeneration but not to a state approaching good condition without intensive management.

Beyond recovery ('Completely degraded' using Bush Forever (2000) scale): 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.

Table 1. Vegetation condition of occurrences that have been surveyed (13) of 'Mandora mound springs'

<table>
<tr><th>Condition Ranking (Keighery 1994) from Government of Western Australia 2000)</th><th>Hectares</th><th>IUCN Criteria condition ranking</th><th>Hectares</th></tr>
<tr><td>Pristine</td><td>3.92</td><td rowspan="3">Good</td><td rowspan="3">26.23</td></tr>
<tr><td>Excellent</td><td>10.96</td></tr>
<tr><td>Very Good</td><td>11.35</td></tr>
<tr><td>Good</td><td>15.31</td><td>Medium</td><td>15.31</td></tr>
<tr><td>Degraded</td><td>3.22</td><td>Poor</td><td>3.218</td></tr>
<tr><td>Completely degraded</td><td>0</td><td>Beyond recovery</td><td></td></tr>
<tr><td>Total</td><td>44.76</td><td>Total</td><td>44.76</td></tr>
</table>

APPENDIX 1 THREATS

Introduced herbivores

Cattle are a major threat to the Mandora mound springs. They cause physical damage to the mounds and the creek beds through trampling, resulting in erosion and increased sediment loads as well as grazing the regenerating vegetation, altering the species composition by selectively removing edible species and opening up disturbed areas for weed invasion.

In heavily grazed areas, *Sporobolis* ground cover is missing and trees have been pruned to cattle-head height, indicative of heavy browsing. Bark on trees has also been damaged by cattle rubbing. Removing the vegetation has the potential to result in an increase in drying of the mound springs. Such damage is evident at Saunders spring where root damage to trees from cattle has resulted in death of tops of trees. In addition, at Grant spring cattle have pushed over young *Sesbania* and cleared most of the mound vegetation. Of all the mound spring occurrences, Stockyard mounds are the most affected by cattle. Broad-scale data from remote sensing assessment from 2002 to 2014 indicated vegetation cover in most of the mound springs remained stable. However, Stockyard springs showed the largest major loss of vegetation cover (22%), which is likely attributable to cattle (Huntley 2016).

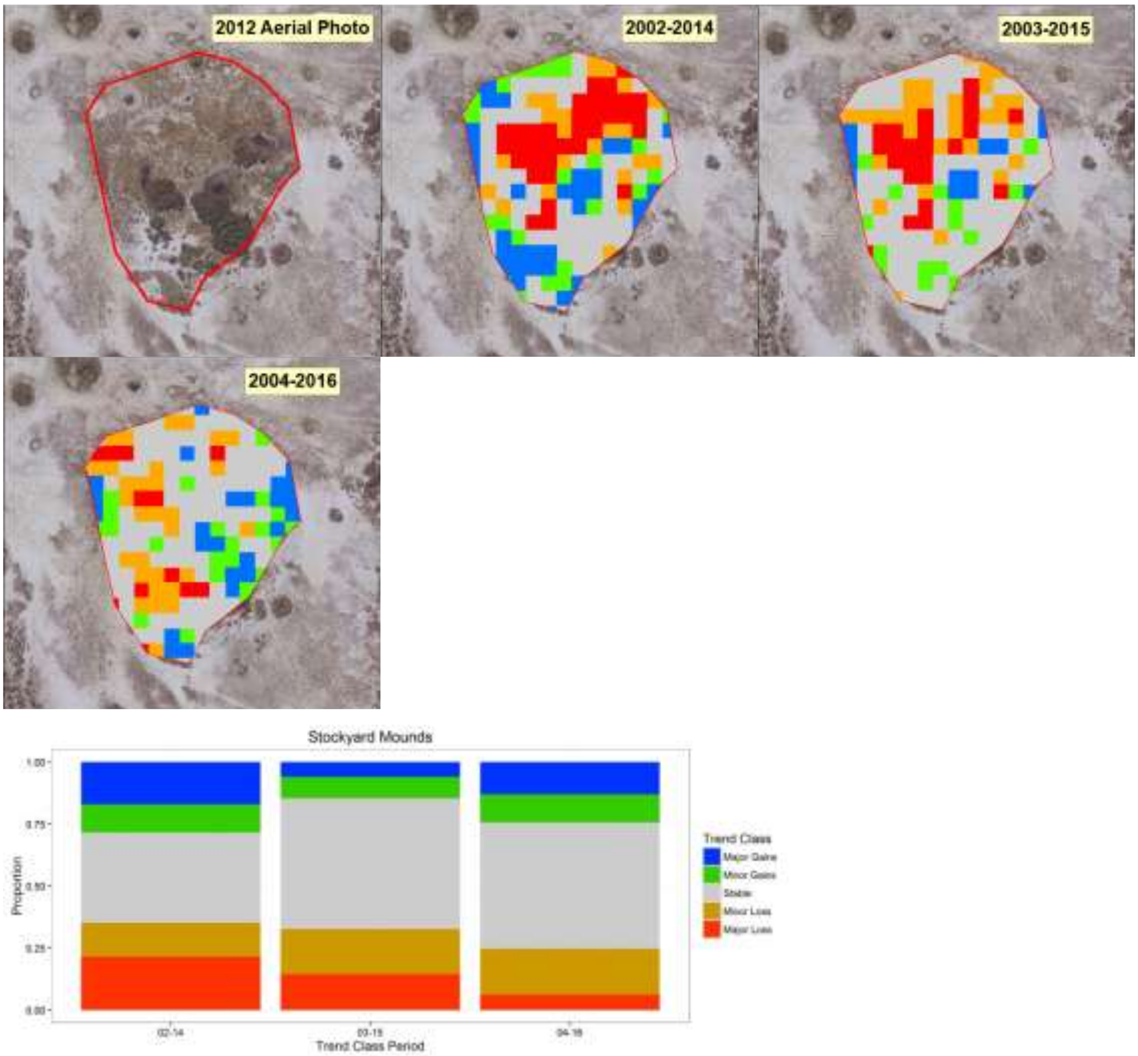

Figure 1. Spatial extent of trend classes for different monitoring periods (above) and bar chart (below) showing the change in proportional make-up of trend classes in each monitoring period for Stockyard springs (from Huntley 2016).

In addition to physical disturbance, faeces of cattle contaminate the soil and water causing nutrient enrichment, particularly in the moat. This may enhance the introduction of weeds as well as elevate nutrient levels in the groundwater. Storey *et al*. (2011) recorded the occurrence of algal blooms in 1999 in the shallow moats around Melaleuca and Saunders springs as well as elevated nitrogen levels indicating nutrient enrichment. In 2015, higher levels of turbidity and nutrients (nitrogen and phosphorus) concentrations were also recorded at Saunders and Grants springs, indicating enrichment by cattle (Quinlan *et al*. 2016). This adversely affects the aquatic invertebrates that rely on the water supply.

Other introduced species including camels (*Camelus dromedarius*), donkeys (*Equus asinus*) and cats (*Felix catus*) are recorded on occasions and impact on the mound springs. As with cattle, larger animals can cause damage to the vegetation through trampling and grazing, compaction and erosion of the soil, and nutrient enrichment of the water. Cats predate on native species as well as disrupt waterbird breeding. Large feral herbivores such as camels and donkeys also damage the fences (DEC 2009; Graham 1999; Parks and Wildlife 2016).

Hydrological changes

Large-scale developments, such as irrigated fodder, horticulture (primarily in the northern La Grange subarea), native food production, tree plantations, mining and tourism ventures, are proposed for the La Grange region, and these will require a significant increase in consumptive water (DOW 2010).

Significant volumes of water are planned to be extracted from the Broome and Wallal (West Canning, Canning) aquifers. The Department of Water (DOW) (2012; 2013) identified an allocation limit of 41 GL per year of groundwater in 2013 to be taken from the aquifers to support growth in Port Hedland, including 10 GL per year for public water supply. The allocation limit for the Wallal aquifer was set to 50 GL per year, significantly greater than the 10 GL per year limit set in 1997 (DOW 2012; 2013). An increase in iron ore production as well as development of unconventional gas reserves in the area may also increase the demand for water significantly (DOW 2012). An Allocation Statement for the West Canning Basin was released in 2018 by the Department of Water and Environmental Regulation (DWER) and states there have been requests for an additional 10 GL per year for the Wallal aquifer and 9.2 GL per year for the Broome aquifer (DWER 2018).

The impact of groundwater extraction will have on the mound springs is not clear, but it is likely that large-scale developments that require large amounts of consumptive water have potential for significant impacts on this groundwater dependent community, particularly the aquatic flora and fauna that depend on the constant supply of fresh water. Abstraction from the Wallal aquifer has the potential to reduce the pressure head and therefore spring discharge over time. Certain vegetation assemblages, such as riparian trees (*Sesbania formosa* and *Melaleuca leucadendra*) and macrophytes (*Typha domingensis* and sedges, *Schoenoplectus* spp., *Fimbristylis* spp., *Sporobolus virginicus* and *Acrostichum* sp.) are more at risk to changes in groundwater due to their maximum rooting depth (Loomes 2010). Loomes (2010) suggests groundwater levels may be maintained at two to four metres below ground level for macrophytes and riparian trees potentially able to tolerate lower groundwater levels of four to five metres below ground level. It is not known how tolerant these vegetation assemblages are to changes in water quality but as they occur in areas which are regularly flooded, it is likely they will have a low tolerance to a higher salinity (Loomes 2010).

DWER and licencees have a monitoring program in place, with a regional network of monitoring bores to collect information about water resources to provide a better understanding of how resources are responding to abstraction. Information provided is to be assessed against performance indicators to evaluate if the objectives above are being met (DOW 2013). Currently there is only one bore (SD1 WB; -19.815996560; 121.224228092) located within the Walyarta Conservation Park (SD1 WB) and this drill-hole provides information on the Broome Sandstone (Rutherford *et al*. 2018). The single bore is not considered adequate as an early warning system to indicate if the springs will be impacted in the near future by abstraction. It is unlikely that a reduction in abstraction will occur if the trigger in this bore is reached without supported visible detrimental changes in mound spring health. With the time lag it is also likely that detrimental changes to the mound springs detected at this stage will be too late to ameliorate. Furthermore, Currell *et al*. (2017) indicate that drawdown at springs is a poor early warning indicator as changes in water level will usually only reach the springs after the groundwater flow direction has reversed towards the region of extraction.

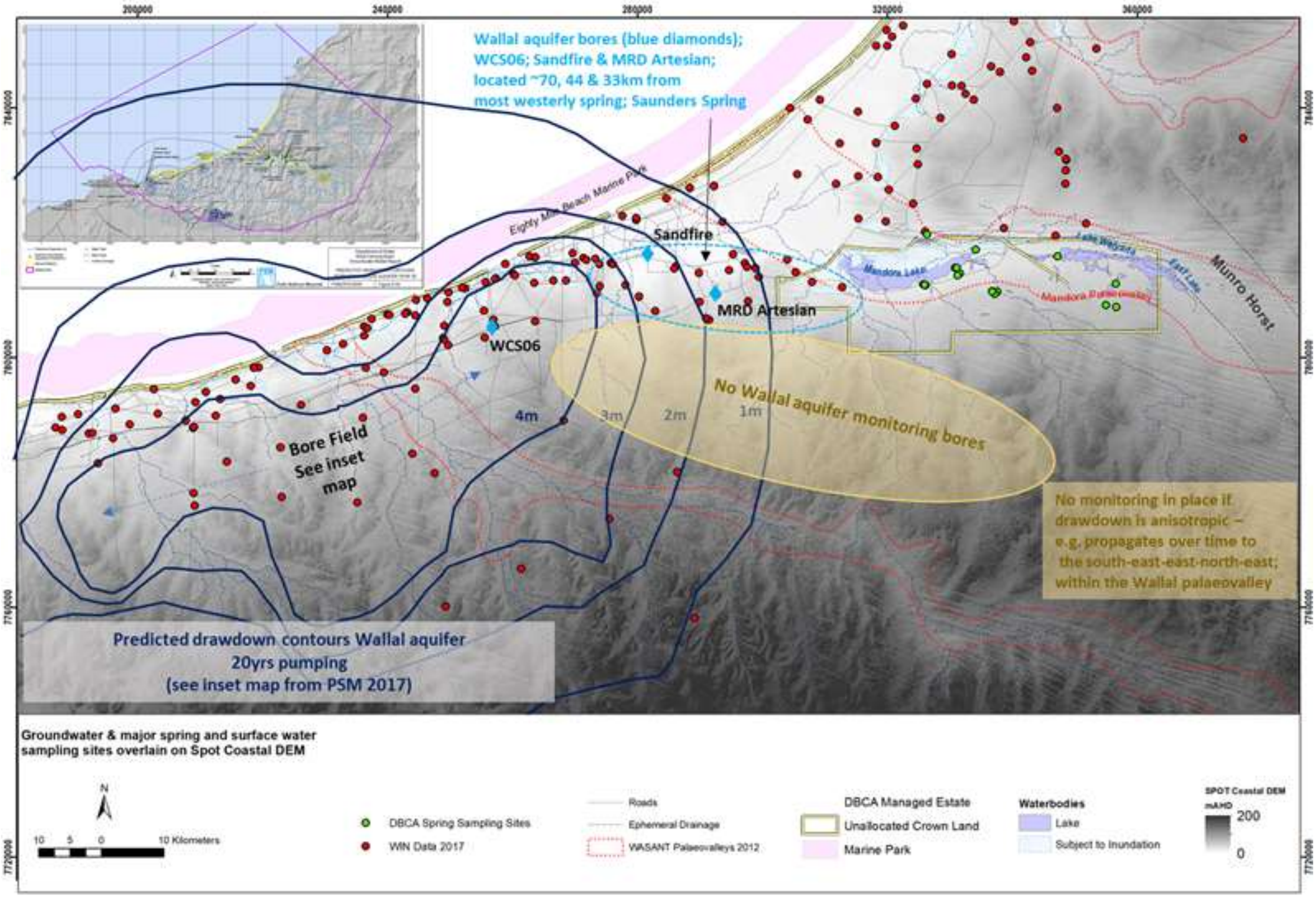

Figure 2. Sampling sites and monitoring bores within the Walyarta Conservation Park and surrounding area (from [redacted]).

Weed invasion

Current weed levels are currently low within Mandora mound springs. Some weed invasion has occurred, likely a result of the increase in nutrients and disturbance from cattle. The weeds are mainly located within the moats; the dense vegetation of the mound springs appearing to provide a barrier to reduce the likelihood of weed invasion. Couch (*Cynodon dactylon*), a strongly invasive weed which is able to tolerate varying conditions is adjacent to Saunders spring and requries urgent control. It has also been previously recorded in Eil Eil, Fern and Camp springs. Kapok Bush (*Aerva javanica*) has been recorded at Saunders and Grants springs; Buffel Grass (*Cenchrus ciliaris*) at Saunders and Grants springs; and *Phyla nodiflora* at Top spring.

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. Weeds 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.

In some of the springs, disturbance from introduced fauna (cattle, camels and donkeys) has likely encouraged an acceleration of the proliferation and abundance of particular native flora species. *Acacia ampliceps* has formed a low shrubland thicket around the fringes and outer boundaries of the springs, extending out 200 to 300 m from the spring. Although it is usually common in the midstorey of the community it is not usually abundant, however in some areas it has become a dense monoculture which dies off, creating large volumes of dead material that are quickly replaced by new growth. The dense *Acacia* thickets inhibit other species from growing, thereby leading to a change in species composition of the mound springs assemblage. *Typha domingensis* similarly appears to be increasing in abundance at the mound springs (*pers comm.* [redacted][1]).

Altered fire regimes

Inappropriate fire regimes are a potential risk to the Mandora mound springs. Historically, fires in the mound springs were probably only very occasional, and the majority of the occurrences are long unburnt (from DBCA ARCGIS fuel age layer). Areas

[1] Principal Botanist, Astron Environmental Services

within the Walyarta Conservation Park, such as the *Sporobolis virginicus* grassland in the south-west part of Walyarta Conservation Park, will readily carry a fire, as indicated in November 2017 when a fire burnt much of the area. Whether the surrounding vegetation of samphire shrublands are flammable or act as a firebreak to the springs cannot be determined from the November 2017 burn, as the subsequent flooding removed evidence of fire scars and burnt samphire shrubs (Markey 2018). It is unlikely a burn would take hold in some of the springs due to the damp conditions (DEC 2009), but some such as Eil Eil would likely carry a fire in extensive areas of dry peat. It is likely that the springs may be adapted to occasional fire as they contain species that will burn when the vegetation is dry and reproduce from seed. An increase in the fire frequency within the community however, may alter its structure and composition, removing the vegetation and the peat layer. The peat soils of the mound springs require particular fire management considerations as they can be damaged or destroyed by fires that smoulder for long periods (Parks and Wildlife 2016). Appropriate management will be required to ensure that the impacts of fire do not increase as the region is predicted to become even more fire prone with a drying climate (CSIRO and BOM 2015).

Insects

Evidence of leaf death in *Acrostichum speciosum* (Mangrove fern) was discovered at Saunders spring in 2009 and was likely to be caused by insects (DEC 2009). The leaf deaths did not appear to be widespread and were not apparent when the spring was surveyed in 2015.

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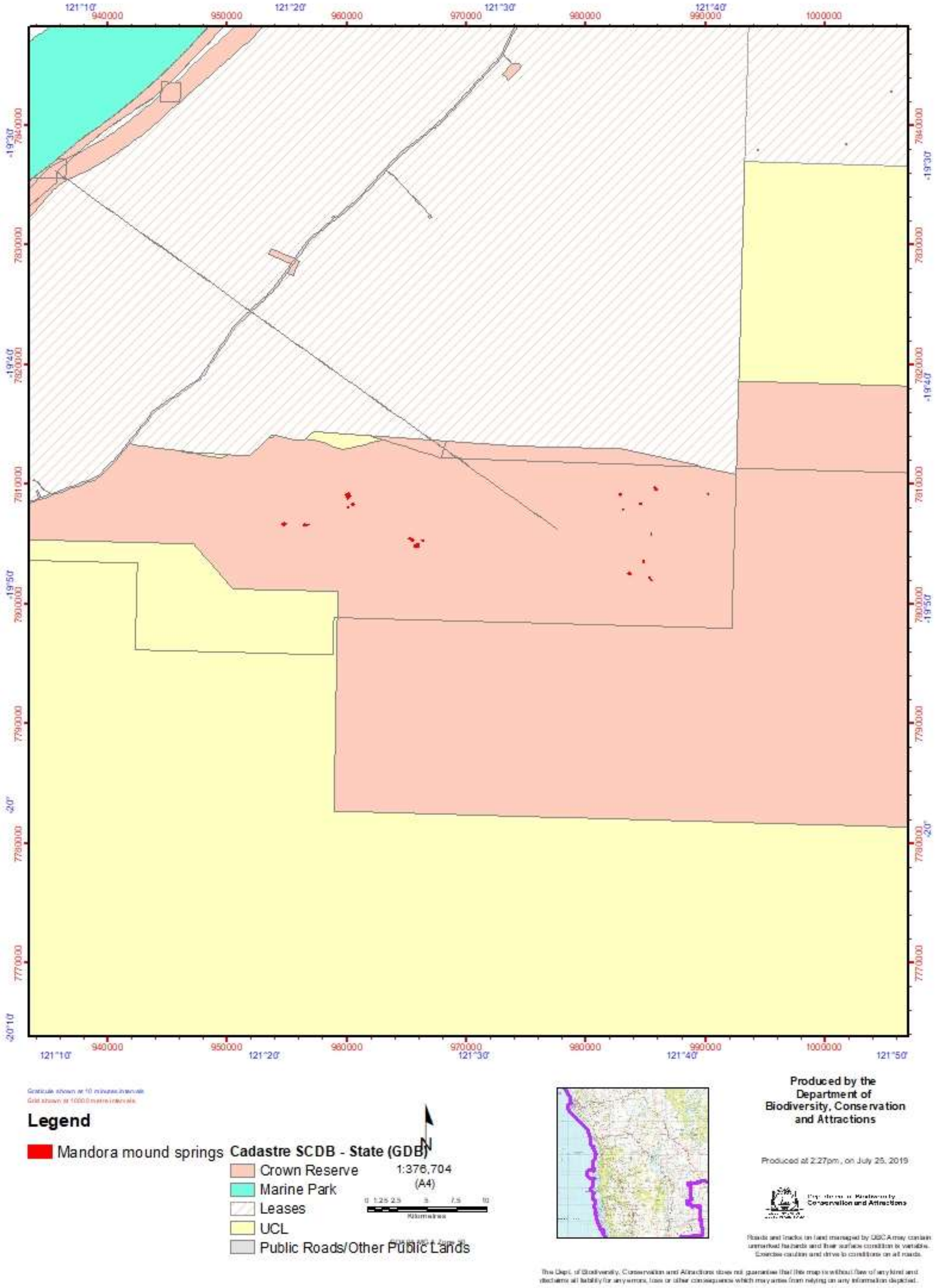
APPENDIX 2 Assemblages of the organic springs and mound springs of Mandora Marsh area (red)



APPENDIX 3 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		
D2			≥ 80	≥ 50	≥ 30

	(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