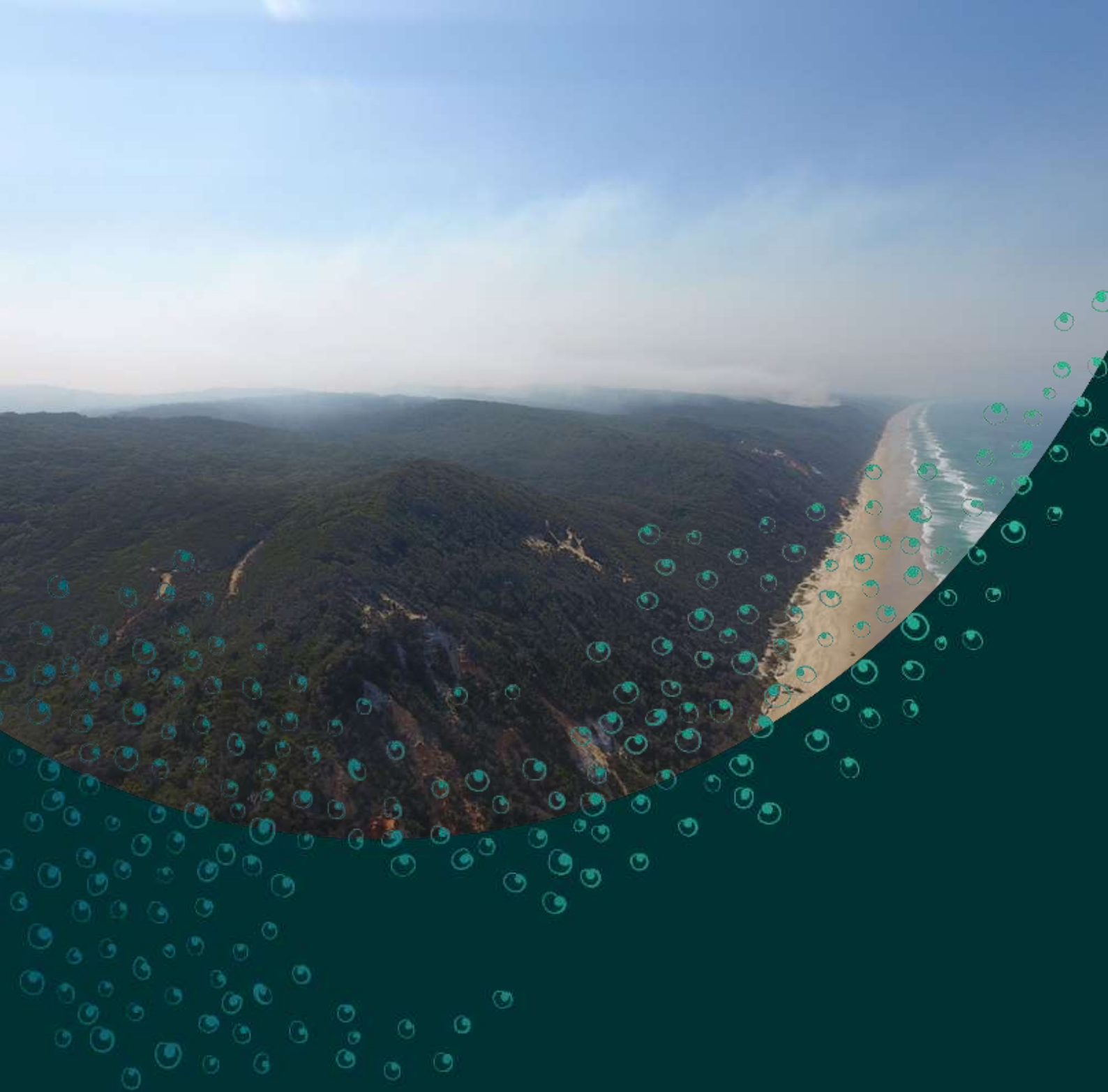

Post-fire Assessment Report—Natural Values:

2019 Bushfire, Great Sandy and Noosa National Parks, South East Queensland Bioregion

Version: 16 December 2020

Queensland Government

Prepared by: Technical Services, Coastal and Islands Region and South East Queensland Region of Queensland Parks and Wildlife Service and Partnerships and the Queensland Herbarium, Department of Environment and Science

Citation

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Twitter- @envirogov #BushfireRecoveryAU
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Front cover: view of bushfire near Kings Bore Road (from a drone), Cooloola Recreation Area, Great Sandy National Park Photo: QPWS Cooloola 2019.

Contents

List of acronyms and abbreviations used in the text

BVG	Broad Vegetation Groups (BVGs) as described by Neldner *et al.* (2019b).
dNBR	Normalised Burn Ratio difference product.
CP	Conservation Park
E	Endangered.
EPBC	Federal *Environment Protection and Biodiversity Conservation Act 1999.*
FIRMS	Fire Information for Resource Management System available online at https://firms.modaps.eosdis.nasa.gov/
FLAME	QPWS Fire Management System.
FR	Forest Reserve.
LC	Least Concern.
KNV	Key Natural Value
NAFI	Northern Australia & Rangelands Fire Information.
NBR	Normalised Burn Ratio.
NCA	Queensland *Nature Conservation Act 1992.*
NP	National Park.
NT	Near Threatened.
QPWS	Queensland Parks and Wildlife Service.
QPWS estate	National Parks, Conservation Parks, Resources Reserves, State Forests and Forest Reserves (in the context of the area encompassed by this report).
RE	Regional Ecosystem, as defined by Queensland Herbarium (2019), is a vegetation community in a bioregion that is consistently associated with a particular combination of geology, landform and soil (Neldner *et al.* 2019a).
REDD	Regional Ecosystem Description Database, Version 11.1 (Queensland Herbarium 2019).
RR	Resources Reserve.
SF	State Forest.
V	Vulnerable.

1 Executive summary

During a period of prolonged fire danger in late 2019, a series of bushfires impacted Great Sandy NP (Cooloola Recreation Area) and Noosa NP in the South East Queensland Bioregion. Seven separate fires burned within these national parks and adjacent reserves over the period 22 August 2019 to 8 January 2020, impacting a total area of 21,479ha.

This report identifies known and likely impacts of the protracted bushfire event to the natural values on QPWS estate. It provides practical recommendations for mitigation, recovery and monitoring over the short to long-term.

A total area of 15,413 hectares burnt across six estates: Noosa NP; Great Sandy NP *; Cooloola (Noosa River) RR; Cooroibah CP; Great Sandy RR; and Toolara SF (the study area). Substantial areas of: eucalypt forests to woodlands (8,394ha); Melaleuca swamps (2,683ha); and closed, wet heath (2,393ha) were burnt representing 8.1%, 21.8% and 22.9% of these habitat types respectively within the study area. Fire-sensitive foredune vegetation experienced catastrophic and high Potential Ecological Impact over an area of 188ha and 159ha respectively, representing 0.9% and 0.8% of this vegetation type. The rainforest communities on these reserves escaped relatively unscathed with a total of 44ha (0.7%) of this community impacted.

A detailed assessment of the impact to natural values, together with recommended recovery actions is provided in section 6. The highest priority recommendations for on-ground operations are to:

1. Prevent the establishment of high biomass grasses, bitou bush (*Chrysanthemoides monilifera* subsp. *rotundata)* and lantana (*Lantana camara*) immediately adjacent to and within burnt foredune, rainforest, and ecotone communities.
2. Conduct ongoing surveillance to ensure early detection and treatment of new weed incursions.
3. Undertake a targeted control program for pigs, consider implementing cane toad adult and tadpole trapping (e.g. Cane Toad Challenge https://imb.uq.edu.au/canetoadchallenge) and assess need for fox and cat control.
4. Protect regenerating foredunes from recreational use.
5. Review fire management planning (particularly for wet heath environments) with the aim to establish a greater diversity of age classes.
6. Undertake Health Checks to facilitate early detection of weeds and enable condition to be evaluated across the park over time.
7. Avoid use of fire-fighting retardants and foams in and near small, nutrient poor wetlands with limited flushing/dilution such as: window lakes, perched lakes, swamps (grass, herb, sedge) and wet heaths.

Several threatened flora and fauna species have a significant portion (>15%) of their modelled state-wide habitat within the study area impacted by fire: *Pezoporus wallicus wallicus* (ground parrot); *Stipiturus malachurus* (southern emu-wren); *Crinia tinnula* (wallum froglet); *Litoria olongburensis* (wallum sedgefrog); *Litoria freycineti* (wallum rocketfrog); *Archidendron lovelliae* (bacon wood); *Boronia keysii* (Key's boronia); *Blandfordia grandiflora* (Christmas bells); *Cryptocarya foetida* (stinking cryptocarya); and *Acacia attenuate* (whipstick wattle). Further survey and monitoring of these species is warranted.

The natural values known or likely to have been significantly impacted by the bushfire and associated severity and Potential Ecological Impact are outlined in Table 1.

** Note: Figures on ecosystem extent and percent impacted are based on an entire National Park's area, which includes K'Gari (Fraser Island) as part of Great Sandy NP, despite it falling outside the area evaluated in this report.*

Table 1: Summary of natural values and impacts of the fires.

The total area burnt, the area burnt within four relative fire severity classes (percentage of the total area of value in the study area in parentheses) and area of the Potential Ecological Impact for each natural value.

Natural value descriptor	Total area burnt (ha)	Relative fire severity (ha) with percentage of total in parentheses	Potential Ecological Impact for burnt area (ha) with percentage of total in parentheses
NV_1: Foredune complex • Fire-sensitive ecosystem – dominated by *Casuarina equisetifolia* which is typically killed by fire. • BVG 28a – RE 12.1.1, 12.2.14, 12.2.16. • Known or likely habitat for threatened flora and fauna species.	603	Low: 245 (1.2) Moderate: 168 (0.8) High: 113 (0.5) Extreme: 78 (0.4)	Limited or none: 6 (0.03) Moderate: 210 (1) High: 159 (0.8) Catastrophic:188 (0.9)
NV_2: Heath (Closed – Wet) • Fire tolerant ecosystem – tolerant of high severity fires except when peat fires occur. • Includes Draft Natural Key Value Noosa NP *Coastal heath and Ground Parrot habitat.* • BVG 29a – RE 12.2.12, 12.3.13, 12.5.9. • Known or likely habitat for threatened flora and fauna species. Particularly critical for acid frog and fish species.	2,393	Low: 66 (0.6) Moderate: 156 (1.5) High: 481 (4.6) Extreme: 1,690 (16.2)	Limited or none: 703 (6.7) Moderate: 1,690 (16.2) High: 0 Catastrophic: 0
NV_3: Heath (Open – Dry) • Fire-adapted ecosystem. • Includes Draft Natural Key Value Noosa NP Coastal heath and Ground Parrot habitat. • BVG29a – RE 12.2.9, 12.3.14, 12.5.10, 12.2.13. • Known or likely habitat for a suite of threatened flora and fauna species.	1,036	Low: 79 (0.1) Moderate: 165 (0.3) High: 312 (0.6) Extreme: 479 (0.9)	Limited or none: 267 (0.5) Moderate: 292 (0.5) High: 479 (0.9) Catastrophic: 0
NV_4: Grass, sedge, herb swamps (palustrine wetland) • Fire-adapted ecosystem. Can be impacted by peat fires. • BVG 34 – RE 12.2.15, 12.2.15, 12.9-10.22. • Includes patterned fens. • Known or likely habitat for a suite of threatened flora and fauna species. Particularly critical for acid frog and fish species.	213	Low: 49 (0.4) Moderate: 63 (0.5) High: 56 (0.5) Extreme: 45 (0.4)	Limited or none: 118 (1) Moderate: 60 (0.5) High: 35 (0.3) Catastrophic: 0
NV_5: Tree swamps – Melaleuca open forest to woodland on seasonally inundated plains (palustrine wetland) • Fire-adapted ecosystem. • BVG 22a – RE 12.2.7, 12.3.5, 12.3.4. • Known or likely habitat for a suite of threatened flora and fauna species.	2,683	Low: 356 (2.9) Moderate: 641 (5.2) High: 961 (7.8) Extreme: 725 (5.9)	Limited or none: 1,958 (15.9) Moderate: 725 (5.9) High: 0 (0) Catastrophic: 0 (0)
NV_6: Rainforest communities • Includes draft NKV (Noosa) – Vine forest communities. • Fire-sensitive ecosystem. • BVG 3 (RE 12.2.3): BVG 4 (RE 12.2.1): BVG 5 (RE 12.5.13a, 12.9-10.16). • Known or likely habitat for a suite of threatened flora and fauna species.	44	Low: 39 (0.6) Moderate: 4 (0.1) High: 1 (0.01) Extreme: 0 (0)	Limited or none: 0 (0) Moderate: 39 (0.6) High: 4 (0.1) Catastrophic: 1 (0.0)
NV_7: Eucalypt Forest to Woodlands • Fire-adapted ecosystems but with some fire intolerant species (e.g. *Callitris columellaris*). • BVG 12; BVG 16; BVG 8; BVG 9. • Known or likely habitat for a suite of threatened flora and fauna species.	8,394	Low: 3,130 (3) Moderate: 2,249 (2.2)) High: 1,981 (1.9) Extreme: 1,033 (1)	Limited or none: 5,528 (5.3) Moderate: 1,821 (1.8) High: 957 (0.9) Catastrophic: 87 (0.1)

2 Introduction and purpose of this report

This is a report on a rapid assessment of the known and likely impacts to the natural values of protected areas arising from a series of bushfire events. It is not intended to be a comprehensive report. It provides an overview of the fire/s and provides information to inform planning for recovery of natural values, particularly Key Natural Values determined through the QPWS Values Based Management Framework (DES 2020).

The report succinctly documents the extent and ecological severity of the fires, prevailing weather conditions, and suppression methods. It describes the spatial data used for impact evaluation and summarises areas and values within the burnt area (**Section 5**). It provides QPWS with a prioritised snapshot of the impacts and associated risks to natural values following the bushfire; and practical recommendations for mitigation, recovery and monitoring (**Section 6**).

Scoping the scale and nature of short to long-term recovery actions as soon as possible after a fire event enables land managers to manage immediate risks and plan for the future. It also assists in determining likely cost and resourcing implications.

This assessment is limited to the estimated extent of the series of bushfires that impacted the Cooloola Recreation Area within Great Sandy NP (hereafter Great Sandy) and Noosa NP in the South East Queensland Bioregion from August 2019 to January 2020 (**Figure 1, Figure 2**).

Landscape features and place names used in this report are as per 1:25 000 scale topographic mapping available online at QTopo: https://qtopo.information.qld.gov.au/.

3 Background

3.1 Landscape overview of the fire and timeframe

3.1.1 Overview

The Great Sandy-Noosa 2019 bushfire event evaluated here consisted of seven separate fires that occurred across Great Sandy and Noosa NP between 22 August 2019 and 8 January 2020 (**Table 2, Figure 1** and **2**).

Table 2: Bushfire events impacting Great Sandy and Noosa National Parks August 2019–January 2020. The bushfire identifiers listed below are those used in the Department's fire information system FLAME.

Bushfire	Ignition Date	Out Date	Approximate Area Impacted (Ha)
Great Sandy National Park			
Great Sandy/NP/W/2019/004	8/09/2019	13/10/2019	14,620
Great Sandy/NP/W/2019/005	5/11/2019	3/12/2019	4,137
Great Sandy/NP/W/2019/008	15/12/2019	7/01/2020	1,833
Noosa National Park			
Noosa/NP/W/2019/001	22/08/2019	25/09/2019	125
Noosa/NP/W/2019/002	9/09/2019	28/09/2019	370
Noosa/NP/W/2019/003	22/10/2019	25/10/2019	18
Noosa/NP/W/2019/004	18/12/2019	8/01/2020	376

The progression of the Great Sandy-Noosa fires from September 2019 to December 2019 is shown in **Figure 3.** Based on NASA's Fire Information for Resource Management System (FIRMS), Visible Infrared Imaging Radiometer Suite (VIIRS), the different coloured hotspots show the progression of these fires across the landscape. Some hotspots however, may have been missed due to low intensity fire, cloud cover or incomplete passes (FIRMS 2019).

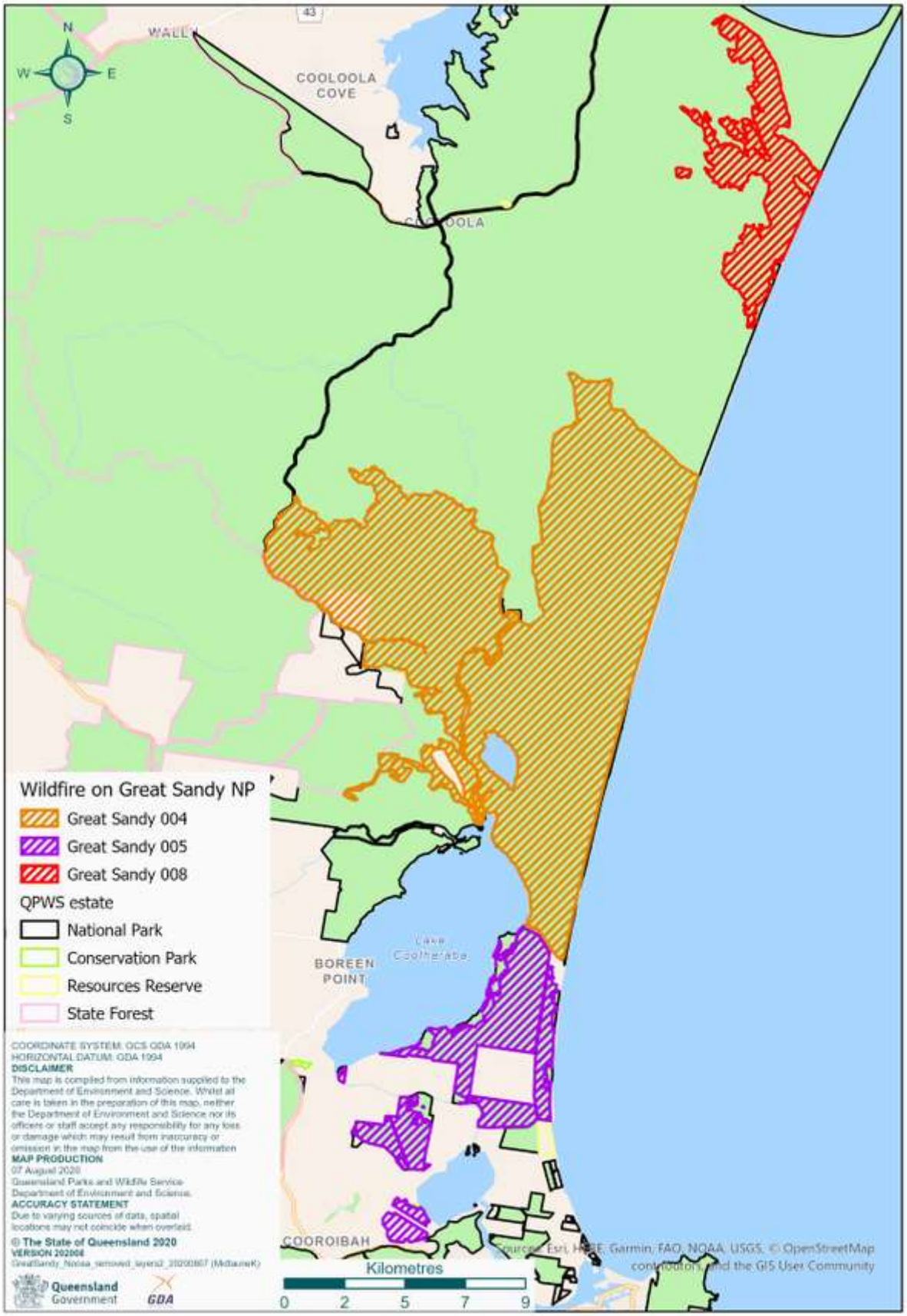

Figure 1: Estimated extent of bushfire in Great Sandy National Park, August to January 2020. Refer to Table 1 for the complete fire identifier used in FLAME. Base map: QTopo.

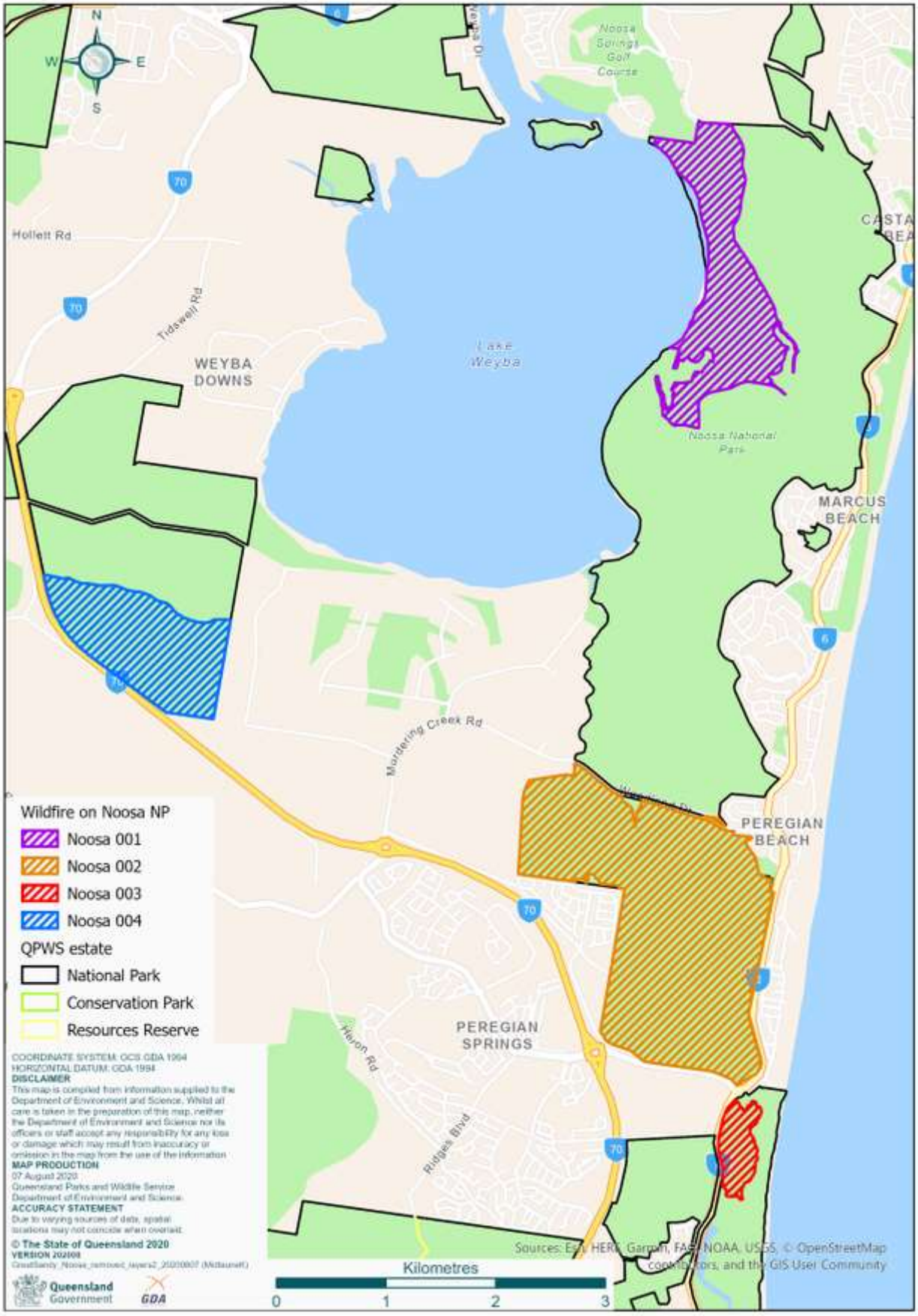

Figure 2: Estimated extent of bushfire in Noosa National Park, August to January 2020. Refer to Table 1 for the complete fire identifier used in FLAME. Base map: QTopo.

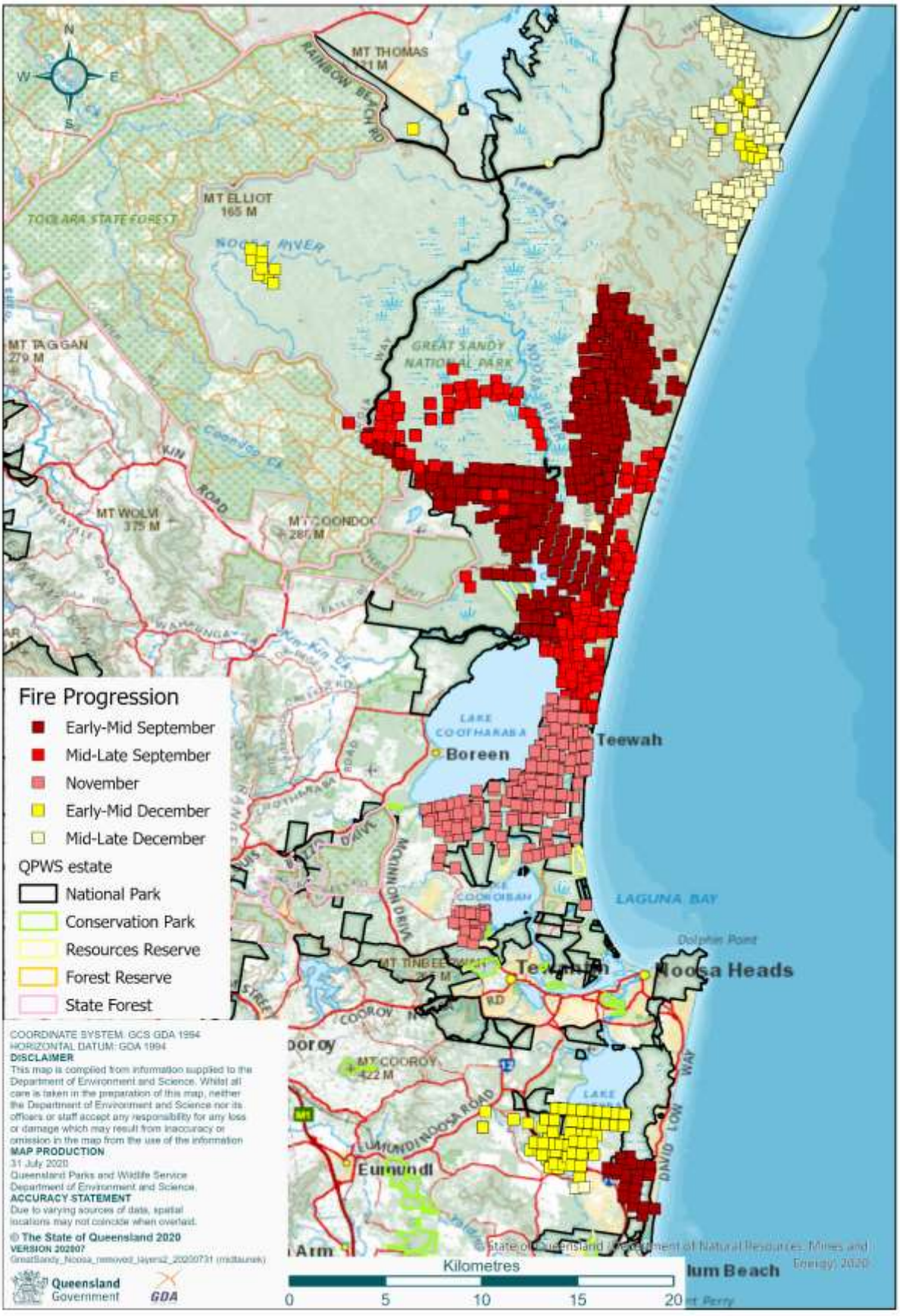

Figure 3: The progression of the Great Sandy-Noosa bushfires across the landscape September to December 2019, from VIIR hotspots FIRMS (2019).

3.1.2 Fire Activity and behaviour

3.1.2.1 Great Sandy/NP/W/2019/004 (8/09/19 to 13/10/19)

- First detected at 9:50am on 8 September 2020 in the Great Sandy NP. Crews arrived onsite at 10:00am, by which time the fire had progressed to the top of a steep dune.
- Strong south-westerly winds reignited the fire on the 10 September 2019.
- Fire was contained in the north at Kings Bore but burned in a westerly direction at greater intensity through dry heathland and then low, wet heathland and spotted across the Noosa River on 18 September 2019 and continued westward towards Cooloola Way.
- QPWS crews worked with RFS Brigade (Teewah) and were able to contain the fire within the western boundary of the park before the fire turned south-east towards Harry's Hut.
- The fire jumped the Noosa River just north of Harry's Hut, then moved south along the eastern side of Lake Cootharaba to Teewah Landing.
- It was contained at the Teewah Landing fireline by QPWS and RFS crews before it slowly moved north back towards the King's Bore Road burning through beach foredunes.
- Rainfall (89mm recorded at Tewantin) on 1 and 2 October 2019 slowed the fire considerably, observations continued until the fire was declared out on 8 October 2019.

3.1.2.2 Great Sandy/NP/W/2019/005 (5/11/2019 to 3/12/2019)

- The fire was reported at 5:00pm on 5 November 2019; reported to have started off park, before jumping the Noosa River at John's Landing (where it burned through Melaleuca woodlands at high rate and intensity), moving in a north-easterly direction.
- On the 7 November 2019 the fire spread westward onto the peninsula to the south of Lake Cootharaba and started spotting over the Noosa River to freehold land on the western bank.
- On the 8 November 2019 multiple spot fires ignited east and west of block 1161, then moved south-west towards John's Landing Campground.
- On the 13 November 2019 an active fire was detected at Noosa North Shore. QFES and QPWs crews attended with aerial support, and QFES issued a 'leave now' advice for Noosa North Shore Residents.
- A wind change followed by storm activity on 17 November 2019 helped to contain the fire with no signs of active fire after 28 November 2019 and the fire being declared out on 3 December 2019.

3.1.2.3 Great Sandy/NP/W/2019/008 (15/12/2019 to 7/01/2020)

- Report of a fire received from QFES at 6:51pm on 15 December 2019, QFES commenced waterbombing the fire but fading light only allowed a few loads to be delivered.
- On 22 December 2019 the fire stopped at the edge of rainforest communities to the north-west. The fire also burned south of the Freshwater Road through dune vegetation toward the Teewah Beach Camping zone.
- Approximately 15mm of rain fell on 25 December 2019 which assisted in efforts to contain the fire.
- The contained fire was subsequently patrolled until, with the help of some addition rain it was declared out on 7 January 2020.

3.1.2.4 Noosa/NP/W/2019/001 (22/08/2019 to 25/09/2019)

- QFES and RFS crews responded to fire in Noosa Springs (on-park) around midnight 22-23 August 2019.
- A strengthening wind resulted in a flare-up of active fire in the duff layer (and potentially peat layer) of the wetland, flaring when consuming small trees (e.g. banksias).
- Fire declared out on 25 September 2019.

3.1.2.5 Noosa/NP/W/2019/002 (9/09/2019 to 28/09/2019)

- Fire reported by QFES at 4:30pm on 9 September, near Pitt Street, Peregian Springs headed in an easterly direction toward Lake Weyba, having jumped Emu Rd.
- The fire escaped containment lines on the afternoon of 10 September and destroyed private residences and other property.
- Numerous crews from both QFES and QPWS with support from aerial bombardment (airplane and helicopter) attacked the fire and strengthened containment lines from 10 to 14 September 2019.
- No active fire was reported from 14 September 2019 with patrols and mopping-up activities continuing until the 28 September 2019.

3.1.2.6 Noosa/NP/W/2019/003 (22/10/2019 to 25/10/2019)

- First detected on 22 October to the south of the Peregian Beach access boardwalk and initially attended by QFES, urban and then QPWS crews.
- The fire spread in a north-easterly direction, fanned by 25km/h winds.
- A waterbomber was used to extinguish the head of the fire, after which the backing fire mostly self-extinguished before being extinguished by QPWS ground crews working from the boardwalk.
- Mop-up was undertaken using backpacks, rake hoes and chainsaw before the fire being considered out on 25 October 2019.

3.1.2.7 Noosa/NP/W/2019/004 (18/12/2019 to 8/01/2020)

- First detected on 18 December 2019 on the western side of the park and the Rural Fire Brigade commenced a back burn.
- North-easterly winds fanned the fire resulting in relatively high intensity fire on the eastern edge of the block. Despite this, the fire was able to be contained to the block.
- Some large stumps continued to smoulder.
- The fire was declared out on 8 January 2020.

3.2 Weather

3.2.1 Forest Fire Danger Index

The Bureau of Meteorology (2019) undertook detailed analyses of the fire weather affecting north-east New South Wales (NSW) and south-east Queensland (Qld) during early September 2019. Key climate and weather factors leading up to and during the fire event include:

- Rainfall prior to September 2019 had been below average on a range of timescales from months to years, leading to a prolonged and severe drought.
- At Tewantin, the year-to-date rainfall total was around 35–40% below average and ninth lowest on record. Most of that deficit was in January and February. March to June had near-average rainfall, but July and August were about 60% below average. Tewantin had only received 6.4 mm in the 30 days before the start of the fires.
- From 6 September 2019 there were much warmer than average daytime temperatures, very low relative humidity (<15%), and gusty winds.

The McArthur Forest Fire Danger Index (FFDI) is commonly used in Australia to indicate the combined influence of various weather factors associated with bushfire conditions. It reflects longer-term rainfall and temperature patterns and shorter-term weather. A time series of the FFDI data as described by Dowdy (2018) for Noosa (26.381S, 153.099E) is provided in **Figures 4** and **5**: annual averaged FFDI, and average number of severe FFDI days per year (i.e. FFDI greater than 50), respectively. These figures show the FFDI for the region was much higher than average, with one day of severe FFDI in 2019 (atypical for this location) compared to the historical data (Dowdy, 2018).

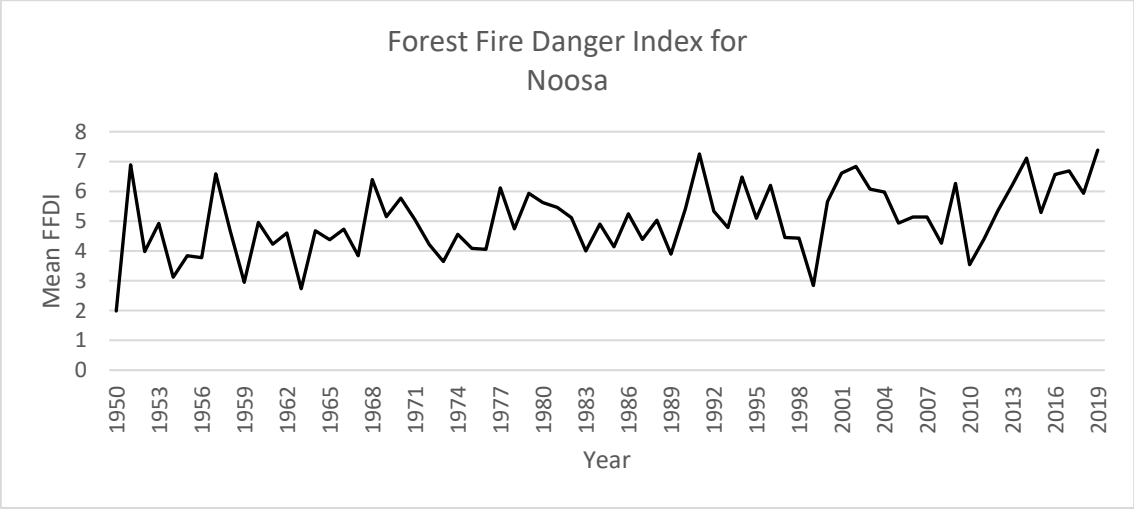

Figure 4: Time series of annual averaged Forest Fire Danger Index for Noosa (26.381S, 153.099E).

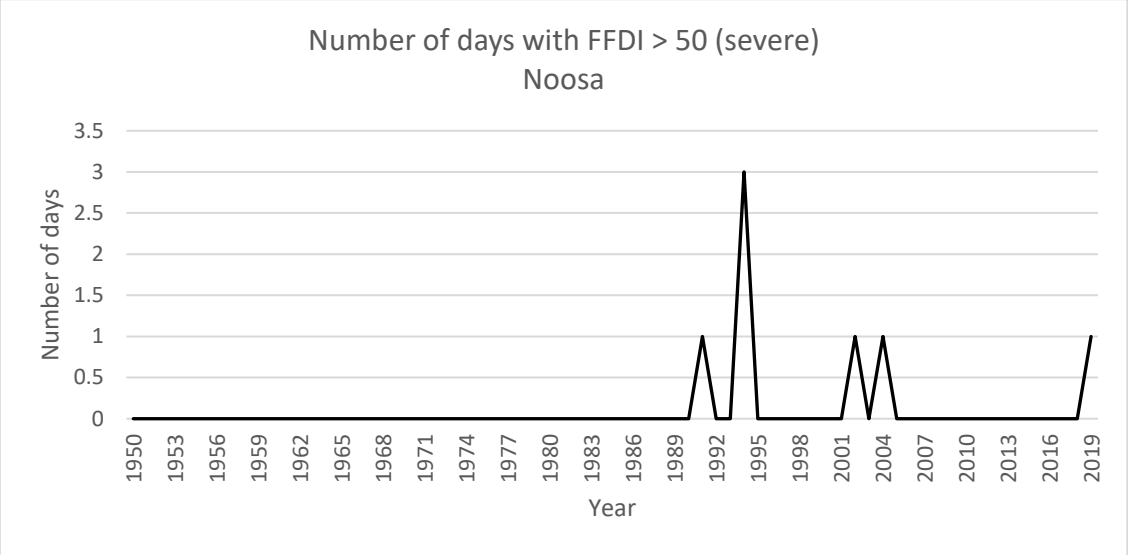

Figure 5: Time series of the number of severe Forest Fire Danger Index days per year, for Noosa (26.381S, 153.099E).

3.3 Suppression methods used on estate

The aim of this section is to briefly describe fire suppression methods used within QPWS estate, particularly those that may have significant impacts on natural values (e.g. construction of new fire lines, use of foams and retardants in sensitive ecosystems).

A range of suppression methods were used on QPWS estate during the event. Brief details are provided here.

3.3.1.1 Great Sandy/NP/W/2019/004 (8/09/19 to 13/10/19)

- Aerial water bombing support using a helicopter and airplane (direct attack to slow progress of the fire). Water was sourced from a variety of dams, with possible inclusion of Class A foam.
- Ground crews used rake hoes to chip new, and widen existing, fire containment lines.
- Back-burning on-park was conducted along various fire-lines in a range of vegetation types. Back burning was undertaken along: King's Bore firebreak; western firebreak; and north of Teewah Village.
- A tractor and slasher were used to construct new fire-lines, widen current lines, push over hazardous trees and re-open old forestry tracks within Great Sandy NP (Kin Kin Creek) and at the boundary with Tarangau (private property).
- Watercraft attacked the fire from the river, sourcing water directly from the Noosa River.
- Fire-fighting foams (Class A – foam block) were used by ground crews but not watercraft.

3.3.1.2 Great Sandy/NP/W/2019/005 (5/11/2019 to 3/12/2019)

- Aerial water bombing support using a helicopter and airplane (direct attack to slow progress of the fire). Water was sourced from various lakes and dams.
- Ground crews used rake hoes to chip new and widen existing fire containment lines.
- Back-burning was conducted along the Southern Powerline Easement. Approximately 4km in length, into Melaleuca woodland.
- Watercraft attacked the fire from the river, sourcing water directly from the Noosa River.
- Fire-fighting foams (Class A – foam block) were used by ground crews, avoiding wetland areas.

3.3.1.3 Great Sandy/NP/W/2019/008 (15/12/2019 to 7/01/2020)

- Aerial water bombing support: helicopters with water sourced from various regional lakes.
- A Posi-track and dozer were used to construct new fire-lines, widen current lines, push over hazardous trees and re-open old forestry tracks within Great Sandy National Park at: Freshwater Road, a new break north of Freshwater camp to the beach and re-opening of an existing break from Pettigrews Road in a northern direction to Bymien Day Use Area.
- Back-burning was conducted along Freshwater Road, commencing 50m from its most northern point.
- Fire-fighting foams (Class A – foam block) were used by ground crews, avoiding wetland areas.

3.3.1.4 Noosa/NP/W/2019/001 (22/08/2019 to 25/09/2019)

- Ground crews used rake hoes to chip new, and widen existing, fire containment lines: at the north-east corner of the block and along other breaks.
- Back-burning was conducted: from the ridge break down to the wetland; from the south-east to Lake Weyba; and from a new chipped line back to the previously burnt area.
- Water, for on-ground fire-fighting, was obtained from Lake Weyba.
- Fire-fighting foams were not used on QPWS estate.

3.3.1.5 Noosa/NP/W/2019/002 (9/09/2019 to 28/09/2019)

- Aerial water bombing support:
  - a Boeing 737 large air tanker did one drop of retardant gel, coloured with red dye, concentrated on the north-western corner of the park. Water for this drop was sourced from central NSW.
  - Helicopters with water sourced from golf course dams.
- A grader was used to widen existing containment line along the boundary to the corner of Peregian Breeze.
- Back-burning was not conducted due to weather conditions and proximity to major roads.
- Ground crews used rake hoe lines at numerous locations to contain hotspots
- Water, for on-ground firefighting, was obtained from golf course dams.
- Fire-fighting foams were used in defence of adjacent private property, both on and off estate.

3.3.1.6 Noosa/NP/W/2019/003 (22/10/2019 to 25/10/2019)

- Aerial water bombing support: helicopters with water sourced from local dams.
- Urban grade firefighting foam was used in the initial attack near Peregian Beach access.
- Ground crews used rake hoes, backpacks and chainsaws in mopping-up activities.
- Water, for on-ground firefighting, was obtained from urban fire hydrants.

3.3.1.7 Noosa/NP/W/2019/004 (18/12/2019 to 8/01/2020)

- Backburning was conducted by the Rural Fire Brigade – conditions resulted in a higher than intended intensity.
- Ground crews used rake hoes, backpacks and chainsaws throughout the block in mopping-up activities.
- Water, for on-ground fire-fighting, was obtained from fire hydrants in Peregian Springs.

3.4 Potential impacts of suppression methods

The Department of Environment and Science, *Procedural Guide: 2.20 – Use of bushfire firefighting agents* provides guidance on the potential impacts of fire-fighting agents in order to facilitate decision making on their use. The Procedural Guide details the toxicity of various agents and their environmental fate, demonstrating agents currently in use tend to break down rapidly in the environment and have a generally acceptable level of toxicity. There are, however, a number of potential impacts relevant to the areas in question.

1. In wetlands where there is limited dilution or flushing there is a potential for fish kills due to the rapid depletion of dissolved oxygen from increased biochemical oxygen demand (BOD).
2. Retardants have the potential to increase nutrients (N and P) as they break down. This could impact wetland systems with limited dilution or flushing that are adapted to nutrient poor environments (e.g. wet heaths, window lakes).
3. While not specifically addressed in the Procedural Guide, amphibians are known to be sensitive to surfactants (Mann, 2001) such as those in firefighting agents. However, there is a lack of a detailed information on the potential impacts of these products on the acid frog species known to inhabit the area. Given the conservation significance of the area to these frog species, the precautionary principle should be applied and the use of foams, retardants or suppressants should be avoided within or near known acid frog habitats.

4 Assessment methods

4.1 Fire extent and severity mapping

Spatial data was supplied by Department of Environment and Science, Queensland Fire and Emergency Services, and Department of Natural Resources Mines and Energy.

Fire severity mapping (**Figure 6**, **Figure 7**), using 12 band Sentinel-2 L2A satellite imagery, formed the basis of the assessment. The fire severity classification was derived from pre- and post-fire imagery (

Table 3). Images have a resolution of approximately 10-20m. A Normalised Burn Ratio (NBR) classification was developed for both the pre-fire and post-fire images (Brewer *et al.* 2005, Miller and Thode 2007). Using Sentinel-2 bands 8 and 12 the formula used was:

$$NBR = (b8 - b12) / (b8 + b12)$$

An NBR difference product (dNBR = Pre fire NBR - Post fire NBR) was derived and divided into five relative fire severity classes (Extreme, High, Moderate, Low and Unburnt) (**Table 4**). These classes were based on visual interpretation of the imagery, informed by ground-based field assessment. **Appendix 1** contains photographs of burnt sites within the assessment area.

The final fire extent (Figure 1) was digitised from the fire severity mapping. Digitising was completed using ArcGIS Pro 2.4.2. Fire progression was mapped using NASA's FIRMS, Visible Infrared Imaging Radiometer Suite (VIIRS), (FIRMS 2019). Linescan data was provided by Queensland Fire and Emergency Services.

Overall, the dNBR analysis created a consistent and generally reliable classified product reflecting relative damage to the forest canopy and subcanopy. Factors, such as vegetation structure and substrate type appear to affect the sensitivity of this product in different vegetation communities.

Note that fire severity refers to an observable effect on vegetation (in our assessments through the use of satellite imagery, with some ground observation). It shouldn't be confused with fire intensity, which in its simplest definition is the energy output of a fire (which is influenced by a range of variables including amount of fuel, fuel configuration, fuel dryness, prevailing weather, slope, residence time). Thus, a low intensity fire in some vegetation communities (e.g. grasslands) can result in high fire severity (complete removal of standing vegetation) but a fire of the same intensity in an open forest can result in low fire severity (complete removal of the grassy understorey, with no scorching or consumption of shrub or canopy layers).

The relative fire severity classification must be treated as an approximation as the analysis was rapid in nature and verification limited, so users need to be aware of potential limitations. However, these limitations are unlikely to significantly affect overall assessments of likely ecological impacts nor unduly influence management and recovery recommendations.

The study area included extensive wet heath and other peat forming communities, which can experience high to extreme severity bushfires. The ability to detect areas of potential peat fires rapidly, post-fire would assist the evaluation of impacts and direct management actions. With improvement it may be possible to refine this methodology to better identify those areas of peat burning, and perhaps redefine the *Extreme* severity category, for wet heaths and sedge-lands, to include only those areas where peat engagement occurred.

Sourcing appropriate satellite imagery that was cloud and smoke free, for the area proved to be difficult. Imagery for each separate fire event was sourced from available cloud-free runs as close as possible to the fire ignition and completion dates before being stitched together to form a composite severity raster spatial layer. The dates and resolution of imagery sourced for each bushfire are provided in

Table 3.

Table 3: Imagery dates used to calculate dNBR and image resolution.

Bushfire	Start imagery date	End imagery date	Resolution
Great Sandy National Park			
Great Sandy/NP/W/2019/004	9/7/2019	10/7/2019	20m
Great Sandy/NP/W/2019/005	10/27/2019	11/16/2019	10m
Great Sandy/NP/W/2019/008	12/6/2019	1/5/2020	10m
Noosa National Park			
Noosa/NP/W/2019/001	8/3/2019	9/12/2019	10m
Noosa/NP/W/2019/002	8/3/2019	9/12/2019	10m
Noosa/NP/W/2019/003	10/22/2019	10/27/2019	10m
Noosa/NP/W/2019/004	12/16/2020	1/5/2020	10m

Table 4: Relative fire severity classes, derived from the dNBR analysis.

Severity class	Relative fire severity class description
Unburnt	Unburnt, canopy and subcanopy unchanged (within the mapped extent).
Low	Canopy and subcanopy un-scorched, shrubs may be scorched, fire-sensitive low shrubs may be killed.
Moderate	Partial canopy scorch, subcanopy partially or completely scorched, and/or fire-sensitive tall shrub or small tree layer mostly killed.
High	Full canopy scorch to partial canopy consumption, subcanopy fully scorched or consumed.
Extreme	Full canopy, subcanopy and understorey consumption. Includes areas with significant peat burning.

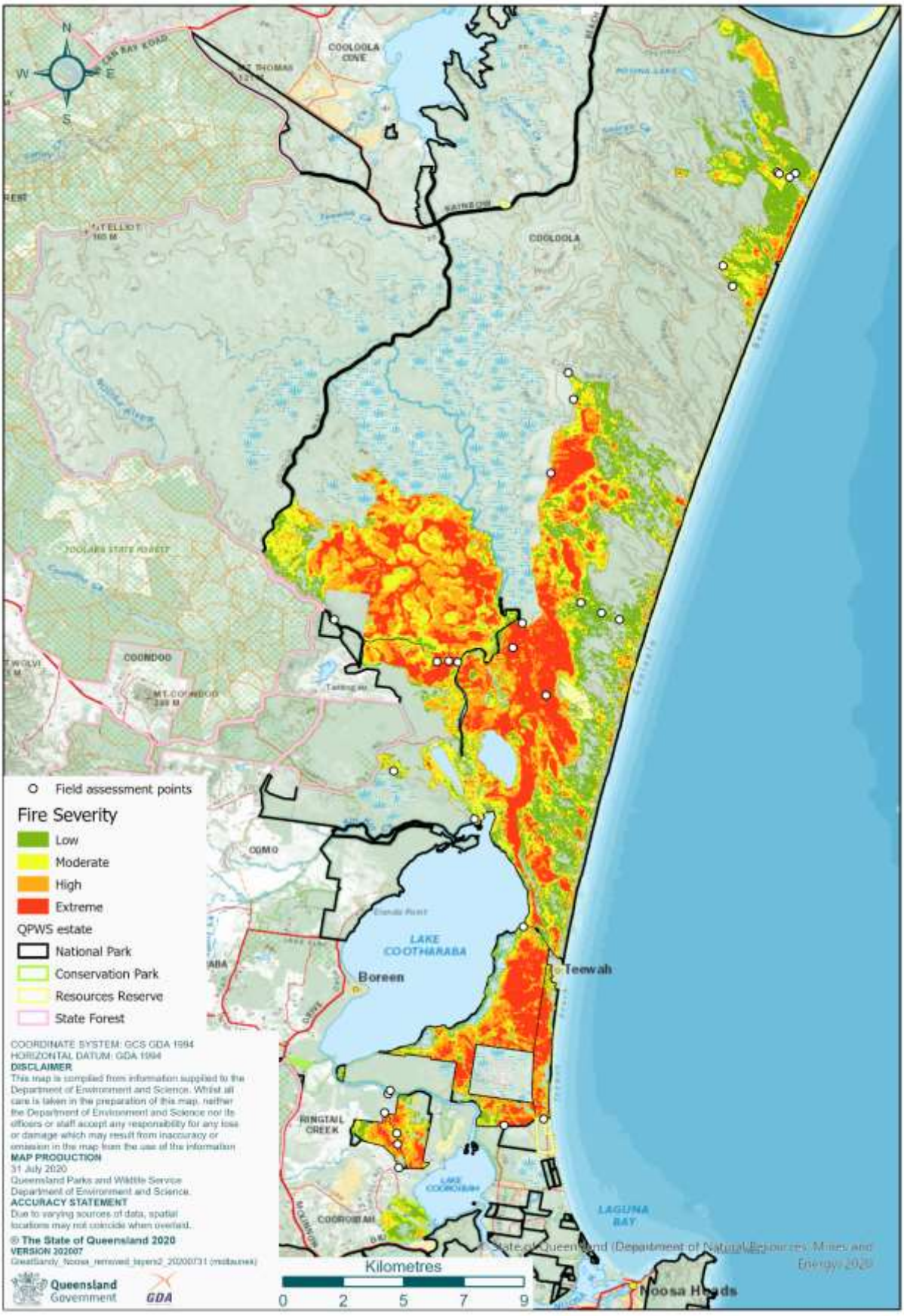

Figure 6: Estimated severity of bushfires in Great Sandy NP, September 2019 - January 2020.

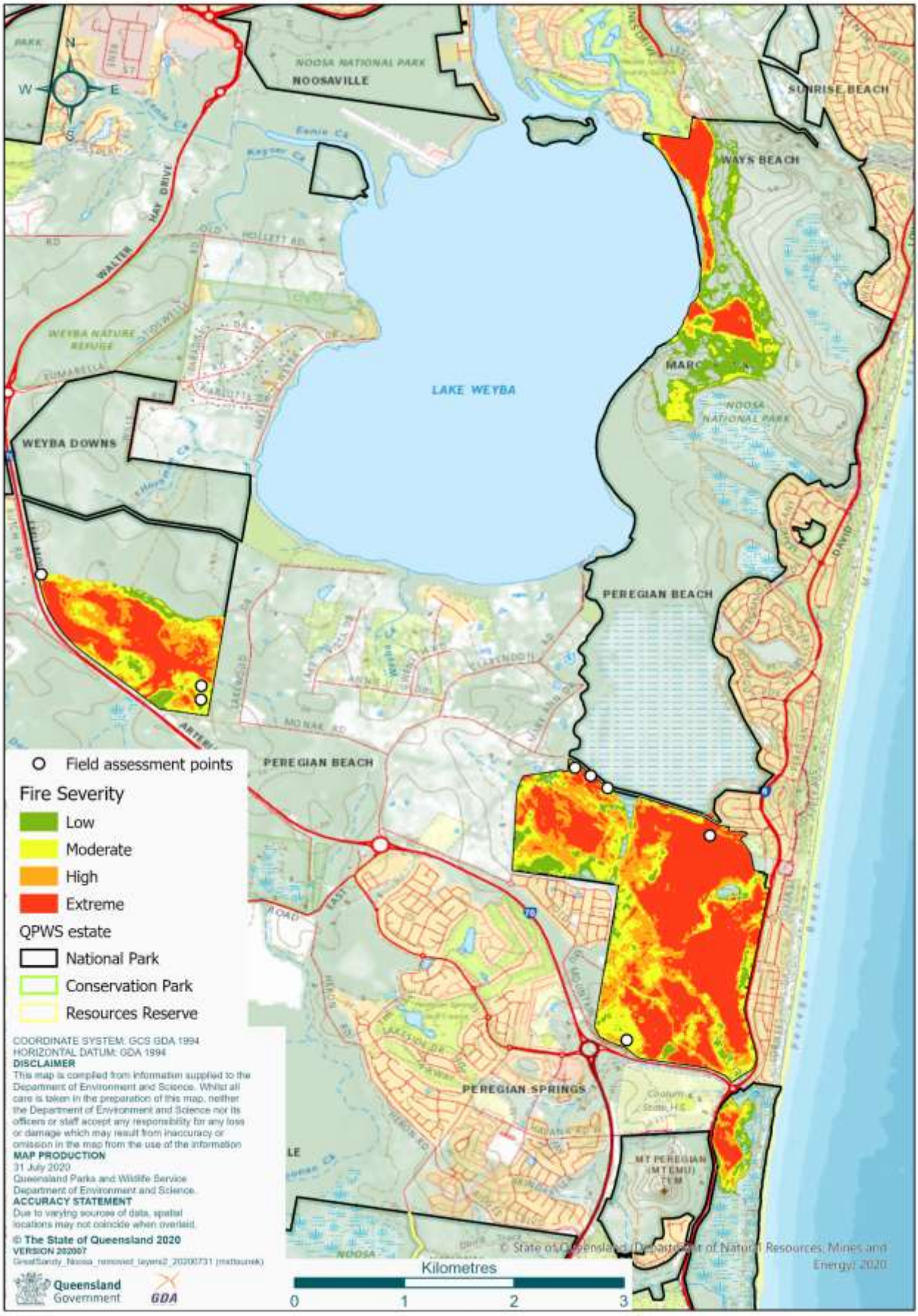

Figure 7: Estimated severity of bushfires in Noosa NP, September 2019 – January 2020.

4.2 Vegetation

Regional Ecosystems (REs) are vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The Queensland Herbarium has mapped REs throughout Queensland. We used version 10.1 of the mapping for this assessment (Queensland Herbarium 2019). Many areas have a high spatial diversity of vegetation communities, so at 1:100 000 scale it is not always possible to spatially delineate each vegetation community into homogenous (pure) polygons. Consequently, mapped RE polygons are often heterogeneous, such that a polygon may be attributed to more than one regional ecosystem code (e.g. 11.3.2/11.3.25), with the percentage of the area of the polygon occupied by each regional ecosystem or vegetation recorded (Neldner *et al.* 2020). For the purposes of this report the RE assessment utilises RE1 or the dominant RE for each mapped polygon and doesn't attempt to take into account the percentage of it within the polygon. The resolution or scale of RE mapping delineates a minimum area for remnant vegetation of 1 ha and/or 35 m in width.

REs are grouped into higher-level vegetation communities referred to as Broad Vegetation Groups (BVGs) (Neldner *et al.* 2019b), and we provide some summaries at the 1:2 000 000 and 1:5 000 000 scales.

4.3 Conservation species data sources

Information on conservation significant species (Threatened, Near Threatened, Special Least Concern or Endemic terrestrial or freshwater fauna and flora species) known, or likely, to occur in the fire extent, was principally derived from the state's wildlife information system WildNet (accessed 14/07/2020) which includes plant species locality information held by the Queensland Herbarium. WildNet was searched for records that fell within the latitudes of -25.939 and -26.5079 and longitudes of 153.1575 and 152.9583. This rectangle included an approximate 2km buffer on the northern, eastern, southern and western extent of the QPWS estate affected by the fire. Limited spatial validation of these records was undertaken, with some records rejected due to having: very poor spatial precision; erroneous georeferences; coordinates well outside of the fire extent; or intertidal or marine dependent species.

Spatial datasets on significant species are inherently limited and biased, so we also summarised the area of modelled potential habitat for selected conservation significant species within the burn area. Refer to **Appendix 5** for a description of methods used. The lists generated by the models were scrutinised by departmental experts and species deemed highly unlikely to occur on the park were removed.

We also referred to knowledge of local staff, published and unpublished information, as well as expert opinion to augment the spatial analyses and inform the impact assessment process.

Species nomenclature, taxonomy and status used in this report follow WildNet. In the body of the report we use common names for birds and mammals and scientific names for all other species.

4.4 Field assessment

Field assessment of ecological impacts and limited verification of fire extent and severity mapping was conducted on foot and by vehicle over the period 18-19 May and 2-4 June 2020. Observations regarding the vegetation, signs of fire severity and a series of photographs were recorded at various locations throughout each of the areas impacted by fire (See **Appendix 1**). Access to some of the fire affected areas was restricted at this time due to inundation of the extensive wetland systems. A combination of first-hand observation from officers involved in the fire-fighting efforts and satellite imagery was used to verify the severity mapping in these areas.

4.5 Data and report availability

The fire severity mapping is available via the Queensland Government's Open Data Portal, through the Queensland Spatial Catalogue at http://qldspatial.information.qld.gov.au/catalogue/custom/index.page. Internally the mapping is available through the Spatial Information Resource (SIR) (administered by Department of Natural Resources and Mines).

This report is available in WildNet Multimedia, Media ID = 27900, and is searchable using the keywords: fire, severity, ecological, natural values, assessment, Cooloola, Noosa, Great Sandy or via the link: http://wildnet/wildnet/bin/WNE0130$VMEDIAQRY.QueryView?P_MEDIA_ID=27900

5 Summary of areas burnt

Basic fire details and a summary of areas burnt is provided in **Table 5**. Statistics were derived using ArcGIS and the sources identified in the table. A summary of the areas burnt (ha) within QPWS managed estate, by relative fire severity class, is provided in **Table 6**. Maps of relative fire severity are provided in **Figure 6** and **Figure 7**.

Table 5: Summary of burnt areas.

Description	Value and units	Source and notes
FLAME Fire ID(s) and Names	13274304 13274317 13274316 13281610 13274363 13277394 13279864	Noosa National Park/NP/W/2019/001 Noosa National Park/NP/W/2019/002 Noosa National Park/NP/W/2019/003 Noosa National Park/NP/W/2019/004 Great Sandy National Park/NP/W/2019/004 Great Sandy National Park/NP/W/2019/005 Great Sandy National Park/NP/W/2019/008
Fire start date: Noosa/NP/W/2019/001 Noosa/NP/W/2019/002 Noosa/NP/W/2019/003 Noosa/NP/W/2019/004 Great Sandy/NP/W/2019/004 Great Sandy /NP/W/2019/005 Great Sandy /NP/W/2019/008	 22/08/2019 9/9/2019 22/10/2019 18/12/2019 8/9/2019 5/11/2019 15/12/2019	FLAME
Fire started on or off-estate Noosa/NP/W/2019/001 Noosa/NP/W/2019/002 Noosa/NP/W/2019/003 Noosa/NP/W/2019/004 Great Sandy/NP/W/2019/004 Great Sandy /NP/W/2019/005 Great Sandy /NP/W/2019/008	 On Off On Off On Off On	FLAME/ FIRMS hotspots
Date fire first recorded on estate	Same dates as Fire start date	FLAME
Date fire declared contained Noosa/NP/W/2019/001 Noosa/NP/W/2019/002 Noosa/NP/W/2019/003 Noosa/NP/W/2019/004 Great Sandy/NP/W/2019/004 Great Sandy /NP/W/2019/005 Great Sandy /NP/W/2019/008	 25/09/2019 28/09/2019 25/10/2019 8/01/2020 13/10/2019 3/12/2019 7/01/2020	FLAME
Total area burnt (on and off estate combined)	17,316ha	Fire severity analysis from EO Browser
Bioregion(s)	South East Queensland	
Estate name(s) burnt	Noosa NP, Great Sandy NP, Cooloola (Noosa River) RR,	FLAME Fire severity analysis from EO Browser

Description	Value and units	Source and notes
	Cooroibah CP, Great Sandy RR, Toolara SF	
QPWS Region(s)	South East Queensland & Coastal and Islands Region	Noosa NP – SEQ Great Sandy NP – CIR
Area burnt within QPWS estate	15413ha	This report (Table 4, Appendix 2), based on relative fire severity mapping. See also Table 4.
Area burnt within World Heritage Area	0ha	World Heritage, DES ENVBAT.QLD_WORLDHERTAREA
Area burnt within Ramsar areas	0ha	WetlandInfo
Directory of Important Wetlands of Australia within burn extent	2643ha	Directory of Important Wetlands in Australia (DIWA)
Area burnt of habitat of state Biodiversity Significance (BAMM)	10250ha	This report - relative fire severity mapping. SIR dataset: ENVBAT.BPA_SEQ See also Table 5.
Area of core Koala habitat (SEQ Koala Conservation Strategy 2019-2024) burnt	4417ha	This report - relative fire severity mapping. SIR datasets: ENVBAT.HSM_SEQRP_KOALA See also Table 5.

Table 6: Area burnt by severity class within estate (Table 4) as at 8 January 2020.

Severity class	Great Sandy-Noosa NP	DIWA	BAMM State Biodiversity Significance	Core Koala habitat
Low	3989	395	2365	1097
Moderate	3460	568	2290	1023
High	3914	718	2789	1338
Extreme	4051	961	2806	959
Total	**15413**	**2643**	**10250**	**4417**

5.1 Vegetation burnt

Summaries of the area of Regional Ecosystems and Broad Vegetation Groups burnt and the severity of the burn are provided in **Appendices 2** and **3** respectively.

5.1.1 Potential Ecological Impact

The ecological impact of any given fire event on a vegetation community depends upon the extent and severity of the fire and the tolerance or sensitivity of the community to fire, as well as the history of previous fires. Many ecosystems are adapted to a particular fire regime (intensity, frequency, season) and require appropriate fire to maintain ecosystem health. Other ecosystems are fire intolerant or fire sensitive and if they burn significant long-term ecological damage is likely.

This report is focused on the Potential Ecological Impact (PEI) from the Great Sandy-Noosa 2019 bushfire event on the vegetation communities within the mapped fire extent. To aid in evaluating PEI the REs were classified into four fire tolerance categories using fire management guidelines provided in the Regional Ecosystem Description Database (Qld Herbarium 2019) for RE1 and expert knowledge (**Appendix 2**):

1. ***Intolerant*** *– communities which are sensitive to fire, where management aims to exclude fire.*
2. ***Low*** *tolerance – communities with a mix of fire-sensitive and fire-tolerant species, where management aims to burn at low intensity and with high patchiness (40-60%), in conditions where fire-sensitive components are protected from fire.*
3. ***Moderate*** *tolerance – communities where the management aim is to burn at low-moderate intensity.*
4. ***High*** *tolerance – communities where the aim is to burn at higher intensity and/or where it is acknowledged that occasional high intensity fire will occur and the ecosystem is known to recover.*

The concept of PEI, which integrates fire severity mapping with knowledge of vegetation community fire tolerance and threats to post-fire recovery, helps identify areas likely to be most severely impacted that may require increased resources (e.g. pest management), or altered management approaches (e.g. modification to planned burn program) to enhance recovery. Conversely, areas may be identified as likely requiring little or no additional management intervention. The classes of PEI used for this assessment are further explained in Box 1.

For the purposes of this report the wet heaths and other peat forming systems have been classified as having a high fire tolerance as they are fire-adapted systems and can tolerate fires of high severity as long as the peat layer is wet enough not to burn. In certain situations (i.e. lower water table during drought) peat deposits can become dry and, if ignited during bushfire, catastrophic ecological impact can occur. Very minimal peat engagement was reported to have occurred during these fires and when detected, was responded to rapidly by crews. Improving the ability of the severity mapping to detect areas of peat engagement would improve the ability to identify areas of potentially catastrophic impacts due to extensive peat fires.

The area, of each of the four fire tolerance categories, subjected to low, moderate, high or extreme fire severity, is shown in

Table 7. Burnt areas were assigned to four PEI classes, based on the matrix

Table 7) of fire severity and fire tolerance of the vegetation communities. A summary of the PEI is provided in

Table 7, is mapped in Figure 7 and **Figure 8**, and discussed in **Section 6.0**.

Table 7: Fire tolerance and Potential Ecological Impact

Summary of burn severity (ha) of vegetation communities, classified by fire tolerance

	Fire tolerance of vegetation community (based on RE1)			
Relative Fire Severity Class	**Intolerant**	**Low**	**Mod**	**High**
Low - Canopy and subcanopy un-scorched, shrubs may be scorched, fire-sensitive low shrubs may be killed.	261	733	1,015	1,890
Moderate - Partial canopy scorch, subcanopy partially or completely scorched, and/or fire-sensitive tall shrub or small tree layer mostly killed.	164	286	1,419	1,519
High - Full canopy scorch to partial canopy consumption, subcanopy fully scorched or consumed.	112	204	1,615	1,887
Extreme - Full canopy, subcanopy and understorey consumption.	77	87	1,250	2,595

Area (ha) of Potential Ecological Impact (within estate)

	Fire tolerance of vegetation community (based on RE1)			
Potential Ecological Impact	**Intolerant**	**Low**	**Mod**	**High**
Limited or no ecological impact likely		733	2,434	5,296
Moderate ecological impact likely	261	286	1,615	2,595
High ecological impact likely	164	204	1,250	
Catastrophic ecological impact possible	190	87		

Box 1. Overview of the Potential Ecological Impact classes

Limited or no Potential Ecological Impact (green):

The consequence of the fire is likely to be short-term with the persistent canopy and subcanopy cover, and expected relative rapid regeneration by native, fire-adapted, species, helping to minimise the risk of invasion by ecosystem-changing plant species (if they were not already established prior to the fire). There will be limited or no impact on fauna species reliant on the canopy species for food and/or shelter (e.g. hollows) and likely relatively short-term impacts on species.

Moderate Potential Ecological Impact (yellow):

There may be localised decline in, or loss of, some species, over the short-term as a direct consequence of the fire and associated poor regenerative capacity or specialised requirements of some species for successful regeneration, and/or as a consequence of a reduction in resources or specialised niches. Ecosystems in this impact class are expected to recover over the short to mid-term.

High Potential Ecological Impact (orange):

There is expected to be localised decline in, or loss of, some species and regeneration of these areas is expected to take time, depending on structure and species composition. The rating of High PEI reflects: the immediate to short or mid-term impacts on food resources for fauna; loss of critical structural elements and faunal habitat features such as large hollow bearing trees which take decades to hundreds of years to replace; likely changes in understorey species composition, in the short to mid-term at least. The risk of invasion by ecosystem-changing weeds is likely to be high, may be exacerbated by past disturbance regimes and may further exacerbate future bushfire events.

Catastrophic Potential Ecological Impact (red):

There is significant risk of an ecosystem not recovering as a consequence of the substantial changes in: vegetation structure and composition; soil structure, composition and chemistry (e.g. consumption of peat, altered nutrient availability or increased susceptibility to erosion); and microclimate. These changes can increase likelihood of invasion by ecosystem-changing plant species (weeds or native) better adapted to the post-fire environment than the impacted ecosystem, potentially increasing fuel loads further exacerbating the risk of future high severity fire. Some, possibly many, flora and fauna species can be expected to be permanently lost from the location. The risk of permanent change is greater where surrounding ecosystems are also significantly impacted by the bushfire or other disturbances and/or there are no sources of propagules nearby.

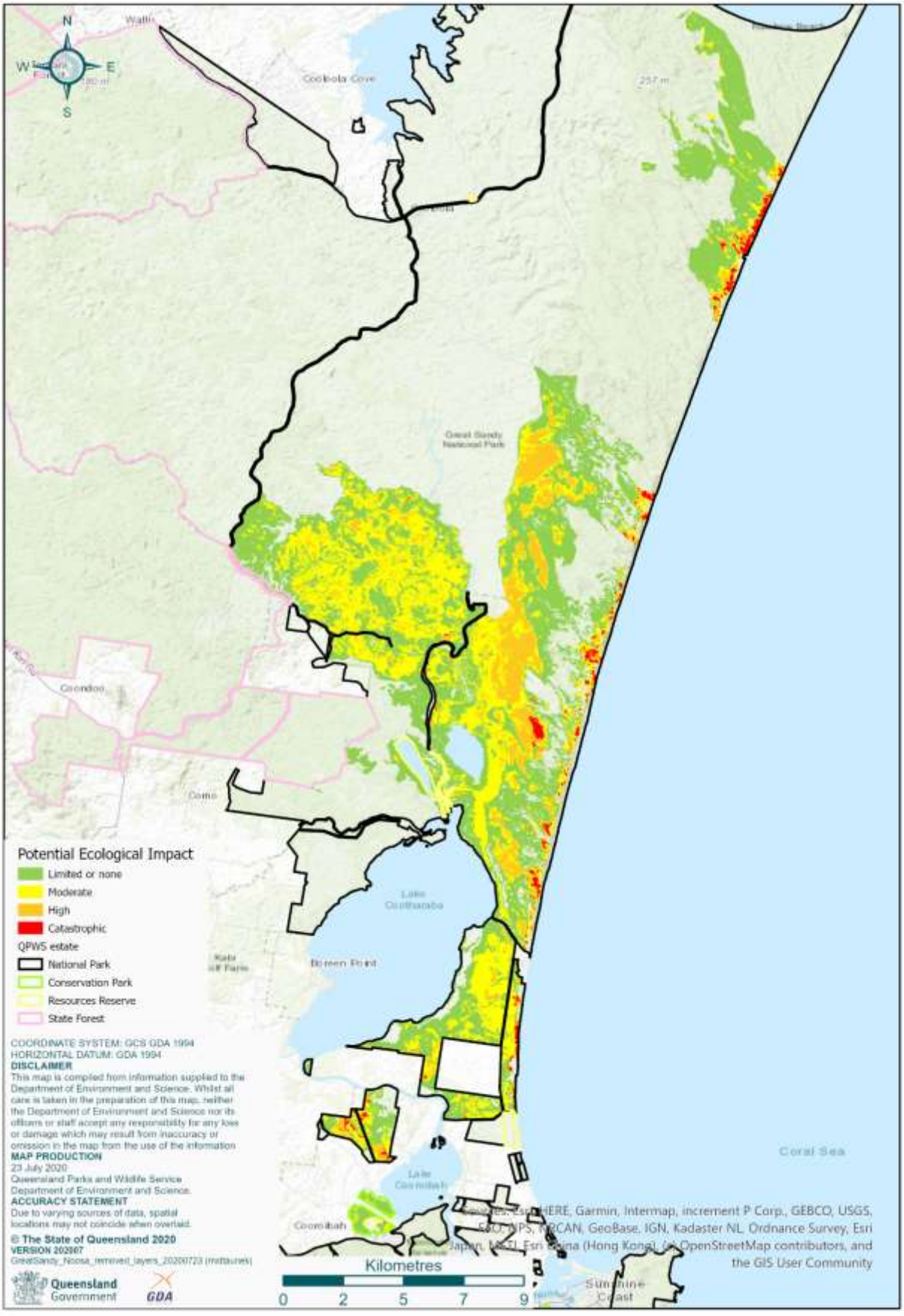

Figure 8: Potential Ecological Impact - Great Sandy (Cooloola) NP.

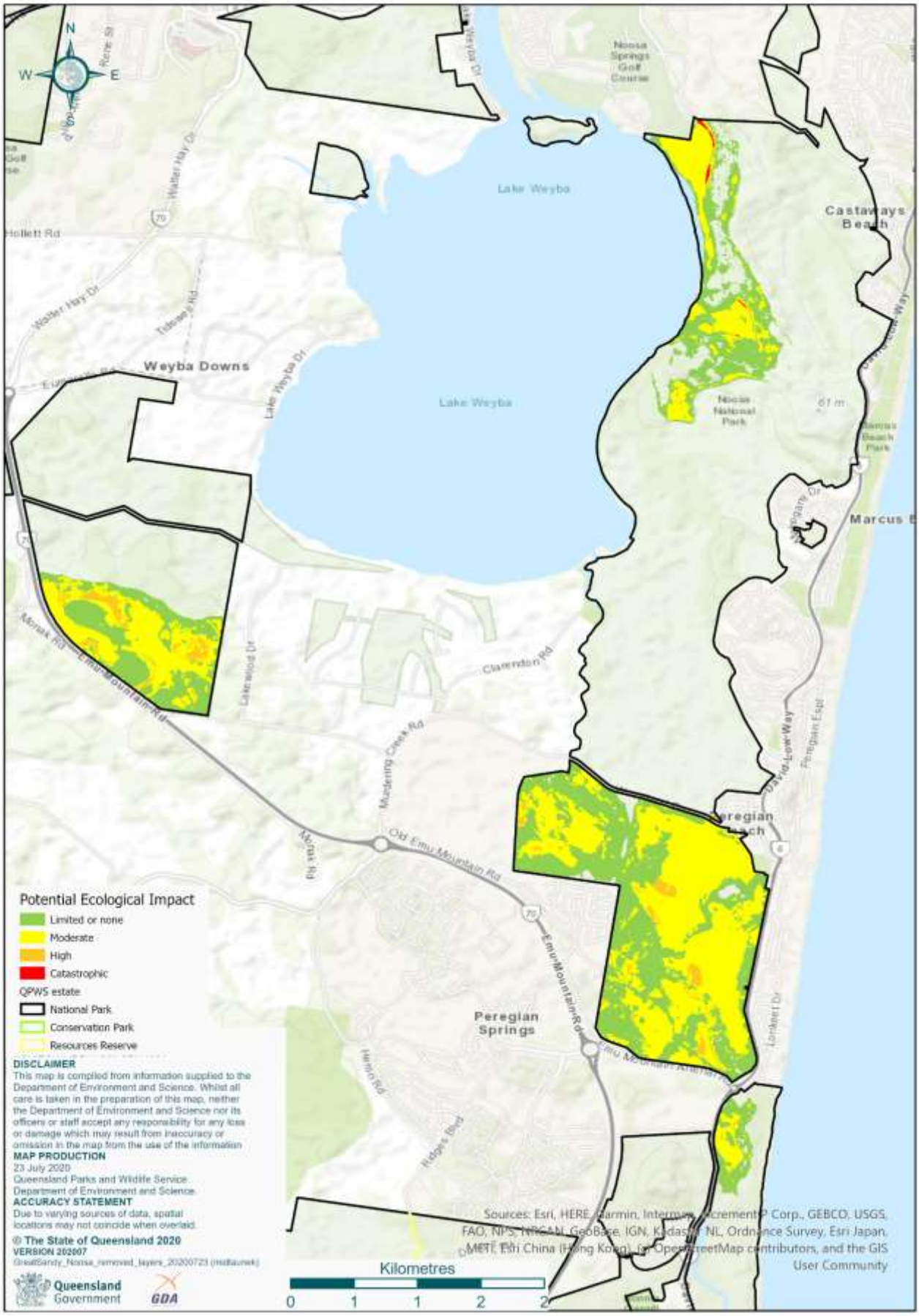

Figure 9: Potential Ecological Impact - Noosa NP.

5.2 Significant species potentially impacted

The list of significant forest fauna and flora species recorded from within a buffered, bounding rectangle of the fire extent is provided in **Appendix 4**. **Appendix 5** summarises the area of modelled potential habitat for selected threatened species within the extent of the fire.

There are fourteen threatened species (five fauna, nine flora) for which a substantial proportion (≥15%) of their modelled potential habitat occurs in the study area – Great Sandy NP, Noosa NP, Cooloola (Noosa River) RR, Cooroibah CP, Great Sandy RR, Toolara SF (refer **Appendix 5**). Of these species, ten had a substantial (≥10%) proportion of their modelled habitat in the study area burnt in the bushfire event. Summary details are provided for these ten species in **Table 8** and maps, showing the modelled potential habitat and PEI, are provided in **Appendix 5**.

Table 8: Threatened species with a substantial portion of modelled potential habitat burnt.

Scientific name	Common name	Status		Potential Habitat (PH)			
		NCA	EPBC	PH in study area (ha)	% Qld PH in study area	Total PH burnt (ha)	% study area PH burnt
Pezoporus wallicus wallicus	ground parrot	V		33,444	59	4,358	13
Stipiturus malachurus	southern emu-wren	V	V	16,169	52	3,374	21
Crinia tinnula	wallum froglet	V		84,459	31	13,200	16
Litoria olongburensis	wallum sedgefrog	V	V	42,016	30	8,276	20
Litoria freycineti	wallum rocketfrog	V		34,798	29	6,845	20
Archidendron lovelliae	bacon wood	V	V	23,103	54	3,556	15
Boronia keysii	Key's boronia	V	V	4,834	42	2,083	43
Blandfordia grandiflora	christmas bells	E		16,120	27	3,505	22
Cryptocarya foetida	stinking cryptocarya	V	V	11,488	25	2,523	22
Acacia attenuata	whipstick wattle	V	V	31,950	19	7,192	22

5.3 Natural Key Values

Under the Values Based Management Framework, six Natural Key Values (NKV) have been identified for Noosa NP. **Figure 10** shows the location of NKVs with respect to the extent of the 2019 bushfire. The total area and extent burnt for each NKV is summarised in **Table 9**. The Broad Vegetation Group (BVG) of each NKV is shown in **Table 9** in parentheses: refer to **Appendix 3** for a description of the BVG and a summary of areas burnt within each severity class.

Table 9: Area of Natural Key Values (NKV) burnt (ha) in Noosa NP, by relative fire severity class.

Draft Natural Key Value Noosa NP (corresponding BVG*)	Area of NKV within estate (ha)	% NKV burnt (within estate)	Relative fire severity (ha) of NKVs			
			Low	**Moderate**	**High**	**Extreme**
Rocky Headlands (Coastal heath on dunes, sandplains and headlands (BVG 29a)	28	0				
Coastal heath and Ground Parrot habitat (Coastal heath on dunes, sandplains and headlands (BVG 29a)	1,020	26	12	26	48	183
Vine forest communities (Rainforest typically with hoop or kauri pine BVG 5)	46	0				
Vine forest communities (Rainforest on coastal dunes BVG 3)	56	0				
Coastal woodlands (Moist to dry eucalypt open forests to woodlands usually on coastal lowlands & ranges BVG 9)	278	0				
Cyperaceae swamp (Coastal freshwater swamps BVG 34c)	41	0				
Total	**1,423**	**26**	**12.3**	**25.5**	**47.5**	**183.4**

Natural Key Values for Great Sandy NP exist in an early draft stage and are currently unavailable. However, many of the same values listed for Noosa NP (**Table 9**) are present at Great Sandy (Cooloola) NP. Great Sandy NP is home to a diversity of high value ecosystems, many with restricted ranges, which support a diversity of significant species. Rather than attempting to pre-empt the formal process for identifying Natural Key Values in Great Sandy NP, by identifying possible KVs, the PEI (product of tolerance and severity) has been used to identify areas of specific concern.

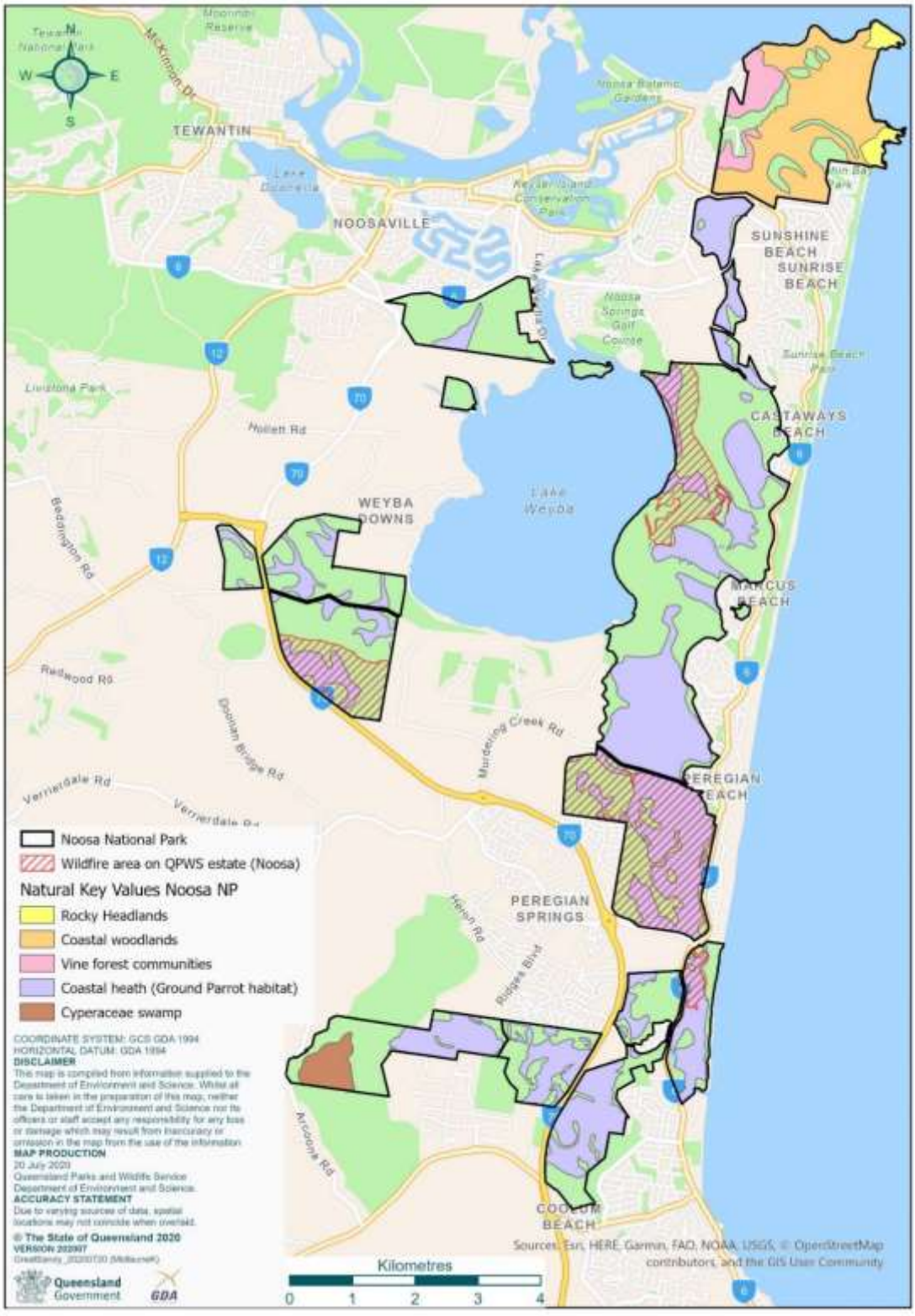

Figure 10: Estimated extent of Natural Key Values and bushfire extent - Noosa NP.

5.4 Other Natural Values

5.4.1 Wetlands

Both Great Sandy (Cooloola) and Noosa National Park contain large and diverse wetlands. The *Aquatic Conservation Assessment (ACA) for the riverine and non-riverine wetlands of Southeast Queensland catchments* (DEHP 2015) was used to identify the relative conservation value of wetlands based on their 'AquaScore'. A wetlands 'AquaScore' is determined based on a combination of scores for a range of criteria, with 'Very High' value wetlands being: *These wetlands have very high values across all criteria (aquatic naturalness, catchment naturalness, diversity and richness, threatened species, special features and representativeness), or they have very high representativeness values in combination with very high aquatic naturalness, catchment naturalness or threatened species values. They may also be wetlands nominated as a special feature by an expert panel for their very high flora, fauna and/or ecological values, regardless of values across other criteria* (DEHP 2015: P36*).*

The extent of wetlands burnt at each relative fire severity class is provided in Table 10 and shown in **Error! Reference source not found.** and Figure 11.

The fire tolerance or sensitivity of these wetlands has been considered in **Section** Error! Reference source not f ound.. Another factor requiring special consideration was the degree to which peat deposits burnt during the bushfire. Peat fires have the potential to result in catastrophic impacts to wetland systems. Various reports of peat burning were made during these bushfires, particularly within Noosa NP. Crews actively worked to control burning peat. Reports from the fire ground and the healthy post-fire regrowth in these systems indicate that peat burning was limited.

One of the limitations of the severity mapping using satellite imagery, was the ability to differentiate severity classes, in communities with low, dense canopies, such as heath-, shrub-, sedge- and grass-land communities. With improvement it may be possible to refine this methodology to better identify those areas of peat burning, and perhaps redefine the *Extreme* severity category, for wet heaths and sedge-lands, to include only those areas where peat engagement occurred.

Table 10: Area (ha) burnt of non-riverine wetlands per AquaScore - Aquatic Conservation Assessment: Non-Riverine wetlands of SEQ

	Wetland AquaScore		
Relative fire Severity	Very High	High	Medium
Low - Canopy and subcanopy un-scorched, shrubs may be scorched, fire-sensitive low shrubs may be killed.	555.2	63.6	1.7
Moderate - Partial canopy scorch, subcanopy partially or completely scorched, and/or fire-sensitive tall shrub or small tree layer mostly killed.	987.7	46.9	2.1
High - Full canopy scorch to partial canopy consumption, subcanopy fully scorched or consumed.	1,762.5	14.9	1.9
Extreme - Full canopy, subcanopy and understorey consumption.	2,693.7	27.2	4.4

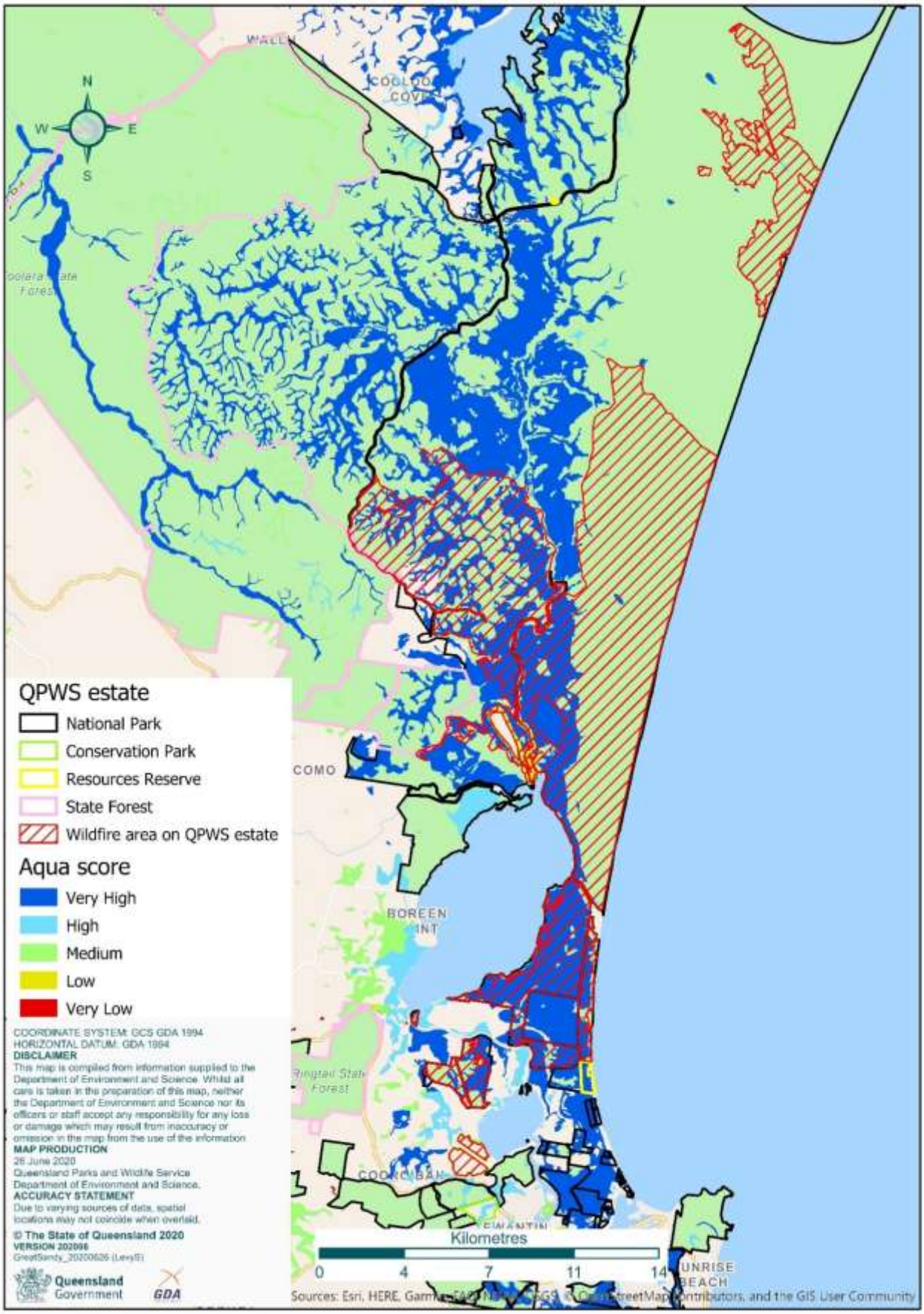

Figure 11: Great Sandy (Cooloola) NP - Wetland AquaScore and fire extent on reserve.

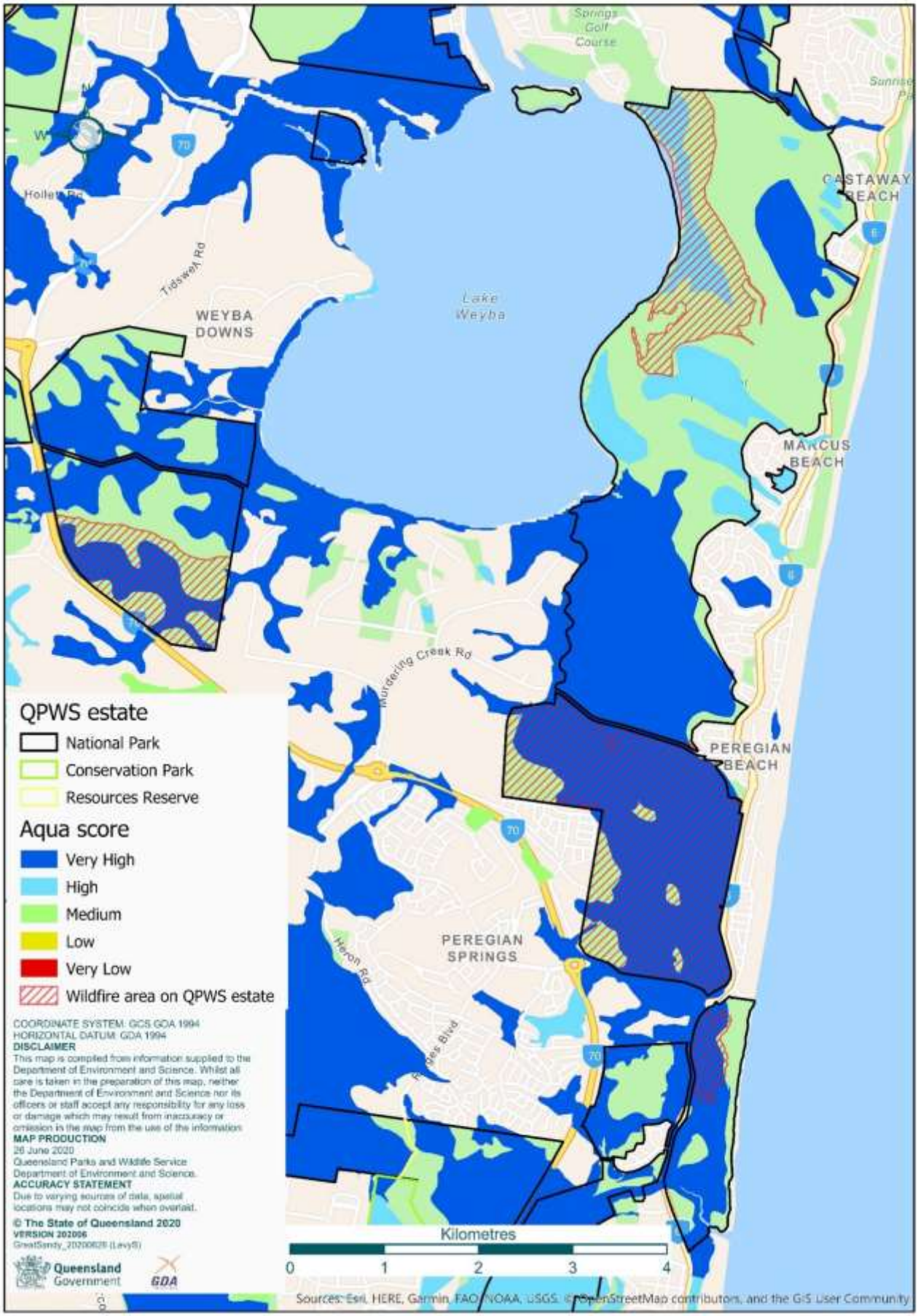

Figure 12: Noosa NP - Wetland AquaScore and fire extent.

6 Significant impacts and recovery actions

6.1 Summary of priority impacts and recovery actions

Seven ecosystem types are discussed in Section 6. They are listed in Table 12 together with the associated Regional Ecosystems and Broad Vegetation Groups.

Table 11: Natural values potentially impacted.

Value descriptor	Associated Broad Vegetation Groups and Regional Ecosystems
Foredune complex	• BVG 28a – RE 12.2.14, 12.2.16
Heath (Closed – Wet)	• BVG 29a – RE 12.2.12, 12.3.13, 12.5.9
Heath (Open – Dry)	• BVG29a – RE 12.2.9, 12.3.14, 12.5.10, 12.2.13
Grass, sedge, herb swamps (palustrine wetland)	• BVG 34c, f – RE 12.2.15, 12.2.15a, 12.2.15g (*patterned fens) 12.9-10.22
Tree swamps – Melaleuca open forest to woodland on seasonally inundated plains (palustrine wetland)	• BVG 22a – RE 12.2.7, 12.3.5, 12.3.4
Rainforest communities	• BVG 3 – RE 12.2.3 • BVG 4 – RE 12.2.1 • BVG 5 – RE 12.5.13a, 12.9-10.16
Eucalypt Forest to Woodlands	• BVG 12a – RE 12.9-10.7a • BVG 16c-d – RE 12.3.11, 12.3.7b • BVG 8a,b – RE 12.2.4, 12.2.8, 12.3.2, 12.5.6c ,12.9-10.1, • BVG 9g,h – RE 12.2.6, 12.5.2a, 12.5.3, 12.5.12, 12.5.4, 12.8.20, 12.9-10.4, 12.3.14a

The highest priority impacts and actions for recovery are summarised below. A detailed assessment of each significant known or likely impact to natural values and a full list of recommended recovery actions are provided in section 6.3.

- **NV_1 - Foredune complex –** Significant areas of this fire intolerant ecosystem experienced a high to catastrophic PEI. *Casuarina equisetifolia,* (beach she-oak), a dominant species in much of the foredune complex, is typically killed by even low intensity fire. The fire management intent is for complete exclusion from this community. Recovery of this community is expected to be slow, with potential for increased erosion and weed invasion during recovery. Recreational use requires focused management during this time to ensure recovery is not jeopardised by inappropriate access and use.

- **NV_2 - Heath – Wet –** A large extent of this habitat type was impacted by high severity fire. Despite this, the PEI on this community is low to moderate as it is adapted to high intensity fires (unless there has been significant loss of peat). This community type was observed to be recovering well six months post-fire. Management options to limit impact of pests on recovery of the ecosystem and threatened species could include pig trapping (remote operated) and cane toad trapping (adult and tadpole). Regular site inspections and surveillance should be undertaken to enable early detection and rapid response to weed incursions. Ongoing fire management should focus on establishing greater pyro-diversity (i.e. areas of different fire intensity, frequency, seasonality and extent within the acceptable fire regime tolerances for the community).

- **NV_3 - Heath – Dry –**Less than two percent of the total extent of this value was impacted and the ecosystem is fire tolerant. Some areas of RE 12.2.9 (*Banksia aemula* low open woodland on dunes and sand plains) experienced moderate (272ha) and high (470) PEI. Extensive epicormic growth, coppicing and re-shooting was observed six months post-fire. Ongoing monitoring of these areas to detect encroachment by weeds and to identify areas of increased erosion is recommended.

- **NV_4 - Swamps – Grass, Herb, Sedge (Palustrine Wetland) –** These systems likely experienced relatively minor impacts from the fire event. They are fire tolerant and showed good signs of recovery during field work. The primary threat from fire to these systems occurs when the peat deposits burn. The exact extent and severity of peat burning during this fire event is not fully understood, however observations at the time of the fire suggest peat burning was limited. Further improvement to the fire severity mapping should focus on the ability to better detect areas of burnt peat. Management should focus on managing threat from pest animals (pigs and cane toads) and from weeds. These ecosystems are adapted to nutrient poor conditions and amphibians are sensitive to surfactants. Use of fire-fighting foams and retardants should be avoided in these areas.

- **NV_5 - Tree Swamps – Melaleuca woodlands (Palustrine Wetland) –** These communities have a high tolerance to fire. However, significant areas of this community experienced high to extreme relative fire severity. Areas most impacted were in Block 1161 (south of the river) and North Shore, Noosa. These areas will be prone to weed invasion. Preventing the establishment of weeds is the priority action.

- **NV_6 - Rainforest** – Only small areas of rainforests were burnt, with no known significant incursions of fire into this a habitat type. Some areas adjacent to these communities were impacted by fire and some additional fire control lines were established adjacent to, but no within rainforest communities. These cleared/disturbed areas have the potential to act as vectors for weed invasion into and around the rainforest communities. Preventing the establishment of weeds adjacent to these areas is a priority, particularly for high biomass grasses and other weeds that increase fuel load and future fire risk.

- **NV_7 - Eucalypt forests and woodlands** – the PEI is predominantly limited to moderate but with small areas of high impact. Whilst these ecosystems are fire-adapted, the partial to full consumption of the canopy and subcanopy in some areas represents a long-term impact with respect to faunal habitat values, some of which take decades to hundreds of years to form (e.g. hollow-bearing trees).
  The majority of these vegetation communities are relatively fire tolerant. Some of the communities in this group are, however, less tolerant. RE 12.2.5 is a less fire tolerant community and experienced significant areas of high to catastrophic PEI. Preventing the invasion of ecosystem-changing weeds is the priority.

6.2 Limitations

This report focuses on a single fire event; we recognise that the response/recovery of ecosystems and species will vary depending on fire history and future fire and climate. For many species, information on their fire ecology is lacking or poorly known. The direct impact from fire, post-fire response and recovery potential will vary among sites and species.

In our assessment of the PEI of the fire we assumed that impacts to ecosystems dominated by fire tolerant species were likely to be relatively lower and of shorter duration than impacts to fire-sensitive communities, based on known and assumed species and ecosystem fire response.

Limited field evaluation was possible. Sites burnt with high and extreme relative fire severity in the wet heath environment west of the Noosa River were mostly inaccessible, due to lack of access tracks, waterlogged nature of the environment. Satellite imagery, observations from vantage points and observations from rangers actively involved in fighting the fire have been relied upon to confirm the severity and PEI mapping.

The delay in field assessment meant that it was not always possible to attribute canopy death to drought, the immediate impacts of the fire (i.e. scorch), or subsequent death of the tree or shrub. This may have affected our field assessment of fire severity but was unlikely to unduly affect our assessment of the ecological outcome.

Regional Ecosystem mapping and Broad Vegetation Groups underpin our assessment. Some polygons mapped are heterogeneous, meaning more than one regional ecosystem occurs within the polygon, generally because the REs occur in a mosaic below the scale of mapping. Our quantitative analyses are based on RE1 (the dominant RE in a mixed polygon). The limitations of scale and heterogeneity are unlikely to grossly affect recommended post-fire management actions.

6.3 Impact assessment and recovery actions

Refer to **Appendices 2** and **3** for details of the area burnt within each fire severity class by Regional Ecosystem and Broad Vegetation Group, respectively.

6.3.1 NV1: Foredune Complex

Potential Ecological Impact: significant areas of moderate, high and catastrophic.

Recommended recovery actions:

1. Prevent the establishment of weeds in the burnt area. It is particularly prone to invasion from *Chrysanthemoides monilifera* subspecies *rotundata*, bitou bush.
2. Prevent inappropriate recreational use and regularly check for areas of increased erosion.
3. Continue to manage the impact of the leaf hopper *Jamella australiae* on *Pandanus tectorius* populations.
4. Undertake Health Checks (Melzer *et al*. 2019) – these will facilitate early detection of weeds and enable condition to be evaluated across the park.

Overview of value and impact

Approximately 560 ha of foredune vegetation burnt on Great Sandy NP (none on Noosa NP). While representing just under 3% of this community on Great Sandy NP (due to extensive occurrence across the park, which includes K'gari), it experienced the most extensive catastrophic PEI (188 ha). Comprised of BVG 28a – *Complex of open shrubland to closed shrubland, grassland, low woodland and open forest on strand and foredunes* and includes RE 12.2.14 (strand and foredune complex comprising *Spinifex sericeus* grassland *Casuarina equisetifolia* subsp. *incana* low woodland/open forest) and RE 12.2.16 (sand blows largely devoid of vegetation).

RE 12.2.14 experienced the greatest PEI (Error! Reference source not found. and **Plate 2**) of any RE within the study area. Catastrophic, High and Moderate PEI occurred over 187.8 ha (0.9%), 157.7 ha (0.8) and 207.8ha (1%), respectively out of a total area on Great Sandy NP of 16,600ha (NB total for whole of Great Sandy NP, including K'gari / Fraser Island).

This community is dominated by *Casuarina equisetifolia* with *Pandanus tectorius*, and is situated along the foredunes behind Teewah beach. It is highly fire-sensitive with a fire of any severity presenting a threat to its integrity. Species present are readily killed by fire and lack adaptations to aid recovery, such as the ability to coppice or reshoot. This community plays a vital role in stabilising foredunes and impacts to it have the potential to result in increased erosional or aeolian process. These areas are also particularly prone to invasion from the weed *Chrysanthemoides monilifera* subspecies *rotundata* (bitou bush) and exotic grasses.

This community is known or likely habitat for *Calyptorhynchus lathami lathami* (glossy black cockatoo) and *Pandion cristatus* (eastern osprey).

6.3.2 NV2: Coastal Heath – Wet

Potential Ecological Impact: Limited to moderate impact.

Recommended recovery actions

1. Prevent the establishment of weed species through regular surveillance and rapid response to detections.
2. Limit the impact of pest species (particularly pigs and cane toads)
3. Investigate ways to limit the extent of this community being burned during any one fire event (i.e. improving pyro-diversity or heterogeneity of age classes).
4. Undertake Health Checks (Melzer *et al*. 2019) – these will facilitate early detection of weeds and enable condition to be evaluated across the park.
5. Avoid use of fire-fighting retardants in these areas.

Overview of value and impact

This value encompasses a draft Natural Key Value under the VBMF for Noosa NP comprised of BVG 29a – RE 12.2.12 - Closed heath on seasonally waterlogged sand plains (of concern), 12.3.13 - Closed heathland on seasonally waterlogged alluvial plains usually near coast (no concern at present), 12.5.9 - Sedgeland to heathland in low lying areas (of concern).

Despite extensive, high relative fire severity across this community none is classified as experiencing catastrophic PEI. A very small area experienced a high PEI (1.5 ha), while 1,702 ha and 722.5 ha experienced moderate and

limited PEI, respectively. In total, 2,133 ha (22.5%) were impacted on Great Sandy NP and 255 ha (26.7%) on Noosa NP.

Coastal wet heaths are a significant value of both Noosa and Great Sandy NP and provide habitat for a diversity of significant species, including the ground parrot (*Pezoporus wallicus wallicus*), acid frogs - wallum froglet (*Crinia tinnula*), wallum rocket frog (*Litoria freycineti*), wallum sedge frog (*Litoria olongburensis*), and the Cooloola sedgefrog (*Litoria cooloolensis*) and plants - *Acacia attenuata, A. baueri* subsp. *baueri, Allocasuarina emuina, Blandfordia grandiflora, Boronia keysii, B. rivularis, Eucalyptus conglomerata*.

These systems are fire tolerant and areas of Wet Heath (and sedgeland) are prone to invasion by melaleucas from adjacent ecosystems under certain fire frequency and intensity regimes. Signs of healthy regrowth were observed onsite throughout the community (**Plate 3**). Areas where the fire event has helped by removing melaleuca were observed during the field work (**Plate 4** and **Plate 5**).

While the fire severity and PEI on the wet heaths raises few concerns, the extent that has been impacted in the fire event is of concern, particularly for species, such as the ground parrot. Establishing a diversity of age classes within the wet heaths may reduce the risk of future extensive, high severity fires. It is likely that an increased use of aerial ignition will be required to achieve this given on-ground access constraints.

Wet heath communities are adapted to nutrient poor conditions (DES 2020b) and low pH and are habitat for a number of significant amphibian and fish species. The use of fire-fighting foams and retardants should be avoided in these communities.

6.3.3 NV3: Coastal Heath – Dry

Potential Ecological Impact: Mostly limited but some areas of moderate to high impact.

Recommended recovery actions

1. Prevent the establishment of weeds such as *Androgpogon virginicus* (whiskey grass*)*, and *Chrysanthemoides monolifera* (bitou bush).
2. Check for inappropriate access and increased erosion.
3. Undertake Health Checks (Melzer *et al*. 2019) – these will facilitate early detection of weeds and enable condition to be evaluated across the park.

Overview of value and impact

This value encompasses a draft Natural Key Value under the VBMF for Noosa NP and extensive areas exist within Great Sandy NP. The dry heaths are comprised of BVG 29a – RE 12.2.13 - Open or dry heath on dunes and beaches (Endangered), 12.2.9 - *Banksia aemula* low open woodland on dunes and sand plains (No concern at present), 12.3.14 - *Banksia aemula* low woodland on alluvial plains usually near coast (of concern), 12.5.10 - *Eucalyptus latisinensis* and/or *Banksia aemula* low open woodland on complex of remnant Tertiary (No concern at present).

These heaths are fire-adapted, however high to extreme relative fire severity occurred across large areas resulting in 475ha, 280.5ha and 275ha experiencing high, moderate and limited PEI, respectively. A total of 1,002ha was burnt (**Plate 6**) equating to only 1.9% of the total extent on Great Sandy NP but 30.7% on Noosa NP.

This community provides habitat for a diversity of significant species and significant aesthetic value for visitors. There was evidence of regeneration (epicormic growth, coppicing, reshooting and germination) throughout the burnt areas. In the absence of weed invasion or successive intense fires, this community should recover well from the fire event.

The nutrient poor nature of dry heath/wallum communities tends to make weeds less likely. However, some species such as: whiskey grass (*Andropogon virginicus*), broad leaved paspalum (*Paspalum mondiocanum*), and bitou bush (*Chrysanthemoides monilifera*) may be able to invade these areas post fire. Regular inspections to detect infestations early will facilitate rapid and more cost effective control.

General opening up of the area and loss of vegetation could increase the risk of erosion and could also lead to increased recreational misuse (e.g. vehicle access). Signs of increased erosion or misuse should be monitored.

6.3.4 NV4: Grass, Sedge, Herb Swamps (Palustrine Wetland)

Potential Ecological Impact: mostly limited but with areas of moderate to high impact.

Recommended recovery actions

1. Prevent the establishment of semi-aquatic grass species. This requires an early and regular ongoing response.
2. Manage pest animals – pig trapping and cane toad tadpole control.
3. Improve the fire severity mapping to better detect areas that experience peat engagement.
4. Undertake Health Checks (Melzer *et al*. 2019)– these will facilitate early detection of weeds and enable condition to be evaluated across the park.
5. Avoid use of fire-fighting retardants in these areas.

Overview of value and impact

This value encompasses a draft Natural Key Value under the VBMF for Noosa NP (Cyperaceae swamps). Extensive areas of these wetlands exist within Great Sandy NP. The value is comprised of BVG 34c – RE 12.2.15 - *Gahnia sieberiana*, *Empodisma minus*, *Gleichenia* spp. closed sedgeland in coastal swamps (No concern), 12.2.15a – Permanent and semi-permanent window lakes (No concern) and 12.2.15g - Swamps dominated by *Empodisma minus*, *Gahnia sieberiana*, other sedges and forbs and shrubs such as *Leptospermum liversidgei* (No concern). This NV includes patterned fens (12.2.15g) which are unique to Great Sandy NP.

A relatively small proportion was impacted with 187 ha (1.6%) on Great Sandy NP and 16.5 ha (14%) on Noosa NP (**Plate 7**).

Palustrine wetlands provide critical habitat for a diversity of threatened species, particularly the acid or wallum frogs and fish species. The fire and associated opening up of the landscape has the potential to allow invasion of these areas by pest animals. Pigs and cane toad tadpoles are of particular concern as they have the ability to impact on the quality of this habitat for species of concern. Evidence was observed, during field inspections, of pig activity to the west of Noosa River and local rangers have reported increased pig activity after the fires. A combination of control techniques, including trapping and shooting should be considered to manage the impact of pigs.

These systems provide important water quality benefits to local waterways. The potential impact of fires, particularly peat fires, on water quality is not well understood (aside from the known impact of increased erosion post-fire). The potential pathways and thresholds of fire related water quality impacts on significant species may warrant further investigation. As does improving our ability to detect and or respond to peat fires and associated water quality impacts.

These communities are adapted to nutrient poor conditions (DES, 2020b) and low pH and are habitat for a number of significant amphibian and fish species. The use of fire-fighting foams and retardants should therefore be avoided in these communities.

6.3.5 NV5: Tree Swamps – Melaleuca Open forest to woodland (seasonally inundated)

Potential Ecological Impact: mostly limited to moderate but with localised areas of high impact.

Recommended recovery actions

1. Prevent the establishment of high biomass and/or semi-aquatic grasses (whiskey grass *Andropogon virginicus* was observed within this community).
2. Assess the establishment of tree and shrub weeds and undertake 6-12 monthly, targeted control (particularly prone to invasion from *Schinus terebinthifolius* (broadleaved pepper)).

Overview of value and impact

This community is extensive across Noosa and Great Sandy NPs, provides habitat for a diversity of significant species and performs highly valuable ecosystem services (e.g. water quality improvement and flood mitigation). It is comprised of BVG 22a – RE 12.2.7 – *Melaleuca quinquenervia* or rarely *M. dealbata* open forest on sand plains (no concern), RE 12.3.5 – *M. quinquenervia* open forest on coastal alluvium (no concern), RE 12.3.4 – *M. quinquenervia, Eucalyptus robusta* woodland on coastal alluvium (of concern).

The bushfires resulted in 725ha (5.9%) of this value experiencing a moderate PEI, with a further 1,957ha (15.9%) experiencing limited or no PEI. An area of 2,551ha (22%) was burnt on Great Sandy NP and 111ha (20.2%) on Noosa NP.

These communities have a high tolerance to fire. However, areas of this community experienced extreme relative fire severity (i.e. areas of complete canopy consumption) particularly in Block 1161 (south of Noosa River) (**Plate 8Plate 9**) and along the southern fire breaks near Cootharaba Landing (**Plate 10**) and the third cutting, North Shore, Noosa (**Plate 11).**

These areas will be particularly prone to weed invasion. *Andropogon virginicus* (Whiskey grass) and *Schinus terebinthifolius* (broad-leaved pepper) (**Plate 12**) were observed to be invading this community during the field visits. The semi-aquatic grasses (e.g. *Urochloa mutica* (para grass) and *Hymenachne amplexicaulis* (olive hymenachne) – no known infestations adjacent to burnt area) and shrubs such as *S. terebinthifolius* are a threat to this community. Preventing the establishment of weeds is the priority action.

6.3.6 NV 6: Rainforests

Potential Ecological Impact: mostly high to catastrophic but with significant areas of moderate impact.

Recommended recovery actions

1. Assess the establishment of weeds and undertake strategic control. High biomass grasses and *Lantana camara* are of particular concern. This requires an early and regular ongoing response.
2. Review strategies for weed and fire management in adjacent fire-adapted communities; aim to reduce the risk of future fire encroachment into rainforests.
3. Undertake Health Checks (Melzer *et al*. 2019) for the rainforest communities – these will facilitate early detection of weeds and enable condition to be evaluated across the park.

Overview of value and impact

This value encompasses three draft Natural Key Values under the VBMF for Noosa NP comprised of BVG 3 – RE 12.2.3 – Araucarian vine forest on parabolic high dunes (of concern); BVG 4 – RE 12.2.1 – Notophyll vine forest on parabolic high dunes (of concern): BVG 5 – RE 12.5.13a - Microphyll to notophyll vine forest +/- *Araucaria cunninghamii* on remnant Tertiary surfaces (Endangered), 12.9-10.16 - Araucarian microphyll to notophyll vine forest on Cainozoic and Mesozoic sediments (of concern).

Rainforests are highly fire-sensitive communities and the management intent is to exclude fire from them. They are typically self-protecting from fire and can usually be relied upon to stop fires. Observations from this fire suggest they did just that – with fire pulling up at the rainforest margins. Of this NV only 44ha was impacted – 1ha (0.02%) catastrophic, 4ha (0.1%) high, 39ha (0.6%) moderate PEI. The most extensive impact occurred in RE 12.2.1 with 38ha experiencing a PEI of moderate.

The establishment or promotion of ecosystem-changing weeds (refer **Appendix 6**), including high biomass grasses, poses a risk to rainforest communities. High biomass exotic grasses (e.g. *Megathyrsus maximus, Andropogon virginicus*) are common in disturbed areas of the park and adjoining lands. They greatly increase the risk of future fire incursion and the fire intensity.

Burnt rainforest communities are at risk due to increased edge effects including weed and pest animal invasion.

6.3.7 NV 7: Eucalypt forests and woodlands

Potential Ecological Impact: predominantly limited to moderate, but with small areas of high to catastrophic impact**.**

Recommended recovery actions

1. Assess the establishment of weeds and undertake strategic control. This requires an early and regular ongoing response. Particular attention should be paid to ecosystem changing weeds, such as vines (i.e. *Dolichandra unguis-cati, c*at's claw creeper*)* and high biomass grasses (e.g. *Andropogon virginicus*, whiskey grass).
2. Undertake a control program for feral pigs.
3. Review strategies for weed and fire management in these communities; aim to reduce the risk of widespread impacts to less tolerant species (e.g. *C. columellaris)*
4. Undertake Health Checks (Melzer *et al*. 2019) – these will facilitate early detection of weeds and enable condition to be evaluated across the park.
5. Monitor for increased biosecurity risk from pathogens such as myrtle rust. The latter favours new growth which is common post-disturbance.

Overview of value and impact

This value partially encompasses a Natural Key Value defined under the VBMF for Noosa NP (coastal woodlands) and is present on Great Sandy NP. This NV is very diverse and is comprised of BVG 9 – RE 12.2.5, 12.2.6, 12.5.2a, 12.5.3, 12.5.12, 12.5.4, 12.8.20, 12.9-10.4; BVG 12 – RE 12.9-10.7a; BVG 16 – RE 12.3.11; and BVG 8 – RE 12.2.4, 12.2.8, 12.3.2, 12.5.6c ,12.9-10.1.

These tend to be fire-adapted communities and fire management is critical to their conservation. Management of these communities includes burning to maintain their health, with desired extent, frequency and intensity of burning guided by the ecology of these systems and the threats to them (e.g. weed invasion) (NPRSR 2013, Queensland Herbarium 2019). Extensive areas of high to extreme relative fire severity is likely to have serious ecological impacts in the short to medium term.

In total 8,193ha (8.1%) of eucalypt forests and woodlands were burnt (**Plate 13**), the majority with limited to moderate impact due to their fire tolerance. There are however some notable exceptions to the general 'rule' that these ecosystems are fire-adapted. For example, RE 12.2.5 (*Corymbia intermedia* +/- *Lophostemon confertus* +/- *Banksia* spp. +/- *Callitris columellaris* open forest on beach ridges – of concern) contains a mix of fire-adapted and fire-sensitive species. About 45% of the total area of the RE (across the reserves) was burnt with approximately, 66.2ha, 146.7ha, 260.7ha and 705.5ha experiencing catastrophic, high, moderate and limited PEI, respectively.

Dry eucalypt forests and woodlands within the extent of the fire are known or likely habitat for a number of threatened or other significant wildlife species (**Appendices 4** and 5). Impacts on these species will vary but those that live in or depend upon the forest floor and associated leaf litter and biota for cover or foraging (e.g. long-nosed potoroo, *Adelotus brevis*), depend upon foliage for food (e.g. koala, greater glider), or large hollow bearing trees (e.g. greater and yellow-bellied gliders, various micro bats and birds) are likely to be most significantly impacted.

The establishment or promotion of ecosystem-changing weeds (refer **Appendix 6**) poses a risk to eucalypt forest and woodland communities. High biomass exotic grasses (e.g. *Megathyrsus maximus, Andropogon virginicus*) and *Lantana camara* are common in disturbed areas of the park and adjoining lands. They increase the risk of higher fire frequency and/or severity. The bare ground and loss of canopy cover resulting from the fire provide an ideal environment for their germination and establishment, particularly in moister communities on higher fertility soils.

Burnt communities are at risk due to increased edge effects including weed and pest animal invasion.). Indications of pig damage were also observed in this community during field visits (**Plate 14**).

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Appendix 1. Fire severity and impact photographs

Plate 1: Foredune community impacted by fire (Teewah Beach – south of King's Bore) (A Meiklejohn, 19 May 2020)

Plate 2: Foredune community impacted by fire (Teewah Beach) (A Meiklejohn 19 May 2020)

Plate 3: High to extreme burn severity in Wet Heath (sedge-land) community (A Meiklejohn 19 May 2020)

Plate 4: 'Helipad' (near Camp 3) – 2 months post fire – Wet Heath – Sedge-land with woody encroachment of Melaleuca (the shrubs over topping the heath) killed by the fire (J Olds Dec 2019)

Plate 5: 'Helipad' (near Camp 3) – 9 months post fire (J Olds July 2020), showing rapid recovery of heath and death of encroaching Melaleuca.

Plate 6: Extreme burn severity in Dry Heath (Wallum), Cooloola Rec Res, Great Sandy NP (A Meiklejohn 18 May 2020)

Plate 7: Noosa NP – Mix of Wet Heath and palustrine grass, herb, sedge wetland which experienced high to extreme severity fire (A Meiklejohn 2 June 2020)

Plate 8: Extreme fire severity in Tree Swamp – seasonally inundated M. quinquenervia woodland (block 1161) (A Meiklejohn 19 May 2030)

Plate 9: Extreme fire severity in M. quinquenervia woodland just south of where the fire jumped the river (block 1161) (A Meiklejohn 19 May 2030)

Plate 10: Fire break near Cootharaba Landing – Tree swamp impacted by high severity fire (A Meiklejohn 19 May 2020)

Plate 11: Powerline fire break (near 3rd cutting), backburn and waterbombing stopped the fire up here – Tree Swamp (A Meiklejohn 19 May 2020)

Plate 12: Schinus terebinthifolius (Broad-leaved pepper), an invasive ecosystem changing weed, near fire impacted site - Noosa NP (J Olds 2 June 2020)

Plate 13: Low severity - northern extent of GS-004 on King's Bore Rd (A Meiklejohn 18 May 2020)

Plate 14: Evidence of pig damage (post fire) (A Meiklejohn 3 June 2020)

Plate 15: Repairs to damage at Harry's Hut campground. Note surviving Callitris columellaris. (J Olds 3 June 2020)

Appendix 2. Area burnt within each fire severity class, by Regional Ecosystem, within QPWS estate.

Regional Ecosystem (RE) mapping and Broad Vegetation Groups (BVGs) as described by Neldner *et al.* (2019b & 2020). All areas are in hectares, for RE1 (see **Section 4.2**). Column headings are: RE1 – Regional Ecosystem identifier for RE1; Short Description – brief description of RE1; Status – Biodiversity Status; BVG 2M – Broad Vegetation Group at the 1:2 000 000 scale; Tolerance – ability of community to tolerate fire (used in calculating PEI); Total – area of RE1 burnt within QPWS estate, Low, Moderate, High, Extreme – area of RE1 burnt at each fire severity class.

RE1	Short Description	Status	BVG2M	Tolerance	Total	Low	Mod	High	Extreme
12.2.8	Eucalyptus pilularis open forest on parabolic high dunes	No concern at present	8	High	2374	1271	595	359	150
12.2.6	Eucalyptus racemosa subsp. racemosa open forest on dunes and sand plains. Usually deeply leached soils	No concern at present	9	Mod	1885	579	386	344	576
12.9-10.4	Eucalyptus racemosa subsp. racemosa woodland on sedimentary rocks	No concern at present	9	Mod	1861	231	689	804	137
12.2.7	Melaleuca quinquenervia or rarely M. dealbata open forest on sand plains	No concern at present	22	High	1459	201	353	512	393
12.2.12	Closed heath on seasonally waterlogged sand plains	Of concern	29	High	1420	48	128	295	949
12.2.5	Corymbia intermedia +/- Lophostemon confertus +/- Banksia spp. +/- Callitris columellaris open forest on beach ridges usually in southern half of bioregion	Of concern	9	Low	1179	705	261	147	66
12.3.13	Closed heathland on seasonally waterlogged alluvial plains usually near coast	No concern at present	29	High	958	16	28	182	733
12.2.9	Banksia aemula low open woodland on dunes and sand plains. Usually deeply leached soils	No concern at present	29	Mod	954	69	142	272	471
12.3.5	Melaleuca quinquenervia open forest on coastal alluvium	No concern at present	22	High	825	63	170	351	241
12.2.14	Foredune complex	No concern at present	28	Intolerant	553	208	158	110	77
12.3.4	Melaleuca quinquenervia, Eucalyptus robusta woodland on coastal alluvium	Of concern	22	High	370	90	117	88	75
12.5.3	Eucalyptus racemosa subsp. racemosa woodland on remnant Tertiary surfaces	Endangered	9	Mod	230	70	79	66	15

RE1	Short Description	Status	BVG2M	Tolerance	Total	Low	Mod	High	Extreme
12.3.14a	Eucalyptus racemosa subsp. racemosa woodland to open forest. Occurs on Quaternary alluvial plains in near coastal areas.	Of concern	29	High	192	18	75	60	39
12.2.4	Syncarpia hillii, Lophostemon confertus tall open to closed forest on parabolic high dunes	Of concern	8	High	177	142	28	5	2
12.2.15	Gahnia sieberiana, Empodisma minus, Gleichenia spp. closed sedgeland in coastal swamps	No concern at present	34	Mod	114	41	48	20	4
12.5.2a	Corymbia intermedia, Eucalyptus tereticornis open forest on remnant Tertiary surfaces, usually near coast.	Endangered	9	Low	100	12	16	52	21
12.5.12	Eucalyptus racemosa subsp. racemosa, E. latisinensis +/- Corymbia gummifera, C. intermedia, E. bancroftii woodland with heathy understorey on remnant Tertiary surfaces	Of concern	9	Mod	93	4	38	46	4
12.2.15g	Swamps dominated by Empodisma minus, Gahnia sieberiana, other sedges and forbs and shrubs such as Leptospermum liversidgei.	No concern at present	34	Mod	67	0	8	29	30
12.2.1	Notophyll vine forest on parabolic high dunes	Of concern	4	Intolerant	43	38	4	1	0
12.2.16	Sand blows largely devoid of vegetation	Of concern	28	N/A	41	31	8	2	0
12.5.9	Sedgeland to heathland in low lying areas on complex of remnant Tertiary surface and Tertiary sedimentary rocks	Of concern	29	Mod	35	10	12	12	1
12.3.14	Banksia aemula low woodland on alluvial plains usually near coast	Of concern	29	High	34	0	9	22	2
12.5.6c	Eucalyptus siderophloia, E. propinqua, E. microcorys and/or E. pilularis open forest on remnant Tertiary surfaces.	Endangered	8	High	22	14	7	1	0
12.9-10.22	Closed sedgeland/shrubland on sedimentary rocks. Generally coastal	Of concern	34	High	21	4	2	6	10
12.9-10.1	Tall open forest often with Eucalyptus resinifera, E. grandis, E. robusta, Corymbia intermedia on sedimentary rocks.	Of concern	8	High	20	13	6	1	0
Estuary	Area below HAT	N/A		N/A	20	5	8	6	1
12.8.20	Shrubby woodland with Eucalyptus racemosa subsp. racemosa or E. dura on Cainozoic igneous rocks	Of concern	9	Mod	18	4	5	7	3
12.3.2	Eucalyptus grandis tall open forest on alluvial plains	Of concern	8	High	18	9	3	5	1

RE1	Short Description	Status	BVG2M	Tolerance	Total	Low	Mod	High	Extreme
12.3.11	Eucalyptus tereticornis +/- Eucalyptus siderophloia, Corymbia intermedia open forest on alluvial plains	Of concern	16	Low	14	5	5	4	0
12.5.10	Eucalyptus latisinensis and/or Banksia aemula low open woodland on complex of remnant Tertiary surface and Tertiary sedimentary rocks	No concern at present	29	Mod	13	0	3	6	4
12.5.13a	Microphyll to notophyll vine forest +/- Araucaria cunninghamii on remnant Tertiary surfaces	Endangered	5	Intolerant	11	9	1	1	
12.2.15a	Permanent and semi-permanent window lakes. Occurs as a window into the water table on Quaternary coastal dunes and beaches.	No concern at present	34	Mod	10	4	4	1	1
12.1.1	Casuarina glauca woodland on margins of marine clay plains	Of concern	28	Low	9	6	2	1	0
12.9-10.7a	Eucalyptus crebra +/- E. tereticornis, Corymbia tessellaris, Angophora spp., E. melanophloia woodland on sedimentary rocks	Of concern	13	Mod	8	1	3	4	0
12.1.3	Mangrove shrubland to low closed forest on marine clay plains and estuaries	No concern at present	35	Intolerant	7	5	1	0	
12.5.4	Eucalyptus latisinensis +/- Corymbia intermedia, C. trachyphloia subsp. trachyphloia, Angophora leiocarpa, Eucalyptus exserta woodland on complex of remnant Tertiary surfaces and Cainozoic and Mesozoic sediments	No concern at present	9	Mod	7	0	0	3	3
12.3.7b	Naturally occurring instream waterholes and lagoons, both permanent and intermittent.	Of concern	16	Low	6	4	2	0	0
non-rem	Non remnant vegetation	N/a		N/A	3	2	1	1	0
12.2.13	Open or dry heath on dunes and beaches	Endangered	29	Mod	2	2	0		
12.1.2	Saltpan vegetation including grassland, herbland and sedgeland on marine clay plains	No concern at present	35	Low	1	0	0	0	
12.9-10.16	Araucarian microphyll to notophyll vine forest on Cainozoic and Mesozoic sediments	Of concern	5	Intolerant	1	0	0	0	0
12.2.3	Araucarian vine forest on parabolic high dunes	Of concern	3	Intolerant	0.3	0.3			
Total					**15183**	**3939**	**3407**	**3827**	**4010**

Appendix 3. Area burnt within each fire severity class, by Broad Vegetation Group, within QPWS estate.

Broad Vegetation Groups (BVGs) as described by Neldner *et al.* (2019b), derived from Regional Ecosystem mapping (using RE1). All areas are in hectares. Estate refers to the QPWS estate(s) affected by the fire event (see Table 2).

Column headings are: BVG 5M & BVG 2M – BVG number and short description at the 1:5 000 000 and 1:2 000 000 scales; Estate – area of BVG 2M within QPWS estate, Burnt – area of BVG 2M burnt on QPWS estate, Percentage – the percentage of BVG 2M within QPWS burnt, Low, Moderate, High, Extreme – area of RE1 burnt at each fire severity class (see **Section 4**).

BVG5M	BVG2M	Estate	Burnt	Percent	Low	Mod	High	Extreme
1. Rainforests, scrubs.	3. Notophyll vine forest/ thicket (sometimes with sclerophyll and/or Araucarian emergents) on coastal dunes and sandmasses	2,438	0.3	0.01%	0.3			
	4. Notophyll and mesophyll vine forest with feather or fan palms on alluvia, along streamlines and in swamps on ranges or within coastal sandmasses	3,750	43.0	1.15%	38.0	4.2	0.7	0.0
	5. Notophyll to microphyll vine forests, frequently with Araucaria spp. or Agathis spp. (kauri pines)	103	11.6	11.35%	9.6	0.9	1.0	0.1
2. Wet eucalypt open forests.	8. Wet eucalypt tall open forest on uplands and alluvia	30,545	2,611.3	8.55%	1,448.6	638.7	371.1	152.8
3. Eastern eucalypt woodlands to open forests.	9. Moist to dry eucalypt open forests to woodlands usually on coastal lowlands and ranges	74,139	5,566.1	7.51%	1,624.4	1,548.6	1,529.5	863.7
	12. Dry eucalypt woodlands to open woodlands, mostly on shallow soils in hilly terrain (mainly on sandstone and weathered rocks)	84	8.4	9.98%	0.9	3.3	3.8	0.5
4. Eucalypt open forests to woodlands on floodplains	16. Eucalyptus spp. dominated open forest and woodlands drainage lines and alluvial plains	200	20.9	10.48%	9.3	6.8	4.5	0.3
8. Melaleuca open woodlands on depositional plains	22. Melaleuca spp. on seasonally inundated open forests and woodlands of lowland coastal swamps and fringing lines. (palustrine wetlands)	12,350	2,654.3	21.49%	354.4	639.9	951.1	708.9
12. Other coastal communities or heaths	28. Open forests to open woodlands in coastal locations. Dominant species such as Casuarina spp., Corymbia spp., Allocasuarina spp., Acacia spp.,	20,873	603.2	2.89%	244.5	167.9	113.0	77.8

BVG5M	BVG2M	Estate	Burnt	Percent	Low	Mod	High	Extreme
	Lophostemon suaveolens, Asteromyrtus spp., Neofabricia myrtifolia							
	29. Heathlands and associated scrubs and shrublands on coastal dunefields and inland rocky substrates	64,635	3,415.8	5.28%	144.8	321.4	789.0	2,160.7
15. Wetlands (Swamps and Lakes)	34. Wetlands. Swamps (wooded or otherwise) and lakes (permanent or ephemeral), claypans. Includes fringing woodlands and shrublands	12,410	212.0	1.71%	49.2	62.5	55.6	44.7
16. Mangrove and Saltmarshes	35. Mangroves and saltmarshes	3,357	7.8	0.23%	5.8	1.6	0.5	
	Estuary	371	19.5	5.25%	5.0	7.8	6.1	0.6
	Non-remnant vegetation	1,312	3.4	0.26%	1.6	1.0	0.6	0.2

Appendix 4. Conservation significant terrestrial and freshwater fauna and flora species of the area.

Column headings: **NCA** (*Nature Conservation Act* 1992) and **EPBC** (*Environment Protection and Biodiversity Conservation Act* 1999) statuses are: EX = extinct, E = endangered, V = vulnerable, NT = near threatened, LC = least concern, SL = special least concern.

Habitat type – FD = foredune complex, **WH** = wet heath (closed), **DH** = dry heath (open) **SwG** = Swamp – grass, herb, sedge, **SwT** = swamp - treed (Melaleuca woodland), **Rf** = rainforests, **Euc** = Eucalypt forest to woodlands.

			Status		Habitat Type						
Group	**Scientific name**	**Common name**	**NCA**	**EPBC**	**FD**	**WH**	**DH**	**SwG**	**SwT**	**Rf**	**Euc**
amphibians	*Litoria cooloolensis*	Cooloola sedgefrog	NT			X		X	X		
amphibians	*Litoria freycineti*	wallum rocketfrog	V			X		X	X		
amphibians	*Litoria olongburensis*	wallum sedgefrog	V	V		X		X	X		
amphibians	*Adelotus brevis*	tusked frog	V					X		X	X
amphibians	*Crinia tinnula*	wallum froglet	V			X	X	X	X		
birds	*Rhipidura rufifrons*	rufous fantail	SL							X	X
birds	*Symposiachrus trivirgatus*	spectacled monarch	SL							X	X
birds	*Calyptorhynchus lathami lathami*	glossy black cockatoo (eastern)	V		X		X				X
birds	*Stipiturus malachurus*	southern emu-wren	V			X	X	X			
birds	*Pandion cristatus*	eastern osprey	SL		X						X
birds	*Podargus ocellatus plumiferus*	plumed frogmouth	V							X	X
birds	*Pezoporus wallicus wallicus*	ground parrot	V			X		X			
birds	*Ninox strenua*	powerful owl	V							X	X
birds	*Turnix melanogaster*	black-breasted button-quail	V	V						X	
insects	*Ornithoptera richmondia*	Richmond birdwing	V							X	
malacostracans	*Tenuibranchiurus glypticus*	swamp crayfish	E			X		X	X		
mammals	*Xeromys myoides*	water mouse	V	V		X		X			
mammals	*Phascolarctos cinereus*	koala	V	V					X		X
mammals	*Petauroides volans volans*	southern greater glider	V	V							X
mammals	*Pteropus poliocephalus*	Grey-headed flying fox	LC	V					X		X
mammals	*Tachyglossus aculeatus*	Short-beaked echidna	SL							X	X

			Status		Habitat Type						
Group	**Scientific name**	**Common name**	**NCA**	**EPBC**	**FD**	**WH**	**DH**	**SwG**	**SwT**	**Rf**	**Euc**
ray-finned fishes	*Nannoperca oxleyana*	Oxleyan pygmy perch	V	E		X		X			
ray-finned fishes	*Pseudomugil mellis*	honey blue eye	V	V		X		X			
reptiles	*Acanthophis antarcticus*	common death adder	V				X			X	X
reptiles	*Anilios silvia*	Cooloola blind snake	NT							X	

			Status		Habitat Type						
Group	**Scientific name**	**Common name**	**NCA**	**EPBC**	**FD**	**WH**	**DH**	**SwG**	**SwT**	**Rf**	**Euc**
Apocynaceae	*Marsdenia coronata*	slender milkvine	V							X	X
Aristolochiaceae	*Pararistolochia praevenosa*	Richmond birdwing vine	NT							X	
Bignoniaceae	*Tecomanthe hillii*	Fraser Island creeper	NT							X	
Blandfordiaceae	*Blandfordia grandiflora*	Christmas bells	E			X		X			
Campanulaceae	*Lobelia membranacea*		NT			X	X		X		
Casuarinaceae	*Allocasuarina emuina*	Mt. Emu she-oak	E	E		X	X				
Cyperaceae	*Eleocharis difformis*		E			X		X			
Fabaceae	*Glycine argyrea*		NT							X	X
Lamiaceae	*Prostanthera spathulata*		V	V							X
Lauraceae	*Cryptocarya foetida*	stinking cryptocarya	V	V						X	
Laxmanniaceae	*Romnalda strobilacea*		V	V						X	
Macarthuriaceae	*Macarthuria complanata*		NT				X				
Mimosaceae	*Acacia attenuata*	whipstick wattle	V	V		X			X		X
Mimosaceae	*Acacia baueri subsp. baueri*	tiny wattle	V			X	X		X		
Mimosaceae	*Archidendron lovelliae*	bacon wood	V	V						X	
Myrtaceae	*Eucalyptus conglomerata*	swamp stringybark	E	E			X		X		X
Myrtaceae	*Melaleuca cheelii*		NT						X		
Myrtaceae	*Rhodomyrtus psidioides*	native guava	E							X	
Myrtaceae	*Xanthostemon oppositifolius*	southern penda	V	V						X	

			Status		Habitat Type						
Group	**Scientific name**	**Common name**	**NCA**	**EPBC**	**FD**	**WH**	**DH**	**SwG**	**SwT**	**Rf**	**Euc**
Orchidaceae	*Diteilis simmondsii*		NT							X	
Orchidaceae	*Phaius australis*	lesser swamp orchid	E	E		X		X	X		
Orchidaceae	*Prasophyllum wallum*	wallum leek orchid	V	V	X		X		X		
Proteaceae	*Banksia conferta*		V							X	
Rhamnaceae	*Pomaderris crassifolia*		V				X				
Rubiaceae	*Durringtonia paludosa*	durringtonia	NT			X					
Rutaceae	*Acronychia littoralis*	scented acronychia	E	E						X	
Rutaceae	*Boronia keysii*	Key's boronia	V	V							X
Rutaceae	*Boronia rivularis*	Wide Bay boronia	NT			X		X	X		
Symplocaceae	*Symplocos harroldii*	hairy hazelwood	NT							X	
Zamiaceae	*Macrozamia pauli-guilielmi*	pineapple zamia	E	E		X	X				

Appendix 5. Modelled potential habitat for selected conservation significant species within the burnt area.

The Queensland Herbarium's potential habitat models were created using Maxent (v 3.4.1) (Phillips *et al.* 2006), a proven species distribution modelling tool well suited to the development of models based on records of species presence (Elith & Leathwick 2009). The models utilise vetted records of fauna species occurrence compiled for the purpose of Biodiversity Assessments by the Queensland Department of Environment and Science and additional records held in WildNet. Flora records were compiled from the Queensland Herbarium's Herbrecs specimen database. All records had location precision of better than +/- 2000m, and all fauna records had a collection date post-1975. Records were screened for taxonomic and georeferencing accuracy. As records of species occurrence are heavily biased toward accessible parts of the landscape, a mask of Queensland's road network was used to down-weight species records collected along roads to have half the value of records collected away from roads. Models were constrained within an occurrence mask for each species, defined by a buffer of 200km around a convex hull encompassing all records of that species. These masks are used in Maxent to restrict the selection of background points (pseudo-absences) to the region of species presence and have important implications for model performance (Van Der Waal *et al.* 2007).

Models were based on seven environmental variables:
1. Annual mean temperature;
2. Temperature seasonality (coefficient of variation);
3. Annual precipitation;
4. Mean moisture index of the lowest quarter moisture index;
5. Broad vegetation group (BVG 1:1M);
6. Land zone; and
7. Terrain ruggedness index (after Riley *et al.* 1999)

The four climate variables were modelled from Australian monthly mean climate values nominally centred on 1990 (1976-2005) using Anuclim Version 6.1 software (Xu and Hutchinson 2011) applied to a SRTM-derived 3 Second Digital Elevation Model (DEM) (Geoscience Australia 2019). A terrain ruggedness index was also derived from the DEM using the methodology of Riley *et al.* (1999) and indicates the change in elevation between adjacent cells across Queensland. The two categorical variables, land zone and pre-clearing broad vegetation group, were derived from the pre-clearing Regional Ecosystem mapping. Land zone provides a high-level classification of substrate and geomorphology into twelve groups ranging from marine sediments through to ancient igneous substrates (Neldner *et al*. 2020) and broad vegetation group is a high-level classification of vegetation composition at the 1:1M scale (Neldner *et al.* 2019).

Model performance was assessed by comparing the area under the ROC curve (AUC) with the 95th percentile AUC from 1000 null models for each species created by randomly selecting locations from under the species' mask (Raes and ter Steege 2007). Maxent produces a grid of continuous values, analogous to probabilities of habitat suitability, ranging from zero to one. We applied a 50% threshold to each model in order to convert this grid output into a binary prediction of high probability potential habitat. The use of conservative thresholds increases the risk of omission but reduces commission error. Any location records that were excluded as a result of this threshold were added back into the output following the application of a 1km radius buffer. The resulting output was clipped to the species' mask and simplified using a majority filter algorithm to remove outlying 'orphan' cells in the model output.

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Table 12: Modelled potential habitat impacted - Flora

Species	Common name	NCA status	Total Qld habitat	Habitat in study area	Total habitat burnt	% study area habitat burnt
Boronia keysii	Key's boronia	V	11,625	4,834	2084	43.1
Archidendron lovelliae	bacon wood	V	43,073	23,104	3557	15.4
Blandfordia grandiflora	Christmas bells	E	59,330	16,121	3505	21.7
Cryptocarya foetida	stinking cryptocarya	V	46,704	11,488	2523	22.0
Acacia baueri subsp *baueri*	tiny wattle	V	99,577	55,171	4745	8.6
Acacia attenuata		V	167,103	31,950	7193	22.5
Eucalyptus conglomerata	swamp stringybark	E	34,088	3,832	1453	37.9
Zieria exsul		E	34,005	3,355	1115	33.2
Phaius australis		E	380,295	117,563	10854	9.2
Allocasuarina emuina	Mt. Emu she-oak	E	15,434	1,722	437	25.4
Thelypteris confluens		V	57,954	16,637	1573	9.5
Leptospermum oreophilum		V	15,809	505	353	70.0
Diploglottis campbellii	small-leaved tamarind	E	200,536	6,984	2214	31.7
Macrozamia pauli-guilielmi		E	190,975	32,657	1665	5.1
Leptospermum luehmannii		V	3,565	74	17	22.4
Rhodomyrtus psidioides	native guava	E	294,703	3,562	1196	33.6

Species	Common name	NCA status	Total Qld habitat	Habitat in study area	Total habitat burnt	% study area habitat burnt
Planchonella eerwah		E	229,834	5,778	915	15.8
Banksia conferta		V	3,152	45	9	21.0
Coleus nitidus		E	118,005	2,542	319	12.5
Lenwebbia sp Blackall Range		E	23,302	314	54	17.2
Xanthostemon oppositifolius	southern penda	V	65,980	1,742	146	8.4
Gonocarpus effusus		V	8,456	75	17	22.1
Myrsine serpenticola		E	1,077,368	31,498	1672	5.3
Cupaniopsis shirleyana	wedge-leaf tuckeroo	V	600,543	10,174	525	5.2
Floydia praealta	ball nut	V	319,846	14,081	263	1.9
Endiandra hayesii	rusty rose walnut	V	21,433	54	17	31.0
Syzygium hodgkinsoniae	red lilly pilly	V	63,911	3,255	41	1.3
Marsdenia coronata	slender milkvine	V	321,605	408	133	32.5
Corynocarpus rupestris subsp *arborescens*	southern corynocarpus	V	396,187	6,156	120	2.0
Mallotus megadontus		V	64,651	89	8	9.2
Ricinocarpos speciosus		V	187,298	83	20	23.7
Samadera bidwillii		V	625,134	19,276	62	0.3
Jasminum jenniae		E	77,817	3,047	7	0.2
Baloghia marmorata	jointed baloghia	V	27,772	61	2	2.6
Pomaderris crassifolia		V	121,170	31	5	17.5
Macadamia integrifolia	macadamia nut	V	142,935	370	6	1.7
Rhodamnia rubescens		E	290,240	99	9	9.0
Parsonsia larcomensis		V	54,455	93	1	0.7
Arthraxon hispidus		V	1,094,540	604	8	1.3
Cupaniopsis tomentella	Boonah tuckeroo	V	64,709	74	0	0.3
Thesium australe	toadflax	V	1,105,581	951	1	0.1

Table 13: Modelled potential habitat - Fauna

Species	Common name	Fauna group	NCA status	Total Qld habitat	Total study area habitat	Total habitat burnt	% study area habitat burnt
Stipiturus malachurus	southern emu-wren	Birds	V	31,182	16,169	3,375	20.9
Pezoporus wallicus wallicus	ground parrot	Birds	V	56,693	33,445	4,359	13.0
Litoria olongburensis	wallum sedgefrog	Frogs	V	138,919	42,017	8,277	19.7
Litoria freycineti	wallum rocketfrog	Frogs	V	116,901	34,799	6,846	19.7
Crinia tinnula	wallum froglet	Frogs	V	270,543	84,460	13,200	15.6
Xeromys myoides	water mouse	Mammals	V	133,086	14,286	2,974	20.8
Calidris ferruginea	curlew sandpiper	Birds	E	1,295,692	132,425	10,106	7.6
Esacus magnirostris	beach stone-curlew	Birds	V	698,461	92,157	4,856	5.3
Limosa lapponica baueri	Western Alaskan bar-tailed godwit	Birds	V	881,036	132,355	5,862	4.4
Cyclopsitta diophthalma coxeni	Coxen's fig-parrot	Birds	E	173,270	4,047	1,103	27.3
Botaurus poiciloptilus	Australasian bittern	Birds	E	840,577	44,025	4,921	11.2
Numenius madagascariensis	eastern curlew	Birds	E	1,042,349	129,139	6,067	4.7
Turnix melanogaster	black-breasted button-quail	Birds	V	1,013,079	74,152	5,043	6.8
Charadrius leschenaultii	greater sand plover	Birds	V	806,691	105,802	3,783	3.6
Charadrius mongolus	lesser sand plover	Birds	E	888,751	102,420	4,111	4.0
Calidris tenuirostris	great knot	Birds	E	775,486	96,534	3,060	3.2
Acanthophis antarcticus	common death adder	Reptiles	V	3,452,148	211,105	12,796	6.1
Calidris canutus	red knot	Birds	E	689,178	100,224	2,455	2.5
Anthochaera phrygia	regent honeyeater	Birds	E	398,685	4,721	1,278	27.1
Ninox strenua	powerful owl	Birds	V	2,239,060	60,032	5,864	9.8
Phascolarctos cinereus	koala	Mammals	V	4,372,008	62,485	10,165	16.3
Podargus ocellatus plumiferus	plumed frogmouth	Birds	V	180,202	1,974	418	21.2
Calyptorhynchus lathami	glossy black-cockatoo	Birds	V	527,111	19,288	1,179	6.1
Ardenna pacifica	wedge-tailed shearwater	Birds	V	5,459	917	11	1.2
Lathamus discolor	swift parrot	Birds	E	970,350	11,453	1,858	16.2
Rostratula australis	Australian painted snipe	Birds	E	4,438,067	104,381	8,126	7.8

Species	Common name	Fauna group	NCA status	Total Qld habitat	Total study area habitat	Total habitat burnt	% study area habitat burnt
Petauroides volans	greater glider	Mammals	V	4,275,994	26,400	4,864	18.4
Potorous tridactylus tridactylus	long-nosed potoroo	Mammals	V	190,173	1,768	214	12.1
Acrodipsas illidgei	Illidge's ant-blue	Invertebrates	V	70,551	4,384	51	1.2
Chalinolobus dwyeri	large-eared pied bat	Mammals	V	1,060,419	2,158	33	1.5
Adelotus brevis	tusked frog	Frogs	V	985,730	453	20	4.4
Grantiella picta	painted honeyeater	Birds	V	9,111,521	9,922	103	1.0
Ornithoptera richmondia	Richmond birdwing	Invertebrates	V	236,182	341	2	0.7
Geophaps scripta scripta	squatter pigeon (southern subspecies)	Birds	V	9,761,274	968	14	1.5

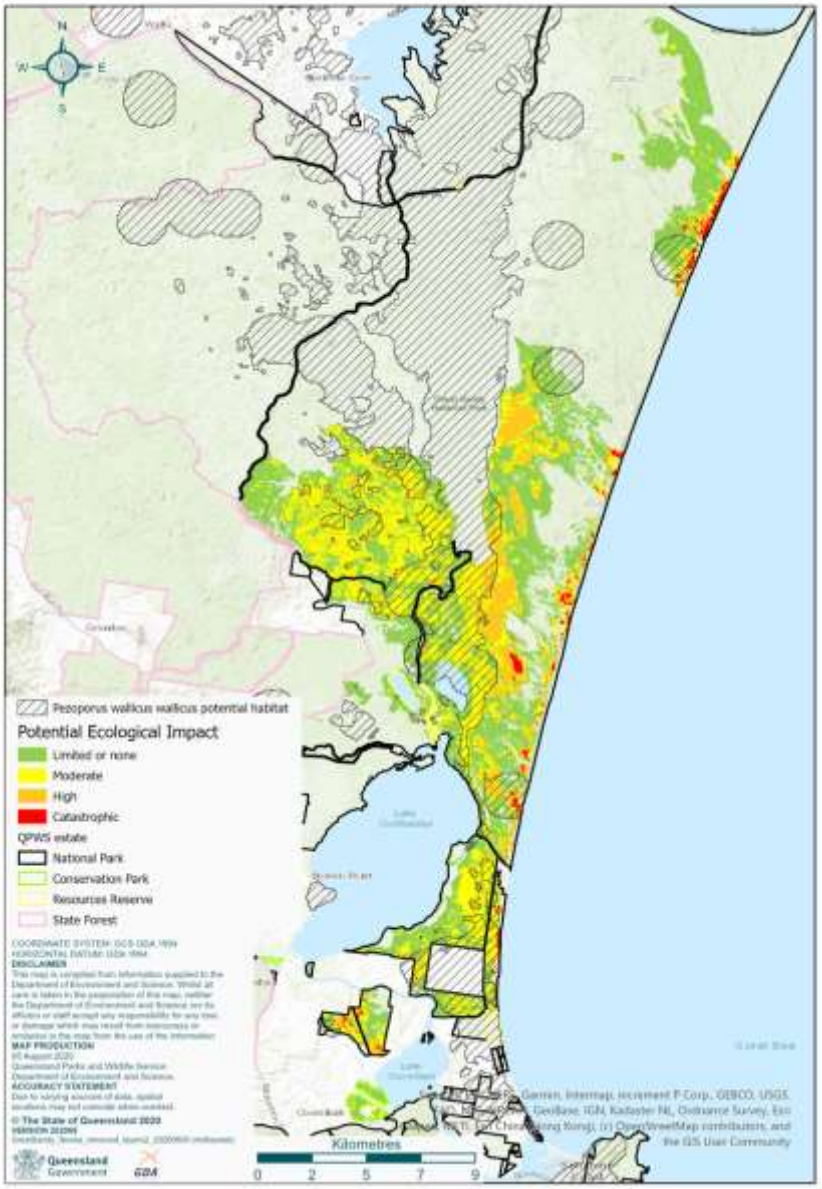

Figure 13: <u>Pezoporus wallicus wallicus</u> potential habitat – Great Sandy NP

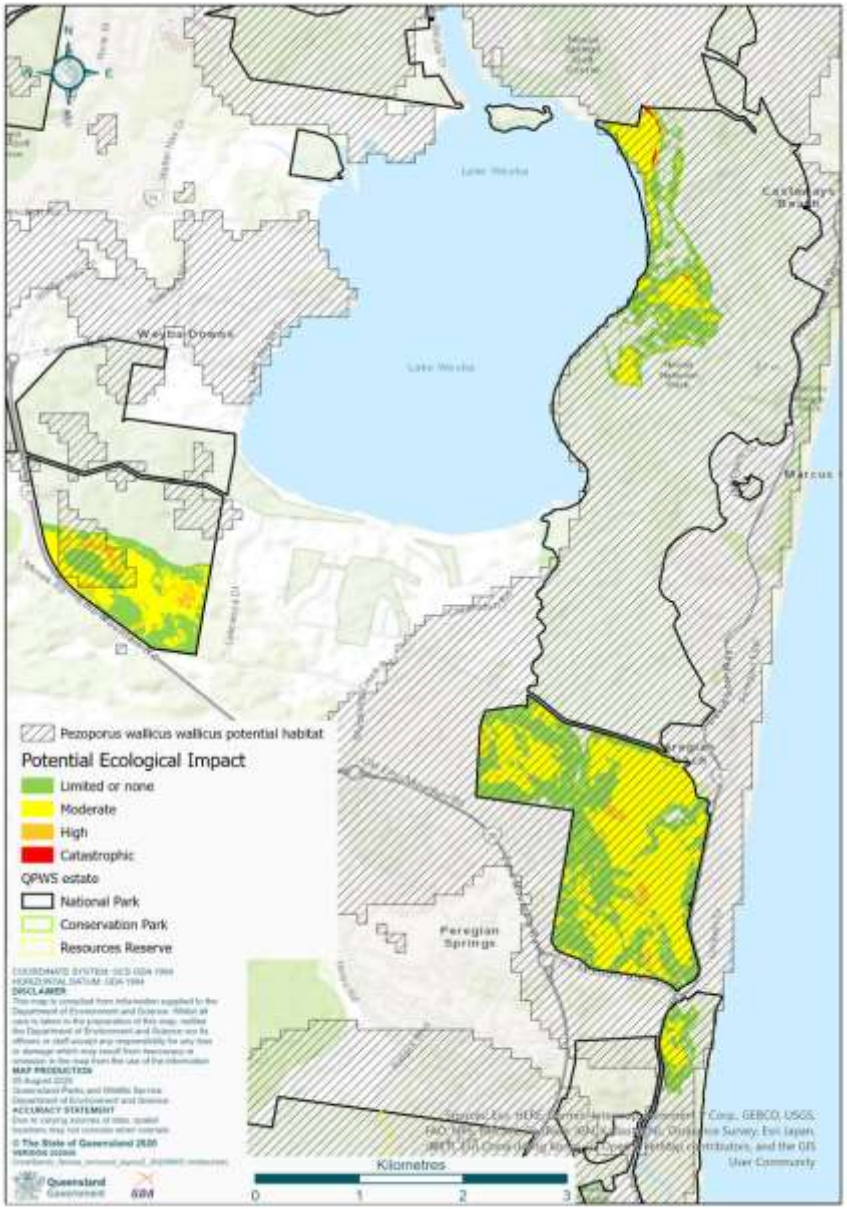

Figure 14: <u>Pezoporus wallicus wallicus</u> potential habitat – Noosa NP

Figures 15 and 16 are not for public release as they include detailed distributional information for a species deemed confidential by the Department.	
Figure 15: Stipiturus malachurus potential habitat – Great Sandy NP	*Figure 16: Stipiturus malachurus potential habitat – Noosa NP*

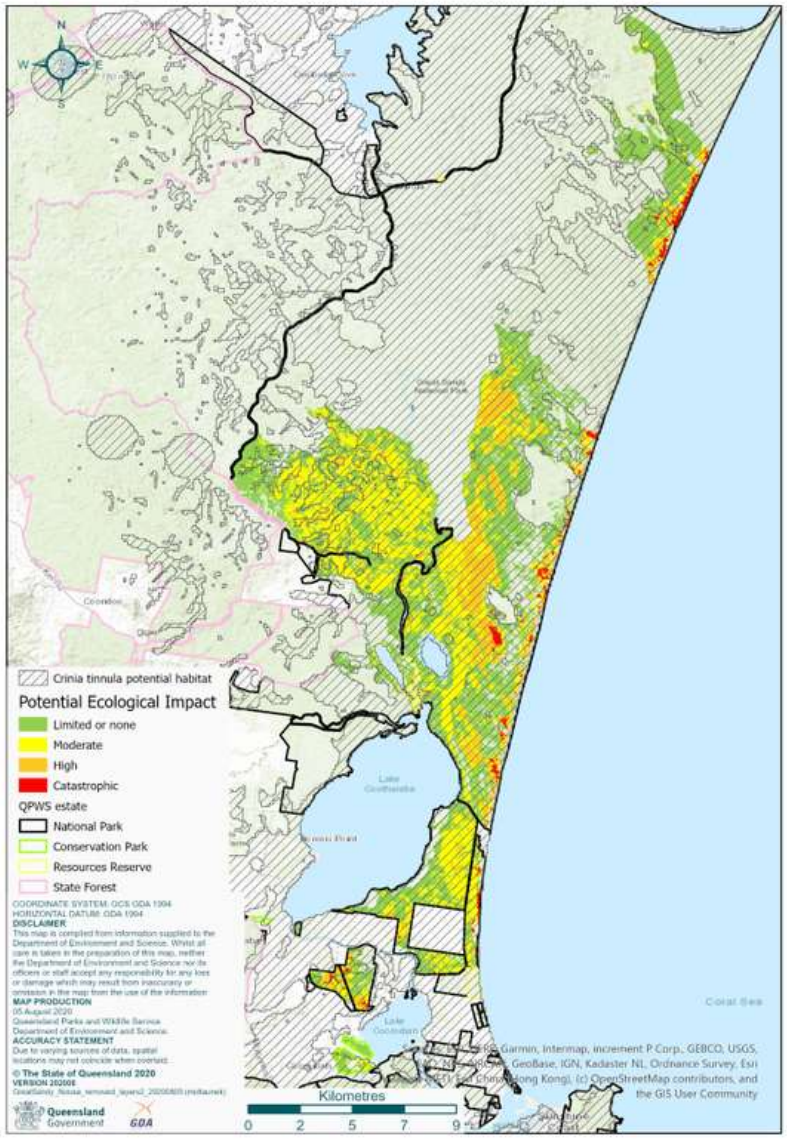

Figure 17: *Crinia tinnula potential habitat – Great Sandy NP*

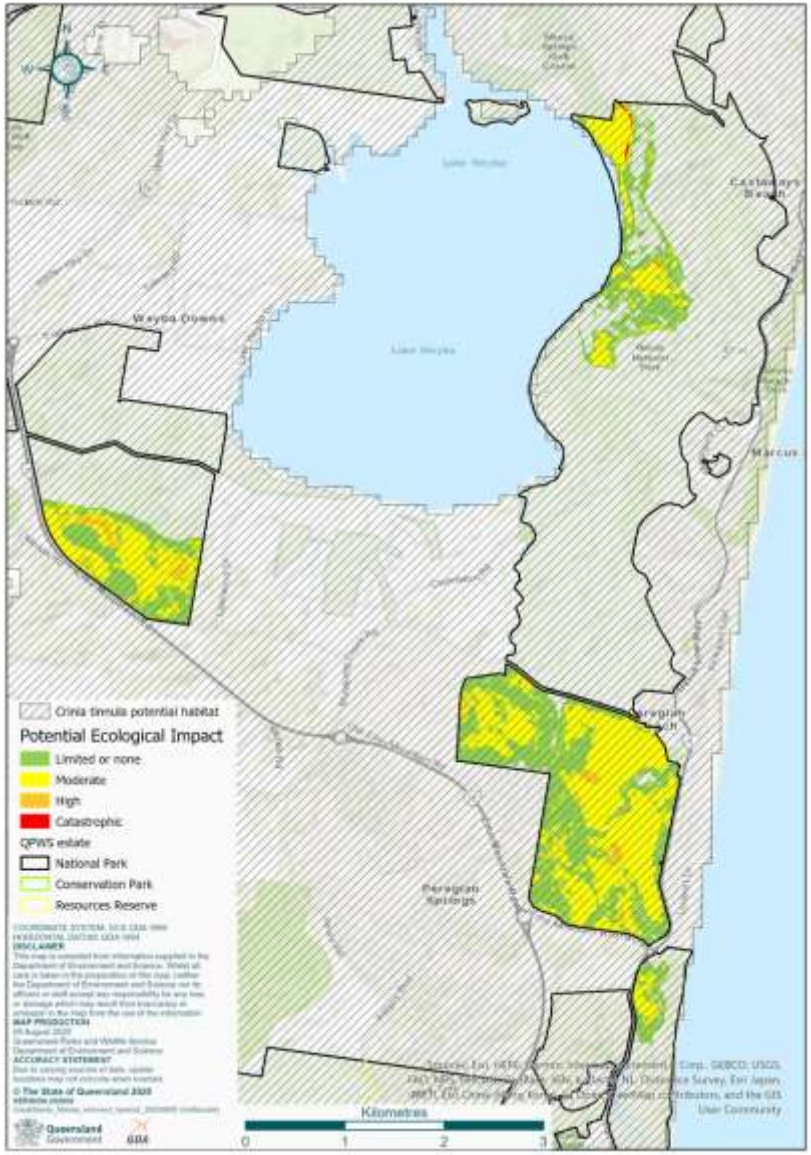

Figure 18: Crinia tinnula potential habitat – Noosa NP

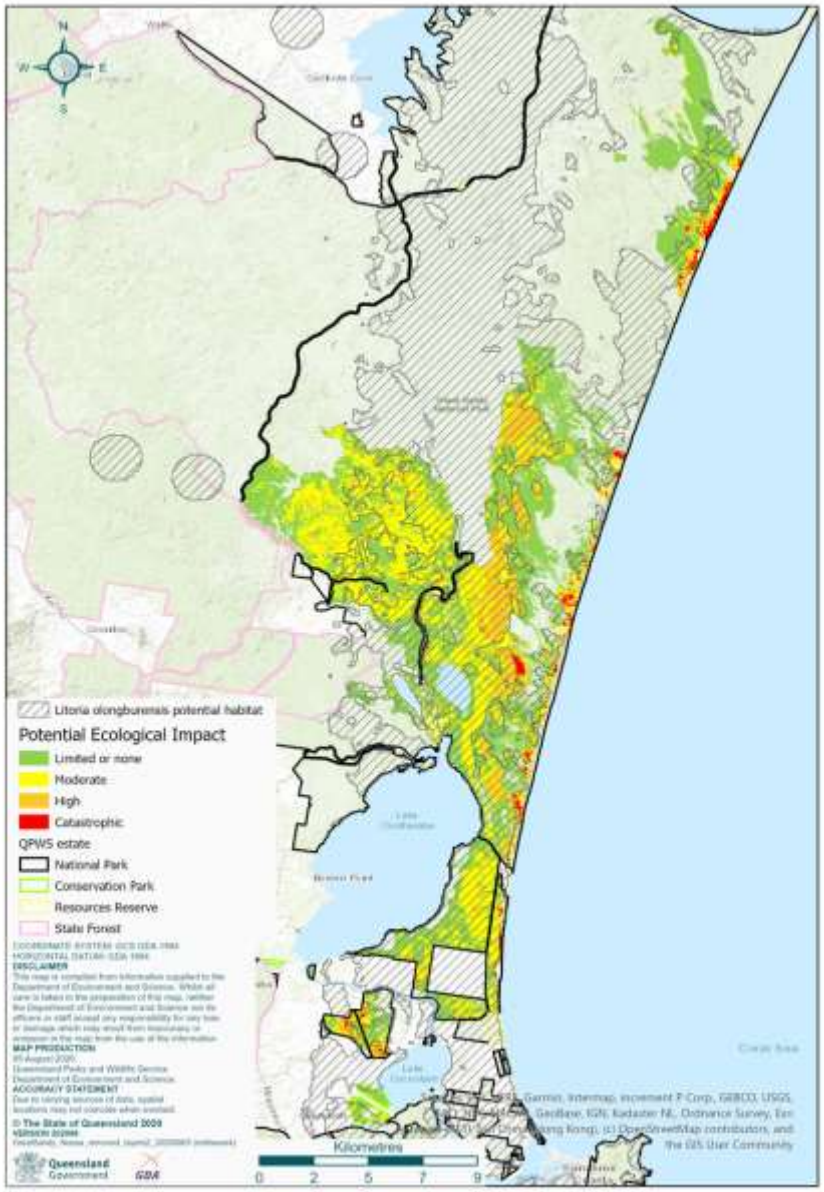

Figure 19: Litoria olongburensis potential habitat – Great Sandy NP

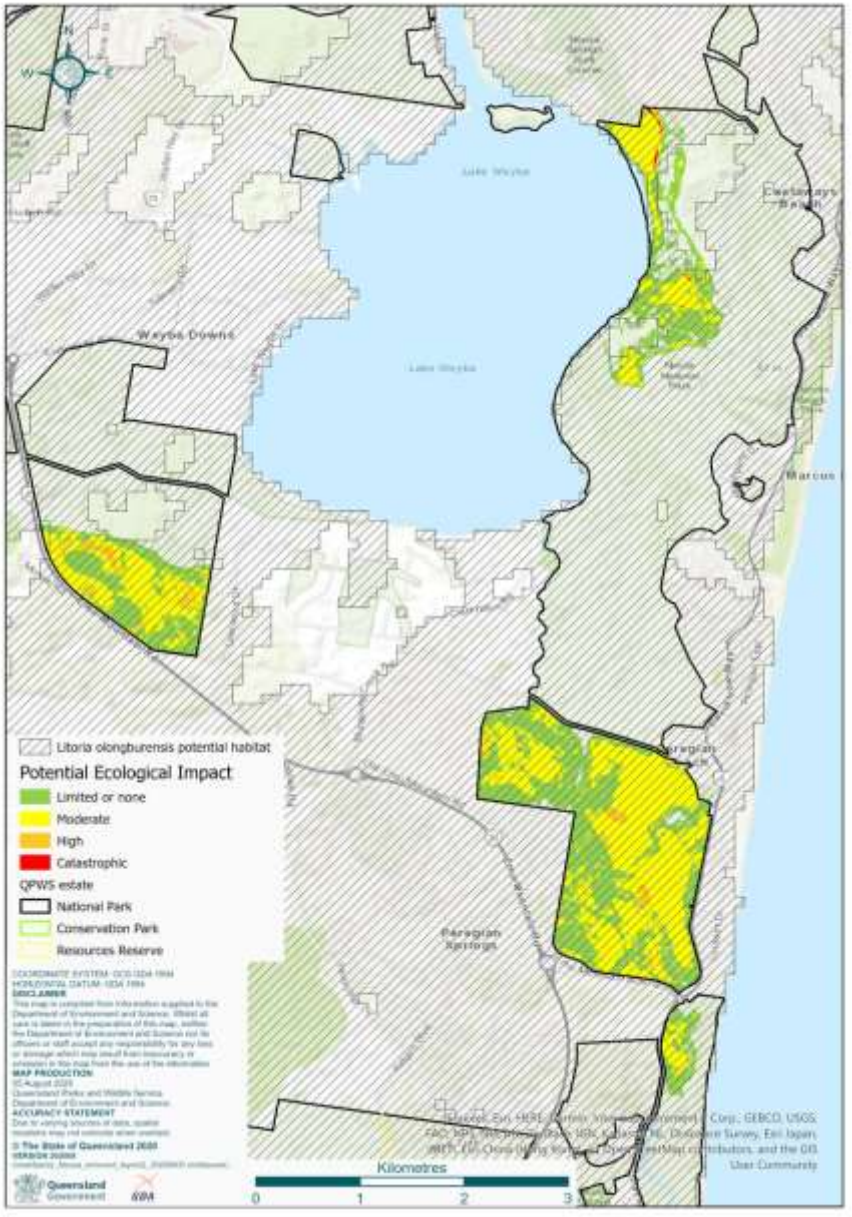

Figure 20: Litoria olongburensis potential habitat – Noosa NP

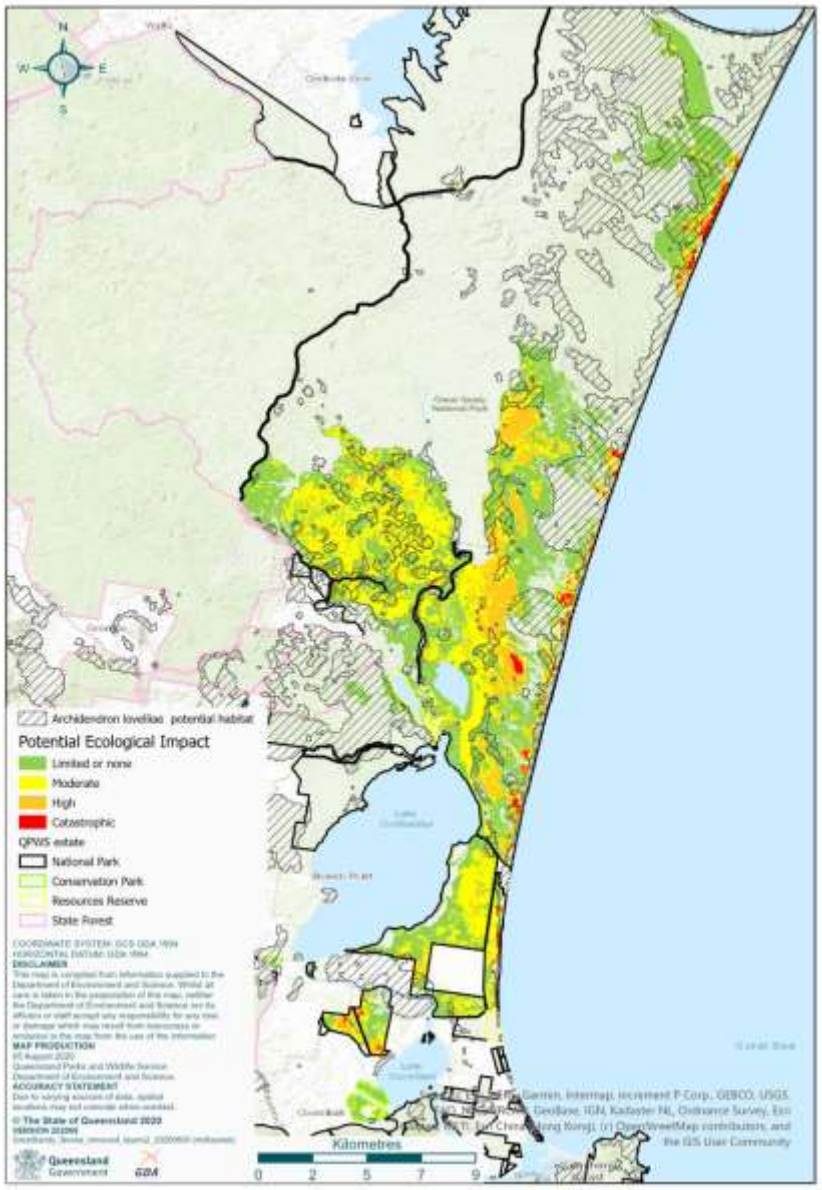

Figure 21: Archidendron lovelliae potential habitat – Great Sandy NP

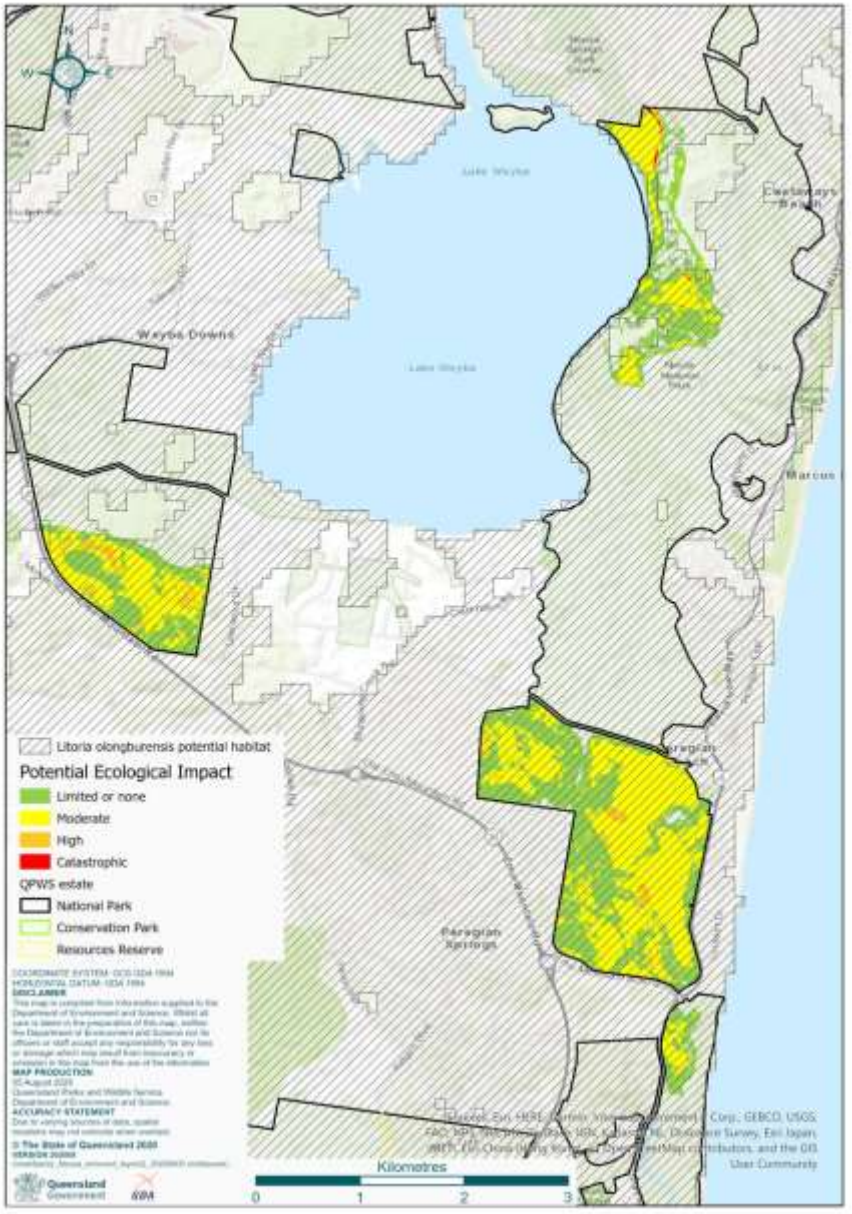

Figure 22: Archidendron lovelliae potential habitat – Noosa NP

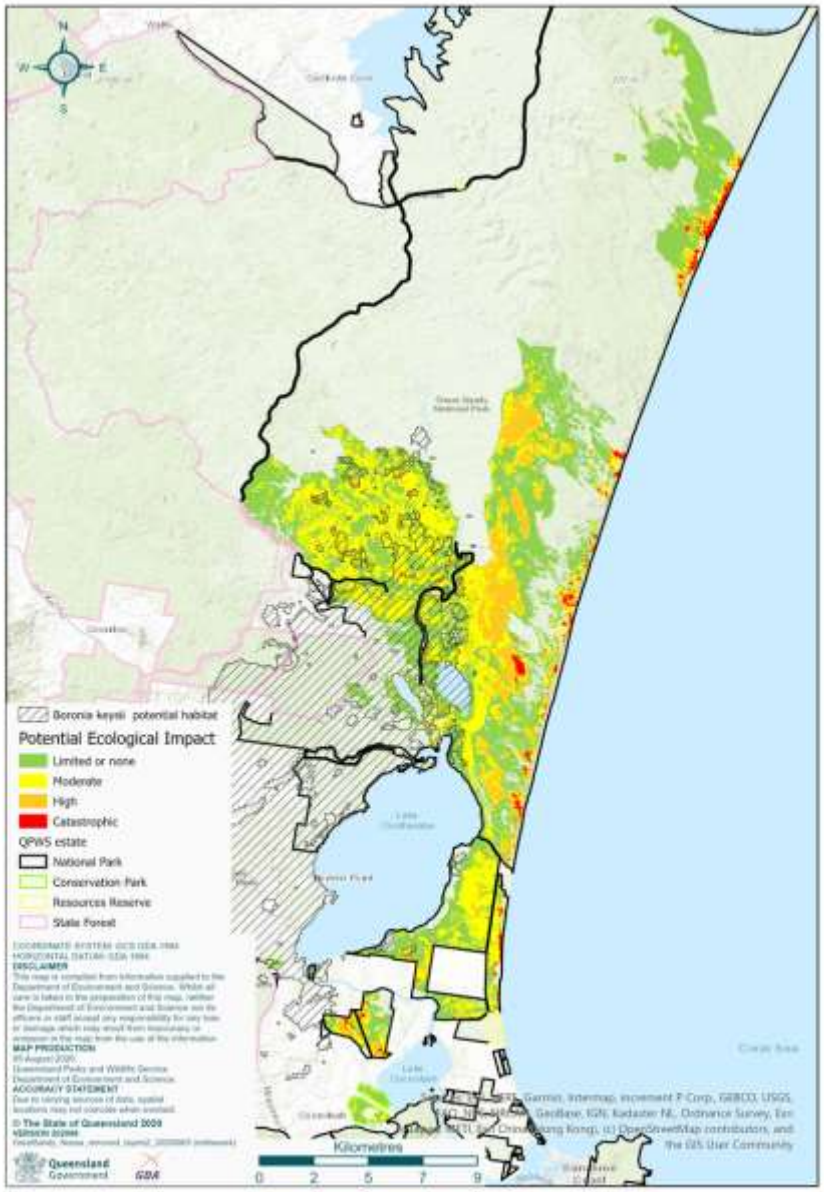

Figure 23: <u>Boronia keysii</u> potential habitat – Great Sandy NP

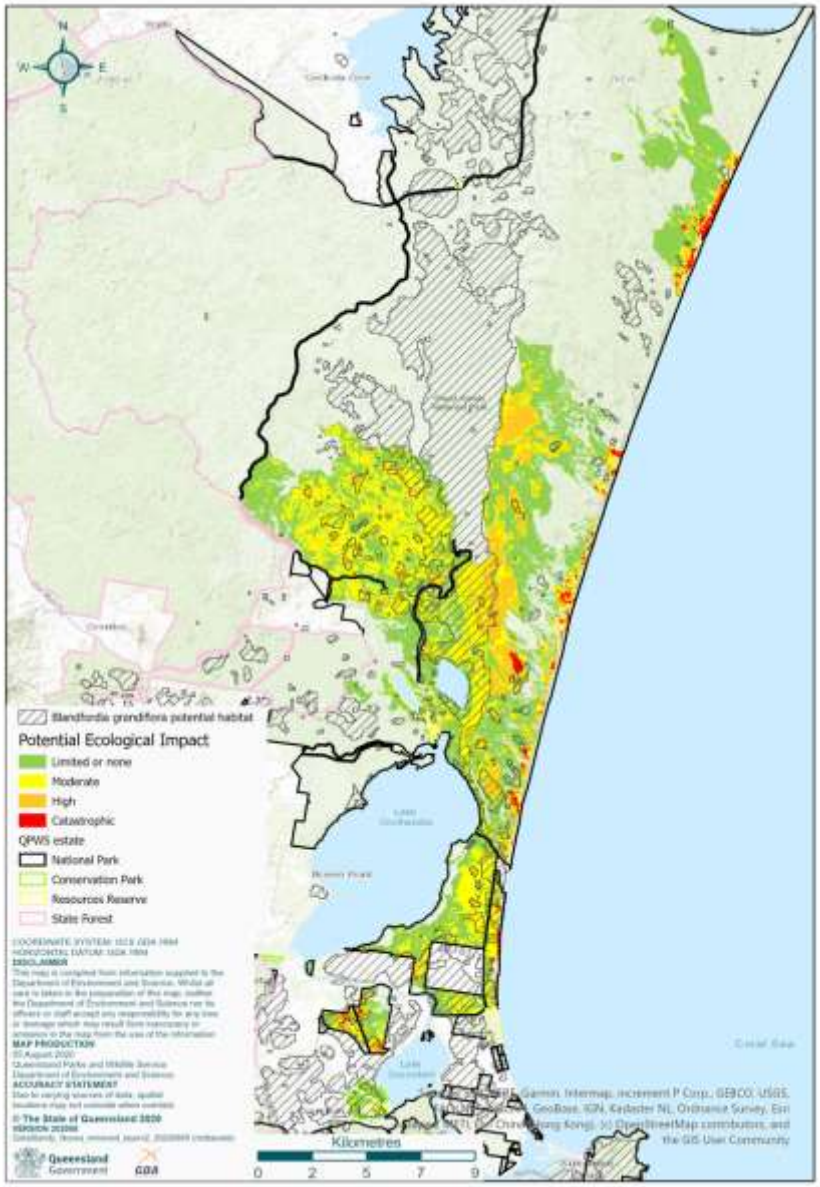

Figure 24: Blandfordia grandiflora potential habitat – Great Sandy NP

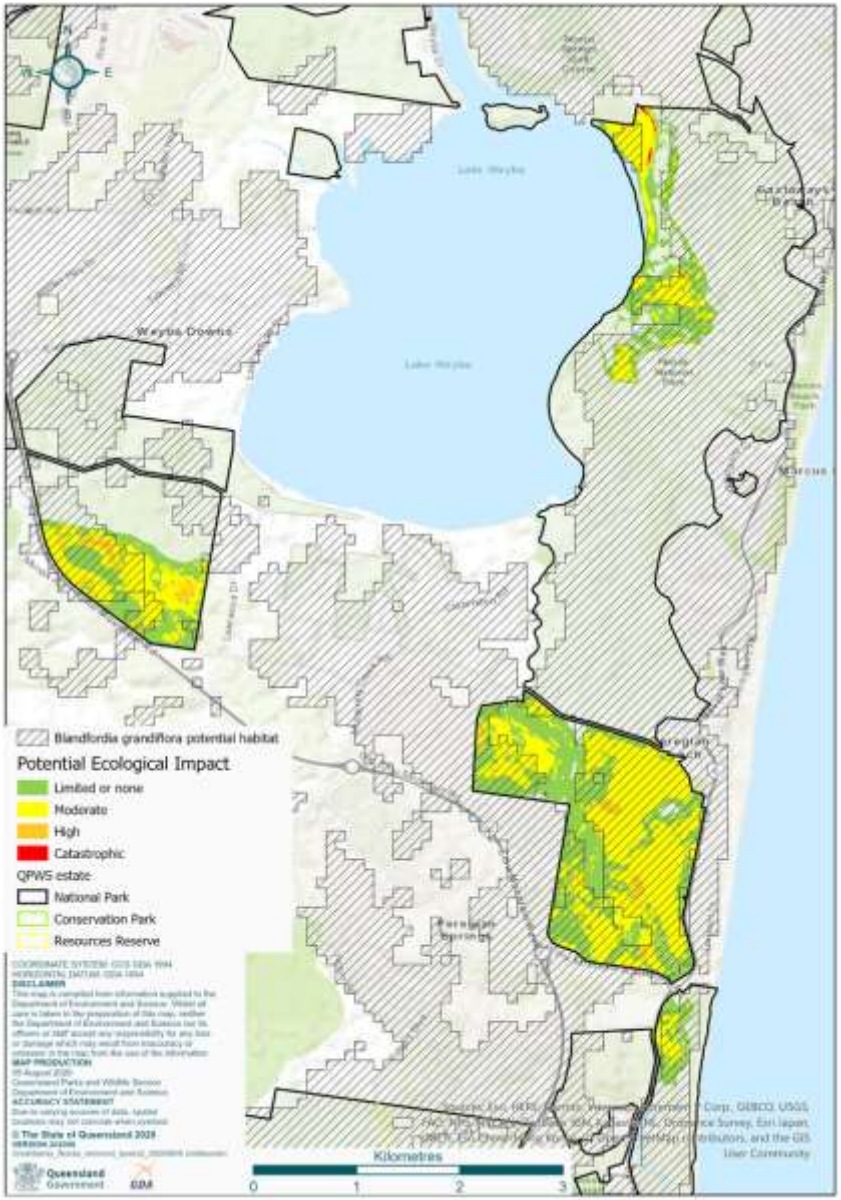

Figure 25: Blandfordia grandiflora potential habitat – Noosa NP

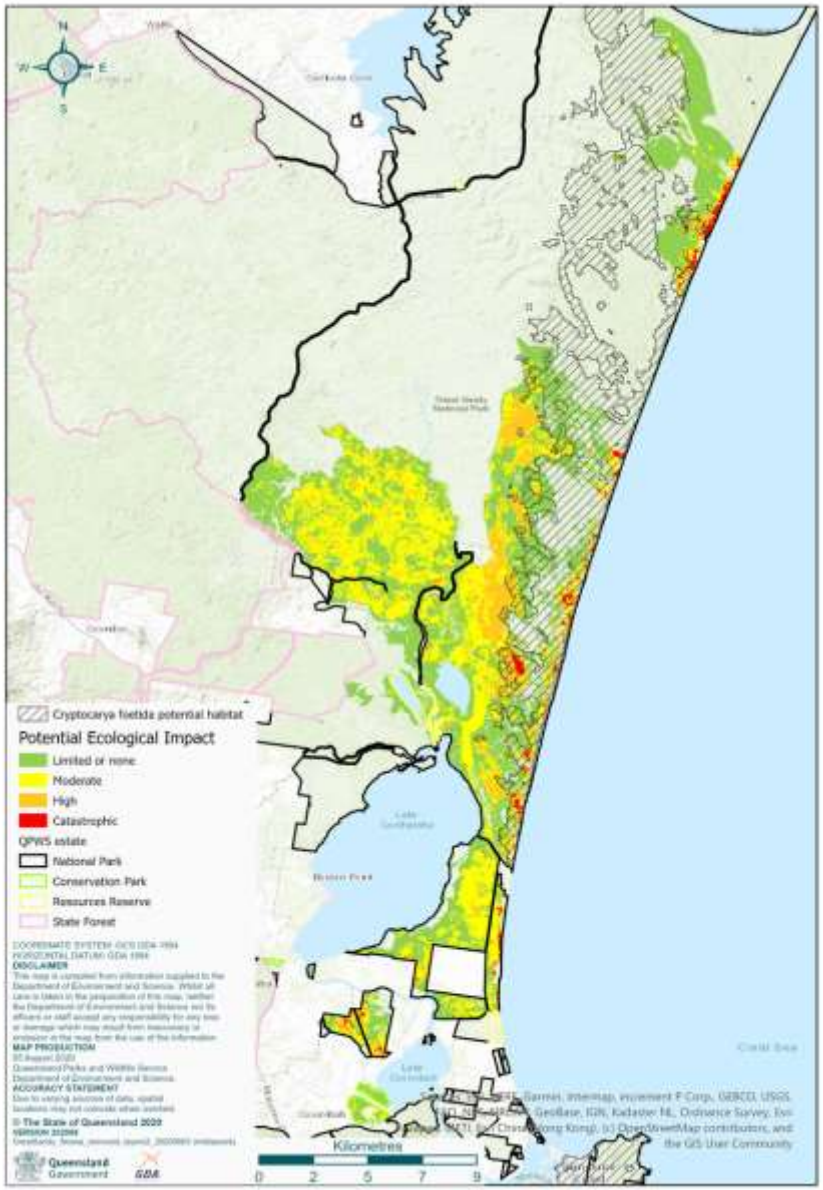

Figure 26: Cryptocarya foetida potential habitat – Great Sandy NP

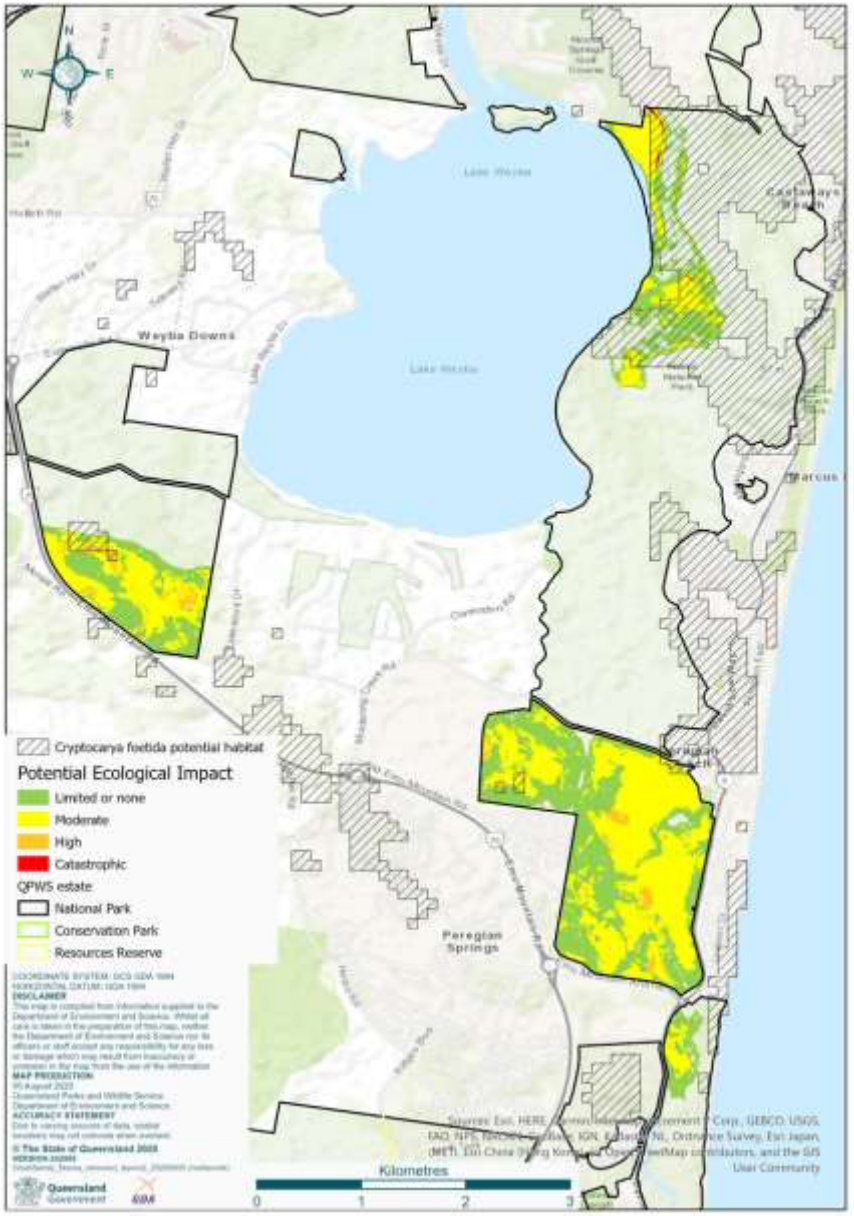

Figure 27: Cryptocarya foetida potential habitat – Noosa NP

Appendix 6. Significant pest plants and animals likely to affect recovery of burnt habitat or impact significant species.

More pest species have been recorded in the burnt estates than those listed below. Only those that are currently known to occur on the estates and have the potential to significantly impact on recovering ecosystems or threatened species, and/or impact on their future protection have been included here.

	Group	Common name	Scientific name
Animals	amphibians	cane toad	*Rhinella marina*
	mammals	pig	*Sus scrofa*
	mammals	dog	*Canis familiaris*
	mammals	fox	*Vulpes vulpes*
Plants	Anacardiaceae	broadleaved pepper	*Schinus terebinthifolius*
	Poaceae	whiskey grass	*Andropogon virginicus*
	Ochnaceae	Mickey Mouse plant	*Ochna serrulata*
	Fabaceae	siratro	*Macroptilium atropurpureum*
	Asparagaceae	climbing asparagus fern	*Asparagus africanus*
	Asparagaceae	basket asparagus fern	*Asparagus plumosus*
	Asteraceae	groundsel	*Baccharis halimifolia*
	Asteraceae	bitou bush	*Chrysanthemoides monilifera* subsp. *rotundata*
	Basellaceae	madeira vine	*Anredera cordifolia*
	Caesalpiniaceae	Easter cassia	*Senna pendula*
	Lauraceae	camphor laurel	*Cinnamomum camphora*
	Ulmaceae	Chinese celtis	*Celtis sinensis*
	Poaceae	green panic and Guinea grass	*Megathyrsus maximus*
	Poaceae	rats tail grasses	*Sporobolus* spp. (exotic species only)
	Poaceae	molasses grass	*Melinis minutiflora*
	Poaceae	pigeon grass	*Setaria sphacelata*
	Asteraceae	Singapore daisy	*Sphagneticola trilobata*
	Solanaceae	giant devil's fig	*Solanum chrysotrichum*
	Poaceae	broad-leaved paspalum	*Paspalum mandiocanum*
	Verbenaceae	lantana	*Lantana camara*
	Passifloraceae	corky passionfruit	*Passiflora suberosa*
	Bignoniaceae	cats claw creeper	*Dolichandra unguis-cati*