21 March 2023
Our Ref: 20909G.5RP.docx

planning consultants

Adam Susko
Principal Planner
Development Assessment – North Team
Northern Beaches Council
PO Box 82
MANLY NSW 1655

By Email: Adam.Susko@northernbeaches.nsw.gov.au

Dear Adam

Development Application No. DA2022/1649 for alterations and additions to the Narrabeen North Public School and Narrabeen Sports High School at 6 and 10 Namona Street, North Narrabeen

We refer to Development Application No. DA2022/1649 for alterations and additions to the Narrabeen North Public School (NNSP) and the Narrabeen Sports High School (NSHS) at 6 and 10 Namona Street, North Narrabeen (the site) submitted by School Infrastructure NSW (SINSW) on behalf of NSW Department of Education to Northern Beaches Council (Council) on 18 October 2022.

We also refer to the request for additional information received from Heritage NSW (James Quoyle) in respect to the proposed development as follows:

> *"There is an Arborist report for the southern section. The applicant should provide the Arborist Report and assessment for the northern area of the site within which the SHR item is located and address the proposed removal of the two Eucalyptus botryoides."*

Please see attached letter prepared by City Plan dated 20 March 2023 (the City Plan letter) which provides a response to the above stated request for information from Heritage NSW in relation to the proposed development and which also provides the following specialist/ consultants reports which were submitted to Council with DA22/1649:

- Heritage Impact Statement for Narrabeen Educational Precinct prepared by City Plan Heritage (September 2022); and
- Arboricultural Impact Assessment for Narrabeen North Public School by Independent Arboricultural Services (12 September 2022).

The City Plan letter states as follows:

> *"The subject trees 55 and 58 (Eucalyptus botryoides) are not identified as being of State heritage significance, and the assessment of their removal was undertaken as a part of the overall Heritage Impact Statement (HIS) and Arboricultural Impact Assessment (AIA) submitted for the above-noted DA submission (DA2022/1649) (See attached HIS and AIA submitted for the main DA). Our assessment notes that the SHR listing relates to the Binishell B only, and the trees within the curtilage are not noted as being of State heritage significance in the Statement of Significance and the SHR listing form; rather the native landscaping and mounds are noted in the description only.*
>
> *Notwithstanding, a comparison of the historical aerial imagery between the years of 1951 and 1978 clearly shows that the subject trees within the SHR curtilage of the Binidomes were introduced following the construction of the Binidomes in the 1970s. Although the subject tees are considered in the Arboricultural Impact Assessment report as being of High ecological significance, they do not contribute significantly to the historical landscaping of the site. Therefore, their removal will have a negligible impact on the setting of the Binidomes and the overall landscape setting of the Narrabeen North Public School."*

Should you have any queries, please contact Rob Player, Managing Director of DFP Planning.

Yours faithfully
DFP PLANNING PTY LTD

ROBERT PLAYER
MANAGING DIRECTOR

rplayer@dfpplanning.com.au

Encl.

dfp

planning consultants

ATTACHMENT

City Plan Heritage P/L
ABN 46 103 185 413

20 March 2023

Our Ref: H-22027

The Executive Director
Heritage NSW
Department of Premier and Cabinet
Locked Bag 5020
PARRAMATTA NSW 2124
heritagemailbox@environment.nsw.gov.au

Dear Sir/Madam,

RE: RESPONSE TO 'REQUEST FOR INFORMATION' FROM HERITAGE NSW - NARRABEEN EDUCATIONAL PRECINCT (DA2022/1649)

The following brief letter has been commissioned by the NSW Department of Education, Northern Sydney Asset Management Unit (NSAMU), in response to the request for additional information by Heritage NSW for the Development Application (DA2022/1649) lodged to the Northern Beaches Council for alterations and additions to an educational establishment at 6 Namona Street and 10 Namona Street, North Narrabeen NSW 2101 (subject sites).

We note that the additional information relates to the proposed removal of the two Eucalyptus botryoides (Trees 55 and 58) located within the SHR Curtilage. Heritage NSW has already received an arborist report for the southern section of the subject site and seeks an additional Arborist Report and assessment for the northern area of the site that includes the assessment of the proposed removal of the two Eucalyptus botryoides.

The subject trees 55 and 58 (Eucalyptus botryoides) are not identified as being of State heritage significance, and the assessment of their removal was undertaken as a part of the overall Heritage Impact Statement (HIS) and Arboricultural Impact Assessment (AIA) submitted for the above-noted DA submission (DA2022/1649) (See attached HIS and AIA submitted for the main DA). Our assessment notes that the SHR listing relates to the Binishell B only, and the trees within the curtilage are not noted as being of State heritage significance in the Statement of Significance and the SHR listing form; rather the native landscaping and mounds are noted in the description only.

Notwithstanding, a comparison of the historical aerial imagery between the years of 1951 and 1978 clearly shows that the subject trees within the SHR curtilage of the Binidomes were introduced following the construction of the Binidomes in the 1970s. Although the subject trees are considered in the Arboricultural Impact Assessment report as being of High ecological significance, they do not contribute significantly to the historical landscaping of the site. Therefore, their removal will have a negligible impact on the setting of the Binidomes and the overall landscape setting of the Narrabeen North Public School.

We trust this brief response letter enclosing the detailed Heritage Impact Statement and Arboricultural Impact Assessment for assessing the proposed works at Narrabeen Educational Precinct will satisfy the heritage requirements in assessing the proposed alterations and additions to the educational establishment.

Should you have any questions or wish to discuss the matter further, please do not hesitate to contact the undersigned on 8270 3500 / 0414 421 035 or at kerimed@cityplan.com.au.

Yours Sincerely,

Kerime Danis
Director - Heritage

Enclosed:

Heritage Impact Statement for Narrabeen Educational Precinct prepared by City Plan Heritage (September 2022)

Arboricultural Impact Assessment for Narrabeen North Public School by Independent Arboricultural Services (12 September 2022)

Heritage Impact Statement

Narrabeen Educational Precinct

6 Namona Street, North Narrabeen NSW 2101

Submitted to JohnStaff Pty Limited
On Behalf of Schools Infrastructure NSW

SEPTEMBER 2022

REPORT REVISION HISTORY

Revision	Date Issued	Revision Description		
01	08/08/2022	DRAFT		
		Prepared by	**Reviewed by**	**Verified by**
		Asmita Bhasin *Heritage Consultant*	Kerime Danis *Director - Heritage*	 Kerime Danis *Director - Heritage*
02	23/08/2022	REVISED DRAFT		
		Prepared by	**Reviewed by**	**Verified by**
		Asmita Bhasin *Heritage Consultant*	Kerime Danis *Director Heritage*	Kerime Danis *Director Heritage*
03	15/09/2022	FINAL		
		Prepared by	**Reviewed by**	**Verified by**
		Asmita Bhasin *Heritage Consultant*	Kerime Danis *Director Heritage*	Kerime Danis *Director Heritage*

Acknowledgement of Country

City Plan acknowledges the First Nations Peoples upon whose lands and waters we live and work, we respect their cultural heritage and continuing connection to Country and thank them for protecting the coastline and its ecosystems through time. We acknowledge that sovereignty over these lands and waters has never been ceded and extend our respect to Elders past, present and emerging. We proudly operate from the lands of the Gadigal, Darkinyung, Danggan Balun and Turrbal Peoples.

Copyright

Disclaimer

This report has been prepared by City Plan Heritage P/L with input from a number of other expert consultants (if relevant). To the best of our knowledge, the information contained herein is neither false nor misleading and the contents are based on information and facts that were correct at the time of writing. City Plan Heritage P/L accepts no responsibility or liability for any errors, omissions or resultant consequences including any loss or damage arising from reliance in information in this publication.

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FIGURES

1. BACKGROUND

1.1. Introduction

City Plan Heritage (CPH) has been engaged by JohnStaff Pty Limited, on behalf of NSW Department of Education - School Infrastructure, to prepare this Heritage Impact Statement (HIS) to accompany a Development Application[1] to Northern Beaches Council for new development and upgrading works to Narrabeen Educational Precinct.

Narrabeen Educational Precinct comprises of Narrabeen North Public School and Narrabeen Sports High School. Narrabeen Educational precinct is located at Namona Street, North Narrabeen NSW 2101 (subject site). Within North Narrabeen Public School are Binishell structures, which are locally listed heritage items (item no. 2270341) in Part 1 of Schedule 5 attached to the *Pittwater Local Environmental Plan 2014* (LEP) and is protected under the *Environmental Planning and Assessment Act 1979* (NSW). Under Section 5.10 (4) of Pittwater LEP 2014, Council is obliged to '*…consider the effect of the proposed development on the heritage significance of the item or area concerned'.* This HIS has been prepared to assist the Council in its consideration of the proposed development. All recommendations are made in accordance with statutory requirements and cultural heritage best practice.

1.2. The Site

The subject sites are located at 6 and 10 Namona Street, North Narrabeen (referred to as the Narrabeen Education Precinct) and falls within the local government area of Northern Beaches Council. The Narrabeen Education Precinct has a total area of 9.84 hectares, as shown in Figure 1. The site contains two irregular portions of land with Namona Street in between further connected with Pittwater Road and in close proximity to Narrabeen Lagoon and Tributary Mullet Creek.

Figure 1: Site Aerial Map indicating the location of the subject site (indicated in blue) within its surrounding context (Source: Nearmap).

Narrabeen North Primary School (NNPS) is located on the northern side of Namona Street, North Narrabeen and is legally described as Lot 3 Deposited Plan (DP) 1018621. NNPS is surrounded by

[1] Schools Infrastructure NSW determined the works to be local development, based on their size and scale, and the appropriate approval pathway is lodgement of a Development Application with Northern Beaches Council, the consent authority.

residential dwellings to the east, grassed sporting fields (Warriewood Valley Sportsground) to the north and Northern Beaches Indoor Sports Centre to the west.

Narrabeen Sports High School (NSHS) is located on the southern side of Namona Street and is legally described as Lot 12 DP 1119562. NSHS is surrounded by Pittwater Road to the east, Pittwater Sports Centre to the south and Mullet Creek to the west.

For a more detailed description of the site and its context, see *Section 2.0 Site Description and Context*.

1.3. Legal Description

Narrabeen Education Precinct site comprises the following parcels of land on the records held by the NSW Land & Registry Services:

- Lot 3, DP 1018621 (Narrabeen North Public School)
- Lot 12, DP 1119562 (Narrabeen Sports High School)

1.4. Heritage listing

NNPS contains two (2) Binishell domes (Block A and Block B) which are identified as a local heritage item under Part 1 of Schedule 5 of the Pittwater Local Environmental Plan 2014 as 'Concrete Geodesic Domes (North Narrabeen Public School)', (item no. 2270341) at 6 Namona Street comprising Lot 3 of DP1018621. The two (2) Binishell Domes are listed as State significant on DoE's Section 170 Heritage and Conservation Register. The Double Binishell Dome (Block B) is listed on the State Heritage Register (SHR) under the NSW Heritage Act, 1977 as part of the 'The Binishell Collection (Department of Education)' (SHR no. 02037) listing. The SHR listing curtilage excludes Bini Shell A, which remains as a local heritage item.

In addition, the basic search of the Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) identified zero Aboriginal Sites and Places recorded in or near the subject site within a buffer of 50 and 200 meters.

The subject site is also located in proximity to the following heritage items:

- '"Alma's Tree", Moreton Bay Fig Tree', 1468 Pittwater Road, Warriewood (item no. 2270331)
- 'Warriewood Wetland', 14 Jacksons Road, Warriewood (item no. 2270516)

Figure 2. Heritage Map showing the location of North Narrabeen Public School (indicated in red) within its current heritage context (Source: Pittwater LEP 2014, Heritage Map - Sheet HER_019).

1.5. Proposal

The proposed Narrabeen Education Precinct development includes redevelopment of Narrabeen North Public School (NNPS) and Narrabeen Sports High School (NSHS). The Public School and High School have been identified by the NSW Department of Education (DoE) as requiring upgrade works.

The works at NNPS upgrade the school include combination of demolition of existing buildings (Blocks H and J), construction of three (3) new buildings with refurbishment of three (3) existing buildings (Blocks B, K and V), which will be subject to separate approval pathways as detailed below.

The works at NSHS upgrade include addition of new two (2) storey extension to Building A, construction of new single storey amenities building and refurbishment of four (4) existing buildings (Buildings A, B, C and K).

The project will undergo through five different planning pathways with the following scope of works for each:

- **Tree Removal DA:** Removal of up to thirty (30) trees at NNPS and nine (9) trees at NSHS to facilitate the following planning pathway works;
- **Development Application (Regionally significant development):** New hall & admin block with COLA (NNPS); Refurbishment and extension to Building A (NSHS); trees within the SHR curtilage including Trees 55, 57 and 58; two trees within COLA of Block A.
- **Exempt Development:** Removal and/or relocation of existing demountable buildings (NNPS);
- **Development without consent (REF):** Demolition of Blocks H, J and the amphitheatre; upgrades to Block B, K and V; and construction of new two (2) storey GLS building (NNPS).
- Refurbishment and upgrades to Buildings A, C and K (NSHS).
- **Designated Development:** New substation associated conduit connections; new hydrant booster associated conduit connections; removal of 10 trees in coastal wetland; pathways from Namona Street and NBISC area.

This HIS has been prepared to accompany the Development Application (DA) to Northern Beaches Council to seek consent for the following works at NNPS & NSHS. It is noted that works, including Demolition of Blocks H, J and the amphitheatre, upgrades to Block B, K and V, construction of new two (2) storey GLS building (NNPS), and refurbishment and upgrades to Buildings A, C and K (NSHS) forms part of the Development without consent (REF) and is not a part of the DA. However, this assessment has included the works for the purposes of explaining impacts in relation to heritage matters.

The works subject to the Development Application (DA) at NNPS comprise:

- Construction of a new two (2) storey building containing administration facilities, multi-purpose hall and out-of-school-hours care (OSHC) facility on the ground floor with staff facilities and amenities on the first floor;
- New Covered Outdoor Learning Area (COLA); and
- Removal of trees within the SHR including Trees 55, 57 and 58.

The works subject to the DA at NSHS comprise:

- Alterations and additions to Building A (Gymnasium) to create new stage for gymnasium and new two (2) storey addition comprising canteen, boys and girls changing rooms and staff room on the ground floor; and movement studio and two (2) new General Learning Spaces (GLS) on the first floor.

The proposed development does not seek to increase staff or student numbers.

Architectural Drawings - DesignInc Sydney Pty Ltd			
Date	Title	Drawing No	Revision
0000 - General & Site Information			

Architectural Drawings - DesignInc Sydney Pty Ltd			
23.08.2022	Cover Sheet, Location Plan & Drawing List	DA-P-0101	B
18.08.2022	Site Analysis	DA-P-0200	A
18.08.2022	Photomontage - New Admin & Hall	DA-P-0210	A
18.08.2022	Materials Board - New Admin & Hall	DA-P-0220	A
18.08.2022	3D Site Topography Height Plane	DA-P-0302	A
18.08.2022	3D Site Topography Height Plane - New Admin & Hall	DA-P-0303	A
23.08.2022	New Site Plan - School - Ground Floor	DA-P-0521	B
23.08.2022	New Site Plan - School - Level 01	DA-P-0522	B
23.08.2022	New Site Plan - School - Roof	DA-P-0523	B
18.08.2022	Shadow Diagrams	DA-P-0600	A
1000 - GA Plans			
18.08.2022	New Hall & Admin - Ground Floor	DA-P-1040	A
23.08.2022	New Hall & Admin - Level 1	DA-P-1041	B
23.08.2022	New Hall & Admin - Roof Plan	DA-P-1042	B
3000 - Elevations & Sections			
18.08.2022	New Admin & Hall - Site Elevations	DA-P-3001	A
18.08.2022	New GLS Hub - Site Elevations	DA-P-3002	A
18.08.2022	New Admin & Hall - GA Elevations	DA-P-3040	A
23.08.2022	New Hall & Admin - GA Elevations	DA-P-3041	B
18.08.2022	New Hall & Admin - GA Sections	DA-P-3042	A

Landscape Drawings - DesignInc Sydney Pty Ltd			
Date	Title	Drawing No	Revision
19.08.2022	Cover Sheet	LA-DA-P-0010	A
19.08.2022	Masterplan	LA-DA-P-0020	A
19.08.2022	Site Plan	LA-DA-P-0100	A

Landscape Drawings - DesignInc Sydney Pty Ltd			
19.08.2022	Sheet Layout	LA-DA-P-0110	A
19.08.2022	Tree Removal	LA-DA-P-0120	A
19.08.2022	Canopy Cover	LA-DA-P-0130	A
19.08.2022	Overall Plan	LA-DA-P-1000	A
19.08.2022	GA Plan 01	LA-DA-P-1001	A
19.08.2022	GA Plan 02	LA-DA-P-1002	A
19.08.2022	Fencing Plan	LA-DA-P-1101	A
19.08.2022	Planting Plan 01	LA-DA-P-2001	A
19.08.2022	Planting Plan 02	LA-DA-P-2002	A
19.08.2022	Sections/Elevation 01	LA-DA-P-3001	A
19.08.2022	Sections/Elevations 02	LA-DA-P-3002	A
19.08.2022	Typical Details 01	LA-DA-P-4001	A
19.08.2022	Palette/Schedules	LA-DA-P-5001	A

Relevant Reports and Statutory Instruments

The following previous studies and reports were reviewed during production of this report. Relevant information has been included where necessary:

- Pittwater Local Environmental Plan (LEP) 2014.
- Pittwater 21 Development Control Plan (DCP).
- Pittwater Heritage Inventory
- *Narrabeen Education Precinct - Heritage Report for Masterplan,* OCP Architects, 5 November 2019
- *Narrabeen Education Precinct, Historical Archaeological Assessment,* AMBS Ecology & Heritage, October 2019
- *A Heritage Assessment - Binishells NSW* for School Infrastructure NSW Department of Education dated May 2019, prepared by Anne Warr Heritage Consulting

1.6. Methodology

This HIS relates to the proposed redevelopment works to the existing school complex at 6 and 10 Namona Street in North Narrabeen. This HIS has been prepared in accordance with the NSW *Heritage Manual* publications, *Statements of Heritage Impact*, *2002* and *Assessing Heritage Significance, 2001*. It is also guided by the philosophy and processes included in *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013* (Burra Charter).

The subject development has been assessed in relation to the relevant controls and provisions contained within the Pittwater LEP 2014 and the Pittwater 21 DCP. It forms one of a collection of specialist reports.

Research for this HIS has adopted a two-stepped approach. Step 1 comprised a desktop assessment and Step 2 was a site survey. This document provides the combined findings and recommendations resulting from this approach.

Step 1

Research into the early development of the site was undertaken to get a better understanding of the place. In addition, the Aboriginal Heritage Information Management System (AHIMS) was searched to establish the location and background information on any Aboriginal objects or Aboriginal Places that are known to have special significance with respect to Aboriginal culture. Further, the Pittwater LEP 2014 and the SHR were examined to determine the known heritage values of the subject site and the items in vicinity.

Step 2

A site survey of the subject site and the surrounding context was carried out by Kerime Danis (Director-Heritage) and Asmita Bhasin (Heritage Consultant) on 1 April 2022 with the purpose of photographing and understanding the place. All results are presented in *Section 2 - Site Context and Description*.

1.7. Constraints and limitations

- This report does not include a heritage landscape assessment
- The assessment in this report relates to the proposed works and documentation described in Section 1.5 - Proposal and Section 1.6 - Methodology. It does not relate to any additional or revised documentation by any party.
- This report does not include an archaeological assessment or opinions regarding such matters; neither does it form part of a Section 140 Application for an Excavation Permit or Section 144 Application for an Excavation Variation Permit
- This report does not include an assessment of Aboriginal values.
- Only a visual assessment of the subject site was carried out. Intrusive methods were not employed.
- This report does not include for the provision of a title search for the subject site.

1.8. Author Identification

This report has been prepared by Asmita Bhasin (Heritage Consultant) under the direction of Ms Kerime Danis (Director - Heritage) who has also provided input, reviewed, and endorsed its content.

1.9. Acknowledgements

CPH acknowledge the work and assessment undertaken by the following authors, which has been utilised in the preparation of this report:

- *Heritage Report for Masterplan - Narrabeen Education Precinct, Namona Street, North Narrabeen* for School Infrastructure NSW dated November 2019, prepared by OCP Architects.
- *Historical Archaeological Assessment - Narrabeen Education Precinct* for OCP Architects dated October 2019, prepared by AMBS Ecology + Heritage.
- *A Heritage Assessment - Binishells NSW* for School Infrastructure NSW Department of Education dated May 2019, prepared by Anne Warr Heritage Consulting.

2. SITE CONTEXT AND DESCRIPTION

2.1. Site Context

The subject site is located at 6 and 10 Namona Street, North Narrabeen, within the Northern Beaches Local Government Area (LGA) and approximately 22km northeast of the Sydney central business district (CBD). The surrounding setting can be defined as a largely low to a medium-density residential area with local and neighbourhood centres in the vicinity. A large part of the surroundings (northeast and west) of the school site comprises land allocated for Public Recreation.

Namona Street runs in between the two school sites, with Narrabeen North Public School in the north and Narrabeen Sports High School in the south. Jacksons Road runs north of Narrabeen North Public School. While the school is primarily accessible from Namona Street, Pittwater Road runs along the Narrabeen Sports High School in the east. Northern Beaches Indoor Sports Centre is also located adjacent to Narrabeen North Public School.

The site is also located in proximity to a number of heritage items, described in *Section 1.4 - Heritage listing*.

Figure 3: Aerial view of the subject site (indicated in red boundary) within its surrounding context (Source: SIX Maps, accessed 6 June 2022).

2.2. Site Description

The subject site, as mentioned earlier has two school sites including Narrabeen North Public School (Lot 3 DP1018621) and Narrabeen Sports High School (Lot 12 DP 1119562). Narrabeen North Public School is located north of Namona Street and has structures listed as state and locally significant heritage items in Pittwater LEP 2014 and State Heritage Register.

2.2.1. Narrabeen North Public School

The buildings on the Narrabeen North Public School site include a series of individual demountable classrooms. The buildings include a combination of low-height permanent and demountable structures, where the permanent ones are constructed in brick and timber. The demountable structures are primarily located northwest and south of the public school. The buildings include:

- Building A / Binidome A - The singular Bini Shell, located at the centre of the public school, functions as an administration building (ground floor) with a library (first floor).
- Building B / Binidome B - The centrally double dome structure located adjacent to Binidome A functions as OOSH (Outside of School Hours) for Before and After School Care programs. The upper floor plate is used as storage space for the school.
- Building H - The building is a single-storey timber structure built in the 1950s, currently being used as a staff building. The building has a front-facing verandah with timber posts and supporting brackets, and timber flooring. The timber structure has a symmetrical façade with single-hung timber windows.
- Building J - Constructed in the 1950s, the building is a linear, single-storey timber structure functioning as another home base for the school. The building has a gabled roof form with north-facing covered verandah with timber posts and supporting brackets.
- Building K - Constructed in 1938, the brick building is a single-storey structure with a covered porch facing north. The building has a symmetrical façade with horizontal brick bands. The building has single-hung timber framed windows with brick sills and lintels. The northern façade of the building has wrought iron lettering depicting the name and year of the school. The building is being used to conduct school programs and craft sessions.
- Building V - Constructed in 2010, the building is a single-storey weatherboard structure currently functioning as a home base and a library.

The oldest building, the original 1938 school house (currently known as K block), is a single-storey face brick building with a hipped roof clad in terracotta tiling. The building has a covered elevated porch facing north with metal posts.

Most of the buildings at Narrabeen North Public School are aligned along the east-west axis located in the east with three Bini Shells, two of which are interconnected and located at the centre. Pittwater LEP 2014 has categorised the three Bini Shells as significant items with the North Narrabeen Public School.

The following information provides a brief description and photographs of the school buildings that would be modified or demolished under the current proposed development.

Figure 4: View of Building J and Demountable located south of the Narrabeen North Public School, view looking northwest.

Figure 5: View of Building K (left) and Building H (right), view looking west.

Figure 6: View of Building P located southeast of Binidome A, view looking northeast.

2.2.2. Binidomes A and B

The school site comprises centrally located three Bini Shells, two of which are interconnected. The singular Bini Shell (Bini Shell A) currently functions as an administration building with a library, while the interconnected Bini Shell (Bini Shell B) is used to run OOSH (Outside of School Hours) - Before and After School Care programs. Both Bini Shells are centrally located within the Narrabeen North Public School site. Bini Shell A was one of the first 18-meter diameter domes constructed in New South Wales (NSW), while Bini Shell B, located adjacent to Bini Shell A, is one of the few dome structures formed of two interconnected domes, each 18 meters in diameter, constructed in steel and concrete with glass

windows. Both Bini Shells are surrounded by rectangular face brick and weatherboard school buildings with hipped roofs.

Constructed in c1974 by the Italian architect Dr Dante Bini, the Bini Shells are one of the few remaining concrete futuristic bubble structures within the Binishell Collection at the Department of Education. They demonstrate distinctive landmark aesthetic qualities within their significant landscaped setting.

Physical Description

The following physical description has been extracted from the State Heritage Inventory (SHI) form for 'Concrete Geodesic Domes (North Narrabeen Public School)' (item no. 2270341)[2]:

> *The dome is one of the most efficient structures ever developed but also one of the most difficult and costly to build. The development of the Binishell process of pneumatically inflating concrete made the construction of concrete domes possible with both speed and economy, and introduced a new dimension into the range of architecture in new educational buildings in NSW The first 18 metre diameter dome to be constructed in NSW was at Narrabeen North Public School, where a three-domed complex was erected. The project consisted of 2 interconnected domes, which were designed to be used as a library, while a third binishell served as an administration office for the school. The library had thick carpet covering a large part of the floor area, extending up the walls to the window sill level. Other parts of the floor were covered in deep brown quarry tiles and white floor tiles. Group activity, office, audio-visual work room and recreation areas were provided, along with toilets and a mezzanine floor. The library was furnished with circular moulded furniture imported from Italy, in bright colours of blue, green, white and yellow, which formed an effective contrast to the simple off-white colour of the interior walls. The administration unit incorporated a garden in the centre, with a small opening in the top of the dome. The unit contained two levels, with offices on the ground floor and staff facilities on the upper level. Materials used were concrete and steel (Glimpses 1989).*

Interiors

The Bini Shell A is a single dome structure with its primary and only entrance along the southern surface. The dome structure has a central courtyard enclosed by timber and metal framed louvred windows. The courtyard is used as an indoor garden space with a skylight that is one of the prominent sources of light and ventilation within the dome. A staircase runs alongside the central courtyard leading to the first-floor learning space. Around the courtyard is a corridor that connects with the administration rooms placed in a hexagonal layout. Amenities like toilets, etc., are located at the ground floor level. The dome structure has triangular openings on its surfaces with recessed fixed and openable windows.

The Binishell B is an interconnected, double dome structure constructed using a concrete and steel framework. The primary entrance at the south of the structure is recessed, forming a covered porch, while the other two entry-exit points are located alongside the northeast and northwest surfaces of the Binishell. The rear dome of Binishell B contains an open gathering/meeting hallway, while the front dome is utilised as a library, administration, and service area, including a kitchen, washrooms, and laundry rooms. The front dome has a staircase leading to the upper level, currently functioning as a storage and office space. The front dome also has windows along the southeast and southwest surface of the dome. The rear dome has a circular skylight in the middle of the ceiling for a continuous inflow of natural light.

The Binishell has internal timber and glass partitions. The front dome has segregated rooms with wall surfaces clad in low-height timber panelling. The structure has varied window types, including single hung, casement, and jalousie windows with timber and metal frames and clear glass. The doors at the entry and exit points are double doors with timber frames and clear glass windows on both sides. Other than the front entrance, located in the south, the building can be accessed through north-eastern and north-western openings as they are used as secondary access points.

The following images provide an overview of the existing external and internal presentation and configuration of the subject Bini Shells A and B.

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2 Concrete geodesic domes (North Narrabeen Public School)', State Heritage Inventory (SHI) form, available at https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=2270341

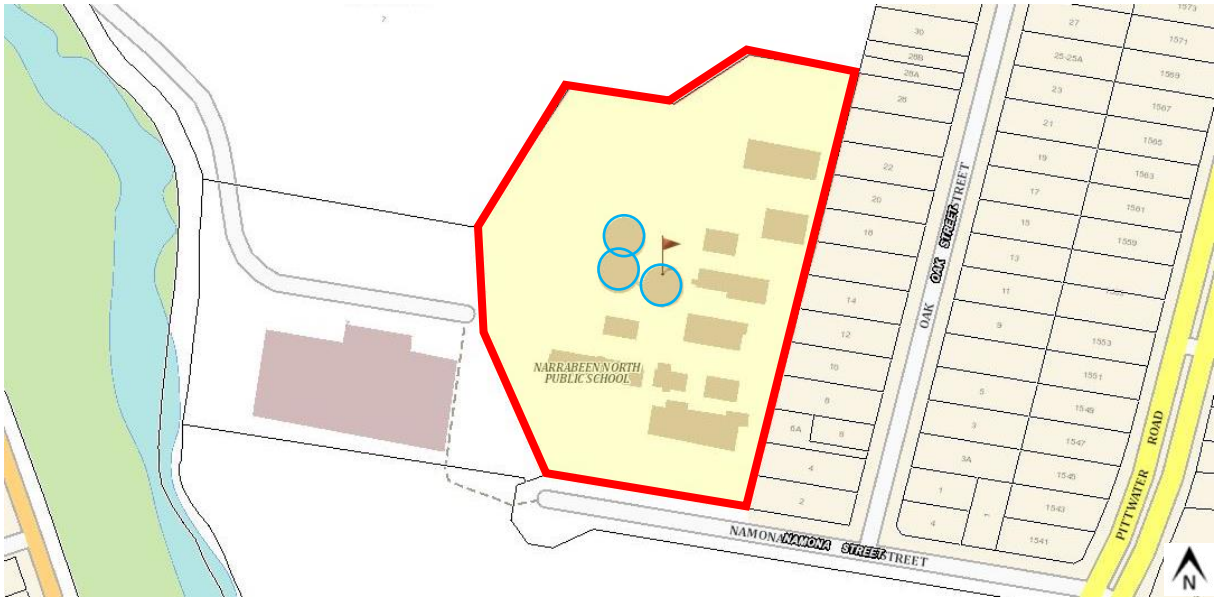

Figure 7: Bini Shells A and B (indicated in blue) located within the Narrabeen North Public School (subject site outlined in red) and their surrounding context and locality (Source: SIX Maps, accessed July 2022).

Figure 8: External view of Bini Shells A and B located in the center of North Narrabeen Public School, view looking northwest.

Figure 9: Primary entrance of Bini Shell B, view looking northwest.

Figure 10: Primary entrance of Bini Shell B, view looking northeast.

Figure 11: Secondary entrance/exit of Bini Shell B, view looking south. Note Bini Shell A to the most left of the image.

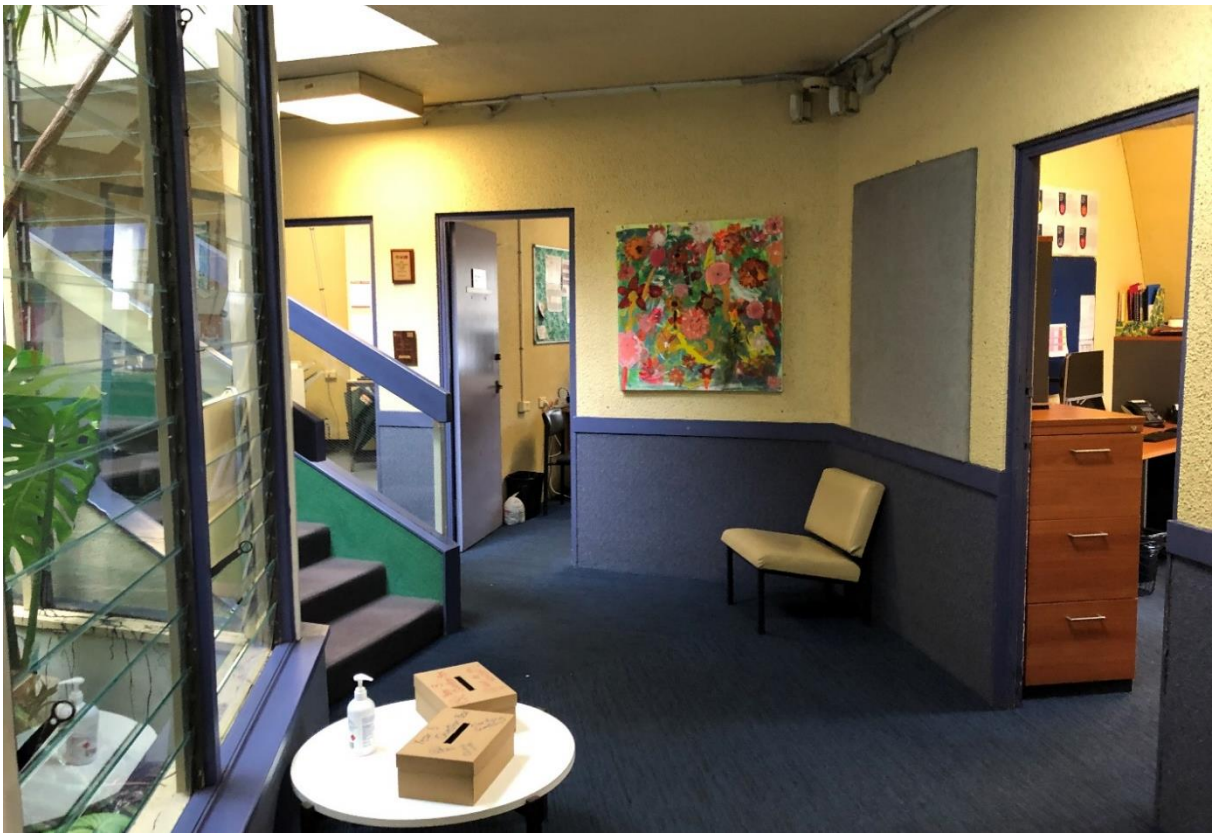

Figure 12: Internal layout of Bini Shell A with central enclosed courtyard (left) and administration area (right).

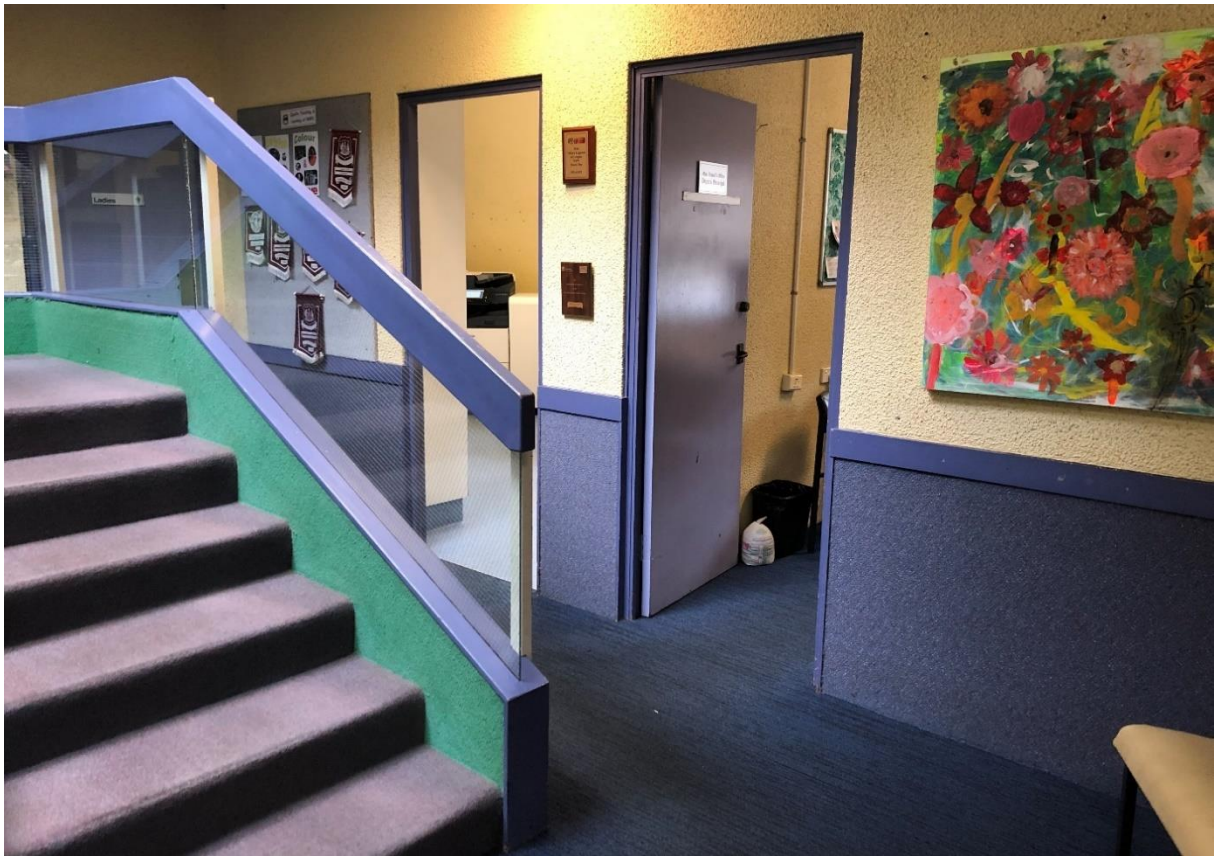

Figure 13: Staircase at Bini Shell A located adjacent to the enclosed courtyard space.

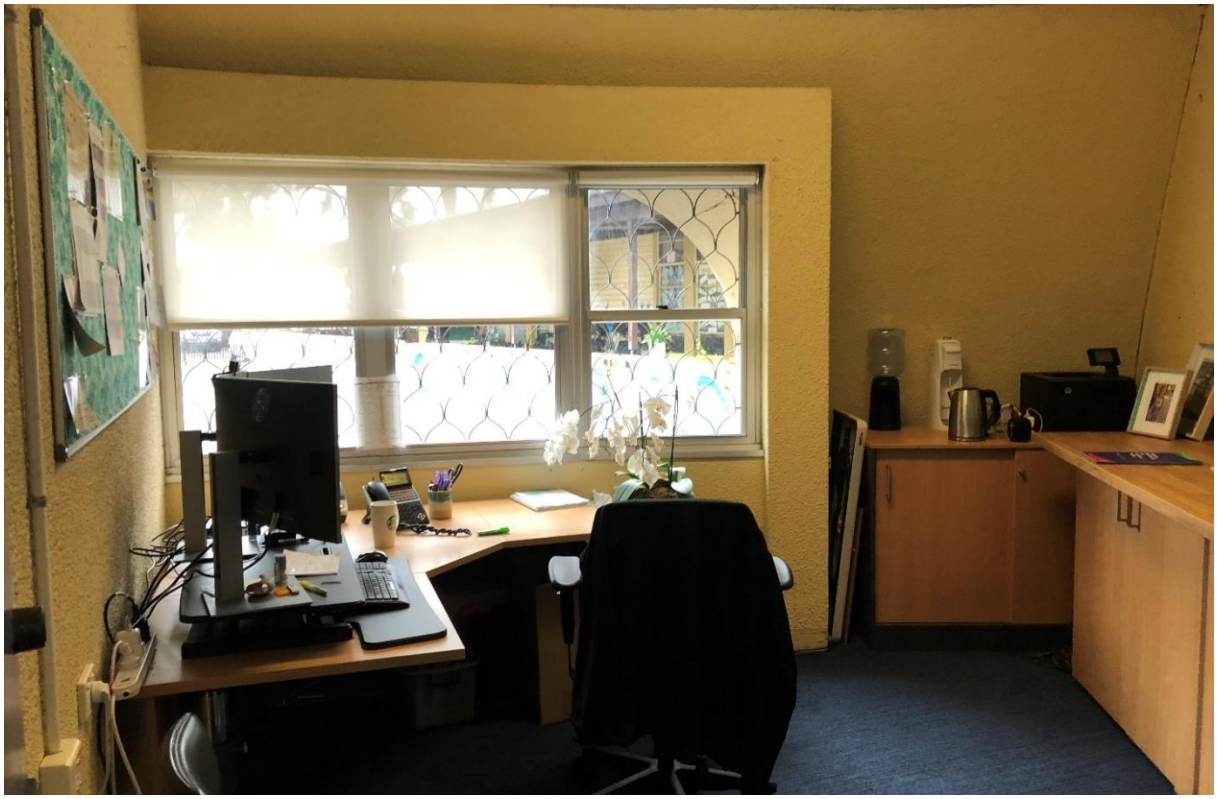

Figure 14: Administration room in Bini Shell A with single hung metal framed windows.

Figure 15: Learning space at first floor level in Bini Shell A.

Figure 16: Gathering Hall in the rear dome, view looking northwest.

Figure 17: Front dome with administration at ground floor and storage at the upper floor level.

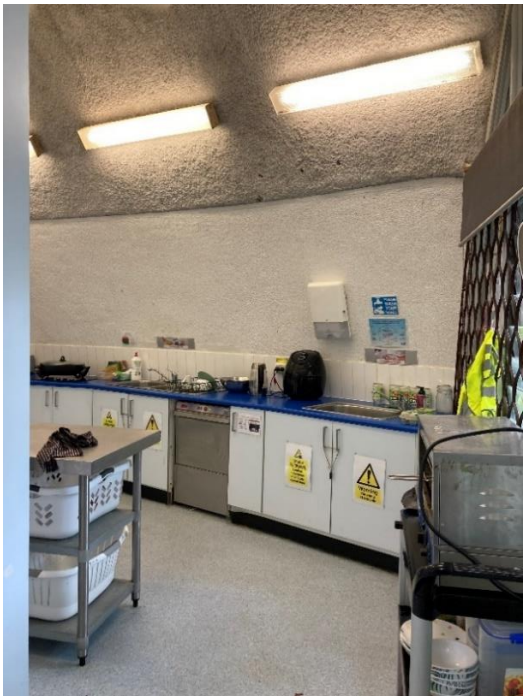

Figure 18: Kitchen in the front dome of Bini Shell B.

Figure 19: Irregular window openings in Bini Shell B kitchen.

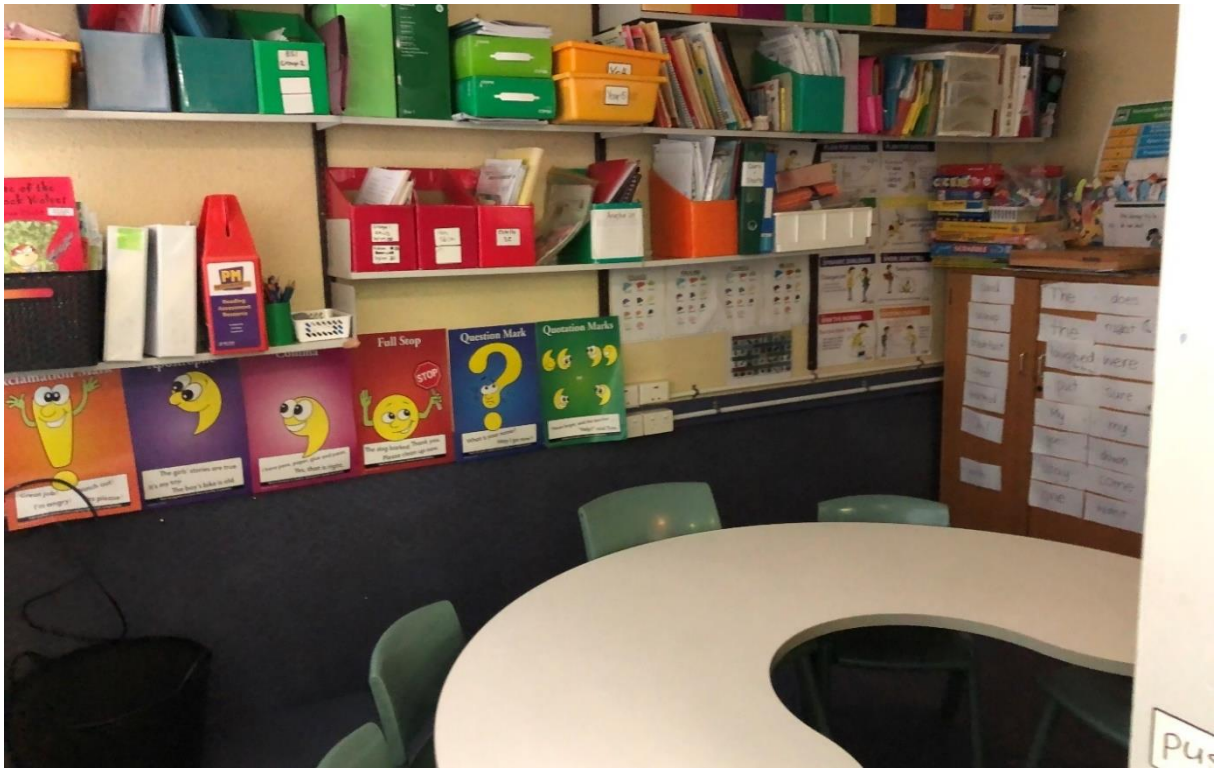

Figure 20: Internal leaning space at Bini Shell B with low-height timber wall panelling.

Figure 21: Existing secondary door and window openings at Bini Shell B, view looking northwest.

3. HISTORICAL OVERVIEW

The following history has been extracted from the Heritage Report for Narrabeen Education Precinct - Historical Archaeological Assessment by AMBS Ecology & Heritage in October 2019 for the subject site:[3]

3.1. The Northern Beaches

The Indigenous heritage of the Northern Beaches is unclear, while it was generally understood that the Guringai occupied the land, the term Guringai was a term coined in the nineteenth century and does not accurately represent the region (Aboriginal Heritage Office 2015:41). Prior to the amalgamation of Manly, Pittwater and Warringah councils into the Northern Beaches in 2016, Narrabeen was located within the shire of Warringah, an area occupying the Northern Peninsula from Manly to Palm Beach, the shire was created in 1905[4]. The first explorations into the region occurred in March 1788 by Captain Phillip when he sailed north to the bay now known as Brisbane Water on the Central Coast. In June 1792, the waters of Bayview, Newport, around Church Point and McCarrs Creek were surveyed by William Dawes when he walked from Manly to Barrenjoey[5].

The settlement of Warringah Shire was constrained by steep slopes and the lack of arable soil which limited agrarian pursuits; it was the lower slopes which were settled and cleared for farming and grazing (Figure 23)[6]. The earliest evidence of settlement occurs along the northern portion of the peninsula where there was access to the Hawkesbury River and the ocean[7]. Settlement in the southern portion of the shire occurred between 1810 and 1820[8]. While large land grants were made in the region, a lack of transportation and difficulties with the topography meant settlement was sparse and farms were few and far between[9]. Built structures during the early development of the region were simple with a mixture of timber structures and huts of slab and bark[10]. The first road was roughened out by James Jenkins, a key landholder in the region, in the early 1820s which went from Manly to Long Reef, this was later extended to Newport in the 1880s (Figure 22)[11]. It was not until the late nineteenth century with the establishments of roads and of a port at Newport when small pockets of the region were settled[12].

The first industries in the region focused around agrarian pursuits and exploitation of natural resources such as timber-getting and shell gathering[13]. Heavy industry did not flourish in the region, attempts were made to mine coal in the late nineteenth century; however, this did not prove to be profitable[14]. The twentieth century saw further exploitations of natural resources, in sand dredging and oyster leases, and a shift to urban businesses[15].

[3] AMBS Ecology and Heritage (October 2019), 'Narrabeen Education Precinct - Historical Archaeological Assessment', pp. 4 - 21.
4 Kennedy, B & Kennedy, B (1982). Sydney and Suburbs. A History & Description. Wellington: Reed, pp. 136.
5 Kennedy, B & Kennedy, B (1982). Sydney and Suburbs. A History & Description. Wellington: Reed, pp. 137.
Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 6.
6 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 4.
7 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 6.
8 Ibid.
9 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 4.
10 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 12.
11 Kennedy, B & Kennedy, B (1982). Sydney and Suburbs. A History & Description. Wellington: Reed, pp. 137.
12 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 4.
13 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 44.
14 Ibid.
15 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 45.

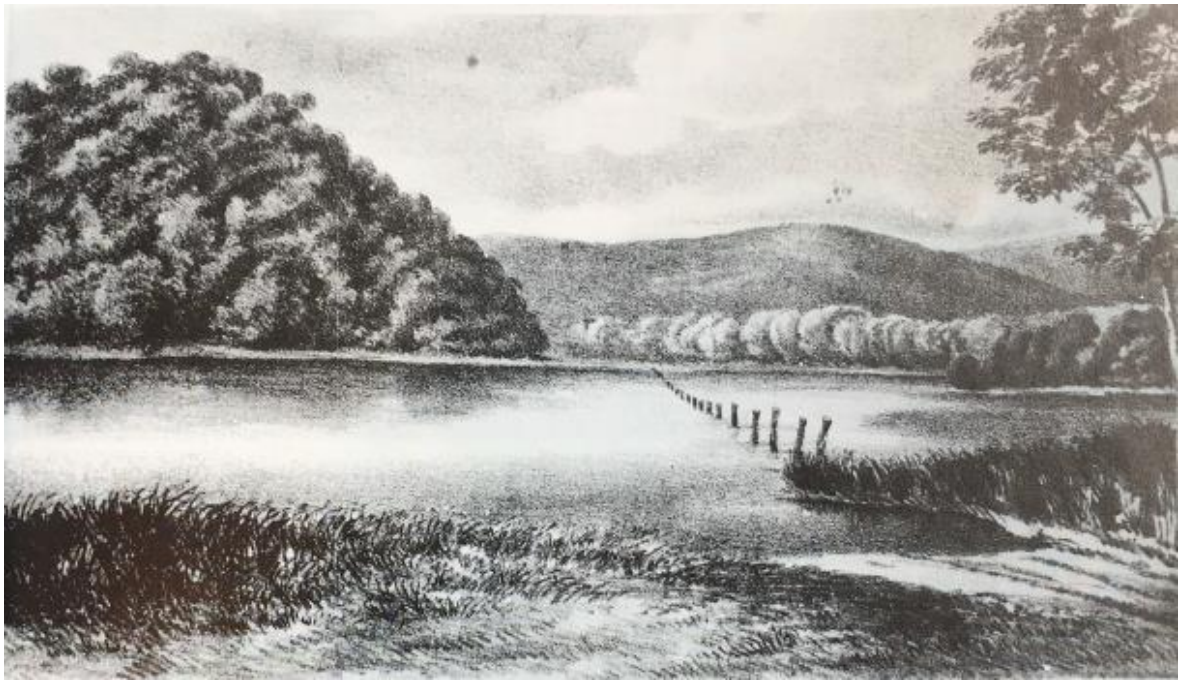

Figure 22: The first ford across Narrabeen Lakes, used to guide carriages, the first bridge was constructed in the 1880s (Source: Sharpe 2004:89).

Figure 23: Narrabeen Lagoon 1890 (Source: State Library of NSW, Dixson Library, IE8795087).

3.2. Narrabeen

The first record of Narrabeen appears in 1814 – 1815 on the maps of Surveyor James Meehan. The earliest land grants in the area was made to John Ramsay in 1818. James Jenkins received multiple grants in the area during 1824 – 1831, eventually holding over 600 acres (Pollen 1988:184). In 1882, Finding Narrabeen appeared in Sydney Punch describing the area with rugged rocks and sterile slopes, and bramble, briar, and thorn reaffirming the isolation of the region prior to reliable transportation[16]. Another article describes the scenery… on the Narrabeen Lagoon… is exceedingly fine in a broken, sterile, and uninteresting country (Figure 24)[17].

Despite advertising land allotments during the 1820s and 1830s, the 1856 census only records five houses and 30 people permanently residing in the Narrabeen parish (Empire 1856:5). 1861 saw a substantial decrease in the population with only 18 people recorded (SMH 1862:4). When allotments were first being sold around Narrabeen, they were going for £5 to £10; however, by 1886 prices increased to between £25 to £60 (Figure 25)[18].

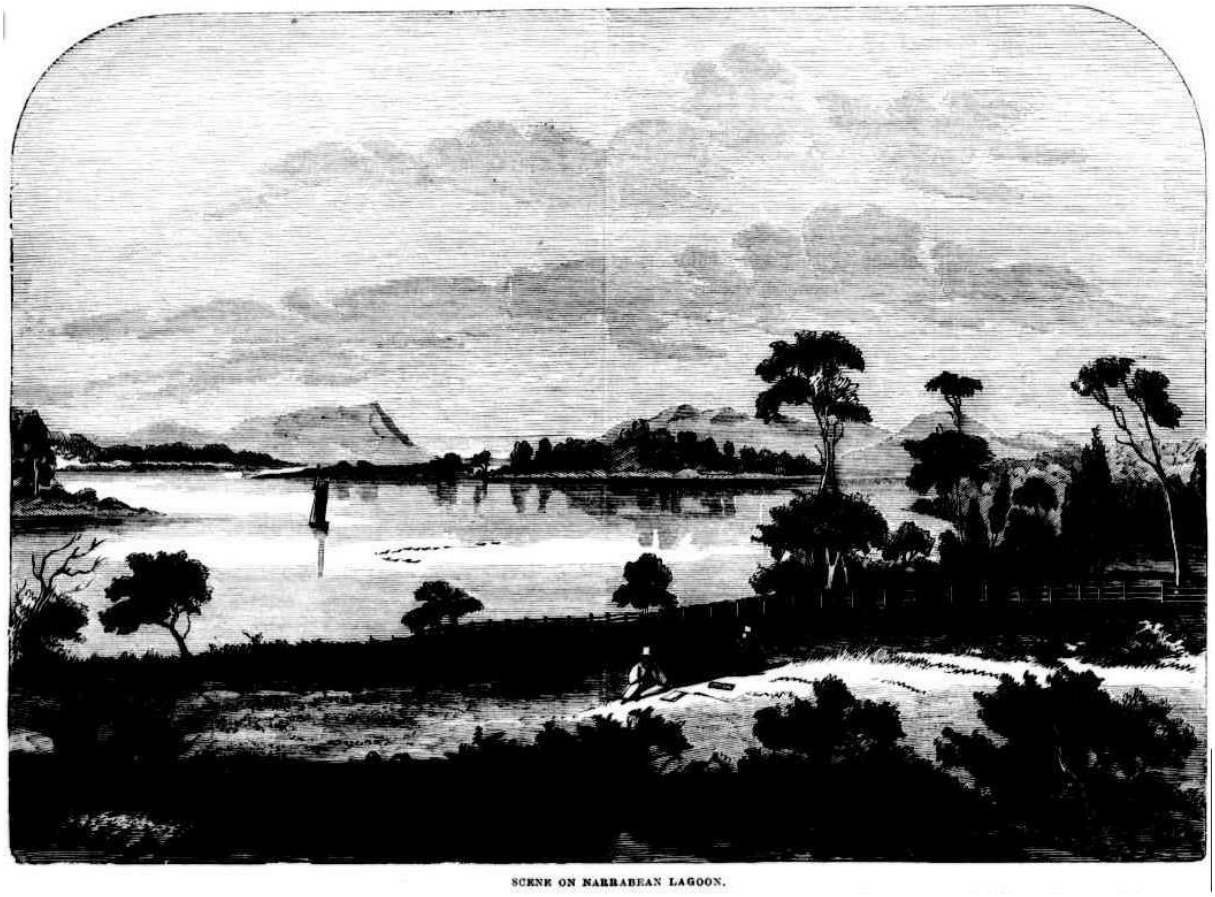

Figure 24: "Scene on Narrabeen Lagoon" sketch (Source: Australian Town and Country Journal, 1877:20).

16 Sydney Punch (11 November 1882) Finding Narrabeen, page 3. Available from: <http://nla.gov.au/nla.news-article253069538> Accessed 25/09/2019.
17 Colonist (28 February 1838) Broken Bay and Brisbane Water, page 2. Available from: <http://nla.gov.au/nla.news-article31720524> Accessed 25/09/2019.
18 Evening News (20 February 1886) Advertising, page 3. Available from: <http://nla.gov.au/nla.news-article111188350> Accessed 25/09/2019.

Figure 25: Narrabeen Park subdivision advertisement, study area arrowed. The location of the tram terminus can be seen in the SE corner of the plan (Source: State Library of NSW, IE9053161).

Sir Henry Parkes established the Casual Labour Board in May 1887 and created a register in which the particulars of the applicant were recorded and relief work was found[19]. Within the first 18 months of the board's establishment, 8119 men sought work; the average daily wage for these men, after their rations were paid, averaged between three and four shillings[20]. In October 1888, there were 250 men employed in Narrabeen to clear the land and build roads, originally work had started in August 1887 with 900 men; however, this number was gradually reduced[21]. The relief works provided for the unemployed ceased in 1889 with the Government deciding the work was a serious drain upon the public revenue[22].

The area surrounding Narrabeen Lake was the first portion of Narrabeen to attract tourists. From the 1870s there was an increase in commercial development of shops and hotels, and a greater number of jetties were built for private and public transportation to accommodate the increasing number of tourists[23]. An advertisement in 1877 offers family excursions by private transport to Narrabeen Lake with accommodation provided in a furnished cottage[24]. Narrabeen Lake continued to attract tourists, leading to an increase in the number of coaches offering tours, such as E.J. Black Coach Proprietor (Figure 26)[25]. By 1898, the swamps and marshes in the region

19 The Sydney Morning Herald (19 March 1888) The Unemployed and the Casual Labour Board, page 4. Available from: <http://nla.gov.au/nla.news-article13671083> Accessed 26/09/2019.
20 The Daily Telegraph (15 October 1888) The Unemployed, page 5. Available from: <http://nla.gov.au/nla.news-article235702626> Accessed 26/09/2019.
The Sydney Morning Herald (19 March 1888) The Unemployed and the Casual Labour Board, page 4. Available from: <http://nla.gov.au/nla.news-article13671083> Accessed 26/09/2019.
21 The Daily Telegraph (15 October 1888) The Unemployed, page 5. Available from: <http://nla.gov.au/nla.news-article235702626> Accessed 26/09/2019.
22 Newcastle Morning Herald and Miners' Advocate (8 January 1889) Casual Labour Board, page 2. Available from: <http://nla.gov.au/nla.news-article138835783> Accessed 26/09/2019.
23 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 13.
24 The Cumberland Mercury (29 October 1887) Local and General, page 4. Available from: <http://nla.gov.au/nla.news-article248801943> Accessed 25/09/2019.
25 Ibid.

had been drained and bridges had been built over the lagoons with a well paved road extending from Manly to Newport, dramatically reducing the time it took to travel from Sydney into the region[26]. Narrabeen began to grow in the twentieth century with touring cars operating between Narrabeen and Church Point during 1915 and 1920 before being superseded by buses[27]. The tram was proposed in 1889 with a route that would extend from the North Shore through to Broken Bay with stops at those places that were popular recreation spots, including Narrabeen[28]. During the early twentieth century, the region developed as a weekend and holiday destination; land close to the coast was developed with an emphasis on holiday cottages as well as developments on the steeper slopes to take advantage of the ocean views[29].

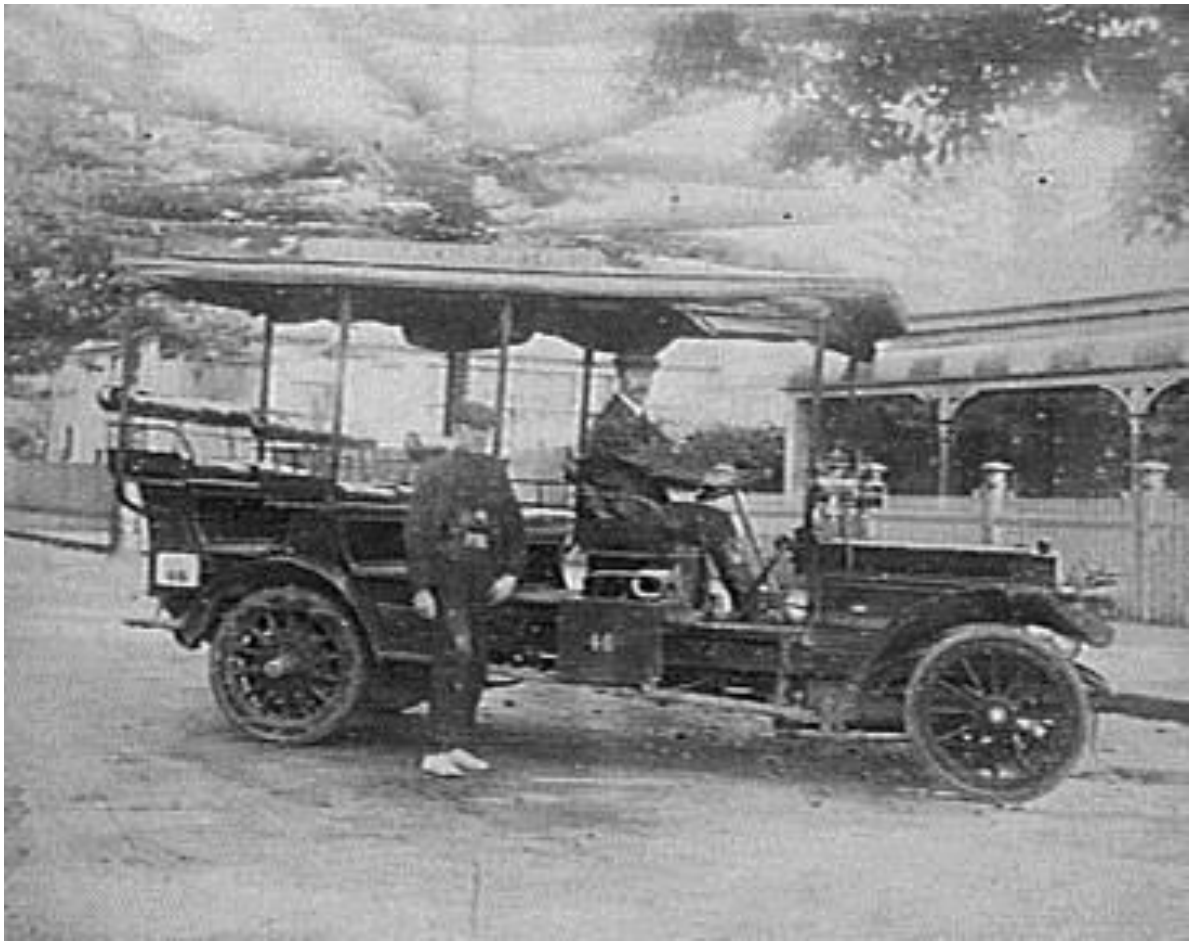

Figure 26: The Narrabeen Rock Lily Pittwater bus, c.1900, one of the coaches to offer tours around the Narrabeen region, along with E.J. Black Coach Proprietor (Source: Northern Beaches Council, Manly Local Studies Image Library, MML/288).

26 Freeman's Journal (7 May 1898) A Sketch of Pittwater, page 20. Available from: <http://nla.gov.au/nla.news-article11538653> Accessed 25/09/2019.
27 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 20.
28 The Daily Telegraph (3 June 1889) Advertising, page 3. Available from: <http://nla.gov.au/nla.news-article236019558> Accessed 25/09/2019.
29 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 5 - 7.

Figure 27: Narrabeen and Lakes aerial 1962, tram terminus arrowed (Source: National Library of Australia, Call Number: PIC FH/7114 LOC Cold store PIC HURL 217/10).

Narrabeen attracted the less affluent compared to more exclusive areas within the peninsula such as Palm Beach, with more affordable fibro cottages being built near the tram terminus (Figure 27)[30]. The tram terminating at Manly was extended to Collaroy Beach, in the southern portion of Narrabeen, in August 1912 with the route proposed to extended to Narrabeen Lake[31]. In February 1912, during the tram line's construction into the district, a strike occurred, affecting 60 men involved in the work and delaying the opening of the line[32]. The tram terminus was extended to Narrabeen, running parallel with Pittwater Road, in December 1913 where it was met by coaches and buses that were used to access the rest of the peninsula[33] (Figure 28 and Figure 29).The opening of the tram line was said to boost the development of the district and to grow as an easily accessible tourist territory[34]. In the 1920s, the area was advertised to potential residents as being 7 miles from Manly by tram, with a good hotel and the usual week-end accommodation cottages with one of the best surfing beaches in the state. The district is eminently suited for Orchards, Flower and Vegetable Gardens and Poultry Farms (Pollen 1988:184). In 1938, the tram to Narrabeen ceased and buses ran directly from Manly[35]. Prior to the closure of the tram line, the service had begun to see a loss in profit, this was attributed to a number of reasons including the

30 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 20.
31 The Sun (4 August 1912) Narrabeen's Gala Day, page 10. Available from: <http://nla.gov.au/nla.news-article228820805> Accessed 26/09/2019.
Clarence and Richmond Examiner (22 October 1912) Tramway Extension, page 5. Available from: <http://nla.gov.au/nla.news-article61666586> Accessed 26/09/2019.
32 Northern Star (29 February 1912) Tramway Men Strike, page 5. Available from: <http://nla.gov.au/nla.news-article72312090> Accessed 26/09/2019.
33 Daily Telegraph (12 December 1913) Narrabeen Tram Opening, page 7. Available from: <http://nla.gov.au/nla.news-article23896063> Accessed 26/09/2019.
Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 37.
34 The Sun (4 August 1912) Narrabeen's Gala Day, page 10. Available from: <http://nla.gov.au/nla.news-article228820805> Accessed 26/09/2019.
35 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 26.

opening of the Harbour Bridge to bus services, an increase in wages and the rising costs of power – these combined, it was no longer financially viable to maintain the trams[36].

Figure 28: Opening of the Narrabeen Tramway 1913 (Source: State Records of NSW, ID: 17420_a014_a0140001165).

Figure 29: Narrabeen tram sheds, Pittwater Road, Narrabeen 1925, with waiting coaches (Source: Northern Beaches Council, Warringah Image Library, Acc: 285206).

Besides being a popular tourist destination, natural resources were found in Narrabeen which were subsequently mined. Coal mining began in the region in the late 1800s with the discovery of coal seams. In 1890 two diamond drill bores had been put down by Mr J Coghlan with natural gas discovered during the boring[37]. In 1904, a bore was drilled into the edge of Narrabeen Lagoon[38]. In the beginning of August 1884, the first powder works in Australia was opened in Narrabeen for the manufacture of blasting powder and gunpowder by Carl Von Bieren (Figure

36 The Sun (6 November 1938) Tram May Soon Give Way to Bus, page 13. Available from: <http://nla.gov.au/nla.news-article231135173> Accessed 26/09/2019.
37 Newcastle Morning Herald and Miners' Advocate (12 July 1890) Natural Gas at Narrabeen, page 3. Available from: <http://nla.gov.au/nla.news-article138937107> Accessed 26/09/2019.
38 The Capricornian (8 October 1904) Geological Discovery at Narrabeen, page 35. Available from: <http://nla.gov.au/nla.news-article71961259> Accessed 26/09/2019.

30)[39]. The high import rates of gunpowder proved the necessity of establishing a powder works in Australia, its opening would provide employment within Narrabeen as well as cheapen the costs of blasting compounds[40]. However, gunpowder would never be produced at Narrabeen, Carl Von Bieren declared insolvency in 1885 and attempted to leave the country before he was caught and tried for embezzlement[41]. After serving only a part of his sentence, Von Bieren was released and he disappeared[42].

Figure 30: Powder works factory at Narrabeen (Sharpe: 91).

The first water supply was reticulated during the opening of the tram line to Collaroy Beach in August 1912, with a display made by the local fire department[43]. A new water pumping station opened up in Ryde in September 1921 to service the northern suburbs of Sydney, including Narrabeen, this increased the supply of water into the district[44]. The Northern Suburbs sewer began construction in 1920, a system which proposed to service 186 square miles including the peninsula and was said to be one of Australia's greatest engineering undertakings[45]. Electricity was extended to the district surrounding Narrabeen in 1923[46]. In March 1925, it was announced that works would begin in connecting Narrabeen and other towns on the peninsula to gas with 12 to 13 miles of mains to be connected, the work was expected to take 12 months[47].

The second half of the twentieth century saw the region develop as a commuter district as well as an exclusive residential area, the development was aided by reliable transport and the connection of services in the region[48]. The construction of the Warringah Expressway, commencing in 1965, and regular ferry services, commencing in 1955, connected the Northern Beaches region to the city allowing for the development of a commuter suburb[49]. Between 1947

39 Newcastle Morning Herald and Miners' Advocate (29 July 1884) New Powder Works, page 2. Available from: <http://nla.gov.au/nla.news-article135855581> Accessed 26/09/2019.
The Sydney Morning Herald (6 March 1884) A New Industry, page 3. Available from: <http://nla.gov.au/nla.news-article13554539> Assessed 26/09/2019.
40 Illawarra Mercury (11 March 1884) The First Powder Mill in Australia, page 4. Available from: <http://nla.gov.au/nla.news-article136462483> Accessed 26/09/2019.
41 Sharpe, Alan (2004) Pictorial Memories Manly to Palm Beach. Kingsclear Books: Alexandria, pp 91.
42 Ibid.
43 The Sun (4 August 1912) Narrabeen's Gala Day, page 10. Available from: <http://nla.gov.au/nla.news-article228820805> Accessed 26/09/2019.
44 The Daily Telegraph (16 September 1921) Suburban Water, page 4. Available form: <http://nla.gov.au/nla.news-article239709562> Accessed 26/09/2019.
45 Sydney Mail (4 August 1920) A Gigantic Undertaking: Northern Suburbs Sewer, page 15. Available from: <http://nla.gov.au/nla.news-article159041168> Accessed 26/09/2019.
46 The Sydney Morning Herald (3 August 1923) The Suburbs. Electricity in Warringah Shire, page 14. Available from: <http://nla.gov.au/nla.news-article16085068> Accessed 26/09/2019.
47 Evening News (27 March 1925) Gas at Last, page 14. Available from: <http://nla.gov.au/nla.news-article117449239> Accessed 26.09.2019.
48 Thorp, Wendy (1988a) Historical Archaeological Resource of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp. 8.
49 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp 31.

and 1961, Warringah saw a 187% increase in population from 32,856 to 94,440 with spikes in population during holiday periods[50].

3.3. Development of the Narrabeen Education Precinct

The earliest schools in the Northern Beaches region were built in the late nineteenth century with Bay View and Newport hosting the first school in 1884 and 1889 respectively[51]. The first school in the Narrabeen area, Narrabeen Public School, was proposed and opened in 1889, changing its name to Narrabeen Lakes in 1995 and continues to operate today[52].

The Narrabeen Education Precinct is located within William Bernard Rhodes original 50 acres, Portion 47 of the Narrabeen Parish, granted on 16 December 1836 (Figure 31)[53]. Rhodes was a merchant from Wellington, New Zealand and sold his land to Thomas Collins in September 1849[54]. Throughout the nineteenth century, the land was owned and leased by numerous individuals including James Blair and John Thomas Collins[55]. In February 1903, when Edward Augustus Macpherson owned and occupied the study area, part of the original 50-acre grant was resumed under the Public Roads Act 1902, to deviate the road from Manly to Pittwater through Portion 47 (Figure 32)[56].

On 26 March 1912, 55 acres 1 rood and 28 perches were transferred to Septimus W. Macpherson[57]. The associated Certificate of Title includes a 100 feet wide reservation along the Main Creek; the purpose of this reservation is unknown (Figure 33)[58].

By 1912, the north-eastern section of the original 50-acre portion has been separated for a subdivision, with Oak Street established to service the new residential area (Figure 35). Between the time of Rhode's original purchase and 1912, when this subdivision occurred, the study area remained largely undeveloped, occupied by natural bushland (Figure 34). The development which did occur in the area following the subdivision was focused on Oak St where there had been allotment sales since 1912 (Figure 36).

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50 Ibid.
51 Thorp, Wendy (1988b) Thematic Development History of Warringah Shire. Prepared for the Warringah Shire Heritage Study, pp 21.
52 Newcastle Morning Herald and Miners' Advocate (9 March 1889) Government Gazette, page 2. Available from: <http://nla.gov.au/nla.news-article138842130>.Accessed 26/09/2019.
NSW Department of Education (2019) School history database search. Available from: <https://education.nsw.gov.au/about-us/our-people-and-structure/history-of-government-schools/school-database-search> Accessed on 23/09/2019.
53 NSW Land and Registry Services (2019) 'Primary Application 17427' Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.
54 Champion, Shelagh and Champion, George (1996) Profiles of the Pioneers in Manly Warringah and Pittwater. S. and G. Champion: Killarney Heights, pp 14.
55 NSW Land and Registry Services (2019) 'Primary Application 17427' Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.
56 NSW Land Registry Services (2019) 'Crown Plan R7580.1603R'. Direct Info. Property Services and Products, Document Request. Available from: <https://www.directinfo.com.au/> Accessed on 24/09/2019.
57 NSW Land Registry Services (2019) 'Crown Plan R7580.1603R'. Direct Info. Property Services and Products, Document Request. Available from: <https://www.directinfo.com.au/> Accessed on 24/09/2019.
NSW Land and Registry Services (2019) 'Certificate of Title Vol 2239 Fol 168'. Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.
58 NSW Land and Registry Services (2019) 'Certificate of Title Vol 2239 Fol 168'. Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.

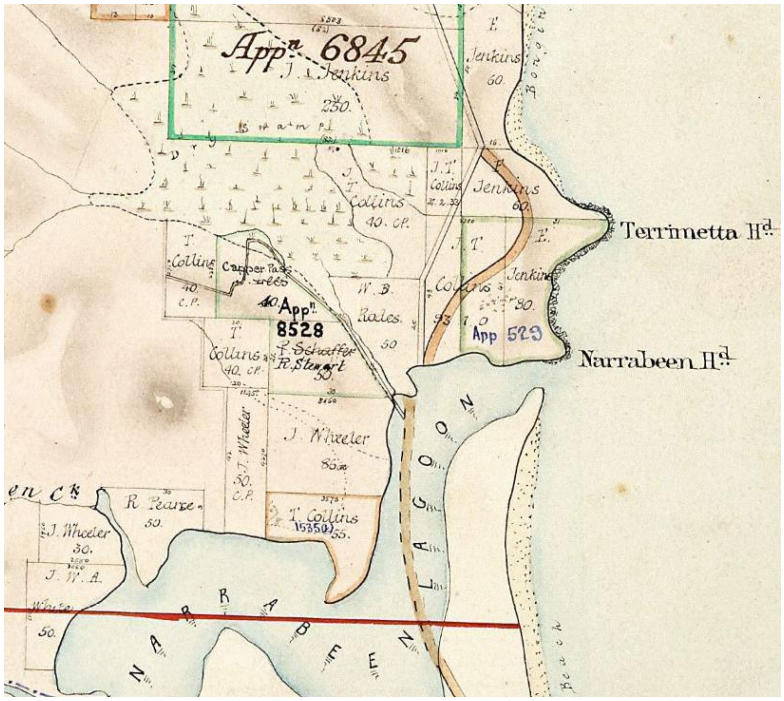

Figure 31: Detail of Narrabeen Parish Map (23 October 1867) with study area (Part of Portion 47) arrowed (HLRV: https://hlrv.nswlrs.com.au/).

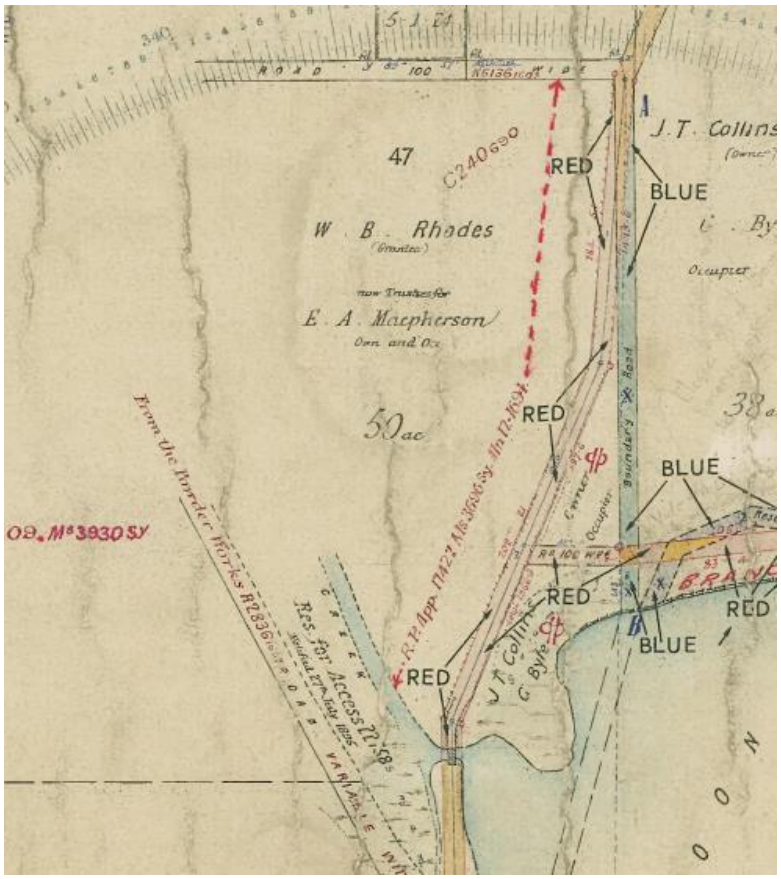

Figure 32: Detail of Crown Plan showing land coloured red (through Portion 47) resumed under the Public Roads Act 1902, to deviate the road from Manly to Pittwater (Crown Plan R7580.1603R).

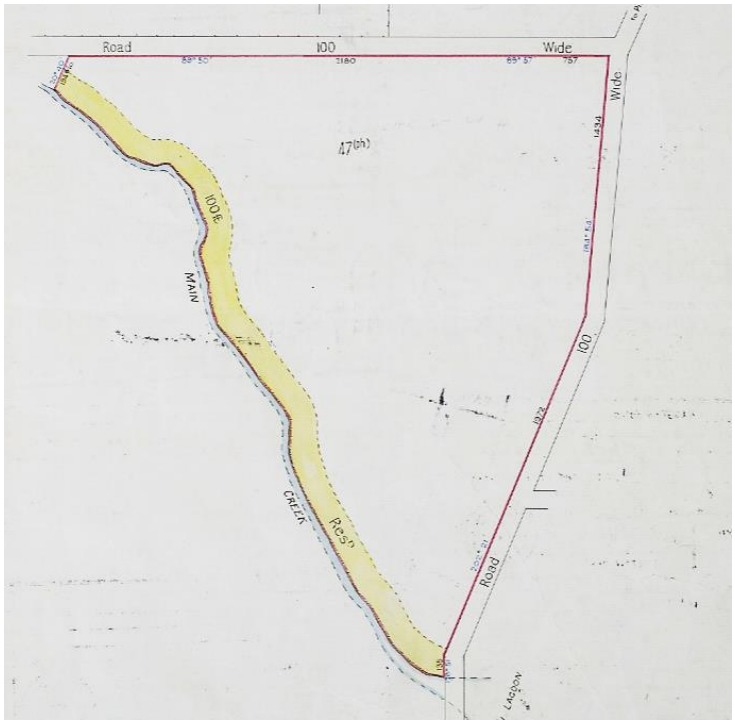

Figure 33: Map of Portion 47 (55 acres 1 rood 28 perches) transferred to Septimus W. Macpherson on 26 March 1912. Note the 100-ft wide strip of land west of the Main Creek, coloured yellow, was reserved (Certificate of Title Vol 2239 Fol 168).

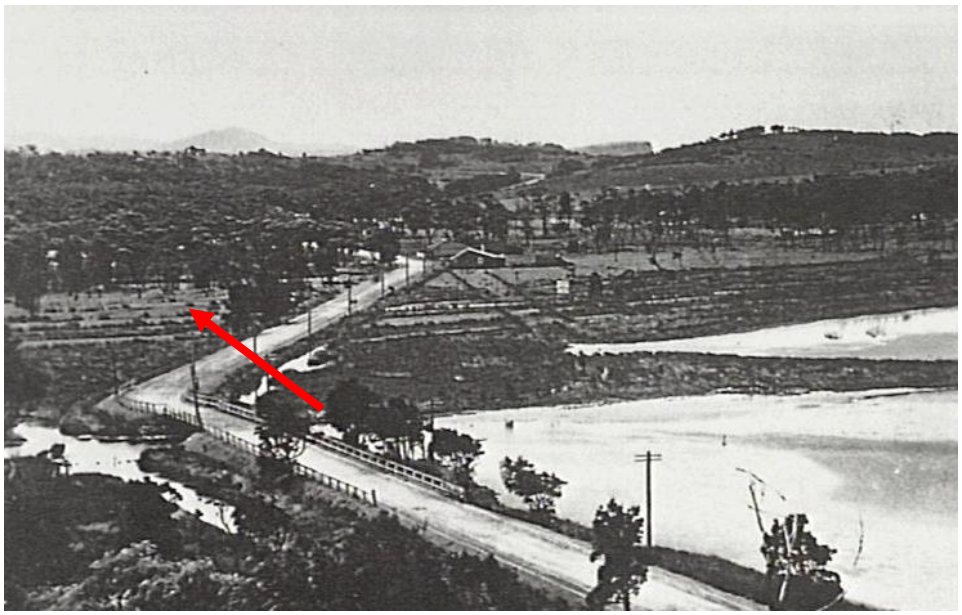

Figure 34: Photograph c.1910 facing north towards bridge on Pittwater Road across Mullet Creek and Narrabeen Lagoon, showing the south-eastern portion of the study area as undeveloped (arrowed), as well as dense vegetation further north (before the Oak Street subdivision) (Source: Pittwater Image Library, NNAR-050).

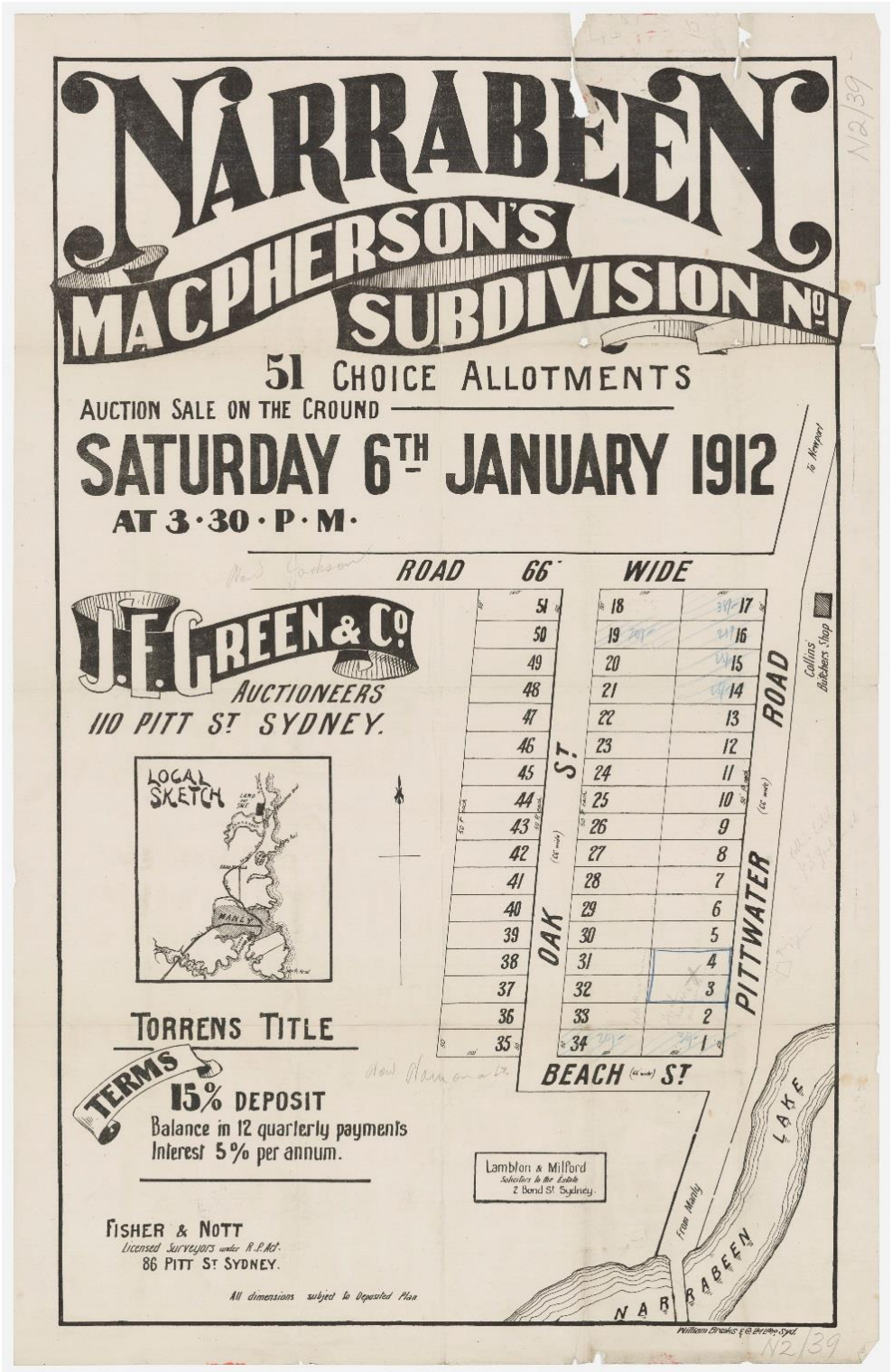

Figure 35: Macpherson's Subdivision No1' 6 January 1912, showing 51 allotments for sale on Oak St, north-eastern section of Rhode's original 50-acre portion. Note: Namona Street was formerly known as Beach Street and only extended as far west as Oak Street (Source: NSW State Library, IE9053687).

Figure 36: c.1920 photograph facing north-east showing development on Oak Street (arrowed). This photo was taken during a flood event; water can be seen across the southern portion of the study area (Source: Historic Photographs, Photo ID: S127).

On 18 January 1928, a 5-acre portion of the original 50-acre grant (north of Namona Street) was purchased for Public School Purposes at Green Hills, "Narrabeen North"; this purchase was vested on 4 September 1929 in the Education Department (Figure 37)[59]. On 8 April 1932, the Narrabeen Beach Estates Limited became the proprietor of a 123-acre estate encompassing the study area; the associated Certificate of Title makes mention to 'reservations in the Grants of Portions 2 (2 of Parish/and Portion 96 of minerals and in the Grant of 50 acres (Portion 47 of Parish) of all mines of gold and silver', suggesting that mining activities occurred in the vicinity of the study area (and possibly in the 100 feet wide reserve within Portion 47) (Figure 38)[60]. The study area at this time, prior to the commencement of construction of the Narrabeen North Public School, remained undeveloped, as can be seen in aerial photographs of the area (Figure 39 to Figure 41).

On 17 January 1946, a plan was approved for part of the estate owned by Narrabeen Beach Estates Limited to be acquired for the Narrabeen North Secondary School; these 38 acres 2 roods and 16 perches of land (excluding the 100 feet reservation) were purchased by the Department of Education on 27 June 1947 (Figure 42). On 22 March 1948, King George VI became the proprietor of the estate acquired for the Secondary School, inclusive of the 100 feet reservation[61]. The land in the 100 feet reservation was resumed for the Secondary School by Government Gazette on 24 August 1956 (Crown Plan 11903.3000). One acre 1 rood and 22 ½ perches of the study area were appropriated for the widening of Pittwater Road to the, gazetted on 6 June 1958, for the purposes of the Main Roads Act 1924-1957[62].

59 NSW Land Registry Services (2019) 'Crown Plan 7018.3000'. Direct Info. Property Services and Products, Document Request. Available from: <https://www.directinfo.com.au/> Accessed on 24/09/2019.
60 NSW Land and Registry Services (2019) 'Certificate of Title Vol 4525 Fol 219' Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.
61 NSW Land and Registry Services (2019) 'Certificate of Title Vol 5802 Fol 236' Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.
62 NSW Land and Registry Services (2019) 'Certificate of Title Vol 5802 Fol 236' Historical Lands Records Viewer (HLRV). Available from: <https://www.nswlrs.com.au/Parish-and-Historical-Maps> Accessed on 24/09/2019.

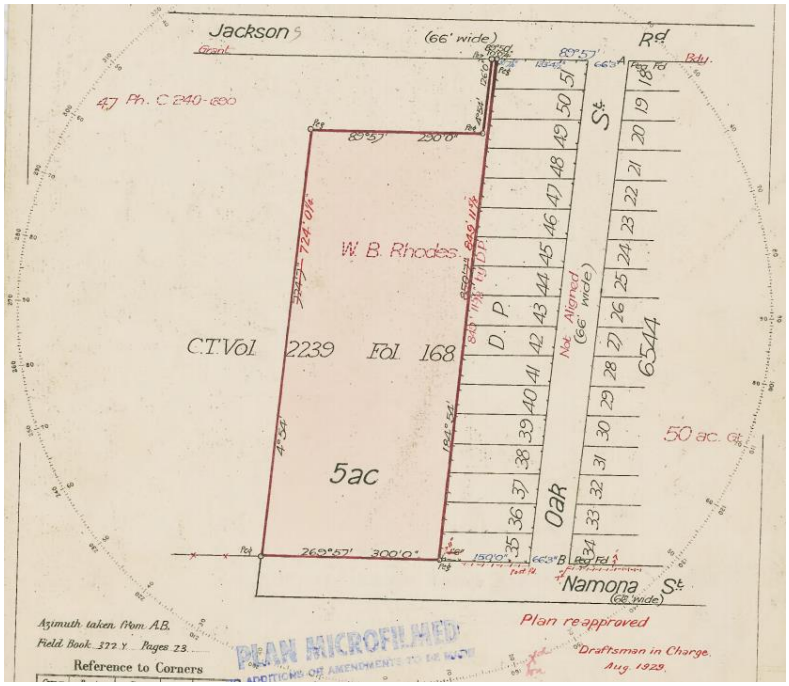

Figure 37: 5-acre portion of the original 50-acre grant purchased on 18 January 1928 for Narrabeen North Public School (Crown Plan 7018.3000).

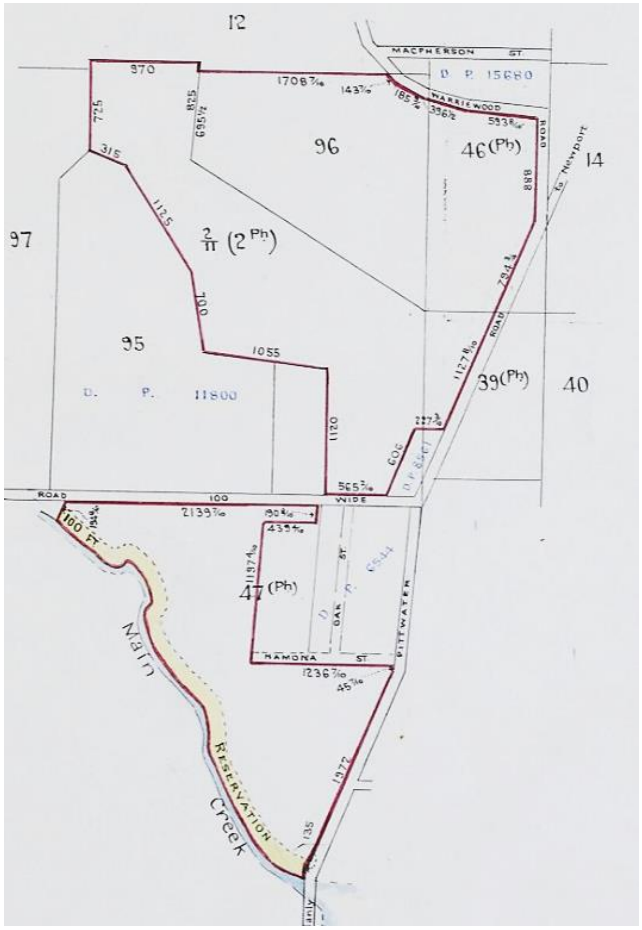

Figure 38: Estate of 123 acres 3roods and 3 ¾ perches transferred to the Narrabeen Beach Estates Limited on 8 April 1932. Note the 5-acre portion of the study area that was reserved for Narrabeen North in 1928 (Certificate of Title Vol 4525 Fol 219).

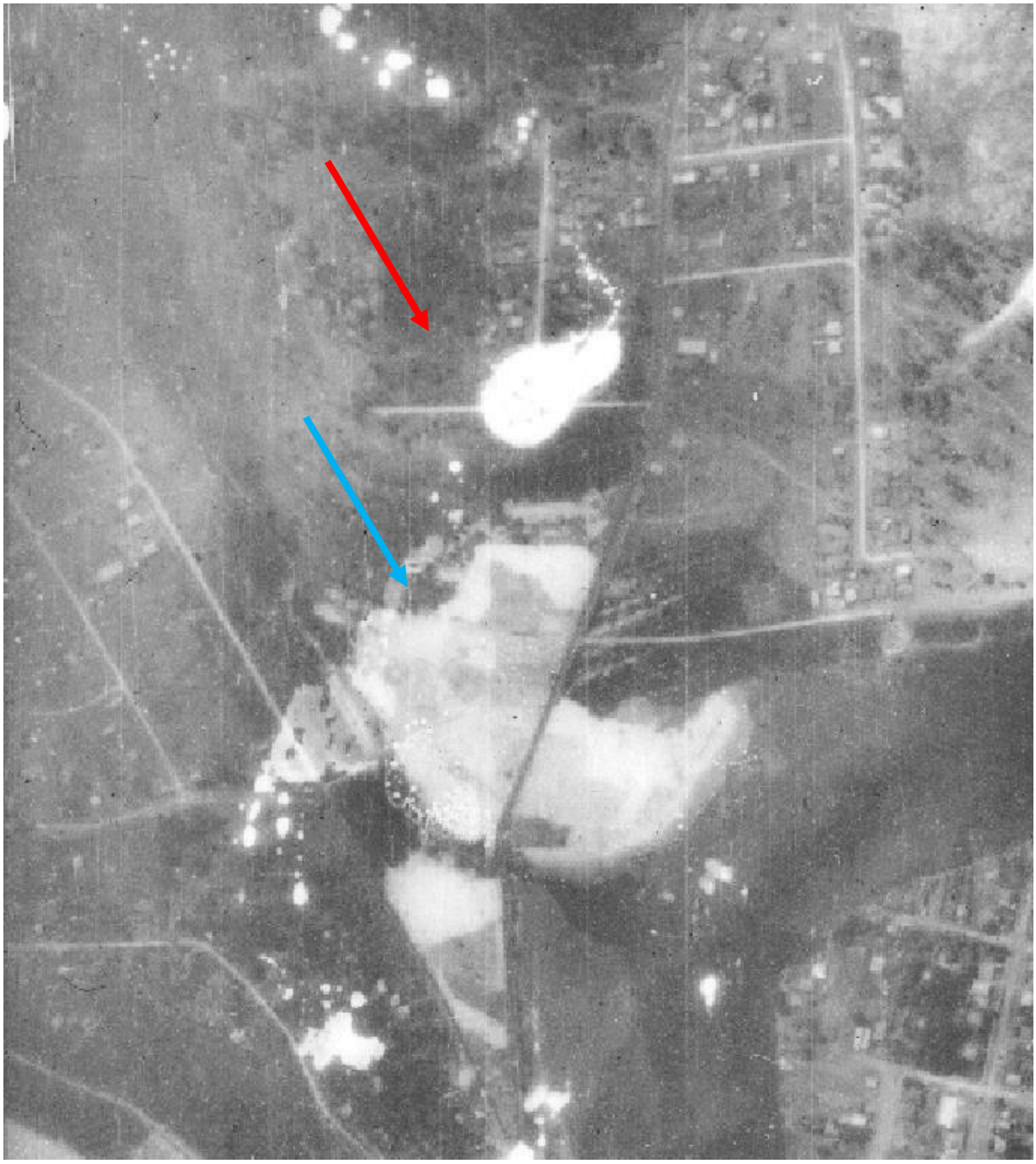

Figure 39: 1930 aerial of study area. While this aerial is of poor quality, it can be seen that there was little activity within the study area at this time. The location of the current NNPS is arrowed in red and NSHS is arrowed in blue (Source: NSW Department of Customer Service, Spatial Services, spatialservices.nsw.gov.au. Image CAC_01_1134).

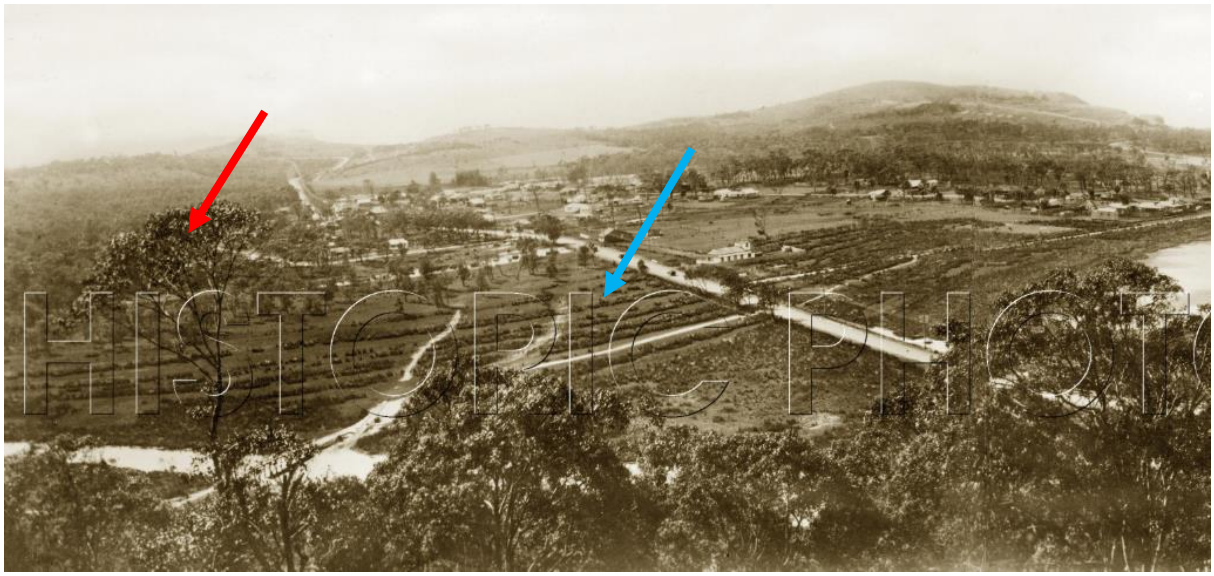

Figure 40: c1930 aerial photograph of the study area facing north-east towards Warriewood, showing study area as undeveloped. The location of the current NNPS is arrowed in red and NSHS is arrowed in blue (Source: Historic Photographs, Photo ID: P18).

Figure 41: 1943 aerial of southern portion of study area, Narrabeen Sports High School (Source: SIX, https://maps.six.nsw.gov.au/).

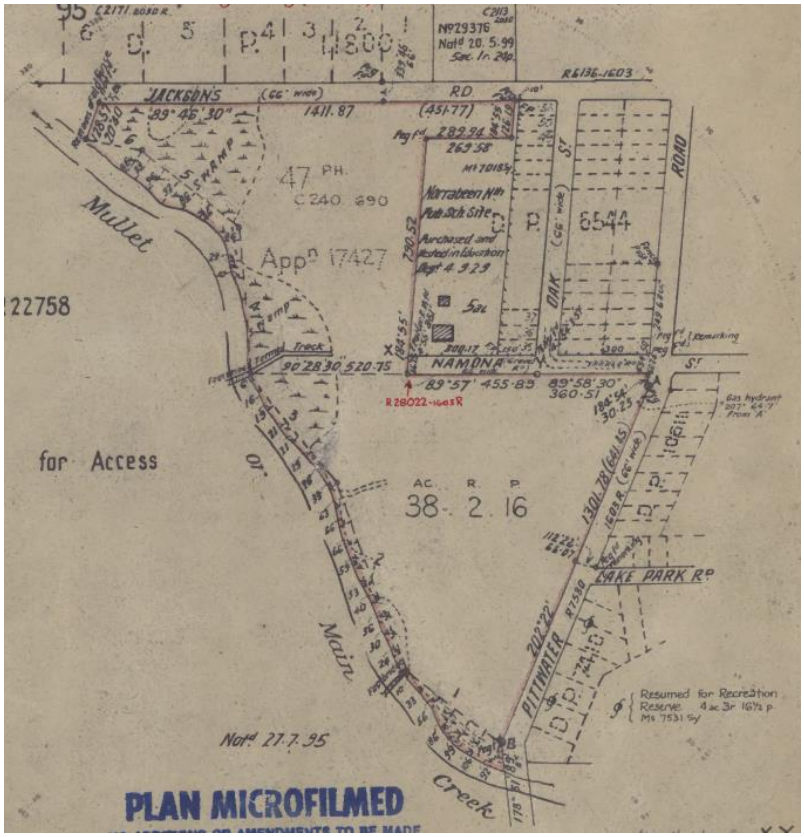

Figure 42: Crown Plan dated 17 January 1946 detailing land resumed for The Narrabeen North Secondary School, later purchased in June 1947. Note two buildings present in the 5-acre lot occupied by the Narrabeen North Public School site (Crown Plan 11903.3000).

3.3.1. North Narrabeen Public School

The North Narrabeen Infants' School was built on the 5-acre lot purchased for Public School purposes in 1928, as seen in the 1946 Crown Plan, two buildings were located on the site which could be the buildings referred to in the Sun article (Figure 37 and Figure 42). The North Narrabeen Infants School was officially opened in 1939; however, it had its beginnings in 1935[63]. Mrs V E Norman ran the first school out of the nearby Welfare Hall, later converted to a wire factory, from 1935 until the new school was constructed in 1938 (North Narrabeen Public School 1989:9). During the time the school operated out of the Welfare Hall, the Sun records floods in 1936 reporting that at the North Narrabeen Infants' School, the children's playing area was under water. The house adjoining the school hall was surrounded by water…[64]. A tender was placed in the Government Gazette in 1938 for new building at North Narrabeen and new brick closets in 1942 (Figure 43)[65]. Transport in the region for school children was poor, demonstrated by a strike in 1948 with parents protesting the lack of transport, highlighting the fact that some children were walking four miles to get to school; however, little improvements were made and another strike was held the following year (The Riverine Herald 1948:1; Daily Telegraph 1948:7).

North Narrabeen School attainted Primary status in 1953, the Infants school was closed and was reopened as North Narrabeen Public School (North Narrabeen Public School 1989:11). Soon after the opening of the North Narrabeen Public School, a tender was put forward for the building

63 NSW Department of Education (2019) School history database search. Available from: <https://education.nsw.gov.au/about-us/our-people-and-structure/history-of-government-schools/school-database-search> Accessed on 23/09/2019.
64 The Sun (19 June 1936) Into the Sea. Lakes' Overflow, page 12. Available from: <http://nla.gov.au/nla.news-article231312054> Assessed 26/09/2019.
65 Government Gazettes (20 May 1938) Tenders, page 2016. Available from: <http://nla.gov.au/nla.news-article225120738> Accessed 26/09/2019.
Government Gazettes (6 November 1942) Education Department Tenders, page 2937. Available from: <http://nla.gov.au/nla.news-article225125448> Accessed 26/09/2019.

of a four roomed timber classroom, demonstrating the growth of the school and the need for more teaching space[66]. In 1956 another timber framed building was erected that was also supplied with electricity[67].

Figure 43: Students at Narrabeen North Public School 1939, in front of the original brick school building (current K Block) (Source: Pittwater Image Library, NNAR-051).

In 1974 a three concrete shell dome complex, was constructed at Narrabeen North Public School. This was achieved using the method devised by an Italian architect Dr Dante Bini; the domes are often referred to as Binishells, after Bini. The domes were 18 metres in diameter; two interconnecting domes were used as a library, and the third dome served as an administration office for the school.

3.3.2. Narrabeen Sports High School (NSHS)

The Narrabeen Girls High School, established in January 1954, and the Narrabeen Boys High School, established in January 1959 (Figure 44), were both closed in Dec 1975. In January 1976 they were merged to form the co-educational Narrabeen High School (Figure 45), known as the Narrabeen Sports High School (NSHS) since 2000 (NSW Department of Education, 2019)[68].

The buildings associated with the Narrabeen Boys High School are no longer extant; these buildings were likely located where the current sports oval is situated in the north-eastern corner of the school. The original Narrabeen Girls School were located in the southern half of the study area; the only building associated with the former remains extant is the former gymnasium[69]. The Hawksley prefabricated aluminium gymnasium was completed in June 1955, there were four

66 Government Gazettes (24 September 1954) Tenders, page 2912. Available from: <http://nla.gov.au/nla.news-article220293674> Accessed 26/09/2019.
67 Government Gazettes (27 July 1956) Tenders, page 2111. Available from: <http://nla.gov.au/nla.news-article220388894> Accessed 26/09/2019.
68 Louise Anne Wilson (2018) Louise Wilson, Author: Brainboxes. Available from: <https://www.louisewilson.com.au/brainboxes.html> Accessed on 23/09/2019.
69 Ibid.

other schools across Sydney where the same style of gymnasium was constructed at the same time[70].

Figure 44: South-western view of Pittwater Road, from near entrance to Namona Street, 1962. Narrabeen Boys High School on the right (arrowed) (Source: Pittwater Image Library, NNAR-155).

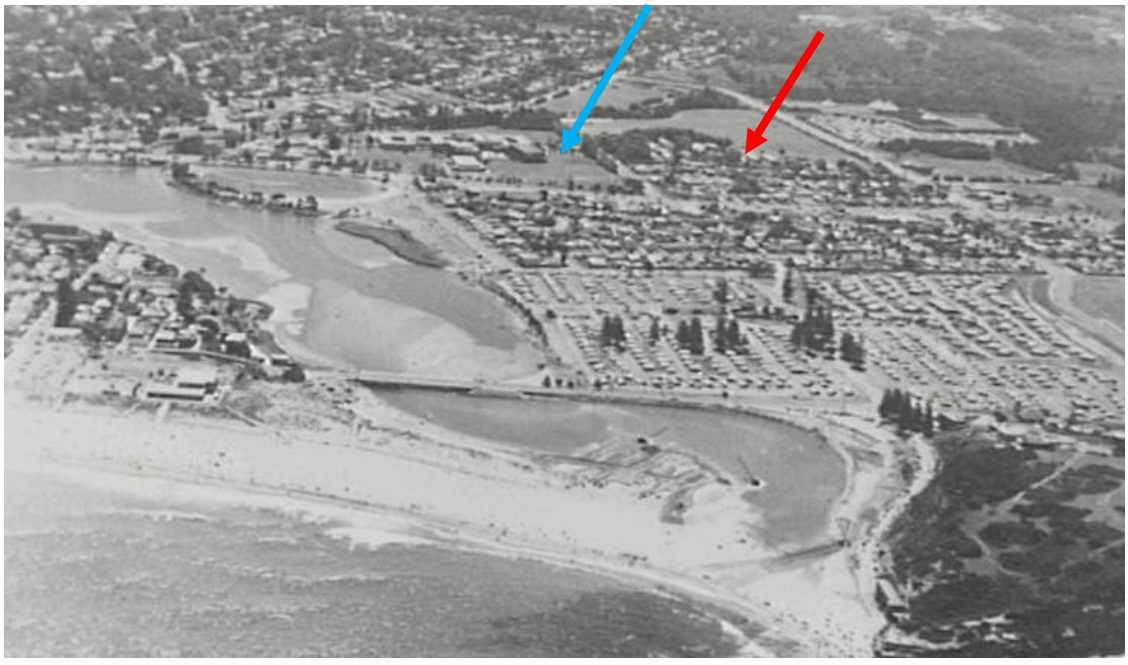

Figure 45: Aerial view of Narrabeen (1982) facing north-west, showing the study area. NSHS (then Narrabeen High School) is arrowed in blue and NNPS is arrowed in red. Note the buildings associated with Narrabeen Boys High School have been demolished (Source: Pittwater Image Library, NNAR-011).

70 Government Gazette of the State of New South Wales (10 June 1955) Tenders, page 1581. Available from: <http://nla.gov.au/nla.news-article220302030> Accessed 26/09/2019.

3.4. Brief History of Bini Shells

The following history has been extracted from the Heritage Report for Masterplan - Narrabeen Education Precinct by OCP Architects in November 2019 for the subject site[71]. The following background information has been retrieved from the National Trust SHR nomination form, dated 18 September 2018:

> *Dr Dante Bini built his first hemispherical, thin shell structure in 1964, constructing this prototype Bini shell in 60 minutes ("Binisystems"). The technique gained wide recognition in 1967 after Bini used a gigantic balloon and a robot to build a 50-foot tall concrete Binishell dome at Columbia University in less than two hours. He described the construction process as "Pressing a button. That's it".*
>
> *The house that Bini built in 1969 for film director Michelangelo Antonioni in Gallura (Costa Paradiso), Sardinia, was…a pragmatic synthesis that only an architect-builder who was capable of inventing and exporting both architectural stylistic features and effective construction methods worldwide could realise. It was a business system which, at that time, had already proved to be successful in Italy, Japan and possibly even in Australia.*
>
> *Bini's invention was the perfect, as well as obvious synthesis of three construction techniques that developed independently. First, the one for in-situ reinforced concrete shells; second, the inflatable and pneumatic membrane technology for air structures; third, the self-shaping steel reinforcement.*
>
> *Bini's merit not only consists in having developed a construction technique which has met with success almost all over the world in the erection of round domes of large diameter (up to 300 feet) for schools, gymnasiums, and halls, but mainly in having generated "nuove formule architettoniche", that is new architectural formulae, as Bini himself defined them.*
>
> *It is estimated that more than 1,500 Bini shells were built in 23 countries throughout the world, used as houses, schools, libraries, gyms and shopping centres.1 The advantages of the Bini shells form of construction included the speed of construction and the relatively low cost in comparison to other forms of construction. The exterior walls and roof are erected in one completed operation, and the only materials required are steel and concrete.*
>
> *…*
>
> *From the first 'inflations', the Binishell system was gradually perfected. For example, the technique for the reinforcing bars was optimised by the addition of metal springs, permitting better control over the folding and position of bars during erection. The inflatable structure went from a single layer, placed beneath the cast concrete, to two layers, enveloping the shell both above and below during the phase of forming. Further, for the first commissions outside Italy, Bini prepared the membrane in Italy so that it was brought to the site ready for use; he sometimes brought it with him on the airplane. This was the case of the Binishell demonstration in America, performed for Salvadori at Columbia University. That experience taught him that jumps in temperature due to flights neutralised the effects of the glue, causing the PYC strips of the membrane to come apart. With the growing number of commissions from abroad, the preparation of the pneumatic formwork had to be radically reconsidered; this began with understanding that PVC sheets were easily available near the various work sites. Thus all of the pneumoforms in Australia were assembled with square PVC sheets 3m wide.*

3.4.1. Binishells in NSW State Schools

> *Bini reported that he first got in touch with Australian authorities in Autumn 1971 because NSW Minister Leon Punch was seeking a rapid system to build multi-purpose centres, schools and libraries to fulfil election promises[72]. In 1973, Dr Dante Bini was invited by the NSW Government to introduce the Binishell concept to Australia. NSW Department of Works described the Binishells as 'A revolutionary "wet" building concept, which allows a layer of concrete to be blown up into a dome-shaped building[73]. The advantages of the construction type were recognised as being the*

71 OCP Architects (November 2019), 'Heritage Report for Masterplan - Narrabeen Education Precinct', pp. 8 - 12.
72 Bini, Dante, Building with Air, published by Bibliotheque McLean, June 2014.
73 Department of Public Works NSW Annual Report 1973-74, p.11.

considerably reduced construction time and economic use of labour and materials and it was considered that these advantages warranted an experimental program in NSW school buildings. In addition to minimising materials and labour, the sustainability of Binishells also related to reuse of the pneumoform to build more Binishells[74].

The first Binishells constructed as part of the State's school building program were the three Binishells constructed at Narrabeen North Public School and one at Killarney Heights Public School, all of which comprised 18 metre diameter domes. Subsequent planning by the Department was for 'six shells of 36-metre diameter, which will be erected at selected high schools and used as school centres'[75] (Peakhurst, Randwick Girls, Fairvale, Ingleburn, Pittwater and Ku-ring-gai High Schools) following which the system was to be evaluated for suitability for a range of further applications.

By 1975, the NSW Department of Public Works and Department of Education jointly decided to adopt the system 'as part of the programme to provide multipurpose centres, or libraries, at selected schools.'[76] Dr Dante Bini held the patent rights to the system and entered into an agreement with the Department of Public Works to supervise the design, construction and fitting-out of the 18-metre and 36-metre Binishells. Binishells or multi-shell complexes were erected at fourteen schools in NSW, with the three-dome complex at Narrabeen North remaining as one of Bini's career favourites.

Enthusiasm for Binishells in Australia waned following collapse of the first 36-metre diameter structure at Fairvale High School on 4 January 1975. This event raised major concerns about their safety given their use as school facilities. While the situation deescalated when the reasons for the collapse were revealed (an exceptional temperature gradient of 25 degrees overnight when the shell was still uninsulated and unfinished) a second collapse at Pittwater High School on 4 August 1986 sealed the fate for use of Binishells in Australia, despite the installation of precautionary support towers in the other 36-metre domes (which affected the functionality of the interior spaces due to the introduction of columns). Other issues relating to leakage and maintenance costs led to a range of schools planning replacement of their Binishells with more conventional structures.

There are currently 11 remaining Binishells in NSW Public Schools, located on 9 separate school sites, including the 18-metre dome at Killarney Heights Public School which has received demolition approval early in 2018. As described by Margaret Betteridge:

> *Their loss can be attributed to their ageing, lack of or deferred maintenance, poor quality repairs, the deterioration of concrete, the presence of asbestos, work, health and safety issues– and the ever-growing pressure for shiny new, improved school facilities[77].*

3.4.2. The Binishell at North Narrabeen Public School

The Binishells at North Narrabeen Public School (NNPS) were constructed in mid 1974. While a number of other Binishells were constructed for the NSW Department of Education, those at Narrabeen North are notable as being the first complex completed for the NSW government. The complex was officially opened in November 1974 by NSW Premier, Sir Robert Askin.

The two interconnected domes (Building B) were designed to be used as a library, while the third Binishell served as an administrative office for the school. Each of the three Binishell buildings at North Narrabeen are 18 metres in diameter. Only two other Binishells of this diameter were constructed in NSW schools, at Killarney Heights Public School and Ashbury Public School, with other Binishell complexes being 36 metres in diameter.

A photograph of this building was the initial (promotional) image in the Building Centre, London video - Dante and Nic Bini - Shell Structures produced in 2013. In that video, when Dante Bini is

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74 Betteridge, Margaret, Binishells, Their Context and Significance in School Architecture in NSW, March 2018, p. 16; included in Heritage Asset Advisory, NSW Public Works Advisory, NSW Department of Education Binishell Strategy Stage 1, revised May 2019.
75 Ibid.
76 Department of Public Works NSW Annual Report 1974-75, p.12.
77 Betteridge, Margaret, Binishells, Their Context and Significance in School Architecture in NSW, March 2018, p. 3; included in Heritage Asset Advisory, NSW Public Works Advisory, NSW Department of Education Binishell Strategy Stage 1, revised May 2019.

asked to nominate his favourite buildings, he nominates two buildings. His first favourite was the Sardinia La Cupola house he built in the late 1960s for the movie director Michelangelo Antonioni and his partner, actress Monica Vitti. His other favourite building was the North Narrabeen Binishell with the "oyster" at the opening of the "shell". He goes on to explain that he worked with the NSW Govemment Architect, JW (Ian) Thomson and he was requested by the then NSW Minister for Education, Sir Eric Willis "to do something that represents the knowledge of the world for the kids. So, first of all, I cut this shell, like a shell that was opening. And, when the pearl of the shell, which was representing to me the knowledge of the world, was exposed to the kids, this was something that everyone approved, the kids loved it. And also I used the concept of Michelangelo Antonioni to have a space which was not flat, underneath the shell."

Figure 46: North Narrabeen Public School Binishells, 1975 (Source: NSW State Archives and records, GPO 2 - 47287, File No. FL2347486).

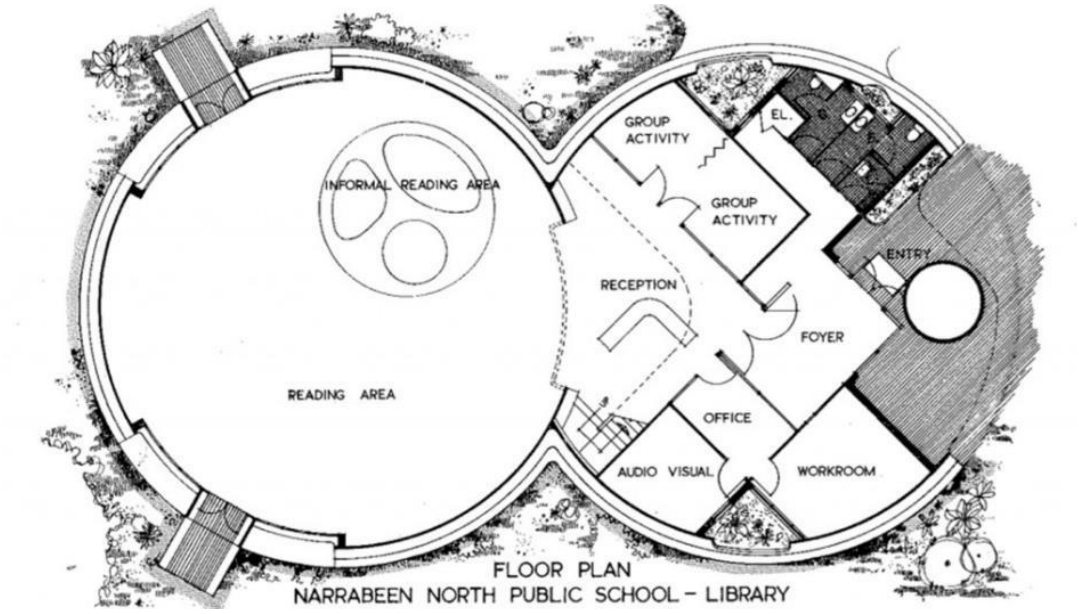

Figure 47: Narrabeen North Primary School Library, Floor Plan 1974 (Binishell B) (Source: Binisystems.com).

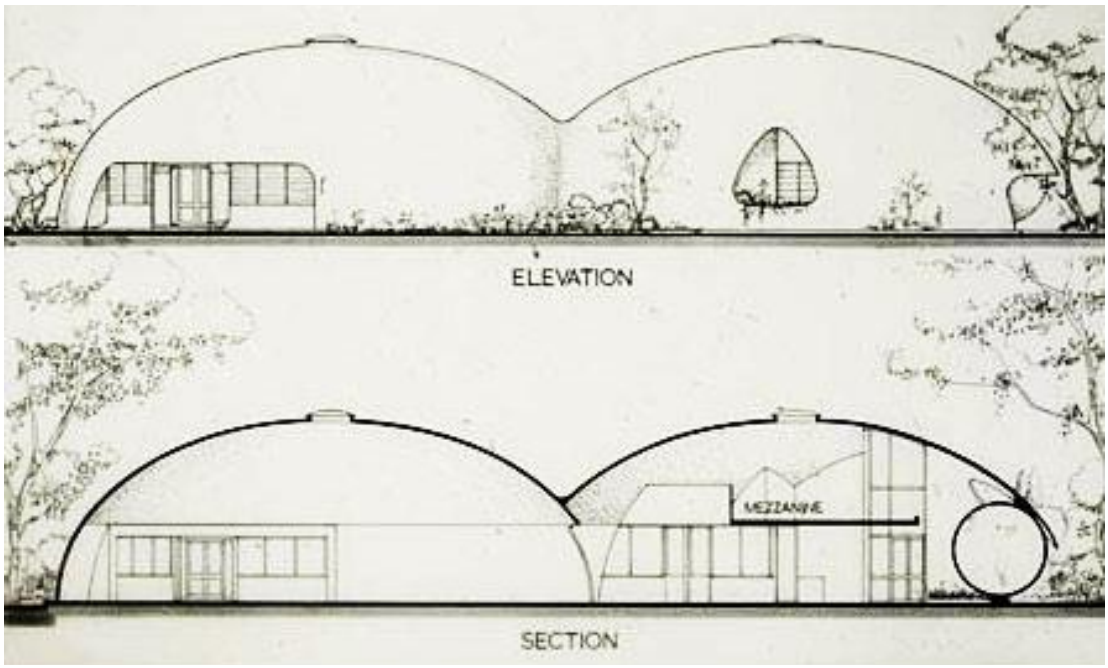

Figure 48: Narrabeen North Primary School Library, Elevation and section 1974 (Binishell B) (Source: Binisystems.com).

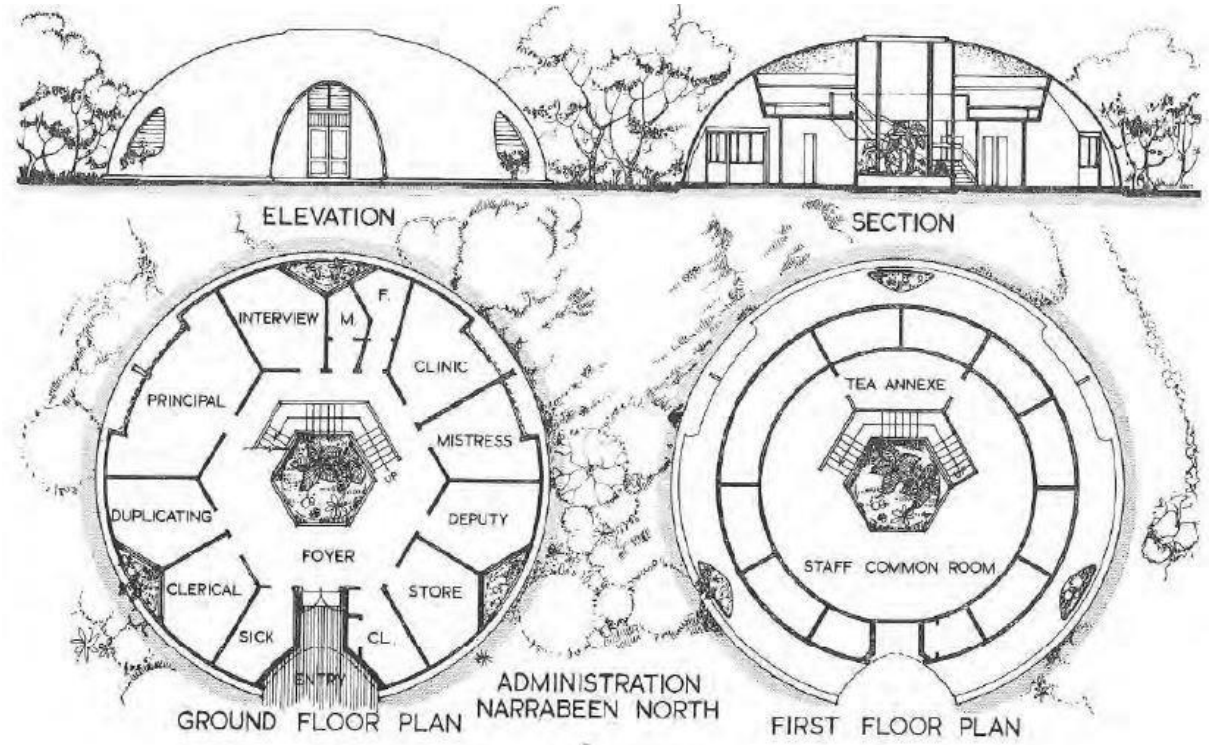

Figure 49: Plans, Section and Elevation for the Administration building, North Narrabeen Public School (Bini Shell A) (Source: Reproduced in construction of Binishell reinforced concrete domes, Department of Public Works, 1978, p. 9, cited in Betteridge, 2018, p. 22).

4. ASSESSMENT OF SIGNIFICANCE

4.1. Understanding Heritage Significance

Each place is unique and has its own combination of values. Therefore, before making decisions about the future of a heritage item it is essential to understand its heritage values so that these will be retained when making future decisions about the place. The statement of heritage significance summarises an item's heritage values.

4.2. Statements of Significance

4.2.1. State Heritage Register

The following Statement of Significance has been extracted from the State Heritage Inventory (SHI) form for State heritage item 'The Binishell Collection (Department of Education)' (SHR no. 02037):[78]

> *The Binishell Collection (Department of Education) is of state heritage significance for its historic values as part of the innovative NSW Public Works Binishell Program which successfully and quickly responded to the sudden growth in public schools in NSW at the end of the 1960s and through the 1970s.*
>
> *The Binishell Collection (Department of Education) is of state heritage significance for its association with the NSW government's innovative response need to fast track an economical, labour effective and speedy program of building in NSW Schools in the early 1970s. It is also of significance for its association with the Italian architect, Dr Dante Bini who developed and patented the system of constructing reinforced concrete domes.*
>
> *The Binishells in the collection are of state heritage significance as each demonstrate the distinctive, landmark aesthetic qualities and variations of the concrete futuristic bubble design popular in the late 1960s and 1970s.*
>
> *The Binishell Collection (Department of Education) is of state heritage significance for its ability to demonstrate the innovative design and construction techniques used in their construction.*
>
> *The Binishell Collection (Department of Education) is of state heritage significance an intact rare example of the Binishell as multipurpose school buildings in NSW schools*.

4.2.2. Pittwater Local Environmental Plan 2014

The following Statement of Significance has been extracted from the State Heritage Inventory (SHI) form for heritage item 'Concrete geodesic domes (North Narrabeen Public School)' (item no. 2270341):[79]

> *The concrete geodesic domes are one of a very limited number of Binishells in Australia and one of the few remaining constructed as part of the NSW Department of Public Works building program for schools in the 1970s. This program sought to construct 10 binishells across the state to provide large open floor spaces for schools, using the new construction method invented by Italian architect, Dr Dante Bini. This method of construction has been used around the world, mainly to build houses. These buildings are aesthetically and technically significant as they represent a new method of public building construction in the 1970s. The North Narrabeen Binishells were the first 18 metre domes built in NSW and were one of the first such buildings in NSW public schools.*

[78] 'The Binishell Collection (Department of Education)', State Heritage Inventory (SHI) form, available at https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5066940
79 'Concrete geodesic domes (North Narrabeen Public School)', State Heritage Inventory (SHI) form, available at https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=2270341

4.2.3. Binishells NSW - A Heritage Assessment

The following Statement of Significance has been extracted from the Heritage Assessment of Binishells NSW for School Infrastructure NSW Department of Education by Anne Warr Heritage Consulting in May 2019:[80]

> *The construction of Binishells as school facilities to house libraries, multi-purpose centres and gymnasia in NSW schools between 1974 and 1979, demonstrated a period of creativity and experimentation by the NSW Government, including the Government Architects Branch and NSW Department of Education, to provide much needed accommodation for a booming school population. The program ceased in 1979 after fifteen Binishells were constructed across fourteen schools, making it the largest collection of Binishells in the world devoted to a public enterprise.*
>
> *Binishells are significant for their association with Dr. Dante Bini, a highly creative Italian architect who patented the system of building reinforced concrete domes by using compressed air to inflate a large membrane covered with wet concrete, and developed the product in many forms and for many applications around the world. The Binishell project was able to come to fruition in NSW because of the atmosphere of creativity, experimentation and problem solving which flourished in the Government Architects Branch of the NSW Public Works Department in the 1970s. The willingness of NSW Government to import foreign ideas and expertise reflected the spirit of Internationalism of the time, embracing innovative ideas in a spirit of international[81] cooperation.*
>
> *Binishells embody a high degree of aesthetic significance as examples of Modernism which departed from traditional rectilinear forms in NSW school architecture, and for a high level of intactness including custom designed interiors of timber joinery, colour schemes, furniture and spatial arrangements. It was an imaginative and cutting-edge initiative which brought 'space age' design and technical innovation to the forefront of public architecture.*
>
> *The uniqueness of the construction and design enables the Binishell structures to reveal information over time about an innovative construction technique, modern architectural design, the use of space in learning environments, and lessons regarding durability of materials, maintenance and sustainability. The structural failure of two of the domes in 1975 and 1986 have provided opportunitities for research into the reasons for the failures and the development of structural understanding and alternatives.*
>
> *Of the fifteen Binishells originally constructed, eight2 remain, six have been demolished and one collapsed. The eight remaining Binishells are a precious collection demonstrating a period of modern architecture which expressed optimism in the future, a willingness to experiment with new building techniques and a desire to create innovative learning spaces. It was an investment by the NSW government that has provided memorable experiences for generations of school children over the past 40 years. Although examples of Binishells can be found around the world, the comprehensive development of the system for school education by the NSW Department of Public Works remains unique in the world.*

A significance ranking of the existing fabric and view analysis have been undertaken by City Plan Heritage and provided as Appendix A for reference.

[80] Warr, A. (May 2019), 'Binishells NSW - A Heritage Assessment', pp. 2-3.
[81] Interestingly, the construction method was brought to the attention of the NSW Minister for Public Works by Sir William Davis Hughes, himself a former NSW Public Works Minister, then Agent General in London. David Hughes was the initial intermediary between the architects at NSW Public Works and Dante Bini. (Source: Betteridge/Musecape 2018).

5. HERITAGE IMPACT ASSESSMENT

5.1. Statutory Controls

Narrabeen North Public School contains two (2) Binishell domes (Block A and Block B) which are identified as a local heritage item under Part 1 of Schedule 5 of the Pittwater Local Environmental Plan 2014 as 'Concrete Geodesic Domes (North Narrabeen Public School)', (item no. 2270341) at 6 Namona Street comprising Lot 3 of DP1018621. The two (2) Binishell Domes are listed as State significant on DoE's Section 170 Heritage and Conservation Register. The Double Binishell Dome (Block B) is listed on the State Heritage Register (SHR) under the NSW *Heritage Act, 1977* as part of the 'The Binishell Collection (Department of Education)' (SHR no. 02037) listing. The SHR listing curtilage excludes Bini Shell A, which remains as a local heritage item.

The subject site is also located within proximity to a number of heritage items, therefore is subject to the heritage controls in the Pittwater LEP 2014 and the Pittwater 21 Development Control Plan.

Narrabeen Sports High School, located within the Narrabeen Education Precinct, is not listed as a heritage item and hence is no further assessed against the heritage controls. Notwithstanding, the proposed works within the NSHS, which are considered being in the vicinity of a heritage item, will have no impact on the established heritage significance of the Binishell domes (Block A and Block B) as the works are located to the south of the NSHS site with no changes to the setting and configuration along Namona Street.

5.1.1. Pittwater Local Environmental Plan (LEP) 2014

The proposal is addressed below in relation to the relevant clauses of the LEP.

Clause 5.10 Heritage conservation	Discussion
(2) Requirement for consent *Development consent is required for any of the following—* *(a) demolishing or moving any of the following or altering the exterior of any of the following (including, in the case of a building, making changes to its detail, fabric, finish or appearance)—* *(i) a heritage item,* *(ii) an Aboriginal object,* *(iii) a building, work, relic or tree within a heritage conservation area,* *(b) altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in Schedule 5 in relation to the item,* *(c) disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed,* *(d) disturbing or excavating an Aboriginal place of heritage significance,* *(e) erecting a building on land—*	Narrabeen North Public School (subject site) contains two (2) Binishell domes (Block A and Block B) which are listed as a local heritage item under Part 1 of Schedule 5 of the Pittwater Local Environmental Plan 2014 as 'Concrete Geodesic Domes (North Narrabeen Public School)', (item no. 2270341) at 6 Namona Street comprising Lot 3 of DP1018621. The subject site is also located within proximity to a number of heritage items. The proposed works involve construction of a new two (2) storey building containing administration facilities, multi-purpose hall and out-of-school-hours care (OSHC) facility on the ground floor with staff facilities and amenities on the first floor, and new Covered Outdoor Learning Area (COLA). The proposed development requires the consent of the Northern Beaches Council under subclause 2(a)(i), 2(b), and 2(e)(i). Accordingly, an application will be made to the Council to obtain its consent. As noted in Section 1.5 above the demolition of existing buildings (Blocks H and J), and refurbishment of three (3) existing buildings (Blocks B, K and V) have been included for the purpose of explaining the reasons behind the location of the proposed new building and COLA but they are subject to a separate path of

Clause 5.10 Heritage conservation	Discussion
(i) on which a heritage item is located or that is within a heritage conservation area, or *(ii) on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance,* *(f) subdividing land—* *(i) on which a heritage item is located or that is within a heritage conservation area, or* (ii) *on which an Aboriginal object is located or that is within an Aboriginal place of heritage significance.*	approval under Development without consent - REF, and are not part of the current Development Application.
(4) Effect of proposed development on heritage significance *The consent authority must, before granting consent under this clause in respect of a heritage item or heritage conservation area, consider the effect of the proposed development on the heritage significance of the item or area concerned. This subclause applies regardless of whether a heritage management document is prepared under subclause (5) or a heritage conservation management plan is submitted under subclause (6).*	This HIS has given careful consideration to the proposed construction of a new two (2) storey building, and new Covered Outdoor Learning Area (COLA), and the subsequent impacts on the known heritage values of the State and locally significant heritage item. A more detailed discussion can be found in *Section 5.1.2 - Pittwater 21 Development Control Plan (DCP).*
(5) Heritage assessment *The consent authority may, before granting consent to any development—* *(a) on land on which a heritage item is located, or* *(b) on land that is within a heritage conservation area, or* *(c) on land that is within the vicinity of land referred to in paragraph (a) or (b),* *require a heritage management document to be prepared that assesses the extent to which the carrying out of the proposed development would affect the heritage significance of the heritage item or heritage conservation area concerned.*	This HIS has been prepared in accordance with this clause as the subject site is listed as a heritage item in Part 1 of Schedule 5 of the Pittwater LEP 2014 as 'Concrete Geodesic Domes (North Narrabeen Public School)' (item no. 2270341). It follows the methodology in line with the NSW *Heritage Manual* "*Statement of Heritage Impact*" and "*Assessing Heritage Significance Guidelines*."
(6) Heritage conservation management plans *The consent authority may require, after considering the heritage significance of a heritage item and the extent of change proposed to it, the submission of a heritage conservation management plan before granting consent under this clause.*	Due to the nature of the proposed works and the level of significance identified in *Section 4 - Assessment of Significance,* as well as the previous exhaustive documentation of the Binishell domes as part of their SHR listing consideration preparation of a specific Conservation Management Plan for the site is not considered necessary.

Clause 5.10 Heritage conservation	Discussion
(7) Archaeological sites *The consent authority must, before granting consent under this clause to the carrying out of development on an archaeological site (other than land listed on the State Heritage Register or to which an interim heritage order under the Heritage Act 1977 applies)—* *(a) notify the Heritage Council of its intention to grant consent, and* (b) *take into consideration any response received from the Heritage Council within 28 days after the notice is sent.*	The subject site went under Historical Archaeological Assessment in October 2019 by AMBS Ecology and Heritage[82], and the assessment concludes that the Narrabeen Education Precinct has no archaeological significance. It is therefore unlikely for archaeological remains with research potential or significance to be present within the site. The assessment concluded that should any archaeological remains be present; those would be associated with the twentieth-century development of the school and would not make a substantive contribution to research questions relevant to the early history of the site or local area that are not available from other sources. Therefore, the subject clause does not apply. Notwithstanding, should any unexpected archaeological finds be uncovered during any ground works, the 'STOP WORK' procedure will be applied to allow for the inspection of an appropriately qualified archaeologist in order to advise on the required management and consultation with Heritage NSW. A more detailed discussion can be found in *Section 5.1.2 - Pittwater 21 Development Control Plan (DCP).*
(8) Aboriginal places of heritage significance *The consent authority must, before granting consent under this clause to the carrying out of development in an Aboriginal place of heritage significance—* *(a) consider the effect of the proposed development on the heritage significance of the place and any Aboriginal object known or reasonably likely to be located at the place by means of an adequate investigation and assessment (which may involve consideration of a heritage impact statement), and* (b) *notify the local Aboriginal communities, in writing or in such other manner as may be appropriate, about the application and take into consideration any response received within 28 days after the notice is sent.*	Investigation into the potential Aboriginal heritage of the subject site is beyond the scope of this report. However, a basic search of the Department of Premier and Cabinet AHIMS Web Services (Aboriginal Heritage Information Management System) was undertaken for the following allotments comprising the whole Narrabeen Education Precinct (Narrabeen North Public School and Narrabeen Sports High School) for 50m and 200m buffer zone: ▫ Lot 3, DP 1018621 ▫ Lot 12, DP 1119562 The results have shown that: ▫ 0 Aboriginal sites are recorded in or near the location, and; ▫ 0 Aboriginal places have been declared in or near the location. Therefore, no impact on a known Aboriginal place of significance is anticipated.

5.1.2. Pittwater 21 Development Control Plan (DCP)

The subject site at Narrabeen North Public School contains two (2) Binishell domes (Block A and Block B) which are identified as a local heritage item under Part 1 of Schedule 5 of the Pittwater LEP 2014 as

82 AMBS Ecology and Heritage (October 2019), 'Narrabeen Education Precinct - Historical Archaeological Assessment', pp. 38.

'Concrete Geodesic Domes (North Narrabeen Public School)', (item no. 2270341) at 6 Namona Street comprising Lot 3 of DP1018621. The current heritage listing applies to only the Binidomes or Binishells, which are significant items within its context, but the LEP description of the property and the heritage map list the whole site identified as Lot 3 of DP1018621 under NSW Land Registry Records. Hence, the proposed development is assessed under *clause B1.1 of the Pittwater 21 DCP.*

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
B1.1 Heritage Conservation - Heritage items, heritage conservation areas and archaeological sites listed in Pittwater Local Environmental Plan 2014 *Any development application involving work likely to impact the heritage significance of a heritage item or archaeological site is to be accompanied by a Heritage Impact Statement, prepared by an appropriately qualified heritage professional. Guidance on preparing a Heritage Impact Statement (Statement of Heritage Impact) is available at NSW Office of Environment & Heritage in the NSW Heritage Manual or superseding publication.*	▪ This HIS has been prepared in response to this clause as the site of the Narrabeen North Public School containing two (2) Binishell domes (Block A and Block B) are identified as a local heritage item under Part 1 of Schedule 5 of the Pittwater Local Environmental Plan 2014. ▪ This HIS follows the methodology in line with the NSW *Heritage Manual* publications *Statement of Heritage Impact, 2002* and *Assessing Heritage Significance, 2001.* ▪ It provides recommendations for conserving the heritage significance of the Binishell domes and their setting.
Alterations and additions to buildings and structures, and new development of sites containing a heritage item or archaeological site are to be designed to respect and complement the heritage significance in terms of the building envelope, proportions, materials, colours and finishes, and building alignment.	▪ The proposed development, consisting of demolition, construction and refurbishment works, is located in proximity to the significant Binidomes but will have no impact on the significance of the items. The development involves the removal of two contemporary building blocks (Block H and J), which are subject to a separate approval pathway under Development without consent (REF) process, as well as a few demountable structures at the west and south through Exempt Development pathway, which do not contribute to the significance of the site. The demolition of Block J, in particular opens up a view corridor towards Binidomes A and B from the primary entrance at Namona Street. ▪ The refurbishment works involve minor internal alterations to Blocks K and V (under separate Development without consent (REF) approval pathway) to accommodate new school facilities, including Special Programs Rooms and Support Learning Unit, with no impact on the significance of the Binidomes. ▪ The internal refurbishment works to Binidome B will be under separate Development without consent (REF) approval pathway.

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
	▪ The proposed new Hall and Administration Block connected to the new GLS Hub and COLA is located at the west of Binidome B outside of the established SHR curtilage. The new development is low height similar to the recent Block V building utilising site's topography that avoids excessive overshadowing over the Binidomes and has open corridors and COLA and continues to maintain the low-rise character around the site. Currently, the Binidomes cannot be viewed from the west and southwest of the site as they are surrounded by fully grown trees and the existing school buildings and demountable classrooms. As such, the development in the west will not disrupt any significant view corridors to and from the Binidomes maintaining a sufficient gap between the new GLS and the new Hall buildings. The proposed new development will generally align with the height and scale of the adjoining buildings and demountable structures on site with a slightly higher and longer footprint but in an area that will not be within the curtilage or primary setting of the Binidomes. ▪ Further, the proposed design of the Hall and Administration Block connected to the new GLS Hub and COLA will aim to generally align with the scale of other buildings around the site. The COLA has been specifically made at a height to ensure the visual corridor to the Binidomes as open as possible, which is one of the positive aspects of the proposed development. Views to the Binidomes are currently limited to the internal courtyard of the School site and not available from the main pedestrian entrance to the School from Namona Street. ▪ The existing buildings, other than the Binidomes, are aligned both horizontally and vertically to the subject site along the north-south and east-west axis. The proposed double-storey Hall building is aligned at an angle to match the existing site boundary while the new GLS building align with the remainder of the buildings within the site. Moreover, the angular alignment of the proposed building was required to accommodate the structure outside the designated SHR curtilage of the State significant Binidome B.

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
Development on land containing a heritage item or archaeological site is to minimise the impact on the setting of the item or site by providing an adequate buffer zone where appropriate, and maintaining and respecting significant views to and from the heritage item or archaeological site.	▪ The subject site is listed for the existing two Binidomes A and B, located in the middle of Narrabeen North Public School. The proposed refurbishment works have no impact on the current setting of the Binidomes. ▪ The proposed demolition of Building Blocks H and J (under separate Development without consent (REF) approval pathway) will have no impact on the existing setting and curtilage of the state and locally significant Binidomes A and B. Rather, the demolition of the two modern structures will open a direct view corridor to the Binidomes from the primary entrance to the school site view Namona Street enhancing and improving their setting and views to and from them. ▪ The construction of the new double-storey GLS and Administration Building with a new hall and COLA is located southwest of the two Binidomes with adequate buffer. A part of the proposed Administration building and COLA is slightly encroaching within the heritage curtilage of the state significant Binidome B on the southwest corner. Notwithstanding, the development does not block any significant views to and from the Binidomes and is setback from the structure, thereby maintaining the current setting of Binidome B. The new COLA, which extends out from the new Hall and the Administration buildings is higher than the Binidomes and supported on slender aluminium posts with aluminium battens. The new COLA with its contemporary design and earthy colour scheme, in fact, will blend in within the existing trees and frame the view corridor to the Binidomes from the pedestrian's entrance to the site.
Fencing and gates that are complementary to a heritage item should be retained, particularly those constructed from sandstone and are significant or represent important character elements for a locality.	▪ Not Applicable
New fencing and gates to a heritage item are to be compatible with the style and scale of the heritage item.	▪ Not Applicable

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
Original face brick or stone surfaces are not to be painted nor rendered.	▪ Not Applicable ▪ Binidomes A and B were one of the first dome structures constructed in New South Wales (NSW). Bini Shell A is a single 18-meter diameter dome structure, while Bini Shell B, located adjacent to Bini Shell A, is one of the few dome structures formed of two interconnected domes, each 18 meters in diameter, constructed in steel and concrete with glass windows. The structures are painted and will continue to remain in painted form as a part of the proposal.
Garages and carports are to be located as far behind the front building alignment of a heritage item as possible, if the site conditions allow. Garages and carports ideally should not be attached or integrated with heritage items, but set carefully next to them. Where possible they should not entail alteration of the heritage item to accommodate them, so that the heritage item is not distorted.	▪ Not Applicable
The scale and form of any alterations and additions are not to dominate the existing building, especially when viewed from the most significant elevations. New alterations and additions should be consistent with the existing building form with respect to roof shape and pitch, façade articulation, fenestrations, proportions and position of windows and door openings.	▪ The proposed works, including demolition of Blocks H and J, refurbishment of Blocks K and V (both under separate Development without consent (REF) approval pathway), and construction of a new GLS Building along with a new Administration Building, Hall and COLA, do not dominate or impact the significant 1970s Binidome structures. The proposed buildings on the site are single to double-storey structures utilising the topography of the site to respond appropriately to the scale of the Binidomes and other school buildings. The surrounding residential areas of the site are located on the eastern side of the school boundary and well distant from the proposed area of the development on the western boundary of the site. The architectural detailing of the new development with the concept of Tree House will allow the Binidomes to continue to be prominent features on the site, with the new buildings blending well within the current varying architectural forms of the overall site. The architectural form of any new development responds in a contemporary and sympathetic manner to the strong architectural forms evident in the existing Binidomes by utilising minimal modulation and adopting contemporary aesthetics that are contextually fitting.

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
	▪ The proposed structures are carefully sited to respect the cultural significance of the place. The significant setting of the Binidomes is being retained as the new development is setback from the designated heritage curtilage. As noted above, a part of the proposed Administration building and COLA is slightly encroaching within the heritage curtilage of the State significant Binidome B. This encroachment is minor in nature, and it does not block any significant views to and from the Binidomes and is setback from the structure through angular placement of the new buildings, thereby maintaining the current setting of Binidome B with an increased and newly created visual connection to the main pedestrian entrance to the site. An appropriate setting around the Binidomes, as well as a sense of the open space character around the northeast setting for the Binidomes, is being retained, which provides for the original intended relationship between the buildings and the landscape setting. ▪ The demolition of Blocks H and J (under separate Development without consent (REF) approval pathway) will open up a view corridor to and from the Binidomes to the main entrance to the school site via Namona Street. The proposed works will continue to retain significant views of the Binidomes within the site, in particular the view of the three domes available in the area northeast of the Binidomes. ▪ No changes are proposed to the significant Binidomes, and the existing form, bulk, materiality, colour scheme, and fenestrations, which will continue to remain in their current form and scheme. Material investigation is being undertaken under separate approval as explained below to establish the required repairs and maintenance for the Binidomes, which will be integrated into the implementation of the refurbishment works to Binidome B. This work will ensure the fabric and significance of the Binidomes preserved.

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
Alterations and additions to heritage items should not necessarily attempt to replicate the architectural or decorative detail of the original but be sympathetic and compatible so as to maintain a distinction between old and new in a subtle manner. Alterations and additions should complement a heritage item's existing period style and character. Reconstruction or reinstatement of the original details and finishes is encouraged.	▪ The subject Binidomes require structural investigative works to understand their current condition and if they further require any repairs. Two separate applications were lodged, including the S60 Fast Track Application for State significant Binidome A and Exemption Application for locally significant Binidomes A and B to Northern Beaches Council. ▪ Currently, the proposed works do not involve any modifications and alterations to the existing Binidome structures and any works will be (under separate Development without consent (REF) approval pathway
Original roofing materials should be retained wherever possible. New roofing material should match the original as closely as possible in terms of colour, texture and profile.	▪ Not Applicable. ▪ The proposed works do not involve changes to any existing roofing materials. No new roof form is proposed over the existing buildings. The roof form for the proposed buildings (GLS Building and Administration Building and Hall) aligns with the existing roof forms across the site and continues to retain the prevailing character of the Binidomes in the center of the site.
The materials, finishes and colours used in alterations and additions should complement the heritage item. Modern materials can be used if their proportions and details are harmonious within the surrounding heritage context or with the heritage item.	▪ The proposed works are located within the heritage site but do not include any changes to the significant concrete Binidomes. The proposed development of new buildings at the southwest of Binidomes are single to double storey using the topography of the site and responding appropriately to the scale of the Binidomes. The new buildings follow a contemporary form and material palette but are sympathetic to the strong architectural forms of the Binidomes and do not overwhelm the significant qualities of the structures. ▪ The proposed buildings utilised the concept of a tree house, considering the natural setting and characteristics of the school site, and the minimalist design sits homogeneously within the 1970s dome structures.

The following table addresses the relevant controls of the DCP. Part B - Development Controls Section 13 - Heritage and Conservation	This proposal relates to these matters as follows:
Colour schemes for heritage buildings should generally be compatible with the particular architectural style and period of the building.	▪ The existing complex has a group of buildings constructed using different materials, form, style and colour schemes. Narrabeen North Public School include structures construed in weatherboard, reinforced concrete, facebrick, plywood and fibreboard (demountable structures). The original materials of the significant buildings are being retained as a part of the proposed works. ▪ The proposed works utilise high-quality, well-crafted durable materials consistent with the existing materials and colours of the school buildings. The proposed materials and finishes palette is included in the documentation set for the development application. ▪ The proposed colour scheme is designed to be compatible with the neutral colour scheme of significant buildings (Binidomes) on the school site utilising combination of earthy natural colour shades in line with the tree house design concept.
If work associated with a development approval is likely to adversely impact the heritage item, Council requires an archival recording of a heritage item to be prepared by an appropriately qualified heritage professional.	▪ The proposed works are not likely to adversely impact the state and locally significant Binidomes A and B. However, this Heritage Impact Statement does include recommendations that could be considered as part of the development of the site, which include undertaking a photographic archival recording prior to the commencement of any works.

5.1.3. Warriewood Locality Desired Character Statement[83]

The subject site (Narrabeen Educational Precinct - Narrabeen North Public School and Narrabeen Sports High School) is located within the Warriewood Locality and the following statement identifies the guidelines for the desired character for the locality.

> *The Warriewood locality will remain characterised by a mix of residential, retail, commercial, industrial, recreational, and educational land uses.*
>
> *Existing residential areas will remain primarily low-density with dwelling houses a maximum of two storeys in any one place in a landscaped setting, integrated with the landform and landscape. Secondary dwellings can be established in conjunction with another dwelling to encourage additional opportunities for more compact and affordable housing with minimal environmental impact in appropriate locations. Any dual occupancies (detahced) will be located on the valley floor and lower slopes that have less tree canopy coverage, species and habitat diversity and fewer other constraints to development. Any medium density housing will be located within and around commercial centres, public transport and community facilities.*
>
> *Warriewood Square will meet the retail needs of the local and regional community as well as some smaller neighbourhood centres.*

83 'A4.14 Warriewood Locality - Desired Character', Pittwater 21 Development Control Plan, Northern Beaches Council, accessed [online] https://eservices.northernbeaches.nsw.gov.au/ePlanning/live/pages/plan/Book.aspx?exhibit=PDCP&hid=11792

Future development will maintain a building height limit below the tree canopy and minimise bulk and scale. Existing and new native vegetation, including canopy trees, will be integrated with the development. Contemporary buildings will utilise facade modulation and/or incorporate shade elements, such as pergolas, verandahs and the like. Building colours and materials will harmonise with the natural environment. Development on slopes will be stepped down or along the slope to integrate with the landform and landscape, and minimise site disturbance. Development will be designed to be safe from hazards.

Discussion

Narrabeen Educational Precinct caters to the education requirements of the local residents. Therefore, the proposed development at the subject site will continue to cater to the increased requirements of the local community and aim to improve the amenities and facilities in line with the current educational standards. The subject site is surrounded by low to medium-density residential buildings, and the school complex will continue to maintain the existing low-density character across the school site. The proposed height for the new Administration and GLS buildings remains around the maximum building height with only a few areas of departure at the apex of the gables and the COLA, which is specifically kept higher to allow for a clear view corridor to the Binidomes. Notwithstanding, the new buildings and COLA respond appropriately to the scale of the Binidomes and that of the surrounding residential areas, which are located at a distance on the eastern side of the school site. Notwithstanding, the project team has carefully considered the design and palette of materials and colours of the new building to ensure its compatibility with the existing significant Binidomes and other early buildings at the school site.

Most of the existing significant trees around the school site are being retained, while some smaller trees are being removed to accommodate the new development, subject to a separate development application.

5.2. Heritage NSW Guidelines

The following questions have been extracted from the NSW *Heritage Manual* publication, *Statements of Heritage Impact, 2002*. Responses have been provided in relation to the proposed development.

Questions to be answered	This proposal relates to these matters as follows:
Can all of the significant elements of the heritage item be kept, and any new development be located elsewhere on the site?	▪ As noted throughout this report, although the heritage listing curtilage is for the entire allotment of the Narrabeen North Public School, the key heritage listing for the subject site relates directly to the two (2) Binishell domes (Block A and Block B), which are recognised as a local heritage item known as 'Concrete Geodesic Domes (North Narrabeen Public School)', (item no. 2270341). The two (2) Binishell Domes are also listed as State significant on DoE's Section 170 Heritage and Conservation Register while the Double Binishell Dome (Block B) is listed on the State Heritage Register (SHR) under the NSW *Heritage Act, 1977* as part of the 'The Binishell Collection (Department of Education)' (SHR no. 02037) listing. The significant Binidomes will be retained as they are under the current development proposal. ▪ The proposed works involve construction of a new two (2) storey building containing administration facilities, multi-purpose hall and out-of-school-hours care (OSHC) facility on the ground floor with staff facilities and amenities on the first floor, and new Covered Outdoor Learning Area (COLA). It also includes demolition of existing buildings (Blocks H and J), and refurbishment of three (3) existing buildings (Blocks B, K and V), which are subject to a separate planning approval pathway under Development without consent - REF).

Questions to be answered	This proposal relates to these matters as follows:
	▪ All significant heritage elements of the Binidomes are kept, and the proposal ensures that the significant elements on the subject site are maintained.
Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible?	▪ The demolition of Building Blocks H and J (a non-significant modern structure within the heritage item) (under separate approval pathway as part of Development without consent - REF) is necessary to accommodate the new double-storey Administration and GLS buildings on the site and cater to the increased demand for the services on the subject site by providing new building in its place. ▪
Has the advice of a heritage consultant / specialist been sought? Have the consultant's recommendations been implemented? If no, why not?	▪ City Plan Heritage (CPH) was involved in the design process from the initial stage and has provided advice prior to the finalisation of the proposed design. The current form of the proposed design incorporates CPH's recommendations in relation to heritage matters.

The following table addresses the proposal in relation to relevant 'questions to be answered' relating to a new development adjacent to a heritage item (including additional buildings and dual occupancies).

Questions to be answered	This proposal relates to these matters as follows:
How is the impact of the new development on the heritage significance of the item or area to be minimised?	▪ The proposed single to double-storey new hall, Administration buildings and COLA in place of Building blocks H and J (considered under separate panning approval pathway as part of Development without consent - REF) and relocated several demountable classrooms (as an Exempt Development) will have an acceptable impact on the heritage significance of Binidomes A and B, of which the school has been listed as a heritage item. The school site has undergone significant development since the construction of the Binidomes around the 1970s, and the proposed buildings with similar bulk and scale will continue to enhance the significance of the item as an educational facility by providing additional and compatible facilities that are essential for the continuation of the school activities in line with the current educational standards. ▪ The new Administration and GLS buildings with a Hall and COLA are essentially a replacement structure within a larger footprint than the existing Blocks H and J (part of Development without consent - REF), and relocated several demountable classrooms (Exempt Development), and are slightly higher than the existing structures around the school site but in a similar scale of recent Block V at the current entrance of the site along Namona Street. The proposed buildings respond appropriately to the scale of the Binidomes and other school buildings on site. The architectural detailing of the new development with the concept of Tree House will allow the Binidomes to continue to be prominent features on the site, with the new buildings blending well within the current architectural form and tree canopies of the overall site. The architectural form of any new development responds in a contemporary and

Questions to be answered	This proposal relates to these matters as follows:
	sympathetic manner to the strong architectural forms evident in the existing Binidomes by utilising minimal modulation and adopting contemporary aesthetics that are contextually fitting.
Why is the new development required to be adjacent to a heritage item	▪ The proposed location for the Administration and GLS buildings is the most suitable area within the restricted school site that would ensure the curtilage around Binidomes A and B is retained in an appropriate manner while also it is close and connected to the essential school facilities and activities located within the Binidomes. The new building includes administration functions and accommodates staff, and locating the functions at the proposed central location connects it to the other school structures as well as the open car park along the southwest. The new COLA will allow outdoor learning adjacent to the two significant Binidomes, and the users will be able to regularly appreciate the aesthetics of the three domes as they are now in an enhanced visual connection across the site.
How does the curtilage allowed around the heritage item contribute to the retention of its heritage significance?	▪ The proposed structures are carefully sited to respect the cultural significance of the place. The significant setting of the Binidomes is being retained as the new development is set back from the designated SHR curtilage for Binidome B. The existing curtilage of Binidome A is being retained as the proposed development is not adjacent to the subject building. The proposed new buildings are located adjacent to the existing, State significant Binidome B. A part of the proposed Administration building and COLA is slightly encroaching within the heritage curtilage of the state significant Binidome B. The encroachment is minor in nature and was unavoidable due to the restrictions of the school grounds including the Binidomes and the biodiversity zone to the south and west of the proposed location. New building and COLA do not block any significant views to and from the Binidomes and are setback from the structure, thereby maintaining the current setting of Binidome B. An appropriate setting around the Binidomes, as well as a sense of the open space character around the northeast setting for the Binidomes, is being retained.
How does the new development affect views to, and from, the heritage item? What has been done to minimise negative effects?	▪ The existing significant views to and from the Binidomes from the north and south are being retained as a part of the proposal. In addition, with the demolition of Blocks J and H (under separate planning approval pathway as a Development without consent (REF)), the view corridor to the Binidomes from the southern entrance will be enhanced. The new development is located along the west and southwest of the subject site, which was always screened with natural vegetation blocking all western views to and from the Binidomes. ▪ As noted earlier and evident from the submitted photomontage views the COLA with its higher awning and tree-like slender posts will frame the views towards the Binidomes when one approaches the site from the main

Questions to be answered	This proposal relates to these matters as follows:
	pedestrian entrance. This view corridor is currently not available and obscured by Blocks H, J and V limiting the views to the Binidomes being internal only. Relocation of the main entrance pathway will create a new focal point and draw the users of the site directly into the Binidomes.
Is the development sited on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?	▪ The research conducted to date makes it evident that the subject site is unlikely to contain archaeological remains with research potential or significance to be present. The previous (October 2019) assessment concluded that should any archaeological remains be present; those would be associated with the twentieth-century development of the school and would not make a substantive contribution to research questions relevant to the early history of the site or local area, that is not available from other sources. Therefore, no archaeological impact is anticipated under the current proposed development.
Is the new development sympathetic to the heritage item? In what way (e.g. form, sitting, proportions, design)?	▪ As described and discussed throughout this HIS, the proposed development of new buildings at the southwest of Binidomes are combination of single to double storey and respond appropriately to the scale of the Binidomes. The new buildings follow a contemporary form and material palette similar to the recent school buildings but are sympathetic to the strong architectural forms of the Binidomes and do not overwhelm the significant qualities of the structures. ▪ The proposed buildings utilised the concept of a tree house, considering the natural setting and characteristics of the school site, and the minimalist design sits homogeneously within the 1970s dome structures. ▪ The proposed development has been designed to be compatible with the existing contemporary school buildings and demountable structures. on the site. Through the articulated design and the selection of materials, the buildings are easily identifiable as new work and generally remains compatible in character. While the building is visually more expansive than Blocks J and H (proposed for demolition under a separate planning approval pathway as a Development without Consent - REF), the design of the structures is consistent with the neighbouring school buildings and integrates sympathetically within the site as a new infill development.
Will the additions visually dominate the heritage item? How has this been minimised?	▪ The proposed two buildings with COLA are combination of single to two-storey structures, replacing the existing building blocks J and H, which are single-storey in height but have relatively high pitched roof forms making them approximately 1 and half storey high in comparison with the proposed buildings. The proposed buildings will be placed in close proximity to the significant Binidomes A and B; however, while this increase will make the buildings visually more dominant than the existing buildings; the well-considered and articulated design following the concept of a Tree House will ensure they fit comfortably within the restrictions of the site conditions while allowing

Questions to be answered	This proposal relates to these matters as follows:
	adequate buffer just outside of the SHR curtilage of Binidome B. As detailed throughout this report, the proposed building will not dominate the identified curtilages of the Binidomes, and the existing significant views to and from Binidomes A and B will not be blocked as an outcome of the proposed works. Rather they will be further enhanced and improved for an increased appreciation of the concrete Binidomes from the point one sets a foot in to the school from Namona Street.
Will the public, and users of the item, still be able to view and appreciate its significance?	▪ Significant views to and from Binidomes A and B are not being impacted by the proposed works to the subject site. As noted above and detailed in the submitted documentation the views to the Binidomes will significantly be improved hence the appreciation of, as described in the Statement of Significance, *their distinctive, landmark aesthetic qualities and variations of the concrete futuristic bubble design popular in the late 1960s and 1970s*.

5.3. Proposed tree removal

The current DA includes removal of three trees within the SHR curtilage including Trees 55, 57 and 58; and two trees within COLA of Block A. The SHR listing relates to the Binishell B only and the trees within the curtilage are not noted as being of State heritage significance in the Statement of Significance and the SHR listing form rather the native landscaping and mounds are noted in the description only. Notwithstanding, comparison of the historical aerial imagery between the years of 1951 and 1978 clearly show that the subject trees that are within the SHR curtilage of the Binidomes have been introduced following construction of the Binidomes in the 1970s. Although, the subject trees are considered in the Arboricultural Impact Assessment report as being High ecological significance, they do not contribute significantly to the historical landscaping of the site. Therefore, their removal will have negligible impact on the setting of the Binidomes and the overall landscape setting of the NNPS.

The 1951 Historical Aerial Imagery for North Narrabeen Public School provides evidence of a larger landscaped area at the school site in that period; however, around 1961, a significant area of the school site was cleared to accommodate more structures within the site. It is evident from the 1961 Imagery that the school site has two landscaped areas remaining from the 1951 period along the south and southwest of the school site. Later, in between 1961 to 1978, a large area of the open space around the school buildings and Binidomes was enhanced with natural landscape that contributed to the aesthetic characteristics of the school.

6. CONCLUSION AND RECOMMENDATIONS

In conclusion, it is considered by City Plan Heritage that the proposed works, including construction of a new two (2) storey building containing administration facilities, multi-purpose hall and out-of-school-hours care (OSHC) facility on the ground floor with staff facilities and amenities on the first floor, and new Covered Outdoor Learning Area (COLA), and removal of three trees within the SHR curtilage including Trees 55, 57 and 58; and two trees within COLA of Block A, will result in some but an acceptable impact on the heritage significance of the Concrete Geodesic Domes (Binidomes A and B) located at the subject site. There will be no impact on the significance of the nearby heritage items, which are distant from the school site with limited to no visual connections. The proposed change to the site aims to upgrade the school and available facilities to accommodate a projected increase in student capacity and meet the current educational standards of the Narrabeen Educational Precinct. The design and the location of these changes have been selected considering the fundamental need to retain the site's significant heritage elements and their appreciation.

The mitigating design factors, including the selection of materials and detailing the architectural language of the neighbouring school buildings around the Binidome structures, and placing the new buildings outside of the designated State Heritage Register curtilage of Binidome B, will help soften the introduction of what is a much-needed addition to the site. The works will ensure the continuation of the school functions in line with the current educational standards and improve the facilities that are essential for its continuing function as a school complex. The upgrading of educational facilities is integral in ensuring that the site remains capable of servicing the long-term use of the Narrabeen Educational Precinct while ensuring no physical impact on the 1970s Dante Bini's Bini Shell structures of the high and exceptional significance. The continuation of the site's active use as an educational facility assists in ensuring the continued maintenance and conservation of the site's significant heritage values as part of the Department of Education's Binishell Collection. This proposal has provided a means to facilitate the upgrade of the site while considering how to best manage the conservation of the heritage item as a whole through careful consideration of the site's conditions including the biodiversity zone, the relationship between Binidomes and the new buildings incorporating the COLA, façade and mass articulation, retention of mature trees as much practicable, employing a compatible but contemporary palette of materials and colours.

The Tree House design concept ensures the new structures in particular the COLA, which frames the views to Binidome B in particular, integrate well into the existing trees and landscape setting of the site. The proposed development provided an opportunity to further enhance and improve the visual curtilage to the Binidomes for their increased appreciation from the point one sets a foot in to the school from Namona Street through demolition of existing buildings (Blocks H and J), which are subject to a separate planning approval pathway under Development without consent - REF process. There is no direct view to the Binidomes from Namona Street entrance of the school as it is obscured by Blocks H and J limiting their views to the internal areas only. As such, the views to the Binidomes will significantly be improved hence the appreciation of *their distinctive, landmark aesthetic qualities and variations of the concrete futuristic bubble design popular in the late 1960s and 1970s* as described in the Statement of Significance of the Binishell Collection.

The eastern side of the subject site is surrounded by low-density residential buildings, and the existing school buildings align with the ones in the vicinity. Hence, the new buildings, in relation to the existing school buildings and Binidomes on the site, will follow similar characteristics in terms of form, bulk, materials, finishes and scale. Therefore, it is considered that while the new buildings will make changes to the site's conditions along the western side of the site, they will not adversely affect the residential character of the surrounding neighbourhood. The new buildings appropriately respond to their educational facility requirements and architectural character in this regard.

The following recommendations have been made to ensure the assessed heritage values of the subject site, and its layered history is conserved and communicated to its future users:

- A temporary protection plan should be prepared to ensure Binidomes and in particular Binidome B are protected during works and to guide the demolition works of the buildings and relocation of demountable structures around the Binidomes;
- A photographic archival recording of Binidomes and their surroundings where the proposed development will take place should be undertaken prior to the commencement of any works in

accordance with the Heritage NSW guidelines for *Photographic recording of Heritage Items Using Film or Digital Capture (2006)*;

- A built heritage specialist should be involved and be on site during all critical processes that require specialist heritage expertise and detailing; and
- Ensure STOP WORK provisions are in place for any unexpected findings that could be considered archaeological relics or an Aboriginal object during the works to prevent any harm to the finds. Consult a suitably qualified archaeologist to inspect the find and advice on the appropriate management approach.

Provided that the above recommendations are integrated into the approval process, the proposed development is deemed acceptable from a heritage perspective and is consistent with the relevant controls regarding heritage contained in the Pittwater LEP 2014 and Pittwater 21 DCP. Therefore, approval of the application is recommended, and the above recommendations are to be considered for inclusion in the Conditions of Consent.

CITY PLAN HERITAGE

SEPTEMBER 2022

APPENDIX A:

Significant views & vistas to & from Binidomes A and B

(for information only to assist in the assessment of the works under the current DA as the refurbishment works to Binidomes are subject to a separate planning approval pathway under an REF process)

CLEAR VIEW OF BINI SHELL A FROM SCHOOL BUILDINGS AND DEMOUNTABLES

EXISTING SIGNIFICANT VIEWS OF BINI SHELL A AND BINI SHELL B

DISTANT VIEW OF BINI SHELLS A AND B FROM JACKSON ROAD

JACKSON ROAD

LOT 3
D.P. 101862

NEW GLS HUB
FFL 4.95
916m²

NEW SUPPORT LEARNING UNIT

E

UP

HERITAGE CURTILAGE

REFURBISHED LIBRARY
FFL 4.70
522m²

B

A

EXISTING COLA

U

T

S

EXISTING SHADE

SHED
SHED

R

19

21385

NEW HALL & ADMIN BLOCK
FFL 4.95
667m²

D

NEW COLA

466m²
FFL 4.95

P

EXISTING CARPARK

REFURBISHED SPECIAL PROGRAMS ROOMS

FFL 4.85
118m²

K

N

10440

FFL 2.35

9900

REFURBISHED GLS HUB
FFL 4.31
407m²

V

REFER TO LANDSCAPE ARCHITECT'S PLANS FOR RAMP DETAILS

NEW SUBSTATION

NEW FIRE BOOSTER ASSEMBLY

+FFL 3.01

SHED

NAMONA STREET

0 5 10 15 20 25 m
SCALE BAR

LEGEND

- DEVELOPMENT APPLICATION
- DEVELOPMENT WITHOUT CONSENT (SEPARATE APPLICATION)
- DESIGNATED DEVELOPMENT APPLICATION (SEPARATE APPLICATION)
- 1 DEMOUNTABLES
- EXISTING PERMANENT BUILDING / STRUCTURE
- COASTAL WETLANDS/ BIODIVERSITY ZONE
- PROJECT SITE EXTENTS
- HERITAGE CURTILAGE
- MAIN ENTRY
- SECONDARY ENTRY
- ENHANCED VIEW CORRIDOR
- EXISTING SIGNIFICANT VIEW CORRIDOR

HERITAGE VIEW LINES

Independent
Arboricultural
Services

Arboricultural Impact Assessment

Prepared For: School Infrastructure NSW

Narrabeen North Public School
Narrabeen NSW 2101

12th September 2022

IAS8602

Independent Arboricultural Services - Disclaimer

The material contained in this document has been prepared on an independent basis free of any bias and represents the honest opinion of the consulting arborist.

Tissue or soil samples have not been collected nor submitted for testing unless otherwise stated. Excavation is limited to minor earthworks and we submit this assessment on the basis that all data is based on visual inspection of the tree/s and its/their location, species, health and condition at the time of writing unless otherwise stated. Measurements and tree locations noted in this report are approximate and have not been determined by survey unless information and analysis has been provided by the consultant or such information is otherwise noted. Please request a more detailed arborist report if further information and analysis is required. Depending on site requirements, specific alternate specialist advice including engineering consultancy and certification maybe required in combination with this assessment. This assessment contains arborist advice and associated general information only and does not purport to provide other site-specific specialist advice such as engineering certification unless arrangement to source such advice for inclusion in this assessment has been requested and authorised.

This report containing opinions, advice and recommendations based on information and data gathered from site inspections carried out by personnel from Independent Arboricultural Services as well as information provided by the client and/or its representatives, is to be relied on by the client in that context. It is assumed that all such information provided to Independent Arboricultural Services is correct. All recommended arboricultural works detailed in this assessment including pruning of tree canopy or roots, tree removal, tree transplantation or other associated works including stump grinding or the application of any prescribed treatment shall be carried out in accordance with applicable standards including Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 Protection of trees on development sites.

The invoice for this report will be issued to the person or entity as per the address advised at the time of confirmation of appointment. Assessment in this report is based on plans provided at the time of confirmation of engagement and report preparation. Additional time required for re-assessment of report detail due to subsequent re-issue of plans after report preparation will be subject to an additional fee which will be charged at our hourly rate. This report shall not be conveyed to any third party including regulatory authority/s until full payment of this invoice is received by Independent Arboricultural Services and a finalised report has been issued unless agreement to do so has been granted.

Factors including the absence of historical records or local knowledge, recognition of the variability of the integrity of a tree as a naturally living organism as well as the impact of conditions within its surrounds to which it maybe subject including the impacts of mechanical force and the occurrence of weather events, do not allow an arborist to guarantee the age of a tree, or the length of time a tree/s may live or such time as it /they may fail. There is no warranty or guarantee, expressed or implied that the problems or deficiencies of the plants or property in question may not arise in the future.

Table of Contents

Document Tracking & Information

Project Name	Arboricultural Impact Assessment – Tree 57 & 58		
Project Arborist	Chantelle Hughes (AQF Level 5) & Roger Rankine (AQF Level 8)		
Client	School Infrastructure NSW		
Address	Narrabeen North Public School, Narrabeen NSW 2101		
IAS Reference	IAS8602		
Prepared By	Chantelle Hughes (AQF Level 5) & Roger Rankine (AQF Level 8)		
Checked By	Andrew Rankine (AQF Level 8)	**Date**	12th September 2022
Revision	1		
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Abbreviations

NBC	Northern Beaches Council	**RPA**	Root Protection Area
DA	Development Application	**TMP**	Tree Management Plan
VPO	Vegetation Protection Order	**CMP**	Construction Management Plan
ULE	Useful Life Expectancy	**VMP**	Vegetation Management Plan
BLF	Building Location Footprint	**AS**	Australian Standard
BLE	Building Location Envelope	**AS 4373: 2007**	Pruning of amenity trees
TPZ	Tree Protection Zone	**AS 4970: 2009**	Protection of trees on development sites
SRZ	Structural Root Zone	**DBH**	Diameter at Breast Height

All comments and recommendations in this report have been determined in accordance with Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 Protection of trees on development sites. All recommended tree work should be carried out in accordance with these standards.

Roger Rankine

Consulting Arborist

Map

Figure 1: Subject Site (Nearmap 2021)

Introduction

This report is based on a visual inspection carried out from the ground on the 24th November 2021 & 9th May 2022. No soil or tissue sampling has been conducted. Tree assessment and Qualitative Visual Tree Analysis has been carried out in accordance with TRAQ ISA guidelines. Data and information provided to the client by others has been incorporated into this report as appropriate.

All Arboricultural recommendations contained in this report have been determined in accordance with Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 Protection of trees on development sites.

For the purposes of this report reference to a Consulting or Project Arborist is held to mean an Arboricultural specialist who holds minimum Arboricultural qualifications of Dip Arb/AQF 5, appropriate professional insurances and has appropriate experience in the protection of trees on construction sites. Where tree work is specified, all recommended tree work is to be carried out in accordance with the above-mentioned standards by an appropriately trained and AQF qualified arborist practitioner/s with an up-to-date record of training and membership of a recognised Australian Arboricultural association, e.g. Qld Arboricultural Association (QAA), Arboriculture Australia (AA), or a recognised international Arboricultural association. No climbing spikes are to be used if pruning is to be carried out on live trees except in the instance of an emergency.

Qualifications of the report authors include Diploma of Arboriculture/AQF Level 5 and ISA Certified Arborist accreditation. Report authors hold current insurances and memberships including qualified memberships of Queensland Arboricultural Association (QAA), and Arboriculture Australia (AA) as well as current accreditation and membership of International Society of Arboriculture (ISA).

Independent Arboricultural Services is a qualified registrant on the QAA Register of Consulting Arborists.

Executive Summary

Independent Arboricultural Services have been engaged by School Infrastructure NSW to assess potential impacts to the nominated vegetation resulting from the proposed Narrabeen Education Precinct development which includes the redevelopment of the Narrabeen North Public School (NNPS) and Narrabeen Sports High School (NSHS).

The proposed Narrabeen Education Precinct development includes redevelopment of Narrabeen North Public School (NNPS) and Narrabeen Sports High School (NSHS). The Public School and High School have been identified by the NSW Department of Education (DoE) as requiring upgrade works.

The works at NNPS upgrade the school including demolition of existing buildings (Blocks H and J), construction of three (3) new buildings with refurbishment of three (3) existing buildings (Blocks B, K and V).

This Development Application (DA) will seek consent for the following works at NNPS & NSHS: The works the subject of the Development Application (DA) at NNPS comprise:

- Construction of a new two (2) storey building containing administration facilities, multi-purpose hall and out-of-school-hours care (OSHC) facility on the ground floor with staff facilities and amenities on the first floor; and
- New Covered Outdoor Learning Area (COLA).

Other development works are occurring on the site under separate planning pathways including:

- Development without consent (REF); and
- Exempt development
- The proposed development does not seek to increase staff or student numbers.

Chantalle Hughes (AQF Level 5) attended site on 24th November 2022 & 9th May 2022 to undertake the assessment of the impact of the works. Roger Rankine (AQF Level 5) attended site on the 21st June 2022. Assessment of the impacts of proposed development on the identified trees in and around the development envelope, roads and services has been undertaken. Advice on both specific and general tree protection measures and Project Arborist Requirements have been detailed in this report. It is important as the design is refined, further reviews are undertaken by the Project Arborist and protection measures are further specified as required.

Further detailed designed will be assessed as available during the project including civil works (cut / fill) services layouts and building footprints. Protection measures and assessment of incursion has been based on the available information provided.

As part of the design process and operational works it is recommended that the following is undertaken,

- The Project Arborist is to be consulted during the detailed design phase to minimise impacts to retainable vegetation.
- Current retention/removal recommendations are based on plans provided. Detailed assessment of final design plans and bulk earthworks are required prior to final retention/removal recommendations.
- Ensure all approvals and permits are in place before works commence.
- Undertake a pre-start meeting with contractors before works commence.
- Tree Protection Fencing is to be erected before works commence and audited by the Project Arborist (Min AQF Level 5).

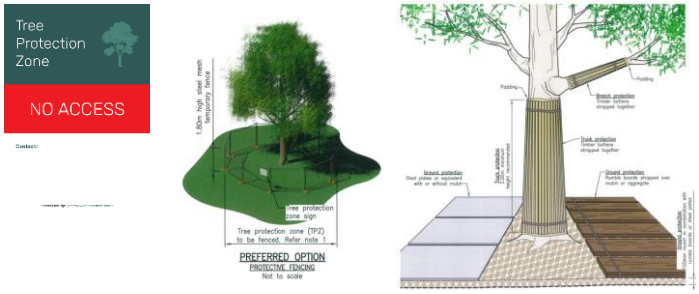
- Supervision by a Project Arborist (Min AQF Level 5) and Fauna Spotter/Catcher of the approved tree removals.
- Any works proposed within the TPZ of retained trees requires supervision of a minimum AQF5 Project Arborist.
- Tree Pruning is to be undertaken by a minimum AQF Level 3 Arborist.
- Laydown areas and site shed/office locations are to be identified/finalised and excluded from the Tree Protection Zones of retained trees and minimise public impact.
- Route vehicles and equipment outside of TPZs. If access is required within TPZ, mulch to a depth of 100mm and tree padding needs to be installed with the option of track mats as determined and signed off by a minimum AQF5 Project Arborist.
- Construction materials, spoil, stockpiles, tools and equipment are not permitted within the TPZs of retained trees.

Arborist Comment

- **Protection of retained trees during construction works**
- **Impact of the proposed works on nominated trees**

Protection of Retained Trees During Construction Works

An exclusion zone is to be established along the perimeters of retained trees and cordoned off with a physical barrier of wire mesh fence, 1.8m in height, which is securely anchored. The role of these fences is to prevent any damage to the complete tree including root system (SRZ & TPZ), stem and branch structure as well as the crown or canopy. Alternatively, and on approval of a minimum AQF5 Project Arborist, plastic mesh fencing, 1.2m in height, secured with star pickets and caps with straining wire can be utilised. All TPZ fencing will require appropriate signage to signify the relevant protection zones. This will require audit and sign off prior to operational works onsite.



Tree Protection Fencing to be utilised. Where works will be undertaken close to and within Tree Protection Zones specific tree protection measures to be utilised a directed by the project Arborist.

Impact of proposed works

Based on the proposed new mechanical plant Trees 57 & 58 will encounter major incursion under AS4970-2009 and the long-term health and structural viability will be affected by the proposed works. The proposed new buildings will result in completed incursion of Tree 55 and the long-term health and structural viability will be affected by the proposed works. It is recommended that all removals are replaced in accordance with the landscaping plans.

Project Hold Points

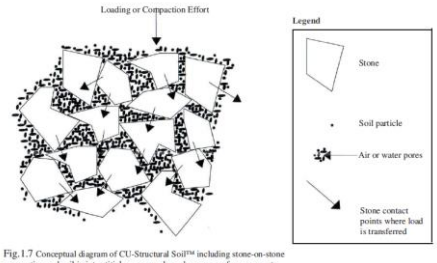
Engage an AQF5 minimum Project Arborist during the project life;

- Once tree protection fencing and signage has been established and finalised. Project Arborist (minimum AQF Level 5) to audit and sign off.
- Supervision of approved tree removals in conjunction with a fauna spotter.
- Any works within the TPZ of retained trees is required.
- If tree roots are encountered over 50mm in diameter outside of TPZs of retained trees.
- Changes to the plans occur.
- On completion of the project to conduct a final audit and summary.

(Site audits/summary reports will be conducted at each hold point interval by the Project Arborist)

Project Arborist Requirements	
1.	Pre-Start Inspection and Audit of Tree Protection Fencing Before Works Commence
2.	Any required Tree Works to be undertaken by a minimum AQF Level 3 Arborist under the Supervision of the Project Arborist (Min AQF Level 5). Tree Services Company to be a member of Queensland Arboricultural Association or Arboriculture Australia.
3.	All works within the Tree Protection Zones of the retained vegetation to be supervised by the Project Arborist (Min AQF Level 5). Audit Reports to be completed and submitted by the Project Arborist. Any below ground incursion to be water excavated under low pressure, under the supervision of the Project Arborist.
4.	All works to be excluded from the Structural Root Zone (SRZ) and supervised if located within Tree Protection Zone.
5.	The Project Arborist to be consulted if changes to plans are made that affect any retained vegetation.
6.	At the Completion of works, Project Arborist to undertake a site assessment and an audit report compile of any further remedial actions required.

Examples of Amended Protection Measures

Examples	Photos
Example of the use low pressure water excavation for the installation of conduits	 
Example of the use of black plastic to line pier holes	
Example of the use of black plastic to line concrete	 
Example of the use of Structural Soil. Structural Soils – (Source: Cornell University)	   Fig.1.7 Conceptual diagram of CU-Structural Soil™ including stone-on-stone compaction and soil in interstitial spaces used as a base course for pavements.

Conclusion

For all retained trees, with due care, implementation of appropriate work methodology as noted in this report and isolation of all TPZs of retained trees from construction works, the potential for ill-effect to retained/affected trees can be minimised in accordance with guidelines of AS4970:2009 – Protection of trees on development sites.

The following must occur:

NBC approvals must be in place prior to the commencement of any tree work for future construction work. Approvals are required should the Project Arborist prescribe pruning such as crown clean, canopy lift and/or directional pruning.

- Project Arborist must be appointed and engaged to guide the protection of protected trees from project commencement, i.e. during Design Planning and during the construction period until its completion.
- **All Arboricultural reports, TMPs, VMPs & approvals must be included in the CMP**
- Design Plans must be drafted to incorporate raised foundations supported by sleeved pier design or similar low impact design to bridge the roots zone of any development within TPZ's. Exploratory low pressure water excavation is to be undertaken as specified.
- Arborist briefing of all engaged persons on their commencement as well as diligent work practice must occur during all approved future construction work.
- Root disturbance must be minimised to prevent accidental injury, compression and the creation of exposure points to allow future entry of pests and pathogens.
- **All work within any TPZ must be supervised by the Project Arborist.**

All work within TPZs must be carried out with due care to avoid mechanical impact with retained tree/s during the construction phase. Where present existing strip footings or installed pier locations are to be utilised for any replacement of existing fence structures; alternatively, any removal of existing fence structures and new replacement work is to be carried out as detailed above, i.e. new fence foundations should utilise post and rail design with no concreted footing unless authorised by the Project Arborist. Sleeving should be installed to provide an impervious barrier between exposed TPZ perimeter/s and new concreted areas to prevent chemical leeching into the surrounding soil of retained trees.

Reactionary processes, such as the emergence of deadwood, dieback etc. are likely to occur as a result of disturbance and/or injury to any retained tree on a construction site. Amended design plans and construction methodology can serve to avoid or minimise the likely emergence of such issues and therefore their associated future OH&S issues to the future occupants of the new dwellings and or pedestrian or vehicular traffic within the vicinity of retained tree/s. Any required pruning is to be undertaken by a minimum AQF Level 3 Arborist under the supervision of the Project Arborist (AQF Level 5).

Tree Locations W/O TPZ

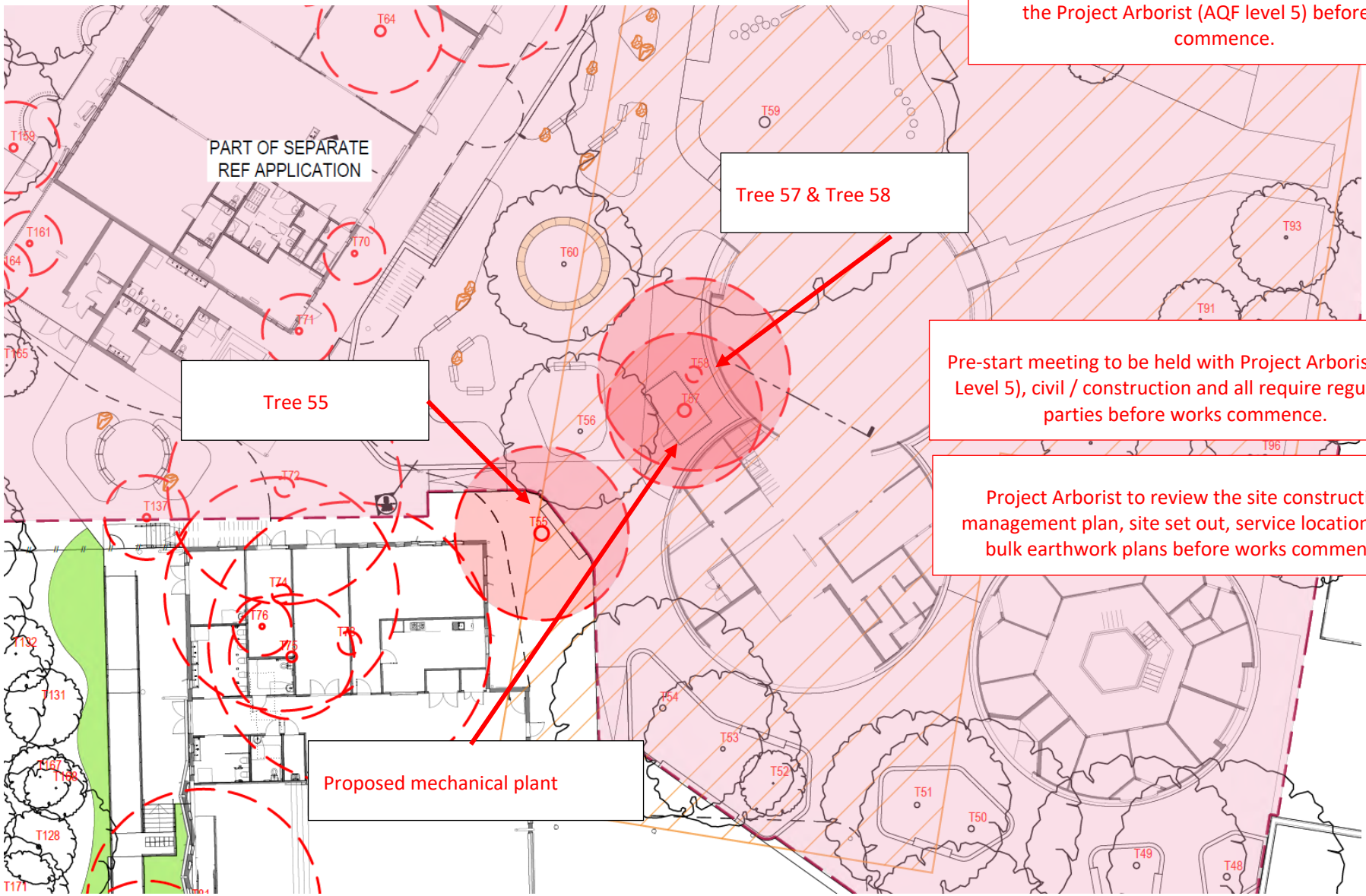
Please Note: Tree Locations are approximate only. Green circles represent TPZ as defined in AS4970 -2009 Protection of trees on development sites


Common Name
Avocado
Bangalow Palm
Black Tea-tree
Blue Berry Ash (2)
Blueberry Ash
Cabbage Fan-palm (2)
Camphor Laurel (7)
Canary Island Date Palm
Cedar Wattle (4)
Cheese Tree (24)
Coast Banksia (14)
Common Paperbark (2)
Cotton Wood
Crimson Bottle Brush
Flame Tree (3)
Fragrant Olive
Frangipani
Golden Banksia
Grey Gum
Grey She-oak (6)
Group of Trees
Gum (5)
Hills Weeping Fig
Jacaranda
Kaffir Plum
Kentia Palm
Lemon-scented Gum (9)
Lilly Pilly
Mango
Monterey Pine (2)
Moreton Bay Fig
Pencil Pine
Queen Palm (7)
Queensland Brush Box
Red Ironbark
Red Mahogany (3)
River She-oak
Saw Leaf Banksia (2)
Smooth-barked Apple Myrtle (5)
Southern Mahogany (31)
Swamp Mahogany (14)
Sweet Pittosporum
Sydney Blue Gum (3)
Tuckeroo (3)
Wallangarra Gum (4)
Wattle (7)
Weeping Fig
10 m

Tree Locations with Tree Protection Zones


Common Name
Avocado
Bangalow Palm
Black Tea-tree
Blue Berry Ash (2)
Blueberry Ash
Cabbage Fan-palm (2)
Camphor Laurel (7)
Canary Island Date Palm
Cedar Wattle (4)
Cheese Tree (24)
Coast Banksia (14)
Common Paperbark (2)
Cotton Wood
Crimson Bottle Brush
Flame Tree (3)
Fragrant Olive
Frangipani
Golden Banksia
Grey Gum
Grey She-oak (6)
Group of Trees
Gum (5)
Hills Weeping Fig
Jacaranda
Kaffir Plum
Kentia Palm
Lemon-scented Gum (9)
Lilly Pilly
Mango
Monterey Pine (2)
Moreton Bay Fig
Pencil Pine
Queen Palm (7)
Queensland Brush Box
Red Ironbark
Red Mahogany (3)
River She-oak
Saw Leaf Banksia (2)
Smooth-barked Apple Myrtle (5)
Southern Mahogany (31)
Swamp Mahogany (14)
Sweet Pittosporum
Sydney Blue Gum (3)
Tuckeroo (3)
Wallangarra Gum (4)
Wattle (7)
Weeping Fig
10 m

Tree Protection Plan



Tree Detail

Tree Id	Botanical Name	Common Name	DBH [cm]	TPZ [m]	SRZ (m)	Height [m]	Spread [m]	Est Height to Lowest Branch (m)	Health	Form	STARS - Tree Significance	Tree Retention Value	SULE
55	*Eucalyptus botryoides*	Southern Mahogany	46.1	5.53	2.57	14	18	3	Good	Typical	High Significance	High	2A-2D
57	*Populus deltoides*	Cotton Wood	46	5.52	2.45	12	7	2	Good	Typical	High Significance	High	2A-2D
58	*Eucalyptus botryoides*	Southern Mahogany	64	7.68	3.01	26	8	2	Good	Typical	High Significance	High	2A-2D

Tree Recommendations

Tree Id	Botanical Name	Common Name	DBH [cm]	TPZ [m]	Impact	Recommendations*
55	*Eucalyptus botryoides*	Southern Mahogany	46.1	5.53	Major - Building	Remove and replace in accordance with landscaping plans
57	*Populus deltoides*	Cotton Wood	46	5.52	Major - Mechanical plant	Remove and replace in accordance with landscaping plans
58	*Eucalyptus botryoides*	Southern Mahogany	64	7.68	Major - Mechanical plant	Remove and replace in accordance with landscaping plans

*Project Arborist (AQF Level 5) to be engaged during detailed design through to construction works. Reviews the final footprint of building works including cut / fill, building and services layout.

**Retention of trees is subject to a review of the finalised design, set out and pruning requirements by the Project Arborist (AQF Level 5).

Table Legend:			
Health	**Form**	**Aged Class**	**Further Detail**
Good: Trees foliage is in exceptional condition and can be considered an excellent specimen of its species. No pests or diseases are present.	Good: Trees structure is exceptional and can be considered an excellent specimen of its species. No visible defects are present.	Juvenile: Tree will generally grow rapidly in this phase of its life cycle.	Diameter at Breast Height (DBH) measured at 1.4m above ground level. Diameter at Root Flare (DRF) measured at the base of the tree, at the trunk / root system transition zone. Diameter = circumference divided by π
Fair: Trees foliar condition is satisfactory but may be exhibiting some signs of stress such as tip dieback or chlorosis, pests or diseases may be present but not adversely affecting the tree.	Typical: Trees structure is normal for the species; some minor structural constraints may be present.	Mature: Tree has reached maturity and is producing flowers, fruits and seeds. Tree continues to grow.	Tree Protection Zone (TPZ) defined as metres radius. Calculated being DBH x 12 (minimum 2.0m and no greater than 15m).
Poor: Foliage density is sparse or largely discoloured, tree health is at or approaching a critical value which may be irreversible, pests or diseases are highly prevalent throughout the crown.	Poor: Structure is a poor example of its species and exhibits a combination of structural issues.	Full to Late Maturity: Tree has reached the maximum height for its species, elongation has stopped but the trunk continues to thicken, overall growth rate is starting to slow, foliar density may be starting to thin.	Structural Root Zone (SRZ) displaced as metres radius. Calculation being $(DRF \times 50)^{0.42} \times 0.64$ (never less than 1.5m or greater than 15m).
Dead: Tree is in advanced decline or completely dead.	Dead: Tree is in advanced decline or completely dead.	Senescent: Tree has / is starting to retract in size through dieback and shedding of limbs. Trees in this age class may be ecologically valuable, as their structure contains habitat necessary for native fauna.	

Tree Protection Measures and Guidelines

Note 1: TPZ perimeter fencing should be grouped where perimeters overlap and appropriate.

Note 2: Signage is to be installed in accordance with Australian Standard AS 4970-2009 Protection of trees on development sites as illustrated below.

Protective Fencing

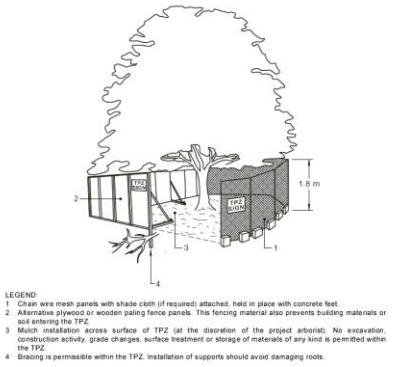


Figure 2

Examples of Trunk, Branch & Ground Protection

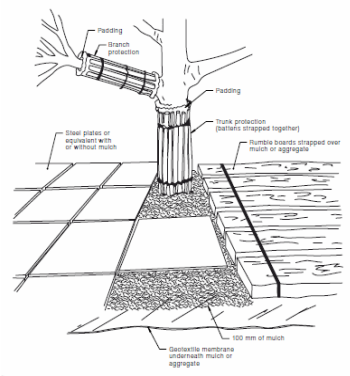


Figure 3

Tree Protection Zone Signage

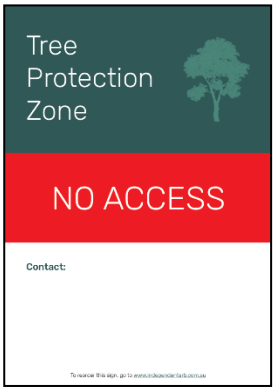


Figure 4

Low pressure Ground Excavation & Water Cutting

Figure 5

Figure 6

Figure 7

Figure 8

Example of Fauna Friendly Rigid Style Temporary Fencing

Figure 9

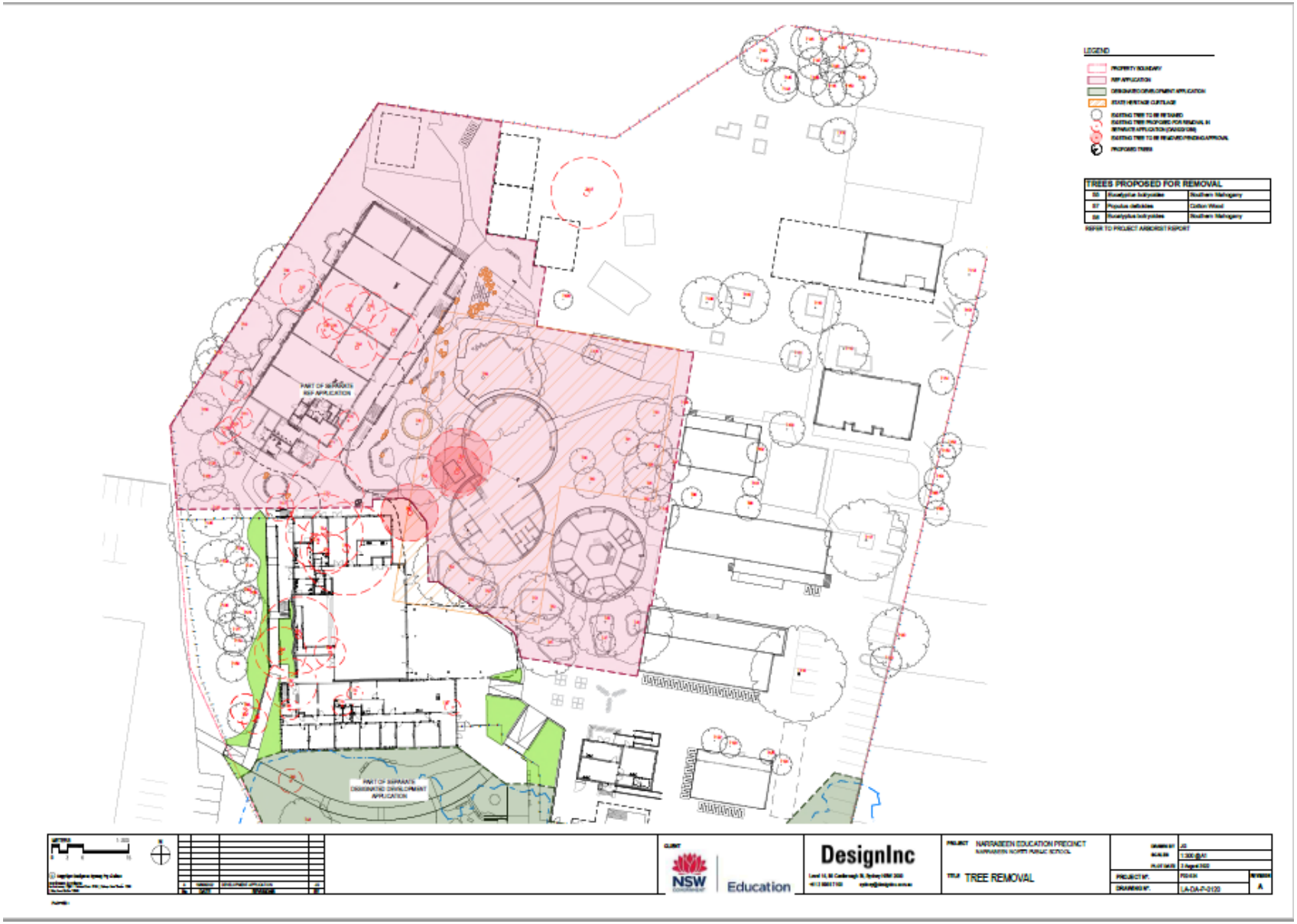
Figure 10

Source: AS4970-2009 Protection of Trees on Development Sites

Tree Management Plan (TMP) – Works Progress: Development Phase

Stage	Tasks	Specific Outcomes
Pre-construction Phase		
Prepare and finalise Arboricultural Impact Assessments for submission to Council	Project Arborist to be appointed Review tree details in all approved Arboricultural reports following any new issue of plans	Submit Arboricultural reports including Arboricultural Impact Assessment for final Council Approval
Project Arborist to conduct Prestart Meeting with all representatives involved in construction	Prior to meeting: TPZ temporary protection/fencing installed **Arboricultural Report, TMP & Council approval copies to be included in CMP** and made available to onsite crews	Prestart Certification and approvals in place & available onsite with CMP
Commencement - Construction Phase		
Initial Site Preparation	Project Arborist to supervise all tree work. **Construction crew or others are not to remove any part of a tree.** Arborist prestart site inspection.	Compliance Certification of Arboricultural works for lodgement to Council Arborist certification of TPZ measures.
Prestart Toolbox Meeting	All relevant onsite crews to be briefed by Project Arborist prior to commencement of each work phase. Project Arborist must be notified and onsite at all times when construction works are within or close to TPZ. Note: Onsite attendance of Project Arborist is a condition for issue of Arboricultural Site Audit Statement/s.	Arborist Site Audit Reporting system to be in place. Copies of Arboricultural Report to be retained onsite. Arboricultural Site Audit Statement/s will not be issued retrospectively
Construction Phase		
Site Establishment	Project Arborist to monitor tree health during establishment phase including bulk earthworks, changes in hydrology etc.	Instigate remedial tree care measures if required
Construction work	Site Manager to liaise with and ensure Project Arborist is advised in time to allow them to be present for all work carried out within TPZ area including any work likely to affect identified tree/s. Any deviation/s from approved plans to be approved by Project Arborist. **Project Arborist to provide ongoing Site Audit Certification of all work within TPZ**	Any remedial tree works to be carried out by qualified arborists under supervision of Project Arborist. Project Arborist is responsible for issue of Arborist Site Audit Reports.
Practical Completion	Project Arborist to carryout review of tree health and vigour and advise on TPZ fencing.	On Project Arborist approval, carryout removal of remaining temporary tree protection measures
Post Construction Phase		
Final Arborist inspection	Carryout tree health review and provide recommendations for required tree care.	Issue of final Arborist Site Audit Compliance Statement for inclusion in final DA documentation and sealing.

Plans


LEGEND
TREES PROPOSED FOR REMOVAL
REFER TO PROJECT ARBORIST REPORT
NSW
Education
DesignInc
TREE REMOVAL

Photos

Tree 54

Tree 57

Tree 58

Reference Page

1. Australian Standards 2009, AS 4970-2009 Protection of trees on development sites
2. Australian Standards 2007, AS 4737-2007 Pruning of Amenity Trees
3. Mattheck K, Breloer H. 1994. The body language of trees, a handbook for failure analysis, London, England
4. Shigo, A.L. 1986. A New Tree Biology. Shigo & Trees, Associates, Durham, New Hampshire
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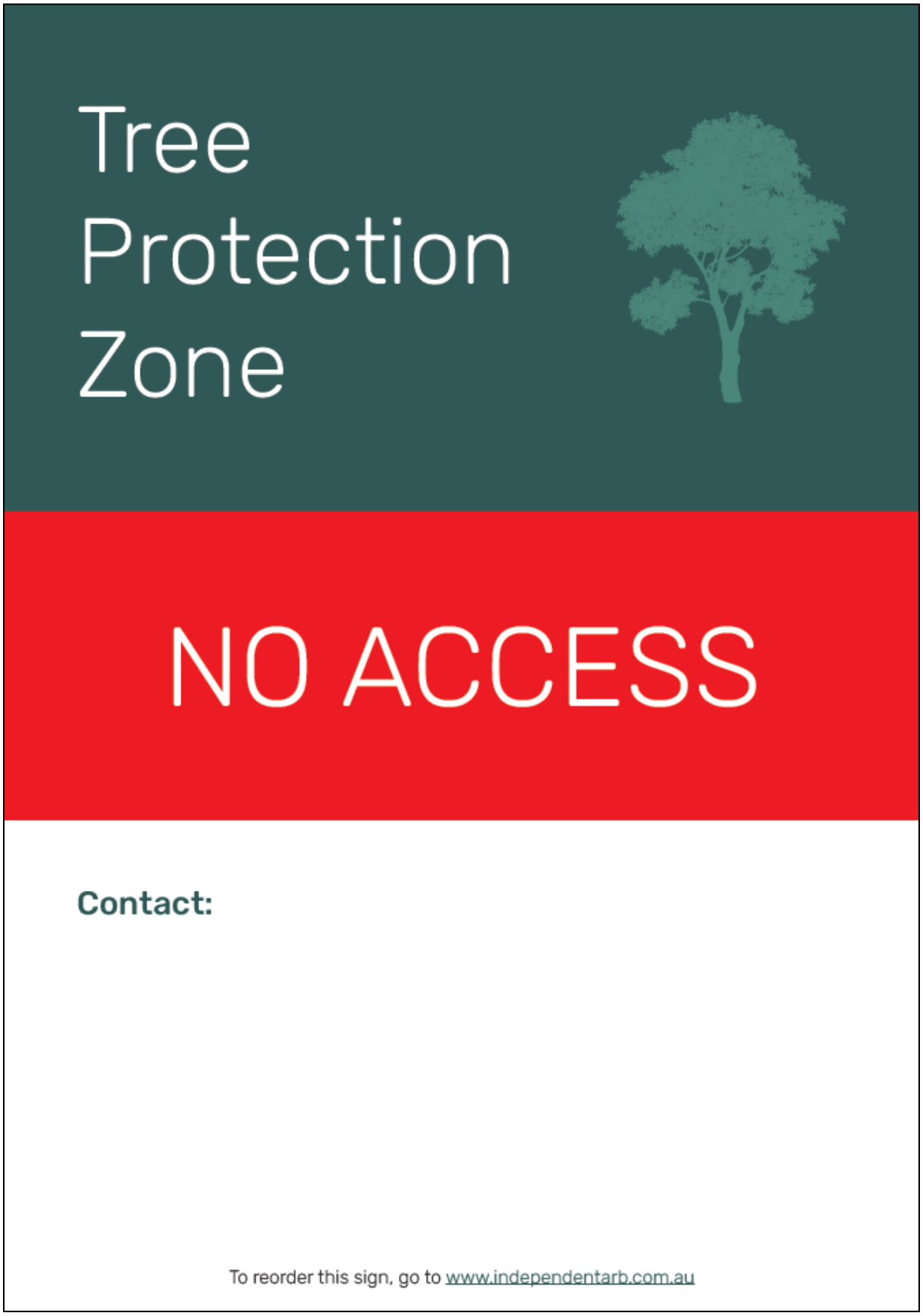
6. Bassuk, Nina, Jason Grabosky, Peter Trowbridge, and James Urban. "Structural Soil." Urban Horticulture Institute. Cornell University, 1996. Web. 26 Apr 2010. <http://www.hort.cornell.edu/uhi/outreach/csc/article.html>
7. Urban, J 2008, Up By Roots, Healthy Soils and Trees in the Built Environment, International Society of Arboriculture
8. Nearmap 2020, www.nearmap.com.au

Appendix 1


Tree
Protection
Zone
NO ACCESS
Contact:
To reorder this sign, go to www.independentarb.com.au

Appendix 2: Explanation of Terminology

Definition	Process Description
Removal	Complete tree removal leaving stump as close as possible to ground level. Recommended process will include chipping of all foliage limbs and timber and reinstatement of work site. Recommendation typically based on tree being assessed as representing a health and safety concern [Dead, dying, structurally unsound, unstable, poor form]
Remove and grind	Complete tree removal to include grinding of stump to a depth of 75 millimetres unless otherwise specified. Recommended process will include chipping of all foliage limbs and timber and reinstatement of work site. Stump site will be cleaned of all grinding debris and sawdust and backfilled with premium topsoil free from weeds.
Crown Clean (Deadwood)	Removal of all major/significant deadwood and dead branches up to [and including] 30 millimetres in diameter in trees overhanging pedestrian or vehicular areas or removal of dead branches > 50mm diameter in canopy of trees located in parkland or similar area unless otherwise specified.
Crown Clean (General pruning)	Recommended pruning process will include removal of broken, crossing, rubbing, diseased, stressed or dying branches or limbs with poor attachment. Additional work process may include pruning to define leaders, balance the crown, reduce weight load, or clear the tree from obstructions. In summary, to rectify, as far as is possible, any structural defects and eliminate undesirable growth or deadwood.
Crown Reduction (Canopy reduction)	Recommended pruning process may include light and general pruning typically to encompass removal of up to 15% but no more than 20% of the leaf-bearing crown. By definition the unique shape and form of the tree will not be altered or compromised by the pruning process. Typically, the consulting arborist will nominate the reduction percentage [%] appropriate to species, condition and assessment.
Crown Raising (Canopy lift)	Pruning processes maybe involve the raising of the tree's lower canopy to a height specified in metres. Typically, the process is performed to provide for pedestrian and or vehicular clearance and unless otherwise specified the default parameters will be to provide 2 metres clearance from ground level or as specified by local or state government regulation. From time to time pruning requirements may be altered to accommodate various site-specific requirements as advised by the consulting arborist accordingly.
Crown Restoration	Pruning process will encompass crown restoration and remedial works where the tree has been previously lopped or otherwise damaged. Not feasible when tree has extensive decay and should only be considered when there is evidence of healthy re- growth. When performed correctly the process of remedial pruning will most likely take several years to complete.
Hanger Limb / Unattached branch	Pruning process may be restricted to the removal of any hanger/s or dangerous/dead/dying limbs and will typically involve the removal of a single limb. In some instances, removal of an individual limb may be necessary to accommodate an obstruction and the consulting arborist will advise accordingly.
Directional Pruning	Pruning process will be restricted to pruning canopy away from buildings/service wires/property boundary and will typically be performed to avoid future growth in these areas. Where appropriate future growth will be directed away from obstruction by selected pruning so as to encourage the development of the growth of new leaders.

Habitat Pruning	When pruning deadwood from trees, simple techniques and methods can be employed to achieve hazard reduction whilst leaving food and habitat for tree dwelling fauna. Long pieces of deadwood can be reduced in length to limit potential hazard but still retain food for the insects and microorganisms. Stubs that have been left by old pruning or previous branch failure can be retained, and with the use of a hole-saw or chainsaw they may also be bored out to create a nesting hollow for native birds or small mammals. Source: Mosman Council
Deadwood	Dead branches within canopy of tree59F. Deadwood is a naturally occurring feature of most tree species and comprises dead or decaying branches within the canopy of a tree. Deadwood may have habitat value and require removal only according to the considered risk of its location, i.e. high use pedestrian area or damage to adjacent infrastructure.
Decay	The process of degradation of woody tissues by micro-organisms
Compaction	Results from loads or stress forces applied to the soil as well as shear forces. Both foot traffic and vehicle traffic exert both forces on soils. Vehicle traffic may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). The degree of compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling and transporting also tend to lead to the breakdown of soil structure and thus to compaction. Vibration as a result of frequent traffic or adjacent construction activities will also compact soils55F
Codominant Structure:	Stems or trunks of about the same size originating from the same position from the main stem52F. When the stem bark ridge turns upward the union is strong; when the ridge turns inward the union is weak, a likely point of failure in storm or windy weather conditions or where increasing weight causes undue stress on the defective union53F

Source: AS4373-2003 Pruning of Amenity Trees & AS 4970-2009 Protection of Tree on Development Sites & Habitat Creation By Kieran O'Neill, Mosman Council.

Appendix 3: Normal Function of a Tree

Background Note: The following diagrams and explanatory notes are useful to illustrate the structure of a tree in a normal growing environment. This information is taken from AS4970-2009 Protection of trees on development sites which has been released subsequently to AS4373-2007 Pruning of amenity trees.

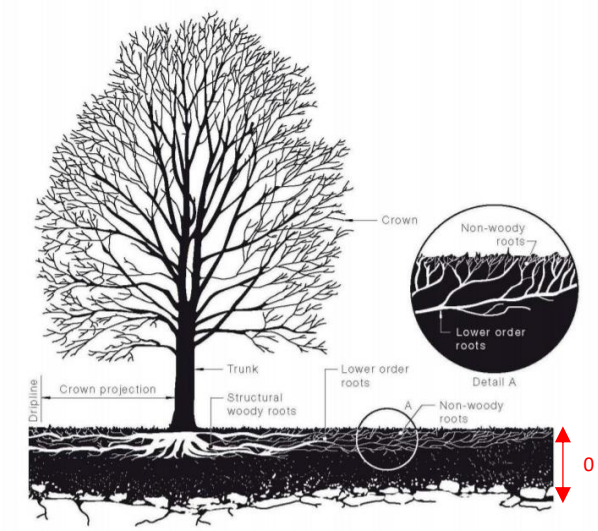


Figure 11: Structure of a tree in a normal growing environment

Leaves
The main function of leaves is photosynthesis, that is, the production of sugars. The sugars produced by the leaves (and any other green tissue) are the source of chemical energy for all living cells in the entire plant and as such are essential for the normal functioning and survival of the tree. Anything that directly or indirectly damages the leaves will interfere with photosynthesis.

Trunks and branches
Branches and trunks are composed of many tissues with specialized functions including the bark (protection), phloem (transport of sugars from the leaves), vascular cambium (growth of new transport tissues), sapwood (transport of water and nutrients from the roots), heartwood (strength and structural support) and rays (internal transport and storage of sugars). Damage to branches or trunks may allow infection by plant pathogens (disease causing organisms), disrupt the movement of vital materials and structurally weaken the tree.

Roots
The main functions of roots include the uptake of water and nutrients, anchorage, storage of sugar reserves and the production of some plant hormones required by the shoots. For roots to function, they must be supplied with oxygen from the soil. The root system of trees consists of several 'types' of roots found in different parts of the soil and is generally much more extensive than commonly thought. The importance of roots is easily overlooked because they are not visible, that is 'out of sight, out of mind'. Damage to the root system is a common cause of tree decline and death and is the most common form of damage associated with development sites.

Root systems consist of three main parts:

1. The structural woody roots (anchorage, storage and transport);
2. Lower order roots (anchorage, storage and transport); and
3. Non-woody roots (absorption of water and nutrients, extension, synthesis of amino acids and growth regulators) (see Figure).

In addition to lateral root spread being underestimated, root depth in trees has also been grossly exaggerated. Deep root systems or taproots are the exception rather than the rule. Most roots of most trees are found in the very top of the soil. The vast majority of these roots are small non-woody absorbing roots which grow upward into the very surface layers of the soil and leaf litter. This delicate, non-woody system, because of its proximity to the surface, is very vulnerable to injury."

Explanatory Note: The importance of gas exchange in soils

The fact that tree roots require oxygen to function is often misunderstood. Accessibility to available oxygen and water within the soil structure is dependent on the integrity of soil structure within their surrounds; when soils are compacted there is little space between soil aggregates with soil volume and total pore space, especially macropore space diminished. In turn, good soil oxygenation and gas exchange (Lonsdale) levels allow for successful function of tree roots. Oxygen levels in soils will typically decrease as soil depth increases and /or soils are heavily compacted.

Macropore is the term used to describe the relatively large space between soil particles that is usually air filled and allows for water movement and root penetration. Micropore is the term used to describe the space between soil particles that is relatively small and likely to be water filled.

Compaction results from loads or stress forces applied to the soil as well as shear forces. When soil within the root zone of a plant, including a tree, is compacted through either pedestrian or vehicular traffic, or by the heavy weight of stored materials or machinery, the ability of water and oxygen to penetrate the soil around the roots of living plants is compromised. Whilst tree roots are typically found in the top 600mm of the soil horizon, vehicle traffic, in particular may cause significant compaction at depths of 150–200 mm (the area in which most absorbing roots are located). (Refer Tree Function Note above).

The degree of soil compaction will depend on weight of vehicles, number of movements, soil moisture levels and clay content. Soil handling, stockpiling and transporting also tend to lead to the breakdown of soil structure and thus to soil compaction. Vibration, as a result of frequent traffic or adjacent construction activities, will also cause compaction of soil.

Contrary to the commonly held myth that all trees have tap roots, tree roots are typically located within the top 600mm of soil. Just as leaves perform the vital function of photosynthesis, tree roots are vital for the primary functions of anchorage, storage, absorption and conduction. Larger tree roots fulfil the main functions of anchorage, storage and conduction and smaller more fibrous tree roots, which grow primarily at the end of the main woody roots, fulfil a vital role in absorbing oxygen, essential mineral elements and moisture from the soil, often through a symbiotic relationship with soil borne fungi referred to as Mycorrhizae; the extent of root loss has the potential to jeopardise any or all of these main functions and most importantly may compromise the structural integrity of an established tree and its associated potential OH&S risk of failure occurring; any OH&S risk of potential failure in a high use area such as public roads, is noteworthy for all the wrong reasons and should be of major concern and avoided at all times. (Refer Appendix 2, Tree Function Note).

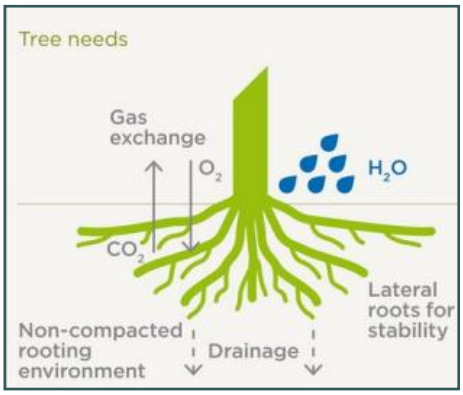


Figure 12: Gas exchange in woody tissues: the diffusion of gases into and out of a particular region (Jaluzot)

Reference Page

1. Australian Standards 2009, AS 4970-2009 Protection of trees on development sites.
2. Australian Standards 2007, AS 4737-2007 Pruning of Amenity Trees.
3. Mattheck K, Breloer H. 1994. The body language of trees, a handbook for failure analysis, London, England.
4. Shigo, A.L. 1986. A New Tree Biology. Shigo & Trees, Associates, Durham, New Hampshire.
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10. Nearmap. (www.nearmap.com.au); accessed 21st March 2021.

Company Details

Independent Arboricultural Services

Independent Arboricultural Services, incorporated in May 2007, offers a completely independent arborist consulting and reporting service. Its directors and associated consultants bring extensive arboricultural knowledge gained over many years to this company. All consulting staff hold AQF Level 5 (Diploma of Arboriculture). Specialised advice when required, such as provision of survey mapping or engineering advice and certification is sourced from reputable professional providers according to site requirements as per Australian Standard 4970-2009.

Statement of Goal

To deliver continual improvement through the use of world's best arboricultural practices, supported by ongoing education and exposure to leading industry experts and research throughout the world.

Mission Statement

To provide timely, relevant and actionable consulting advice and practice based on the latest available and best scientific arboricultural knowledge.

Environmental Statement

Independent Arboricultural Services supports long term environmental sustainability sustainable sourced paper and ensuring all inks cartridges are recycled where possible.

Independent Arboricultural Services actively seeks to maintain a positive carbon footprint status and to that end is committed to protecting and preserving the environment, continuing to carry out tree planting, transplanting and replacement planting where practical, having planted in excess of 4000 trees in the first 2 years after its inception in May 2007 alone. Arboricultural recommendations involving the removal of tree/s will include replanting at a minimum ratio of 2 trees for any tree removed where possible. All arboricultural recommendations are made in accordance with world's best arboricultural practice and within the Australian Standards AS 4373-2007 Pruning of amenity trees and AS 4970-2009 – Protection of trees on development sites so as to ensure optimal outcomes for all living trees.

Independent Arboricultural Services acknowledges the benefits of healthy trees with good vigour and vitality and actively promotes better understanding in the general community of the contribution that trees make to reducing greenhouse gasses, the contribution of trees to better water retention and the prevention of soil erosion, the ability of trees to provide protection to infrastructure by diffusing strong winds in weather events and the contribution of trees to general liveability within the urban environment.

It is an acknowledged fact that air temperature beneath a tree canopy can be in excess of 5^{o} Celsius lower than the surrounding ambient air temperature thereby reducing reliance on greenhouse gas producing air conditioners and coal fired power sources.