Nuwi Wetland Ecological Survey

23 Bennelong Parkway

Final

By Ecological Consultants Australia Pty Ltd TA

Kingfisher Urban Ecology and Wetlands

About this document

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Statement of Authorship

This study and report was undertaken by Ecological Consultants Australia at Studio 1/33 Avalon Parade, Avalon. The author of the report is Geraldene Dalby-Ball with qualifications BSc. majoring in Ecology and Botany with over 20 years' experience in this field, Lisa Jones and Julian Reyes with qualifications BSc. Majoring in Ecology.

Limitations Statement

Information presented in this report is based on an objective study undertaken in response to the brief provided by the client. Any opinions expressed in this report are the professional, objective opinions of the authors and are not intended to advocate any particular proposal or pre-determined position.

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Signed: Geraldene Dalby-Ball – Director of Ecological Consultants Australia

Executive Summary

Purpose

This wetland mapping was conducted to fulfill requirements and answer questions relating to potential impacts from shading on the wetlands. It is in additional to work done by SMEC for the same project in 2018.

The correspondence requests have been included at the front of this report.

- The key requirement was the detailed mapping of the saltwater wetland vegetation – particularly Saltmarsh and searches for Wilsonia and Zannichellia.
- Then with this data detail the potential impacts on Saltmarsh in general and in consideration to it being an EEC. With respect to Saltmarsh there is also the need to provide an accurate area m2 of it within the wetland and the area potentially impact such that the triggers for the need biodiversity off-setting can be accurately accessed.
- Also to address the presence or likelihood of threatened flora species not covered in detail in the SMEC report – in particular the presence of:
    - Horned Pondweed Z*annichellia palustris,* and the terrestrial plants
    - *Pomaderris prunifolia, Epacris purpurpascens* var *purpurpascens* and *Wahlenbergia multicaulis.*
    - Searches were also made for the endangered *Wilsonia backhousei* as it is in other parts of Sydney Olympic Park.

Methods

- Two field survey events occurred. One focused on the fauna and open water areas and the other focusing on the vegetation and included an on-site survey of the entire wetland. The Wetland was walked including the full perimeter and all accessible inner areas (and all areas where Saltmarsh could grow) were assessed on-foot by experts (GDB and SP).
- GPS data was collected, as were photos. Saltmarsh patches exceeding 2m in size were measured with measuring tape. Smaller patches were photographed and noted on the aerial map. It's noted most of the saltmarsh exists as small patches or isolated plants.
- Any plant indicative of Saltmarsh was mapped as Saltmarsh (e.g. an individual Sueada)

Results

- Saltmarsh is scarce in this wetland – occurring as sporadic plants along the edges and the two 'access ways/berms'. The main area of saltmarsh is around the transmission tower.
- There is less than 15m^2 of saltmarsh within the area of proposed shading.
- The area of saltmarsh is well below the threshold to trigger Biobanking offsets. The total area of saltmarsh for the entire wetland is under 200m^2 and 60% of that area is patches under 2m^2.

- The greatest abundance (patch 15.5x3.5m and 15.5 x 7.5) is near and within the reception tower (outside the shaded area) and another strip of mainly Sueada along Hill Road.
- The remaining wetland area is mostly mangroves *Avicenea marina* of various ages. Mangrove ages relate to specific hydrological events and these are known (by SOPA).
- While the vegetative parts of the mangroves appeared in good condition the flowers were dead and no seed set was apparent. Some older mangoes are showing signs of stress with aerial roots having been formed.
- The third vegetation community is She-oaks. Casuarina Forest and this is growing as almost linear strips on the access ways/bunds. The She-Oaks here do not constitute the Swamp Oak EEC.
- An area that was designed as a saltmarsh on the northern side is entirely mangroves.
- Crab holes were observed throughout the Mangroves, casuarina forest and tidal edges (weeds and saltmarsh).
- Searches for Horned Pondweed Z*annichellia palustris* and *Wilsonia backhousei* revealed none present on-site the considerations for these species is included within this report.
- Habitat doesn't occur within the wetland area for *Pomaderris prunifolia, Epacris purpurpascens* var *purpurpascens* and *Wahlenbergia multicaulis.* One *Pomaderris* has been planted on the Western edge of the wetland. It is the only one present and surrounded by weed species. It is not *P. prunifolia* but shows Pomaderris can grow in the terrestrial area of the site.
- Additionally, Nuwi Wetalnds does not host optimal habitat requirements for the GGBF.

Conclusions

- The proposed shading will not impact Saltmarsh such that a viable population would be threatened with extinction.
- The proposed plans do not significantly increase the amount of shading on saltmarsh when compared to the current approved DA, see appendices I. This conclusion is applicable to mid-winter, spring and summer scenarios.
- Shading of Mangroves will occur – refer to SMEC report and conclusions within. Ideally shading should be kept under 3hrs for mangroves.
- The difference in shadowing upon Mangrove forest is negligible between the proposed plans and approved DA. The proposed plan narrowly exceeds the 3hr benchmark for shadowing on mangroves.
- It is unlikely that the additional 1hr of shading mid-winter would lead to a significant impact on the mangrove forest within Nuwi Wetlands as less than 3% of the Mangrove forest in Nuwi will be shaded post 3hr benchmark.
- Mangrove and Saltmarsh environments can be dynamic and it could be that the wetland area provides potential for future saltmarsh colonisation should the water levels drop on a more permanent basis or the land rise such that it is infrequently inundated.

- Weeds along the wetland perimeter are abundant and in areas vines are growing onto the Mangroves. A thin saltmarsh fringe on the western side is boarded by a dense mass of exotic species. Spiny Rush *Juncus acutus* is growing in 3 areas, currently the numbers are low (under 20) for all wetland however eradication is recommended and SOPA have arranged this.

Recommendations

Spiny Rush *Juncus acutus* to be removed (on-going)

Monitor wetland edge and modify if possible to expand the saltmarsh fringe.

If the wetland becomes brackish (rather than salty) then monitor for Z*annichellia palustris.*

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1.1 Limitations of the Study

Limitations of the study may arise where certain cryptic species of plants may occur as soil-stored seed or as subterranean vegetative structures. Some species are identifiable above-ground only after particular environmental circumstances related to factors such as periodic fire frequency, intensity or seasonality, soil moisture regime, biological life-cycle patterns as in the case of small plants such as species of orchids etc. No specific invertebrate surveys were conducted.

Surveys at one time of the year cannot be expected to detect the presence of all species occurring, or likely to occur, in the study area. This is because some species may (a) occur seasonally, (b) utilise different areas

periodically (as a component of a more extensive home range), or (c) become dormant during specific periods of the year or in the case of Z*annichellia* be related to salinity. Rather, the survey provides the opportunity to sample the area, search specifically for species likely to be encountered within the available time frame and assess the suitability of habitat for particular species and make assumptions of likelihood where necessary.

Considering the site and habitat availability Kingfisher are confident that this survey is representative of the likely species and vegetation community and that future studies at other times would not change the conclusions in this report.

2 Purpose of this Report

Ecological Consultants Australia (ECA) has been contracted by SUTHERLAND & ASSOCIATES PLANNING to undertake a detailed field survey and provide information to enable the direct and indirect impacts on any threatened species, populations and communities to be assessed and thus fulfil the ecological questions / requests from assessing agencies. It adds to the work already done by SMEC including the Oct 2018 reporting.

2.1 Scope of works

To provide a flora and fauna assessment for assessing the potential direct and indirect impacts of any threatened species, populations and communities on the site. The assessment includes a specific search and mapping for saltmarsh, *Wilsonia, Zannichellia, Calidris ferruginea, Epthianura albifrons, Haliaeetus leucogaster, Botaurus poiciloptilus, Miniopterus orianae oceanensis, Myotis Macropus, Pteropus poliocephalus* and *Litoria aurea* within Nuwi Wetlands.

The objectives of this Flora and Fauna Impact Assessment are to build upon the report and studies by SMEC (2018) to:

- Survey the wetland for significant species or significant habitat features present within the study area.
- Identify any known or potential habitat for threatened species.
- Targeted searches for significant species.

Works included a site survey/assessment, review of project design and previous ecological reports to answer the questions raised in the following correspondence.

Table i. Kingfisher and EES (DPIE/OEH) responses to date.

OEH comments in 15/10/18 submission	Response by Kingfisher	EES comments on adequacy of response	Update August 2020
No surveys undertaken in Nuwi wetlands, therefore impacts on species are not clear, in particular the Green and Golden Bell Frog and Narrow-leaved Wilsonia	Surveys undertaken for Wilsonia, no consideration of Green and Golden Bell Frog (GGBF)	Inadequate for GGBF	No critical habitat for the survival of the Green and Golden Bell Frog is likely to be present at Nuwi Wetland. Ecologists acknowledge that the GGBF may use Nuwi Wetlands as foraging or transitional habitat. The proposal is unlikely to cause significant impacts such that an area of habitat is reduced/isolated/modified or the population is placed at risk of extinction. A Test of Significance (5 Part Test) has been conducted for GGBF. No significant impact concluded, see section 6.
Maps of the three plant community types on site is required	Maps of the extent of saltmarsh in Figs 4.2 and 4.3 (Feb 2019 report). Sydney Metropolitan Vegetation mapping provided to show extent of other communities (Fig 2, March 2020)	It is not adequate to provide regional scale mapping for projects at the site scale. The mapping of the extent of saltmarsh is also inconsistent between Figure 2 in the FEL and Figures 4.2 and 4.3 in the FNWES.	Vegetation extent displayed on Sydney Metropolitan Vegetation mapping; for Mangrove forest and Swamp Oak forest is generally indicative of on-ground conditions. The vegetation extent for these communities on the Sydney Metro VIS is over estimating extent of vegetation if anything. Thus, the assessment provides “a worst case” assessment on Mangrove forest and Swamp Oak forest. Saltmarsh within Nuwi which has been mapped by ecologists, was found to be significantly restricted in range, when compared to regional scale mapping.

			Negligible impacts on these communities is expected. No valid reasoning as to why additional vegetation mapping would be required as impacts are accounted for in the assessment. Saltmarsh mapping in figures 4.1 and 4.2 is accurate in this update and has been used for the shadow diagram overlay. See appendices I
Shadow diagrams showing impacts on EECs required	Shadow diagram showing impacts on saltmarsh only	Inadequate	Shadow overlays were done using GIS geo-referencing with the latest shadow analysis from Turner (August 2020). The building height has been reduced to 12-14 Storeys and thus decreases the shadowing effect on Nuwi wetlands. See appendices I for saltmarsh only overlay

Estuarine saltmarsh under Biodiversity Conservation Act does not have size thresholds	Acknowledgement that saltmarsh is present. However, report states saltmarsh on site is not viable, and the area of saltmarsh is 'well below the threshold to trigger Biobanking offsets. Also, there is no value provided of the total area of saltmarsh on site.	Inadequate. There is no justification provided for the conclusion that saltmarsh is unviable. In accordance with these guidelines, https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Threatened-species/assessment-of-significance-guide-070393.pdf, any known or presumed local population should be assumed to be viable unless the contrary can be conclusively demonstrated through analysis. Also, there is no area trigger for Biobanking offsetting. There is an area trigger for entry to the Biobanking Offset Scheme, but one of the other triggers is whether there will be impacts (including prescribed impacts) on an area mapped on the Biodiversity Values Map (BVM). The adjoining Nuwi wetlands are mapped on the BVM. A calculation of the total area of saltmarsh on site should be provided.	Total saltmarsh area approximately 405m2 and it is existing in isolated patches around Nuwi and not as a continuous community. This significantly diminishes the viability of the community. The community is in poor condition however, it is expected to persist post development within Nuwi. The shadowing impact upon saltmarsh in the proposed vs approved plans is insignificant. This conclusion is applicable to mid-winter, spring and summer scenarios. The proposed build does not significantly increase the amount of shading on saltmarsh when compared to the current approved plans, this is evident in figures 7.0 -7.3 See appendices I, for shadow diagrams
Need to revise impacts on saltmarsh from shading, given it is present.	Maximum estimated shading (9 am 21 June) is 690m^2	Adequate, though figures for total area of saltmarsh on site would assist with assessing relative impact.	Noted.
List of records of species within 10 km of site is incomplete	None of the species mentioned were observed in surveys.	No updated list of records within 10 km of the site was provided, however, the information provided is adequate for this stage.	Noted
No discussion of whether Zannichellia palustris is present	Surveys for Z. palustris completed in February 2019 and not recorded	Inadequate. Surveys undertaken in summer when species dies back completely	Survey revealed no individuals or areas of critical habitat. Shadowing will occur at Nuwi Wetlands, however areas of marginal/potential habitat for *Zannichellia palustris* will likely remain unaffected by shadowing. Ecologists believe water may be too saline for the species to establish a viable population. A Test of Significance (5 Part

			Test) has been conducted for *Zannichellia palustris*. No significant impact concluded, see section 6.
Inadequate assessment of impacts on Australasian Bittern	Species not discussed	Inadequate	Species may use Nuwi Wetlands occasionally and/or opportunistically for foraging purposes. No areas of critical habitat identified nor will areas of habitat be significantly impacted by the proposal. A Test of Significance (5 Part Test) has been conducted for the Australasian Bittern. No significant impact concluded, see section 6.
Inadequate assessment of White-fronted Chat	Species not discussed	Inadequate	Areas of habitat for the species will remain unaffected by the proposal. Nuwi wetland will retain its habitat value and features for the White-fronted Chat. Species may use Nuwi Wetlands occasionally and/or opportunistically for foraging purposes. A Test of Significance (5 Part Test) has been conducted for the White-fronted Chat. No significant impact concluded, see section 6.
Inadequate assessment of significance for a number of species	Updated assessments of significance not provided	Adequate, assessments of significance are not required at this stage	Noted
Report should have included discussion of impacts to habitat connectivity between Narawang wetlands and other sites in Sydney Olympic Park	Connectivity impacts not discussed	Inadequate	See section 5 for discussion of impacts to habitat connectivity between Narawang wetlands and other sites in Sydney Olympic Park
No consideration of impacts to Sydney Turpentine Ironbark Forest (STIF)	STIF not discussed	Inadequate	Proposal is unlikely to significantly impact upon STIF. The proposal does not directly remove/isolate habitat. Shadowing does not

			reach the STIF and as such unlikely to affect the community. A Test of Significance (5 Part Test) has been conducted for STIF. No significant impact concluded, see section 6.

Table ii. Consideration of issues by Sydney Olympic Park Authority (SOPA) and Kingfisher response

SOPA comments	Kingfisher response
The Ecological Impact Assessment recommends that overshadowing of mangroves should be less than 3 hours per day, however the shadow analysis indicates that mangroves along the northern edge may be overshadowed by 4-5 hours in midwinter.	There will be no shadowing of the mangroves along the northern edge of Nuwi Wetlands by 2pm in midwinter. Less than 3% of the total area of Mangrove forest within Nuwi will be shaded at 12pm, with < 0.13% shaded at 1pm and no shade post 2pm. See appendices I for the shadowing overlay. 3hrs is proposed a guideline and not as a final figure. This figure is indicative and has been determined by the author based on decades of first-hand experience with estuarine environments. As detailed in table two. The difference in Mangrove forest shadowing is negligible between the proposed plans and approved plans. The additional shadowing will primarily occur within 1hr mid-winter (11am - 12pm). It is unlikely that the additional 1hr of shading mid-winter would lead to significant impacts on the mangrove forest within Nuwi Wetlands. Additionally, little research has been conducted to quantify the effects of shading by physical structures, such as buildings, on mangrove species in Australia. Clark and Allaway (1993) concluded via a study on the Grey Mangrove, that seedling densities and survival under canopies (i.e. in full shade) or in canopy gaps (i.e. in sun) are not significantly different (as cited in SMEC 2018). The proposal will not fully shade mangroves along the northern edge of Nuwi Wetlands for extended periods of time. As such, impacts on these mangroves are expected to be minimal.
The Ecological Impact Assessment does not quantify the area of effected mangroves and how many months of the year that the overshadowing will occur and what the likely impacts area.	The maximum amount of shading will occur at 9am 21st June. Less than 3% of the total area of Mangrove forest within Nuwi will be shaded at 12pm, with <0.13% shaded at 1pm and no shade post 2pm. See appendices I for the shadowing overlay.

	Please note – The maximum amount of shading will occur during winter months. Shading of Nuwi wetland will be significantly less during Spring, Autumn and Summer. The shadowing assessment concluded both Estuarine Swamp Oak Forest, and Estuarine Mangrove Forest should be tolerant to the shading impacts of the proposed development (SMEC, 2018). This conclusion was drawn after a review of relevant literature. It must be noted that literature on the topic is limited but early results indicate shadowing is unlikely to significantly impact mangroves.
Effective erosion and sediment control will need to be provide by a site-specific Soil and Water Management Plan.	Noted. This can be detailed in the proposal documents which will follow this stage of assessment.

2.2 Site Location

The study area is Nuwi Wetlands opposite 23 Bennelong Parkway, Wentworth Point, NSW 2127 (see Figure 1.1).

Figure 1.1 Study Area Nuwi Wetlands. Main Study area in bold yellow line. Other areas surveyed in narrow yellow line. Source: Six Maps

3 Methods

3.1 Site Inspections

Two field survey events occurred. One focused on the fauna and vegetation edges and open water areas February 14th 2019 and the other focusing on the vegetation and included an on-site survey of the entire wetland Monday 4th 2019 at low tide (2pm-5pm). Weather was fine and sunny during both inspections.

- The Wetland was walked including the full perimeter and all accessible inner areas (and all areas where Saltmarsh could grow) by experts (GDB and SP).
- GPS data was collected, as were photos.
- Saltmarsh patches exceeding 3m in size were measured with measuring tape. Smaller patches (individual plants) were photographed and noted on the aerial map. It's noted most of the saltmarsh in Nuwi Wetlands exists as small patches or isolated plants.
- Any plant indicative of Saltmarsh was mapped as Saltmarsh (e.g. an individual *Suaeda australis*)
- Fauna was surveyed including looking in the inter areas for wading birds. Despite the inspection times including New Moon low Tide most areas had water ~100mm +. Pied Stilt, *Himantopus leucocephalus,* were observed but not other birds at this time. Those listed in the SMEC (2018) report could at some time feed in Nuwi wetlands..

During site visits, notes and photos were taken of the vegetation types, flora and fauna present. Surveys detailed yet also opportunistic in nature (traversing where possible) and were performed by traversing the site. Surveys took in all areas of potential Saltmarsh, including Wilsonia, habitat and included the shallow still water areas for *Zannichellia palustris.*

Surveys included one diurnal bird and fauna survey and a detailed vegetation survey and a general habitat survey in which fauna habitat resources were identified.

3.2 Previous studies

- SMEC (Oct 2018) and reports associated with the DA
- SOPA mapping and discussion with Swapan Paul SOPA who has expert and detailed knowledge of the estuarine habitat on-site.
- Clark, P.J., & Allaway W.G. (1993). The regeneration niche of the grey mangrove (Avicennia marina): effects of salinity, light and sediment factors on establishment, growth and survival in the field. Oecologia. 93(4), 548-556.

4 Results

4.1 Habitat Assessment for Threatened Species

The detailed site survey included assessment of habitat for Threated species.

- Saltmarsh is scarce in this wetland – occurring as sporadic plants along the edges and the two 'access ways/berms'. The main area of saltmarsh is around the transmission tower.

- There is less than 15m2 of saltmarsh within the area of proposed shading.
- The greatest abundance (patch 15.5x3.5m and 15.5 x 7.5) is near and within the reception tower (outside the shaded area) and another strip of mainly Sueada along Hill Road.
- The remaining wetland area is mostly mangroves Avicenna marina of various ages. Mangrove ages relate to specific hydrological events and these are known (by SOPA).
- While the vegetative parts of the mangroves appeared in good condition the flowers were dead and no seed set was apparent. Some older mangoes are showing signs of stress with aerial roots having been formed.
- The third vegetation community is She-oaks. Casuarina Forest and this is growing as almost linear strips on the access ways/bunds. The She-Oaks here do not constitute the Swamp Oak EEC.
- An area that was designed as a saltmarsh on the northern side is entirely mangroves.
- Crab holes were observed throughout the Mangroves, casuarina forest and tidal edges (weeds and saltmarsh).
- Searches for Horned Pondweed *Zannichellia palustris* and *Wilsonia backhousei* revealed none present on-site the considerations for these species is included within this report.
- Habitat doesn't occur within the wetland area for *Pomaderris prunifolia, Epacris purpurpascens var purpurpascens* and *Wahlenbergia multicaulis*. One Pomaderris has been planted on the Western edge of the wetland. It is the only one present and surrounded by weed species. It is not P. *prunifolia* but shows Pomaderris can grow in the terrestrial area of the site.

Flora

Class	Scientific Name	Common Name	NSW status	Comm. status
Flora	*Acacia pubescens*	Downy Wattle	Vulnerable	Vulnerable
Flora	*Dillwynia tenuifolia*		Vulnerable	-
Flora	*Epacris purpurascens* var. *purpurascens*		Vulnerable	-
Flora	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	Vulnerable	Vulnerable
Flora	*Eucalyptus scoparia*	Wallangarra White Gum	Endangered	Vulnerable
Flora	*Grevillea beadleana*	Beadle's Grevillea	Endangered	Endangered
Flora	*Syzygium paniculatum*	Magenta Lilly Pilly	Endangered	Vulnerable
Flora	*Wilsonia backhousei*	Narrow-leafed Wilsonia	Vulnerable	-
Flora	*Zannichellia palustris*		Endangered	-

Fauna

Class	Scientific Name	Common Name	NSW status	Comm. status
Amphibia	*Litoria aurea*	Green and Golden Bell Frog	Endangered	Vulnerable

Class	Scientific Name	Common Name	NSW status	Comm. status
Aves	*Anthochaera phrygia*	Regent Honeyeater	Critically Endangered	Critically Endangered
Aves	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	Vulnerable	-
Aves	*Botaurus poiciloptilus*	Australasian Bittern	Endangered	Endangered
Aves	*Calidris canutus*	Red Knot	-	Endangered
Aves	*Calidris ferruginea*	Curlew Sandpiper	Endangered	Critically Endangered
Aves	*Calidris tenuirostris*	Great Knot	Vulnerable	Critically Endangered
Aves	*Circus assimilis*	Spotted Harrier	Vulnerable	-
Aves	*Epthianura albifrons*	White-fronted Chat	Vulnerable	-
Aves	*Glossopsitta pusilla*	Little Lorikeet	Vulnerable	-
Aves	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	Vulnerable	-
Aves	*Hieraaetus morphnoides*	Little Eagle	Vulnerable	-
Aves	*Hirundapus caudacutus*	White-throated Needletail	-	Vulnerable
Aves	*Ixobrychus flavicollis*	Black Bittern	Vulnerable	-
Aves	*Lathamus discolor*	Swift Parrot	Endangered	Critically Endangered
Aves	*Limicola falcinellus*	Broad-billed Sandpiper	Vulnerable	-
Aves	*Limosa limosa*	Black-tailed Godwit	Vulnerable	-
Aves	*Ninox strenua*	Powerful Owl	Vulnerable	-
Aves	*Numenius madagascariensis*	Eastern Curlew	-	Critically Endangered
Aves	*Rostratula australis*	Australian Painted Snipe	Endangered	Endangered
Aves	*Sternula albifrons*	Little Tern	Endangered	-
Aves	*Stictonetta naevosa*	Freckled Duck	Vulnerable	-
Mammalia	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	Vulnerable	-
Mammalia	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	Vulnerable	-
Mammalia	*Myotis macropus*	Southern Myotis	Vulnerable	-
Mammalia	*Pteropus poliocephalus*	Grey-headed Flying-fox	Vulnerable	Vulnerable
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	Vulnerable	-

Class	Scientific Name	Common Name	NSW status	Comm. status
Mammalia	*Scoteanax rueppellii*	Greater Broad-nosed Bat	Vulnerable	-

Endangered Population

Class	Family	Scientific Name	Common Name
Flora	Rhamnaceae	*Pomaderris prunifolia*	Plum-leaf Pomaderris
Flora	Campanulaceae	*Wahlenbergia multicaulis*	Tadgell's Bluebell
Aves	Meliphagidae	*Epthianura albifrons*	White-fronted Chat

Sighting of the following species:

Class	Scientific Name	Common Name	Date of sighting
Flora	*Zannichellia palustris*		31 May 2020
Amphibia	*Litoria aurea*	Green and Golden Bell Frog	31 May 2020

Figure 3.1. White-bellied Sea-Eagle (Haliaeetus leucogaster) recorded within Nuwi Wetlands. Orange points are GGBF (*Litoria aurea*) recordings are pre-2018.

4.2 Detailed Site Survey

The purpose of the flora work was an investigation to determine the flora composition of the site, particularly vulnerable and endangered species. It also included an assessment of the flora as habitat. Figure 4.2 and 4.3 show the location of saltmarsh. Following the figure are images from the site showing the saltmarsh.

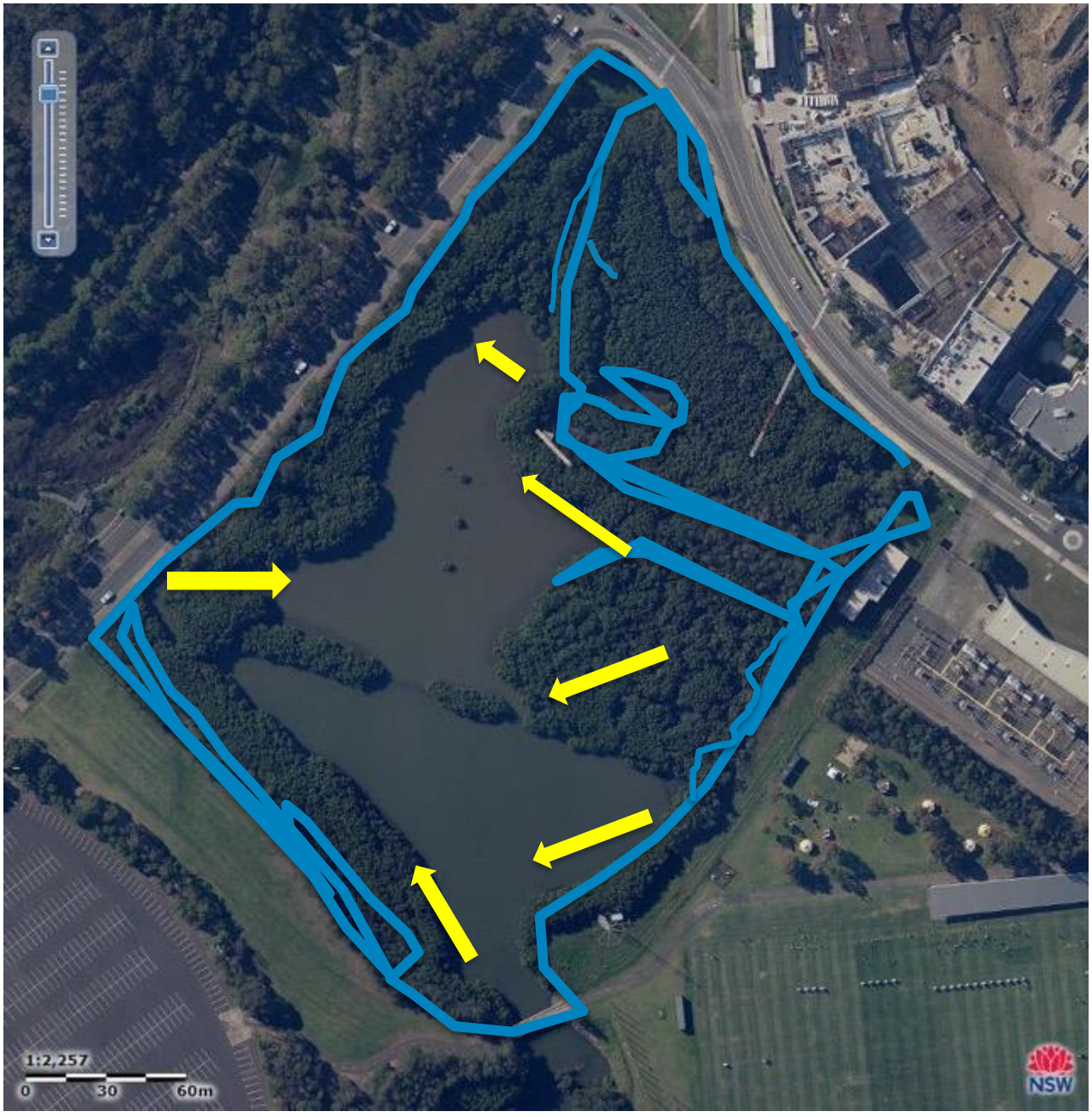


Figure 4.1 Nuwi Wetland. Blue-lines walked and yellow clear visual inspection.

Figure 4.2 Northern half of Nuwi Wetlands – Saltmarsh Mapping

Yellow: *Suaeda australis*	Green: *Sarcocornia quinquenervia*	Red *Einadia hastata*	Blue *Tetragonia tetraganoides*	Red star, *Juncus acutus* (weed)

Figure 4.3 Southern half of Nuwi Wetlands

Yellow: *Suaeda australis*	Green: *Sarcocornia quinquenervia*	Red *Einadia hastata*	Blue *Tetragonia tetraganoides*	Red star, *Juncus acutus* (weed)

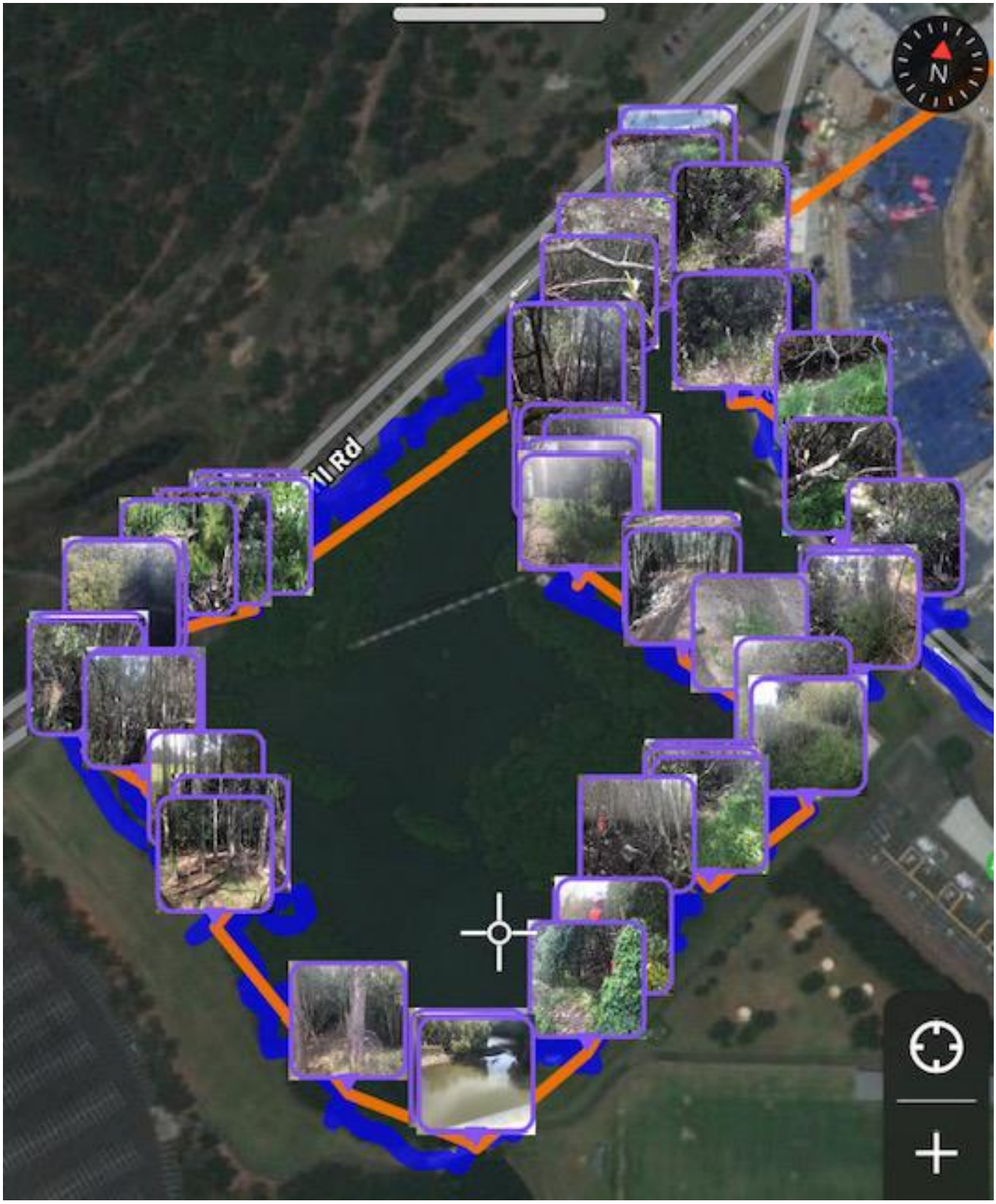


Figure 4.4 Photos at waypoints taken during mapping.

Figure 4.5 close up of survey along Bennalong Drive.

NB: GPS Track ~ 5m out on map over lay.

This area has 4 small (<2x3) patches of Saltmarsh on the edge and one patch of Tetragonia patch ~3.5 x 2.5m)

The berm has 5 Suaeda plants, 1 patch of Sarcocornia (<2m2). The weed Juncus acutus (x 6 plants) is growing on this berm. The surrounding habitat is all Mangroves and the elevation I not suitable for saltmarsh.

The berm leads to the area of high ionising radiation. Around this tower is the largest patch of saltmarsh (7.5 long and 3 to 5 wide maximum) see report for details.

This patch and is present due to the raise ground level for the facility. Shading will not reach this area.

Sueada on entrance to berm off Bennelong Road – less than $2m^2$

***Juncus acutus* on berm.**

Typical view under mangroves

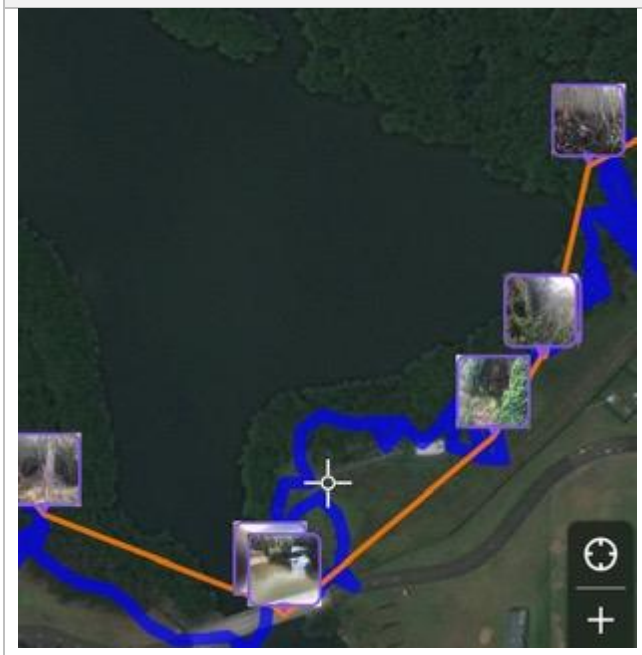
Waterway crossing between berm and facility

Tetragonia under She-Oaks near facility

Sueada australis near facility – largest patch in Nuwi Wetlands

Berm leading from facility to the north – isolated patches of saltmarsh (<6m² total)

Typical saltmarsh in this area. Single plant – see boot for scale.

	Along the eastern boundary the edge is sloping with a narrow tidal band suitable for saltmarsh. This zone is weed dominated however there is a strip of native salt tolerant plants mostly Tetragonia and Einadia. The band is ~ 50cm wide and extends for ~ 2m at a time. Crab holes are present closer to the Mangroves.
	
Sueada plants are present all be it isolated and small. NB: Crab holes.	**No saltmarsh present as viewed from bridge.**
	Edge that could have saltmarsh were visited and none found on the inner water/land interfaces. Too frequent tidal inundation or saltmarsh.

Continuing east to south and over the bridge to Hill Road – the Saltmarsh is largely absent (less than 0.05% of the area). This is due to the inundation levels being currently wrong for Saltmarsh.

Where it does occur, on the terrestrial edge, it is small patches, or individual plants. Species here are, in order of abundance, Tetragonia, Suaeda then Einadia.

The southern edge is dominated by Casuarinas with a think needle understory.

The culvert in the south western corner has accumulated material but no saltmarsh.

From the bridge the mangrove areas were be viewed clearly (at low tide) and no saltmarsh was observed on the inner mangrove/water interfaces.

Eastern corner near Bennelong Road. ~1m^2 of Tetragonia. Steep bank and edge vegetation is dominated by annual weeds central area is SheOaks where high and Grey mangroves where inundated. This area would be shaded. Its current topography make it unsuitable saltmarsh.

<table>
<tr><td></td><td></td></tr>
<tr><td> 
</td><td>Along Hill Road there are two strips of Saltmarsh on the terrestrial edge.

Two strips (7m and 10m long and 0.5 to 1m wide). Saltmarsh is in small patches, or individual plants.

Species here are, in order of abundance, Tetragonia, Suaeda then Einadia.

This area will not be impacted by shading from the proposed building.

  </td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Tetragonia is the most common on this narrow edge</td><td>Weeds dominate the interface</td></tr>
</table>

Inner open water areas were observed for Salmarsh – non present or expected.

She Oak edge on western side

Mangroves – no saltmarsh

Open water interface areas as seen from bridge on Hill Road

One of the strips of Saltmarsh (Sueada) and the Southern end of Hill Road (9.5 x1-2m)

Northern end of Hill Road had steep banks with no saltmarsh species.

Conclusions

- The proposed shading will not impact Saltmarsh such that a viable population would be threatened with extinction. There is not a viable saltmarsh population currently present.
- The area of saltmarsh is well below the threshold to trigger Biobanking offsets. The total area of saltmarsh for the entire wetland is under
- Shading of Mangroves will occur – refer to SMEC report and conclusions within. Ideally shading should be kept under 3hrs for mangroves.
- Mangrove and Saltmarsh environments can be dynamic and it could be that the wetland area provides potential for future saltmarsh colonisation should the water levels drop on a more permanent basis or the land rise such that it is infrequently inundated.
- Weeds along the wetland perimeter are abundant and in areas vines are growing onto the Mangroves. A thin saltmarsh fringe on the western side is boarded by a dense mass of exotic species. Spiny Rush *Juncus acutus* is growing in 3 areas, currently the numbers are low (under 20) for all wetland however eradication is recommended and SOPA have arranged this.

Recommendations

Spiny Rush *Juncus acutus* to be removed (on-going)

Monitor wetland edge and modify if possible to expand the saltmarsh fringe.

If the wetland becomes brackish (rather than salty) then monitor for Z*annichellia palustris.*

5 Connectivity between wetlands

Nuwi Wetland maintains connectivity with Narawang Wetland and the other Millennium Parkland swamps through the watercourse in the western corner of the site - under Hill Rd. Narawang Wetland (100m west of Nuwi) is considered “important” breeding habitat for the Sydney Olympic Park Green and Golden Bell Frog population. In addition to the Millennium Parkland swamps, Sydney Olympic Park is also home to other wetlands, south-east, south and west of Nuwi Wetlands. Water flows from the Millennium Parkland via Nuwi Wetland into Haslams Creek. As such, Nuwi Wetland may play an important role in providing connectivity between Millennium Parkland swamps and the greater area of Sydney Olympic Park.

It is likely that the wetlands immediately west and south-east of Nuwi Wetland support an important population of Green and Golden Bell Frog. The connectivity features of Nuwi Wetland should be protected and remain a high conservation priority. Wetlands within the greater area of Sydney Olympic Park provide habitat and refuge sites for an array of local fauna.

5.1 Impact

The proposal is unlikely to significantly impact habitat connectivity within the greater area of Sydney Olympic Park. The proposal will not directly remove habitat critical to the survival of threatened species. It is unlikely that the proposal will create barriers such that the movement of threatened species is adversely affected. The proposal may periodically shade Nuwi Wetlands - primarily in winter months, however, the impact from shading is unlikely to affect connectivity and/or the lifecycle of threaten species.

Figure 4.6 Aerial view of Nuwi wetland and its surroundings. Source: Six Maps 2020.

6 Test of Significance

6.1 Green and Golden Bell Frog

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Proposed development is unlikely to have an adverse effect on the life cycle of this threatened species' viable population or place the species at risk of extinction. The proposal will not directly remove habitat for the GGBF nor will the proposal create indirect impacts which will significantly affect the lifecycle of the species.

Ecologists acknowledge that the GGBF may use Nuwi Wetlands as foraging or transitional habitat when navigating between Narawang Wetland and wetlands in the south-east of Sydney Olympic Park. However, indirect impacts created by building shadows is unlikely to increase mortality, reduce the extent or adversely modify potential habitat or breeding habitat for the GGBF such that the local population is likely to be placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A. Not an EEC/CEEC.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A. Not an EEC/CEEC.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will not directly remove habitat for the GGBF nor will habitat or potential habitat be significantly modified from its current state. It is acknowledged that the GGBF occurs within the adjoining Narawang Wetland. Habitat within Narawang Wetland will remain unaffected by the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

No area if habitat is likely to become fragmented as a result of the proposal. The proposal does not directly impact habitat for the species. Ecologists recognise that the GGBF may use Nuwi Wetlands as foraging or

transitional habitat when navigating between Narawang Wetland and wetlands in the south-east of Sydney Olympic Park. This habitat corridor will remain unaffected by the proposal.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

No habitat for the GGBF will be removed, modified, fragmented or isolated as a result of this proposal.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

It is unlikely that the proposal will increase the impact of a key threatening process. The proposal will remain outside any areas of habitat for the species. Indirect impacts, such as storm water runoff, will be appropriately managed within site boundaries.

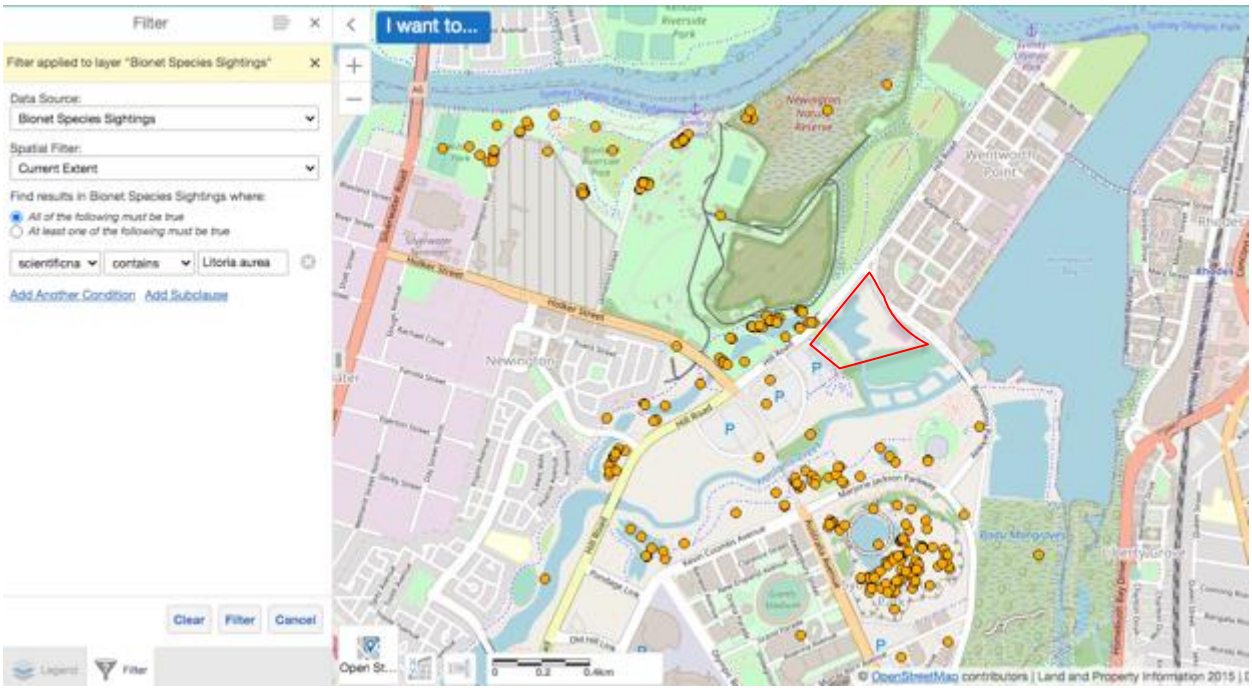


Plate 1. Recorded locations of GGBF as per Bionet recordings – accessed via SEED July 2020.. (Nuwi Wetlands outlined in red).

6.2 *Zannichellia palustris*

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

Site surveys for *Zannichellia palustris* revealed none present. It is acknowledged that the species dies back in summer, although ecologists believe that Nuwi Wetlands may be too saline for the species to establish a viable population. Therefore, the proposal is unlikely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

If the wetland becomes brackish (rather than salty) then monitor for Zannichellia palustris.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

N/A. Not an EEC/CEEC.

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A. Not an EEC/CEEC.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A. Not an EEC/CEEC.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

It is unlikely that Nuwi Wetalnds would not be considered critical habitat for *Zannichellia palustris.* The species is known to occur from freshwater – slightly saline conditions. Ecologists believe that conditions within Nuwi Wetlands may be too saline for *Zannichellia palustris*.

Shadowing (primarily in winter months) will likely occur in areas of Mangrove Forest. Areas of potential habitat for *Zannichellia palustris* within Nuwi Wetlands will likely remain unaffected by the proposal.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

Nuwi Wetlands could be considered marginal habitat for the species. Periodic shading will occur at Nuwi Wetalnds which may alter habitat for the species. However, the site survey did not reveal any *Zannichellia palustris* individuals nor did it reveal areas of significant potential habitat. As such, the proposal is unlikely to fragment or isolate areas of critical habitat for the species.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Periodic shading will occur at Nuwi Wetalnds which may alter habitat for the species. However, ecologists consider Nuwi Wetlands to be marginal habitat for the species. The site survey did not reveal any *Zannichellia palustris* individuals nor did it reveal areas of significant potential habitat. Therefore, it is unlikely that the proposal will influence the long-term survival of the species at Nuwi Wetlands.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

It is unlikely that the proposal will increase the impact of a key threatening process.

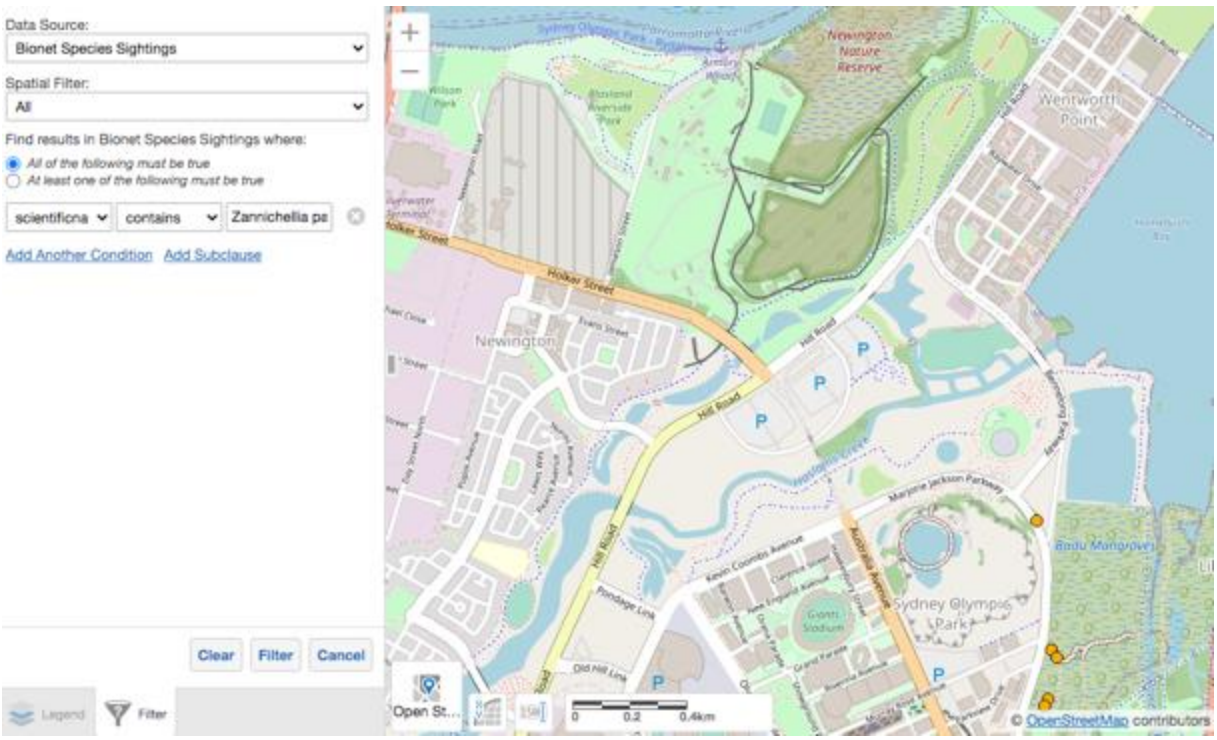


Plate 2. Recorded locations of *Zannichellia palustris* as per Bionet recordings. Recordings in Badu Mangroves with an accuracy of 5000m+. Recorded between 2011 -2017. – accessed via SEED July 2020.. (Nuwi Wetlands outlined in red).

6.3 Coastal Saltmarsh

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

N/A. Not a species.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

> *(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

The proposed shading will not impact Saltmarsh such that a viable population would be threatened with extinction. Saltmarsh within Nuwi Wetland is scarce, it primarily occours as sporadic plants along the edges and the two 'access ways/berms'. The main area of saltmarsh is around the transmission tower.

The largest areas of saltmarsh are near and within the reception tower and mainly Sueada along Hill Road. Both of these area are outside of building shadows. Due to the sporadic distribution, current condition and expected shadowing, it is unlikely that the proposal would have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The largest areas of saltmarsh are near and within the reception tower and mainly Sueada along Hill Road. Both of these area are outside of building shadows. Following the field survey, it was concluded that less than 15m2 of saltmarsh occurs within the area of proposed shading. As such, it is unlikely that the proposal would substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

No habitat for Coastal Saltmarsh will be directly removed. Approximately 15m2 of saltmarsh occurs within the area of shading. This area of saltmarsh may be modified due to shading however the local occurrence of saltmarsh at Nuwi Wetalnds is unlikely to be placed at risk of extinction.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

It is unlikely that habitat for Coastal Saltmarsh will become fragmented or isolated. Impacts will be indirect, via building shadowing, upon approximately 15m2 of saltmarsh within Nuwi Wetlands. This is not expected to significantly disrupt the distribution of saltmarsh within Nuwi Wetlands. Saltmarsh at the site is currently in marginal condition and it primarily occurs as sporadic plants along the edges and the two 'access ways/berms'. The main area of saltmarsh is around the transmission tower and will be outside of shading.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

Saltmarsh at the site is currently in marginal condition and occurs as sporadic plants along the edges of Nuwi Wetlands. Approximately 15m2 of saltmarsh occurs within the area of shading. This patch is not expected to significantly contribute to the long-term survival of saltmarsh at Nuwi Wetlands.

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal does not contribute to and/or is not part of a key threatening process and is unlikely to increase the impact of a key threatening process.

6.4 Australasian Bittern

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The proposal is unlikely to have an adverse effect on the lifecycle of the Australasian Bittern such that a viable local population of the species is to be placed at risk of extinction. The proposal will not impact areas of critical habitat for the species. Shading will occur at Nuwi Wetland, however, this is unlikely to cause a decline in species abundance at the locality. The habitat for the species is not considered critical for the survival for the species.

Additionally, the species is expected to use the site occasionally and/or opportunistically for foraging purposes. Thus, the proposal is unlikely to have an adverse effect on the lifecycle of the Australasian Bittern.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

N/A. Not an EEC/CEEC

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A. Not an EEC/CEEC

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A. Not an EEC/CEEC

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will not remove or modify areas of critical habitat for the species. Nuwi wetland will experience shading as a result of this proposal, however this is not expected to significantly modify areas of foraging habitat for the species. Nuwi wetland is not considered important breeding habitat for the species and the site is unlikely to contribute to the long-term survival of the species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

No habitat for the species will become fragmented or isolated from other areas of habitat as a result of the proposed development. Impacts will remain outside Nuwi Wetland and other areas which would be considered occasional and/or opportunistic habitat for the species.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The proposal will not remove or modify areas of critical habitat for the species. Nuwi wetland will experience shading as a result of this proposal, however this is not expected to significantly modify

areas of foraging habitat for the species. The species is expected to use the site occasionally and/or opportunistically for foraging purposes. Nuwi wetland is unlikely to contribute to the long-term survival of the species.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal does not contribute to and/or is not part of a key threatening process and is unlikely to increase the impact of a key threatening process.

Plate 3. Recorded locations of Australasian Bittern as per Bionet recordings – accessed via SEED July 2020.. (Nuwi Wetland outlined in red).

6.5 White-fronted Chat

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

The proposal will not directly remove habitat for the White-fronted Chat nor will the proposal create indirect impacts which will significantly affect the lifecycle of the species. As such, the proposed development is unlikely to have an adverse effect on the life cycle of this threatened species' viable population or place the species at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

N/A. Not an EEC/CEEC

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

N/A. Not an EEC/CEEC

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

N/A. Not an EEC/CEEC

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

The proposal will not remove or modify areas of critical habitat for the species. Nuwi wetland will experience shading as a result of this proposal, however this is not expected to significantly modify areas of habitat for the species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

No habitat for the species will become fragmented or isolated from other areas of habitat as a result of the proposed development. Nuwi wetlands and other adjoining wetlands will likely retain their habitat features post development and the local population of the White-fronted Chat will be unaffected.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

No habitat which is critical for the long-term survival of the species will be removed, modified, fragmented or isolated. The proposal will not directly effect habitat for the species. Shading will occur at Nuwi Wetlands although this is not expected to significantly modify areas of potential habitat for the White-fronted Chat.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal does not contribute to and/or is not part of a key threatening process and is unlikely to increase the impact of a key threatening process.

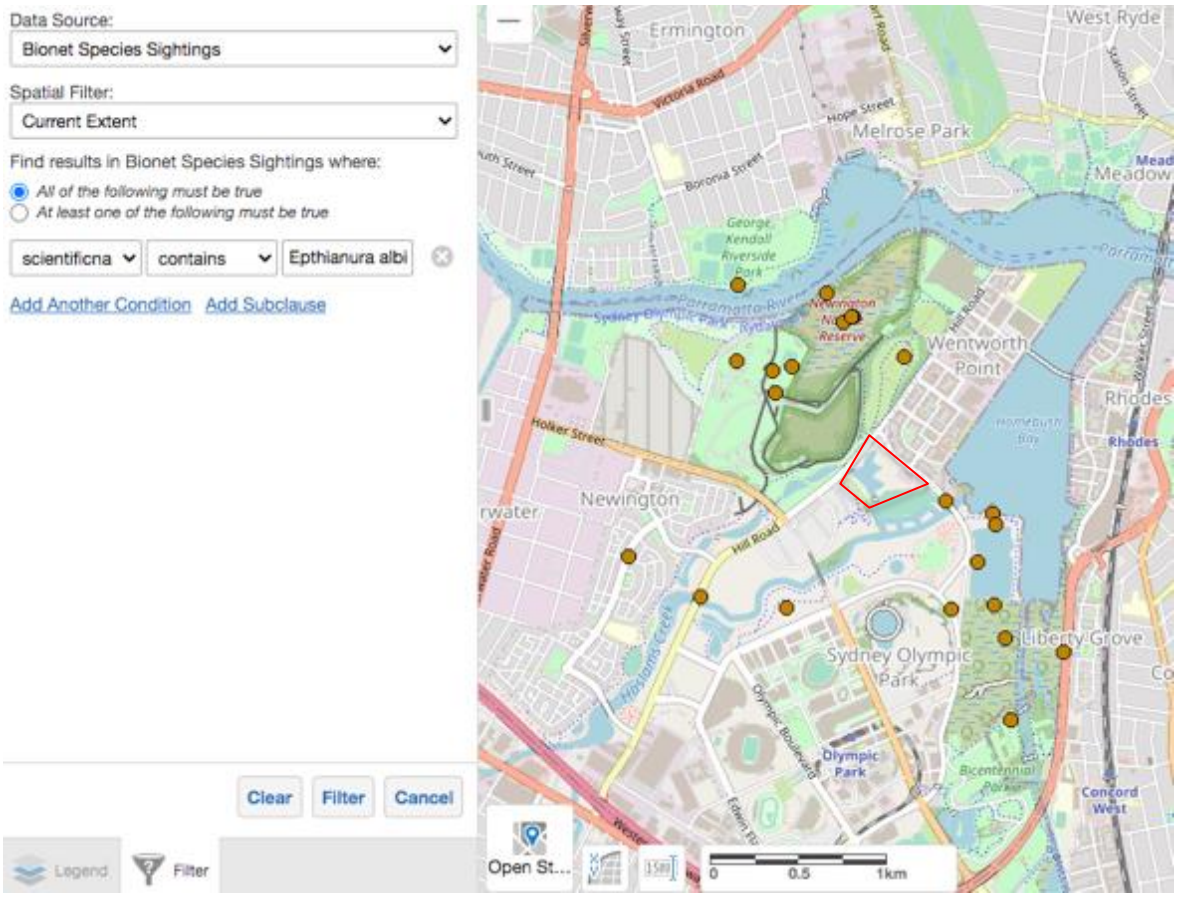


Plate 4. Recorded locations of White-fronted Chat as per Bionet recordings – accessed via SEED July 2020.. (Nuwi Wetland outlined in red).

6.6 Sydney Turpentine Ironbark Forest (STIF)

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

N/A. Not a threatened species.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

The proposal is unlikely to have an adverse effect on the extent of the STIF community such that its local occurrence is likely to be placed at risk of extinction. Additionally, the proposal is unlikely to substantially and adversely modify the composition of the ecological community given that the proposal does not directly impact the community. Furthermore, the proposal is unlikely to create indirect impacts upon the community as shading will not affect the STIF community.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

No habitat for STIF will be removed or modified as a result of the proposal. The development site is devoid of vegetation. Indirect impacts such as shading will not affect the community as building shadows will not reach the STIF or areas of potential habitat.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

No area of habitat or potential habitat will be affected by this proposal. As such, it is unlikely that the proposal would cause STIF at the adjoining Narawang Wetland to become fragmented or isolated from other areas of habitat within the vicinity.

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

No habitat for STIF will be removed, modified, fragmented or isolated as a result of this development.

No declared area of outstanding biodiversity value will be impacted.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposal does not contribute to and/or is not part of a key threatening process and is unlikely to increase the impact of a key threatening process.

7 Appendices I - Vegetation mapping and Shadow Overlay

Shadow overlays were produced using GIS geo-referencing with the latest shadow analysis from Turner (August 2020). The building height has been reduced to 12-14 Storeys and thus decreases the shadowing effect on Nuwi wetlands.

Three PCTs are present within Nuwi Wetlands and are illustrated below in figures 5.0 – 6.9 below. PCTs include;

- PCT 920 - Mangrove Forests in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1234 - Swamp Oak swamp forest fringing estuaries, Sydney Basin Bioregion and South East Corner Bioregion
- PCT 1126 - Saltmarsh in estuaries of the Sydney Basin Bioregion and South East Corner Bioregion

PCT 1281 Sydney Turpentine Ironbark Forest is also present to the west of Nuwi but falls outside of any building shadows.

The plate below also illustrates the true extent of saltmarsh on-ground, following an extensive survey throughout Nuwi Wetland by Kingfisher. The shadowing impact upon saltmarsh in the proposed vs approved plans is insignificant. This conclusion is applicable to mid-winter, spring and summer scenarios. The proposed plans do not significantly increase the amount of shading on saltmarsh when comparing the current plans and approved DA plans, this is evident in figures 5.0 – 5.4 below.

As detailed in table two below, the difference in shadowing upon Mangrove forest is negligible between the proposed plans and approved plans. The additional shadowing will primarily occur within 1hr mid-winter (11am - 12pm). It is unlikely that the additional 1hr of shading mid-winter would lead to significant impacts on the mangrove forest within Nuwi Wetlands. The difference in spring and summer shadowing in the proposed plans vs approved plans is also expected to be insignificant. Figures 6.0 - 6.4 provide a visual comparison between the proposed and approved plans, for shading upon the Nuwi Mangrove forest.

Table 2. Mid-Winter difference in mangrove shadowing - Proposed vs Approved plans

Proposed build –Mid-Winter mangrove shadowing				Approved DA- Mid-Winter mangrove shadowing		
Time	**Shadowing area (M2)**	**% of Total Mangrove Forest within Nuwi**		**Time**	**Shadowing area (M2)**	**% of Total Mangrove Forest within Nuwi**
9am	3863	17.77		9am	2794	12.85
10am	2011	9.25		10am	1264	5.81
11am	1323	6.09		11am	480	2.02
12pm	555	2.55		12pm	Nil	
1pm	29	0.13		1pm	Nil	
2pm	Nil	0.00		2pm	Nil	

7.1 Shadow analysis of surveyed saltmarsh – Proposed and Approved.

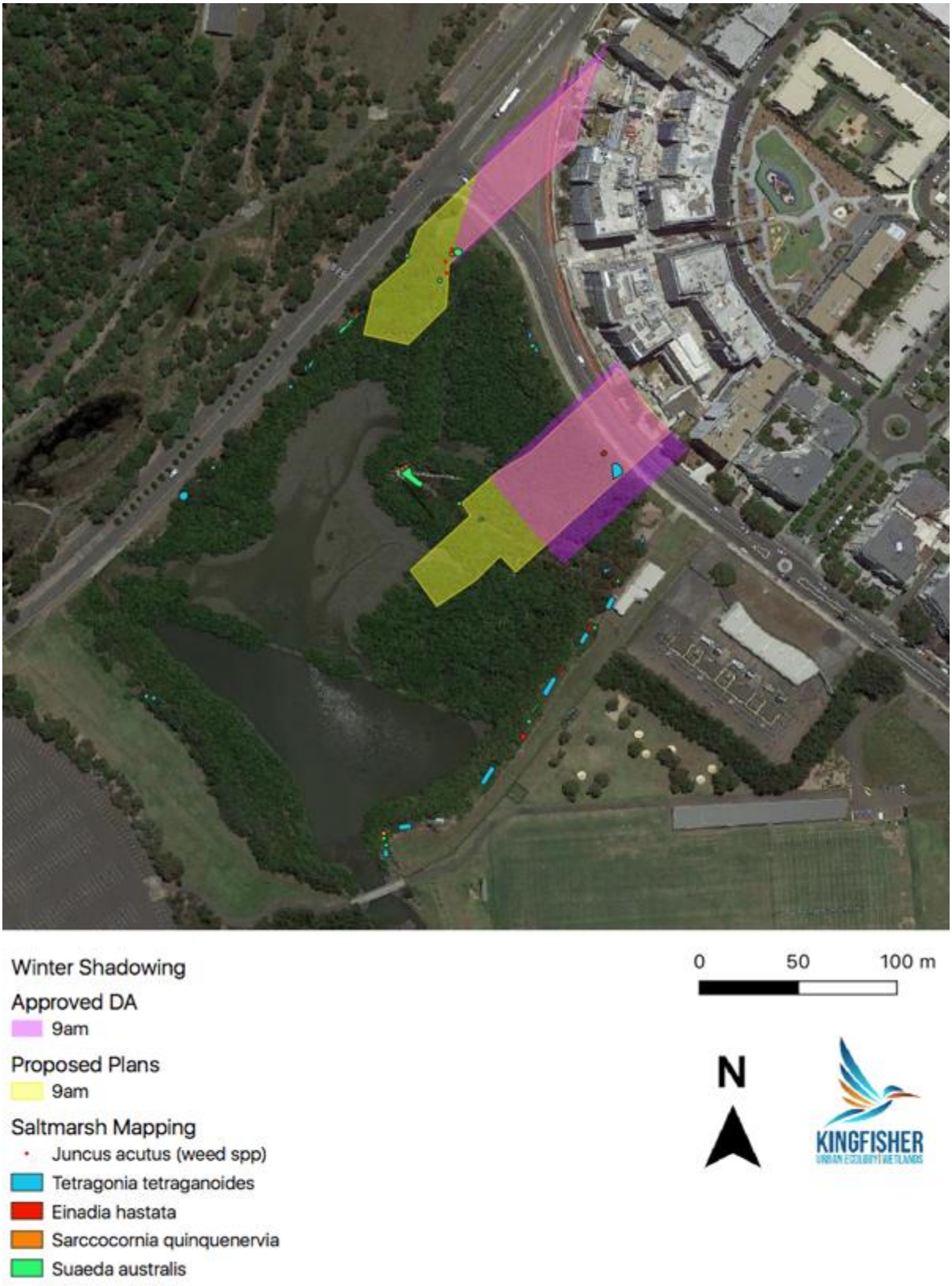


Figure 5.0. 9am Winter

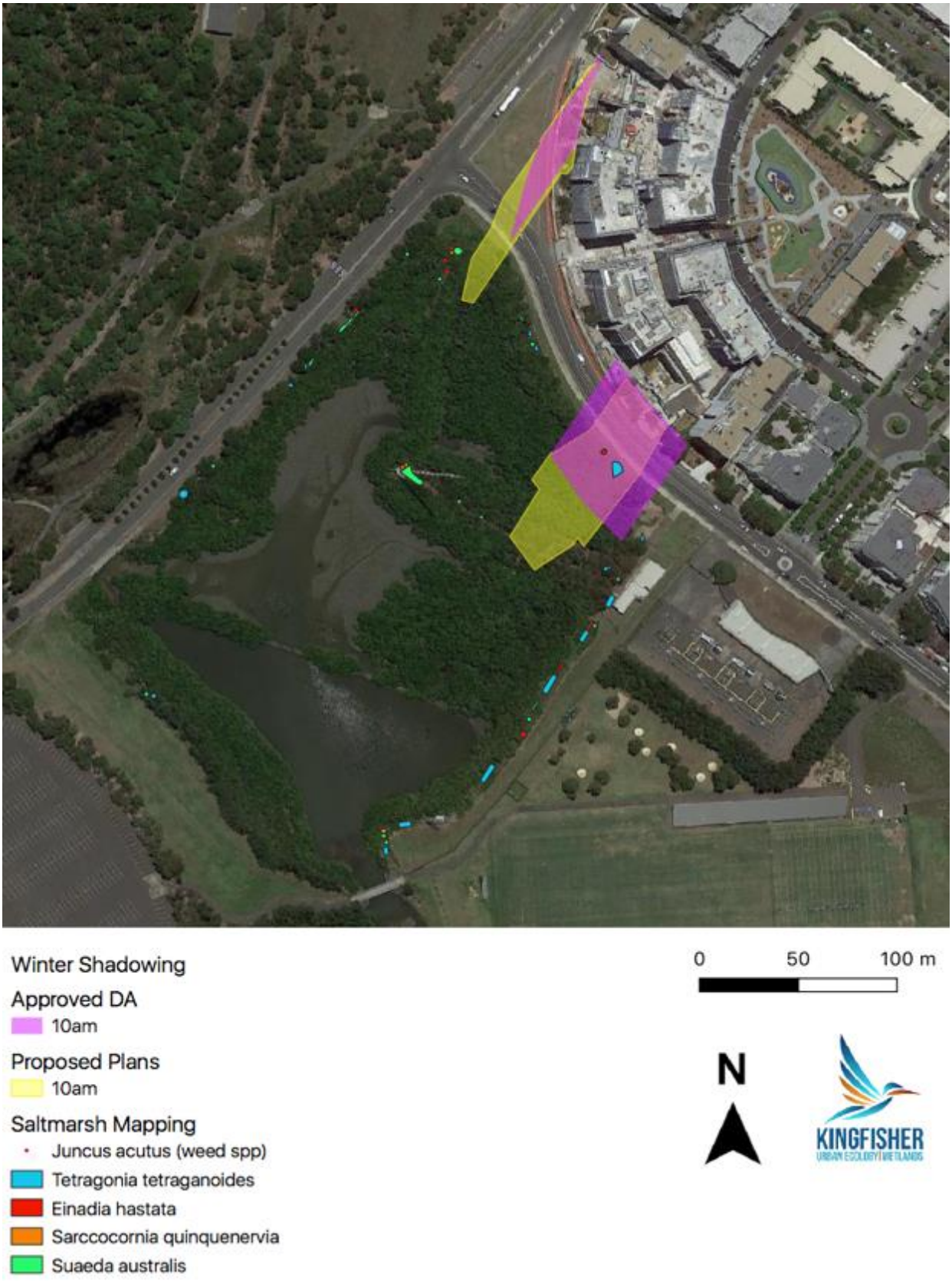


Figure 5.1. 10am Winter

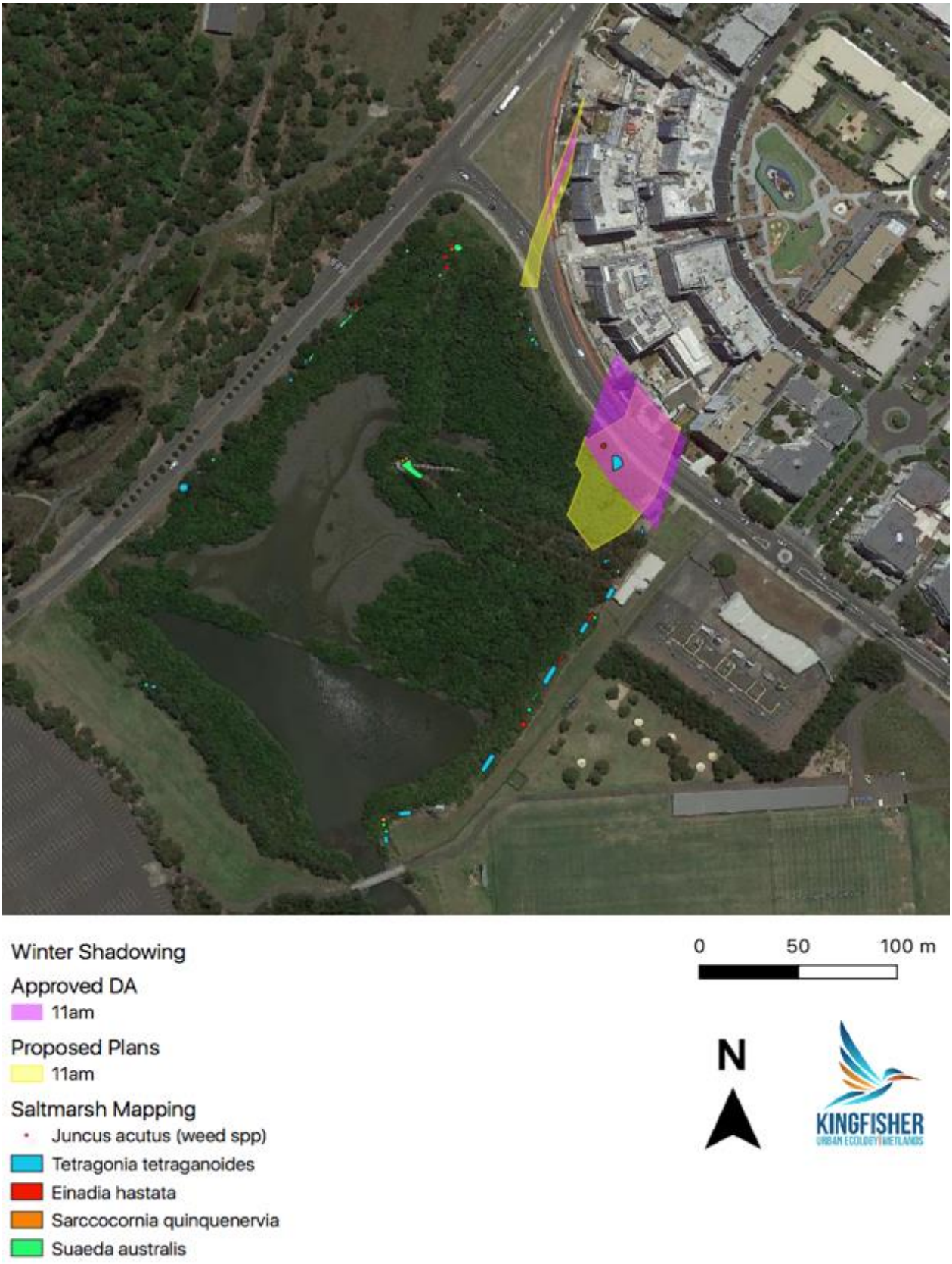


Figure 5.2. 11am Winter

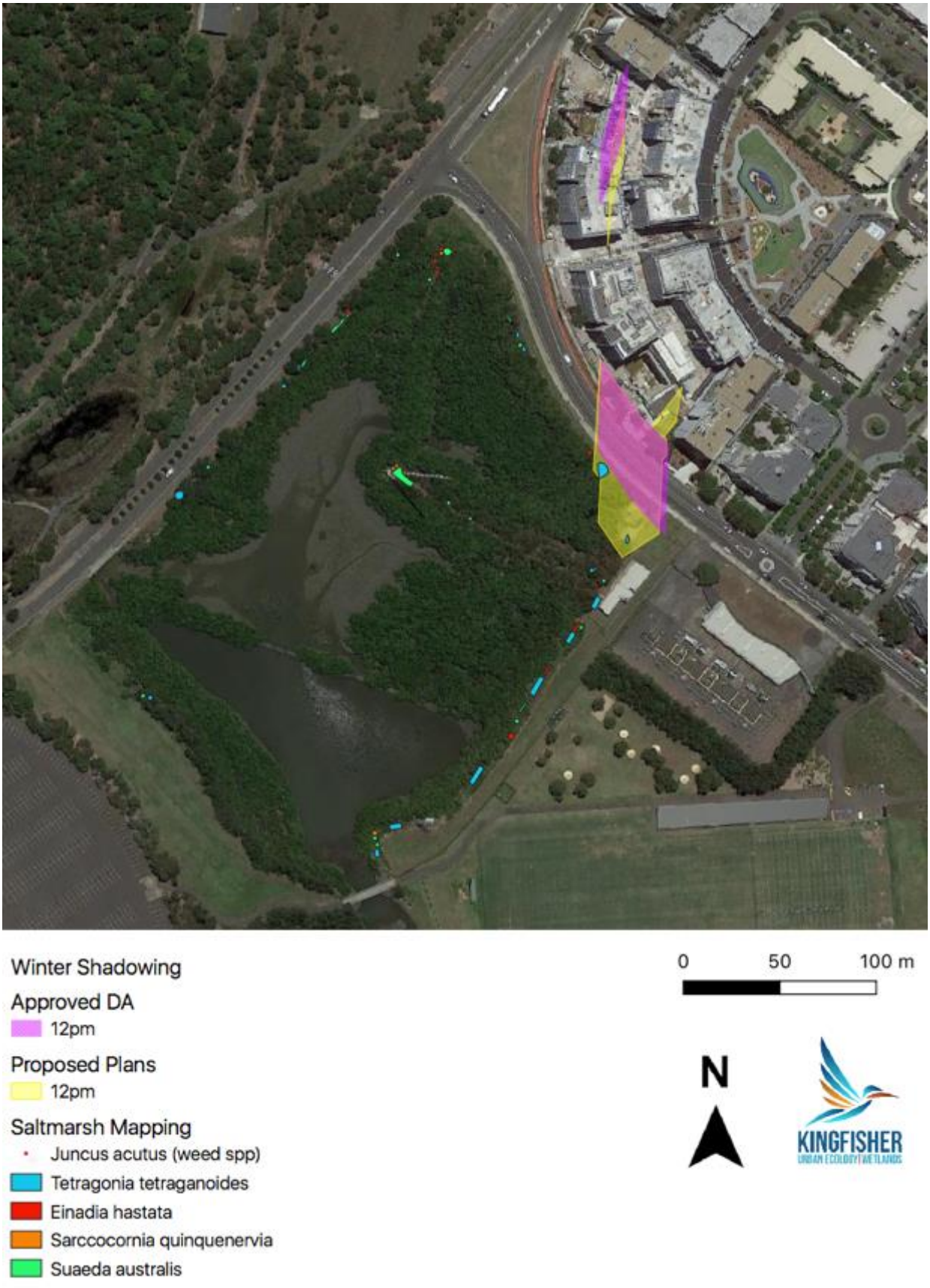


Figure 5.3. 12pm Winter

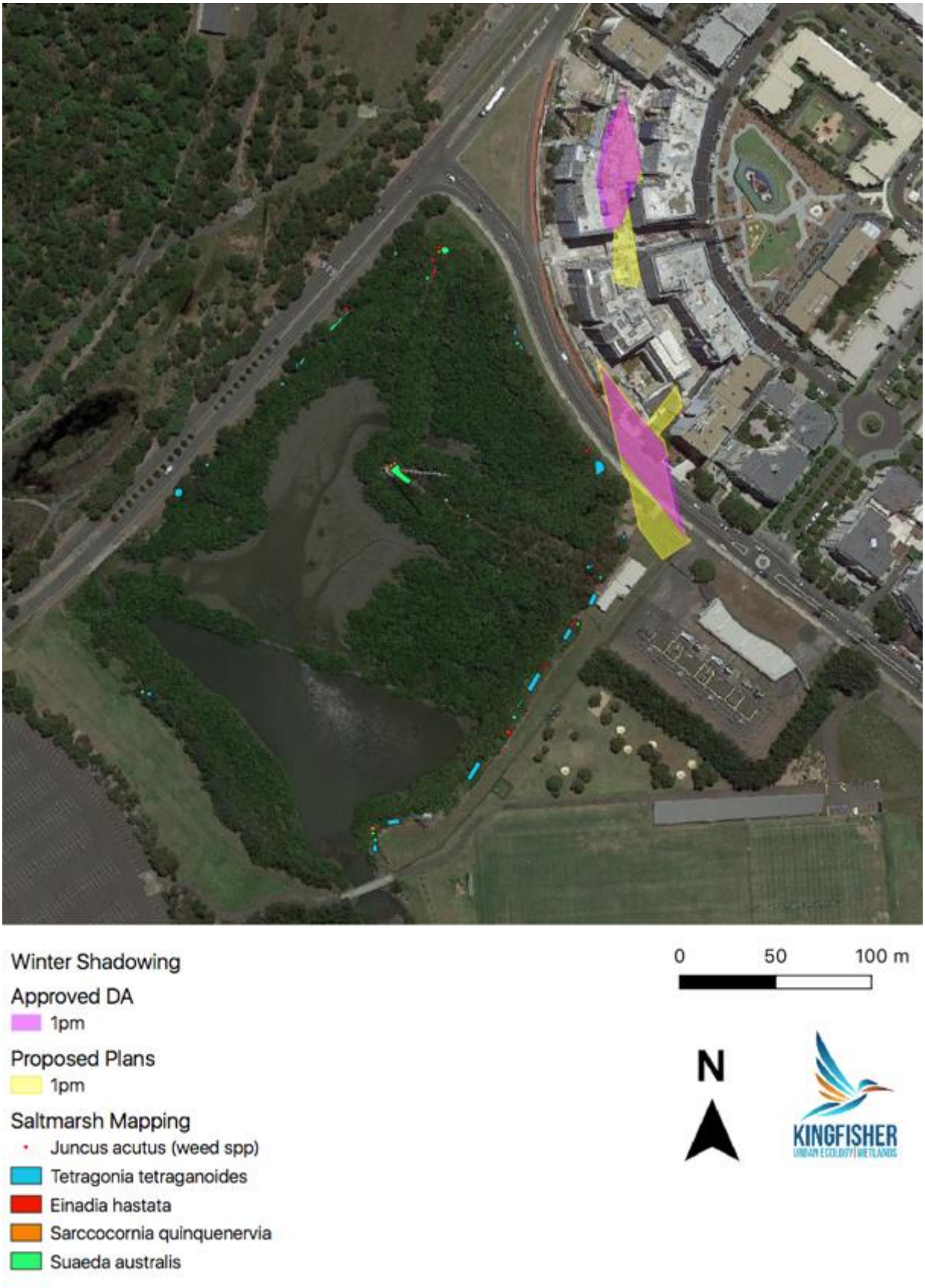


Figure 5.4. 1pm Winter

7.2 Shadow analysis upon mapped vegetation communities – Proposed and Approved.

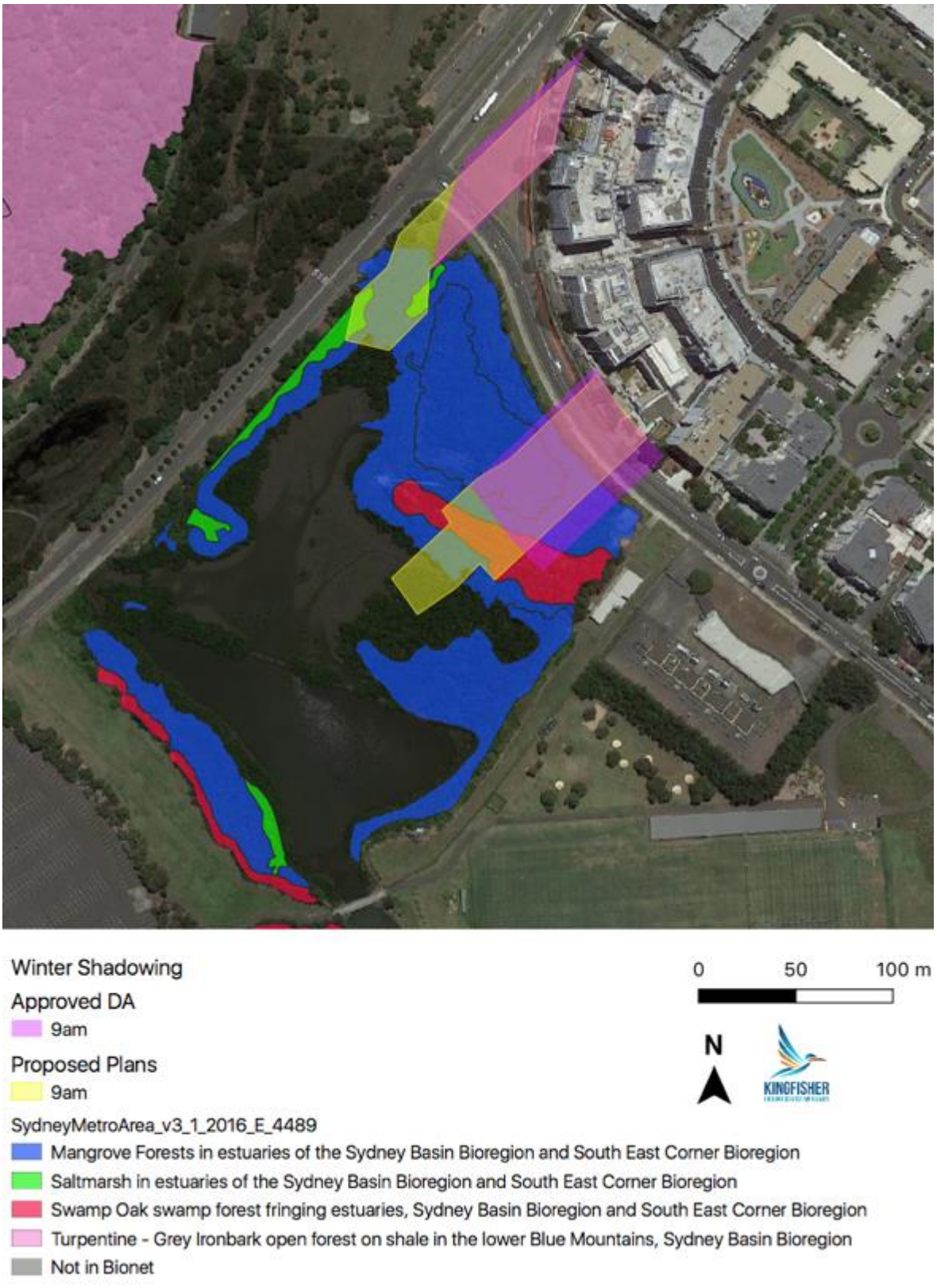


Figure 6.0. 9am Winter

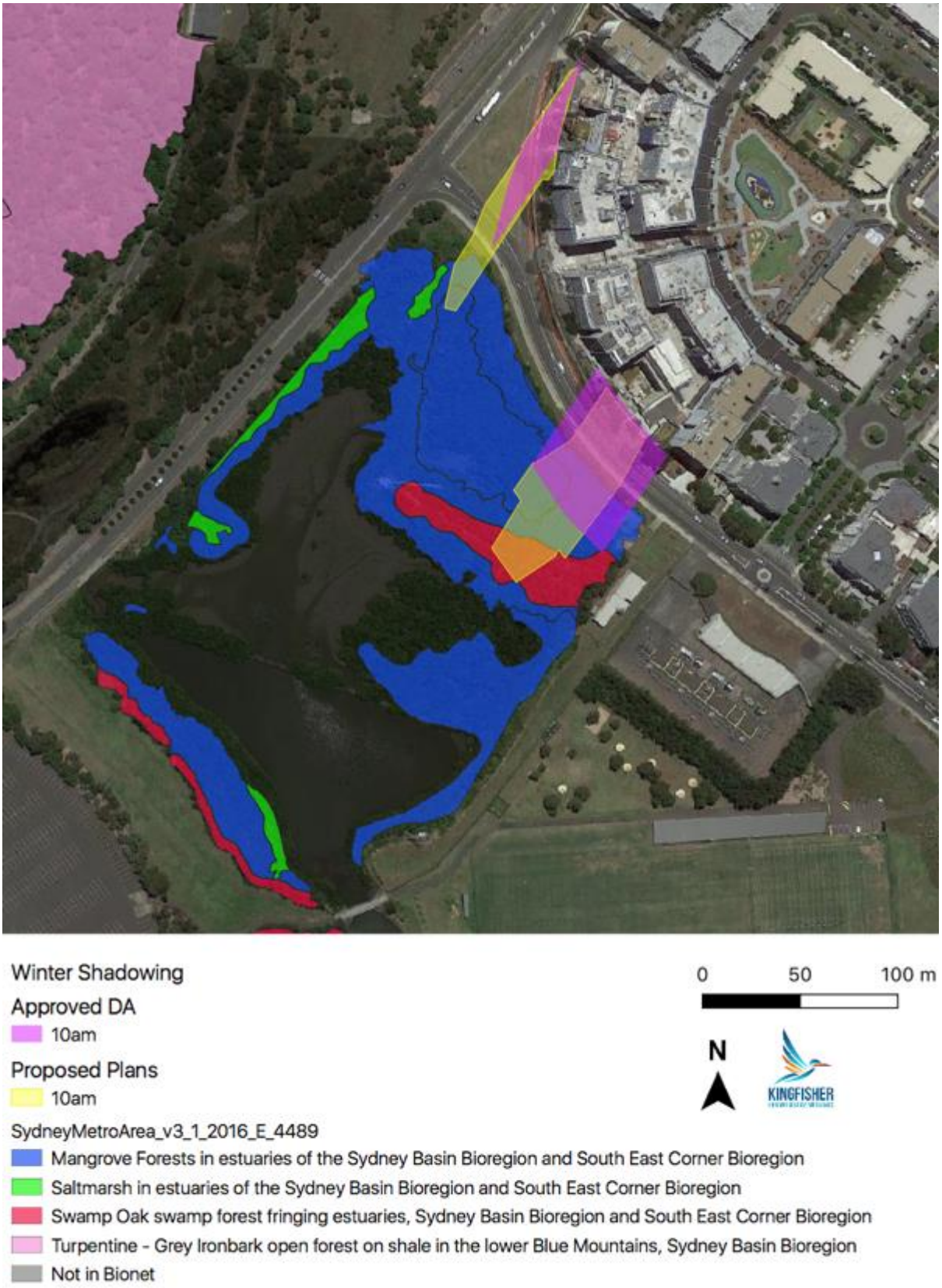


Figure 6.1. 10am Winter

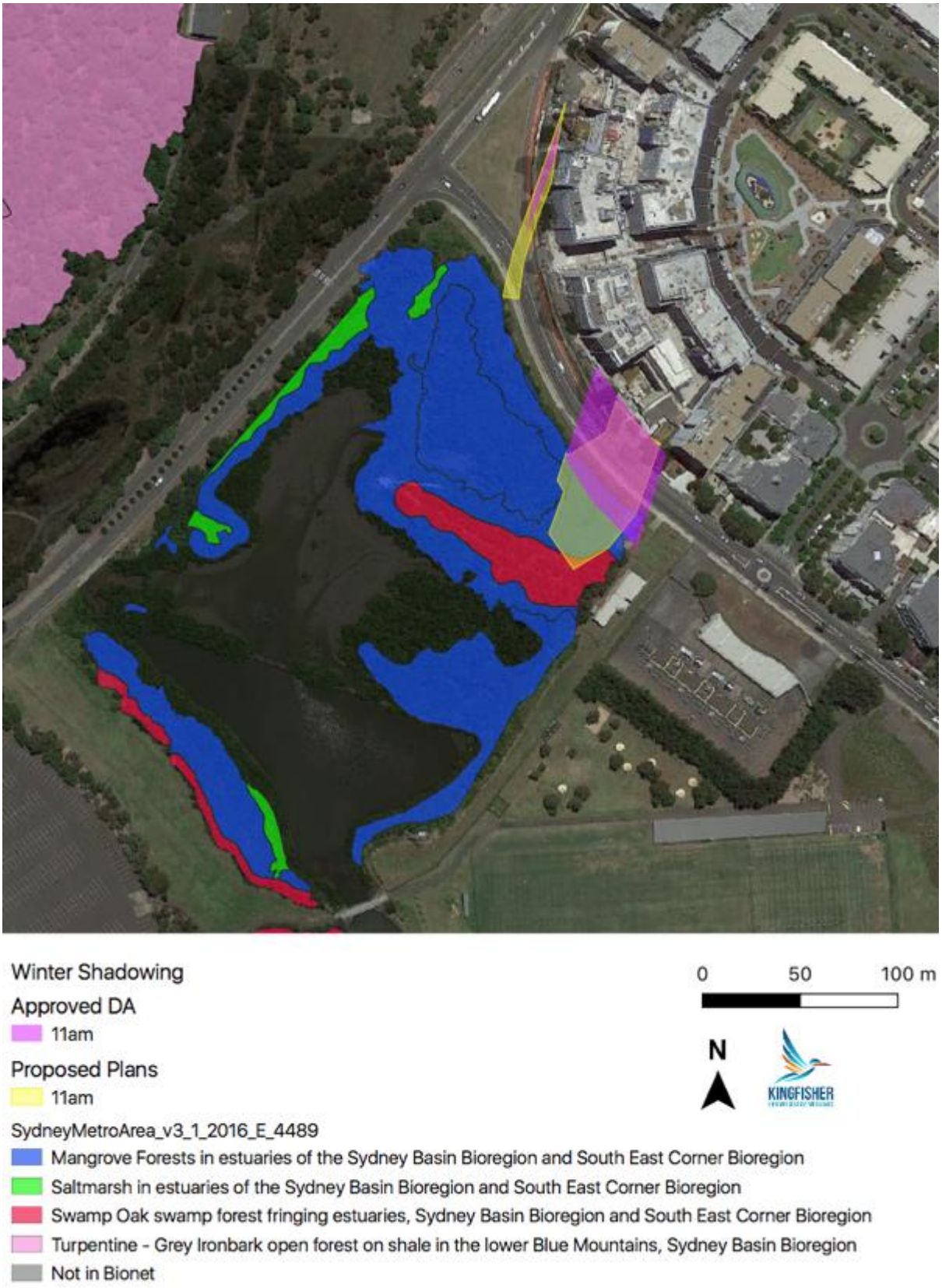


Figure 6.2. 11am Winter

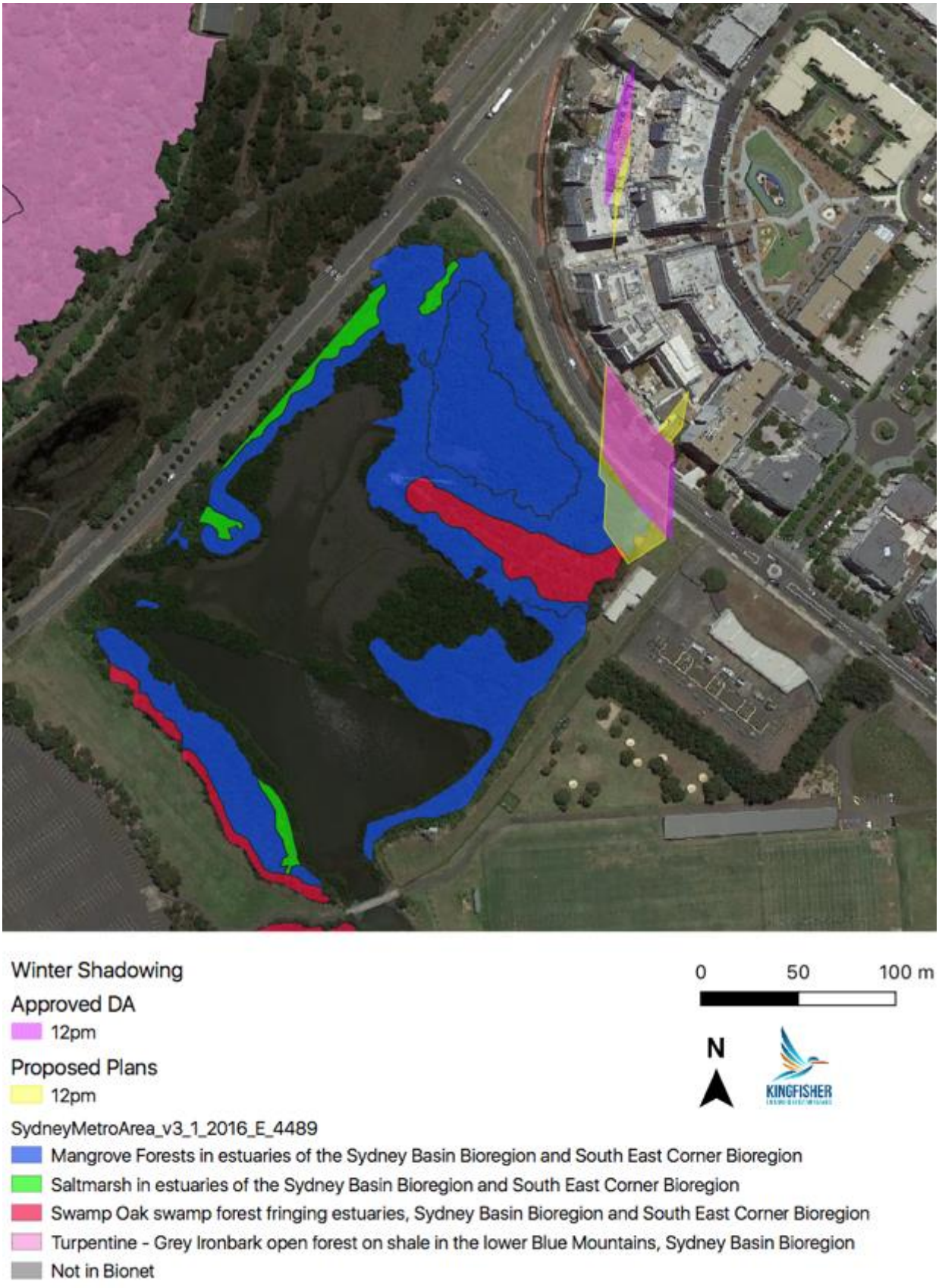


Figure 6.3. 12pm Winter

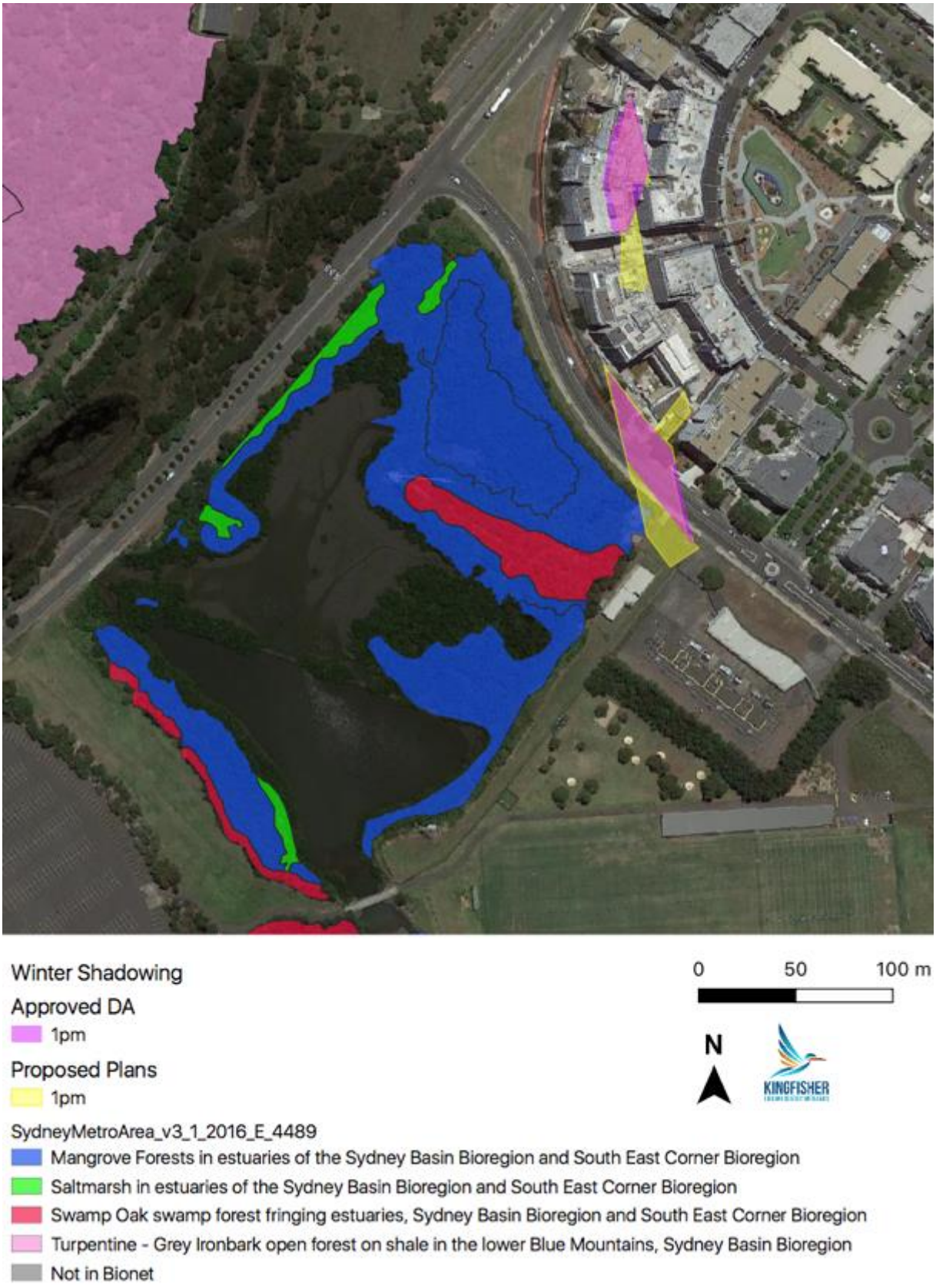


Figure 6.4. 1pm Winter

7.3 Spring Shadowing – Current Proposal.

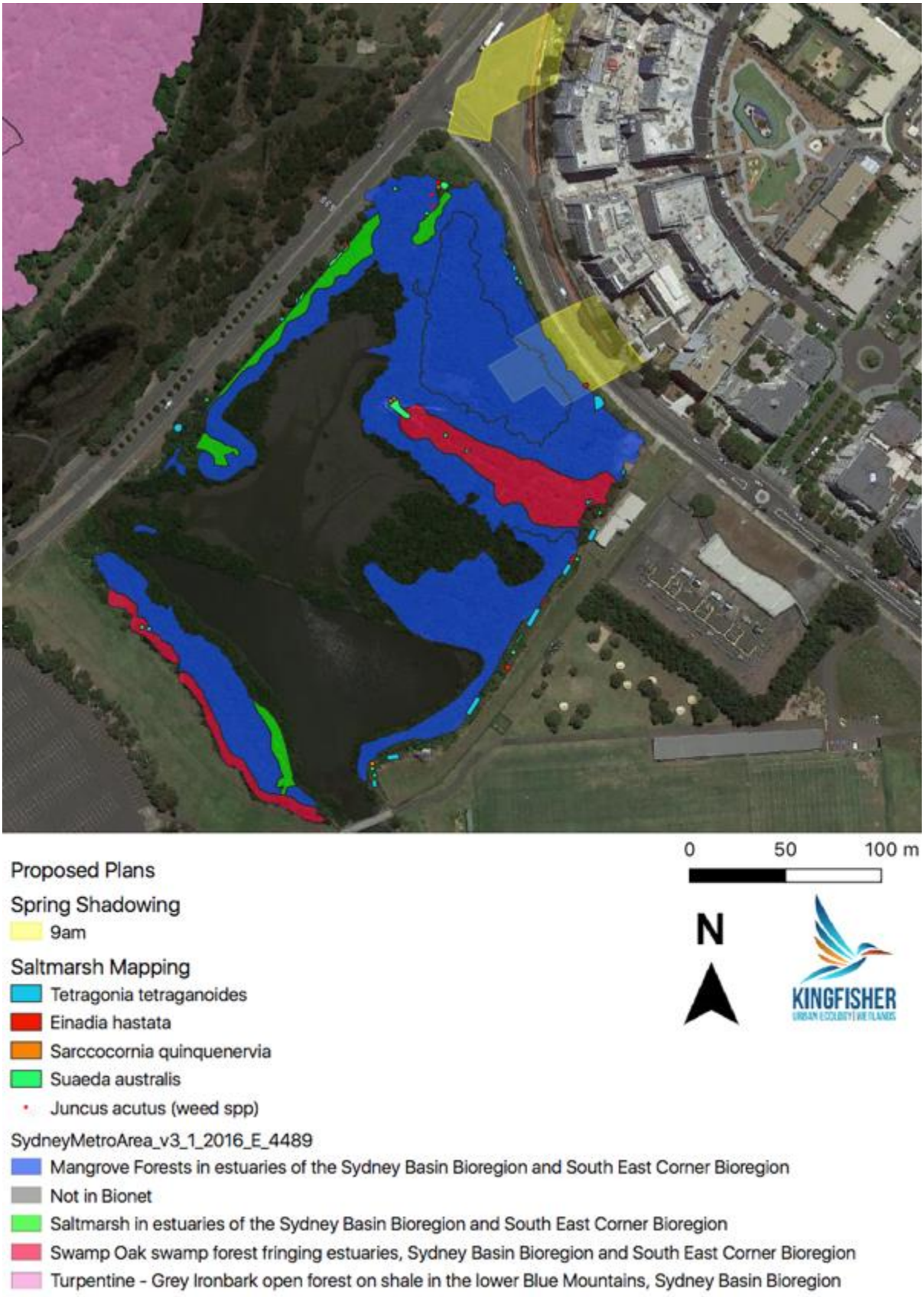


Figure 6.5. 9am Summer – Current proposal.

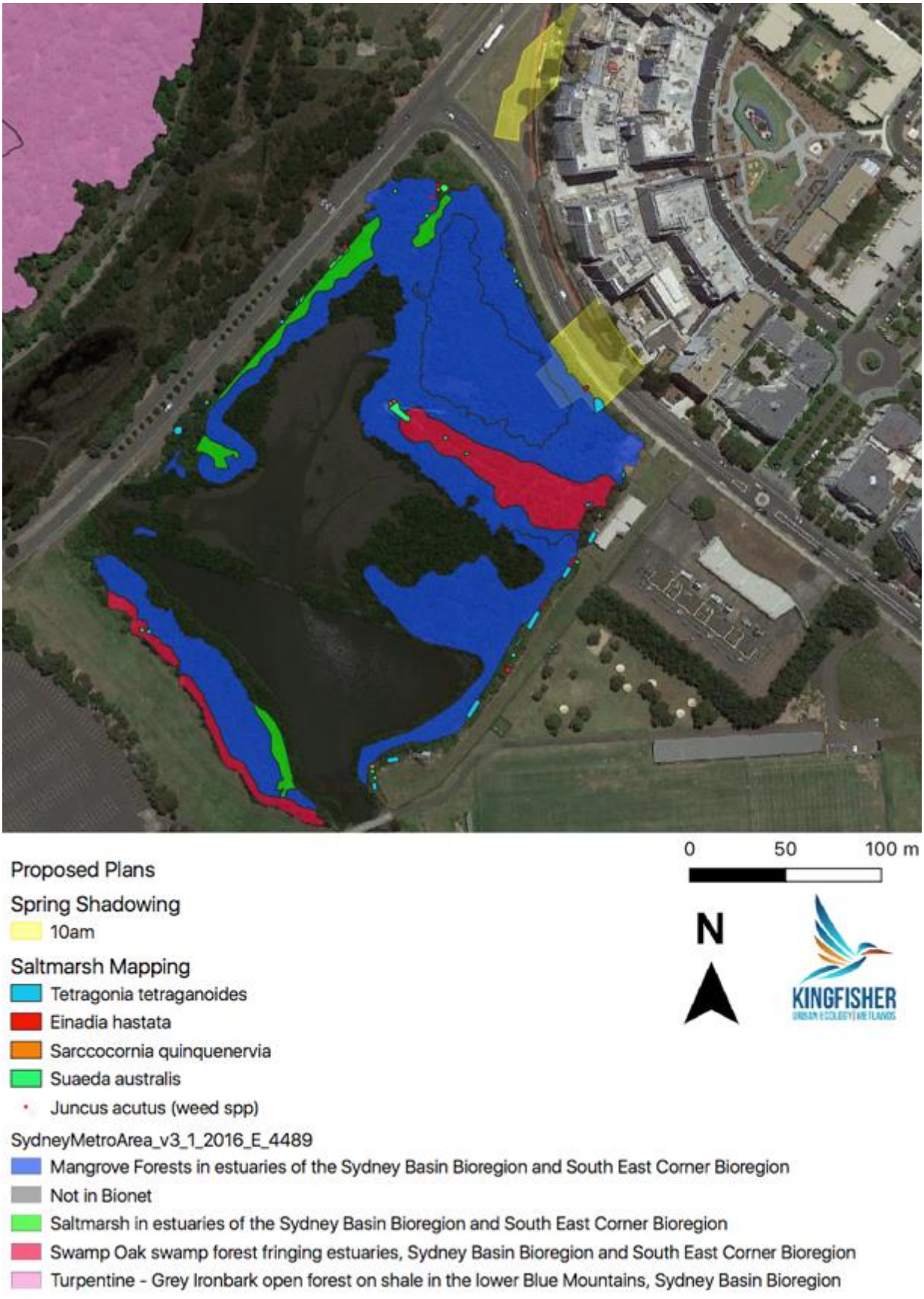


Figure 6.6. 10am Summer – Current proposal.

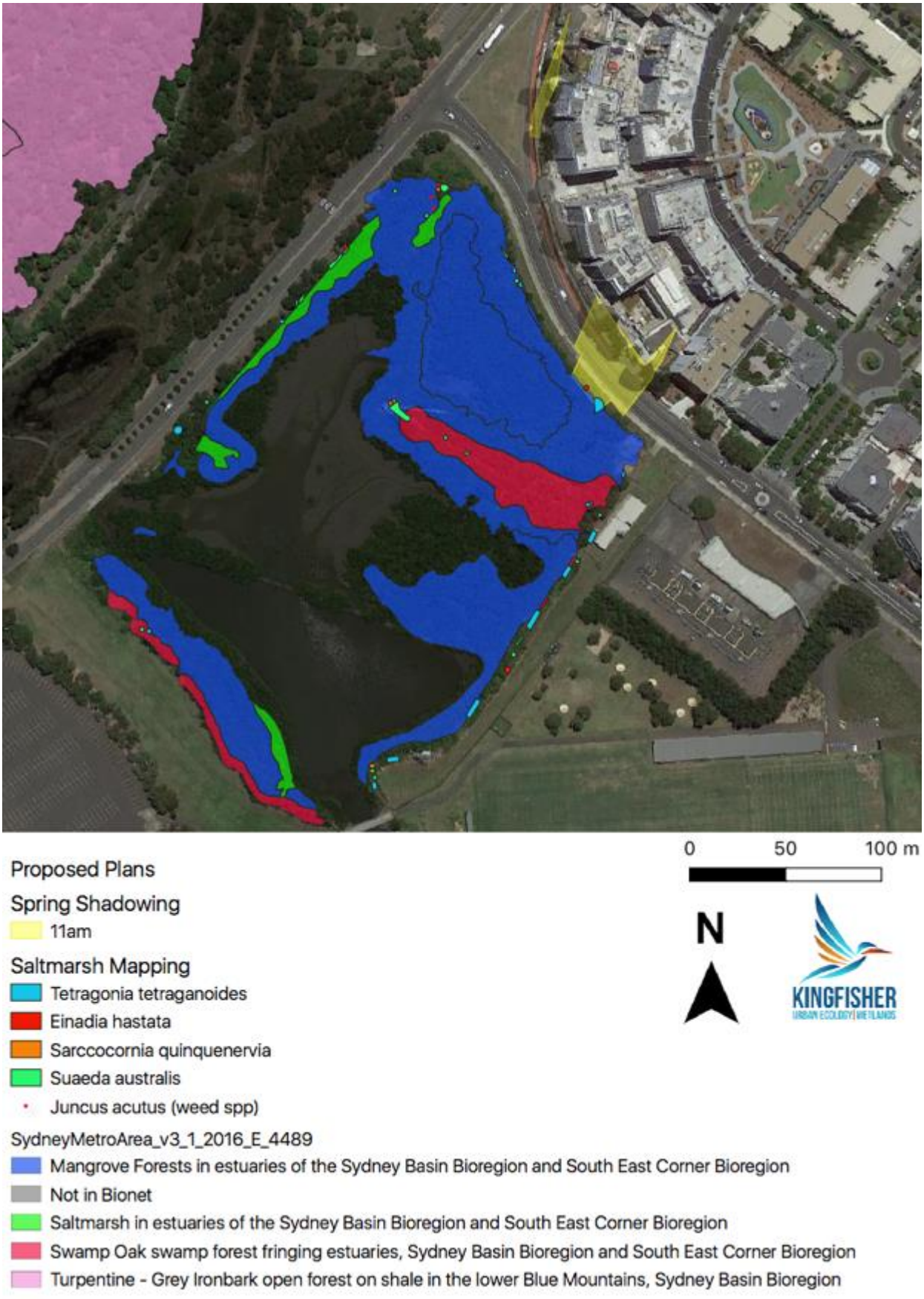


Figure 6.7. 9am Summer – Current proposal.

7.4 Summer Shadowing – Current proposal.

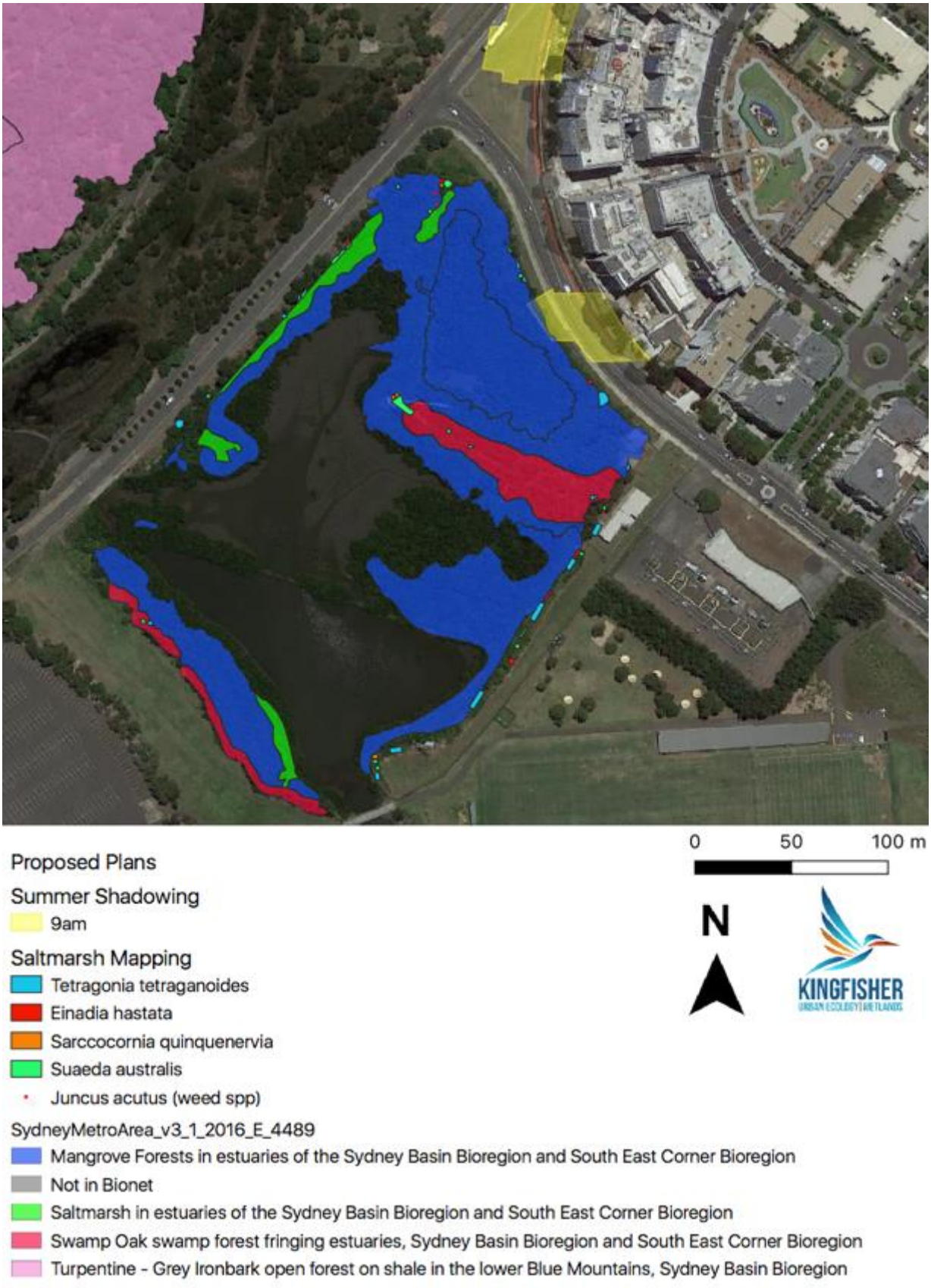


Figure 6.8. 9am Summer – Current proposal.

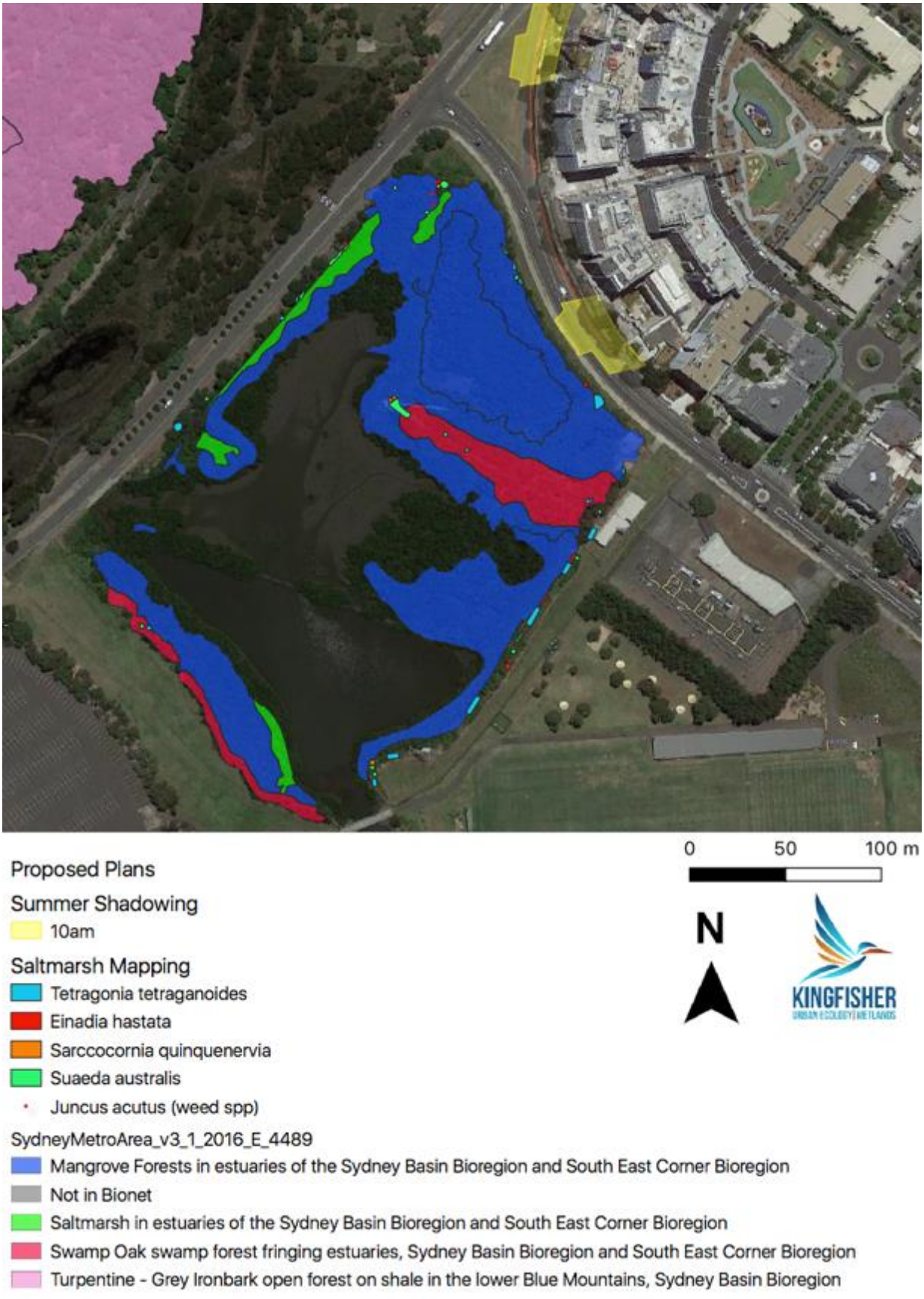


Figure 6.9. 10am Summer – Current proposal.

8 Expertise of authors

With over 20 years wetland and urban ecology experience, a great passion for what she does, and extensive technical and on-ground knowledge make Geraldene a valuable contribution to any project.

Geraldene has over 8 years local government experience as manager of environment and education for Pittwater Council. Geraldene presented papers on the topic at the NSW Coastal Conference, Sydney CMA and Hawkesbury Nepean forums. Geraldene is a Technical Advisor Sydney Olympic Park Wetland Education and Training (WET) panel.

Geraldene has up to date knowledge of environmental policies and frequently provides input to such works. Geraldene was a key contributor to the recent set of Guidelines commissioned by South East Queensland Healthy Waterways Water Sensitive Urban Design Guidelines. Geraldene's role included significant contributions and review of the Guideline for Maintaining WSUD Assets and the Guideline for Rectifying WSUD Assets.

Geraldene is a frequent contributor to many community and professional workshops on ecological matters particularly relating to environmental management. She is an excellent Project Manager.

Geraldene is a joint author on the popular book Burnum Burnum's Wildthings published by Sainty and Associates. Author of the Saltmarsh Restoration Chapter Estuary Plants of East Coast Australia published by Sainty and Associates (2013). Geraldene's early work included 5 years with Wetland Expert Geoff Sainty of Sainty and Associates. Geraldene is an expert in creating and enhancing urban biodiversity habitat and linking People with Place.

Geraldene Dalby-Ball
DIRECTOR

SPECIALISATIONS

- Urban Ecology – and habitat rehabilitation and re-creation.
- Urban waterway management – assessing, designing and supervising rehabilitation works
- Saltmarsh and Wetland re-creation and restoration – assessment, design and monitoring
- Engaging others in the area of environmental care and connection
- Technical Advisor – environmental design, guidelines and policies
- Sound knowledge and practical application of experimental design and statistics
- Project management and supervision
- Grant writing and grant assessment
- Budget estimates and tender selection
- Expert witness in the Land and Environment Court

CAREER SUMMARY

- **Director and Ecologist**, Ecological Consultants Australia. 2014-*present*
- **Director and Ecologist**, Dragonfly Environmental. 1998-*present*
- **Manager** Natural Resources and Education, Pittwater Council 2002-2010
- **Wetland Ecologist** Sainty and Associates 1995-2002

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Science with 1st Class Honors**, Sydney University
- WorkCover WHS General Induction of Construction Industry NSW White Card.
- Senior First Aid Certificate.
- **Practicing member** Ecological Consultants Association of NSW
- **Accredited BioBank Assessor**

Jack is a passionate ecologist who has worked with various stakeholders across both the public and private sectors to deliver sustainable environmental outcomes. He has worked on projects with major construction contractors and has been able to deliver tailored environmental solutions on time and within budget.

As an undergraduate student, he published a study that examined the cost of revegetation across the Richmond River Catchment in NSW. This study provided Jack with a deep understanding of urban and landscape ecology and the environmental factors associated with habitat restoration.

He has advanced communication skills and can deliver professional ecological assessments. He has a thorough understanding of current NSW and Commonwealth environmental legislation. He is also competent in the practical application of flora and fauna surveying and monitoring techniques.

Jack would be a valuable addition to any ecology project as he is committed to achieving the best possible outcome for both the client and the environment.

Key Projects Include:

- Monitoring of Endangered Species, various locations
- Environmental consultant for many civil developments throughout the Sydney region
- Researching the On-farm costs of revegetation in the Richmond River Catchment
- Sustainable business transformation proposal for a retail store.

Jack Hastings

ECOLOGIST

SPECIALISATIONS

- Urban and landscape ecology – design and re-creation
- Environmental Impact Assessments (EIA)
- Review of Environmental Factors for development applications
- Flora and Fauna management plans
- Habitat tree assessment, marking and mapping
- GIS mapping
- Sound understanding and practical application of experimental design
- Grant writing and grant assessment

CAREER SUMMARY

- **Ecologist**, Ecological Consultants Australia. *2019-present*
- **Environmental Consultant,** BBN Consulting. *2018-2019*

QUALIFICATIONS AND MEMBERSHIPS

- **Bachelor of Environmental Science, Southern Cross University.**
- **Certificate II Agriculture.**
- **WHS General Induction of Construction Industry NSW White Card.**