Western Swamp Tortoise

(*Pseudemydura umbrina*)

Recovery Plan

DRAFT FOR PUBLIC CONSULTATION

5th Edition May 2026

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Department of Biodiversity, Conservation and Attractions
Locked Bag 104
Bentley Delivery Centre WA 6983
Phone: (08) 9219 9000
Fax: (08) 9334 0498

www.dbca.wa.gov.au

This plan was prepared by Species and Communities Program, DBCA in consultation with the Swan Region and Western Swamp Tortoise Recovery Team.

Questions regarding the use of this material should be directed to:
Senior Conservation Zoologist
Species and Communities Program
Department of Biodiversity, Conservation, Conservation and Attractions
Locked Bag 104
Bentley Delivery Centre WA 6983
Phone: (08) 9219 9000
Email: fauna.recovery@dbca.wa.gov.au

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Cover image: a wild female western swamp tortoise at Ellen Brook Nature Reserve in 2013.

Photograph: Gerald Kuchling/DBCA.

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Acknowledgements

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Acknowledgement of Country

We acknowledge the Traditional Custodians throughout Western Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

Abbreviations

Term	Definition
BoM	Bureau of Meteorology
BC Act	*Biodiversity Conservation Act 2016* (WA)
CALM Act	*Conservation and Land Management Act 1984* (WA)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DWER	Department of Water and Environmental Regulation
EBNR	Ellen Brook Nature Reserve
EBICG	Ellen Brockman Integrated Catchment Group
EPA	Environmental Protection Authority
EPP	*Environmental Protection (Western Swamp Tortoise Habitat) Policy 2011*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FoWST	Friends of Western Swamp Tortoise
IBRA	Interim Biogeographical Regionalisation for Australia
IUCN	International Union for Conservation of Nature
LWNR	Lake Wannamal Nature Reserve
MRNR	Moore River Nature Reserve
NESP	National Environmental Science Program
NRM	Natural Resource Management
Scott NP	Scott National Park
SWNRM	South West Natural Resource Management
TSNR	Twin Swamps Nature Reserve
WA	Western Australia
WST	Western swamp tortoise (*Pseudemydura umbrina*)

Summary

This document constitutes the Recovery Plan for the Western Swamp Tortoise (*Pseudemydura umbrina*), hereafter referred to as the 'Recovery Plan', which has been prepared to meet the requirements of a recovery plan under the *Biodiversity Conservation Act 2016* (BC Act). The Recovery Plan provides for research and management actions to stop the decline and support the recovery of the western swamp tortoise so that its chance of long-term survival in the wild is maximised.

The objectives, and criteria against success will be measured for this plan are to:

1. Enhance the extent and quality of habitat for existing wild and translocated subpopulations.
   - By 2036 there is a net increase in area and condition of habitat within conservation estate or managed lands compared to 2026.
   - Actions:
     - Increase the area of protected WST habitat through the acquisition of suitable land.
     - Undertake management and restoration of habitat within conservation estate based on long-term monitoring of wetland ecosystem health.
     - Maintain water quality and quantity over a suitable hydroperiod to support WST subpopulations
     - Prepare and adopt a fire response plan for each subpopulation and an approach to fuel management.

2. Increase the population size by managing existing subpopulations and minimising mortality of individuals.
   - By 2036 monitoring demonstrates that the number of adult individuals is stable or increasing within each of the subpopulations.
   - Actions:
     - Undertake management of fauna species that predate or otherwise impact the WST subpopulations, including, but not limited to:
       - Red fox
       - Black rat
       - Feral pig
       - Quenda
       - Raven
       - Feral cat.
     - Implement strategies to prevent illegal take.
     - Maintain a genetically representative captive colony as an insurance population and to support translocations.
     - Develop a population management strategy to promote subpopulation growth and resilience.
     - Undertake translocations as required.

3. Address key knowledge gaps and use information to improve subpopulation and habitat management

- By 2036 monitoring and habitat use continues to be strategically and regularly undertaken across each of the subpopulations; and other sites with suitable habitat are surveyed.
- By 2036 wetland ecosystem health variables (such as water quality, depth and aquatic prey availability) are monitored at each of the subpopulations and used to inform on ground management.
- By 2036 increased knowledge of WST biology, ecology and genetic diversity informs management of the WST metapopulation.
- By 2036 research and monitoring informs decisions to establish one or more subpopulations in an area that is predicted to be suitable for the WST under projected future climate change scenarios.
- Actions:
    - Design and implement a long-term monitoring program for all subpopulations.
    - Design and implement a long-term monitoring program for wetland ecosystem health, which addresses: hydrology, geology and vegetation.
    - Undertake genetic research including genomic mapping and measures of genetic diversity, to inform captive and wild subpopulation management.
    - Review captive breeding and translocation protocols to identify strategies that may improve fitness and survivorship.
    - Continue research and monitoring at existing or new trial translocation sites to determine long-term suitability.
    - Facilitate data-sharing and knowledge exchange between relevant stakeholders involved in WST research, conservation operations, and decision-making.

4. Increase community awareness and support for the conservation of the species
    - By 2036 engagement with Traditional Owners, landowners, government agencies, natural resource management organisations and community members in WST recovery implementation and on ground actions is maintained or increased.
    - By 2036 the production of educational materials and activities that promote the conservation of the WST and improve management of lands adjacent to its viable habitat have increased.
    - Actions:
        - Educate and encourage landowners and managers of properties containing or neighbouring WST habitat to manage and protect for conservation.
        - Engage landowners and managers, Traditional Owners, community members and other interested stakeholders in WST conservation.
        - Pursue funding opportunities to support WST recovery.

This Recovery Plan is intended to operate for a 10-year period but will remain in force until withdrawn or replaced. Under the BC Act, the CEO may review the Recovery Plan at any time but must carry out a review within 10 years from the date the Recovery Plan takes effect. The Recovery Plan is intended to be reviewed at five-year intervals. This is the 5th edition of a recovery plan for this species with the first edition (Burbidge and Kuchling 1994) published 32 years ago.

1 Introduction

1.1 Species description

The western swamp tortoise (WST; *Pseudemydura umbrina*), also known as the western swamp turtle, family Chelidae, is the only representative of the monotypic subfamily Pseudemydurinae. It is a short-necked, freshwater turtle endemic to southwest Western Australia (WA).

The WST is the smallest Australian chelid. Males grow to a maximum 155 mm carapace length and 500 g weight, and females a maximum 135 mm carapace length and 410 g weight (Burbidge et al. 2010). It is readily distinguishable from the only other freshwater turtle naturally occurring in southwest Western Australia (WA), the oblong turtle, western long-necked turtle, or southwestern snake-necked turtle (*Chelodina oblonga*), by its short neck.

When extended, the combined head and neck length of the WST is much shorter than the length of the shell. It has webbed toes with five claws on each foot, the neck has tubercles, and the shell is squarish (Figure 1). It is yellow-brown to black above and whitish-yellowish, or olive-brown (Burbidge 1967; Cogger 2014), or black, or reddish-brown stained below.

Figure 1. Western Swamp Tortoise. Photo - Gerald Kuchling, DBCA.

1.2 Conservation status

The WST (*Pseudemydura umbrina*) is listed as a critically endangered threatened species under both the *Biodiversity Conservation Act 2016* (WA) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.* The species is also listed as Critically Endangered on the IUCN Red List of Threatened Species.

1.3 Distribution

The WST is endemic to the southwest of WA, and its known range is extremely restricted (Figure 2). It has only been recorded from scattered localities in a narrow strip of the eastern Swan Coastal Plain, mostly within the Perth Metropolitan Region. Occurrences were associated with alluvial soils either on the surface or at shallow depth, roughly parallel with and close to the Darling Scarp, running from Perth Airport northwards to Pearce Royal Australian Air Force Base at Bullsbrook.

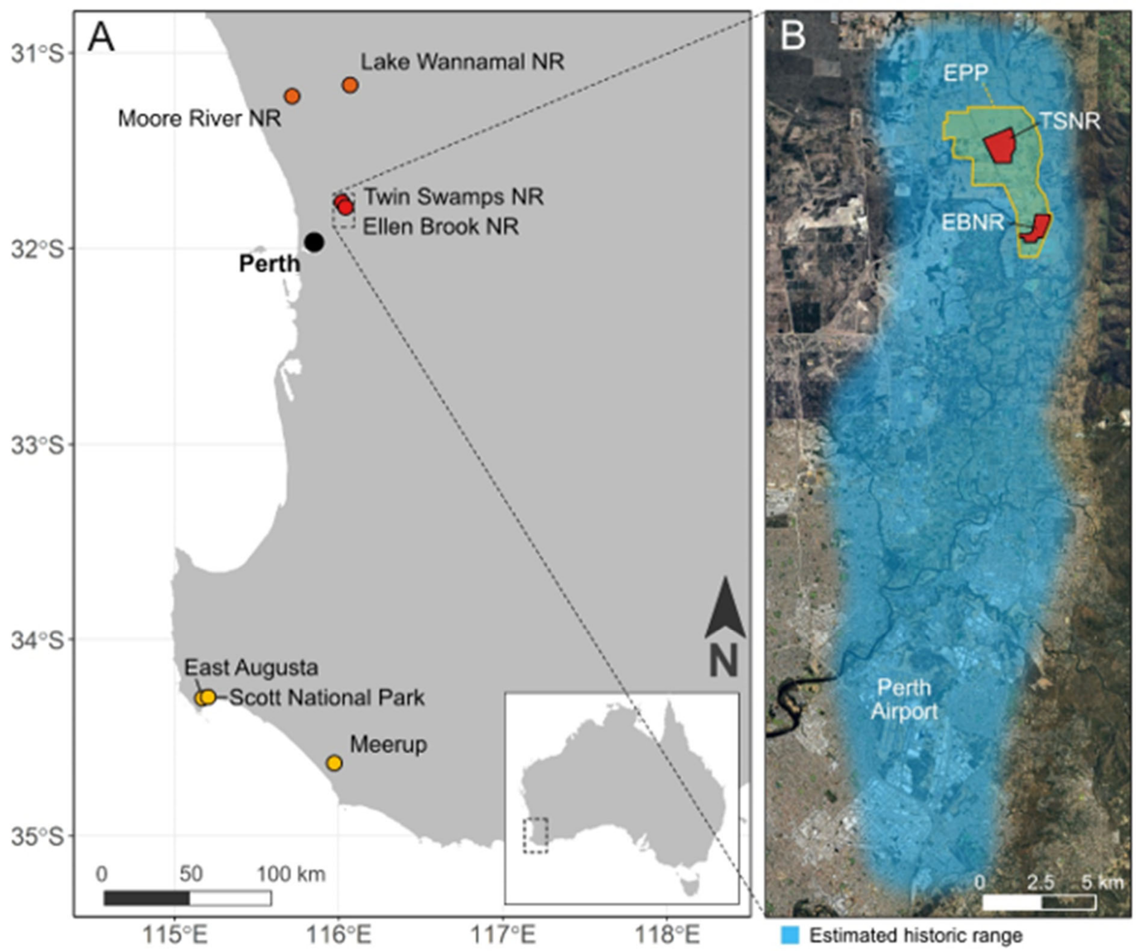

Figure 2. A) WST wild (red dots), translocated (orange dots), and trial assisted colonisation translocation (yellow dots) locations. B) Possible historic WST range estimated by modelled pre-European wetland mosaics and confirmed specimens.

Little is known of the past distribution of the WST. Anecdotal reports of sightings included Mogumber in the north and Pinjarra and Donnybrook to the south, but none were confirmed (Burbidge 1967; Burbidge 1981). The historical distribution likely included seasonal and ephemeral, winter- and spring-wet, clay soils of the Swan Coastal Plain (Burbidge et al. 2010).

From the 1960s until 2000 there were two known wild subpopulations in the northern outskirts of Perth at and adjacent to Ellen Brook Nature Reserve (EBNR) and Twin Swamps Nature Reserve (TSNR). The nature reserves were created in 1962 to protect WST habitat and are located within the *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2011* (EPP) area (Figure 4), which aims to protect habitat suitable for the WST.

TSNR was a stronghold for the species until the 1970s (Burbidge 1967; Burbidge 1981), when it largely collapsed due to drying conditions (reducing rainfall and increasing groundwater abstraction from the Gnangara mound) compounded by other threats, including predation and fire (Kuchling et al. 2018). The last known wild-born individual recorded from the original TSNR subpopulation was captured in 2009. Due to lengthy capture intervals for this species, it is possible that wild-born individuals remain at TSNR. Since 1994, it has been supplemented with captive-raised WST. This subpopulation remains important for the conservation of the species.

EBNR is now a significant area for the species, representing the only known natural subpopulation with original wild-born individuals and their wild-born progeny. WST from EBNR have contributed to the captive breeding program and all other WST subpopulations contain captive bred individuals.

The only other remaining extant habitat in the natural range of the species in which the WST was recorded is within the Perth Airport estate on Commonwealth Government land from the Five Mile Swamp area (Figure 2). In 1970, a juvenile WST was collected about 30 km south of EBNR within the Perth Airport estate. In 2013, a run-over WST was reported at a road construction site previously identified as potential WST wetland habitat by Kuchling and Burbidge (1996). The deceased animal was not retained and therefore species identity was not confirmed by experts. Surveys conducted at Perth Airport land in August 1995 to January 1996 (Kuchling and Burbidge 1996) and from September 2021 to February 2022 (Rodriguez and Kuchling 2022) did not detect the WST.

Two subpopulations were established about 70 km north of EBNR in Lake Wannamal Nature Reserve (LWNR) in 2000 and Moore River Nature Reserve (MRNR) in 2007; (Figure 2). Successful breeding and recruitment occurred at both sites, leading to their confirmation as suitable translocation sites. However, further translocations to LWNR were discontinued in 2008 due to increasingly marginal hydrological conditions. Despite this, both subpopulations demonstrated wild recruitment when last surveyed in 2020 and 2024, respectively.

Trial translocations were conducted to sites in the southwest region approximately 280 – 300 km south of their current distribution at Meerup, East Augusta and Scott National Park (Figure 2). These releases aimed to demonstrate if the WST could survive in a cooler climate with higher rainfall and potentially establish naturalised subpopulations in areas that modelling indicated would be more resilient to climate change (Mitchell et al. 2013; Mitchell et al. 2016).

Trials to Meerup were discontinued in 2019 because released WST did not display adequate first-year growth (Bouma et al. 2020; Paget 2019; Paget et al. 2023), but some individuals remained at the release site. The WST released to the Scott River area east of Augusta in 2016 showed comparable growth rates to the WST at MRNR (Bouma et al. 2020), prompting additional translocations to the region in 2021 and 2022 (Nordstrom 2024).

1.4 Population and trends

Targeted monitoring has been conducted at EBNR and TSNR since 1963 with varying intensity. In the mid-1960s, the total combined population within the two reserves was estimated at approximately 230 individuals (Burbidge 1967). By 1978, the population estimate, based on known to be alive (KTBA) modelling, indicated a decline to fewer than 50 individuals, with the majority at EBNR (Burbidge 1981; Figure 3).

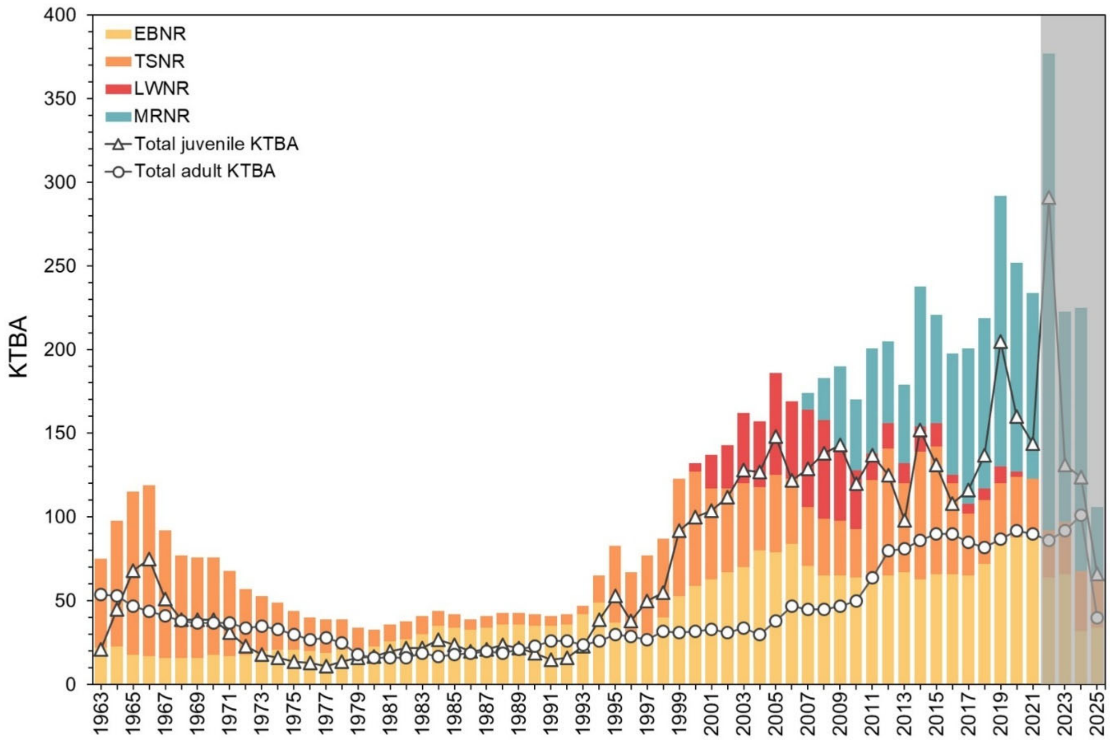

Figure 3. Known to be alive (KTBA) estimates (excluding hatchlings) for all Swan Coastal Plain subpopulations (EBNR, TSNR, MRNR, LWNR) from 1963 to 2025. Note: due to low capture rates, varying intensity of monitoring, and releases of captive-bred animals KTBA data are not indicative of population size for the most recent four years (shaded grey). The addition of known age data as animals are progressively captured over time improves these KTBA estimates.

A captive breeding program was established at the Perth Zoo in 1988 to supplement the wild population and captive-bred juveniles were first released at TSNR in 1994 (Kuchling et al. 2018). Until 2006, over half of the hatchlings produced at Perth Zoo originated from EBNR females held temporarily in captivity. Most were translocated as juveniles to TSNR, LWNR and MRNR, or retained in captivity as breeding stock. The remainder were translocated back to EBNR as hatchlings to compensate for the reduced reproductive output at EBNR whilst adult females were housed in captivity. Translocations from the captive breeding program to northern sites on the Swan Coastal Plain were conducted at LWNR from 2000 and at MRNR from 2007. Limited monitoring was conducted at LWNR after 2010 and at TSNR from 2017 to 2023. More routine monitoring continued at EBNR and MRNR.

Following supplementation with captive bred animals from the Perth Zoo, the wild population estimate rose to over 200 (excluding hatchlings) in 2014. Subsequent declines were thought to be due to continued loss of animals moving away from the nature reserves and predation of eggs and juveniles by quenda (*Isoodon fusciventer*), a species that benefitted from the installation of predator exclusion-fencing. Following routine removal of quenda from EBNR, periodic removal from TSNR, and more intensive monitoring of WST at EBNR in 2023 (70 individuals captured), and MRNR (104) and TSNR (21) in 2024 (see Section 2 Status of Subpopulations below), the total wild population of WST was once again estimated at over 200 individuals (excluding hatchlings) in 2024. An additional 230 WST were also housed in captivity at Perth Zoo at this time.

Monitoring the WST is challenging due to a limited annual window for surveying, drying conditions when WST cannot be captured using submerged nets, and temporary dispersal away from the nature reserves and translocation sites. Modelling subpopulation and therefore population estimates for the species are impeded by the difficulties of capturing a large enough proportion of each of the subpopulations per activity season. KTBA modelling using known-age data can track subpopulation trends, but it underestimates population sizes. Radio tracking using transmitters has provided additional information on mortality events and threats to the species.

1.5 Habitat

Broadly, the key habitat features of the WST are characterised by:

- Mosaics of ephemeral and seasonal (winter- and spring-wet), shallow (< 1 m) swamps with a low shrub canopy that dry in summer.
- Mediterranean climate with an average annual rainfall between 600 – 1000 mm, falling predominantly between May and September/October.
- Optimum water temperatures in late winter and spring between 14 °C and 28 °C (Lucas et al. 1963; King et al. 1998).
- Adequate aquatic invertebrate prey in the water column (Schmölz et al. 2021).
- Perched wetlands on clay or sand-over-clay soils.
- Presence of aestivation refuges that protect against desiccation and heat stress in summer and autumn, in addition to fire (i.e. naturally occurring holes in clay, holes dug by other animals or left by rotting tree roots).

During the wet season (late autumn to early summer) the WST is found in mosaics of shallow, ephemeral and seasonal, winter-wet swamps on clay or sand over clay soils. In EBNR and TSNR this includes areas of *Melaleuca* spp. shrubland that forms an open to dense canopy above the water, a variety of aquatic plants and clumps of sedges (King et al. 1998). During the dry season (summer and autumn) WST move out of the wetlands and into aestivation habitat, which typically comprises upland areas of bushland.

The greater Perth area in which the WST naturally occur, receives an average rainfall of > 600 mm, the majority of which falls in the winter months of May to September (BoM 2023). Mean annual rainfall (1937 to 2024) at Pearce RAAF weather station (ID: 009053) close to where the WST occur was 661 mm (BoM 2025). However, winter rainfall has declined across south-west WA in recent decades (CSIRO and BoM 2024; see Rainfall section).

1.6 Habitat critical to survival

Due to extremely restricted habitat requirements, all existing subpopulations' habitat is likely to be critical to the survival of this threatened species. This includes EBNR, TSNR, LWNR and MRNR.

The lands adjacent to and surrounding EBNR and TSNR, including the area covered by the EPP (Figure 4), may be considered critical to the survival of the species as these areas may provide nesting and aestivation habitat, facilitate movement of the WST between the nature reserves and surrounding areas and/or support the hydrology of the ephemeral and seasonal wetlands within the nature reserves (i.e. lands within the swamps' surface water catchments). These areas also act as a buffer from urbanisation and may provide drought refuges, such as farm dams and clay pits.

The Minister may list habitat as critical habitat under section 54 of the BC Act. Habitat is eligible for listing as critical habitat if it is critical to the survival of a threatened species. Specific areas of habitat that can be spatially delineated and may be eligible for listing as critical habitat under the BC Act are EBNR, TSNR and Lots 505 and 507, which are freehold land owned by DBCA and managed as though it were part of EBNR (Figure 4). EBNR and TSNR are the locations of the only known extant wild subpopulations of WST.

Additional areas may become critical to the survival of this threatened species in the future as habitat is restored, trial translocation sites are determined successful, and key knowledge gaps are better understood, such as movement ecology and aestivation habitat.

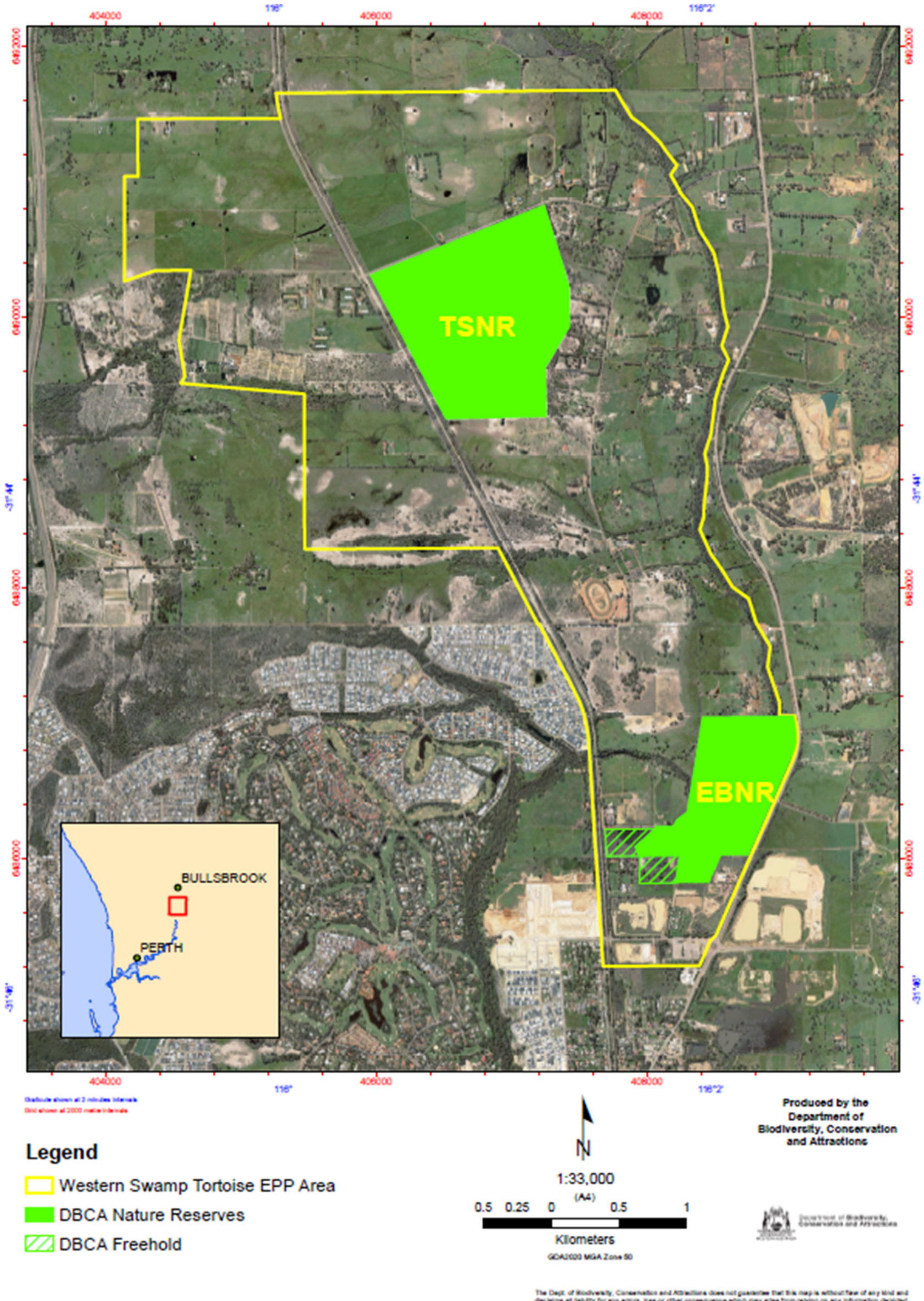

Figure 4. Areas in the Upper Swan and Bullsbrook area that may be eligible for listing as critical habitat are EBNR, TSNR and freehold land owned by DBCA and managed as though they are part of EBNR.

1.7 Biology and ecology

1.7.1 Breeding and growth rates

The WST is a long-lived species with records of an adult male of at least 20 years of age captured in 1959 and still alive in 2025 (at least 80 years old), and an adult female of at least 10 years of age first captured at EBNR in 1963 and over 70 years of age at last capture in 2013. Growth rates are slow and vary considerably between years and between locations depending on seasonal conditions. Therefore, age to sexual maturity (and weight) also varies. Females typically reach sexual maturity at around 110 mm carapace length, generally between 10 and 15 years of age. Their reproductive lifespan was previously estimated at over 30 years (Kuchling and Bradshaw 1993) but is likely much longer. The age of sexual maturity in males is unknown. Adults typically weigh > 200 g, juveniles weigh 50-200 g and hatchlings weigh < 50 g, noting that these values are approximations only.

Under optimal conditions, wild WST breed once every year (Kuchling and Bradshaw 1993). During winter, male and female WST copulate in the water and in late spring the female leaves the water to find a suitable place to construct a nest. The female digs the nest using the forelegs, contrary to all other chelonians, which use their hind legs (Kuchling 1993). In November or early December females lay three to five hard-shelled symmetrical eggs, each approximately 25 mm x 20 mm in size and 8.6 g in weight (Burbidge 1981; Kuchling 1993). The female then covers the nest in soil and returns to the water, usually shortly before aestivating (Kuchling 1993). Eggs hatch and hatchlings emerge from late April to June after early winter rains (Burbidge 1981; Rodriguez 2022).

Sex determination is believed to be genetic, as incubation temperature does not appear to influence hatchling sex ratios and subpopulations generally exhibit an even sex ratio (Burbidge 1981; Kuchling and Bradshaw 1993; Durell 2015). At Perth Zoo where eggs were incubated at 24 ºC and 29 ºC to exclude the possibility of an overproduction of males or females, hatchlings produced at both temperatures had an even sex ratio (Durell 2015). Current incubation temperatures in 2026 were 24 ºC and 27 ºC.

In 2018, Perth Zoo confirmed that female WST can store sperm. Females are therefore able to lay fertile eggs without access to a male. Sperm storage is an important component of turtle reproductive biology, thought to ensure fertilisation of second and subsequent egg clutches, including if the reproductive cycles of male and female turtles are asynchronous (Pearce and Avice 2001). The timeframe over which the WST store sperm and consequent impacts on reproductive success are unknown, but other species of freshwater turtle can store sperm for up to three years (Pearce and Avice 2001).

1.7.2 Seasonal movement and home ranges

The WST spends the majority of the winter and spring in the water. They will only leave the water during this time to bask in the sun, move between swamps, find a mate or a site for nesting. When swamps begin to dry out and water temperatures rise over

28 °C, usually in November, the WST leave the water to find aestivation refuges for the summer and autumn months to avoid desiccation and heat stress (Burbidge 1981).

The species is not territorial but radio tracking studies over multiple years in wild and translocated subpopulations suggest the WST has home ranges (Burbidge 1981; DBCA unpub. data). Individuals use suitable habitat within the protected TSNR and EBNR on the Swan Coastal Plain, and marked individuals recorded outside these nature reserves demonstrate that their home ranges can be larger than the size of the nature reserves (Figure 4). The home ranges of individuals can include a variety of habitats, including wetlands and seasonally inundated areas, drainage lines, and farm dams during wet periods, and adjacent upland bushland during dry periods.

The WST is capable of moving large distances. Individuals from TSNR were recorded moving up to 600 m in two days (Burbidge 1981) and Rodriguez (unpub. data) recorded movements of 400 m in a day within EBNR. Prior to the construction of fences around the nature reserves, individuals were also recorded moving up to 1.5 km over cleared agricultural land with two individuals marked at TSNR later located at EBNR, about 4 km away (Kuchling, Rodriguez unpub. data), suggesting that the area between EBNR and TSNR has been intermittently used by the WST.

Long-range movements may occur due to homing behaviour or when the WST searches for suitable habitat, particularly in dry periods (Burbidge et al. 2010). For example, a male collected in Middle Swan in October 1967 about 15 km south of EBNR was relocated to EBNR and subsequently picked up on Great Northern Highway 1.6 km south of EBNR in August 1968. These movements may become established patterns where animals move between aestivation, wetland and nesting sites. Translocated WST at LWNR were known to move seasonally over cleared pastures between the nature reserve and deeper wetlands, including farm dams (DBCA unpub. data).

1.7.3 Diet

The WST are carnivorous and only eat live prey. They are known to eat insects and insect larvae, small crustaceans, worms and small tadpoles. They are not selective in their prey consumption but are largely reliant on aquatic invertebrate prey in the water column as their main food source (Burbidge 1981; Gilbert 2010; Schmölz et al. 2021). They do not take carrion and are not attracted to baited traps.

There is no evidence that the WST feeds outside the water column (Gilbert 2010). Feeding occurs only when sufficient water is present and when water temperatures exceed 14 °C on the Swan Coastal Plain, noting that individual animals can exploit warmer microclimates during cooler months (King et al. 1998). The majority of feeding therefore occurs in spring and early summer. Studies show that hatchlings and adults will feed at all times of day but most food is consumed between 2:00 pm and 4:30 pm (Mitchell et al. 2012; Schmölz et al. 2021).

1.8 Genetic knowledge

The WST population suffered a severe genetic bottleneck and associated loss of genetic diversity following the reduction in population size to fewer than 50 individuals (less than 25 adults in the wild) in the late 1980s. Previous genetic studies have included trials in chromosome banding, plasma enzyme gel electrophoresis, and DNA fingerprinting but only the latter method was able to detect a small amount of variability between individuals (Kuchling 1997). More recently, a high-quality, chromosome-length reference genome was successfully assembled, providing a foundational genomic resource for the species.

Using techniques to identify genes and what they influence through ‘genome annotation’ will improve the ability to link genetic variation to population viability. Whole-genome resequencing of a subset of 45 individuals, including original founders and the current captive breeding stock is underway, and will provide insights into relatedness, inbreeding, and subpopulation structure. Preliminary analyses indicated minor genetic differentiation between individuals originating from TSNR and EBNR.

These tools will inform recovery actions, including breeding and population management decisions to minimise further loss of genetic diversity and support population viability.

2 Status of subpopulations

2.1 Ellen Brook Nature Reserve (EBNR)

EBNR retains the only confirmed subpopulation of the WST that has not routinely been supplemented and contains wild-born individuals and their wild-born progeny. EBNR is considered the most suitable and highest quality WST habitat due to its unique hydrology and substrate of loam soils over 'gilgai' mounds and depressions formed on clay soils (also known as 'crabholes'), which extends hydroperiods during periods of drought. In years with average and above average winter/spring rainfall, EBNR wetlands overflow and the hydroperiod can extend from June/July to November. These wetlands are less affected by a drying climate than wetlands at many other sites. Even in drier years with below average winter/spring rainfall, water remains in the wetlands for up to five months. EBNR also contains abundant clay-based aestivation refuges underground, which provides substantial protection from summer wildfires (Rodriguez 2022).

Predator-exclusion fencing was installed around the WST habitat of EBNR (29 hectares) in 1991 due to known incidents of introduced red fox (*Vulpes vulpes*) predation on the WST (Burbidge 1967). The fence was replaced and extended to include acquired and rehabilitated land in 2006, with extensions occurring in 2016 and 2025. Following construction of the predator-exclusion fencing, at least seven WST died from overheating and five were killed or injured by Australian ravens (*Corvus coronoides*) while moving along the fence. Two-way gates along the base of the fence were later installed to enable movement of the WST outside of the fence to reduce these impacts. Recruitment declined during the 1990s due to nest predation through mesopredator release of quenda after the exclusion of foxes. To improve recruitment, a program to trap and translocate quenda out of the reserve has been undertaken since 2007, though predation of WST nests by quenda is an ongoing management issue.

The latest fence installed in 2025 following fire damage included larger apertures to allow WST movement and mitigate risks of overheating and predation. The remainder of the fence is scheduled for replacement with this new design.

With land acquisitions, the total reserved area of the WST habitat in EBNR is now 50 hectares. Areas of acquired land have been progressively rehabilitated, with restoration works ongoing. The growth of this subpopulation is constrained by the small area of suitable habitat, pressures of urban and industrial development on the surrounding lands, and dispersal of the WST to adjacent land where they are subject to increased threats. Intensive management across the reserve is required to sustain this subpopulation, which may include weed control, removal of quenda, and fence replacement.

The carrying capacity of EBNR was thought to be around 45 adult WST based on capture data since the 1960s (Figure 3; Burbidge et al. 1990). EBNR had an estimated population of approximately 30 WST from the mid-1960s to mid-1980s (Burbidge et al. 1990) and grew to a peak of 44 adults KTBA in 2013. Intensive surveys in 2020 caught 65 individuals, with comparable numbers captured in 2021 (77) and 2023 (70; which included 25 adults, 33 juveniles, and 12 hatchlings).

2.2 Twin Swamps Nature Reserve (TSNR)

Until the late 1960s, TSNR was the stronghold of the WST, with a relatively large subpopulation estimate of around 200 (Burbidge 1981). By the early 1990s, the subpopulation had declined to near extinction, with the majority of surviving individuals found in clay pans on private property to the east of TSNR (Burbidge et al. 1990). Dispersal into cleared neighbouring areas due to drying conditions and short hydroperiods appears to have been the main reason for the decline. By the 1980s, many swamps that formerly filled to depths of 300 mm or more for four to six months, had no standing water during winter and spring. As with EBNR, a predator-exclusion fence was installed in 1994, and quenda have been removed periodically from 2007 onwards.

The TSNR wetlands are largely underlain by sands, with an impervious white claypan in low lying areas (Burbidge 1967) and are dependent on a hydraulic connection to the increasingly abstracted Gnangara mound (Muirden 2019). Due to the impacts of climate change, groundwater abstraction and loss of original drought refuges (clay pans to the east out of TSNR that lie outside the fence that have been subject to drying conditions and land-use change), the habitat requires restoration and ongoing intensive management, which may include weed control, removal of quenda, fence replacement, groundwater supplementation and creation of artificial ephemeral and seasonal wetlands.

Following the decline in population in the 1990s, groundwater supplementation into TSNR throughout winter and spring, and restocking with 272 captive-bred juveniles between 1994 to 2015, temporarily increased the size of the subpopulation. However, it continued to decline, likely due to a combination of low recruitment, predation by foxes that breached the fence, and dispersal out of the reserve. It is possible this subpopulation is now solely comprised of captive bred, translocated individuals and their offspring.

The last intensive monitoring conducted in 2016 recorded 25 WST (14 adults, 11 juveniles and no hatchlings). More intensive monitoring in 2025 recorded 31 individuals (15 adults, eight juveniles, and eight hatchlings).

2.3 Lake Wannamal Nature Reserve (LWNR)

The translocated subpopulation at LWNR was founded with 180 captive-bred juvenile WST released from the Perth Zoo between 2000 and 2008. Historic records of the species are known from the Mogumber area, likely making this translocation a reintroduction. The seasonal wetlands were selected as potentially suitable habitat but have subsequently been impacted by climate change and declining rainfall.

During initial releases of 26 WST in 2000 and 2001, six individuals moved off reserve to adjacent farmland and two were predated, likely by foxes. A summer bushfire in late 2002 killed about half of the remaining WST, with others likely succumbing to the harsh post-fire conditions. In subsequent releases some WST made seasonal movements between wetlands and aestivation habitat inside the reserve, and drought refuges, such as farm dams or deeper wetlands, on adjacent private agricultural land.

The LWNR area is considered hydrologically marginal due to ongoing drying trends, and the long-term viability of the wetlands to support a WST subpopulation is regarded as low. In some years, the hydroperiod was three months or less, reducing the time available for feeding prior to aestivation.

LWNR has only been monitored sporadically, due to a lack of suitable water levels to survey with capture nets. Regular monitoring ceased in 2010 when five adults and 22 juveniles were captured and no hatchlings recorded. A small number of adults, juveniles and hatchlings were captured in 2019/20. This subpopulation is no longer considered viable as a site for additional translocations.

2.4 Moore River Nature Reserve (MRNR)

The MRNR wetlands were chosen as a translocation site following mapping of remnant wetlands in the region. The area provides seasonal clay pan wetlands that overflow in average and above-average rainfall winter/spring seasons. MRNR appears to be less vulnerable to drying trends than TSNR due to its clay-based substrate. The site also provides an extended hydroperiod in drier years, aided by earthworks undertaken to increase the depth of some wetland areas and bunding of some existing drainage lines of wetlands to inhibit outflow of water to surrounding areas, including agricultural land.

The introduced MRNR subpopulation was established from 429 captive-bred WST between 2007 and 2024. Despite its relatively recent history, the MRNR subpopulation has demonstrated a demographic structure comparable to the EBNR subpopulation, with WST of multiple size classes present. The last intensive monitoring in 2024 captured 162 WST, which included 60 adults, 82 juveniles and 20 hatchlings.

Feral pigs (*Sus scrofa*) have been responsible for at least one WST death and several injuries in MRNR, and likely also disturb aestivation and nesting habitat. DBCA conducts targeted pig trapping and fox baiting in MRNR as part of the Western Shield Program.

2.5 Populations critical to survival

The existing wild and translocated subpopulations of the WST at EBNR, TSNR and MRNR are currently considered populations that are critical to the survival of the species.

2.6 Captive breeding program

Two captive colonies of the WST are jointly managed as part of a specialised breeding program. The largest colony has been housed at Perth Zoo since 1963. Survival and offspring production was erratic until the establishment of the captive breeding program in 1988 (Kuchling et al. 2018). The breeding program had two main purposes, to maintain a genetically representative insurance population to protect against any catastrophic future decline of the wild population, and to provide WST for conservation translocations. As of November 2025, the program had bred more than 1,400 WST of which 1,148 were released to the wild. Since 2003 additional insurance colonies have been housed at Adelaide Zoo and Monarto Zoo (from 2016) by Zoos South Australia to safeguard against sudden loss or significant decline of the Perth Zoo colony.

As of April 2026, 62 adults (and 196 juveniles) were housed at Perth Zoo and 13 adults (and 14 juveniles at Adelaide Zoo that will be returned to Perth Zoo following their second aestivation period and available for translocations) within the South Australian colonies.

2.7 Trial assisted colonisation translocations

Assisted colonisation was trialled for the WST in response to the projected impacts of climate change on the remaining habitat on the Swan Coastal Plain with reduced rainfall and shortened hydroperiods (Mitchell et al. 2013).

Assisted colonisation trial translocations aim to establish secure populations at climatically suitable sites beyond the species' historical range. Early trials in south-west WA had mixed results but demonstrated that it is possible for translocated individuals to persist in novel environments with more reliable rainfall (Bouma et al. 2020).

These trials were the first conducted globally to mitigate the threat of climate change to a vertebrate species (Bouma et al. 2020).

2.7.1 Meerup

Meerup, around 300 km south of the known indigenous distribution of the WST, was chosen as a trial translocation site in 2016. The release was the first conservation introduction, known as 'assisted colonisation' (Seddon et al. 2010) of the WST outside of its known indigenous range. The WST assisted colonisation trials are significant as they were the first conducted globally to mitigate the threat of climate change to a vertebrate species (Bouma et al. 2020).

The trial translocations included the release and radio tracking of 12 captive-bred juvenile WST from the Perth Zoo in 2016, and 18 in 2018. The trial ended in 2018 due to low growth rates and site management concerns. Most WST were returned to Perth Zoo, but 11 could not be accounted for at the conclusion of the two trials, and may have been predated, shed radio transmitters, or dispersed beyond the monitoring area. In 2020, a landowner found a deceased WST near the site (likely from vehicle strike) and in 2023, another WST that showed a higher growth rate was found in the area with a damaged carapace, returned to Perth Zoo and subsequently re-released at Meerup in 2024. This may suggest that acclimatisation periods may be longer than expected.

2.7.2 Scott River area

A second trial translocation site was chosen in the Scott River area east of East Augusta, around 280 km south of the known indigenous distribution of the WST. As for Meerup, 12 juvenile WST were released in 2016, and these individuals showed comparable growth rates to juveniles released at MRNR (Bouma et al. 2020). An initial area near the East Augusta settlement was too small (around one hectare) to support a large future WST population, and with some WST dispersing out of the wetland into adjacent private property, a larger area of similar wetland habitat 6 km away in Scott National Park (Scott NP) was identified for future releases.

One hundred and fourteen captive-bred WST were released in 2021 and 2022 in Scott NP (Nordstrom 2024). Scott NP provided a 2,200-hectare area with a mosaic of seasonal wetland with low canopy of *Melaleuca* spp. It is a hydrologically perched system with mean rainfall of 935 mm per annum, away from population centres and with minimal surrounding development.

Results from the WST released into Scott NP showed a mean increase in body weight of 5.3% and 7.8% in 2021 and 2022 respectively from release to the end of the hydroperiod (approximately 4 months). Known mortality rates were 27% (2021) and 24% (2022) at one-year post-release (Nordstrom 2024). Twenty-one of 89 radio tracked individuals were known to be alive at one-year post release and the fate of the remainder was unknown (Nordstrom 2024). As with other translocation sites, establishing the long-term suitability (e.g. evidence of reproduction, recruitment, and self-sustainability) and impact on the existing values of Scott NP, will take over ten years due to the young age of released WST and lengthy time to sexual maturity.

3 Threats

The following threats to the persistence of the WST are compounded by the species' limited and fragmented geographic range, small population size and specialised biological traits (including low fecundity, slow growth rates, long generation time, obligatory aestivation, and specialised habitat requirements).

3.1 Historical causes of decline

Little is known about the historical causes of decline across the former range of the WST but most of its habitat has been lost. Within its current known distribution, the Swan Valley was one of the first areas of WA developed for agriculture following European colonisation in 1829. Progressive housing developments, agriculture (including viticulture, horticulture, pastures, feed lots, chicken farms, horse studs), groundwater extraction, clay mining for brick and tile manufacture, tourism and light industrial developments have cleared almost all suitable WST habitat and altered existing habitat in EBNR and TSNR.

3.2 Current threatening processes

Key threats to the WST are habitat degradation and availability, predation, fire, climate change, illegal take and loss of genetic diversity.

3.2.1 Habitat degradation and availability

The primary limiting factor for recovery of the WST is the extent and long-term security of suitable habitat. Development pressure is an ongoing threatening process, with urban, industrial and infrastructure development occurring within areas that may be considered critical habitat. These development pressures within the EPP and surrounds may alter hydrological processes, limit WST dispersal and recolonisation opportunities, and reduce landscape resilience in the face of climate change.

The WST relies on both aquatic and terrestrial environments during its life cycle and is therefore highly vulnerable to the degradation and loss of these habitats. Following land acquisitions and rehabilitation works, the reserved area of suitable wetland habitat within EBNR is approximately 50 hectares, within a total reserve area of 80 hectares. TSNR provides a further 140 hectares of upland and wetland habitat, however some areas within the reserve are severely degraded. Without groundwater supplementation, wetlands at TSNR would likely remain largely dry.

Urban and semi-rural development has altered surface water quality and hydrology, and increased weeds, threatening WST habitat within and adjacent to EBNR and TSNR. Clay mining within the EBNR catchment continues to reduce habitat quality by decreasing surface water run-off and lowering perched groundwater levels.

Movements outside EBNR and TSNR may occur when WST search for suitable habitat. Mortality risk is higher in these areas due to the abundance of introduced and native predators, intensive land-use activities, vehicle strike on adjacent roads, and a lack of suitable habitat in surrounding agricultural landscapes. Urban development remains the most significant threat to the WST subpopulations on the Swan Coastal Plain.

3.2.2 Predation

Due to the small population size, low fecundity and slow growth rates of the WST, even limited predation can have a major impact and threaten the species' long-term survival. Eggs, hatchlings and juveniles, due to their small size, have a higher risk of predation by various species of mammals, birds and reptiles, both native and introduced (Burbidge 1967).

There is evidence that red foxes, quenda, black rats (*Rattus rattus*), feral pigs and Australian ravens predate the WST and/or their eggs (Burbidge 1967, Burbidge 2010, Paget 2019, Rodriguez 2022). Additional predators may include water rats (*Hydromys chrysogaster*), raptors (possibly swamp harriers *Circus approximans*), feral cats (*Felis catus*), cormorants (*Phalacrocorax* spp.) and wading birds.

Fox predation has been managed on reserve through 1080 baiting, shooting, and the establishment of predator-exclusion fencing.

Fencing facilitated the mesopredator release of quenda, a highly effective predator of the WST nests (Rodriguez 2022). Recruitment at EBNR was therefore low until the fence deteriorated in the early 2000s and quenda translocations out of the reserve commenced after fence replacement in 2006.

Over 750 quenda were relocated from EBNR and TSNR over a ten-year period from 2010 to 2020, however monitoring of WST nests at EBNR revealed that the intensity of this management action was ineffective in reducing nest predation prior to 2021 (Rodriguez 2022). Subsequently, trapping efforts were increased, with 285 additional quenda relocated from the two nature reserves over four years between April 2021 and April 2026. A replacement fence installed in a section of EBNR in 2025 included a design with larger apertures to facilitate the movement of WST and quenda through the fence but restrict the movement of foxes.

Targeted pig trapping and control of foxes with 1080 baiting is conducted at MRNR. Aerial cat and fox baiting is conducted at the trial translocation site at Scott NP as part of DBCA's Western Shield Program. No targeted feral cat control has been undertaken at EBNR, TSNR or MRNR due to lack of evidence of cat predation events, however feral cats have been recorded predating turtle hatchlings and eggs elsewhere (Ergene et al. 2022).

3.2.3 Fire

Fire events, even if infrequent, can threaten the persistence of WST subpopulations at all sites. Direct impacts include the death of individuals and loss of habitat, whilst indirect impacts may occur due to loss of shade from summer heat, cover to avoid predators, and impacts on food availability.

The WST that aestivate above ground and beneath dense vegetation or leaf litter during summer, or that emerge from underground aestivation refuges in the autumn to rest under leaf litter or low shrubs, are at greater risk from summer and autumn bushfires. Monitoring of juveniles carrying radio transmitters during a bushfire at LWNR in 2002 showed that all animals above ground died, whilst some in underground refuges and all of those in artificial aestivation tunnels survived the direct fire impact. In 2021, aestivating WST were protected from a summer bushfire that burnt 95% of EBNR, as they were sheltering in clay-based underground refuges (Rodriguez 2022).

A combination of the drying climate and associated hydrological impacts exacerbate the intensity and frequency of fires in wetlands and the long-term impact on these habitats (Finlayson et al. 2013). Alteration of habitat may also occur as a result of fire management activities.

3.2.4 Climate change

In Australia, the impact of climate change on water resources has been well-documented. At Pearce RAAF (Station 9053), the closest long-term weather station to EBNR and TSNR, mean winter rainfall from May-September from 1938 to 1974 was 577 mm (BoM 2023). From 1975 to 2000 this declined to 525 mm and from 2001 to 2022 was 465 mm (BoM 2023). This reduction of 19% mean rainfall is consistent with a reduction of 16% in April to October (cool season) rainfall in the south-west of Australia since 1970 (CSIRO and BoM 2024). For a species such as the WST that is reliant on seasonal wetlands, this represents a significant threat to its persistence in its natural range.

Species distribution modelling suggested that the current WST distribution is at the northern-most margin for long-term suitability after accounting for projected climate change (Mitchell et al. 2013; Mitchell et al. 2016; Bin Tareque 2016). Further decreases in rainfall are projected under all future climate scenarios (IPCC 2021). This was a key consideration in the choice of trial translocation sites in the south-west of WA for assisted colonisation (Mitchell et al. 2013; Mitchell et al. 2016; Nordstrom 2024).

Without remedial measures, the WST habitats on the Swan Coastal Plain may become increasingly unsuitable as rainfall declines and seasonal changes shift and shorten wetland hydroperiods. These shortened hydroperiods may reduce the WST breeding success and survival during aestivation, lengthen the time to reproductive maturity, prevent egg production, compromise hatchling survival, and disrupt biological rhythms (Burbidge 1981; Kuchling and Bradshaw 1993; Mitchell et al. 2013; Arnall 2018).

Arnall (2018) determined that longer aestivation periods due to a drier climate may result in depletion of energy reserves, increasing the risk of desiccation and death of younger (smaller) WST, including embryos. Embryonic development rates decline above 30 °C, and modelling indicates that one third of all nests at EBNR may succumb to heat mortality under a 2070 climate scenario (Mitchell et al. 2016). While nests that are dug deeper and located in the shade may allow egg survival in warming climates, the micro-evolution of WST nesting behaviour may be too slow to compensate for rapid climatic change. However, all monitored nests subject to the 2020 summer bushfire at EBNR produced hatchlings (Rodriguez 2022), suggesting that embryos can survive higher temperatures than previously thought, at least acutely.

At TSNR, wetland habitat has been supplemented since 1994 by pumping groundwater from June to December. However, some swamps have been largely dry since 2006, exacerbated by falling groundwater levels (Muirden 2019). Small trial ponds with geotechnical lining constructed in 2022 successfully increased the hydroperiod and availability of aquatic prey for the WST, and WST recruitment has continued.

EBNR and MRNR appear more resilient to climate change, with longer hydroperiods than wetlands at TSNR and LWNR. Habitat modifications at EBNR and MRNR, such as bunding of overflow areas and drainage lines to provide drought refuges, have proved useful adaptive management actions to address climate change.

3.2.5 Illegal take

The 21st century saw the international pet trade emerge as a threatening factor for turtles and tortoises worldwide, and illegal poaching and trafficking has been identified as a major contributor to the declines of some species, particularly as it can compound the impact of other threats (Cox et al. 2022).

The WST is listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) under Appendix 1, which recognises that the species is threatened with extinction from international trade. CITES is enforced under the EPBC Act.

The WST is susceptible to illegal wildlife capture and trading activities, particularly with increasing urbanisation and human activity in the EBNR and TSNR area. One adult WST was unlawfully taken some time after it was last recorded in 2010 from TSNR and subsequently recovered in 2016. Though the impact of illegal take on the WST is difficult to monitor and quantify, the removal of even a small number of animals can lead to further declines or impede recovery for species with small population sizes, restricted ranges, high endemism and/or life history strategies dependent on high adult survivorship (Schlaepfer et al. 2005).

3.2.6 Loss of genetic diversity

The WST persists only in small, isolated subpopulations. Continued erosion of genetic diversity due to inadequate natural gene flow and the potential for deleterious effects from inbreeding, increases extinction risk.

Translocations have assisted in supplementing or establishing subpopulations (Kuchling 2006), however active genetic management is required to maintain genetic diversity and long-term genetic viability of the species.

4 Recovery plan vision and objectives

Long-term vision

To maximise the long-term survival of the WST in the wild by increasing the habitat area, and the size and number of subpopulations, and mitigating threatening processes sufficiently to downgrade its conservation status from Critically Endangered to Endangered under the BC and EPBC Acts.

Recovery Plan objectives

This Recovery Plan guides recovery, research and management actions for the WST over the next ten years, or until replaced or revoked. Four broad recovery objectives are outlined below.

Objective 1: Enhance the extent and quality of habitat for existing wild and translocated subpopulations.

Criterion 1: By 2036 there is a net increase in area and condition of habitat within conservation estate or managed lands compared to 2026.

Objective 2: Increase the population size by managing existing subpopulations and minimising mortality of individuals.

Criterion 1: By 2036 monitoring demonstrates that the number of adult individuals is stable or increasing within each of the subpopulations.

Objective 3: Address key knowledge gaps and use information to improve subpopulation and habitat management

Criterion 1: By 2036 monitoring and habitat use continues to be strategically and regularly undertaken across each of the subpopulations; and other sites with suitable habitat are surveyed.

Criterion 2: By 2036 wetland ecosystem health variables (such as water quality, depth and aquatic prey availability) are monitored at each of the subpopulations and used to inform on ground management.

Criterion 3: By 2036 increased knowledge of WST biology, ecology and genetic diversity informs management of the WST metapopulation.

Criterion 4: By 2036 research and monitoring informs decisions to establish one or more subpopulations in an area that is predicted to be suitable for the WST under projected future climate change scenarios.

Objective 4: Increase community awareness and support for the conservation of the species

Criterion 1: By 2036 engagement with Traditional Owners, landowners, government agencies, natural resource management organisations and community members in WST recovery implementation and on ground actions is maintained or increased.

Criterion 2: By 2036 the production of educational materials and activities that promote the conservation of the WST and improve management of lands adjacent to its viable habitat have increased.

5 Actions to achieve the objectives

The following recovery actions were identified to achieve recovery objectives.

In working towards the long-term vision of the species recovery, these actions identified for implementation over the next decade focus on increasing the area and condition of suitable habitat through restoration and acquisition, establishing subpopulations in climate refugia, and improving strategic management of the species as a metapopulation.

Where recovery actions are needed or appropriate on lands other than those managed by DBCA, permission, coordination or collaboration, as appropriate, will be sought from relevant landowners and/or managers prior to undertaking recovery actions.

Objective 1: Enhance the extent and quality of habitat for existing wild and translocated subpopulations

Action	Description	Outcomes/Further Information	Potential partners
1.1	Increase the area of protected WST habitat through the acquisition of suitable land.	The extent of the WST habitat that is protected and managed under the CALM Act is increased.	DBCA Conservation and Parks Commission
1.2	Undertake management and restoration of habitat within conservation estate based on long-term monitoring of wetland ecosystem health.	Develop and implement a habitat management plan to achieve an increase in area and condition of suitable wetland habitat through rehabilitation at EBNR and TSNR of at least 50%.	DBCA
1.3	Maintain water quality and quantity over a suitable hydroperiod to support WST subpopulations.	Routinely monitor water quality in wetland mosaics available to the WST to inform on ground management. Identify and undertake appropriate drought proofing and hydrological intervention works informed by hydrological monitoring to maintain suitable hydroperiods.	DBCA

1.4	Prepare and adopt a fire response plan for each subpopulation and an approach to fuel management.	Risks of bushfire and prescribed burns to WST and detrimental impacts to the WST habitat are reduced.	DBCA

Objective 2: Increase the population size by managing existing subpopulations and minimising mortality of individuals.

Action	Description	Outcomes/Further Information	Potential partners
2.1	Undertake management of fauna species that predate or otherwise impact the WST subpopulations, including, but not limited to: • Red fox • Black rat • Feral pig • Quenda • Raven • Feral cat.	Introduced and other problem animals are reduced to lessen impacts of predation and damage to the WST habitat. Predators are monitored to improve understanding of impacts and assess effectiveness of control programs. Land managers collaborate with neighbouring land holders to contribute to control efficiency and efficacy.	DBCA
2.2	Implement strategies to prevent illegal take.	Undertake appropriate monitoring and surveillance.	DBCA
2.3	Maintain a genetically representative captive colony as an insurance population and to support translocations.	Perth Zoo maintains a captive breeding program to support translocations as required. Protocols and facilities support improved egg viability, health and fitness of breeding stock, and hatchlings and juveniles.	Perth Zoo (DBCA) Zoos SA
2.4	Develop a population management strategy to	The number of adult WST is increased and genetic	DBCA

	promote subpopulation growth and resilience.	diversity is maintained through management of the WST metapopulation.	Academic institutions
2.5	Undertake translocations as required.	The number of WST in the wild is stable or increased. Translocation and subpopulation supplementation is guided by a population management strategy and informed by research and monitoring.	DBCA SWNRM Perth Zoo Zoos SA

Objective 3: Address key knowledge gaps and use information to improve subpopulation and habitat management.

Action	Description	Outcomes/Further Information	Potential partners
3.1	Design and implement a long-term monitoring program for all subpopulations.	Subpopulation monitoring data are collected and stored on a centralised DBCA database. Knowledge of population and subpopulation estimates and trends, recruitment, survivorship and causes of potential declines is improved and effectively incorporated into adaptive management decisions, habitat restoration and recovery planning. New monitoring techniques and technologies (e.g. drones, eDNA, basking stations) are investigated to improve knowledge of the WST subpopulations. Investigate WST movement at the local and landscape-scale to understand dispersal, habitat use and subpopulation connectivity.	DBCA Academic Institutions

		Continue to investigate suitable habitat to determine if further subpopulations can be found.	
3.2	Design and implement a long-term monitoring program for wetland ecosystem health, which addresses: • hydrology • geology • vegetation.	Wetland ecosystem health is better understood and monitored to enable adaptive management to meet WST habitat requirements. Key actions to support habitat management are identified and incorporated into operational management plans.	DBCA
3.3	Undertake genetic research including genomic mapping and measures of genetic diversity, to inform captive and wild subpopulation management.	Genetic knowledge gaps are identified and addressed to improve genetic management and metapopulation management of the WST.	DBCA Academic institutions
3.4	Review captive breeding and translocation protocols to identify strategies that may improve fitness and survivorship.	Improved fitness and survivorship of captive bred and translocated WST.	DBCA Perth Zoo Academic institutions
3.5	Continue research and monitoring at existing or new trial translocation sites to determine long-term suitability.	Translocations of WST are monitored to determine suitability of translocation strategies and sites to support the creation of self-sustaining subpopulations with ongoing breeding and recruitment. Additional suitable trial translocation sites, including those likely to be buffered against future climate change are identified, and trials commenced.	DBCA Academic institutions NRM groups
3.6	Facilitate data-sharing and knowledge exchange	All historic and current population and habitat	DBCA

	between relevant stakeholders involved in WST research, conservation operations, and decision-making.	monitoring data are digitised and stored in a centralised DBCA database. Knowledge gaps are identified and prioritised for research.	Academic institutions Recovery Team

Objective 4: Increase community awareness and support for the conservation of the species.

Action	Description	Outcomes/Further Information	Potential partners
4.1	Educate and encourage landowners and managers of properties containing or neighbouring WST habitat to manage and protect for conservation.	Landowners and managers are provided with relevant information on managing habitat for WST conservation.	DBCA DWER NRM groups
4.2	Engage landowners and managers, Traditional Owners, community members and other interested stakeholders in WST conservation.	The profile of the WST and its conservation requirements are increased through publications, social media, websites, and media releases. Engagement with Traditional Owners, ranger groups, landowners and managers and community members is maintained or increased. Key stakeholders are invited to be involved in WST recovery actions.	DBCA FoWST EBICG Landowners and managers Traditional Owners
4.3	Pursue funding opportunities to support WST recovery.	Existing and new funding programs identified and applications submitted to support research and recovery actions.	DBCA Academic institutions NRM groups

6 Effects on other native species and biodiversity

Recovery efforts implemented to enhance the habitat quality, size or security of the nature reserves where the WST are located will also benefit ecological communities, flora and fauna, which also occur in these areas. Threatened ecological communities (TECs) and threatened species listed under the BC Act, and priority ecological communities (PECs) and priority species listed by DBCA known to occur within WST habitat are outlined in Table 1.

Table 1: TECs, PECs and threatened or priority-listed species known within WST habitat

Listing	EBNR	TSNR	LWNR	MRNR and MRNP
TEC	SCP 08 Herb rich shrublands in clay pans	SCP 15 Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain	SCP 07 Herb rich saline shrublands in clay pans (Mogumber NR)	SCP 07 Herb rich saline shrublands in clay pans
	SCP 3c *Corymbia calophylla – Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain			SCP 09 Dense shrublands on clay flats
PEC		SCP 21c Low-lying *Banksia attenuata* woodlands or shrublands	Claypans with mid dense shrublands of *Melaleuca lateritia* over herbs	Banksia dominated woodlands of the Swan Coastal Plain
				SCP 23b Swan Coastal Plain *Banksia attenuata – Banksia menziesii* woodlands
				SCP 22 *Banksia ilicifolia* woodlands
Threatened Flora	*Eleocharis keigheryi*		*Eleocharis keigheryi*	*Paracalaena dixonii*

	Trithuria occidentalis		*Eremophila glabra subsp. chlorella* (Mogumber NR)	*Macarthuria keigheryi*
				Drakaea elastica
				Eleocharis keigheryi
				Lepidosperma rostratum
Threatened Fauna	Carnaby's black cockatoo (*Zanda latirostris*)	Carnaby's black cockatoo (*Zanda latirostris*)		
Priority Flora	P3 *Schoenus capillifolius*	P2 *Schoenus sp. Bullsbrook* (J.J. Alford 915)	P1 *Stylidium vinosum* (Mogumber NR)	P2 *Andersonia sp. Mysosma* (E.A. Griffin 2213)
	P4 *Stylidium longitubum*	P4 *Stylidium longitubum*	P4 *Schoenus natans*	P2 *Leucopogon squarrosus subsp. trigynus*
	P4 *Hydrocotyle lemnoides*		P4 *Anigozanthos humilis* subsp. chrysanthus	P3 *Dillwynia dillwynioides*
	P4 *Schoenus natans*		P4 *Verticordia paludosa* (Mogumber NR)	P3 *Banksia dallanneyi subsp. pollosta*
				P3 *Haemodorum loratum*
				P3 *Stylidium nonscandens*
				P3 *Isopogon autumnalis*
				P4 *Verticordia lindleyi subsp. lindleyi*
				P4 *Verticordia paludosa*

				P4 *Schoenus griffinianus*
Priority Fauna	P4 Quenda (*Isoodon fusciventer*)	P4 Quenda (*Isoodon fusciventer*)		

Implementing recovery actions, and in particular modifications to habitat or hydrological regimes, should avoid or minimise any potential impacts to the species and communities outlined in Table 1.

Resident quenda are periodically removed from EBNR and TSNR to reduce predation pressure on WST nests and are translocated to suitable habitat identified within their historic range.

7 Affected interests

DBCA is primarily responsible for the implementation of this Recovery Plan with land that will be materially affected by the implementation of this plan including habitat located on lands that are vested in the Conservation and Parks Commission and/or owned and managed by DBCA.

Other stakeholders potentially affected by the implementation of this Recovery Plan include all those involved in the management of land containing habitat used by the WST or land supporting suitable WST habitat, currently or in the future.

EBNR and TSNR are within a semi-rural environment, and the WST is known to use the surrounding lands, which also support and influence hydrology within the nature reserves. EBNR and TSNR are located within the EPP area (Figure 4), which was prepared by the Environmental Protection Authority and approved by the Minister for the Environment under Part III of the *Environmental Protection Act 1986* (EP Act). The EPP declares beneficial uses that are to be protected and aims to ensure management activities within the policy area do not adversely impact on the environmental values and ecosystem health of the WST habitat. At the time of preparing this recovery plan the EPP is under review.

The City of Swan Local Planning Scheme (No 17) also provides for a Special Use Zone in proximity to EBNR and TSNR and contains provisions to ensure that land uses within this area do not adversely affect WST or their habitat.

Responsibility for development controls rests with the City of Swan, the Department of Planning, Lands and Heritage, and Western Australian Planning Commission. The City of Swan's Local Planning Scheme provisions relating to the Special Use Zone and the EPP provides a critical mechanism to protect the WST habitat. Implementation of land use and development controls in the EPP area, and in proximity to the EBNR and TSNR, assist with the implementation of the Recovery Plan by supporting the protection of WST habitat.

Where subpopulations occur on lands other than those managed by DBCA, permission is sought from the landowners and/or managers before recovery actions are undertaken on their land.

Others potentially affected by or involved in the implementation of this Recovery Plan include Traditional Owners, community and conservation groups, Academic institutions and non-governmental organisations.

8 Social and economic considerations

The implementation of this Recovery Plan may have social and/or economic impacts through the identification and recommendation to protect WST habitat, including impacts on landholders or proponents who require approval to clear or modify WST habitat and may be prevented from doing so. Additionally, costs may be incurred from assessment processes or offset requirements. Some landowners may be required to take measures to reduce the impact of their activities on WST habitat, particularly for lands neighbouring nature reserves where the WST occurs.

Actions in this Recovery Plan largely focus on protecting and enhancing current and future suitable habitat for the WST on lands managed by DBCA and are subject to various public policy, regulatory and management actions with associated costs and benefits to the community.

Control of introduced predators may have a social impact if pets, particularly domestic dogs, ingest toxic baits that have been laid for WST protection. DBCA risk management strategies, including media releases warning the public of the risk that baits pose to domestic animals, signage denoting baited areas, and measures to lay baits in areas not easily accessible to pets. For example, DBCA's baiting program uses buried eggs at EBNR and TSNR.

There is strong community support and interest for the recovery of the WST, including community groups and volunteers that actively participate in the implementation of on ground recovery actions and promote broader awareness for conservation of the species, its habitat and broader catchment area.

This involvement can provide social benefits with community members and groups having a sense of achievement, inclusion and community spirit whilst gaining enjoyment and appreciation of their surrounding natural environment. The community engagement components of the plan also promote community ownership, provide community support and encourage active involvement in conservation.

9 Consultation, implementation and evaluation

This version of the Recovery Plan was developed by DBCA for the purposes of public consultation. It was developed with the Western Swamp Tortoise Recovery Team, species experts and relevant State and local Government agencies, research institutions and local community groups, including those that were identified as likely to be involved in implementing the plan or evaluating its effectiveness.

This draft plan is made available for public comment between 5 June and 1 October 2026. Public comments will be considered when finalising the plan.

The implementation of this Recovery Plan will be overseen by DBCA with support of the Western Swamp Tortoise Recovery Team. Recovery teams are advisory groups that bring together a range of stakeholders, partners and other interested parties to work collaboratively to share information and provide advice to assist DBCA to achieve outcomes for threatened species or ecological community recovery. DBCA recognises that partnerships may need to be developed and expanded to assist in the coordination and delivery of the recovery actions.

Under the BC Act the CEO may review the Recovery Plan at any time but must carry out a review within 10 years from the date the Recovery Plan takes effect. The plan is intended to be reviewed at five-year intervals.

References

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