



Central Coast Council

Ordinary Council Meeting

Enclosures

Monday, 29 April 2019

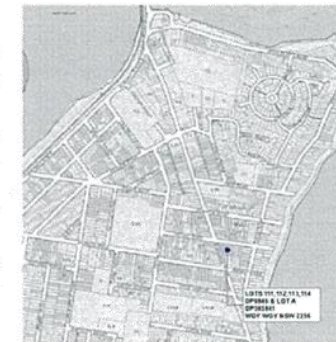
Central Coast Council
Enclosures to the
Ordinary Council Meeting
To be held in the Council Chamber
2 Hely Street, Wyong
On Monday, 29 April 2019
Commencing at 6.30pm

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Planning Reports

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AArqm
BUILDINGDESIGN
INFORMATIONMODELING



DA ISSUE RFI (C)

PROPOSED RESIDENTIAL FLAT DEVELOPMENT

LOTS 111,112,113,114 DP6846 &
LOT A DP385841
WOY WOY NSW 2256

DRAWING SCHEDULE		
#	DRAWING TITLE	ISSUE REVISIONS
01	COVER SHEET & DRAWING SCHEDULE	C
02	BASIC STAMPS AND NOTES	C
03	EXISTING CONCEPT PLAN	C
04	SITE CONTEXT DIAGRAM	C
05	SITE ANALYSIS DIAGRAM	C
06	DEMOLITION, CUT AND FILL SITE PLAN	C
07	SITE PLAN - BASEMENT	C C-01 C-04 C-07 C-08
08	SITE PLAN - GROUND FLOOR	C C-01 C-02 C-03 C-04 C-05 C-07 C-08
09	SITE PLAN - FIRST FLOOR	C C-07 C-08
10	SITE PLAN - SECOND FLOOR	C C-07 C-08
11	STREETSCAPE ELEVATIONS	C
12	SITE SECTIONS	C
13	ELEVATIONS	C
14	SECTIONS	C
15	FLOOR PLAN - BASEMENT IN	C C-01 C-06
16	FLOOR PLAN - GROUND FLOOR IN	C
17	FLOOR PLAN - FIRST FLOOR IN	C
18	FLOOR PLAN - SECOND FLOOR IN	C
19	FLOOR PLAN - ROOF IN	C C-02
20	FLOOR PLAN - BASEMENT S	C C-08
21	FLOOR PLAN - GROUND FLOOR S	C
22	FLOOR PLAN - FIRST FLOOR S	C
23	FLOOR PLAN - ROOF S	C
24	EXTERNAL FINISHES SCHEDULE	C
25	ADAPTIVE FLOOR PLANS	C
26	WASTE ENCLOSURE AND FENCE DETAILS	C
27	WINDOW & DOOR SCHEDULE	C
28	SHADOW DIAGRAMS (JAN)	C
29	SHADOW DIAGRAMS (JULY)	C
30	SHADOW DIAGRAMS (OCTOBER)	C
31	CROSS FLOW VENTILATION	C
32	AREA CALCULATOR PLANS	C
33	PERSPECTIVE IMAGES	C C-06 C-07 C-08



Issue	Issue Description	Rev	Revision Description	Date
1	Initial Issue	1	Initial Issue	2016
2	Revised Issue	2	Revised Issue	2016
3	Final Issue	3	Final Issue	2016

Client Name
**APEX SMARTHOMES
PTY. LTD.**

Project Name
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title
**COVER SHEET & DRAWING
SCHEDULE**

Design	AArqm	00
Technician		
Checked		
Project No	17-241	
Scale @ A1		
Commenced	16/12/2017	00
Plot Date	5/2/18	
Project Status	DA ISSUE RFI	
Issue	C	



BASIX STAMPS AND NOTES
SCALE: 1/10

AArqm
BUILDING DESIGN
INFORMATION MODELING

SITE STATISTICS
SITE AREA
3721 sqm



Issue	Issue Description	Fix	Resolution Description	Date
1	Energy	1.1	Energy	2018
2	Water	2.1	Water	2018
3	Thermal Comfort	3.1	Thermal Comfort	2018
4	Energy	4.1	Energy	2018
5	Water	5.1	Water	2018
6	Thermal Comfort	6.1	Thermal Comfort	2018
7	Energy	7.1	Energy	2018
8	Water	8.1	Water	2018
9	Thermal Comfort	9.1	Thermal Comfort	2018
10	Energy	10.1	Energy	2018
11	Water	11.1	Water	2018
12	Thermal Comfort	12.1	Thermal Comfort	2018
13	Energy	13.1	Energy	2018
14	Water	14.1	Water	2018
15	Thermal Comfort	15.1	Thermal Comfort	2018
16	Energy	16.1	Energy	2018
17	Water	17.1	Water	2018
18	Thermal Comfort	18.1	Thermal Comfort	2018
19	Energy	19.1	Energy	2018
20	Water	20.1	Water	2018
21	Thermal Comfort	21.1	Thermal Comfort	2018
22	Energy	22.1	Energy	2018
23	Water	23.1	Water	2018
24	Thermal Comfort	24.1	Thermal Comfort	2018
25	Energy	25.1	Energy	2018
26	Water	26.1	Water	2018
27	Thermal Comfort	27.1	Thermal Comfort	2018
28	Energy	28.1	Energy	2018
29	Water	29.1	Water	2018
30	Thermal Comfort	30.1	Thermal Comfort	2018
31	Energy	31.1	Energy	2018
32	Water	32.1	Water	2018
33	Thermal Comfort	33.1	Thermal Comfort	2018
34	Energy	34.1	Energy	2018
35	Water	35.1	Water	2018
36	Thermal Comfort	36.1	Thermal Comfort	2018
37	Energy	37.1	Energy	2018
38	Water	38.1	Water	2018
39	Thermal Comfort	39.1	Thermal Comfort	2018
40	Energy	40.1	Energy	2018
41	Water	41.1	Water	2018
42	Thermal Comfort	42.1	Thermal Comfort	2018
43	Energy	43.1	Energy	2018
44	Water	44.1	Water	2018
45	Thermal Comfort	45.1	Thermal Comfort	2018
46	Energy	46.1	Energy	2018
47	Water	47.1	Water	2018
48	Thermal Comfort	48.1	Thermal Comfort	2018

Client Name
**APEX SMARTHOMES
PTY. LTD.**

Project Name
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address
**LOTS 111, 112, 113, 114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title
BASIX STAMPS AND NOTES

Design	AArqm	
Technician		
Checked		
Project No	17-241	
Scale @ A1		
Commenced	18/12/2017	01
Plot Date	5/2/19	
Project Status	DA ISSUE RFI	Issue: C



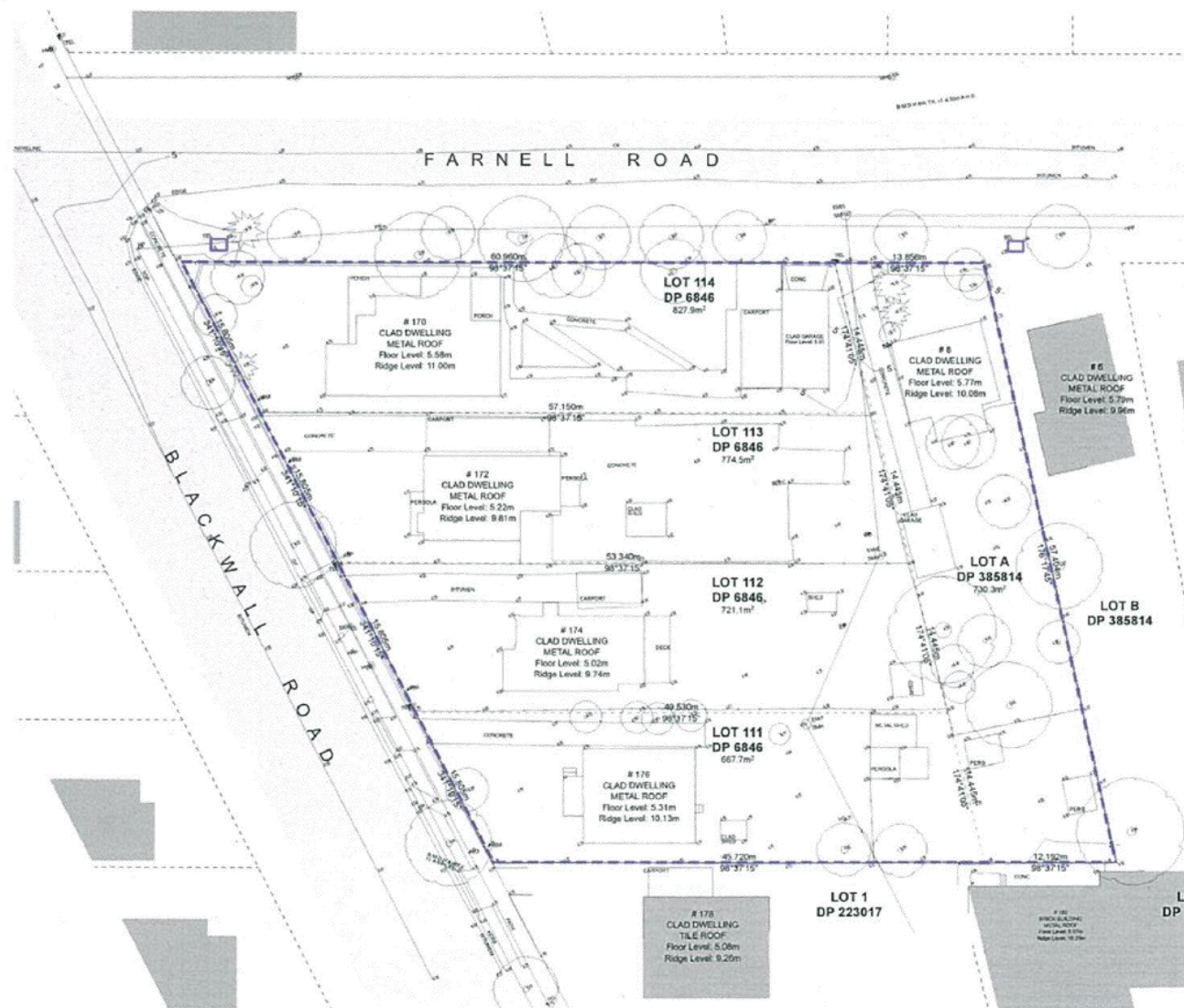
Issue	Issue Description	Res	Resolution Description	Date
1	Device A			2019-01-01
2	Device B			2019-01-01
3	Device C			2019-01-01
4	Device D			2019-01-01
5	Device E			2019-01-01
6	Device F			2019-01-01
7	Device G			2019-01-01
8	Device H			2019-01-01
9	Device I			2019-01-01
10	Device J			2019-01-01
11	Device K			2019-01-01
12	Device L			2019-01-01
13	Device M			2019-01-01
14	Device N			2019-01-01
15	Device O			2019-01-01
16	Device P			2019-01-01
17	Device Q			2019-01-01
18	Device R			2019-01-01
19	Device S			2019-01-01
20	Device T			2019-01-01
21	Device U			2019-01-01
22	Device V			2019-01-01
23	Device W			2019-01-01
24	Device X			2019-01-01
25	Device Y			2019-01-01
26	Device Z			2019-01-01
27	Device A			2019-01-01
28	Device B			2019-01-01
29	Device C			2019-01-01
30	Device D			2019-01-01
31	Device E			2019-01-01
32	Device F			2019-01-01
33	Device G			2019-01-01
34	Device H			2019-01-01
35	Device I			2019-01-01
36	Device J			2019-01-01
37	Device K			2019-01-01
38	Device L			2019-01-01
39	Device M			2019-01-01
40	Device N			2019-01-01
41	Device O			2019-01-01
42	Device P			2019-01-01
43	Device Q			2019-01-01
44	Device R			2019-01-01
45	Device S			2019-01-01
46	Device T			2019-01-01
47	Device U			2019-01-01
48	Device V			2019-01-01
49	Device W			2019-01-01
50	Device X			2019-01-01
51	Device Y			2019-01-01
52	Device Z			2019-01-01
53	Device A			2019-01-01
54	Device B			2019-01-01
55	Device C			2019-01-01
56	Device D			2019-01-01
57	Device E			2019-01-01
58	Device F			2019-01-01
59	Device G			2019-01-01
60	Device H			2019-01-01
61	Device I			2019-01-01
62	Device J			2019-01-01
63	Device K			2019-01-01
64	Device L			2019-01-01
65	Device M			2019-01-01
66	Device N			2019-01-01
67	Device O			2019-01-01
68	Device P			2019-01-01
69	Device Q			2019-01-01
70	Device R			2019-01-01
71	Device S			2019-01-01
72	Device T			2019-01-01
73	Device U			2019-01-01
74	Device V			2019-01-01
75	Device W			2019-01-01
76	Device X			2019-01-01
77	Device Y			2019-01-01
78	Device Z			2019-01-01
79	Device A			2019-01-01
80	Device B			2019-01-01
81	Device C			2019-01-01
82	Device D			2019-01-01
83	Device E			2019-01-01

PROPOSED RESIDENTIAL FLAT DEVELOPMENT

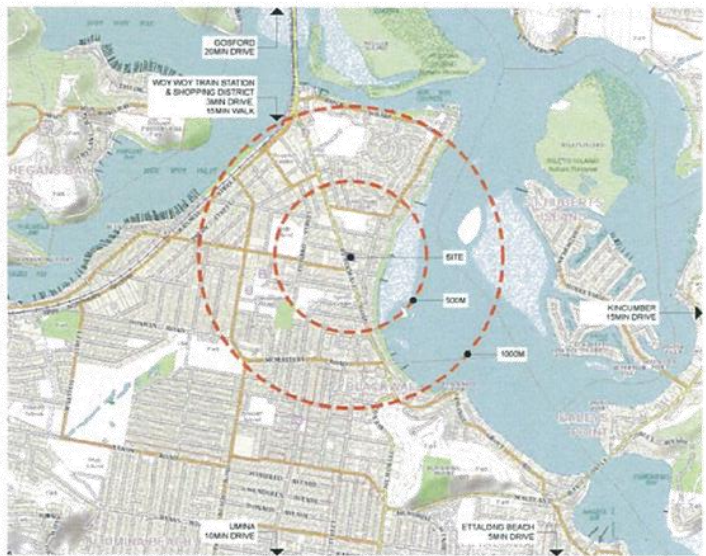
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

EXISTING CONDITIONS PLAN

Design	A.Angus	 <div>02</div>
Technician		
Checked:		
Project No	17-241	
Scale @ A1	1:200	
Commenced	16/12/2017	
Plot Date	5/2/19	
Project Status	DA ISSUE RFI	Issue: C



EXISTING CONDITIONS PLAN
SCALE 1/2"=1'



WIDER CONTEXT PLAN
SCALE: 1:500



SITE CONTEXT PLAN STUDY
SCALE: 1:500



LOCAL CONTEXT PLAN
SCALE: 1:500



SITE AERIAL PHOTOGRAPH
SCALE: 1:500

AArqm
BUILDINGDESIGN
INFORMATIONMODELING

SITE STATISTICS
SITE AREA: 1221 sqm



Item	Item Description	Key Services Description	Date
1	Site Visit	Site Visit	10/10/2017
2	Site Survey	Site Survey	10/10/2017
3	Site Plan	Site Plan	10/10/2017
4	Site Plan	Site Plan	10/10/2017
5	Site Plan	Site Plan	10/10/2017
6	Site Plan	Site Plan	10/10/2017
7	Site Plan	Site Plan	10/10/2017
8	Site Plan	Site Plan	10/10/2017
9	Site Plan	Site Plan	10/10/2017
10	Site Plan	Site Plan	10/10/2017

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing No:
SITE CONTEXT DIAGRAM

Design:	AArqm	
Technician:		
Client:		
Project No:	17-241	
Scale @ A1:	1:1	
Commenced:	18/12/2017	03
Plot Date:	5/3/18	
Project Status:	DA ISSUE R/I	
		Issue: C

AArqm
BUILDINGDESIGN
INFORMATIONMODELING

SITE STATISTICS
SITE AREA 3791.5sqm



Issue	Issue Description	Date	Resolution Description	Date
1	Issue 1	04/10/2018	Resolution 1	04/10/2018
2	Issue 2	04/10/2018	Resolution 2	04/10/2018
3	Issue 3	04/10/2018	Resolution 3	04/10/2018
4	Issue 4	04/10/2018	Resolution 4	04/10/2018
5	Issue 5	04/10/2018	Resolution 5	04/10/2018
6	Issue 6	04/10/2018	Resolution 6	04/10/2018
7	Issue 7	04/10/2018	Resolution 7	04/10/2018
8	Issue 8	04/10/2018	Resolution 8	04/10/2018
9	Issue 9	04/10/2018	Resolution 9	04/10/2018
10	Issue 10	04/10/2018	Resolution 10	04/10/2018

Client Name
**APEX SMARTHOMES
PTY. LTD.**

Project Name
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address
**LOTS 111,112,113,114 DP6846
& LOT A DP385814
WOY WOY NSW 2256**

Drawing Title
SITE ANALYSIS DIAGRAM

Design:	AArqm	
Technician:		
Checked:		
Project No:	17-241	
Scale:	1:200	
Client/Owner:	10/12/2017	04
Plot Date:	5/2/19	
Project Status:	DA ISSUE RFI	Issue: C

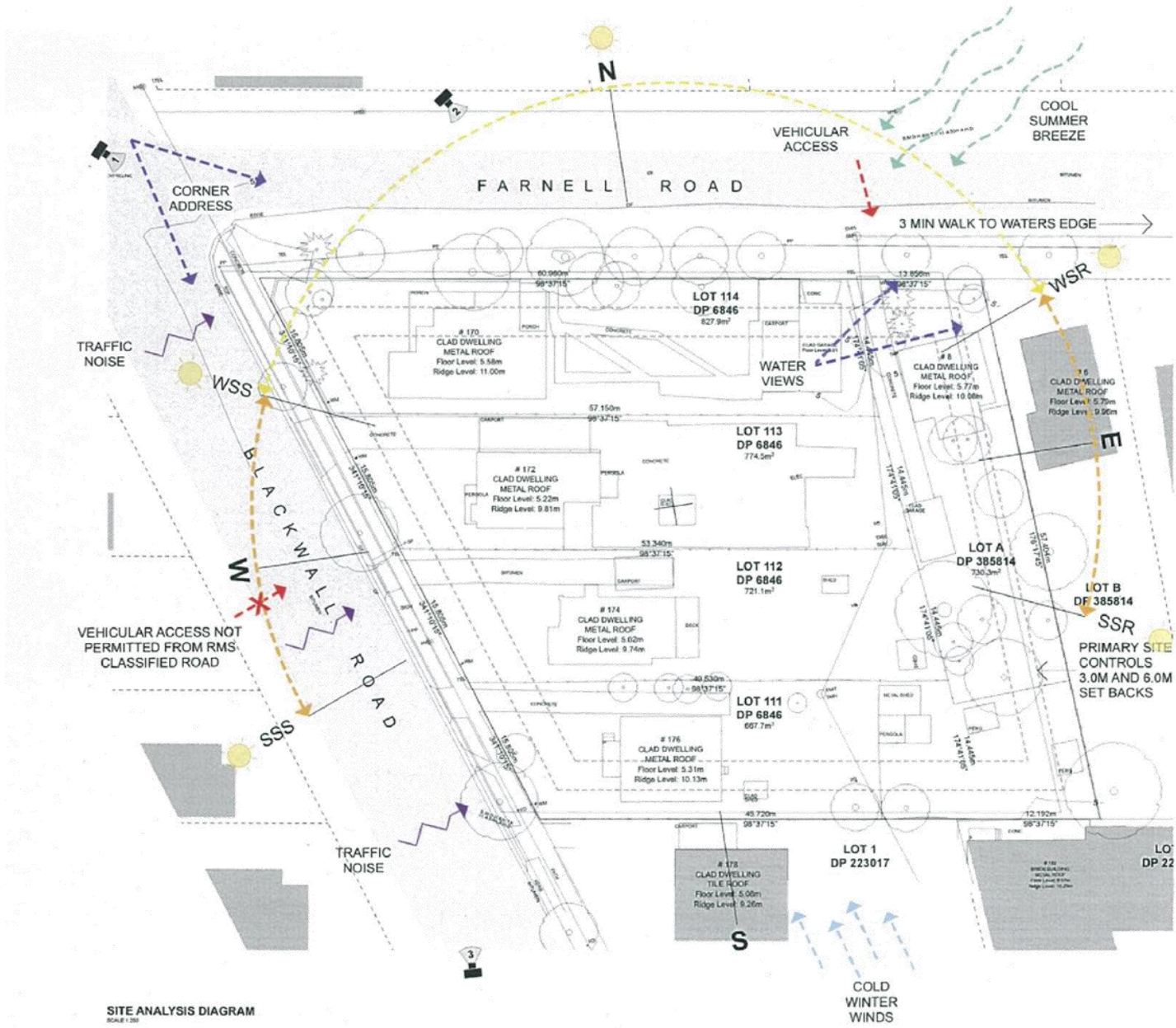


PHOTO LOCATION 1



PHOTO LOCATION 2



PHOTO LOCATION 3



AArqm
BUILDINGDESIGN
INFORMATIONMODELING

SITE STATISTICS
SITE AREA 3.721 Hect



Item	Item Description	Rev	Revision Description	Date
1	Issue 1	1	Initial Issue	20/10/2016
2	Issue 2	2	Revised Issue	20/10/2016
3	Issue 3	3	Revised Issue	20/10/2016
4	Issue 4	4	Revised Issue	20/10/2016
5	Issue 5	5	Revised Issue	20/10/2016
6	Issue 6	6	Revised Issue	20/10/2016
7	Issue 7	7	Revised Issue	20/10/2016
8	Issue 8	8	Revised Issue	20/10/2016
9	Issue 9	9	Revised Issue	20/10/2016
10	Issue 10	10	Revised Issue	20/10/2016

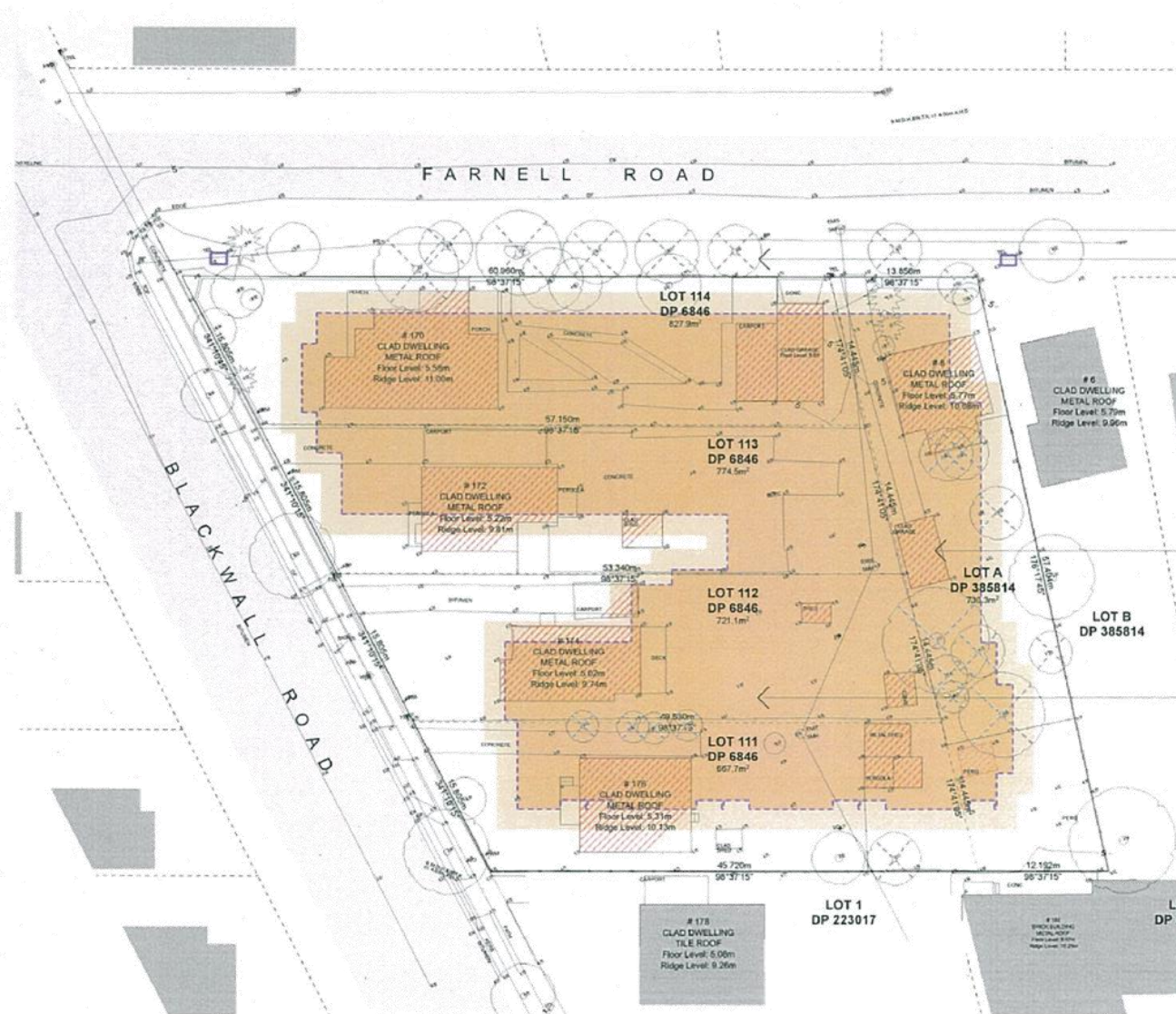
Client Name
**APEX SMARTHOMES
PTY. LTD.**

Project Name
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title
**DEMOLITION - CUT AND FILL
SITE PLAN**

Design:	AArqm	05
Technician:		
Client:		
Project No:	17-241	
Scale @ A1:	1:200	
Commenced:	18/10/2017	05
Plot Date:	5/1/18	
Project Status:	DA ISSUE RFI	Issue: C



DEMOLITION - CUT AND FILL SITE PLAN
SCALE 1:200

EXISTING TREES
TO BE REMOVED, REFER
TO LANDSCAPE PLAN
AND ARBORIST REPORT

DEMOLISH ALL
EXISTING STRUCTURES
REFER TO
WASTE MANAGEMENT
PLAN

EXTENT OF BULK EXCAVATION
FOR CAR PARK BASEMENT
AND SHORING
6000 M3 APPROX.



Issue	Issue Description	Rate	Remedies Description	Rate
B	B - 24 HOUR USE	0.01	Remedial action to be completed by the end of the 24-hour use period.	0.01
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
C	C - 24 HOUR USE	0.01	Remedial action to be completed by the end of the 24-hour use period.	0.01
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	
		0.01	Remedial action to be completed by the end of the 24-hour use period.	

Client Name
**APEX SMARTHOMES
PTY. LTD.**

PROPOSED RESIDENTIAL FLAT DEVELOPMENT

Postal Address
LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256

SITE PLAN - BASEMENT

Design	AAnpm	 06 Issue: C
Technician		
Checked		
Project No	17-241	
Issue (s) A1	1-200	
Commenced	16/12/2017	
Plot Date	5/2/15	
Project Status	DA155UE RPI	

SITE PLAN - BASEMENT
SCALE: 1/8" = 1'-0"





SITE LEGEND

- | Index | Index Name (Symbol) | Rate | Relevant Description | Date |
|-------|---------------------|------|-----------------------|----------|
| A | DAADAR | | | 08/01/14 |
| B | DAADAR | 0.10 | DAADAR 0.10% 08/01/14 | 08/01/14 |
| C | DAADAR | 0.10 | DAADAR 0.10% 08/01/14 | 08/01/14 |

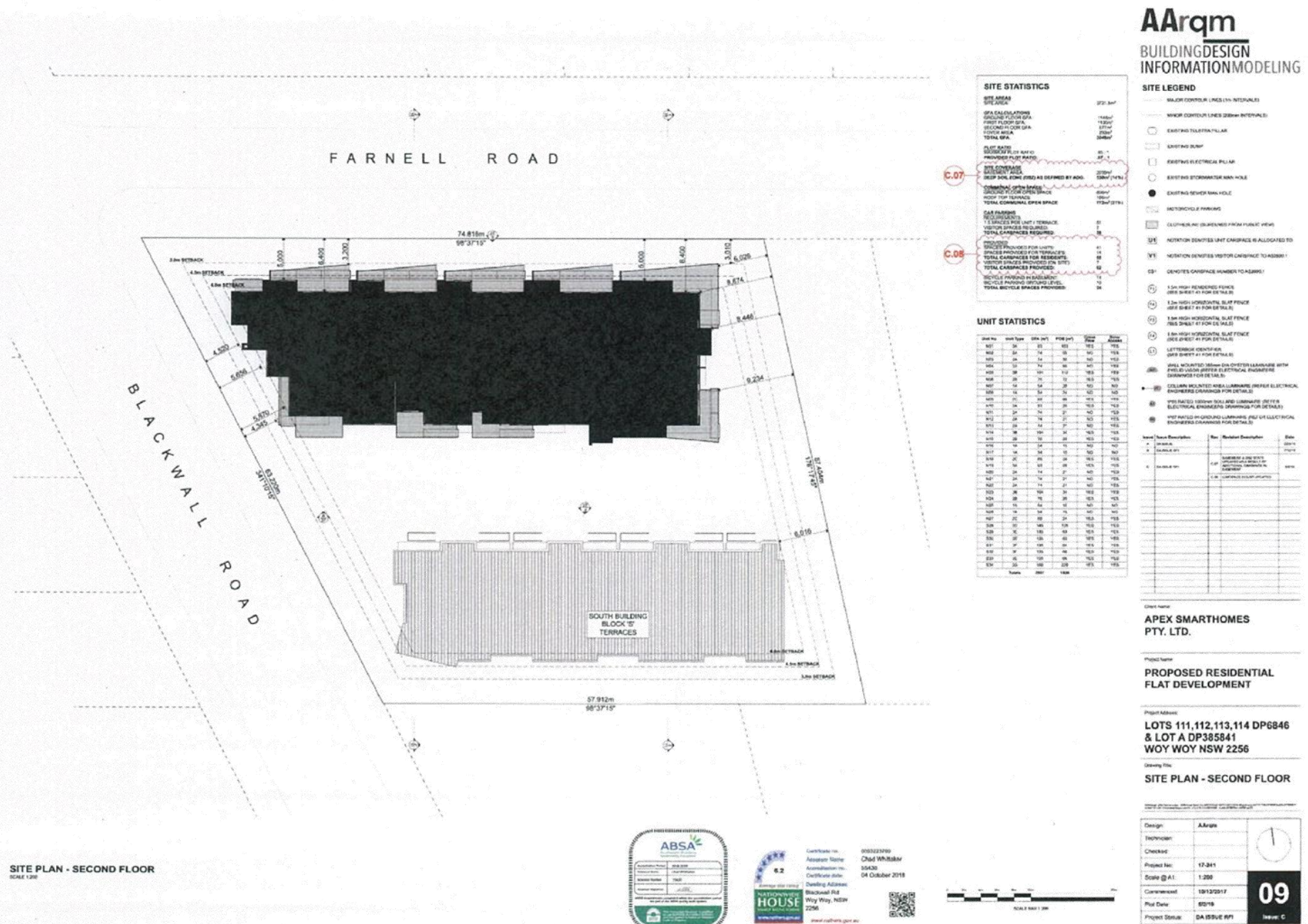
ISSUES OF THE MONTH ARE AVAILABLE TO ALL SUBSCRIBERS OF THE JOURNAL OF POST KEYNESIAN ECONOMICS. IF YOU ARE NOT A SUBSCRIBER, PLEASE CONTACT THE PUBLISHERS FOR MORE INFORMATION.

Design:	A.Agras
Technician:	
Checklist:	
Project No:	17-241
Scale @ A1:	1:200
Commenced:	10/12/2017
Plot Date:	5/2/19
Project Status:	DA ISSUE RFI



08

Unit No.	Unit Type	Area (sq. ft.)	PSF (sq. ft.)	Area (sq. ft.)	PSF (sq. ft.)
101	101	101	101	101	101
102	102	102	102	102	102
103	103	103	103	103	103
104	104	104	104	104	104
105	105	105	105	105	105
106	106	106	106	106	106
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199	199	199	199	199	199
200	200	200	200	200	200





BLOCK 'N'

BLOCK 'S'

SOUTH WEST, STREET ELEVATION - BLACKWALL ROAD, WOY WOY
SCALE 1:200



BLOCK 'N'

NORTH, STREET ELEVATION - FARNELL ROAD, WOY WOY
SCALE 1:200

Item	Issue Description	Rev	Revision Description	Date
1	DA ISSUE			2018/05
2	DA ISSUE NO.			2018/05
3	DA ISSUE NO.			2018/05
4	DA ISSUE NO.			2018/05
5	DA ISSUE NO.			2018/05
6	DA ISSUE NO.			2018/05
7	DA ISSUE NO.			2018/05
8	DA ISSUE NO.			2018/05
9	DA ISSUE NO.			2018/05
10	DA ISSUE NO.			2018/05
11	DA ISSUE NO.			2018/05
12	DA ISSUE NO.			2018/05
13	DA ISSUE NO.			2018/05
14	DA ISSUE NO.			2018/05
15	DA ISSUE NO.			2018/05
16	DA ISSUE NO.			2018/05
17	DA ISSUE NO.			2018/05
18	DA ISSUE NO.			2018/05
19	DA ISSUE NO.			2018/05
20	DA ISSUE NO.			2018/05

Client Name
**APEX SMARTHOMES
PTY. LTD.**

Project Name
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

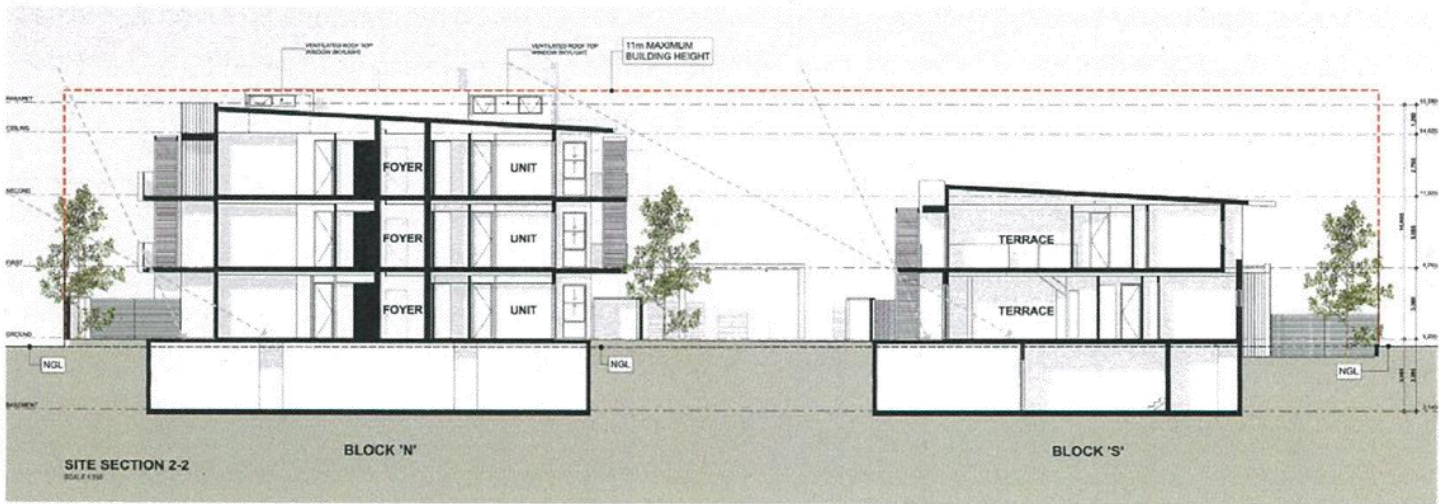
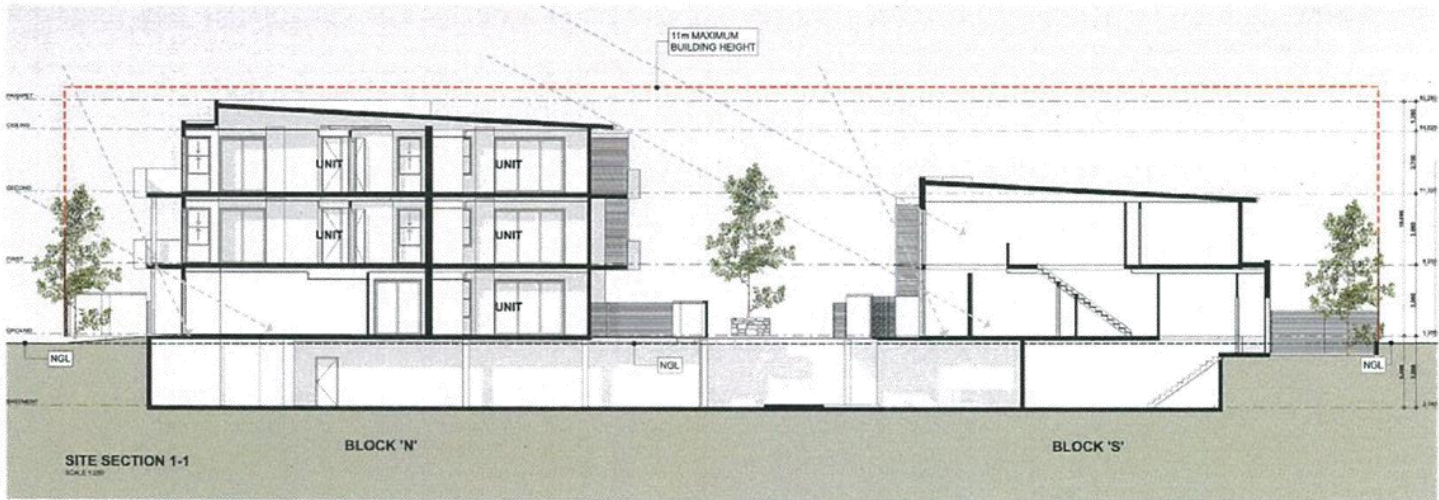
Drawing Title
STREETSCAPE ELEVATIONS

Design	AArqm	
Technician		
Checked		
Project No	17-241	
Scale @ A1	1:250	
Commenced	15/12/2017	10
Plot Date	5/5/19	
Project Status	DA ISSUE RFI	
Issue	C	



Landscaping No: 000223709
Project Name: CHAD WHITAKER
Supervision No: 55435
Compliance Date: 04 October 2018
Blackwall Rd
Woy Woy, NSW
2256
www.nhbc.org.au





Issue	Issue Description	Rev	Revision Description	Date
1	Initial Issue	1	Initial Issue	2019-10-04
2	Revised Issue	2	Revised Issue	2019-10-04
3	Revised Issue	3	Revised Issue	2019-10-04
4	Revised Issue	4	Revised Issue	2019-10-04
5	Revised Issue	5	Revised Issue	2019-10-04
6	Revised Issue	6	Revised Issue	2019-10-04
7	Revised Issue	7	Revised Issue	2019-10-04
8	Revised Issue	8	Revised Issue	2019-10-04
9	Revised Issue	9	Revised Issue	2019-10-04
10	Revised Issue	10	Revised Issue	2019-10-04
11	Revised Issue	11	Revised Issue	2019-10-04
12	Revised Issue	12	Revised Issue	2019-10-04
13	Revised Issue	13	Revised Issue	2019-10-04
14	Revised Issue	14	Revised Issue	2019-10-04
15	Revised Issue	15	Revised Issue	2019-10-04
16	Revised Issue	16	Revised Issue	2019-10-04
17	Revised Issue	17	Revised Issue	2019-10-04
18	Revised Issue	18	Revised Issue	2019-10-04
19	Revised Issue	19	Revised Issue	2019-10-04
20	Revised Issue	20	Revised Issue	2019-10-04

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
SITE SECTIONS



Certificate no.: 003221730
Assessor Name: Chad Whitaker
Accreditation no.: 55430
Certificate date: 04 October 2019
Building Address: Bapenah Rd Woy Woy, NSW 2256
www.nathouse.gov.au



Design:	AArqm	
Technician:		
Checked:		
Project No:	17-241	
Scale @ A1:	1:100	
Commented:	19/12/2017	
Plot Date:	5/2/19	11
Project Status:	DA ISSUE RFI	

AArqm
BUILDINGDESIGN
INFORMATIONMODELING



B. NORTH ELEVATION



C. EAST ELEVATION

Issue	Issue Description	Rev	Revision Description	Date
1	Initial Design	1	Initial Design	04/10/2018
2	Revised Design	2	Revised Design	04/10/2018
3	Revised Design	3	Revised Design	04/10/2018
4	Revised Design	4	Revised Design	04/10/2018
5	Revised Design	5	Revised Design	04/10/2018
6	Revised Design	6	Revised Design	04/10/2018
7	Revised Design	7	Revised Design	04/10/2018
8	Revised Design	8	Revised Design	04/10/2018
9	Revised Design	9	Revised Design	04/10/2018
10	Revised Design	10	Revised Design	04/10/2018
11	Revised Design	11	Revised Design	04/10/2018
12	Revised Design	12	Revised Design	04/10/2018
13	Revised Design	13	Revised Design	04/10/2018
14	Revised Design	14	Revised Design	04/10/2018
15	Revised Design	15	Revised Design	04/10/2018
16	Revised Design	16	Revised Design	04/10/2018
17	Revised Design	17	Revised Design	04/10/2018
18	Revised Design	18	Revised Design	04/10/2018
19	Revised Design	19	Revised Design	04/10/2018
20	Revised Design	20	Revised Design	04/10/2018

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
ELEVATIONS

Revised Design: 04/10/2018

Design	AArqm
Technician	
Checked	
Project No	17-241
Scale @ A1	1:100
Commenced	18/12/2017
Plot Date	5/2/19
Project Status	DA ISSUE RFI

12



AArqm
BUILDINGDESIGN
INFORMATIONMODELING



D. SOUTH ELEVATION



A. WEST ELEVATION

Issue	Issue Description	Rev	Revision Description	Date
1	Issued			
2	Revised			
3	Revised			
4	Revised			
5	Revised			
6	Revised			
7	Revised			
8	Revised			
9	Revised			
10	Revised			
11	Revised			
12	Revised			
13	Revised			
14	Revised			
15	Revised			
16	Revised			
17	Revised			
18	Revised			
19	Revised			
20	Revised			

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
ELEVATIONS

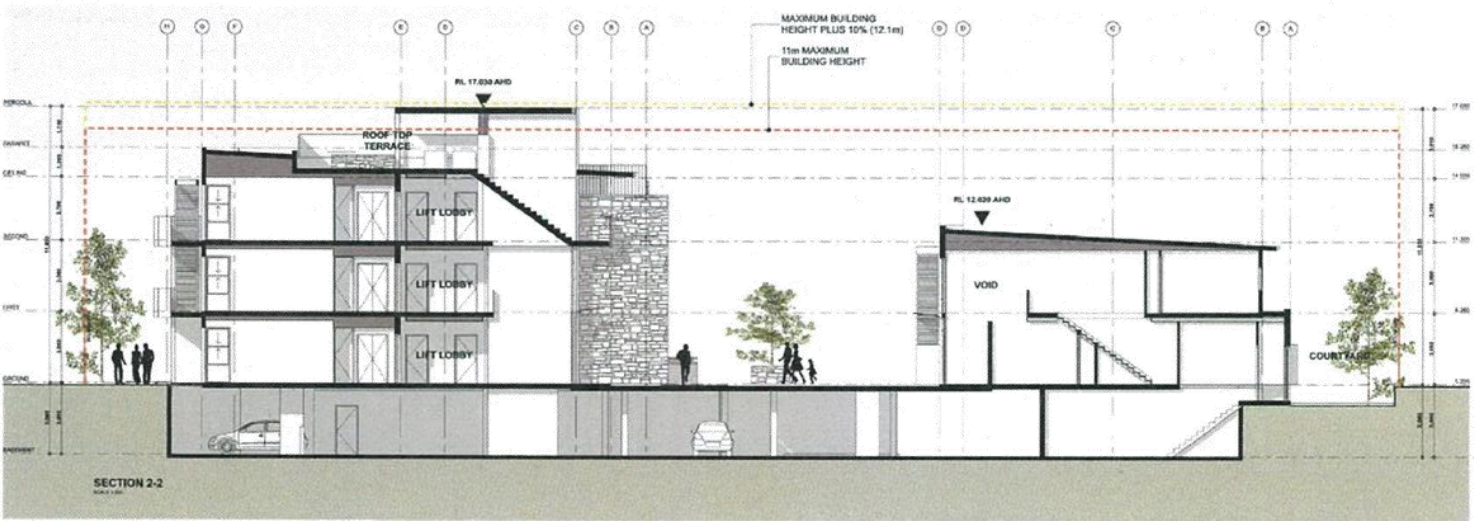
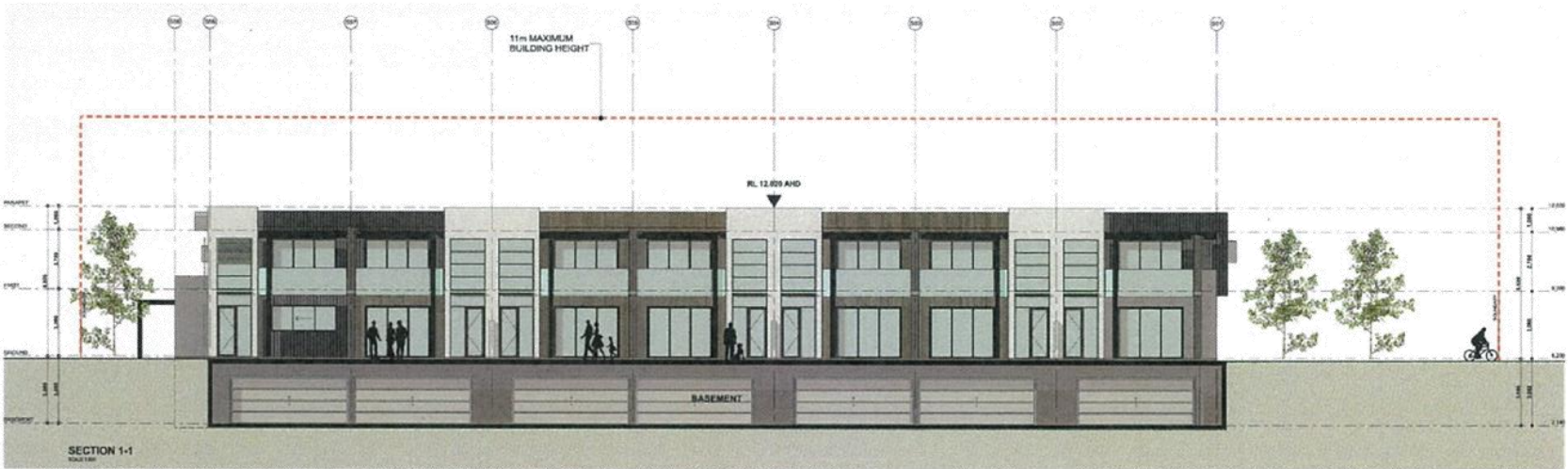
Drawing No. 17-241		
Design:	AArqm	
Technician:		
Checked:		
Project No:	17-241	
Scale @ A1:	1:100	
Commenced:	18/12/2017	13
Plot Date:	5/2/19	
Project Status:	DA ISSUE RFI	
		Issue: C



Client Name: 090322070
Project Name: CHARTERHOUSE
55-630
04 October 2018
Drawing Title: Blackwater Rd
Woy Woy, NSW
2256
www.aarqm.com.au



AArqm
BUILDING DESIGN
INFORMATION MODELING



Rev	Issue Description	Date
1	Issue 1	10/10/2018
2	Issue 2	10/10/2018
3	Issue 3	10/10/2018

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

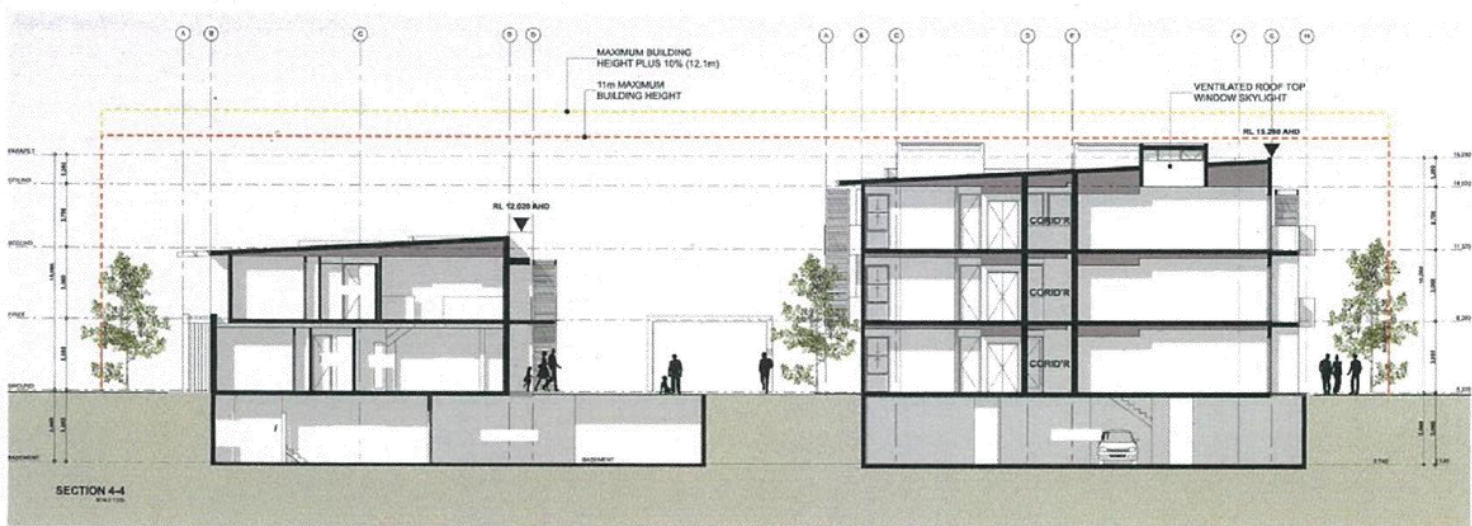
Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
SECTIONS

Design:	AArqm
Technician:	
Checklist:	
Project No:	17-041
Scale @ A1:	1:100
Commenced:	18/12/2017
Plot Date:	5/2/19
Project Status:	DA ISSUED RFI

AArqm
BUILDINGDESIGN
INFORMATIONMODELING



Rev	Description	Date
1	Initial	2018/10/04
2	Revised	2018/10/04
3	Revised	2018/10/04

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

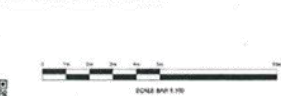
Drawing Title:
SECTIONS

Notes:
1. All dimensions are in millimetres unless otherwise stated.
2. All dimensions are to the face of the work unless otherwise stated.

Design:	AArqm
Technician:	
Checked:	
Project No:	17-241
Scale @ A1:	1:100
Commenced:	10/10/2017
Plot Date:	5/10/18
Project Status:	DA ISSUE RFI
Issue:	C



Certificate No. 000223760
Assessor Name: Chad Whitaker
Assessment No. 64450
Certificate Date: 04 October 2018
Checking Address: Macquarie Rd, Woy Woy, NSW 2256
www.nsw.gov.au





FLOOR PLAN - ROOF N
SCALE 1/250


















Certificate no. 0003223700
 Applicant Name: Chad Whitaker
 Applicant ID: 55430
 Certification Date: 04 October 2018





EXTERNAL FINISHES AND FACADE ARTICULATION - DESIGN INTENT EXAMPLES

 RENDERED WALL FINISH (RWF1) Rendered & Painted Wall Finish Colour: Dulux 'NATURAL WHITE' 15W	 LIGHTWEIGHT WALL CLADDING (LWC2) Urban Line 'Euro Clad' (or similar) Colour: 'Cedar' EC 155X18C	 DOWNPIPES & RAIN HEADS (DP) BlueScope Steel Colorbond Colour: 'Shale Grey'	 OPAQUE GLASS BALUSTRADE (OGB) Dulux Powdercoat to Handrail Colour: Dulux 'Charcoal' Matt Finish with white/green colour back glass infill panels
 RENDERED WALL FINISH (RWF2) Rendered & Painted Wall Finish Colour: Dulux 'TIMELESS GREY' GR23	 METAL ROOF SHEETING (MRS) BlueScope Steel Colorbond Colour: 'Shale Grey'	 METAL PERGOLAS (PGL) Dulux Powdercoat Pergola Members Colour: Dulux 'Charcoal' Satin Finish	 COLORBOND ROLLER DOORS (CRD) BlueScope Steel Colorbond Colour: 'Shale Grey'
 RENDERED WALL FINISH (RWF3) Rendered & Painted Wall Finish Colour: Dulux 'LEADMAN' GR14	 C'BOND FASCIA & GUTTERS (CFG) BlueScope Steel Colorbond Colour: 'Monument'	 CLEAR GLASS BALUSTRADE (AGB) Dulux Powdercoat to Handrail Colour: Dulux 'Charcoal' Satin Finish with clear glass infill panels	 ALUMINUM WINDOWS & DOORS (AWD) Dulux Powdercoat Finish Colour: 'Charcoal' or Natural Anodised
 LIGHTWEIGHT WALL CLADDING (LWC1) Urban Line 'Euro Selesta Clad' (or similar) Colour: 'Silver Oak' EC 155X185O	 ALU. VERTICAL STEEL SCREENS Dulux Powdercoat Colour: 'Anotec Silver Grey' Satin Finish	 STONE FACING Modern or Traditional 'Ashler Pattern' Stone Facing or Similar	

EXTERNAL FINISHES SCHEDULE
SCALE: 1:200

Rev	Issue Description	Date	Revision Description	By
1	Issued			
2	Revised			
3	Revised			
4	Revised			
5	Revised			
6	Revised			
7	Revised			
8	Revised			
9	Revised			
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95	Revised			
96	Revised			
97	Revised			
98	Revised			
99	Revised			
100	Revised			

Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
**EXTERNAL FINISHES
SCHEDULE**

Design	AArqm	
Technician		
Checked		
Project No	17-241	
Scale	@ A1	
Commenced	10/12/2017	25
Plot Date	5/3/18	
Project Status	DA ISSUE RFI	
Issue	C	



Contract No: 3003229108
Accession No: 50430
Contract Date: 04 October 2018
Blackwell Rd
Woy Woy, NSW 2256
www.nationalhouse.com.au



AArqm
BUILDINGDESIGN
INFORMATIONMODELING

UNIT STATISTICS

Unit No.	Unit Type	Area (sqm)	Price (\$)	Area (sqm)	Price (\$)
101	SA	111	111	111	111
102	SA	111	111	111	111
103	SA	111	111	111	111
104	SA	111	111	111	111
105	SA	111	111	111	111
106	SA	111	111	111	111
107	SA	111	111	111	111
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200	SA	111	111	111	111


Unit No.	Unit Type	Area (sqm)	Price (\$)	Area (sqm)	Price (\$)
101	SA	111	111	111	111
102	SA	111	111	111	111
103	SA	111	111	111	111
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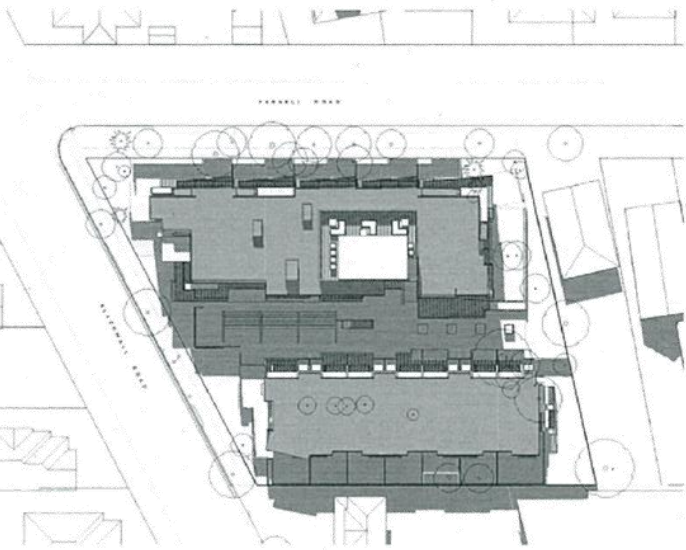
Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

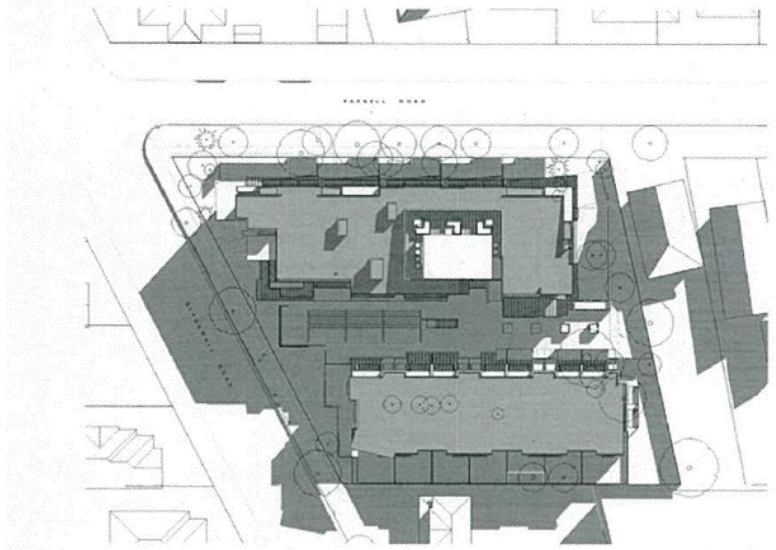
Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
SHADOW DIAGRAMS (JUNE)

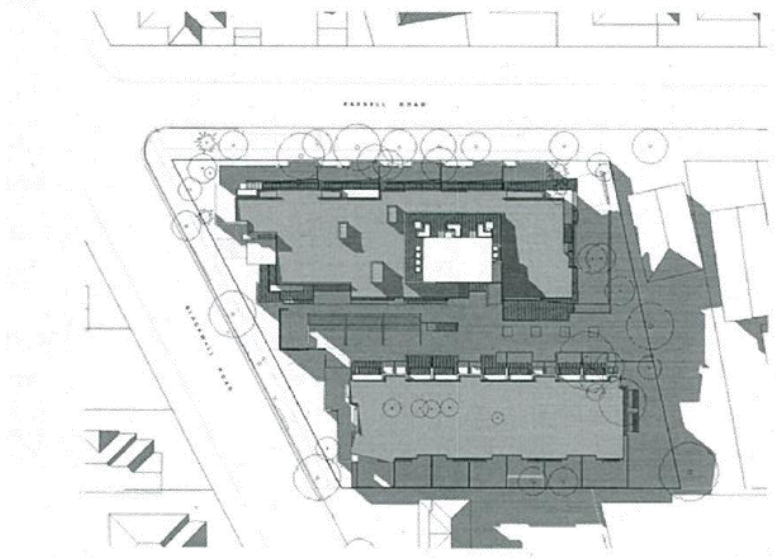
Design	AArqm	 29 Issue: C
Reviewed		
Checked		
Project No.	17-241	
Scale (3 A1)		
Commenced	10/12/2017	
Plot Date	5/2/19	
Project Status	DA ISSUE RFI	



SUN SHADOW DIAGRAM - JUNE 21 @ 12NOON
SCALE 1:400



SUN SHADOW DIAGRAM - JUNE 21 @ 9AM
SCALE 1:400



SUN SHADOW DIAGRAM - JUNE 21 @ 3PM
SCALE 1:400



AArqm
BUILDING DESIGN
INFORMATION MODELING

UNIT STATISTICS

Unit No.	Unit Type	Area (sq. m)	Floor (sq. m)	Level	Total Area (sq. m)
101	3b	83	103	103	103
102	3a	74	103	103	103
103	3a	74	103	103	103
104	3a	74	103	103	103
105	3b	104	112	112	112
106	3b	78	72	113	113
107	3a	84	103	103	103
108	3a	84	103	103	103
109	3b	88	88	103	103
110	3a	88	103	103	103
111	3a	74	103	103	103
112	3a	74	103	103	103
113	3a	74	103	103	103
114	3b	104	112	112	112
115	3b	78	72	113	113
116	3a	84	103	103	103
117	3b	88	88	103	103
118	3a	88	103	103	103
119	3a	88	103	103	103
120	3a	74	103	103	103
121	3a	74	103	103	103
122	3a	74	103	103	103
123	3b	104	112	112	112
124	3b	78	72	113	113
125	3a	84	103	103	103
126	3a	84	103	103	103
127	3b	88	88	103	103
128	3b	104	112	112	112
129	3b	78	72	113	113
130	3b	104	112	112	112
131	3b	78	72	113	113
132	3b	104	112	112	112
133	3b	78	72	113	113
134	3b	104	112	112	112
Total		2987	1838		

Unit	Area Description	Area	Area Description	Area
1	Unit 101	83	Unit 101	83
2	Unit 102	74	Unit 102	74
3	Unit 103	74	Unit 103	74
4	Unit 104	74	Unit 104	74
5	Unit 105	104	Unit 105	104
6	Unit 106	78	Unit 106	78
7	Unit 107	84	Unit 107	84
8	Unit 108	84	Unit 108	84
9	Unit 109	88	Unit 109	88
10	Unit 110	88	Unit 110	88
11	Unit 111	74	Unit 111	74
12	Unit 112	74	Unit 112	74
13	Unit 113	74	Unit 113	74
14	Unit 114	104	Unit 114	104
15	Unit 115	78	Unit 115	78
16	Unit 116	84	Unit 116	84
17	Unit 117	88	Unit 117	88
18	Unit 118	88	Unit 118	88
19	Unit 119	88	Unit 119	88
20	Unit 120	74	Unit 120	74
21	Unit 121	74	Unit 121	74
22	Unit 122	74	Unit 122	74
23	Unit 123	104	Unit 123	104
24	Unit 124	78	Unit 124	78
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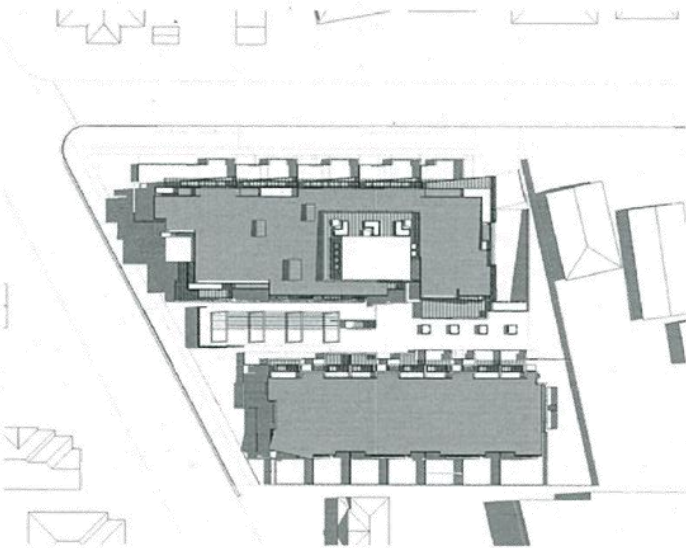
Client Name:
**APEX SMARTHOMES
PTY. LTD.**

Project Name:
**PROPOSED RESIDENTIAL
FLAT DEVELOPMENT**

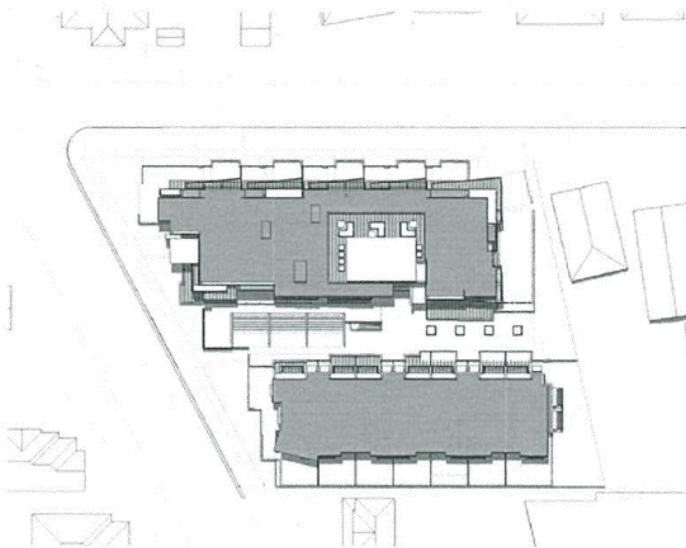
Project Address:
**LOTS 111,112,113,114 DP6846
& LOT A DP385841
WOY WOY NSW 2256**

Drawing Title:
**SHADOW DIAGRAMS
(DECEMBER)**

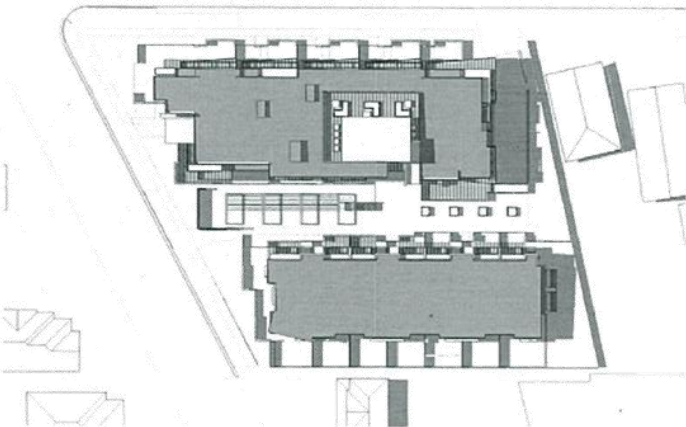
Design	AArqm	 30 Issue: C
Technician		
Checked		
Project No	17-241	
Scale @ A1	1:100	
Commenced	18/12/2017	
Plot Date	5/2/19	
Project Status	DA ISSUE RFI	



SUN SHADOW DIAGRAM - DECEMBER 22 @ 9AM
SCALE 1:400



SUN SHADOW DIAGRAM - DECEMBER 22 @ 12NOON
SCALE 1:400



SUN SHADOW DIAGRAM - DECEMBER 22 @ 3PM
SCALE 1:400



PERSPECTIVE IMAGE, VIEWED FROM SOUTH WEST - BLACKWALL ROAD



PERSPECTIVE IMAGE, VIEWED FROM NORTH EAST - FARNELL ROAD



PERSPECTIVE IMAGE, VIEWED FROM NORTH EAST INTERNAL COMMUNAL AREA



6.2
WILSONS HOUSE
www.wilsonshouse.com.au

Name	Initial Description	Rev	Revision Description	Date
1	Initial	1	Initial	2018
2	Initial	2	Initial	2018
3	Initial	3	Initial	2018
4	Initial	4	Initial	2018
5	Initial	5	Initial	2018
6	Initial	6	Initial	2018
7	Initial	7	Initial	2018
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100	Initial	100	Initial	2018

Client Name
APEX SMARTHOMES PTY. LTD.

Project Name
PROPOSED RESIDENTIAL FLAT DEVELOPMENT

Project Address
LOTS 111,112,113,114 DP6846 & LOT A DP385841 WOY WOY NSW 2256

Drawing No.
PERSPECTIVE IMAGES

Design	AArqm	
Architect		
Client		
Project No.	17-241	
Scale @ A1	1:5.11	
Commenced	18/12/2017	33
Plot Date	5/2/19	
Project Status	DA ISSUE RFI	
Issue	C	

SITE LEGEND

- ① EXISTING TREE TO BE RETAINED
- ② EXISTING TREE TO BE REPLACED WITH NEW LOPHOSTEMON CONFERTUS (BRUSH BOX)
- ③ EXISTING TREE TO BE REMOVED
- EXISTING SHRUB TO BE REMOVED
- A NEW LOPHOSTEMON CONFERTUS (BRUSH BOX)
- B SHADE TREES TO GARDENS (8 TO 10m TALL)
- C COURTYARD GARDEN WITH SMALL SHADE TREES (3 TO 4m TALL) WITH LAYERED SHRUBS AND GROUND COVERS
- D STEPPERS AND DECORATIVE GRAVEL TO COURTYARDS
- E SCREEN PLANTING TO BOUNDARY WITH A MIX OF TREES AND LARGE SHRUBS
- F HEDGE PLANTING ALONG DRIVEWAY

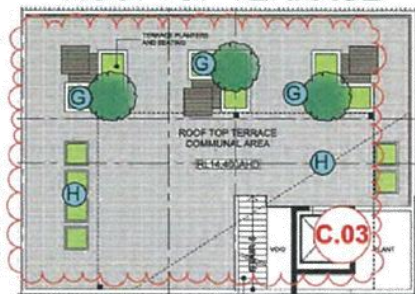
ROOFTOP TERRACE

- G NATIVE TREES 3 - 4m MATURE HEIGHT PROPOSED SPECIES - TRISTANIOPSIS LUSCIOUS (WATER GUM CULTIVAR)
- H NATIVE SHRUB GARDEN BEDS (800mm TALL). PROPOSED SPECIES - BANKSIA BIRTHDAY CANDLES (DWARF BANKSIA SPINULOSA), EREMOPHILA MACULATE (SPOTTED EMU BUSH), GREVILLEA SUPERB (GREVILLEA), GREVILLEA ROBYN GORDON (GREVILLEA), MYOPORUM PARVIFOLIUM (CREEPING BOOIBALLA).

CHANGE REGISTRY

- C.01 V7 CARSPACE REMOVED FROM FARNELL ROAD & RELOCATED TO BASEMENT
- C.02 EXISTING TREES ON FARNELL ROAD RETAINED OR REPLACED
- C.03 PLANTER BOXES ADDED TO ROOFTOP TERRACE
- C.04 PROPOSED TREE REMOVED FROM CORNER
- C.05 TREE LABELLING CORRECTED

ROOFTOP TERRACE



SCALE 1:200

PROPOSED MULTI DWELLING HOUSING

LOTS 111, 112, 113, 114 DP6846 & LOT A DP385841
WOY WOY NSW 2256

SCALE 1:300 A3



1811-LP
ISSUE C
12/2/19

LANDSCAPE PLAN

Jeckie Amos Landscape Architect
Ph 07 4635 7460
M 0427 667748
46 Stokan Street
CENTENARY HEIGHTS Q 4350





Attachment 3 - Gosford Development Control Plan 2013 compliance tableChapter 2 Scenic Quality and Character

Development Control	Required	Proposed	Compliance With Controls	Compliance With Objectives
2.1 Character	<p><u>Desired Character</u></p> <ul style="list-style-type: none"> • These areas should remain medium-density residential neighbourhoods where improved standards of amenity and urban design quality are achieved by new low-rise multi-unit developments. • Surround each multi-unit development with leafy gardens that conserve existing visually-prominent trees, particularly along back fences and street frontages or verges. • Roofs should be gently-pitched to minimise the height of ridges, and flanked by wide eaves that disguise the scale and bulk of exterior walls. • A "light-weight appearance" is preferable for all visible facades, incorporating walls of windows that are shaded by framed balconies or verandahs plus exterior sunscreens, painted finishes and some sheet or board cladding. • Screen driveways, terraces, courtyards and balconies to protect the privacy 	<p>The subject site is within the Woy Woy Character Statement No. 8 Sandplain Medium Density – Desired.</p> <p>The overall design of the development is structured as a compound of two separate forms with varying heights.</p> <p>The development is surrounded by deep soil planting on the boundaries and open space within the centre of the site that is consistent with maintaining landscaping and green space as per the desired character.</p> <p>The roof design is set back from the building street edge (Blackwall Road and Farnell Road) to reduce bulk and scale. The remainder of the roof form is concealed by parapets set at different heights to reduce visual impact.</p> <p>The design steps the shape and height of all visible facades, provide at least one wide landscaped setback that varies in width, and lines Blackwall Road and Farnell Road with avenues of trees and shrubs.</p> <p>The design incorporates a "light-weight appearance" to large portions of the building by use of lightweight façade cladding, 'timber' screening</p>	Yes	Yes

Development Control	Required	Proposed	Compliance With Controls	Compliance With Objectives
	and amenity of neighbouring dwellings.	and glass balustrades, rather than extensive use of plain masonry.		
2.2 Scenic Quality	The subject site is located within the Peninsula Geographic Unit and encompasses the Woy Woy/ Umina Landscape Unit and the Woy Woy Bays Landscape Units	<p>The proposal is subject to the provisions of GDCP 2013 Chapter 2.2 – Scenic Quality.</p> <p>The development includes a higher density of residential development than that existing in the area. However, it is considered the transition between neighbouring development and the proposed development is acceptable. The use of landscaping on boundaries of the proposal enhances the scenic quality of the area.</p> <p>Overall the development does not propose a bulk and scale that will adversely affect the scenic quality of the area. Views will be maintained around and through the site.</p> <p>The proposal is consistent with the stated objectives of GDCP 2013 Chapter 2.2 - Scenic Quality.</p>	Yes	Yes

Chapter 3.3 Multi Dwelling Housing & Residential Flat Buildings

The relevant provisions of Chapter 3.3 have been considered in the assessment of application as summarised in the table below.

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
3.3.2 Desired Character	<ul style="list-style-type: none"> Siting of buildings and surrounding garden areas shall be consistent with locality. Height, size and scale of new buildings shall be compatible with locality 	Consistent with desired character.	Yes	Yes

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
	<ul style="list-style-type: none"> Garden design and details shall be compatible with scenic quality and streetscape character. Street verges shall conserve visually prominent landscape features. 			
3.3.3.1 Height	<ul style="list-style-type: none"> Max height LEP = 11m Max 3 storeys Max height exterior wall 10m Min 2.7m ceiling heights for 2 storey buildings Min 2.4m ceiling heights for 1 storey buildings 	<ul style="list-style-type: none"> Max height = 11.83m Max 3 storeys 10m maximum exterior wall height 3.06m ceiling heights N/A 	<ul style="list-style-type: none"> No Yes Yes Yes 	Yes, see comments under GLEP2014 section Height of Buildings of this report.
3.3.3.2.2a Setbacks	<p>Deep soil along boundaries</p> <ul style="list-style-type: none"> Side boundary min width 2m Rear boundary min width 6m Front boundary min width 6m 	<ul style="list-style-type: none"> Northern side setback at Farnell Road (Building N) is assessed under the <i>Apartment Design Guide</i>, refer attachment 4 Side setback south (Building S) = 5.8m Rear setback east (Building S) = 5m 1m variation or 17% Front setback west (Building S) = 4.2m representing a 1.8m or 30% variation. <p>The proposal is considered to meet the objectives for setbacks as the development provides reasonable amenity for adjoining development and proposed dwellings;</p> <ul style="list-style-type: none"> The deep soil setbacks proposed are capable of providing adequate landscaping including 	<ul style="list-style-type: none"> N/A Yes No No 	Yes, see comments below.

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		shade trees.		
3.3.3.2 Setbacks	Setbacks to Exterior Walls <ul style="list-style-type: none"> • Side boundaries average 4m, min 3.5m • <i>For the exterior walls of any third storey: an additional setback of at least 2.5m measured from the face of the lower storey walls immediately below.</i> 	<ul style="list-style-type: none"> • Northern side setback at Farnell Road (Building N) is assessed under the <i>Apartment Design Guide</i>, refer attachment 4 	<ul style="list-style-type: none"> • N/A 	N/A
	Setbacks to Exterior Walls <ul style="list-style-type: none"> • Side boundaries average 4m, min 3.5m • <i>For the exterior walls of any third storey: an additional setback of at least 2.5m measured from the face of the lower storey walls immediately below.</i> 	<ul style="list-style-type: none"> • —Southern side setback ground floor to first floor 4.6m - 6.6m • —N/A 	<ul style="list-style-type: none"> • Yes 	Yes
	Setbacks to Exterior Walls <ul style="list-style-type: none"> • Front Setback 6m • <i>For the exterior walls of any third storey: an additional setback of at least 2.5m measured from the face of the lower storey walls immediately below.</i> 	<ul style="list-style-type: none"> • Blackwall Road (western boundary) setback (Building N) is assessed under the <i>Apartment Design Guide</i>, refer attachment 4 <p><u>Building S (two storey townhouses)</u></p> <p>The Blackwall Road (western boundary) setback at ground floor to first floor is non-compliant with a minimum setback of 4.2m, representing a non-compliance of 1.8m or 30%. This non-compliant portion is limited to a small corner of the building, while the remainder of the building meets the required setback.</p>	<ul style="list-style-type: none"> • N/A • No 	<p>N/A</p> <p>Yes, see comments below.</p>

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		<p>The proposal is considered to meet the objectives for setbacks as the design of the development provides reasonable amenity for adjoining development and proposed dwellings notwithstanding the reduced side setbacks.</p> <ul style="list-style-type: none"> In terms of solar access, the orientation of the site adequate solar access will be achieved to adjoining sites. In terms of privacy, at ground level, courtyards are integrated with living spaces along the western front and northern side boundaries which are adjacent to a roadway rather than a residential allotment. In terms of privacy, adequate building separation and space for landscaping opportunities are considered to provide a satisfactory level of privacy and amenity to adjoining site to the east. 		
	<p>Setbacks to Exterior Walls</p> <ul style="list-style-type: none"> Rear Setback 6m <i>For the exterior walls of any third storey: an additional setback of at least 2.5m measured from the face of the lower storey walls immediately below.</i> 	<ul style="list-style-type: none"> The eastern rear setback is assessed under the <i>Apartment Design Guide</i>, refer attachment 4 <p><u>Building S (two storey townhouses)</u></p> <p>The eastern rear setback at ground floor is non-</p>	<ul style="list-style-type: none"> N/A No 	<p>N/A</p> <p>Yes, see comments</p>

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		<p>compliant with a minimum setback of 5m, representing a non-compliance of 1m or 17%. This non-compliant portion is limited to a small corner of the building, while the remainder of the building meets the required setback. Further, the first floor is compliant.</p> <p>The proposal is considered to meet the objectives for setbacks. Notwithstanding the reduced side setbacks, the design of the development provides reasonable amenity for adjoining development and proposed dwellings;</p> <ul style="list-style-type: none"> • In terms of solar access, the orientation of the site adequate solar access will be achieved to adjoining sites. • In terms of privacy, at ground level, courtyards are integrated with living spaces along the western front and northern side boundaries which are adjacent to a roadway rather than a residential allotment. • In terms of privacy, adequate building separation and space for landscaping opportunities are considered to provide a satisfactory level of privacy and amenity to adjoining site to the east. 		below.

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
3.3.3.3.2 Car Parking	<ul style="list-style-type: none"> Resident 1.5 sp/unit = 1.5 x 34 = 51 spaces Visitor 0.2 sp/unit = 0.2 x 34 = 7 spaces. On the Peninsula (ie Woy Woy) visitor parking and service vehicle access may be provided on the existing street where: <ul style="list-style-type: none"> * development contains less than 4 units, or * unrestricted on-street parking is safely available within 60m of the development 	<ul style="list-style-type: none"> 55 resident spaces are provided onsite in the basement. 7 visitor spaces are provided onsite in the basement. <p>Total onsite spaces provided: 62 spaces</p> <p>Total required: 58 spaces</p>	<ul style="list-style-type: none"> Yes Yes 	Yes
3.3.3.3.4 Car Parking	<ul style="list-style-type: none"> Not located facing street/lane. Not located in front setback Not create continuous row of enclosed garages 	<ul style="list-style-type: none"> Onsite parking is provided in the basement. 	<ul style="list-style-type: none"> Yes 	Yes
3.3.3.3.5 Driveway Design	<ul style="list-style-type: none"> 3m wide driveway, 5.5m wide width at kerb 	<ul style="list-style-type: none"> Vehicle crossing in Farnell Road has a minimum width of 6m 	<ul style="list-style-type: none"> Yes 	Yes
3.3.3.4.2 Articulation	<ul style="list-style-type: none"> Max width and depth of building - 25m Buildings between 25m-35m must be indented with 6 X 6 courtyard, including 1 canopy tree and reduced wall heights surrounding Each courtyard planted with 1 large canopy tree Surrounding each courtyard height of 	<ul style="list-style-type: none"> N/A Block S (townhouses) is more than 25m in width and 15m in depth. To address articulation as per this clause, indentation via courtyards 6m x 6m. In addition to tree planting and balcony indentation has been 	<ul style="list-style-type: none"> N/A Yes 	Yes

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
	exterior walls reduced	<p>incorporated to reduce continuous high walls.</p> <ul style="list-style-type: none"> A 7.5m deep x 60m width courtyard and circulation area is provided inclusive of canopy trees and landscaping. Each courtyard associated with the units (townhouses) has 1 or more trees. 	<ul style="list-style-type: none"> Yes Yes 	
3.3.3.4.3 Internal Building Separation	<ul style="list-style-type: none"> Separation distance between two buildings on one site is 6m Driveways flanked by landscaped verges Separation between buildings provide satisfactory sunlight and privacy for adjacent dwellings 	<ul style="list-style-type: none"> Separation between in Block N and Block S is 13.5m The driveway to basement is flanked by landscaping The separation provides satisfactory sunlight and privacy 	<ul style="list-style-type: none"> Yes Yes Yes 	Yes
3.3.3.4.4 Articulation	<ul style="list-style-type: none"> The unarticulated length of any wall should not exceed 8m 	<ul style="list-style-type: none"> Portions of unarticulated wall length are less than 8m. 	<ul style="list-style-type: none"> Yes 	Yes
3.3.3.4.5 Appearance of adjoining buildings	<ul style="list-style-type: none"> The appearance of adjoining buildings should be varied 	<ul style="list-style-type: none"> Adjoining units (townhouses) are sufficiently articulated to create a varied façade design. 	<ul style="list-style-type: none"> Yes 	Yes
3.3.3.5.2 Solar Access	<ul style="list-style-type: none"> Sunlight min 3 hrs/day in living, dining, family rooms and 50% of principle Open Space areas. Received by 70% of dwellings. Sunlight retained to existing neighbours. 	<p>The two storey unit development (Block S) would allow greater than three hours solar access between 9am – 5pm to the living areas and private open space areas of the villas/ townhouses. The north-south orientation of the</p>	<ul style="list-style-type: none"> Yes 	Yes

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		allotment allows sufficient solar access to the subject property and neighbouring properties in accordance with Clause 3.3.3.5.2 within the DCP.		
3.3.3.5.3 Site Planning	<ul style="list-style-type: none"> Site planning to provide for reasonable privacy for existing & proposed dwellings. For two storey buildings: provide 9m between adjacent dwellings, If screening is provided these distances can be lessened. 	<ul style="list-style-type: none"> Reasonable privacy is achieved. 9m separation distance (measured as the minimum line-of-sight between the windows of any living room and / or the outer edge of a principal POS) to the existing residential development to the south is provided. 	<ul style="list-style-type: none"> Yes Yes 	<p>Yes</p> <p>Yes</p>
3.3.3.5.4 Natural cross ventilation	<ul style="list-style-type: none"> Min 60% of dwellings must have suitable floor plans for cross ventilation. 	<ul style="list-style-type: none"> 100% of units (townhouses) in Block S provide for cross ventilation. 	<ul style="list-style-type: none"> Yes 	<p>Yes</p>
3.3.3.5.5 Open Space	<ul style="list-style-type: none"> Private open space all dwellings - min area 50m² Min width 5m x 5m Min dimension is 3.5m 1 tree and landscaping per POS All should have one sunny spot, be located adjacent to a living space & a space for clothes drying 	<ul style="list-style-type: none"> All dwellings (townhouses) have 63m² or more private open space. Each courtyard generally provides 5m x 5m or more. Each private courtyard has 1 or more trees. Each private courtyard has sufficient space for solar access, clothes drying and is directly accessed from a living area. 	<ul style="list-style-type: none"> Yes Yes Yes Yes 	<p>Yes</p>
3.3.4.1 Housing Choice	<ul style="list-style-type: none"> Provide a variety of dwelling types a. In developments with more than ten dwellings: at least 10% should be "accessible": 3.4 or 4 dwellings required 	<ul style="list-style-type: none"> A mix of single, double and three bedrooms dwellings proposed. Four (4) adaptable units proposed. 	<ul style="list-style-type: none"> Yes Yes 	<p>Yes</p>

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
3.3.4.2 Residential Address	<ul style="list-style-type: none"> • Provide a traditional street address - Front doors, windows, patios etc facing street • Dwellings with private open space at ground level have private entrance • Garages are not located on street frontage • Solid fences to a height of 1.2m, and partially transparent screening above that for fences that face public/communal areas. 	<ul style="list-style-type: none"> • All units (townhouse) in Block S do not have entry door facing the street, due to building orientation. However entry doors, windows and courtyards are provided facing the communal space between Block N and Block S. The frontages are accessed at ground floor. An appropriate entry address is provided. Further, appropriate articulation (including medium size window openings) is provided to the western façade facing Blackwall Road. • All dwellings with private open space at ground level have private entrances. • No garages are provided on –grade, rather are located in the basement. • Courtyard fences more than 1.2m include timber panelling to allow partial transparency. Higher portions of fencing (1.4m – 1.8m) are provided for privacy between units and street frontages. 	<ul style="list-style-type: none"> • Yes • Yes • Yes • Yes 	Yes
3.3.4.3 Facades	<ul style="list-style-type: none"> • Divide facade into “panels” • Use gently-pitched roof elements • roofs surrounded by wide eaves • Balconies used to disguise expanses of flat exterior walls • Light weight finishes incorporated 	<ul style="list-style-type: none"> • The facades are sufficiently articulated to differentiate each unit. • Appropriate use of eaves is provided. • Balconies are provided for each unit in Block S (townhouses). • Facades give the 	<ul style="list-style-type: none"> • Yes • Yes • Yes • Yes 	Yes

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		appearance of light weight construction through two types of lightweight wall cladding with opaque and clear glass balustrades.		
3.3.4.4 Landscaped Areas	<ul style="list-style-type: none"> • Provide a landscape plan • Site surrounded by canopy trees • New trees to have mature heights of 8-10m (similar height to building) • Continuous screen plantings to side and rear boundaries • Front setback to include 2 canopy trees, side setback to include 1, rear setback to include 2 • Side and rear setbacks should include screen plantings • Driveway flanked by landscaping 	<ul style="list-style-type: none"> • Courtyard trees provided are 3m – 4m mature height. Other shade trees to be used within the site are capable of achieving heights 8 to 10m. • Front, side and rear setbacks include more than the required canopy trees. Sufficient screen planting and low height landscaping is provided. 	<ul style="list-style-type: none"> • Yes • Yes 	Yes
3.3.4.5.2 Stormwater	<ul style="list-style-type: none"> • 25% (930m²) of the development site shall be deep soil 	<ul style="list-style-type: none"> • The total site area allocated for deep soil is 14% (530 m²). 	No , however the deep soil proposed exceeds the minimum required (7%) in the <i>Apartment Design Guide</i> .	Yes
3.3.4.5.3 Garbage bin enclosures	<ul style="list-style-type: none"> • Not compromise urban design quality 	<ul style="list-style-type: none"> • Waste storage is located within the basement. 	<ul style="list-style-type: none"> • Yes 	Yes
3.3.4.5.5 Storage	<ul style="list-style-type: none"> • Two bedroom apartments: 8m³, • Three bedrooms or more: 10m³, 	Additional storage is provided in the designated storage areas in the basement.	<ul style="list-style-type: none"> • Yes 	Yes

Clause	Required	Proposed	Compliance With Controls	Compliance With Objectives
		All 7 units in Block S have 3 bedrooms. Each unit has approximately 15 m ² of storage.		
7.1.2.7 Car Parking with Persons with Disability	<ul style="list-style-type: none"> a) Where car parking is provided in excess of five (5) spaces, provision shall be made for parking for persons with a disability at the rate of one (1) space per one hundred (100) or part thereof of car spaces provided. A higher proportion of such spaces may be required for uses which are likely to generate a higher demand for such facilities. 	<ul style="list-style-type: none"> Included in the parking requirement (51 resident spaces) is the disabled spaces associated with each adaptable unit provided (4 units). <p>As the development provides more than 5 and no more than 100 spaces onsite (total 62), an additional 1 space is required.</p> <p>Therefore five (5) dedicated disabled spaces are required on-site.</p> <p>Five (5) spaces are provided in the basement.</p>	Yes	Yes
7.1.3.3 Bicycle Parking Facilities	<ul style="list-style-type: none"> a) Provision is to be made for cyclists via the installation of bicycle parking facilities in accordance with Australian Standard AS 2890.3. 	<ul style="list-style-type: none"> Fourteen (14) bicycles are proposed in the basement. In additional bicycle parking is provided on-grade. 	Yes	Yes
7.1.4.2- Parking Spaces	<ul style="list-style-type: none"> Single garage 3.2m x 6m Double garage 6m x 6m 	Complies.	Yes	Yes

Chapter 6 Environmental Controls

Development Control	Required	Proposed	Compliance	Compliance with objectives
6.1 Acid Sulfate Soils	Report required.	The site is identified as Class 3 Acid Sulfate Soils. The proposed development basement excavations are up to 3m in depth.	Capable of complying via condition, refer	Yes

Development Control	Required	Proposed	Compliance	Compliance with objectives
		<p>A report was provided. In this instance, the proposed works are not considered to impact on Acid Sulfate Soils. Further, a condition was applied for unexpected finds protocol.</p> <p>Report provided on Geotechnical Investigation prepared by Douglas Partners dated May 2018, assessed the presence of acid sulfate soils at the site with reference to the NSW Acid Sulfate Soil Management Advisory Committee (1998) Acid Sulfate Soil Manual.</p> <p>The investigation assessed the subsurface soil and groundwater conditions across the site in order to provide comment on:</p> <ul style="list-style-type: none"> • Presence or otherwise of acid sulfate soils; • Site Classification in accordance with AS 287-2011: <i>Residential Slabs and Footings</i> (Ref 1); • Parameters for the design of high level footings and piled foundations; • Parameters for the design of basement retaining walls; and • Pavement thickness design for a half road widening of Farnell Road. 	condition 2.10	
6.3 Erosion and Sediment Control	Plans required.	Complies.	Yes	Yes
6.4 Geotechnical Requirements For Development Applications	Report may be required.	Site not identified as in a landslip area.	N/A	N/A
6.6 Preservation of Trees or Vegetation	Landscape plan and arborist report required.	The proposal is supported by an arborist report and Landscape Plan - Issue C. The amended landscape design proposes four (4) street	Yes	Yes

Development Control	Required	Proposed	Compliance	Compliance with objectives
		<p>trees plus one (1) street shrub to be removed, while the remaining eight (8) streets are to be retained. Five (5) replacement trees are proposed along Farnell and Blackwall Road in lieu of the trees and shrub to be removed. The trees are proposed for removal as a result of driveway & footpath construction or tree deterioration.</p> <p>On the development site, six (6) trees are proposed for retention. The majority of these trees are located within close proximity to the north boundary along Farnell Road and the north-west corner boundary of Blackwall Road and Farnell Road. Further, the trees located on adjoining properties are noted by the arborist to have an acceptable impact from the proposed development, thus are able to be retained.</p> <p>Additional planting is provided on-site in the form of garden planting including some shade trees along both street frontages and along the eastern side boundary and southern side boundary.</p> <p>Council's Tree Assessment Officer supports the proposed tree removal and tree replacement, with the following conditions being applied (refer Conditions 1.1, 3.7, 3.8, 3.9, 4.16, 4.17 and 5.14).</p>		
6.7 Water Cycle Management	Minimise the impact of the development on the natural predevelopment water cycle.	The proposal is inconsistent with Chapter 6.7 – Water Cycle Management in that.	Yes	Yes

Chapter 7 General Controls

Development Control	Required	Proposed	Compliance	Compliance with objectives
7.1	<u>Residential Car Parking</u>	The basement car park will	Yes	Yes

Development Control	Required	Proposed	Compliance	Compliance with objectives
Car Parking	<p>1.5 spaces per dwelling: 51 spaces</p> <p><u>Visitor Spaces</u> 0.2 spaces per dwelling: 7 spaces</p> <p>In the area defined as the Peninsula (ie Booker Bay, Blackwall, Ettalong, Umina, Woy Woy) visitor parking and service vehicle access may be provided on the existing street where:</p> <p>* unrestricted on-street parking is safely available within 60m of the development.</p>	<p>be accessed from Farnell Road (north) with an internal lift and stair access to the residential floors of the RFB. While access to the townhouse is provided via individual internal stairs.</p> <p>Total proposed basement car parking exceeds the requirements, at sixty-one (62), including five (5) accessible spaces and seven (7) visitor spaces.</p> <p><u>Residential Car Parking</u></p> <ul style="list-style-type: none"> 1.5 spaces /per dwelling= 51 55 Spaces are provided in basement. Visitor Spaces/0.2 spaces per dwelling = 7 7 spaces are provided in basement. <p>Total required spaces (residential & visitor) is fifty eight (58)</p>		
7.2 Waste Management	<p>Clause 7.2.16.4 states that residential flat buildings having 18 units or less can be serviced at the kerbside with residential flat buildings having over 18 units requiring on-site waste servicing.</p>	<p>The proposal comprises 34 units and kerbside collection, resulting in an 89% or 16 unit variation to this requirement</p> <p>Council's Waste Services Officer has reviewed the documentation provided and supports the application subject to conditions.</p>	No	Yes, see comments below.

1. PARAMETERS OF THIS CONSENT

1.1 Approved Plans and Supporting Documents

Implement the development substantially in accordance with the plans and supporting documents listed below as submitted by the applicant and to which is affixed a Council stamp "Development Consent" unless modified by any following condition.

Architectural Plans by: AArqm

Landscape Plan by: Jackie Amos Landscape Architect

Drawing	Description	Sheets	Issue	Date
00	COVER SHEET & DRAWING SCHEDULE	-	C	5/2/19
01	NatHERS (Nationwide House Energy Rating Scheme) Certificates	-	C	5/2/19
02	EXISTING CONDITIONS PLAN	-	C	5/2/19
03	SITE CONTEXT DIAGRAM	-	C	5/2/19
04	SITE ANALYSIS DIAGRAM	-	C	5/2/19
05	DEMOLITION - CUT AND FILL SITE PLAN	-	C	5/2/19
06	SITE PLAN - BASEMENT	-	C	5/2/19
07	SITE PLAN - GROUND FLOOR	-	C	5/2/19
08	SITE PLAN - FIRST FLOOR	-	C	5/2/19
09	SITE PLAN - SECOND FLOOR	-	C	5/2/19
10	STREETSCAPE ELEVATIONS	-	C	5/2/19
11	SITE SECTIONS	-	C	5/2/19
12	ELEVATIONS	-	C	5/2/19
13	ELEVATIONS	-	C	5/2/19
14	SECTIONS	-	C	5/2/19
15	SECTIONS	-	C	5/2/19
16	FLOOR PLAN - BASEMENT N	-	C	5/2/19
17	FLOOR PLAN - GROUND FLOOR N	-	C	5/2/19
18	FLOOR PLAN - FIRST FLOOR N	-	C	5/2/19
19	FLOOR PLAN - SECOND FLOOR N	-	C	5/2/19
20	FLOOR PLAN - ROOF N	-	C	5/2/19
21	FLOOR PLAN - BASEMENT S	-	C	5/2/19
22	FLOOR PLAN - GROUND FLOOR S	-	C	5/2/19
23	FLOOR PLAN - FIRST FLOOR S	-	C	5/2/19
24	FLOOR PLAN - ROOF S	-	C	5/2/19
25	EXTERNAL FINISHES SCHEDULE	-	C	5/2/19
26	ADAPTABLE FLOOR PLANS	-	C	5/2/19
27	WASTE ENCLOSURE AND FENCE DETAILS	-	C	5/2/19
28	WINDOW & DOOR SCHEDULE	-	C	5/2/19
31	CROSS FLOW VENTILATION	-	C	5/2/19
32	AREA CALCULATION PLANS	-	C	5/2/19
-	Landscape Plan	-	C	12/2/19

Supporting Documentation

Title	Prepared by	Date
Landscape Plan Design Statement and Supporting Schedules	Jackie Amos Landscape Architect	No date / Rev B
Shadow Diagrams	AArqm	5 February 2019
Perspective Images (Renders)	AArqm	5 February 2019
BASIX Certificate No. 918365M	Dartecha Design	14 May 2018
Statement of Environmental Effects Incl. Clause 4.6	Wales & Associates PTY LTD	May 2018
Addendum to SEE (SEPP Coastal Management 2018)	Wales & Associates PTY LTD	27 September 2018
Addendum to SEE (Amended design reporting)	AArqm	2 October 2018
Design Verification Statement – SEPP65	Boris Nedic Architect	23 May 2018
Survey	Clarke Dowdle & Associates	11 August 2017
Water Cycle Management plans	Northrop	29.11.18 / Rev A
Water Cycle Management plan report	Northrop	27.11.18 / Rev A
Report on Geotechnical Investigation	Douglas Partners	2 May 2018
Traffic and Parking Impact Assessment Report	Barker Ryan Stewart	May 2018
Access Report	AED Group	May 2018

- 1.2 Carry out all building works in accordance with the Building Code of Australia.
- 1.3 Comply with all commitments listed in BASIX Certificate as required under clause 97A of the *Environment Planning and Assessment Regulation 2000*.

2. PRIOR TO ISSUE OF ANY CONSTRUCTION CERTIFICATE

- 2.1. All conditions under this section must be met prior to the issue of any Construction Certificate.
- 2.2. Submit amendments to the approved plans to the Accredited Certifier pursuant to clause 139 of the *Environmental Planning and Assessment Regulation 2000* that must detail:
 - a) Basement Plan - Provide a total of five (5) disabled parking spaces within the basement designed in accordance with the relevant Australian Standard. Submit the amended Basement Plan to Council Development Engineer for assessment.
 - b) Compliance with the relevant BASIX Certificate. The use of solar hot water and photovoltaic cells or other energy saving options should also be considered;
 - c) Mail boxes shall be secure and large enough to accommodate articles such as newspapers;
 - d) Locate satellite dish and telecommunication antennae, air conditioning units, ventilation stacks and any ancillary structures:
 - a. Away from the street frontage;
 - b. Integrated into the roof-design and in a position where such facilities will not become a skyline feature at the top of any building;
 - c. Adequately setback from the perimeter wall or roof edge of buildings;
 - e) A master antenna must be provided for the residential apartment buildings. This antenna shall be sited to minimise its visibility from surrounding public areas;
 - f) The reflectivity index (expressed as a percentum of the reflected light falling upon any surface) of external glazing for windows, walls or roof finishes of the proposed development is to be no greater than 20%;
 - g) Fifty-five (55) residential car parking spaces, including four (4) accessible car parking spaces must be provided on-site;
 - h) Seven (7) residential visitor car parking spaces, including one (1) accessible must be provided on site. One (1) car wash bay must be provided with a drain and water supply for the washing of vehicles. The drain is to be connected to the on-site nutrient control facility;
 - i) Four (4) apartments must be capable of being modified to create adaptable units;
 - j) Storage areas are to be in accordance with the following average rates:
 - a. 7.5m³ for studio and one bedroom units; and

- b. 10m³ for two bedroom units;

At least 50% of the required storage areas are to be provided within each dwelling.

- k) Bicycle storage racks capable of accommodating fourteen (14) bicycles (at a minimum) must be provided in the basement;
- l) Demonstrate compliance with the External Finishes Schedule approved in Condition 1.1 of this consent.
- 2.3. Pay to Council a total contribution amount of **\$331,716.00** that may require adjustment at the time of payment, in accordance with the relevant Council Contribution Plans No. 31A, 31B, 31C & 31D - Peninsula.

Roadwork - Capital	B	(Key No 789)	\$17,581.00
Open Space - Land	C	(Key No 791)	\$55,860.00
Open Space - Embellishment	C	(Key No 790)	\$151,200.00
Community Facilities - Land	D	(Key No 793)	\$2,897.00
Community Facilities - Capital	D	(Key No 792)	\$45,012.00
Drainage - Land	A	(Key No 787)	\$12,200.00
Drainage - Capital	A	(Key No 788)	\$46,966.00
TOTAL AMOUNT			\$331,716.00

The total amount must be indexed each quarter in accordance with the Consumer Price Index (All Groups Index) for Sydney issued by the Australian Statistician as outlined in the contributions plan.

Contact Council's Contributions Planner on Tel 4325 8222 for an up-to-date contribution payment amount.

Any Construction Certificate must not be issued until the developer has provided the Accredited Certifier with a copy of a receipt issued by Council that verifies that the contributions have been paid. A copy of this receipt must accompany the documents submitted by the certifying authority to Council under Clause 104/Clause 160(2) of the *Environmental Planning and Assessment Regulation 2000*.

A copy of the Contribution Plan may be inspected at the office of Central Coast Council, 49 Mann Street Gosford or on Council's website: [Development Contributions - former Gosford LGA](#)

- 2.4. Submit an application to Council under Section 305 of the *Water Management Act 2000* to obtain a Section 307 Certificate of Compliance. The *Application for a 307 Certificate under Section 305 Water Management Act 2000* form can be found on Council's website www.centralcoast.nsw.gov.au. Early application is recommended.

A Section 307 Certificate must be obtained prior to the issue of any Construction Certificate.

- 2.5. Submit engineering details prepared and certified by a practising structural engineer that comply with *Council's Building Over or Adjacent To Sewer and Water Main Guidelines* to the satisfaction of Council. Engineering details must be submitted to Council's Water Assessment Team for approval. Plan assessment fees apply.
- 2.6. Submit an application to Council under section 138 of the *Roads Act 1993* for the approval of required works to be carried out within the road reserve.

Submit to Council Engineering plans for the required works within a public road that have been designed by a suitably qualified professional in accordance with Council's Civil Works Specification and Chapter 6.3 - Erosion Sedimentation Control of the Gosford Development Control Plan 2013. The Engineering plans must be included with the Roads Act application for approval by Council.

Design the required works as follows:

- a) Half width road including kerb and guttering, subsoil drainage, footpath formation, drainage and a minimum 6m wide road pavement across the full frontage of the site in Farnell Road. The kerb alignment shall be 5.56m off the boundary.
- b) Footway formation graded at +2% from the top of kerb to the property boundary, across the full frontage of the site in Farnell Road.
- c) 1.2m wide reinforced (SL72 steel fabric, 100mm thick) concrete footpath in an approved location across the full frontage of the site in Farnell Road.
- d) Heavy-duty vehicle crossing in Farnell Road that has a minimum width of 6m and constructed with 200mm thick concrete reinforced with 1 layer of SL72 steel fabric top and bottom.
- e) All redundant vehicular crossings are to be removed and the footway formation reinstated with turf and a 1.2m wide reinforced (SL72 steel fabric, 100mm thick) concrete footpath in an approved location.
- f) Longitudinal street drainage (minimum 375 diameter RCP) in Blackwall Road from the developments stormwater discharge outlet point in Blackwall Road to the existing kerb inlet pit located in Blackwall Road near the intersection of Blackwall Road and Allfield Road.
- g) The piping of stormwater from within the site (associated with the outlet from the on-site detention system) to the required kerb inlet pit within the site frontage at the start of the required longitudinal street drainage in Blackwall Road
- h) A kerb inlet pit adjacent to the vehicle access crossing in Farnell Road and the provisions of an absorption trench in the footway to capture and dispose of stormwater from the road pavement in Farnell Road. Details of the pit and absorption system to be obtained from Council in preparation for the road works design. The absorption trench is to be sited clear of services within the footway.
- i) Stormwater from the drainage pump out from the basement car park is to connect to the required kerb & gutter in Farnell Road and on the high side of the required kerb inlet pit.
- j) Reinstatement of vehicle crossings in Blackwall Road between the subject site and the intersection of Blackwall Road and Allfield Road that are disturbed as a result of the required longitudinal street drainage pipeline in Blackwall Road. Reinstated vehicle crossings shall be constructed with 150mm thick concrete reinforced with SL72 steel fabric.

- k) Replacement of kerb & gutter and vehicle laybacks that are removed to facilitate the required longitudinal street drainage pipeline in Blackwall Road, with new kerb & gutter and vehicle laybacks.
- l) Replacement planting of new street trees to replace any that may be removed in Blackwall Road to facilitate the required stormwater works.
- m) Erosion and sedimentation control plan.

The Roads Act application must be approved by Council prior to commencing works in the road reserve.

A fee for the approval of engineering plans under the *Roads Act 1993* applies. The amount of this fee can be obtained by contacting Council's Customer Service Centre on (02) 4325 8222.

The engineering plans for the works within Blackwall Road will also require approval from the Roads & Maritime Services.

The works within Blackwall Road may require a formal Works Authorisation Deed to be entered into between the developer and the Roads & Maritime Services. It is recommended that the developer contact Roads & Maritime Services (Newcastle) prior to preparation of the engineering plans associated with the Roads Act application.

- 2.7. Submit a dilapidation report to Council with the Roads Act application and / or Construction Certificate application. The report must document and provide photographs that clearly depict any existing damage to the road, kerb, gutter, footpath, driveways, street trees, street signs or any other Council assets in the vicinity of the development. The dilapidation report may be updated with the approval of the Principal Certifying Authority prior to the commencement of works.
- 2.8. Submit design details of the following engineering works within private property:
 - a) driveways / ramps and car parking areas must be designed according to the requirements of Australian Standard AS 2890: Parking Facilities for the geometric designs, and industry Standards for pavement designs
 - b) a stormwater detention system must be designed in accordance with Chapter 6.7 - *Water Cycle Management* of the Gosford Development Control Plan 2013 and Council's *Civil Works Specification*. The stormwater detention system must limit post development flows from the proposed development to less than or equal to predevelopment flows for all storms up to and including the 1% Annual Exceedance Probability (AEP) storm event. A runoff routing method must be used. An on-site stormwater detention report including an operation and maintenance plan must accompany the design. On-site stormwater detention is not permitted within private courtyards, drainage easements, and / or secondary flow paths
 - c) nutrient/pollution control measures must be designed in accordance with Chapter 6.7 - *Water Cycle Management* of the Gosford Development Control Plan. A nutrient / pollution control report including an operation and maintenance plan must accompany the design
 - d) on-site stormwater retention measures must be designed in accordance with Chapter 6.7 - *Water Cycle Management* of the Gosford Development Control Plan 2013. A report detailing the method of stormwater harvesting, sizing of retention

- tanks for re-use on the site and an operation and maintenance plan must accompany the design
- e) piping of all stormwater from impervious areas within the site via an on-site stormwater detention structure to the required kerb inlet pit and longitudinal piped drainage system located in Blackwall Road.

These design details and any associated reports must be included in the Construction Certificate.

- 2.9. Submit a pavement investigation and report prepared by a practising Geotechnical Engineer for the road works. This report must be submitted with the Construction Certificate application or application for work under the Roads Act 1993.

The pavement depths must be determined in accordance with Council's specifications and the following traffic loadings:

Name of Street	Traffic Loading (ESAs)
Farnell Road	2 x 10 ⁶

- 2.10. Submit to Council's Environmental Health Officer for approval an Unexpected Finds Protocol detailing how unexpected contamination encountered within the site during future development works will be managed. The Unexpected Finds Protocol must be prepared by a suitably qualified environmental consultant.
- 2.11. Submit to Council for approval a Noise Management Plan for construction works prepared in accordance with the Interim Construction Noise Guidelines (Department of Environment and Climate Change NSW, 2009).
- 2.12. Design the building so the following internal LAeq levels are not exceeded:
- a) in any bedroom in the residential accommodation—35 dB(A) at any time between 10 pm and 7 am,
 - b) anywhere else in the residential accommodation (other than a garage, kitchen, bathroom or hallway)—40 dB(A) at any time.
- 2.13. No activity is to be carried out on-site until the Construction Certificate has been issued, other than;
- a) Site investigation for the preparation of the construction, and / or
 - b) Implementation of environmental protection measures, such as erosion control and the like that are required by this consent
 - c) Demolition approved by this consent.

3. PRIOR TO COMMENCEMENT OF ANY WORKS

- 3.1. All conditions under this section must be met prior to the commencement of any works.

- 3.2. Do not commence site works until the sediment control measures have been installed in accordance with the approved plans / Gosford DCP 2013 Chapter 6.3 - Erosion Sedimentation and Control
- 3.3. Appoint a Principal Certifying Authority for the building work:
- The Principal Certifying Authority (if not Council) is to notify Council of their appointment and notify the person having the benefit of the development consent of any critical stage inspections and other inspections that are to be carried out in respect of the building work no later than two (2) days before the building work commences.
 - Submit to Council a *Notice of Commencement of Building Works* or *Notice of Commencement of Subdivision Works* form giving at least two (2) days' notice of the intention to commence building or subdivision work. The forms can be found on Council's website www.centralcoast.nsw.gov.au
- 3.4. Erect a sign in a prominent position on any work site on which building, subdivision or demolition work is being carried out. The sign must indicate:
- The name, address and telephone number of the principal certifying authority for the work; and
 - The name of the principal contractor and a telephone number at which that person can be contacted outside of working hours; and
 - That unauthorised entry to the work site is prohibited.
 - Remove the sign when the work has been completed.
- 3.5. Submit both a Plumbing and Drainage Inspection Application, with the relevant fee, and a Plumbing and Drainage Notice of Work in accordance with the *Plumbing and Drainage Act 2011* (to be provided by licensed plumber). These documents can be found on Council's website at: www.centralcoast.nsw.gov.au.

Contact Council prior to submitting these forms to confirm the relevant fees.

- 3.6. Submit to the Principal Certifying Authority a Traffic and Pedestrian Management Plan prepared by a suitably qualified professional.

The Plan must be prepared in consultation with Council, and where required, the approval of Council's Traffic Committee obtained.

The Plan must address, but not be limited to, the following matters:

- Ingress and egress of vehicles to the Subject Site
- Loading and unloading, including construction zones
- Predicted traffic volumes, types and routes
- Pedestrian and traffic management methods, and
- Other relevant matters

The Applicant must submit a copy of the final Plan to Council, prior to the commencement of work.

- 3.7. Ensure that all parties / trades working on the site are fully aware of their responsibilities with respect to tree protection conditions.
- 3.8. Tree Protection is to be as per the recommendations of the Arboricultural Impact Assessment prepared by R Kingdom, dated 15 May 2018.
- 3.9. Protect street trees by installing protective fencing. Any street tree damaged during works must be immediately reported to Council, which may incur a compensation fee, rectifying and / or replaced with a tree of similar height and species at no cost to Council.
- 3.10 Install run-off and erosion controls to prevent soil erosion, water pollution or the discharge of loose sediment on the surrounding land by:
 - a) Erecting a silt fence and providing any other necessary sediment control measures that will prevent debris escaping into drainage systems, waterways or adjoining properties; and
 - b) Diverting uncontaminated run-off around cleared or disturbed areas; and
 - c) Preventing the tracking of sediment by vehicles onto roads; and
 - d) Stockpiling top soil, excavated materials, construction and landscaping supplies and debris within the lot.
- 3.11 Notify the intention to commence works by giving written notice to the owner of the adjoining property affected by the proposed excavation and/or structural protective works. The required notice must be accompanied by details of the proposed work at least seven (7) days prior to the commencement of proposed excavation and/or structural protection works.
- 3.12 Disconnect, seal and make safe all existing site services prior to the commencement of any demolition on the site. Sewer and water services must be disconnected by a licensed plumber and drainer with a Start Work Docket submitted to Council's Plumbing and Drainage Inspector as the Water and Sewer Authority.
- 3.13 Erect a temporary hoarding or temporary construction site fence between the work site and adjoining lands before the works begin and must be kept in place until after the completion of the works, if the works:
 - a) could cause a danger, obstruction or inconvenience to pedestrian or vehicular traffic, or
 - b) could cause damage to adjoining lands by falling objects, or
 - c) involve the enclosure of a public place or part of a public place.

Note 1: A structure on public land or on or over a public road requires the prior approval of the relevant authority under the *Local Government Act 1993* or the *Roads Act 1993*, respectively.

Note 2: The *Work Health and Safety Act 2011* and *Work Health and Safety Regulation 2011* contain provisions relating to scaffolds, hoardings and other temporary structures.

- 3.14 Provide or make available toilet facilities at the work site before works begin and maintain the facilities until the works are completed at a ratio of one toilet plus one additional toilet for every twenty (20) persons employed at the site.

Each toilet must:

- a) be a standard flushing toilet connected to a public sewer, or
 - b) have an on-site effluent disposal system approved under the *Local Government Act 1993*, or
 - c) be a temporary chemical closet approved under the *Local Government Act 1993*.
- 3.15 Undertake any demolition involving asbestos in accordance with the *Work Health and Safety Act 2011*.

The person having the benefit of this consent must ensure that the removal of:

- a) more than 10m² of non-friable asbestos or asbestos containing material is carried out by a licensed non-friable (Class B) or a friable (Class A) asbestos removalist, and
- b) friable asbestos of any quantity is removed by a licensed removalist with a friable (Class A) asbestos removal licence.

The licensed asbestos removalist must give notice to the regulator before work commences in accordance with Clause 466 of the *Work Health and Safety Regulation 2011*.

- 3.16 Provide certification to the Principal Certifying Authority that the structural engineer's details have been prepared in accordance with the recommendations of the geotechnical report(s) listed as supporting documentation in this development consent.
- 3.17 Submit a dilapidation report to Council, the Accredited Certifier and relevant adjoining property owners. The report is to be prepared by a suitably qualified person detailing the structural characteristics of all buildings located on properties immediately adjoining the site boundaries and any Council asset in the vicinity of the development. The report must document and provide photographs that clearly depict any existing damage to the improvements erected upon allotments immediately adjoining the development site and to the road, kerb, footpath, driveways, water supply and sewer infrastructure, street trees and street signs or any other Council asset in the vicinity of the development.

In the event that access to an adjoining property(s) for the purpose of undertaking the dilapidation report is denied, submit evidence in writing demonstrating that all steps were taken to obtain access to the adjoining property(s).

4. DURING WORKS

- 4.1. All conditions under this section must be met during works.
- 4.2. Carry out construction or demolition works during the construction phase of the development only between the hours as follows:
- 7:00am and 5:00pm Monday to Saturday

No construction or demolition works associated with the development are permitted to be carried out at any time on a Sunday or a public holiday.

- 4.3. During the construction phase of the development, if any Aboriginal object (including evidence of habitation or remains) is discovered during the course of the work:
- a) All excavation or disturbance of the area must stop immediately in that area, and
 - b) The Office of Environment & Heritage must be advised of the discovery in accordance with section 89A of the *National Parks and Wildlife Act 1974*.

Note: If an Aboriginal object is discovered, an Aboriginal heritage impact permit may be required under the *National Parks and Wildlife Act 1974*.

- 4.4. Implement and maintain all erosion and sediment control measures at or above design capacity for the duration of the construction works and until such time as all ground disturbed by the works has been stabilised and rehabilitated so that it no longer acts as a source of sediment.
- 4.5. Keep a copy of the stamped approved plans on-site for the duration of site works and make the plans available upon request to either the Principal Certifying Authority or an officer of Council.
- 4.6. Notify Council when plumbing and drainage work will be ready for inspection(s) and make the work accessible for inspection in accordance with the *Plumbing and Drainage Act 2011*.
- 4.7. Re-use, recycle or dispose of all building materials during the demolition and construction phase of the development in accordance with the Waste Management Plan signed by AARQM Pty Ltd, dated 1 October 2018.
- 4.8. Submit to Council a Clearance Certificate issued by a suitably qualified independent Occupational Hygienist or Licensed Asbestos Assessor certifying that the site has been made free of asbestos material following completion of demolition works.
- 4.9. Do not pump out water from the excavation pit into Council's storm water system unless it has been treated and/or tested and will not cause a water pollution incident as defined under the Protection of the Environment Operations Act 1997.

- 4.10. Implement all soil and water management control measures and undertake works in accordance with the approved Soil and Water Management Plan prepared by Northrop dated 29 November 2018. Update the plan as required during all stages of the construction or in accordance with the 'Blue Book' (Managing Urban Stormwater: Soils and Construction, Landcom, 2004).
- 4.11. Implement dust suppression measures on-site during bulk earthworks to suppress dust generated by vehicles and equipment. Dust must also be suppressed at all other stages of construction in order to comply with the *Protection of the Environment Operations Act 1997*.
- 4.12. Classify all excavated material removed from the site in accordance with NSW EPA (1999) *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* prior to disposal. All excavated material must be disposed of to an approved waste management facility, and receipts of the disposal must be kept on-site.
- 4.13. Implement the Unexpected Finds Protocol approved by Council during the construction phase that would provide advice on protocols to follow if an unexpected find is encountered.
- 4.14. Undertake works in accordance with the approved Noise Management Plan.
- 4.15. Ensure that the removal of:
- a) More than 10m² of non-friable asbestos or asbestos containing material is carried out by a licensed non-friable (Class B) or a friable (Class A) asbestos removalist, and
 - b) Friable asbestos of any quantity is removed by a licensed removalist with a friable (Class A) asbestos removal licence.
- 4.16. Undertake the removal of any tree located on Council managed land due to works approved by a Development Application at the full cost and responsibility of the developer / owner using a Pre-qualified Tree Contractor.
- Contact Central Coast Council on 02 4325 8222 for the current list of relevant contractors.
- 4.17. Removal of trees is to be as per the recommendations of the Arboricultural Impact Assessment prepared by R Kingdom, dated 15 May 2018, in a manner so as to prevent damage to those trees that are to be retained.
- 4.18. Place all building materials, plant and equipment on the site of the development during the construction phase of the development so as to ensure that pedestrian and vehicular access within adjoining public roads, footpaths and reserve areas, is not restricted and to prevent damage to public infrastructure. Further, no construction work is permitted to be carried out within the road reserve unless the works are associated with a separate approval issued under the provisions of the *Roads Act 1993*.
- 4.19. Submit a report prepared by a registered Surveyor to the Principal Certifying Authority at each floor level of construction of the building (prior to the pouring of concrete) indicating

that the finished floor level is in accordance with the approved plans. A compilation of these reports is to be provided to Council at completion of the Occupation Certificate

- 4.20 Carry out works in accordance with the approved Acid Sulfate Soils Management Plan.
- 4.21 Cease all excavation works if acid sulfate soils are identified until such time as details of mitigation and treatment measures are submitted to, and approved by, the Principal Certifying Authority.
- 4.22 Implement and maintain all erosion and sediment control measures at or above design capacity for the duration of the construction works and until such time as all ground disturbed by the works has been stabilised and rehabilitated so that it no longer acts as a source of sediment.
- 4.23 Demolish all buildings and / or building components in a safe and systematic manner in accordance with Australian Standard AS 2601-2001: *The demolition of structures*. Waste materials must be disposed of at a waste management facility.
- 4.24 Implement all recommendations of the geotechnical report(s) listed as supporting documentation in this development consent. Furthermore, the geotechnical engineer must provide written certification to the Principal Certifying Authority that all works have been carried out in accordance with the recommendations contained within the geotechnical report(s).

5. PRIOR TO ISSUE OF ANY OCCUPATION CERTIFICATE

- 5.1. All conditions under this section must be met prior to the issue of any Occupation Certificate.
- 5.2. Submit a Certificate of Compliance for all plumbing and drainage work and a Sewer Service Diagram showing sanitary drainage work (to be provided by licensed plumber) in accordance with the *Plumbing and Drainage Act 2011*.
- 5.3. Complete the landscaping works.
- 5.4. Provide the Principal Certifying Authority with written certification from a qualified landscape designer certifying that landscaping has been implemented in accordance with the approved landscape plan as amended by any conditions of this consent.
- 5.5. Provide to the Principal Certifying Authority a design verification statement from a qualified designer, being a statement in which the qualified designer verifies that the residential flat development achieves the design quality of the development as shown in the plans and specifications in respect of which the Construction Certificate was issued, having regard to the Design Quality Principles set out in Part 2 of *State Environmental Planning Policy No 65 - Design Quality of Residential Flat Development*.

- 5.6. Consolidate Lot A DP 385814, Lot 111 DP 6846, Lot 112 DP 6846, Lot 113 DP 6846 and Lot 114 DP 6846 into a single allotment under one Certificate of Title.

Documentary evidence of the lodgement of the Consolidation Plan with the NSW Land and Property Information can be accepted by the Principal Certifying Authority as satisfying this requirement.

- 5.7. Provide any additional civil works required to ensure satisfactory transitions to existing work as a result of work conditioned for the development. Works are to be approved by Council as the Roads Authority.
- 5.8. Construct the stormwater management system in accordance with the approved Stormwater Management Plan and Australian Standard AS 3500.3-2004: *Stormwater drainage systems*. Certification of the construction by a suitably qualified consultant must be provided to the Principal Certifying Authority.
- 5.9. Complete works within the road reserve in accordance with the approval under the *Roads Act 1993*. The works must be completed in accordance with Council's *Civil Design Guide, Construction Specifications and Standard Drawings* and Chapter 6.3 - *Erosion Sedimentation Control* of the Gosford Development Control Plan 2013. Documentary evidence for the acceptance of such works must be obtained from the Roads Authority.
- 5.10. Rectify to the satisfaction of the Council any damage not shown in the dilapidation report submitted to Council before site works had commenced. Any damage will be assumed to have been caused as a result of the site works undertaken and must be rectified at the developer's expense.
- 5.11. Complete the internal engineering works within private property in accordance with the plans and details approved with the construction certificate.
- 5.12. Do not locate fencing, structures, or landscaping with a mature height of greater than 300mm within a 4m x 4m splay corner located at the intersection of Farnell Road and Blackwall Road.
- 5.13. Amend the Deposited Plan (DP) to:

- Include an Instrument under the *Conveyancing Act 1919* for the following restrictive covenants; with Council having the benefit of these covenants and having sole authority to release and modify. Wherever possible, the extent of land affected by these covenants must be defined by bearings and distances shown on the plan
 - a) create a Restriction as to use of land over all lots containing an on-site stormwater detention system and / or a nutrient / pollution facility restricting any alteration to such facility or the erection of any structure over the facility or the placement of any obstruction over the facility

And,

- Include an instrument under the *Conveyancing Act 1919* for the following positive covenants; with Council having the benefit of these covenants and having sole authority to release and modify. Contact Council for wording of the covenant(s)

- a) to ensure on any lot containing on-site stormwater detention system and / or a nutrient / pollution facility that:
 - (i) the facility will remain in place and fully operational
 - (ii) the facility is maintained in accordance with the operational and maintenance plan so that it operates in a safe and efficient manner
 - (iii) Council's officers are permitted to enter the land to inspect and repair the facility at the owners cost
 - (iv) Council is indemnified against all claims of compensation caused by the facility

Submit to the Principal Certifying Authority copies of registered title documents showing the restrictive and positive covenants.

5.14. Street tree planting is to be undertaken as per approved Landscape Plan.

Provide advanced specimens (minimum 45 litre pot size) to be planted, staked/protected to prevent vandalism as per Central Coast Council's Civil Specification Volume 3.

Do not locate trees within an authority's underground service easement

5.15 Provide mail receptacles appropriately numbered for each dwelling unit in the development, as well as for the managing body, in consultation with Australia Post.

5.16 Implement the following Crime Prevention through Environmental Design (CPTED) principles and strategies to minimise the opportunity for crime:

- a) provide adequate lighting to common areas as required under Australian Standard AS 1158: *Lighting for roads and public spaces*
- b) paint the ceiling of the car park white
- c) design of landscaping, adjacent to mailboxes and footpaths, must not provide concealment opportunities for criminal activity
- d) design the development to avoid foot holes or natural ladders so as to minimise unlawful access to the premises
- e) provide signage within the development to identify all facilities, entry / exit points and direct movement within the development
- f) install a system of Closed Circuit Television of a type and in locations on the site that will record high-quality images of all public areas within the site.

5.17 Complete the building in accordance with the relevant provisions and requirements of the National Construction Code Series.

5.18 Provide certification from a geotechnical engineer to the Principal Certifying Authority that all works have been carried out in accordance with the recommendations contained within the geotechnical report(s) listed as supporting documentation in this development consent.

5.19 Provide certification from an appropriately qualified architect to the principal certifier that the External Finishes Schedule approved in Condition 1.1 of this consent is consistent with the development constructed.

6. ONGOING OPERATION

- 6.1. Ensure the garbage / recycling bins do not encroach on the car parking or vehicle manoeuvring areas.
- 6.2. Maintain the nutrient / pollution control facilities in accordance with the operation and maintenance plan.
- 6.3. Store all waste generated on the premises in a manner so that it does not pollute the environment.
- 6.4. Transport all waste generated on the premises to a facility which is licensed to receive that material.
- 6.5. No obstructions to the wheel out of the waste bins are permitted including grills, speed humps, barrier kerbs, etc.
- 6.6. Comply with all commitments as detailed in the Waste Management Plan signed by AARQM Pty Ltd, dated 1 October 2018.
- 6.7. Locate the approved waste storage enclosure / area as indicated on Drawing Number 06, Issue C, dated 5 February 2019, prepared by AARQM Pty Ltd.
- 6.8. Construct and manage the waste storage enclosure in accordance with the provisions of Gosford Development Control Plan 2013, Part 7: *Chapter 7.2 - Waste Management*, Appendix D and Appendix G, as applicable.
- 6.9. Do not place or store waste material, waste product or waste packaging outside the approved waste storage enclosure.
- 6.10. Residential waste bin presentation location, on Farnell Road, to be as indicated on Drawing No. 07, dated 5 February 2019 by AARQM Pty Ltd.
- 6.11. Place the mobile garbage/recycling/green waste containers at the approved location/s in Farnell Road, at the kerbside no earlier than the evening prior to the collection day and return to the approved Basement waste bin storage enclosure as soon as possible after service, no later than the evening on collection day. The residents, caretaker, owner, Owners Corporate are responsible for the placement and return of the mobile waste containers.
- 6.12. Maintain all works associated with the approved Landscape Plans for a period of twelve (12) months from the date of the issue of any Occupation Certificate to ensure the survival and establishment of the landscaping.
- 6.13. Replace all damaged, dead or missing areas of lawn and plantings at the completion of the landscaping maintenance period, including adjoining road reserve areas that are in a

state of decline, to a healthy and vigorous condition in accordance with the approved detailed Landscape Plans and Development Consent Conditions.

- 6.14 Operate and maintain all external lights in accordance with the *AS42821997: Control of the obtrusive effects of outdoor lighting*.
- 6.15 Maintain the external finishes of the building(s), structures, walls and fences for the life of the development and remove any graffiti within seven (7) days.
- 6.16 Do not give to offensive noise as defined in the *Protection of the Environment Operations Act 1997*.
- 6.17 The following residential waste servicing requirements apply to the development approved under this consent:
- 13 x 360 litre shared Mixed waste bulk bins serviced weekly.
 - 11 x 360 litre shared Recyclable waste bulk bins serviced weekly.
 - 4 x 240 litre Green waste MFB's for kerbside collection serviced fortnightly for shared resident use only. No further 240 litre Green waste bins to be issued due to limited, satisfactory kerbside presentation locations.

7. PENALTIES

Failure to comply with this development consent and any condition of this consent may be a criminal offence. Failure to comply with other environmental laws may also be a criminal offence.

Where there is any breach Council may without any further warning:

- Issue Penalty Infringement Notices (On-the-spot fines);
- Issue notices and orders;
- Prosecute any person breaching this consent, and/or
- Seek injunctions/orders before the courts to retain and remedy any breach.

Warnings as to Potential Maximum Penalties

Maximum Penalties under NSW Environmental Laws include fines up to \$1.1 Million and/or custodial sentences for serious offences.

ADVISORY NOTES

- Discharge of sediment from a site may be determined to be a pollution event under provisions of the *Protection of the Environment Operations Act 1997*. Enforcement action may commence where sediment movement produces a pollution event.
- The following public authorities may have separate requirements in the following aspects:

- a) Australia Post for the positioning and dimensions of mail boxes in new commercial and residential developments
 - b) Jemena Asset Management for any change or alteration to the gas line infrastructure
 - c) Ausgrid for any change or alteration to electricity infrastructure or encroachment within transmission line easements
 - d) Telstra, Optus or other telecommunication carriers for access to their telecommunications infrastructure
 - e) Central Coast Council in respect to the location of water, sewerage and drainage services.
- Carry out all work under this Consent in accordance with SafeWork NSW requirements including the *Workplace Health and Safety Act 2011 No 10* and subordinate regulations, codes of practice and guidelines that control and regulate the development industry.
 - Dial Before You Dig
Underground assets may exist in the area that is subject to your application. In the interests of health and safety and in order to protect damage to third party assets please contact Dial Before You Dig at www.1100.com.au or telephone on 1100 before excavating or erecting structures. (This is the law in NSW). If alterations are required to the configuration, size, form or design of the development upon contacting the Dial Before You Dig service, an amendment to the development consent (or a new development application) may be necessary. Individuals owe asset owners a duty of care that must be observed when working in the vicinity of plant or assets. It is the individual's responsibility to anticipate and request the nominal location of plant or assets on the relevant property via contacting the Dial Before You Dig service in advance of any construction or planning activities.
 - Telecommunications Act 1997 (Commonwealth)
Telstra (and its authorised contractors) are the only companies that are permitted to conduct works on Telstra's network and assets. Any person interfering with a facility or installation owned by Telstra is committing an offence under the *Criminal Code Act 1995 (Cth)* and is liable for prosecution. Furthermore, damage to Telstra's infrastructure may result in interruption to the provision of essential services and significant costs. If you are aware of any works or proposed works which may affect or impact on Telstra's assets in any way, you are required to contact: Telstra's Network Integrity Team on phone number 1800 810 443.
 - Install and maintain backflow prevention device(s) in accordance with Council's *WS4.0 Backflow Prevention Containment Policy*. This policy can be found on Council's website at: www.centralcoast.nsw.gov.au
 - The inspection fee for works associated with approvals under the *Roads Act 1993* is calculated in accordance with Council's current fees and charges policy.
 - Payment of a maintenance bond may be required for civil engineering works associated with this development. This fee is calculated in accordance with Council's fees and charges.

Central Coast Council
Terrigal Boardwalk
Basis of Design

TPB-DE-GN-RPT-001

Rev 4 | 2 April 2019



This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 261648-00

Arup
Arup Pty Ltd ABN 18 000 966 165
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ARUP

Document Verification

ARUP

Job title		Terrigal Boardwalk		Job number	
				261648-00	
Document title		Basis of Design		File reference	
				-	
Document ref		TPB-DE-GN-RPT-001			
Revision	Date	Filename	TBP-DE-GN-RPT-001 Basis of Design.docx		
[0]	25 May 2018	Description	Work-in-progress draft		
			Prepared by	Checked by	Approved by
		Name	Various	Rhys Lewis	David Dack
		Signature			
[1]	14 Dec 2018	Filename	TBP-DE-GN-RPT-001 Basis of Design.docx		
		Description	Interim update for Detailed Design stage - refer to Section 1.5 for list of document updates. Final version to follow.		
			Prepared by	Checked by	Approved by
		Name	Various	Rhys Lewis	Mike Cook
		Signature			
[2]	23 Jan 2019	Filename	TBP-DE-GN-RPT-001 Basis of Design.docx		
		Description	Incorporation of CCC comments, completion of outstanding items and inclusion of Rock Pool parameters.		
			Prepared by	Checked by	Approved by
		Name	Various	Rhys Lewis	David Dack
		Signature			
[3]	22 Feb 2019	Filename	TBP-DE-GN-RPT-001 Basis of Design.docx		
		Description	Updated to address RHDHV Peer Review comments.		
			Prepared by	Checked by	Approved by
		Name	Various	Rhys Lewis	David Dack
		Signature			
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Document Verification

Page 2 of 2

Job title		Terrigal Boardwalk		Job number	
				261648-00	
Document title		Basis of Design		File reference	
Document ref		TPB-DE-GN-RPT-001			
Revision	Date	Filename	TBP-DE-GN-RPT-001 [4] Basis of Design_.docx		
Rev 4	2 Apr 2019	Description	Update to design criteria: imposed live loads, deflection criteria for timber decking and pile corrosion rates. Wave loading also added.		
			Prepared by	Checked by	Approved by
		Name	Oliver Davey	Rhys Lewis	David Dack
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
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1 Introduction

1.1 Background

As a result of improved infrastructure and increased developer interest, Terrigal (located on the central coast of New South Wales) has recently become a substantially more urban and consolidated regional tourist attraction.

The existing rock headland and steep roadway currently prevents easy and safe access between Terrigal Beach promenade and The Haven precinct, as shown in Figure 1. An existing road-side path connects these destinations, although it is steep and results in a disconnected journey which prevents the public to have a direct marine foreshore experience.

The proposed Terrigal Beach promenade to The Haven boardwalk (hereafter referred to as 'the boardwalk') is intended to improve the amenity and accessibility for tourists visiting the region. The boardwalk upon completion will become a tourist attraction and a destination-enhancing experience which compliments the natural marine environmental assets.



Figure 1: Existing site condition

Source: Arup / SIX Maps

In addition to the Boardwalk, the project includes the replacement of the dilapidated Rock Pool walls at the western end of the Boardwalk to encourage use of the area and provide a safe environment for bathing.

Central Coast Council

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1.2 Design Process

Arup has been commissioned by Central Coast Council (CCC) to develop a design for the new boardwalk, connecting the beach promenade to The Haven precinct along the rock headland, as well as for reinstating the Rock Pool retaining wall. The design will draw upon site survey and geotechnical investigations, complemented with an environmental assessment. The design will follow a concept design phase, followed by a detailed design and tender documentation phase. The design workflow is illustrated below.

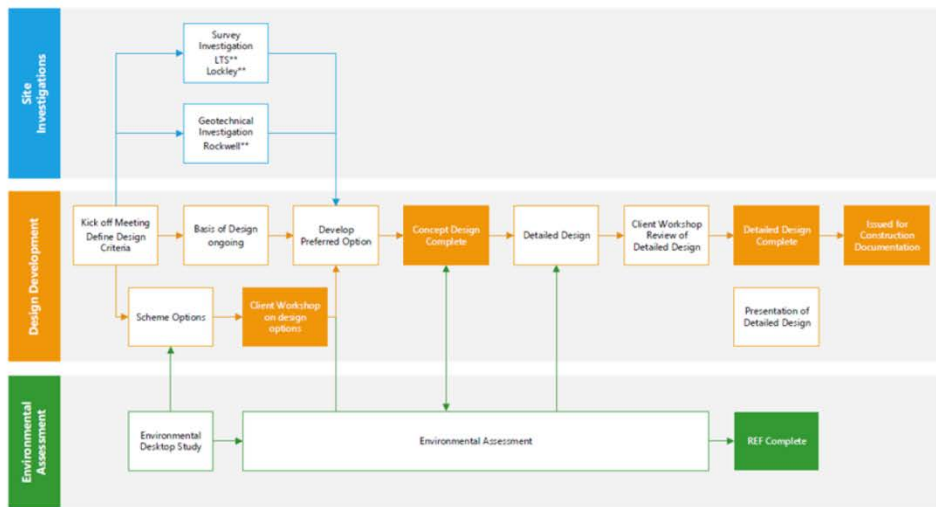


Figure 2: Design Process workflow

1.3 Scope of Document

The purpose of this Basis of Design document is to:

- Document and review all available information to inform the Boardwalk and Rock Pool design;
- Provide a framework of design through establishing constraints, functional requirements and design considerations;
- Set out design assumptions that have been made; and
- Describe the techniques and methods that will be used to analyse and design the boardwalk.

1.4 Document Structure

The Basis of Design documented is structured as follows:

- Section 2** details the functional, architectural and spatial requirements as prescribed by CCC, along with key constraints and assumptions made.
- Section 3** provides relevant site-specific information.
- Section 4** details the relevant design parameters.

1.5 Document Status

This issue has been updated following the concept design stage and to include the specific Rock Pool design criteria prior to proceeding with detailed design. Site investigation and various study findings have been incorporated in this issue. Structural parameter and design loads have also been updated.

1.6 Hold Points

The following aspects are on hold and subject to CCC instruction:

- Functional Requirement: Provide suitable areas along the boardwalk that could be used for displaying public art. Details TBC by CCC.

2 Key Design Requirements

2.1 General

This section presents the key functional, architectural and spatial requirements that will be used to inform and shape the design of the Boardwalk during the options and concept design phases.

2.2 Functional Requirements

The functional requirements prescribed and agreed upon by CCC for the boardwalk and Rock Pool are outlined below. These functional requirements are intended to support CCC's objective of improving amenity and accessibility for locals and tourists visiting the region by creating a boardwalk that enhances the visitor experience through complementing the natural marine assets.

2.2.1 Boardwalk

- Provide public access (i.e. continuous path) between the existing pedestrian links along Terrigal Beach and the Haven precinct, including an at-grade walkway from The Haven precinct.
- Provide similar functionality to the existing beach footpath, in terms of width and loading requirements.
- Be accessible to all users through compliance with the requirements of relevant statutory and standards requirements; this includes adopting the principles of Universal and Inclusive design so that all spaces are accessible and inclusive for everyone.
- Minimise or mitigate against potential adverse environmental impacts.
- Provide a minimum 20-year service life that accommodates for the expected increase in patronage. The proposed design life of the various boardwalk components and expected time to first maintenance is discussed further in Section 4.2.
- Provide for the safety and security of users.
- Minimise maintenance requirements over the design life of the structure, particularly considering the exposed coastal conditions/environment.
- Be able to be practically and safely constructed and maintained.
- Integrate LED lighting into the walkway.
- Provide for a separate standing/viewing platform(s) along the boardwalk with seating. One viewing platform at the rock headland shall be provided following design development and consultation with CCC.

- Provide suitable areas along the boardwalk that could be used for displaying public art (HOLD).

2.2.2 Rock Pool

- Ensure that the structure is capable of withstanding wave and other environmental loading.
- Provide similar functionality and geometry as per the existing Rock Pool for continued use.
- Provide a minimum 50-year service life of the asset.
- Ensure the structure can be safely and practically be constructed, maintained and de-commissioned as required.

The Rock pool design will be based on the Royal HaskoningDHV (RHDHV) reference design and draft Performance Specification (Ref. 12 in Section 3.3). The design will develop the parameters set out in the Performance Specification and the loading requirements built on the verified loading and environmental conditions set out within this basis of design.

These requirements, along with other specific design parameters have been expanded further in Section 4.

2.3 Architectural Principles

The principle objective of the architectural design is to provide a high-quality experience for Terrigal's coastal walk pedestrians that allows for a continuous connection between Terrigal Beach and The Haven.

The design shall be composed of simple and durable materials that will ensure the longevity of the boardwalk and ease of maintenance. The form of the walkway deck and balustrades will sit alongside the rock headland in a sympathetic manner to ensure minimal visual impact to the coastal site.

Architectural design principles, include:

- Statement design that meets the assigned CCC budget.
- Simple and appropriate materials within the coastal context.
- Durable and maintainable.

2.4 Key Spatial Requirements

The alignment/configuration of the boardwalk will be based on the following requirements and constraints:

- The offset distance of the boardwalk from the cliff-line will be based on Arup's geohazard study. The annual risk of loss of life from rockfall/landslide to users of the boardwalk follows the Australian Geomechanics Society

Landslide Risk Management (2007) societal risk acceptance levels. The outcome of this study, including spatial requirements, is summarised in Section 3.14.

- The boardwalk must be high enough to provide an acceptable level of protection from overtopping and damage due to tidal variations, wind/waves and flooding in extreme events. The deck will need to be high enough to mitigate the adverse outcomes whilst balancing the experience of users to be “on the water”. The freeboard height of the boardwalk will be informed by the coastal conditions presented in Sections 3.7 and 3.8, as well as the predicted maximum wave crest elevation presented in 3.10.
- The boardwalk must minimise its northern encroachment onto the beached area between the rock headland and The Haven.
- The end points of the boardwalk must tie-in and transition with the existing pedestrian links along Terrigal Beach and the footpath along The Haven to provide a continuous link. A 3m wide path will be adopted based on similar boardwalk designs and locations; this would be wide enough to accommodate two passing wheelchairs (1.8m). A 3m wide walkway at Level of Service C (LoS C in accordance with the John Fruin Level of Service threshold for pedestrians) would enable 35 people per minute and a peak flow of 85 people per minute, taking edge effects of 300 mm each side.
- Access to the existing Rock pool and stairs is to be maintained from the existing promenade.
- Rock Pool walls to follow the existing line of the Rock pool once the current structure is de-commissioned. The Rock Pool geometry will be based on the Royal HaskoningDHV reference design and draft Performance Specification (Ref. 12 in Section 3.3).

3 Site Information

3.1 General

This section describes the site, and its various aspects which may have an influence on the design of the Boardwalk and Rock Pool.

3.2 Project Location

The proposed boardwalk presented in Figure 3 (shown as the red dotted line) is located along the Terrigal Esplanade, at the southern end of Terrigal Beach.



Figure 3: Site location

Source: Central Coast Council Terrigal Master Plan Concept (2017)

Central Coast Council

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3.3 Requested / Available Information

Table 1 lists the information that has been made available and reviewed by Arup.

Table 1: Information provided to Arup

	Item	Document / Drawing ref.	Source (Date Received)
	CCC Information		
1	Geotechnical Reports	Geotechnical Assessment of Cliff Face - Terrigal Foreshore Masterplan (dated 01/07/1994) Terrigal Beach Headland – Geotechnical Assessment (dated 10/12/1997) Survey Report (dated 07/07/2017)	CCC (03/05/18)
2	Detail Contour Survey Drawings, prepared by Stephen Thorne and Associates	7650_DET SHEET 1 (dated 07/07/2017) 7650_DET SHEET 2 (dated 07/07/2017) 7650_DET.DWG (dated 07/07/2017) 7650_DET-TIN.DWG (dated 07/07/2017)	CCC (07/05/18)
3	Land Ownership and Cadastre	Terrigal Boardwalk	CCC (08/05/18)
4	Central Coast Visitor Data	Destination NSW-Central-Coast-Snapshot-YE-Mar-17	CCC (08/05/18)
5	Haven Sea Wall Construction Certification Statement	Engineer's sign off report (dated 06/04/2010)	CCC (18/05/18)
6	Terrigal Foreshore Pavement Investigations	Report from Mahaffey Associates re: Terrigal Foreshore Pavement Crack Report (dated 08/03/2005) Report on Joint Rectification At Terrigal Foreshore Promenade (dated 05/01/2011) Terrigal Concrete Pavement Investigation (dated July 2005) Terrigal Foreshore Improvement – Final Design Report May 1998 Technical Specifications – Terrigal Foreshore Improvements – Concrete Promenade July 2003	CCC (29/05/18)
7	Aboriginal Heritage Assessment	Aboriginal Heritage Impact Assessment Terrigal Haven (dated 13/03/2009)	CCC (31/05/18)
8	Seawall Construction Drawings	23998_02 Model (1) to 23998_19 Model (1)	CCC (31/05/18)
9	Boardwalk Concept Plan (2017)	Attachment 3 – Concept Plan, Peter Andrews and Associates, September 2017	CCC (12/06/18)
10	Western Pedestrian Walkway Construction Drawings	Footpath Ash St to Terrigal Haven (dated 18/02/2010) Terrigal Seawall drawings (dated 23/03/1999)	CCC (04/09/18)

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	Item	Document / Drawing ref.	Source (Date Received)
11	Terrigal Rock Pool Wall Replacement Performance Specification & Reference Design.	181211 Rock Pool Performance Specification Spec[C] & Ref Design.pdf by Royal HaskoningDHV 12/6/18	CCC (11/12/18)
Arup Investigations and Reports			
12	Options Presentation	TBP-GE-GN-RPT-001	Arup (06/06/18)
13	Concept Design Presentation and Drawings	TBP-GE-GN-RPT-002	Arup (14/09/18)
14	Geotechnical Investigation and Interpretive Report (GIR)	TBP-GE-GN-RPT-002 Rev A	Arup (06/11/18)
15	Review of Environmental Factors	TBP-EN-GN-RPT-003 Rev 1	Arup (30/10/18)
16	Topographic Survey	50338 001DT 25-05-18	Lockley (29/05/18)
17	Point Cloud and Revit Model	180601_Terrigal-Boardwalk	Lockley (01/06/18)
18	Drone Photos and Revit Model	LOD2 and Terrigal drone_photos	Lockley (07/06/18)
19	Bathymetric Survey	20181123 WRL Terrigal Survey	WRL (23/11/18)
20	Material Palette Options and Evaluation	TBP-EN-GN-MEM-002 Rev 0	Arup (30/10/18)
Other information			
	Coastal Assessment	Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study (dated 24/04/2014)	Available online
	Coastal Assessment	Central Coast Council Medium Sea Level Rise Policy http://www.gosford.nsw.gov.au/environment-and-waste/environmental-management-and-planning/sea-level-rise	Accessed online
	Coastal Assessment	Australian Hydrographic Service, 2018 Tide Tables	Physical Copy

3.4 Datum Levels

All levels used throughout this document and in the design drawings are relative to the datum level of Australian Height Datum (AHD).

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Chart Datum (CD) where referred to is approximately 0.93m below AHD.

3.5 Topography and Existing Levels

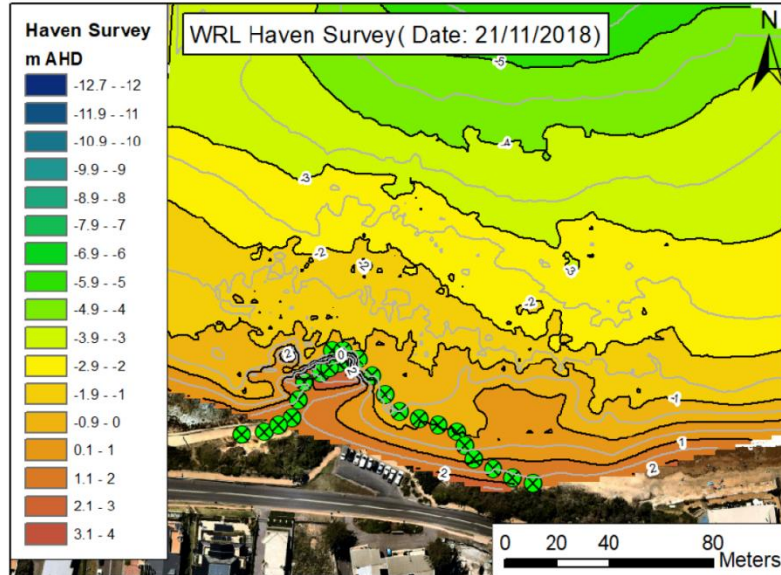
Topographic and existing levels have been obtained from the Lockley topographical survey undertaken on 16 May 2018.

The following key levels are noted:

- East footpath near Reef Restaurant +4.06 to +4.90 mAHD
- Beach level at bottom of block revetment +1.39 to 2.01 mAHD
- Beach level at bottom of cliff +0.12 to 1.82 mAHD
- Rockshelf (at sign) +3.31 mAHD
- West footpath (end of promenade wall) +1.33 mAHD
- West footpath (rock pool steps) +1.75 mAHD
- Top of Rock Pool Walls +0.53 to +0.89 mAHD
- Base of Rock Pool Walls -1.17 to +0.17 mAHD

3.6 Bathymetry

Bathymetric survey levels were provided by the UNSW Water Research Laboratory (WRL) on 23 November 2018.



3.7 Water Levels

3.7.1 Sea Level Rise Allowance

Gosford City Council adopts a medium local sea rise projection for determining future hazards when planning for future development in Gosford. This sea level rise projection is based on RCP8.5 and is projected to be 0.20m in 2050 and 0.74m in 2100 (*Gosford Beaches CZMP 2017*¹). Interpolating these values, the sea level rise allowance adopted for the project at Terrigal Beach for 2069 (50-year design life) is 0.41m.

It should be noted that the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*² adopts a sea level rise allowance in Gosford of 0.4m in 2050 and 0.9m in 2100. If this study predictions are adopted the project sea level rise at Terrigal Beach in 2069 (50-year design life from construction year) would be 0.59m, which is 0.18m higher than the Council's policy.

To inform the design, a sea level rise allowance of 0.41m shall be adopted based on Council's policy. However, the design shall also be tested as a sensitivity case with a sea level rise value of 0.59m and the residual risk of this scenario considered.

3.7.2 Astronomical Tide Levels

The following present-day astronomical tide levels (Table 2) are taken from the Australian National Tide Tables (2018) for Fort Denison³. The tide levels at this location are assumed to be representative of open coast water levels and are therefore adopted for the site at Terrigal Beach. It should be noted that the adopted tide levels at Fort Denison are marginally (0.1m) greater than the tide levels at Little Patonga, which is closest to the site at Terrigal Beach, and therefore the tide levels have been adopted conservatively. Predicted tide levels for the year 2069 incorporating projected sea level rise of 0.41m are also provided.

¹ Gosford City Council (2017), *Gosford Beaches Coastal Zone Management Plan*, a report prepared by WorleyParsons for Gosford City Council

² Gosford City Council (2014), *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*, a report prepared by WorleyParsons for Gosford City Council

³ Australian Hydrographic Service, 2018 Tide Tables

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Table 2: Present day and future tide levels at Fort Denison, Sydney (2018 and 2069 projections)

Tide Level	Present Day (2018)		Year 2069	
	(CD) ¹	(AHD)	(CD)	(AHD)
Highest Astronomical Tide (HAT)	2.1	1.2	2.5	1.6
Mean High Water Springs (MHWS)	1.6	0.7	2.0	1.1
Mean High Water Neaps (MHWN)	1.4	0.5	1.8	0.9
Mean Water Level (MWL)	1.01	0.1	1.4	0.5
Mean Low Water Neaps (MLWN)	0.6	-0.3	1.0	0.1
Mean Low Water Springs (MLWS)	0.4	-0.5	0.8	-0.1
Lowest Astronomical Tide (LAT)	0	-0.9	0.4	-0.5

1. CD = Chart Datum which approximates to LAT and is about 0.93m below AHD.

3.7.3 Extreme Water Levels

The Fort Denison extreme water levels are assumed to be representative of conditions between Patonga and Forrester's Beach, and were therefore adopted for these beaches in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*. The extreme water levels at Fort Denison are noted as 1.41m AHD, 1.46m AHD, and 1.49m AHD for 20, 50 and 100-year ARI respectively. A 500-year ARI case has been extrapolated from these. The present day and 2069 (50-year design life) extreme water levels are presented in Table 3 and incorporate sea level rise at Terrigal.

Table 3: Extreme water levels adopted for Terrigal Beach (2018 and 2069 projections)

Average Recurrence Interval (ARI) (years)	Present Day (2018) Extreme Still Water Level		2069 Extreme Still Water Level	
	m CD ¹	m AHD	m CD	m AHD
20	2.34	1.41	2.75	1.82
50	2.39	1.46	2.80	1.87
100	2.42	1.49	2.83	1.90
500 (extrapolated)	2.50	1.57	2.91	1.98

1. CD = Chart Datum which approximates to LAT and is approximately 0.93m below AHD.

3.8 Currents

Terrigal Beach experiences currents induced by rising and falling tides as well as waves. While tidal currents are directed either seaward or shoreward, oblique wave attack can cause longshore currents. Longshore currents have the potential to become rip currents with differential wave setup. The wave setup generated from large breaking waves can propagate towards areas of lower setup, which is generated from smaller breaking waves. This differential setup creates an alongshore current which then returns seaward at locations where setup is

smallest. These currents may also intensify when exposed to wind stress and can occur at any location along the beach.

Typically, higher storm erosion demand is evident at rip locations, however as discussed in Section 3.11, Terrigal Beach is not expected to undergo significant onshore/offshore sediment transport as a result of swell waves or currents.

3.9 Wave Climate

The site at Terrigal Beach receives waves generated in the southern Coral and Tasman Seas, and the Southern Ocean. The coastal processes experienced at this site are largely influenced by the offshore wave climate from the east.

The offshore and nearshore directional wave extremes for Terrigal Beach are adopted from the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*. These wave extremes have been estimated for the Sydney region based on the analysis of directional Sydney Waverider Buoy data. The dominant wave direction for Terrigal Beach is from the east.

The nearshore significant wave heights were adapted from the offshore values using a wave coefficient of 0.35. This value was determined through a refraction analysis undertaken by Lawson and Treloar (1984)⁴. Further wave transformation modelling using the SWAN program was undertaken in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*, which yielded a peak wave coefficient of 0.70. However, given the fact that the beach becomes more protected from wave energy further south along the beach, particularly from the rocky headland at the southern end of the beach, a coefficient of 0.35 is assumed to be more reflective of the wave climate to the south of the beach where the project site is situated.

Table 4: Offshore and nearshore wave parameters adopted for Terrigal Beach

Average Recurrence Interval (ARI) (years)	Offshore Hs ¹ [m]	Nearshore Hs ¹ [m] (0.35 coefficient)	Tp ² [s]
1	4.8	1.7	9.6
50	6.6	2.3	11.2
100	7.0	2.5	11.6
500	No information available, assumed depth limited at boardwalk location based on Section 3.10.		

1. H_s = significant wave height, defined as the average of the highest 1/3 of waves generated during the storm duration
2. T_p = peak wave period, defined as the wave period with the highest frequency in the wave spectrum.

The design wave conditions presented in Table 4 can be considered applicable for present and future design scenarios given the lack of definitive scientific

⁴ Lawson and Treloar (1984), *Wave Design Criteria – Wamberal and Avoca Beaches*. Report prepared for NSW Public Works Department.

consensus and guidance on how the extreme wave climate along the NSW coast is likely to be affected by climate change.

3.9.1 Wave Setup

Wave setup is defined as the superelevation of mean water level due to the effects of transferring wave related momentum to the surf zone. This phenomenon occurs shoreward of the point at which the wave breaks. At the breaking point, there is a local reduction in water level, termed wave set-down. The maximum wave setup at the shoreline has been calculated as 0.62m using the equations presented in the *Coastal Engineering Manual Part II-4*, and is based on the nearshore significant wave height, H_s . This compares favourably with the estimate in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*.

3.9.2 Overtopping

3.9.2.1 Wave Overtopping

During large storm events, there is the potential for white water overtopping of the boardwalk at the Haven revetment and at the path behind the Rock Pool. The volume of water that makes its way onto the boardwalk may pose a risk to users. Wave overtopping may occur in a coherent mass (green water) where waves run up the face of the structure, or non-continuously (white water) where waves break seaward of or on the structure. Green water overtopping is not expected at the structure.

The potential for wave overtopping and the possible risks to users have been assessed at locations 1 and 4 as presented in Figure 4. At these locations, the structures in front of the boardwalk are assumed to act as armoured rubble slopes.

The overtopping volumes presented in Table 5 have been calculated based on the design overtopping equation for armoured rubble slopes and mounds as presented in the *Manual on wave overtopping of sea defences and related structures, EurOtop 2016*. It is assumed that these overtopping rates may increase with the presence of spray overtopping (Section 3.9.2.2) and standing wave patterns (Section 3.9.4). The risks to users have been determined in accordance with the critical overtopping discharges presented in *The Rock Manual, C683, CIRIA 2007* (Table 6), which are more conservative than the critical overtopping discharges presented in *EurOtop, 2016*.

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Table 5: Overtopping volumes at locations 1 and 2 along the Terrigal boardwalk

Location	Overtopping volume (m ³ /s/m)				
	20-year ARI water level + SLR	50-year ARI water level + SLR	100-year ARI water level + SLR	500-year ARI water level + SLR	500-year ARI water level + SLR + wave setup
1. Western Walkway	2.82×10^{-4}	5.97×10^{-4}	8.95×10^{-4}	2.30×10^{-3}	1.33×10^{-2}
4. Haven Seawall on East side	8.61×10^{-5}	2.00×10^{-4}	3.16×10^{-4}	9.17×10^{-4}	5.76×10^{-3}
Notes: <ol style="list-style-type: none"> The crest / top of deck level is assumed to lie at 4.0m AHD at location 1 and 4.3m AHD at location 4. The seabed level is taken to be 1.0m AHD at both locations as per the bathymetry survey provided by WRL. Wave setup has not been included in the tested water levels. The breaking wave height is adopted at each location for the respective water depth (not including wave setup). 					

Table 6: Critical overtopping discharges and volumes (CIRIA, C683, 2007)

	q mean overtopping discharge (m ³ /s per m length)	V_{max} peak overtopping volume (m ³ /per m length)
Pedestrians		
Unsafe for unaware pedestrians, no clear view of the sea, relatively easily upset or frightened, narrow walkway or proximity to edge	$q > q > 3 \cdot 10^{-5}$	$V_{max} > 2 \cdot 10^{-3} - 5 \cdot 10^{-3}$
Unsafe for aware pedestrians, clear view of the sea, not easily upset or frightened, able to tolerate getting wet, wider walkway	$q > 1 \cdot 10^{-4}$	$V_{max} > 0.02 - 0.05$
Unsafe for trained staff, well shod and protected, expected to get wet, overtopping flows at lower levels only, no falling jet, low danger of fall from walkway	$q > 1 \cdot 10^{-3} - 0.01$	$V_{max} > 0.5$

For the calculated rates of overtopping, the following potential risks are revealed based on the limits set in Table 6:

- Overtopping at the western walkway in location 1 poses a risk to alert pedestrians for all extreme water levels in 2069, with the quantity of overtopping during the 20-year ARI water level only marginally above the critical value;
- Trained staff and professionals using the boardwalk are also at risk at location 1 during the 500-year ARI tide levels;
- Overtopping at the Haven in location 4 poses a risk to alert pedestrians for 2069 extreme water levels above the 50-year ARI water level. Increased wave heights as a result of standing waves may also pose a risk to alert pedestrians during the 20-year ARI water level;

- Trained staff and professionals using the boardwalk are also at risk at location 4 during the 500-year ARI tide levels where continuous wave propagation has resulted in increased wave setup;
- No damage to embankments and seawalls is expected at these locations under the tested design conditions.

Because wave overtopping quantities are only marginally above the critical value for overtopping to be a risk to pedestrians at location 1 for the 20-year ARI water level in 2069, an engineered solution to mitigate wave overtopping is not expected to be required. It is recommended that the boardwalk is closed during storm events with the use of a mobile temporary barrier.

3.9.2.2 Spray Overtopping

When waves impact the rock or cliff-face, there is the potential for waves to send a vertical plume of water into the air and onto the boardwalk, particularly at the rock platform. This spray of water may be carried onto the boardwalk decking by its own momentum or driven by an onshore wind. Standing waves generated by the superposition of incoming waves and waves reflected off the rocks may also result in additional spray when wind acts directly on the wave crests (see Section 3.9.4).

Spray is not expected to contribute significantly to overtopping volumes without the presence of a strong onshore wind. However, it should be noted that the spray caused by incoming waves may impact users during strong winds and storm events. It is therefore assumed that the boardwalk will remain closed in such events.

3.9.3 Wave Runup

Wave runup is considered in the design of the boardwalk at the cliff-face south of the beach between the rock platform and the Haven. For the vertical faces at the Haven seawall, rock platform and the western walkway, wave runup is not assumed to be applicable, and therefore green water wave overtopping is not expected. It should be noted that although the boardwalk is positioned in front of the cliff-face, wave runup may result in some reflected spray back onto the boardwalk.

The *Gosford Beaches CZMP 2017* adopts a wave runup level of 4.0m AHD for Terrigal. In accordance with the *Manual on wave overtopping of sea defences and related structures, EurOtop 2016*, the 2% wave runup value for steep / vertical slopes was calculated as 2.28m above the design water level at the beach. This approximates to 4.26m AHD for the 500-year ARI water level in 2069 and is the level which is exceeded by 2% of the number of incoming waves. It should be noted that the runup level may increase due to larger wave heights that result from the superposition of waves.

3.9.4 Standing Waves

As incoming waves impact structures, there is the potential for a portion of the waves to be reflected seaward. These waves may then superimpose with the incoming waves to create standing waves (clapotie waves) with increased wave heights. Standing waves are expected to occur seaward of the western walkway, rock platform and Haven revetment.

The interaction of incoming and reflected waves may result in waves breaking seaward of the structure, reducing the momentum of incoming waves. Standing waves have not been considered for wave loading on the piles and decking of the structure. However, the increased wave heights generated by the superposition of waves may impact the underside of the boardwalk and increase the potential for overtopping.

3.10 Maximum Wave Crest Height

An assessment of wave crest heights has been undertaken to inform the design level of the boardwalk such that the impact of lateral and vertical wave loading ("wave slam") on the underside of the boardwalk superstructure is avoided. The underside of the deck would have to lie above the maximum wave crest level with an allowance for air gap to avoid wave slam and potential damage to the deck structure.

The height of the wave crest considers the existing bathymetry, water levels and wave climate. These heights have been determined at four locations along the proposed boardwalk as shown in Figure 4. Based on the proposed structural form, the output of this assessment is pertinent to the suspended deck structure in cross sections 2 and 3 to identify the minimum deck level required.

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Cross Section 1
The walkway adjacent to Terrigal rockpool

Cross Section 2
The rock cut platform



Cross Section 3
Terrigal Beach between the rock cut platform
and the Haven

Cross Section 4
The seawall at the Haven

Figure 4: Wave crest heights at four locations along the proposed Terrigal boardwalk site
The adopted site information and methodology for evaluating the maximum wave crest heights are presented in Table 7.

Table 7: Design parameters for wave crest assessment

Design parameter	Value	Reference
Present day (2019) extreme water level (500-year ARI)	1.57m AHD	<i>Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study, Gosford City Council 2014</i>
Sea level rise in 2069 (50-year design life)	0.41m	Interpolation of Gosford City Council medium local sea level rise projection based on RCP8.5 - projected to be 0.20m in 2050 and 0.74m in 2100
Design water level (2069)	1.98m	Sum of the present day 500-year ARI water level and sea level rise in 2069
Offshore significant wave height (H_s) (100-year ARI)	7.0m	<i>Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study, Gosford City Council 2014</i>

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Design parameter	Value	Reference
Nearshore significant wave height (H_s) (100-year ARI)	2.45m	<i>Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study, Gosford City Council 2014</i> Refraction analysis undertaken by Lawson and Treloar (1984) for Terrigal Beach gives nearshore conversion coefficient of 0.35 for southern Terrigal Beach
Peak wave period (T_p)	11.6s	<i>Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study, Gosford City Council 2014</i>
Maximum nearshore wave height (H_{max}) $H_{max} = 1.86 H_s$	4.56m	<i>Coastal Engineering Manual pg. II-1-74, Eqn II-1-132</i>
Breaking wave height (H_b) $H_b = 0.85 d$ d is the water depth at the respective location	Varies with water depth	<i>CEM pg. II-1-37, Boussinesq Eqn – based on solitary waves</i>
Wave setup at shoreline (nearshore significant wave)	0.62m	<i>Coastal Engineering Manual pg. II-4-12 to II-4-14</i>

The height of the crest wave is determined using equation 5.1 from the *Recommendations of the Committee for Waterfront Structures Harbours and Waterways, EAU 2012 (pg. 139)*. The wavelength, L , for use in the formula, was determined using linear wave theory (*CEM pg. II-1-66 Figure II-1-9*). The wave crest heights at each location are presented in Table 8 with the highest wave crest occurring at the beach. Wave setup has been included in the wave crest height at all locations, where the beach is assumed to exhibit a planar profile. At location 2, where the rock platform is located, the breaking point of the nearshore significant wave lies approximately at the location of the boardwalk and therefore wave setup is not assumed to be applicable.

Table 8: Wave crest heights at four locations along the Terrigal boardwalk

Location	Design water level (500-year ARI)	Seabed level for breaking wave **	Wave height Min.(H _b , H _{max})	Ratio of wave height above water level	Wave setup	Wave crest height (h _c) [m AHD]
1. Western Walkway	+1.98 m AHD	+1.00 m AHD	0.83 m	0.76 - 0.78	0.62m	+3.24 m AHD *
2. Rock Platform		-1.00 m AHD	2.53 m		N/A	+3.91 m AHD *
3. Terrigal Beach		-0.50 m AHD	2.10 m		0.62 m	+4.21 m AHD *
4. Haven Seawall on East side		+1.00 m AHD	0.83 m		0.62 m	+3.24 m AHD *
Notes:						
*For 500-year ARI water levels, probability of occurrence is 4% for a 20-year design life and 10% for a 50-year design life in accordance with BS 6349.						
**Determined from bathymetric survey by WRL (November 2018) and taken approximately 1m seaward of boardwalk footprint.						

3.11 Sediment Transport

3.11.1 General

Net sediment transport in the region where waves break and at the shoreline of Terrigal Beach primarily results from two processes. These processes are termed longshore sediment transport and onshore/offshore (cross-shore) sediment transport.

Windblown sand (aeolian transport) as well as stormwater systems and lagoon entrances may also contribute to the movement of sediment on the beach. The impact of sediment transport at the entrance to Terrigal Lagoon is not assumed to be significant to the net sediment transport at the project site.

The volume of sand transported offshore or landward during a storm (storm erosion demand attributable to the 1974, 1978 and 1986 storm events) is estimated in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard*

Definition Study as 60m³/m at the southern end of Terrigal Beach, and is consistent with the findings in the PWD 1985⁵ and PWD 1994⁶ studies.

3.11.2 Longshore Sediment Transport

The *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study* revealed that the previous study conducted by the Public Works Department (PWD) for Wamberal and Avoca Beach could not identify any sources of sediment to Terrigal Beach, with offshore reef systems diverting any supply of alongshore drift further offshore.

3.11.3 Onshore/Offshore Sediment Transport

The onshore movement of sand under low swell conditions would also be prevented by these reef systems. It should be noted however, that local rips may occur at any location along the beach.

3.11.4 Aeolian Sediment Transport

Terrigal Beach is not expected to experience any significant aeolian sediment transport due to the proximity of development and vegetation to the beach.

3.11.5 Sediment Transport at Stormwater Systems

At the south end of Terrigal Beach, a box culvert with seven openings and surrounding rock protection provides local scour but has minimal impact on coastal processes.

3.11.6 Longer Term Sand Movement

Following the PWD 1994 study for long term sand movement utilising photogrammetric techniques, a design recession rate of 0.1m/year was adopted for the entire length of Terrigal Beach. However, due to the presence of a seawall and the ongoing commitment to protecting the business district at Terrigal Beach, design recession rates were not determined for Terrigal Beach in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study*.

Mechanisms for long-term sand losses from Terrigal Beach have been identified by the PWD 1985 study for Wamberal and Avoca Beach and noted in the *Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study* as:

- Net northerly alongshore sediment transport over the offshore reef systems.
- Aeolian sand transport under the action of onshore winds.

⁵ Public Works Department [PWD] (1985), *Wamberal Beach and Avoca Beach Coastal Engineering Advice*. Report No. PWD 85040 prepared by A F Nielsen for Gosford City Council, May, 1985

⁶ Public Works Department [PWD] (1994), *Gosford Coastal Process Investigation*, Coast and Flood, September 1994

- Infilling of lagoon systems.
- Offshore sand transport to the reef system (where it cannot return to the active beach system) due to rip currents in severe storms.

3.12 Wind Climate

Refer to Section 4.6.4 for wind loading parameters.

3.13 Temperature

Records on temperature are available from the Bureau of Meteorology (BoM). The recording station closest to the site is Observatory Hill (Station ID 066062). This has recorded temperature data for the period 1859 to 2013 (154 years).

Extreme temperatures over the recorded period show the highest daily recorded temperature at the station was 45.8°C (18/01/2013) and the lowest daily recorded temperature was 2.1°C (22/06/1932).

The temperature values to be adopted for the design as per AS 5100-2 are described in Section 4.6.8.

3.14 Geohazards

This section is based on the findings of the risk assessment presented in Arup's Geotechnical Interpretive Report (TBP-GE-GN-RPT-002 Rev A).

Five credible hazards with the potential to impact persons on the boardwalk were identified during the site geologic mapping with respect to each of nine geologic domains shown in Figure 5.



Figure 5: Layout of geologic domains

Representative hazard sites were estimated from the geologic mapping. This hazard assessment resulted in minimum offsets required for the boardwalk to reduce the risk of rock and debris fall as summarised in Table 9 below.

Table 9: Minimum boardwalk offsets required for each geologic domain

Domain	Risk	Minimum offset from cliff face measured at deck level
1 & 2	Residual risk of minor debris	2m
3 & 4	Residual risk of minor rock fall	3m
5	Risk of rock fall	6m
6,7 & 8	Risk of rock and debris fall	Due to geometric constraints, unable to accommodate adequate offset from the toe of the slope. Slope remediation in the form of descaling and installation of rock netting is required
9	Risk of debris fall is low	No offset required

The Concept Design boardwalk alignment based on the minimum offset distances summarised in Table 9 was assessed to be 10^{-5} or less for the person most at risk and 10^{-7} for societal risk which are considered acceptable levels of risk based on AGS (2007) and ANCOLD (2003) respectively. Further, on average the risk to property has been assessed to be moderate. Based on AGS guidelines, moderate risk levels can be tolerated.

3.15 Ground Conditions

This section presents the stratigraphy and design parameters set out in Arup's Geotechnical Interpretive Report (TBP-GE-GN-RPT-002). Borehole locations are shown in Figure 5.

3.15.1 Stratigraphy

The stratigraphy at the site is summarised in Table 10. The table is to be updated for the next issue to include RL levels and profiles at the western end.

Table 10: General stratigraphy encountered

Borehole		BH1	BH2	BH3	BH4
Ground Level	(mAHD)	+0.70	+0.95	+2.20	+1.10
Sand	Depth (mbgl)	0.00 – 0.65	0.00 – 1.00	0.00 – 0.90	0.00 – 0.65
	Thickness (m)	0.65	1.00	0.90	0.65
Clay	Depth (mbgl)	-	1.00 – 1.14	0.90 – 1.10	0.65 – 0.71
	Thickness (m)	-	0.14	0.2	0.06
Class V	Depth (mbgl)	Shale: 2.63 – 3.75	-	-	-
	Thickness (m)	Shale: 1.12	-	-	-

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Class IV	Depth (mbgl)	Shale: 5.23 – 7.60, Sandstone: 1.45 – 2.63, 3.75 – 5.23	Sandstone: 1.30 – 7.35	Shale: 1.10 – 3.20, 7.82 – 8.29, Sandstone: 3.2 – 6.25, 6.85 – 7.82	Shale: 1.05 – 1.45, Sandstone: 1.45 – 5.00
	Thickness (m)	Shale: 2.37, Sandstone: 1.18, 1.48	Sandstone: 6.05	Shale: 2.10, 0.47, Sandstone: 3.05, 0.97	Shale: 0.4, Sandstone: 3.55
Class III	Depth (mbgl)	Shale: 0.85 – 1.45	-	-	Sandstone: 5.00 – 7.25
	Thickness (m)	Shale: 0.60	-	-	Sandstone: 2.55
Class II	Depth (mbgl)	Sandstone: 7.60 – 8.55	-	-	Sandstone: 7.25 – 8.80
	Thickness (m)	Sandstone: 0.95	-	-	Sandstone: 1.55

3.15.2 Design Parameters

The following tables summarise the strength and deformation parameters for soil and rock units encountered along the proposed boardwalk.

Table 11 - Summary of soil design parameters

Material type	Consistency	Bulk unit weight (kN/m^3)	Peak friction angle ($^\circ$)	Undrained shear strength (kPa)	Elastic modulus (MPa)	Poisson's Ratio	Ultimate capacity of shallow pad (kPa) ¹	Ultimate end bearing capacity (kPa) ²	Ultimate shaft capacity (kPa)
Marine Sands	Very loose to loose	17	28	-	5 - 10	0.3	-	-	10
	Medium dense	19	33	-	40	0.3	200	200 x z (max 1MPa)	25

Table 11 notes:

1. Assumed depth of shallow footing minimum of 0.5m below a horizontal ground surface and vertically applied load. These values do not account for groundwater table.
2. Minimum of 4 pile diameters in the founding material required to achieve provided bearing capacities, z is the depth below ground.

Table 12 - Earth pressure coefficients

Material type	Drained analysis		
	Active earth pressure coefficient (K_a)	Passive earth pressure coefficient (K_p)	At-rest earth pressure coefficient (K_0)
Marine sands – Very loose to loose	0.36	2.8	0.53
Marine sands – Medium dense	0.29	3.4	0.46

Table 12 notes:

1. Assume horizontal surface in-front and behind a vertical wall.
2. No wall/soil friction has been assumed in earth pressure calculations.
3. In order to mobilise the full passive pressure, displacement is required and therefore must be considered in the design.
4. For retaining walls, a nominal 10kPa locked-in surcharge shall be applied to account for compaction.

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Table 13 - Rock design parameters

Unit	Rock Class	Bulk unit weight (kN/m^3)	Poisson's Ratio	Rock Mass Modulus (MPa)	Ultimate end bearing ¹ (MPa)	Ultimate shaft adhesion ^{1,4} (kPa)	Allowable end bearing ^{2,3} (MPa)
Siltstone	I	24	0.2	2000	100	1000	6
	II	24	0.2	1000	60	800	2
	III	24	0.25	600	20	500	1.5
	IV	24	0.25	300	5	150	1
	V	24	0.3	75	3	75	0.7
Sandstone	I	23	0.2	2000	120	3000	8
	II	23	0.2	1200	80	2500	6
	III	23	0.25	800	30	1200	4
	IV	23	0.25	400	10	500	3
	V	23	0.3	75	3	150	1

Table 13 notes:

1. Ultimate capacities are mobilized at large displacements—generally 5% to 10% of pile diameter (or minimum footing dimension)—and require reduction by ϕ_g for ULS design accordance with AS2159 – 2009 (Australian Standard, 2009). A lower bound value $\phi_g = 0.40$ is advised for preliminary design, though it may be possible to justify higher values with pile testing during construction.
2. Serviceability capacities are mobilised at displacements of 1% pile diameter (or minimum footing dimension).
3. Where the design is dependent upon end-bearing resistance, piles must extend at least one pile diameter into the founding stratum to develop full design end-bearing and found at least three pile diameters above underlying weaker strata. A minimum of 0.5m embedment in the founding material to achieve shaft resistance.
4. Assumes a rock socket roughness category R2 (grooves of depth 1 mm to 4 mm, width greater than 2 mm, at spacing 50 mm to 200 mm) or better (Walker and Pells (Walker, 1998))
5. In the event of uplift, only ULS shaft friction can be relied upon and these values must be reduced by a factor of 0.75 in addition to the geotechnical reduction factor, and mechanisms of piston and cone failure must be considered (Pells et al (Pells)). Cone failure often controls for large tension forces in short rock sockets, particularly near ground surface.

4 Design Parameters and Methods

4.1 General

The design parameters detailed in the sections below are based on Australian and other relevant standards, along with CCC's requirements for the boardwalk.

4.2 Design Life

The design life of the boardwalk and associated elements is presented below. It is assumed that periodic maintenance and inspections will be carried out by CCC. Maintenance requirements described below are not exhaustive and will be expanded further in the Operations and Maintenance (O&M) manual (to be prepared by the appointed Works contractor).

Table 14: Design life and periodic maintenance requirements

Item	Design Life (years)	Period to First Maintenance (years)	Anticipated Routine Maintenance
Structural elements, including foundations and boardwalk sub-structures.	50	50	None.
Non-structural elements including timber decking (other than those listed below)	20	1	Regular cleaning and resealing timber elements at least once a year. Minor repairs to any damaged connections and decking boards.
Pavements and joints (where applicable)	25	15	Repair any damage caused by accidental impact; replacement of jointing compounds every 15 years.
Protective coating systems (piles and any miscellaneous items)	15	15	Re-coating of protective treatment system every 15 years (above waterline).
Sandstone block revetment	50	50	Ongoing maintenance effort to keep catch ditch clear will be required.
Slope remediation works (cliff scaling and vegetation growth as recommended in Section 8.7 in Arup GIR)	50	-	Cliff face hazards to be monitored on annual basis and following storm events – refer to Arup GIR (refer Table 1) Section 8.7 and 8.8 for further discussion.
Services conduits	50	50	None.
Rock pool structural elements	50	50	None.

4.3 Design Codes and Guidelines

A list of applicable design codes and guidelines is provided in Table 15.

Table 15: Applicable design codes and guidelines

Reference	Title
AS/NZS 1170.0	Structural design actions—General principles
AS/NZS 1170.1	Structural design actions—Permanent, imposed and other actions
AS/NZS 1170.2	Structural design actions—Wind actions
AS/NZS 1170.4	Structural design actions—Earthquake action
AS/NZS 2312.1	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings, Part 1: Paint coatings
AS/NZS 2312.2	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS/NZS 4673	Cold-formed stainless steel structures
AS/NZS 4671	Steel reinforcing materials
AS 1428	Design for access and mobility
AS 1657	Fixed platforms, walkways, stairways and ladders – Design, construction and installation.
AS 1720	Timber structures
AS 2159	Piling - Design and installation
AS 5100	Bridge design
AS 3600	Concrete structures
AS 3678	Hot-rolled structural steel plates, floorplates and slabs
AS 1478	Chemical admixtures for concrete, mortar and grout (all parts)
AS 4100	Steel structures
AS 4678	Earth-retaining structures
AS 4997	Guidelines for the design of maritime structures
AS 5604	Timber - Natural durability ratings
AGS 2007	Practice Note Guidelines for Landslide Risk Management 2007
BS 6349	British Standard Code of Practice for Maritime Structures
BS 6744	British Standards – Stainless Steel bars for the reinforcement and use in concrete – Requirements and test methods
API RP 2A-LRFD	Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms (for driven steel tubular pile design)
DSAPT (2002)	Disability Standards for Accessible Public Transport 2002
NSW RMS	Engineering standards and guidelines for maritime structures
Safe Work Australia	Model Code of Practice: Safe Design of Structures
Engineers Australia	Coastal Engineering Guidelines, May 2012
CIRIA (2007)	The Rock Manual, The Use of Rock in Hydraulic Engineering (2 nd Edition), C683, CIRIA, 2007
EurOtop (2016)	EurOtop, Manual on wave overtopping of sea defences and related structures (2 nd Edition)
CEM	Coastal Engineering Manual, 2006
SPM (1984)	Shore Protection Manual, 1984

4.4 Structural Form

The detailed design of the boardwalk will be based on the following structural form and configuration:

Chainage 0 – 55m:

- The existing blockwork wall will be extended at the eastern end of the boardwalk to provide a suitable transition into the suspended deck section. The block work wall will integrate a catch ditch for falling debris and reinstatement of a storm water culvert. The boardwalk path will comprise timber decking.

Chainage 55– 175m:

- The middle section of the boardwalk will be a suspended deck structure. Timber decking will be connected to timber bearers, supported on a reinforced concrete precast deck spanning between headstocks. Each headstock will be supported by a single pile at nominal 7.5m centres. Open mesh flooring will be used for the viewing platform beyond the seaward edge of the rock headland.

Chainage 175 – 215m

- An earth filled embankment and retaining structure will be used to transition the West end of the boardwalk with the existing promenade and levels. The boardwalk path will comprise timber decking.

Rock Pool Walls

- The Rock Pool walls will comprise reinforced concrete precast walls and grouted into rock with stainless steel rods, as per Royal Haskoning DHV's reference design (Ref 12 in Section 3.3).

Material specifications have been expanded further in Section 4.13.

4.5 Deck Level

The following deck levels will be adopted for the various boardwalk structures.

Table 16: Deck levels

Location	Maximum Wave Crest Height (500-year ARI)	Proposed Deck Level	Commentary
Western Walkway	+2.62 mAHD	Varies +2.94 to +4.5 mAHD	Level to tie-in with exiting promenade at most western point. Boardwalk will be susceptible to overtopping - refer to Section 3.9.2.
Rock Platform	+3.91 mAHD	+4.5mAHD	Deck in this area is assumed to be protected from wave loading, but may be susceptible to spray overtopping.
Rock Platform (Viewing platform if used)	+3.91 mAHD	+4.5mAHD	Open mesh flooring provided over this area as overhanging deck susceptible to spray overtopping (Section 3.9.2.2) and standing waves (Section 3.9.4) as a result of waves impacting the face of rock headland.
Terrigal Beach	+4.21 mAHD	+4.7mAHD	Landward edge of boardwalk offset 6m from cliff face as required in Section 3.14 from geohazard study. This will reduce the impact of spray overtopping as a result of waves breaking on the cliff-face. Deck in this area is assumed to be protected from wave loading.
Haven Seawall on East side	+3.24 mAHD	+4.5mAHD	Level to tie in with existing revetment. Boardwalk will be susceptible to overtopping - refer to Section 3.9.2.

Source: a. Section 3.10

4.6 Loading

4.6.1 Load Combinations

The design shall consider all combinations of loads with appropriate load factors according to AS 4997 and AS/NZS 1170.0. Load factors for earth retaining structures will in accordance with AS 4678.

In defining combinations, it shall be ensured that all realistic load cases are included. In particular, the design shall ensure that any load combinations applicable to intermediate stages of construction are addressed.

4.6.2 Design Return Periods for Environmental Loads

The design criteria return periods are specified below:

Serviceability Limit State (SLS)

- 1:50 year return period event for metocean (Wind, wave, current, water levels and seismic)

Ultimate Limit State (ULS)

- 1:500* year return period event for metocean (Wind, wave, current, water levels and seismic)

*Source: AS4997 Table 5.4

4.6.3 Imposed Live Loads

Imposed live loads are presented in Table 17.

Table 17 Imposed Live Loads

Vertical imposed loads on floors:			
Public access floor design live load	UDL	5kPa	Pedestrian and public boardwalk.
	Point Load	4.5 kN	Pedestrian crowd load.
Imposed loads on balustrade:			
Areas without obstacles for moving people and not susceptible for overcrowding	UDL horizontal	0.75 kN /m	Infill section assumed to be governed by wind loading.
	UDL vertical	0.75 kN /m	
	UDL Inwards	0.60 kN /m	
	Point Load	0.6kN	Positioned inwards, outwards or downwards and not to be applied in combination with UDL loads.
Other live loads			
Calculated in accordance with AS1170-1			

Source: AS/NZS 1170.1 and AS4997 (Table 5.1)

4.6.4 Wind Loads

This section sets out requirements for considering wind loads on fixed structures, which shall be determined in accordance with AS1170.2.

Design wind load parameters are provided in Table 18.

Table 18: Design Wind Load Parameters

Wind Parameters	Serviceability Event (SLS)	Extreme Event (ULS)
Wind Region	A2	
Terrain Category	2	
Importance Level	3	
Recurrence Interval Design, R	25 years	1000 years
Factor for Region C, F_c	1.00	1.00
Regional Wind Speed, V_R	37	46
Wind Direction Multiplier, M_d	1.00	1.00
Shielding Multiplier, M_s	1.00	1.00
Topographic Multiplier, M_t	1.00	1.00
Terrain/Height Multiplier, $M_{z,cat}$	Table 4.1(A) -Part 2	Table 4.1(B) -Part 2
Design wind speed, 3s gust	$V_{des} = V_R M_d (M_{z,cat} M_s M_t)$	

4.6.5 Wave and Current Loads on Piles

Morrison's equation will be used to calculate the resulting loads on piles / foundations.

H_b and T_p will be used as the design wave parameters for structures as waves are depth-limited at the structure. The relationship of $H_b = 0.85d$ will be used in the design based on the wave data presented in Section 3.9. Wave parameters between the boardwalk and the shoreline for the determination of nearshore wave loads will consider wave transformation and wave breaking onset.

Pile diameters shall be increased to allow for 50mm of marine growth where submerged below Mean Sea Level (resulting in 100mm increase in diameter), in calculating of wave forces. Drag and inertia factors used in the calculation of wave forces on piles are to be as shown below in accordance with the guidance presented in *Shore Protection Manual (SPM)*, 1984 and AS 4997 respectively.

Since the depth limited design wave is likely to occur at the structure during its life, a safety factor of 2 will be applied to the calculated wave loads to account for uncertainty in C_M and C_D , in accordance with guidance on page VI-5-307 of CEM.

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Member	Drag Coefficient C_D	Inertia Coefficient C_M
Piles	1.75*	1.5
Deck Structure (if required)	2.20	1.5

Note: * C_D multiplied by 2.5 in accordance with SPM (1984) P7-157 to account for shallow breaking waves.

The wave loads have been calculated based on the above parameters. A summary of the wave loads applied to the 600mm diameter piles is provided below for the linear wave force as well as the point load applied for the breaking wave.

Loading	ULS	SLS
Maximum Load on Force Profile (kN/m)	29.8	14.7
Minimum Load on Force Profile (kN/m)	4.4	1.9
Breaking Wave Load * (kN/m)	78.6	38.6

*Source: DNV-RP-C205 8.6.3.2

4.6.6 Wave Loads on Solid Structures

Wave and water loading on solid faced structures, including Rock Pool wall and the extended sandstone wall, will be determined using Modified Goda and Minikin equations in accordance with accepted guidelines such as Shore Protection Manual (SPM) and Coastal Engineering Manual (CEM).

4.6.7 Seismic Loads

Seismic design of structures shall be carried out in accordance with Table 19 and AS/NZS 1170.4 (2007) Structural Design Actions, Part 4: Earthquake actions in Australia.

Table 19: Seismic design requirements

Parameter	Criteria
Importance Level	3
Annual Probability of Exceedance	$P = 1:1000$
Soil Site Class	Ce
Probability Factor, k_p	1.3
Hazard Factor, Z	0.08
Earthquake Design Category	II for $h_n < 50m$

In accordance with AS/NZS 1170.0, a value of $\psi_E = 0.6$ shall be adopted for earthquake load combinations.

4.6.8 Thermal Loads

All structures shall be designed to resist the forces and effects caused by thermal expansion and contraction based on the temperature ranges below.

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Table 20: Extreme shade air temperatures (AS 5100-2: 2017 - Table 18.2(A) – Coastal Region II)

Maximum Temperature	44 °C
Minimum Temperature	-1 °C

Table 21: Thermal Bridge temperatures (AS 5100-2: 2017 - Table 18.2(B))

Maximum Temperature	54 °C
Minimum Temperature	2 °C

4.7 Deflection Limits

The structural deflection limits are listed in Table 22. Here, h_s indicate the structure height above design seabed level and L indicates span length. Design seabed level is defined as the natural seabed indicated by the bathymetric plan. The deflection limits are applicable in SLS conditions.

Deflection limits shall be determined including allowances for seabed scour.

Table 22: Deflection limits

Element		Action	Limit
Superstructure and headstock	Members over two or more supports	Full design load	1/240 L (vertical)
	Members over two or more supports	Live load only	1/360 L (vertical)
	Cantilevers	Full design load	1/120 L (vertical)
	Cantilevers	Live load only	1/180 L (vertical)
Pile / column	Member supporting superstructure	Full design load	1/200 h_s (horizontal)
Timber Decking	Continuous member over multiple supports	Dead & Factored Live Load	1/300L (vertical)

4.8 Sandstone Block Revetment

The sandstone block revetment to be designed to the west of the Haven, forms an extension of the existing revetment. This extension is to be designed with the following parameters:

Table 23: Sandstone block revetment design parameters

Design Parameter	Value	Commentary
Wave height (depth limited based on 500-year ARI water level)	0.83m	The adopted wave height is taken as the breaking wave height, H_b , at the toe of the structure for a design water level of 1.98m.

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Design Parameter	Value	Commentary
Block sizing	The existing revetment block size and arrangement will be adopted.	Stability of revetment and individual blocks (sliding, overturning) to be checked for the overall structure in accordance with AS 4678. Required block sizing for hydraulic stability to be determined in accordance with Van der Meer shallow water equations, <i>The Rock Manual, The Use of Rock in Hydraulic Engineering (2nd Edition)</i> , C683, CIRIA, 2007
Acceptable % damage during 100-year ARI storm event	0-5%	Based on damage level parameter, $S_d = 2$ <i>The Rock Manual, The Use of Rock in Hydraulic Engineering (2nd Edition)</i> , C683, CIRIA, 2007

4.9 Revetment Stormwater Design

Three stormwater culvert outlets were constructed in 2010 during the installation of the eastern end sandstone revetment. These outlets convey flow from a stormwater pipe which passes through riprap rock protection and a series of reno mattresses (refer to gbaCOASTAL report referenced as item 5 in Table 1). It is noted that the as-built position and number of outlets, as well as the type of rock and openings in the mattresses differ from the design specifications. It is understood that the existing culverts have performed well since construction, and minimal scour has been observed at the beach. The design intention is to reinstate the existing storm water culvert and scour protection on a like-for-like basis as per the existing gbaCOASTAL design (including the high flow and low flow outlets).

Behind the new revetment extension, a catch ditch is to be installed between the footpath and the cliff. The purpose of this ditch is to collect cliff face debris and minor flows from the cliff face and footpath. The stormwater will discharge onto the beach either through the reinstated culvert or a new outlet similar in design to the existing to mitigate beach scour.

4.10 Scour

During storm events, discharge from the stormwater culvert at the Haven seawall may induce scour of the beach. This stormwater outlet is to be reinstated for the redesign of the revetment. It is understood that no significant scour has occurred since the sandstone block revetment was installed in 2010. A combination of reno mattresses and riprap distribute the discharge flows between two sets of box culverts. This arrangement and distribution of flow is to be maintained for the redesign of the revetment, in accordance with the previous design conducted by gbaCOASTAL.

For the boardwalk piles, a scour allowance of 1.6 times the pile diameter shall be applied in the Ultimate Limit State design only, based on local site and ground conditions.

4.11 Access Criteria

The boardwalk shall comply with the applicable disability access legislation, regulations and guidance documents as listed below:

- The Disability Discrimination Act (1992)
- AS 1428.1
- AS 1428.2
- Disability Standards for Accessible Public Transport 2002

Key access limitations to be adopted for the boardwalk are detailed in Table 24 for reference. This is not exhaustive and all other limits in the relevant standards are to be complied with.

Table 24: Summary of boardwalk access requirements

[illegible]

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Criteria	Value	Source
Deck	<ul style="list-style-type: none"> Walking surfaces, including steps, treads and rungs shall be slip resistant. The smallest dimension of any opening shall not exceed 45mm. Any gap between adjacent panels shall not exceed the requirement for openings in gratings. Where the parts of the boardwalk are accessible for people to work or walk underneath, the floor must be designed to prevent objects falling through the floor. 15mm diameter ball bearing may not pass through. A toe board in accordance with AS 1657 Cl.6.1.2 is also required. Notwithstanding the above, a 2mm nominal gap between decking boards will be adopted. 	AS 1657 and AS3661.2
Other	<ul style="list-style-type: none"> Tactile warning strips shall be in accordance with AS1428 with warning strips provided at change in gradients, change in direction of walkway, or hazards. Warning strips will not be provided at change in direction if boardwalk gradient is less than 1:34. 	AS 1428

4.12 Lighting

The boardwalk shall provide an electrical supply for integration of the LED lighting into the structure. An average illumination level of 50 lux (TBC) shall be adopted.

Design consideration will be given to protecting the lighting from vandalism.

4.13 Materials and Durability

4.13.1 Material Use

Materials chosen are to be sufficiently durable for the coastal environment. Key requirements for materials is that they are:

- Durable.
- Maintenance requirements are reasonable.
- Graffiti proof.
- Tamper proof.

4.13.2 Concrete

All concrete structures to comply with the requirements of AS 3600. Concrete is to be precast where possible to achieve the best surface finish to prevent moisture ingress.

The concrete shall conform to the specification as listed below, in Table 25 and in Table 26 unless noted otherwise. A 50MPa concrete shall be used in tidal and

splash seawater zones while a 40MPa concrete may be used for structural elements that are installed within 1km of the coast.

- Maximum aggregate size is 20mm
- Cement type shall be GP blended
- The finest ratio which is defined as the proportion by weight of aggregate passing the 1.18mm sieve size to the total aggregate in the mix, must not exceed 0.4
- Maximum drying shrinkage strain measured in accordance with AS1012.13 shall not exceed 600×10^{-6} at eight weeks for all critical elements
- In-situ concrete density of 2500kg/m³
- Pre-cast concrete density of 2500kg/m³

Table 25: Concrete mix data

Strength grade	Min. Cement Content	Max. w/c ratio
S40	330	0.4
S50	400	0.4

Table 26: Concrete cover Specifications

Type	Concrete Grade	Exposure classification	Minimum Reinforcement Cover
Precast (exposed face)	50 MPa	C2	70mm
Precast (un-exposed face)	50 MPa	B2	35mm
In-situ (exposed face)	50 MPa	C2	70mm
In-situ (un-exposed face)	50 MPa	B2	35mm
In-situ (exposed face)	40 MPa	C2	80mm
In-situ (un-exposed face)	40 MPa	B2	45mm

4.13.3 Reinforcement

Reinforcement steel will be as shown in Table 27 in accordance to AS/NZS4671. All reinforcement steel must be ACRS certified.

Table 27: Reinforcing design data

Strength grade	Steel Grade
Deformed bars	500N
Round bars	250N

4.13.4 Structural Steel

Steel works shall be designed in accordance with AS 4100-1998, AS/NZS 4673:2001 and AS/NZS 2312.2:2014. All structural steelwork, unless noted otherwise, is to be:

- Hot rolled plates, flats – Grade 250MPa minimum yield strength;

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- Angles, UB, UC, PFC, WB, WC – Grade 300MPa minimum yield strength;
- SHS, RHS, CHS – Grade 350MPa minimum yield strength;
- Purlins and Girts – Grade 450MPa minimum yield strength.

All mild steel is to be coated with high performance protective treatment systems with proven performance in their specific application.

Stainless steel is to be minimum grade 316 or equivalent in terms of corrosion resistance.

4.13.5 Steelwork Fixings

Bolts will be designed in accordance with AS4100. All bolts will be stainless steel and shall be duplex Grade 2215 or low carbon Grade 316 (316L) stainless steel. All stainless steel bolts to be passivated after manufacture.

Minimum bolt sizes will be 20mm diameter for all principal structural elements.

4.13.6 Corrosion Protection Philosophy

Corrosion allowance for the structural elements are outlined in Table 28 below.

No corrosion allowance is required for the internal surfaces of open-ended tubular steel piles provided the piles have airtight closures at the top.

Table 28: Corrosion Allowance

Element	Protection	Corrosion Allowance (mm)
Fixings	Fixings, connections and attachments (including bolts, studs, screws and nails) to be Stainless steel Grade 316L or Duplex 2215	1.0mm nom.
Structural Steelwork	External Paint Coating System: 600 micron epoxy Internal Paint Coating System: none required for closed sections assuming airtight closures	1.0mm nom.
Balustrades	Stainless steel grade 316L	1.0mm nom.
Steel tubular piles	Paint Coating System: 1000 micron epoxy to 1m below seabed	Above ground level to top of pile = 5.6 mm *

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Element	Protection	Corrosion Allowance (mm)
	Below water level protected with sacrificial steel. Tube / CHS sections utilised to minimise exposed surfaces.	Below ground level (- 0.5 m AHD) to pile toe = 1.5mm **

Notes:

* Corrosion of piles above ground level (-0.5 m AHD) based on 15 years of protection from paint system and 35 years of corrosion thereafter. Splash and low water zone corrosion rate (0.16 mm / yr) adopted from AS5100.3.

** Corrosion of piles below ground level (-0.5 m AHD) based on 50 years of corrosion. Corrosion loss based on AS5100.3 for pile in contact with ground.

4.13.7 Timber Decking and Bearers

Timber elements shall be designed in accordance with AS1720.

Arup technical memorandum TM-02 (Material Palette Options and Evaluation) recommends the following options for CCC consideration:

- Blackbutt,
- Spotted Gum or
- Accoya.

Blackbutt will be adopted in consultation with CCC.

4.13.8 Perforated Mesh Floor

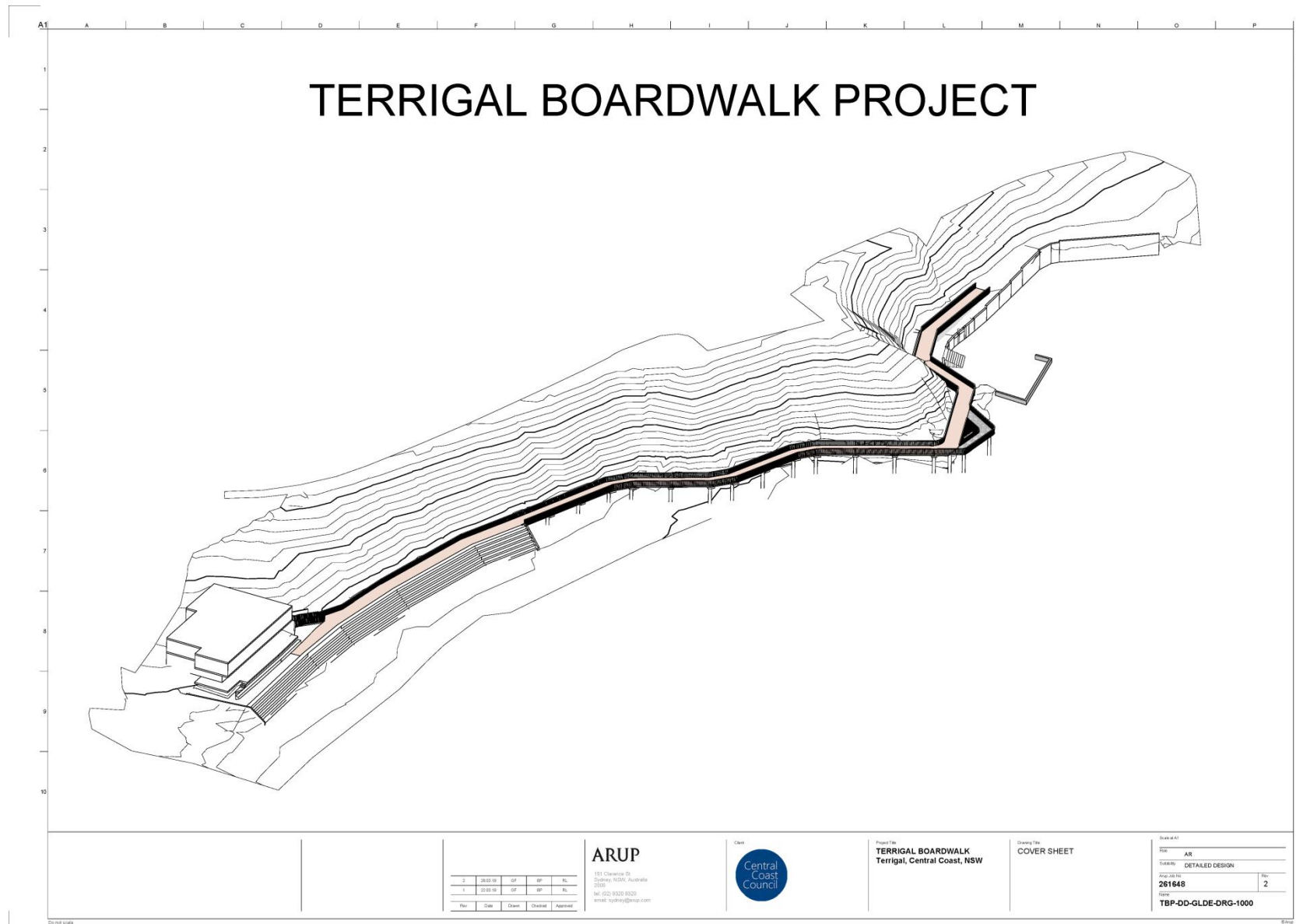
Fibre Reinforced Polymer (FRP) will be used for the perforated mesh flooring at the drop down viewing platform. Arup technical memorandum TM-02 (Material Palette Options and Evaluation) recommends two products for CCC consideration:

- FRP Grat Ex Mini Mesh
- FRP MoultrEX.

Typical spans for these products are between 600mm to 900mm. Colour TBC by Arup.

4.13.9 Aluminium

Any aluminium elements will be marine Grade 6061-T6, 6082-T5/T6 and plates Grade: 5083-H32.



DRAWING NUMBER	DRAWING TITLE
GENERAL	
TBP-DD-GLDE-DRG-1001	GENERAL COVERSHEET
TBP-DD-GLDE-DRG-1002	GENERAL DRAWING INDEX
TBP-DD-GLDE-DRG-1005	GENERAL GENERAL NOTES SHEET 1
TBP-DD-GLDE-DRG-1006	GENERAL GENERAL NOTES SHEET 2
TBP-DD-GLDE-DRG-1007	GENERAL GENERAL NOTES SHEET 3
TBP-DD-GLDE-DRG-1010	GENERAL LOCATION PLAN
TBP-DD-GLDE-DRG-1011	GENERAL SITE PLAN
MARITIME - HAVEN SEA REVETMENT	
TBP-DD-MADE-DRG-2005	MARITIME HAVEN SEA REVETMENT DEMOLITION PLAN
TBP-DD-MADE-DRG-2010	MARITIME HAVEN SEA REVETMENT GENERAL ARRANGEMENT SHEET 1
TBP-DD-MADE-DRG-2011	MARITIME HAVEN SEA REVETMENT GENERAL ARRANGEMENT SHEET 2
TBP-DD-MADE-DRG-2020	MARITIME HAVEN SEA REVETMENT TYPICAL CROSS SECTION SHEET 1
TBP-DD-MADE-DRG-2021	MARITIME HAVEN SEA REVETMENT TYPICAL CROSS SECTION SHEET 2
TBP-DD-MADE-DRG-2022	MARITIME HAVEN SEA REVETMENT TYPICAL CROSS SECTION SHEET 3
TBP-DD-MADE-DRG-2030	MARITIME HAVEN SEA REVETMENT MISCELLANEOUS DETAILS
MARITIME - SUSPENDED DECK	
TBP-DD-MADE-DRG-3010	MARITIME SUSPENDED DECK GENERAL ARRANGEMENT SHEET 1
TBP-DD-MADE-DRG-3011	MARITIME SUSPENDED DECK GENERAL ARRANGEMENT SHEET 2
TBP-DD-MADE-DRG-3012	MARITIME SUSPENDED DECK GENERAL ARRANGEMENT SHEET 3
TBP-DD-MADE-DRG-3020	MARITIME SUSPENDED DECK TYPICAL CROSS SECTION
TBP-DD-MADE-DRG-3030	MARITIME SUSPENDED DECK PILE LAYOUT AND DETAILS SHEET 1
TBP-DD-MADE-DRG-3031	MARITIME SUSPENDED DECK PILE LAYOUT AND DETAILS SHEET 2
TBP-DD-MADE-DRG-3040	MARITIME SUSPENDED DECK ABUTMENT A CONCRETE SHEET 1
TBP-DD-MADE-DRG-3041	MARITIME SUSPENDED DECK ABUTMENT A CONCRETE SHEET 2
TBP-DD-MADE-DRG-3050	MARITIME SUSPENDED DECK ABUTMENT B CONCRETE SHEET 1
TBP-DD-MADE-DRG-3060	MARITIME SUSPENDED DECK PRECAST HEADSTOCK DETAILS
TBP-DD-MADE-DRG-3070	MARITIME SUSPENDED DECK BEARING DETAILS
TBP-DD-MADE-DRG-3080	MARITIME SUSPENDED DECK PRECAST PLANK DETAILS
TBP-DD-MADE-DRG-3090	MARITIME SUSPENDED DECK INSITU DECK CONCRETE
TBP-DD-MADE-DRG-3100	MARITIME SUSPENDED DECK VIEWING PLATFORM LAYOUT
TBP-DD-MADE-DRG-3110	MARITIME SUSPENDED DECK VIEWING PLATFORM DETAILS
TBP-DD-MADE-DRG-4001	MARITIME SUSPENDED DECK ABUTMENT A REINFORCEMENT SHEET 1
TBP-DD-MADE-DRG-4002	MARITIME SUSPENDED DECK ABUTMENT A REINFORCEMENT SHEET 2
TBP-DD-MADE-DRG-4003	MARITIME SUSPENDED DECK ABUTMENT B REINFORCEMENT SHEET 1
TBP-DD-MADE-DRG-4004	MARITIME SUSPENDED DECK PRECAST HEADSTOCK REINFORCEMENT
MARITIME - WESTERN SEA WALL	
TBP-DD-MADE-DRG-4005	MARITIME WESTERN SEA WALL DEMOLITION PLAN
TBP-DD-MADE-DRG-4010	MARITIME WESTERN SEA WALL GENERAL ARRANGEMENT
TBP-DD-MADE-DRG-4020	MARITIME WESTERN SEA WALL TYPICAL CROSS SECTION
TBP-DD-MADE-DRG-4040	MARITIME WESTERN SEA WALL MISCELLANEOUS DETAILS
MARITIME - ROCK POOL WALL	
TBP-DD-MADE-DRG-5005	MARITIME ROCK POOL WALL DEMOLITION PLAN
TBP-DD-MADE-DRG-5010	MARITIME ROCK POOL WALL GENERAL ARRANGEMENT
TBP-DD-MADE-DRG-5020	MARITIME ROCK POOL WALL TYPICAL CROSS SECTION
ARCHITECTURAL - GENERAL ARRANGEMENTS	
TBP-DD-GLDE-DRG-6101	GENERAL ARRANGEMENT - FLOOR PLAN - SHEET 1
TBP-DD-GLDE-DRG-6102	GENERAL ARRANGEMENT - FLOOR PLAN - SHEET 2
TBP-DD-GLDE-DRG-6130	GENERAL ARRANGEMENT - TYPICAL SECTIONS - SHEET 1
TBP-DD-GLDE-DRG-6131	GENERAL ARRANGEMENT - TYPICAL SECTIONS - SHEET 2

DRAWING NUMBER CONTINUED	DRAWING TITLE CONTINUED
TBP-DD-GLDE-DRG-6132	GENERAL ARRANGEMENT - TYPICAL SECTIONS - SHEET 3
ARCHITECTURAL - DETAILS	
TBP-DD-GLDE-DRG-6201	DETAILED ARRANGEMENT - TYPICAL RAISED DECK BAY
TBP-DD-GLDE-DRG-6202	DETAILED ARRANGEMENT - LOOKOUT AREA DETAILS
TBP-DD-GLDE-DRG-6204	DETAILED ARRANGEMENT - TYPICAL BALUSTRADE DETAILS - SHEET 1
TBP-DD-GLDE-DRG-6205	DETAILED ARRANGEMENT - TYPICAL BALUSTRADE DETAILS - SHEET 2
TBP-DD-GLDE-DRG-6206	DETAILED ARRANGEMENT - TYPICAL TIMBER DECK DETAILS
TBP-DD-GLDE-DRG-6207	DETAILED ARRANGEMENT - ABUTMENT DETAILS
TBP-DD-GLDE-DRG-6208	DETAILED ARRANGEMENT - TIMBER SEAT DETAILS

A1	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	GENERAL:				STRUCTURAL CONCRETE CONTINUED:				PRECAST CONCRETE CONTINUED:				STRUCTURAL STEEL ELEMENTS CONTINUED:			
2	G1. READ THESE ABRIDGED NOTES IN CONJUNCTION WITH CONSTRUCTION SPECIFICATION, AND WITH SUCH OTHER WRITTEN INSTRUCTIONS ISSUED.				C3. QUALITY OF CONCRETE ELEMENTS TO BE AS FOLLOWS IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION:				PC1. THE PRECAST CONTRACTOR SHALL:				SS6. ALL MILD STEEL ELEMENTS TO BE COATED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION AND AS 2312 FOR 20-YEAR COATING LIFE AND THE SPECIFICATION.			
3	G2. ALL LEVELS ARE IN METRES MEASURED ABOVE AUSTRALIA HEIGHT DATUM (MAHD) UNLESS OTHERWISE NOTED.				C4. MIX CONCRETE TO ENSURE UNIFORM DISTRIBUTION OF CONSTITUENTS.				PC2. FOR STANDARD REQUIREMENTS FOR CONCRETE AND REINFORCING, REFER TO ABOVE CONCRETE NOTES.				SS7. ALL MILD STEEL ELEMENTS IN CONTACT WITH UNPROTECTED STEEL, TO BE ELECTRICALLY SEPARATED. THE MATERIAL FOR THIS SEPARATION IS TO BE NON-CONDUCTING, NON-COMPRESSIBLE, NON-WATER ABSORBING AND COMPATIBLE.			
4	G3. DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.				C5. FINISHED CONCRETE TO BE DURABLE, DENSE, HOMOGENOUS MASS COMPLETELY FILLING FORMWORK, EMBEDDING REINFORCEMENT AND TENDONS, AND FREE OF STONE POCKETS, OF UNIFORM COLOUR AND TEXTURE, WITH LOW PERMEABILITY AND ADEQUATE BUT NOT EXCESSIVE STRENGTH FOR GRADE.				PC3. ALL PANELS TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 50 MPa AT THE TIME OF LIFTING, UNLESS NOTED OTHERWISE.				SS8. ALL MILD STEEL ELEMENTS TO BE PAINTED TO NOTED COLOUR: RAL 9005 IN ACCORDANCE WITH THE SPECIFICATION.			
5	G4. CARRY OUT WORK IN A SAFE MANNER IN ACCORDANCE WITH APPLICABLE STATUTORY REGULATIONS, BY-LAWS OR RULES. CONTRACTOR IS RESPONSIBLE FOR OCCUPATIONAL HEALTH AND SAFETY OF SITE PERSONNEL AND GENERAL PUBLIC IN ACCORDANCE WITH LEGISLATIVE REQUIREMENTS, INDUSTRIAL AGREEMENTS AND ACCEPTED INDUSTRY PRACTICE.				C6. RESPONSIBILITY FOR DESIGN, CERTIFICATION, CONSTRUCTION AND PERFORMANCE OF FORMWORK LIES WITH CONTRACTOR.				PC4. ANY PRECAST FACES IN CONTACT WITH CAST-IN-SITU CONCRETE SHALL BE GROUTED WITH A WATERPROOF NON-SHRINK GROUT AS PER THE MANUFACTURER'S SPECIFICATION.				SS9. ALL STAINLESS STEEL TO BE OF GRADE 316 L.			
6	G5. REFER DISCREPANCIES TO THE SUPERINTENDENT BEFORE PROCEEDING WITH WORK.				C7. DO NOT SUPPORT OR RESTRAIN FORMWORK ON PERMANENT WORKS WITHOUT THE SUPERINTENDENT'S WRITTEN APPROVAL.				PC5. WHERE PANELS ARE SUPPORTED ON SHIMS THE GAP IS TO BE FULLY GROUTED WITH A WATERPROOF NON-SHRINK GROUT AS PER THE MANUFACTURER'S SPECIFICATION.				SS10. ALL WELDING TO BE STRUCTURAL PURPOSE (SP) IN ACCORDANCE WITH AS/NZS 1554 USING ELECTRODE TYPES E48XX or W50X MINIMUM U.N.O.			
7	G6. SUBMIT DETAILS OF CHANGES TO SCOPE, WORK METHODS OR MATERIALS ETC FOR APPROVAL BEFORE PROCEEDING. APPROVAL DOES NOT AUTHORISE A VARIATION TO THE CONTRACT.				C8. CONSTRUCT FORMWORK TO COMPLY WITH AS3600 AND THE SPECIFICATION.				PC6. PRECAST ELEMENTS DESIGNED FOR IN-SERVICE LOADS ACTING WHEN PANEL IS IN ITS FINAL POSITION AND CONNECTED TO THE COMPLETE STRUCTURE.				SS11. WELDS TO BE 6mm CONTINUOUS FILLER WELDS U.N.O. BUTT WELDS ARE TO BE COMPLETE PENETRATION BUTT WELDS AS DEFINED IN AS/NZS 1554 U.N.O.			
8	G7. NOMINATION OF PROPRIETARY ITEMS DOES NOT INDICATE EXCLUSIVE PREFERENCE, BUT INDICATES REQUIRED PROPERTIES OF ITEM. SIMILAR ALTERNATIVES HAVING REQUIRED PROPERTIES MAY BE OFFERED FOR APPROVAL. INSTALL PROPRIETARY ITEMS IN ACCORDANCE WITH MANUFACTURER'S REQUIREMENTS AND RECOMMENDATIONS.				C9. DO NOT USE FORMWORK HARDWARE THAT FORMS A COMPLETE HOLE THROUGH CONCRETE ELEMENTS. DO NOT USE REINFORCEMENT TO SUPPORT FORMWORK.				PC7. DAMAGED PRECAST ELEMENTS INCLUDING BREAKINGS DURING CONSTRUCTION, TRANSPORTATION AND/OR ERECTION SHALL BE REJECTED, UNLESS INFORMED OTHERWISE BY THE SUPERINTENDENT SUBSEQUENT TO INSPECTION.				SS12. ALL PLATES SHALL BE 10mm THICK U.N.O.			
9	G8. OBTAIN NECESSARY PERMITS AND APPROVALS FROM RELEVANT AUTHORITIES BEFORE COMMENCING WORK ON SITE.				C10. PROVIDE HOLES IN REBATE FORMERS ETC, AS REQUIRED TO PREVENT AIR ENTRAPMENT.				PC8. PRECAST ELEMENTS DESIGNED FOR IN-SERVICE LOADS ACTING WHEN PANEL IS IN ITS FINAL POSITION AND CONNECTED TO THE COMPLETE STRUCTURE.				SS13. THE ENDS OF ALL HOLLOW SECTIONS SHALL BE SEALED WITH 10mm END PLATES U.N.O.			
10	G9. NOTIFY RELEVANT SERVICE AUTHORITIES BEFORE COMMENCING WORK ON SITE.				C11. CONSTRUCTION TOLERANCES TO BE IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION.				PC9. DAMAGED PRECAST ELEMENTS INCLUDING BREAKINGS DURING CONSTRUCTION, TRANSPORTATION AND/OR ERECTION SHALL BE REJECTED, UNLESS INFORMED OTHERWISE BY THE SUPERINTENDENT SUBSEQUENT TO INSPECTION.				SS14. ALL BOLTS SHALL BE M20 8.8/S U.N.O. NO STEEL TO STEEL CONNECTION SHALL HAVE LESS THAN 2 X M16 8.8/S BOLTS U.N.O.			
11	G10. VERIFY ON SITE SETTING OUT DIMENSIONS BEFORE SHOP DRAWINGS, CONSTRUCTION AND FABRICATION IS COMMENCED.				C12. PROVIDE EXPOSED EDGES AND RE-ENTRANT CORNERS WITH 45 DEGREES 25mm CHAMFERS OR FILLETS U.N.O.				PC10. THE CONTRACTOR SHALL PROVIDE AS BUILT SURVEY OF INSTALLED PILES. ANY PILES LOCATED OUTSIDE THE NOMINATED TOLERANCE SHALL BE REPORTED TO THE SUPERINTENDENT ALONG WITH THE REMEDIAL WORK PROPOSED FOR APPROVAL. THESE ADDITIONAL DESIGN AND CONSTRUCTION COSTS SHALL BE BORNE BY THE CONTRACTOR.				SS15. M12 AND SMALLER BOLTS SHALL BE COMMERCIAL GRADE (4.6/s) U.N.O. M16 AND LARGER BOLTS SHALL BE HIGH STRENGTH SNUG TIGHTENED (8.8/s) U.N.O.			
12	G11. THE SUPERINTENDENT'S REVIEW OF SHOP DRAWINGS IS OF GENERAL CONFORMANCE WITH DESIGN CONCEPT AND GENERAL COMPLIANCE WITH CONTRACT DOCUMENTS ONLY. CONTRACTOR HAS RESPONSIBILITY FOR COMPLIANCE WITH REQUIREMENTS OF CONTRACT DRAWINGS AND SPECIFICATION.				C13. DO NOT MAKE HOLE, PENETRATIONS, RECESSES, CHASES, NOR EMBED PIPES (OTHER THAN THOSE SHOWN ON STRUCTURAL DRAWINGS) WITHOUT APPROVAL OF THE SUPERINTENDENT. DO NOT PLACE CONDUITS, PIPES ETC ONLY IN MIDDLE THIRD OF SLAB OR BEAM DEPTH, AND SPACED AT 3x DIAMETER CENTRES MINIMUM. DO NOT CUT REINFORCEMENT AT PENETRATIONS WITHOUT APPROVAL.				PC11. PILES SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION.				SS16. GROUT UNDER BASEPLATES TO BE HIGH STRENGTH CEMENTITIOUS NON-SHRINK (MASTERFLOW 870 BY MASTER BUILDER OR EQUAL APPROVED) U.N.O.			
13	G12. MAINTAIN STRUCTURES IN A STABLE CONDITION DURING CONSTRUCTION AND PROVIDE TEMPORARY BRACING AND/OR SUPPORT AS REQUIRED. ENSURE NO PART IS OVERSTRESSED. DO NOT PLACE OR STORE BUILDING MATERIALS ON STRUCTURAL MEMBERS WITHOUT THE SUPERINTENDENT'S APPROVAL. PROVIDE CALCULATIONS TO PROVE ADEQUACY OF STRUCTURE FOR PROPOSED CONSTRUCTION METHODS AND LOADS.				C14. MAXIMUM TEMPERATURE OF THE FOUNDATION CONCRETE POUR MUST NOT EXCEED 70 DEGREES.				PC12. REFER TO ARUP GEOTECHNICAL ENGINEERING REPORT FOR SITE SPECIFIC GEOTECHNICAL INFORMATION.				SS17. EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH LANDCOM "SOILS AND CONSTRUCTION MANUAL VOLUME 1, MARCH 2004".			
14	G13. THESE DRAWINGS DO NOT DETAIL TEMPORARY WORKS. CONSTRUCTION METHODS AND TEMPORARY WORKS ARE THE RESPONSIBILITY OF THE CONTRACTOR.				C15. CONSTRUCTION JOINTS WHERE NOT SHOWN ON DRAWINGS SHALL BE LOCATED TO THE APPROVAL OF THE ENGINEER. CONSTRUCTION JOINTS SHALL BE ROUGHENED PRIOR TO CONCRETE SETTING, OR SCABBLD AS REQUIRED. SAWN CUT JOINTS TO BE CUT AFTER THE CONCRETE HAS SUFFICIENTLY HARDENED THAT IT WILL NOT BE DAMAGED BY THE SAWING BUT BEFORE SHRINKAGE CRACKING CAN OCCUR.				PC13. CONSTRUCTION AND INSTALLATION TOLERANCES PROVIDED IN THE CONSTRUCTION SPECIFICATION.				SS18. EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH LANDCOM "SOILS AND CONSTRUCTION MANUAL VOLUME 1, MARCH 2004".			
15	G14. MAKE GOOD ANY DAMAGE TO EXISTING ELEMENTS AT COMPLETION OF WORKS. REFER TO CONSTRUCTION SPECIFICATION FOR DETAILS OF DILAPIDATION SURVEY.				C16. ALL SCABBLD SURFACES TO ACHIEVE MINIMUM 5MM ROUGHNESS AMPLITUDE.				PC14. THE CONTRACTOR SHALL PROVIDE AS BUILT SURVEY OF INSTALLED PILES. ANY PILES LOCATED OUTSIDE THE NOMINATED TOLERANCE SHALL BE REPORTED TO THE SUPERINTENDENT ALONG WITH THE REMEDIAL WORK PROPOSED FOR APPROVAL. THESE ADDITIONAL DESIGN AND CONSTRUCTION COSTS SHALL BE BORNE BY THE CONTRACTOR.				SS19. EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH LANDCOM "SOILS AND CONSTRUCTION MANUAL VOLUME 1, MARCH 2004".			
16	G15. WHERE NEW WORK ABUTS EXISTING STRUCTURES, PROVIDE SMOOTH TRANSITION FREE OF ABRUPT CHANGES.				C17. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				PC15. DYNAMIC LOAD TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS2559 ON PILE LOCATIONS AS AGREED WITH THE SUPERINTENDENT AND AS NOTED ON THE DRAWINGS.				SS20. EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH LANDCOM "SOILS AND CONSTRUCTION MANUAL VOLUME 1, MARCH 2004".			
17	G16. CONSTRUCTION SURCHARGE OVER EXISTING WESTERN SEA WALL AND WAVE CUT PLATFORM TO BE LIMITED TO 10 KPA. LOADING OF THE SEA WALL AND WAVE CUT PLATFORM SHOULD BE LIMITED/MINIMISED WHEN POSSIBLE.				C18. ALL SCABBLD SURFACES TO ACHIEVE MINIMUM 5MM ROUGHNESS AMPLITUDE.				PC16. ANY PILES WHICH ARE DAMAGED DURING THE EXECUTION OF THE WORKS BY THE CONTRACTOR, OR WHICH DO NOT COMPLY WITH THE SPECIFIED TOLERANCES SHALL BE MADE GOOD OR REPLACED AS THE SUPERINTENDENT MAY DIRECT.				SS21. EROSION AND SEDIMENT CONTROL MEASURES TO BE IN ACCORDANCE WITH LANDCOM "SOILS AND CONSTRUCTION MANUAL VOLUME 1, MARCH 2004".			
18	DESIGN CRITERIA:				PRECAST CONCRETE:				STEEL PILING:				SCOUR PROTECTION (REVEMENT):			
19	D1. REFER TO ARUP BASIS OF DESIGN DOCUMENT.				PC1. THE PRECAST CONTRACTOR SHALL:				P1. PILES SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION.				S1. DURING CONSTRUCTION OF THE SCOUR PROTECTION, GEOTEXTILE SHALL BE FOLDED OVER THE LAST PLACED ROCK SUCH THAT THE COMPACTED FILL AND GEOTEXTILE FILLS THE VOID BEHIND THE ROCK AND MAXIMISES THE CONTACT AREA BETWEEN THE ROCK AND THE GEOTEXTILE.			
20	STRUCTURAL CONCRETE:				PC2. REFER TO ARUP GEOTECHNICAL ENGINEERING REPORT FOR SITE SPECIFIC GEOTECHNICAL INFORMATION.				P2. REFER TO ARUP GEOTECHNICAL ENGINEERING REPORT FOR SITE SPECIFIC GEOTECHNICAL INFORMATION.				S2. SCOUR PROTECTION SHALL BE PROVIDED WHERE SHOWN ON THE DRAWINGS. THE THICKNESS OF THE RIP-RAP SCOUR PROTECTION SHALL BE A MINIMUM OF 2x THE D50 SIZE SHOWN ON THE DRAWINGS.			
21	C1. WORKMANSHIP AND MATERIALS TO COMPLY WITH THE REQUIREMENTS OF AS 3600, EXCEPT WHERE VARIED BY THE CONSTRUCTION SPECIFICATION.				C19. CONSTRUCTION JOINTS WHERE NOT SHOWN ON DRAWINGS SHALL BE LOCATED TO THE APPROVAL OF THE ENGINEER. CONSTRUCTION JOINTS SHALL BE ROUGHENED PRIOR TO CONCRETE SETTING, OR SCABBLD AS REQUIRED. SAWN CUT JOINTS TO BE CUT AFTER THE CONCRETE HAS SUFFICIENTLY HARDENED THAT IT WILL NOT BE DAMAGED BY THE SAWING BUT BEFORE SHRINKAGE CRACKING CAN OCCUR.				P3. CONSTRUCTION AND INSTALLATION TOLERANCES PROVIDED IN THE CONSTRUCTION SPECIFICATION.				S3. THE ROCK SHALL BE REASONABLY WELL GRADED AND IN ACCORDANCE WITH THE FOLLOWING TABLE:			
22	C2. WET CONCRETE TO BE UNIFORM HOMOGENOUS, COHESIVE AND ABLE TO WORK READILY INTO CORNERS AND AROUND REINFORCEMENT, COMPLETELY FILLING FORMWORK WITHOUT SEGREGATION, EXCESS FREE WATER ON SURFACE, LOSS OF MATERIAL OR CONTAMINATION. CONCRETE TO HAVE GOOD DIMENSIONAL STABILITY AND ABLE TO RESET PLASTIC SETTLEMENT CRACKING, THERMAL CRACKING AND SHRINKAGE CRACKING.				C20. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P4. THE CONTRACTOR SHALL PROVIDE AS BUILT SURVEY OF INSTALLED PILES. ANY PILES LOCATED OUTSIDE THE NOMINATED TOLERANCE SHALL BE REPORTED TO THE SUPERINTENDENT ALONG WITH THE REMEDIAL WORK PROPOSED FOR APPROVAL. THESE ADDITIONAL DESIGN AND CONSTRUCTION COSTS SHALL BE BORNE BY THE CONTRACTOR.				S4. FOR GEOTEXTILE REQUIREMENTS, REFER TO CONSTRUCTION SPECIFICATION (EARTHWORKS SECTION).			
23					C21. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P5. DYNAMIC LOAD TESTING SHALL BE CARRIED OUT IN ACCORDANCE WITH AS2559 ON PILE LOCATIONS AS AGREED WITH THE SUPERINTENDENT AND AS NOTED ON THE DRAWINGS.				S5. ROCK IS TO BE HARD, DENSE, DURABLE, RESISTANT TO WEATHERING AND ANGULAR IN SHAPE. IT SHALL BE FREE FROM OVERBURDEN, SPOIL, SHALE, AND ORGANIC MATTER. ROCK THAT IS LAMINATED, FRACTURED, POROUS OR OTHERWISE PHYSICALLY WEAK IS UNACCEPTABLE.			
24					C22. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P6. ANY PILES WHICH ARE DAMAGED DURING THE EXECUTION OF THE WORKS BY THE CONTRACTOR, OR WHICH DO NOT COMPLY WITH THE SPECIFIED TOLERANCES SHALL BE MADE GOOD OR REPLACED AS THE SUPERINTENDENT MAY DIRECT.				S6. RIP-RAP SCOUR PROTECTION TO HAVE A RELATIVE DENSITY OF 2.6 TO 2.8.			
25					C23. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P7. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.				S7. RIP-RAP ROCK TO BE LIGHT SANDSTONE IN COLOUR TO MATCH WITH EXISTING BEACH SAND.			
26					C24. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P8. PILING RECORDS SHALL BE PROVIDED IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATION.							
27					C25. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P9. PILING METHOD STATEMENT SHALL BE PROVIDED AT LEAST 2 WEEKS BEFORE COMMENCEMENT OF WORKS FOR SUPERINTENDENT'S REVIEW.							
28					C26. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P10. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
29					C27. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P11. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
30					C28. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P12. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
31					C29. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P13. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
32					C30. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P14. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
33					C31. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P15. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
34					C32. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P16. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
35					C33. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P17. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
36					C34. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P18. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
37					C35. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P19. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
38					C36. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P20. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
39					C37. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P21. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
40					C38. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P22. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
41					C39. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P23. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
42					C40. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P24. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
43					C41. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P25. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
44					C42. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P26. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
45					C43. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P27. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
46					C44. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P28. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
47					C45. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P29. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
48					C46. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P30. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
49					C47. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P31. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
50					C48. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P32. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
51					C49. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P33. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
52					C50. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P34. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
53					C51. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P35. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
54					C52. THE MAXIMUM DIFFERENTIAL TEMPERATURE IN THE CONCRETE POUR MUST NOT EXCEED 35 DEGREES.				P36. THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER IF GROUND CONDITIONS VARY FROM THOSE SHOWN ON THE DRAWINGS OR INDICATED BY THE REPORT OF THE GEOTECHNICAL INVESTIGATION.							
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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P																																								
A1																																																								
1	<p>DRAINAGE:</p> <p>D1. ALL GRATED INLET PIT GRATES SHALL BE LOAD CLASS D IN ACCORDANCE WITH AS3996-2006 ACCESS COVERS AND GRATES.</p> <p>D2. REINFORCED CONCRETE PIPES (RCP) TO BE CLASS 2 375mm DIAMETER RUBBER RING JOINTS UNLESS NOTED OTHERWISE AND SHALL COMPLY WITH THE REQUIREMENTS OF AS4958-2007 - PRECAST CONCRETE PIPES AND FITTINGS.</p> <p>D3. SPOON DRAINS TO BE CONSTRUCTED ON 100mm GRANULAR BASECOURSE LAYER COMPACTED TO MINIMUM 98% MODIFIED DRY DENSITY (AS 1289 S.2.1)</p> <p>D4. ALL CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 32MPa AT 28 DAYS UNO.</p> <p>D5. GEOTEXTILE FILTERS SHALL MEET THE REQUIREMENTS OF ROADS AND MARITIME SERVICES SPECIFICATION R63 GEOTEXTILES (SEPARATION AND FILTRATION)</p>																																																							
2	<p>EARTHWORKS AND TIMBER DECKING:</p> <p>REFER TO CONSTRUCTION SPECIFICATION.</p>																																																							
3	<p>REINFORCEMENT NOTES:</p> <p>R1. ALL BARS SHALL BE GRADE D500N IN ACCORDANCE WITH AS/NZS 4671 UNO.</p> <p>R2. THE CONTRACTOR SHALL SUPPLY ALL NECESSARY BAR CHAIRS, SUPPORT AND SPACER BARS TO PLACE STEEL IN ITS CORRECT POSITION DURING CONCRETING.</p> <p>R3. COGS, HOOKS AND HEADS TO BE STANDARD IN ACCORDANCE WITH AS 3600.</p> <p>R4. SPLICES IN REINFORCEMENT TO BE IN ACCORDANCE WITH AS 3600.</p> <p>R5. SEE CONCRETE NOTES FOR COVER TO REINFORCEMENT FOR DURABILITY. REINFORCEMENT SHALL BE SUPPORTED ON PLASTIC OR CONCRETE CHAIRS ONLY.</p> <p>R6. BARS TO BE TIED AT ALL INTERSECTIONS TO ENSURE ELECTRICAL CONTINUITY.</p> <p>R7. GIVE THE SUPERINTENDENT 48 HOURS NOTICE FOR INSPECTION OF REINFORCEMENT. DO NOT HAVE CONCRETE DELIVERED UNTIL FINAL APPROVAL IS OBTAINED BY THE SUPERINTENDENT.</p> <p>R8. ALL RE-ENTRANT CORNERS AND SERVICE HOLES ARE TO HAVE TRIMMER BARS PLACED DIAGONALLY AT CORNERS USING TWO BARS (600 LONG), ONE TIED TO THE UNDERSIDE OF THE TOP REINFORCEMENT AND THE OTHER TIED TO THE TOP OF THE BOTTOM REINFORCEMENT UNO. TRIMMER BARS TO BE N20 OTHERWISE UNO.</p> <p>R9. THE MINIMUM LENGTH OF LAP SHALL BE AS FOLLOWS. LAPS SHALL BE STAGGERED WHERE POSSIBLE.</p>																																																							
4	<table border="1"> <thead> <tr> <th>BAR SIZE:</th> <th>N10</th> <th>N12</th> <th>N16</th> <th>N20</th> <th>N24</th> <th>N28</th> <th>N32</th> </tr> </thead> <tbody> <tr> <td>a) LAP LENGTH - HORIZONTAL BARS-300mm OF CONCRETE CAST BELOW THE BAR</td> <td>400</td> <td>475</td> <td>625</td> <td>800</td> <td>950</td> <td>1200</td> <td>1550</td> </tr> <tr> <td>b) LAP LENGTH - OTHER BARS</td> <td>320</td> <td>400</td> <td>520</td> <td>640</td> <td>800</td> <td>950</td> <td>1200</td> </tr> <tr> <td>c) DEVELOPMENT LENGTH</td> <td>300</td> <td>350</td> <td>475</td> <td>600</td> <td>700</td> <td>850</td> <td>950</td> </tr> <tr> <td>d) DEVELOPMENT LENGTH - HORIZONTAL BARS WITH-300mm OF CONCRETE CAST BELOW THE BAR</td> <td>400</td> <td>475</td> <td>625</td> <td>800</td> <td>950</td> <td>1100</td> <td>1250</td> </tr> </tbody> </table>																BAR SIZE:	N10	N12	N16	N20	N24	N28	N32	a) LAP LENGTH - HORIZONTAL BARS-300mm OF CONCRETE CAST BELOW THE BAR	400	475	625	800	950	1200	1550	b) LAP LENGTH - OTHER BARS	320	400	520	640	800	950	1200	c) DEVELOPMENT LENGTH	300	350	475	600	700	850	950	d) DEVELOPMENT LENGTH - HORIZONTAL BARS WITH-300mm OF CONCRETE CAST BELOW THE BAR	400	475	625	800	950	1100	1250
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6																																																								
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2 28.03.19 MA CH RL

1 22.03.19 MA CH RL

Rev	Date	Drawn	Checked	Approved

ARUP

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Client

Central Coast Council

Project Title

TERRIGAL BOARDWALK

Drawing Title

GENERAL NOTES SHEET 2

Scale: A1

Rev: **2**

Project No: **261648**

Drawn: **TBP-DD-GLDE-DRG-1006**

SHAPE CODE	AUSTRALIAN STANDARD SHAPE	SHAPE CODE	AUSTRALIAN STANDARD SHAPE	SHAPE CODE	AUSTRALIAN STANDARD SHAPE	SHAPE CODE	AUSTRALIAN STANDARD SHAPE	SHAPE CODE	AUSTRALIAN STANDARD SHAPE	SHAPE CODE	AUSTRALIAN STANDARD SHAPE
S		F		SC		J		LH		XT	
L		V		CC		LJ		SP		CT	
LL		U		RC		JJ		RT			
H		T		VL		A		HT			
HH		SH		VV		R		DT			
SHAPE CODE	NON STANDARD SHAPE	SHAPE CODE	NON STANDARD SHAPE								
NS1		NS5									
NS2		NS6									
NS3		NS7									
NS4		NS8									

BAR MARKING LEGEND

THE METHOD USED TO DESCRIBE REINFORCEMENT ON THE DRAWINGS IS AS FOLLOWS:

4/S1 N16-S-300 EF *

↑ LENGTH VARIES
↑ INFORMATION FOR PLACING
↑ SPACE ALONG LIMIT LINE
↑ BAR SHAPE CODE
↑ BAR SIZE IN MILLIMETRES
↑ BAR STRUCTURAL PROPERTIES
↑ BAR NUMBER IN SEQUENCE
↑ STRUCTURE ELEMENT DENOTATION
↑ NUMBER OF BARS IN THE SET

STRUCTURE ELEMENT DENOTATION

A - ABUTMENT A
B - ABUTMENT B
D - DECK
F - FOUNDATIONS (PILES)
G - GRIDDERS (PLANKS)
P - PIERS
R - RETAINING STRUCTURES

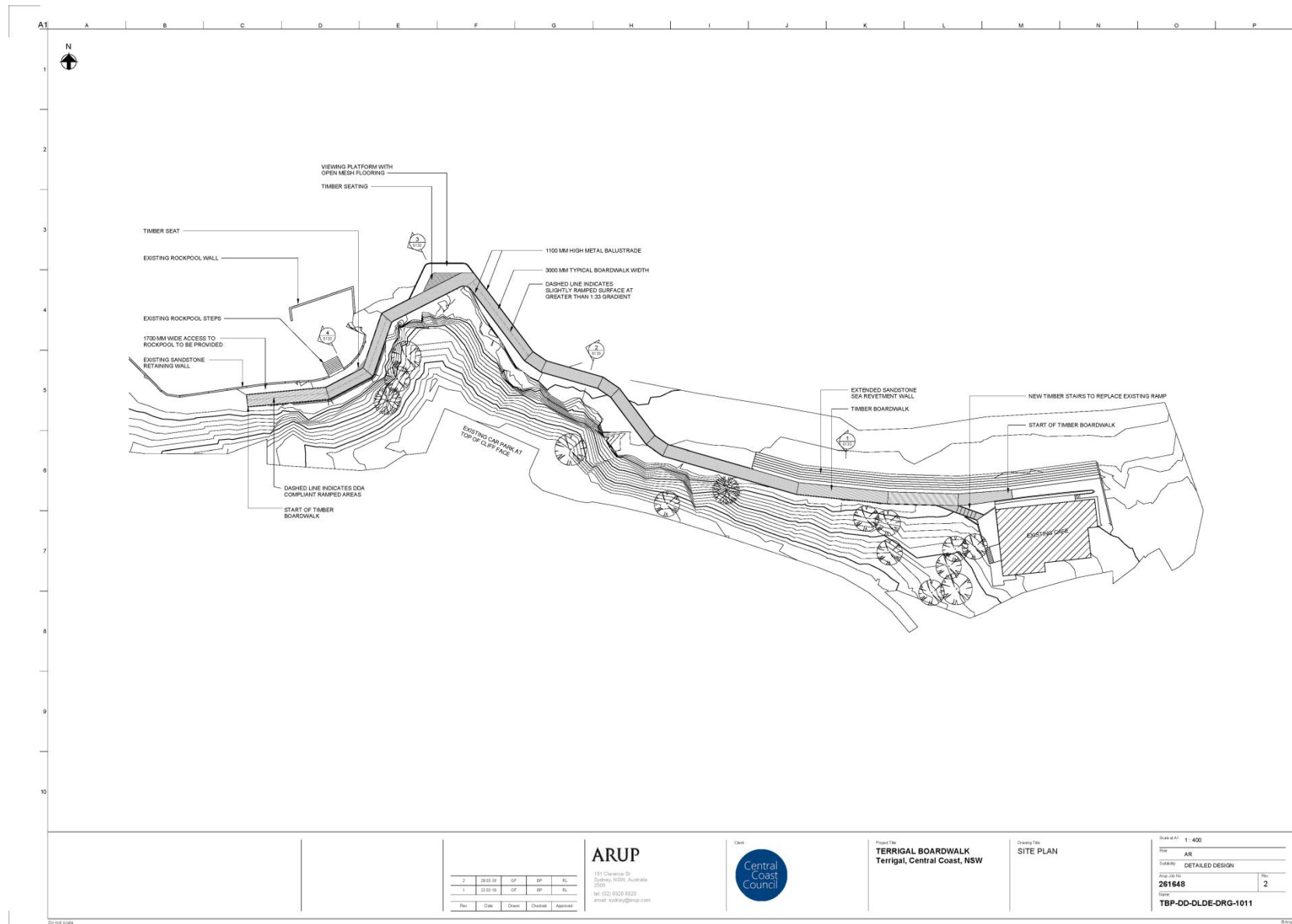
INFORMATION FOR PLACING

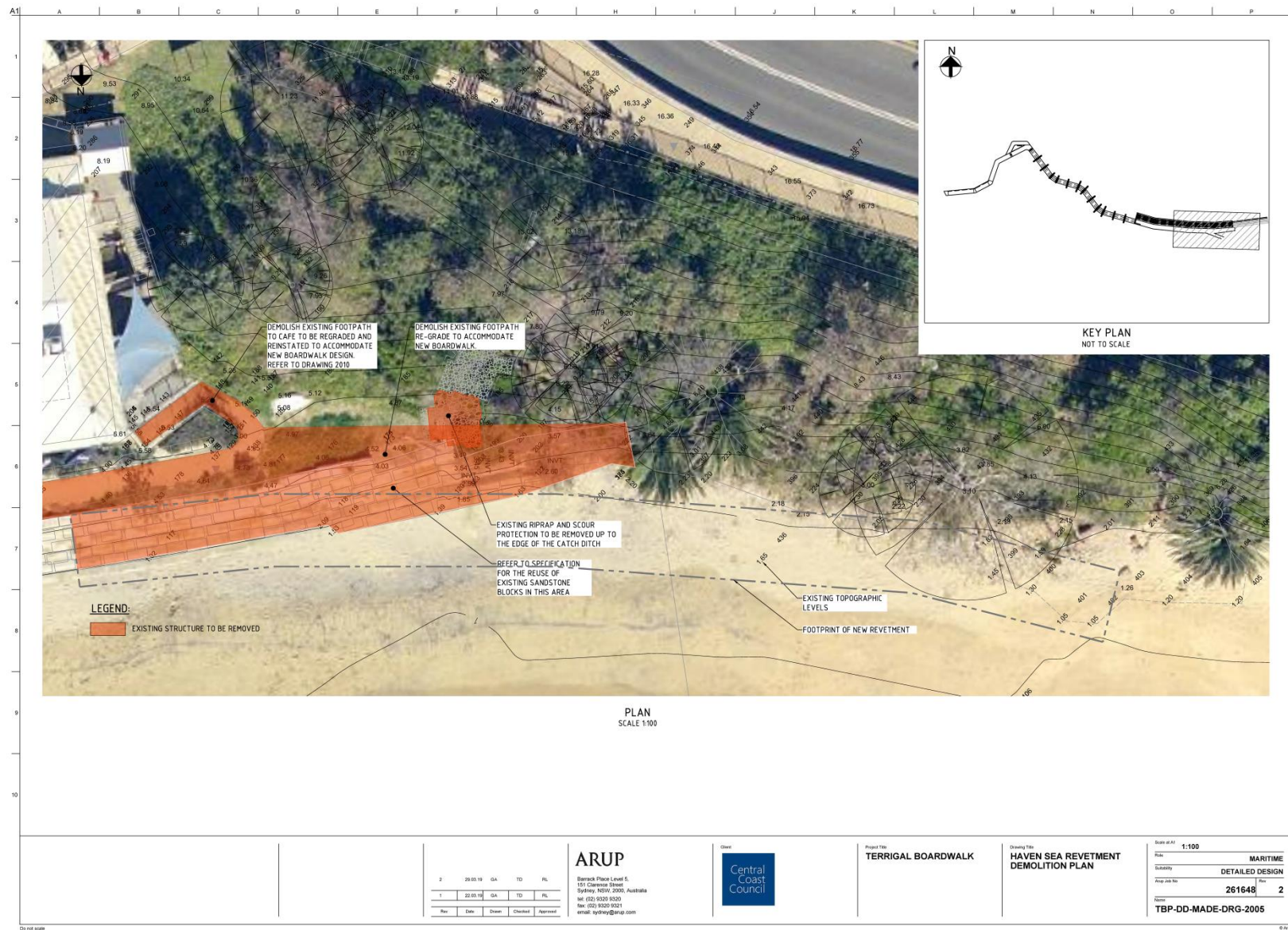
B - BOTTOM
CP - CENTRALLY PLACED
EF - EACH FACE
EW - EACH WAY
FF - FAR FACE
NF - NEAR FACE
T - TOP
NSOP - NOT SHOWN ON PLAN FOR CLARITY

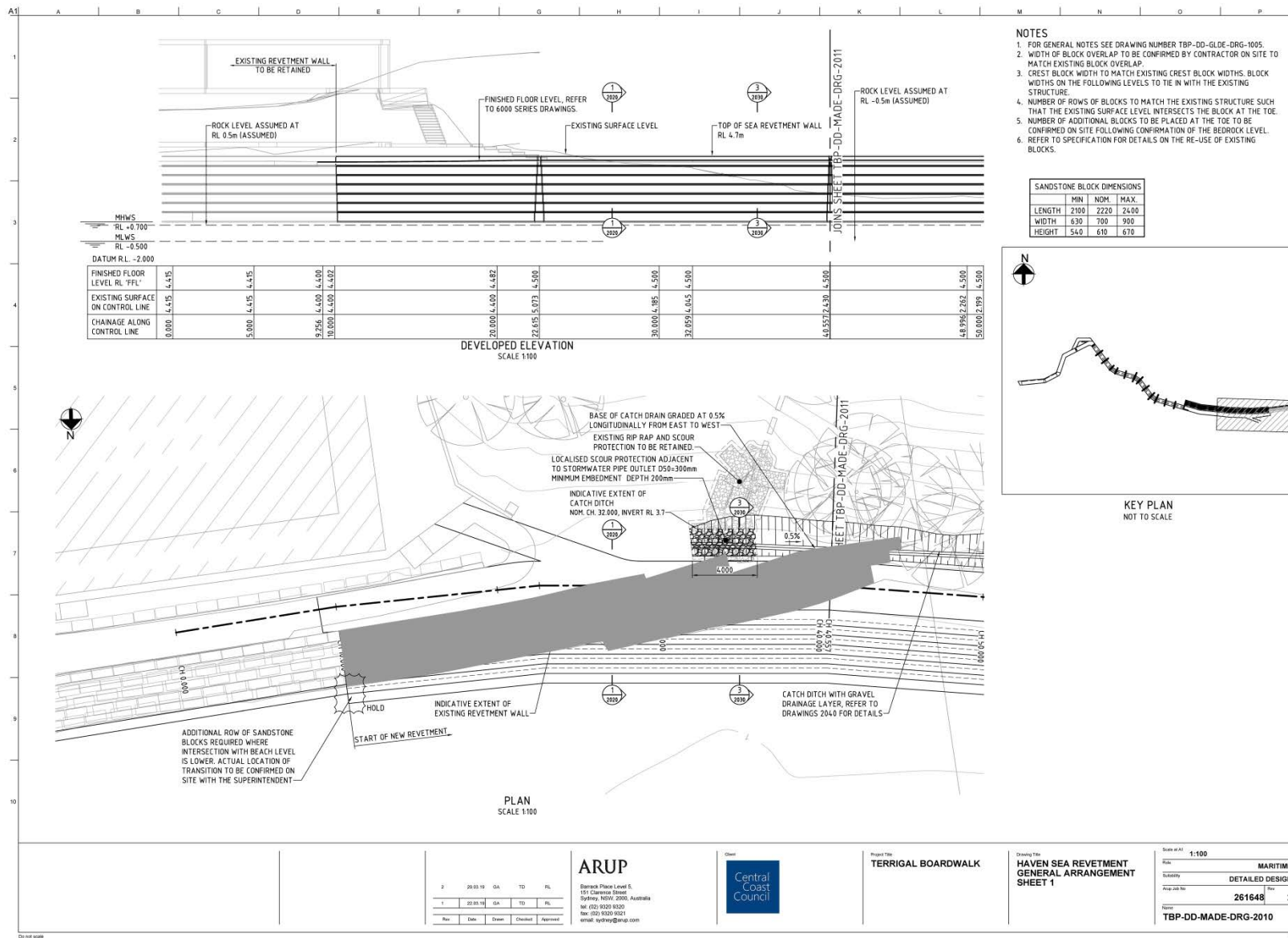
REINFORCEMENT NOTES

1. AUSTRALIAN STANDARD BAR SHAPES ARE IN ACCORDANCE WITH AS 1100.501.
2. BAR SIZE IS THE NOMINAL DIAMETER IN MILLIMETRES, OR THE AS/NZS 4671 MESH NUMBER.
3. THE GRADE OF REINFORCEMENT, IF NOT STATED ON THE DRAWINGS, TO BE D500N TO AS/NZS 4671.
4. DIMENSIONS SHOWN ON BAR SHAPES DIAGRAMS ARE MEASURED FROM THE OUTSIDE FACES OF THE BARS AND ARE IN MILLIMETRES.
5. THE INCLUDED ANGLE OF ANY BEND TO BE A RIGHT ANGLE IF NO DIMENSION SHOWN.
6. BARS OF DIAMETER GREATER THAN 24mm NOT TO BE REBENT.
7. BAR BENDING AND HOOK DETAILS TO BE IN ACCORDANCE WITH SECTION 5.13 OF AS 5100-BRIDGE DESIGN.

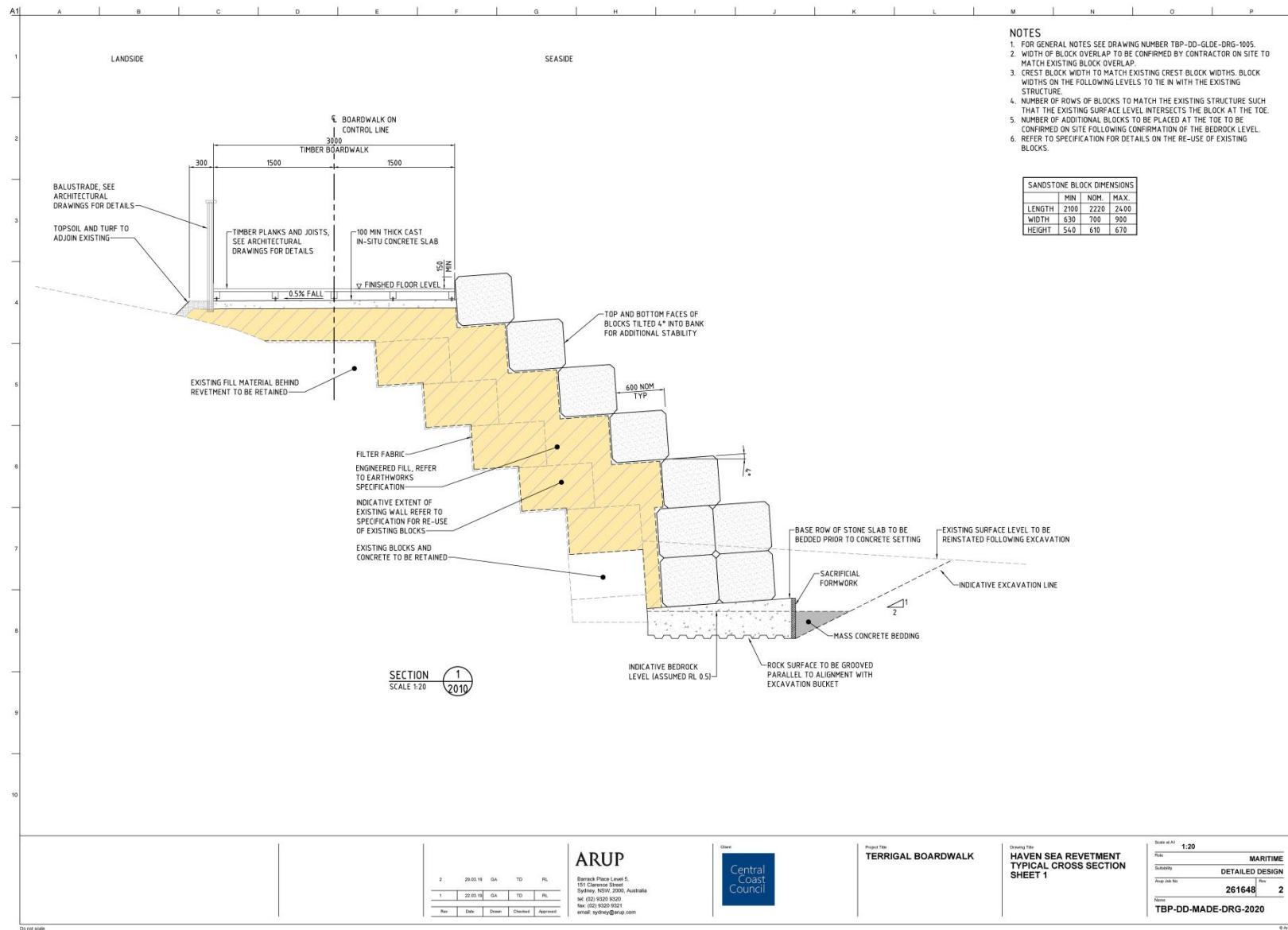




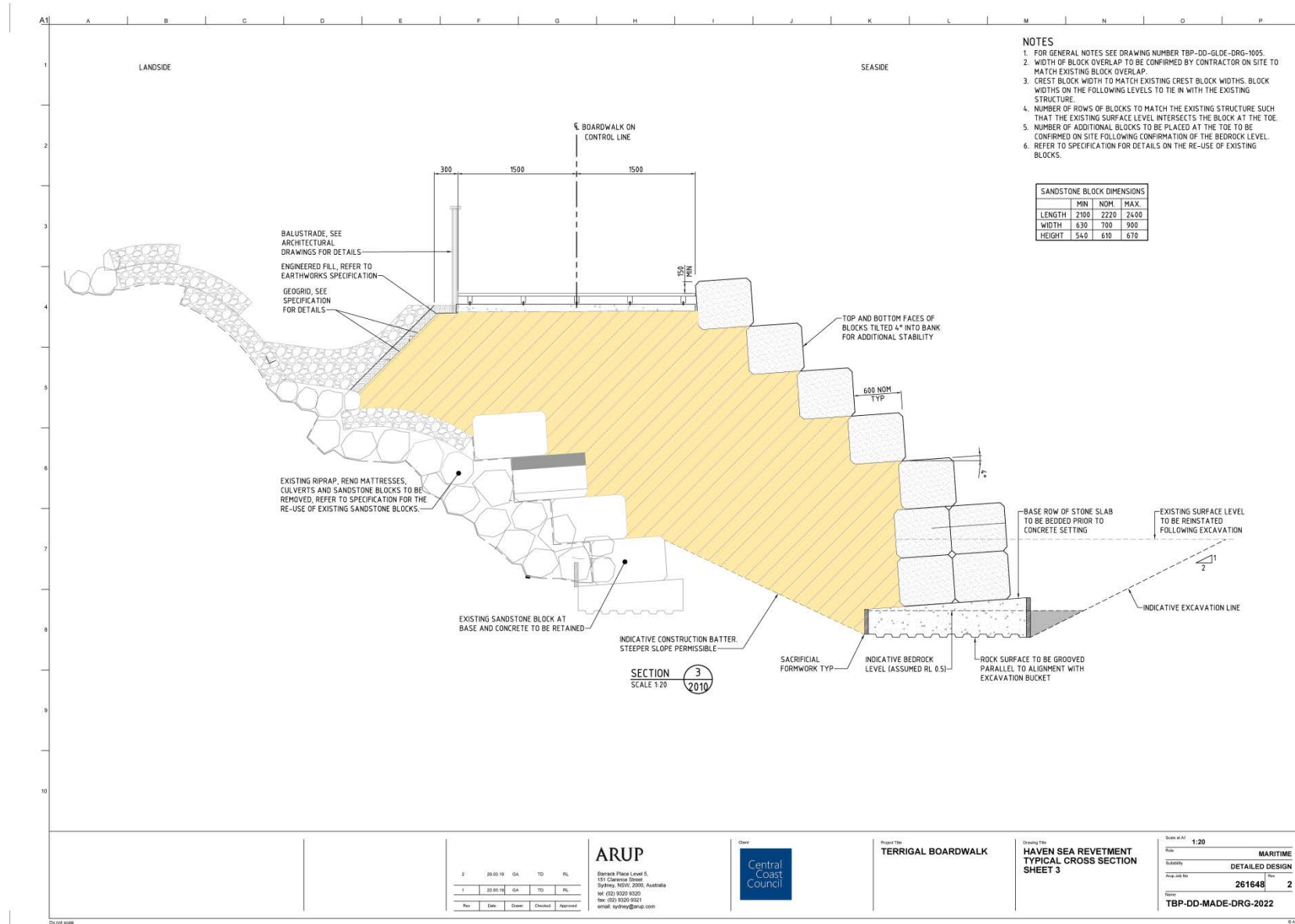


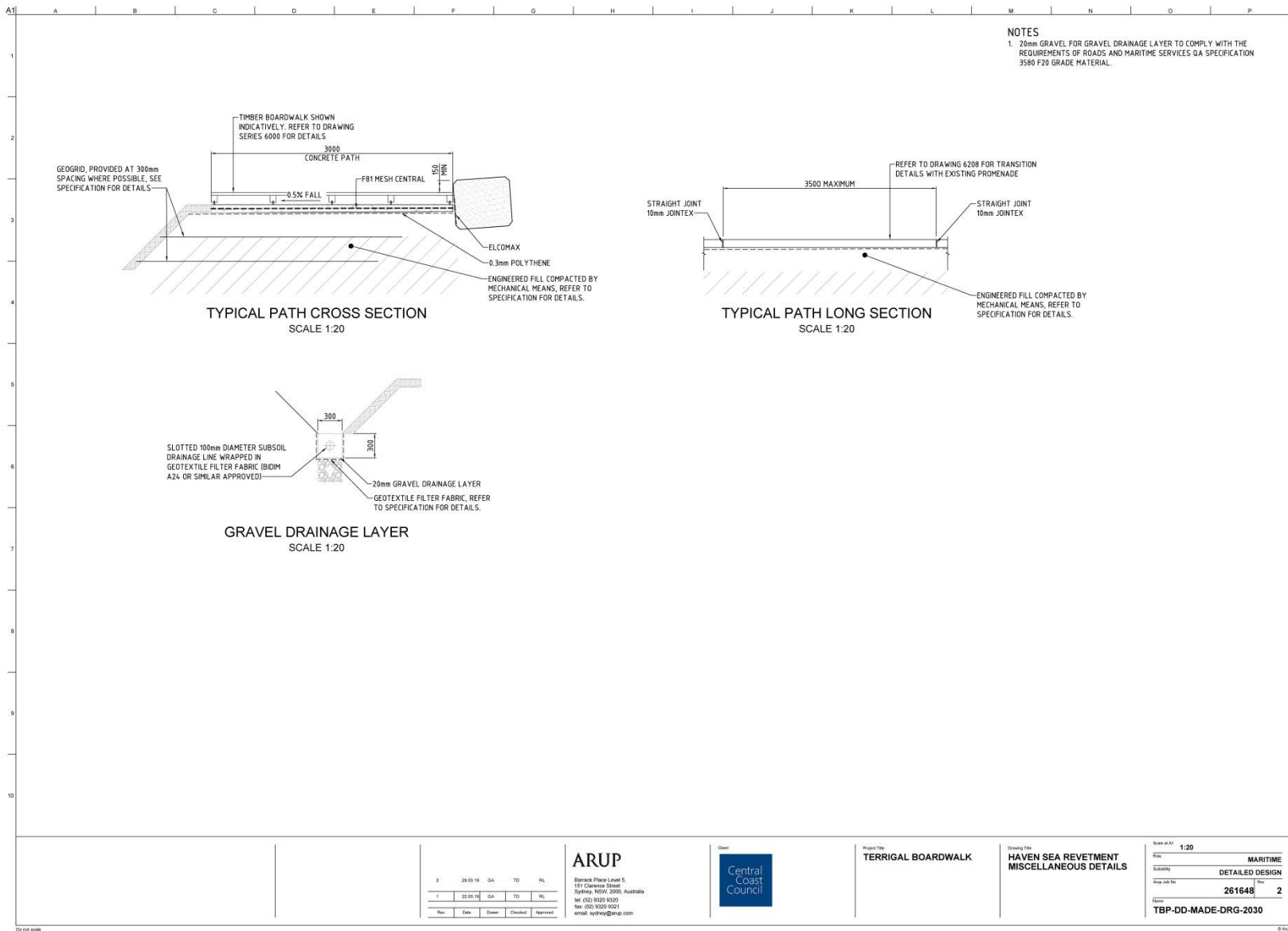




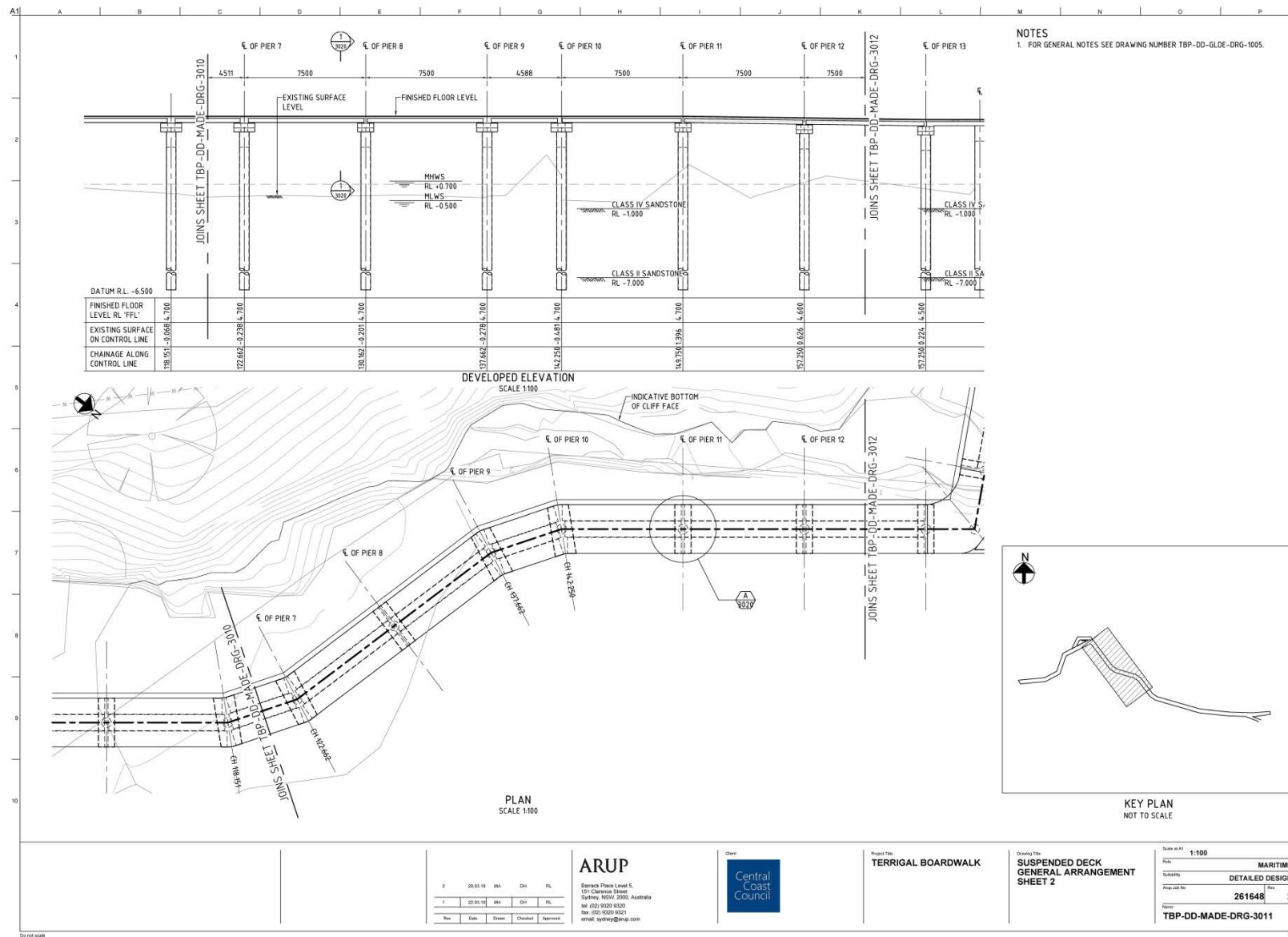


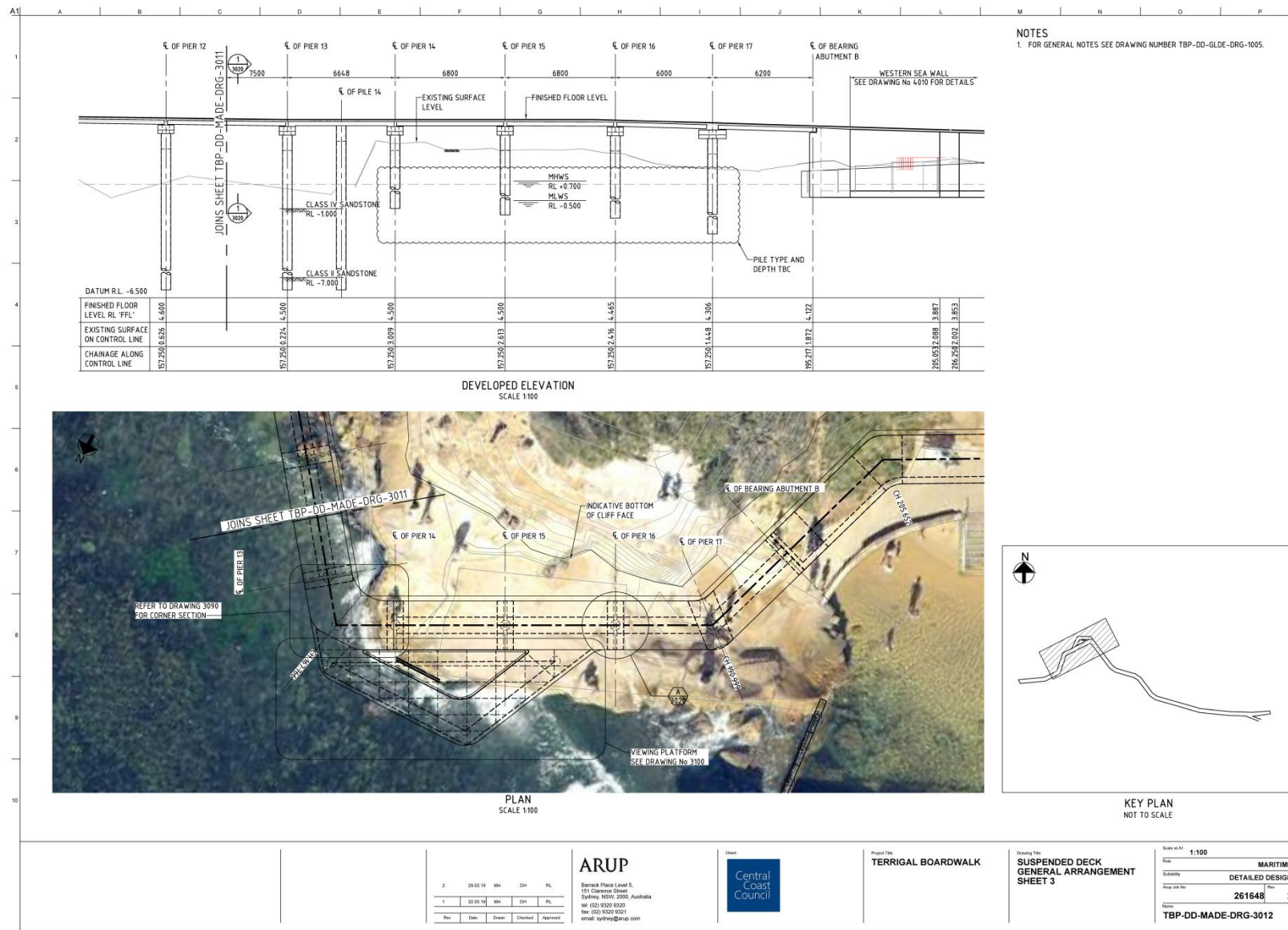


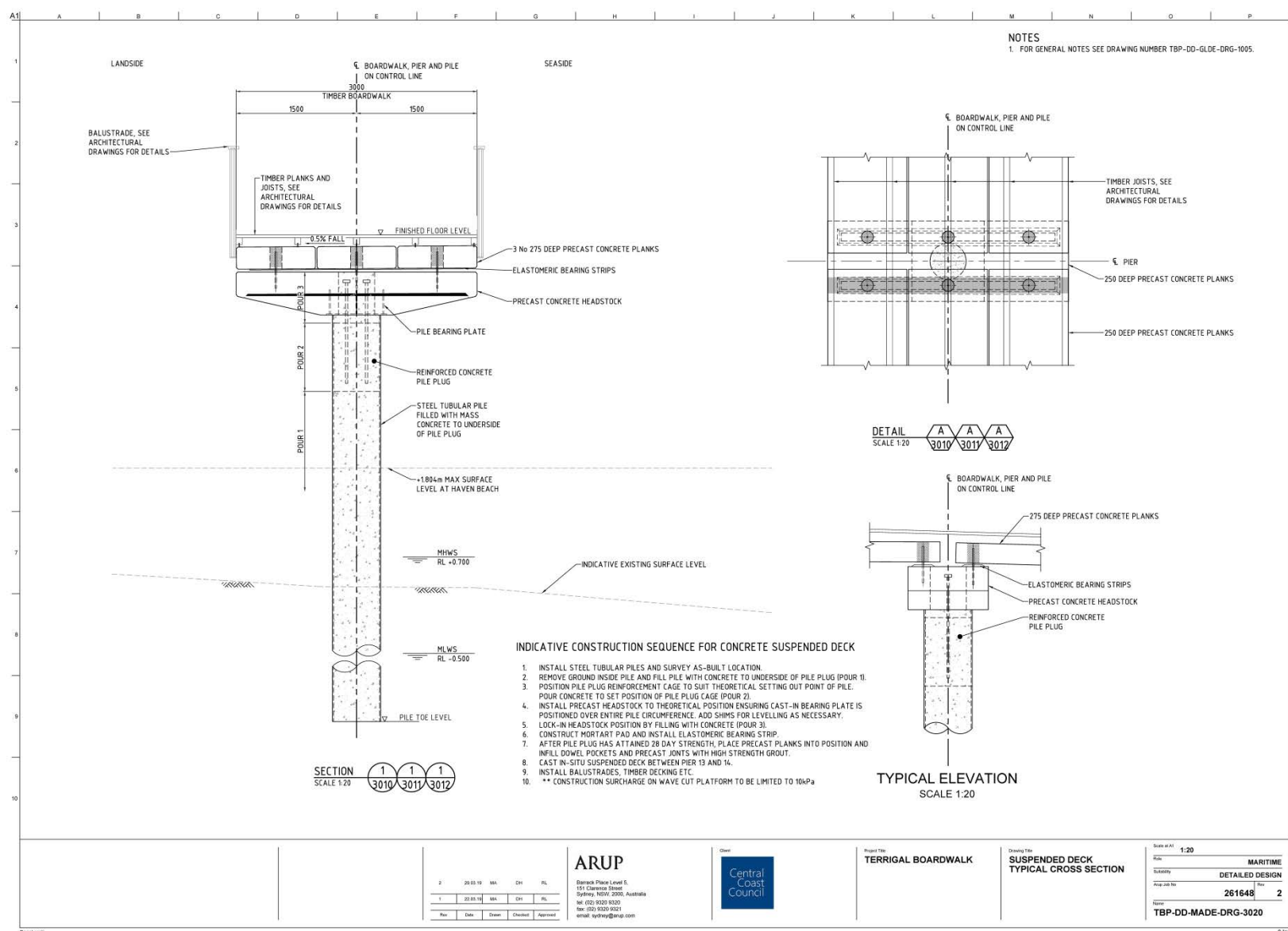












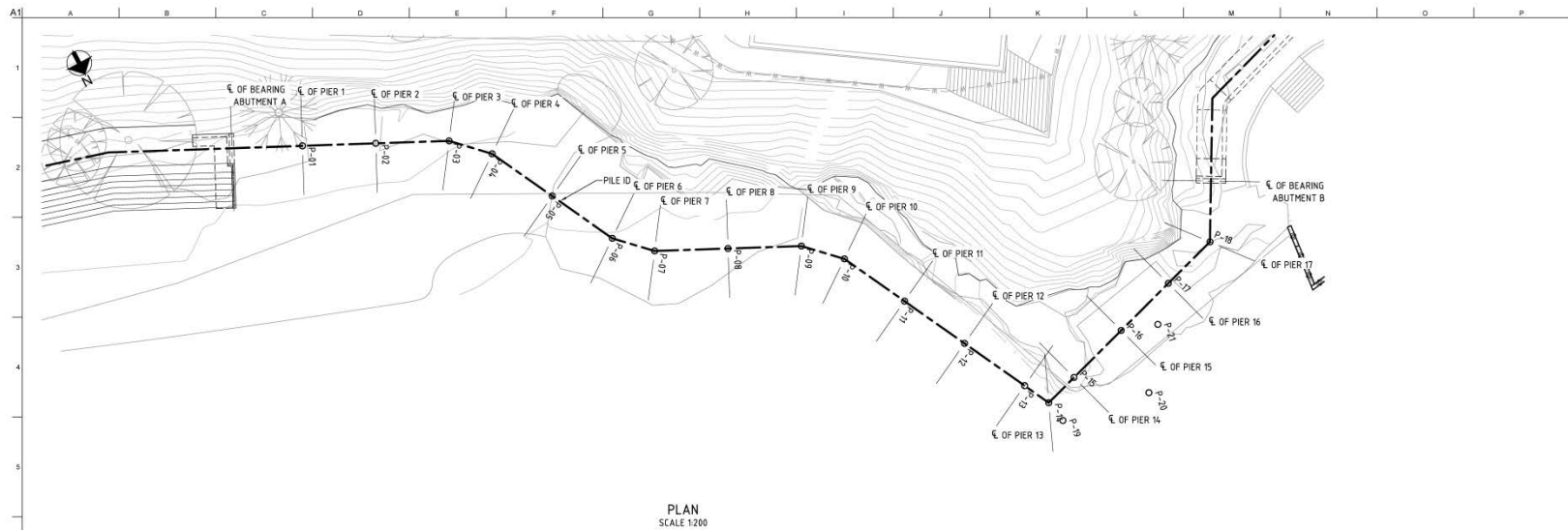


TABLE : PILE SET OUT AND DETAILS

PILE ID	PILE TYPE	SOP		BEARING (D°M'S")	TOP OF PILE RL 'A'	TOE OF PILE RL 'B'	PILE LENGTH 'L'	SOCKET LENGTH 'S'
		EASTING	NORTHING					
P-01	TYPE 1	355748.643	6297952.724	15°58'31"	3.540	-6.000	9.540	TBC
P-02	TYPE 1	355741.432	6297954.788	15°58'31"	3.610	-6.000	9.610	TBC
P-03	TYPE 1	355734.226	6297956.851	25°13'31"	3.680	-6.000	9.680	TBC
P-04	TYPE 1	355730.444	6297959.449	43°43'31"	3.680	-6.000	9.680	TBC
P-05	TYPE 1	355725.928	6297965.436	52°58'31"	3.680	-6.000	9.680	TBC
P-06	TYPE 1	355721.411	6297971.424	43°43'31"	3.680	-6.000	9.680	TBC
P-07	TYPE 1	355717.692	6297973.978	25°13'31"	3.680	-6.000	9.680	TBC
P-08	TYPE 1	355710.482	6297976.042	15°58'31"	3.680	-6.000	9.680	TBC
P-09	TYPE 1	355703.272	6297978.106	25°13'31"	3.680	-6.000	9.680	TBC
P-10	TYPE 1	355699.489	6297980.703	43°43'31"	3.680	-6.000	9.680	TBC
P-11	TYPE 1	355694.973	6297986.691	52°58'31"	3.675	-6.000	9.675	TBC
P-12	TYPE 1	355690.457	6297992.679	52°58'31"	3.575	-6.000	9.575	TBC
P-13	TYPE 1	355685.941	6297998.667	52°58'31"	3.480	-6.000	9.480	TBC
P-14	TBC	355684.125	6298001.074	12°59'36"	4.065	-6.000	10.065	TBC
P-15	TYPE 1	355680.888	6297999.426	333°0'41"	3.480	-6.000	9.480	TBC
P-16	TYPE 1	355674.828	6297996.340	333°0'41"	3.480	-6.000	9.480	TBC
P-17	TYPE 1	355668.769	6297993.254	333°0'41"	3.445	-6.000	9.445	TBC
P-18	TYPE 1	355663.422	6297990.531	310°56'42"	3.265	-6.000	9.265	TBC
P-19	TBC	355683.316	6298003.240	0°0'0"	TBC	-6.000	TBC	TBC
P-20	TBC	355674.080	6298003.240	0°0'0"	TBC	-6.000	TBC	TBC
P-21	TBC	355671.071	6297996.902	0°0'0"	TBC	-6.000	TBC	TBC

IF TOP OF CLASS IV SANDSTONE AND/OR CLASS II SANDSTONE VARIES BY MORE THAN 0.5M FROM ASSUMED VALUE, CONTRACTOR SHALL NOTIFY PRINCIPAL ENGINEER FOR IMPACT ASSESSMENT

NOTES

- FOR GENERAL NOTES SEE DRAWING NUMBER TBP-DD-GLDE-DRG-1005.

Do not scale

S:\Proj

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Project Title:

TERRIGAL BOARDWALK

Drawing Title:

SUSPENDED DECK
PILE LAYOUT AND DETAILS
SHEET 1

Scale: A1:

1:200

Date:

MARITIME

Subsidiary:

DETAILED DESIGN

As per job file:

Rev:

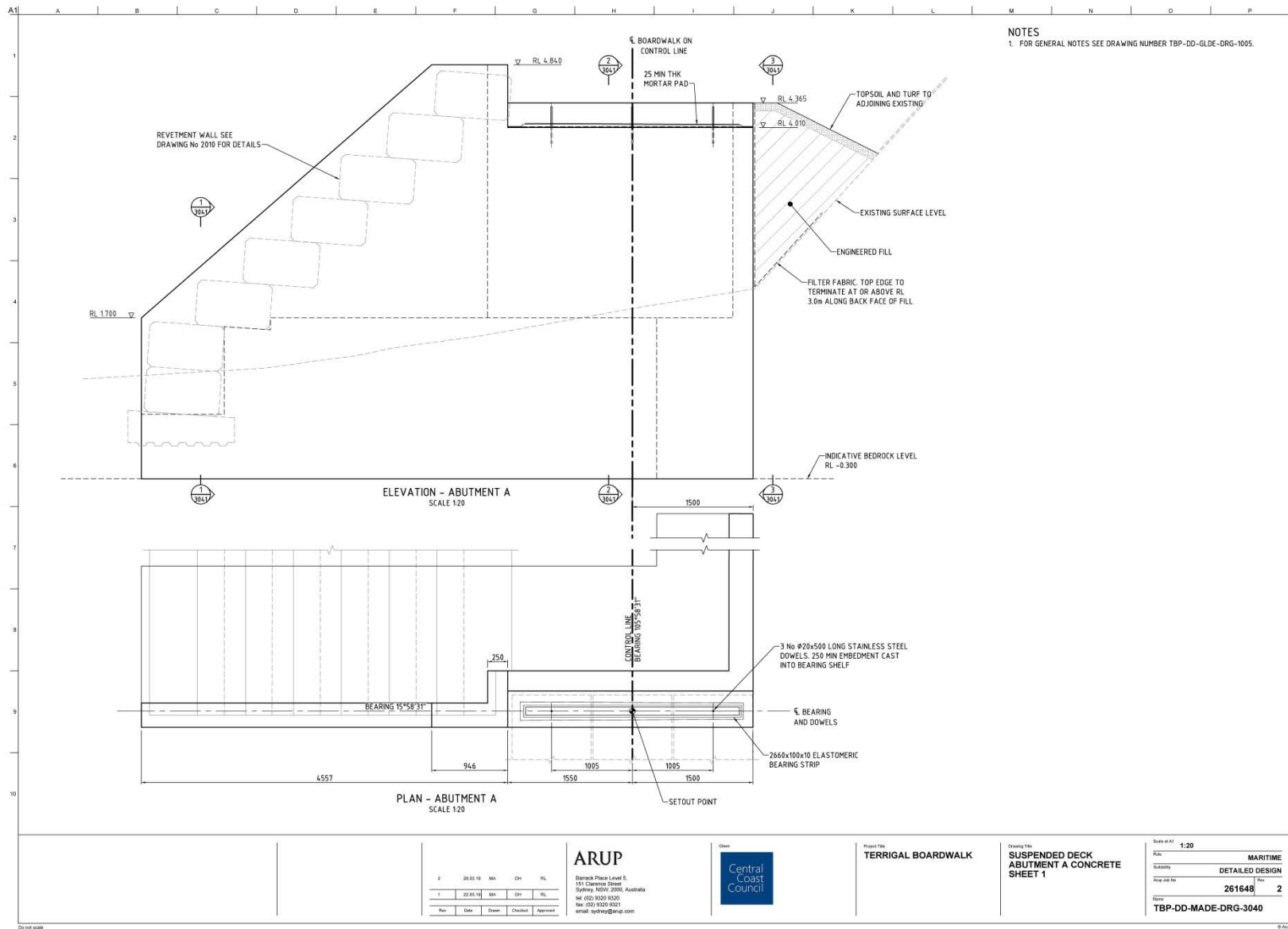
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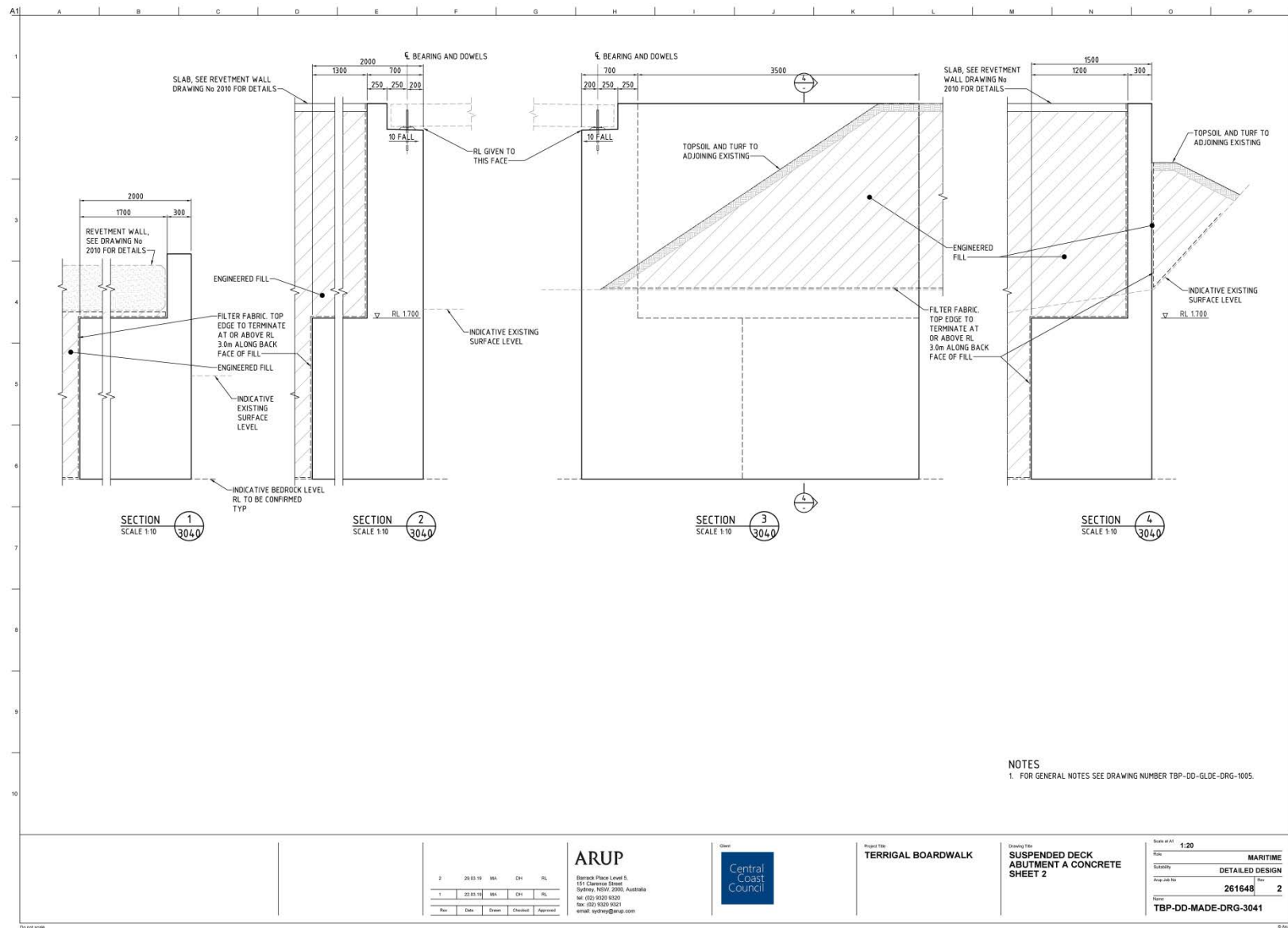
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Name:

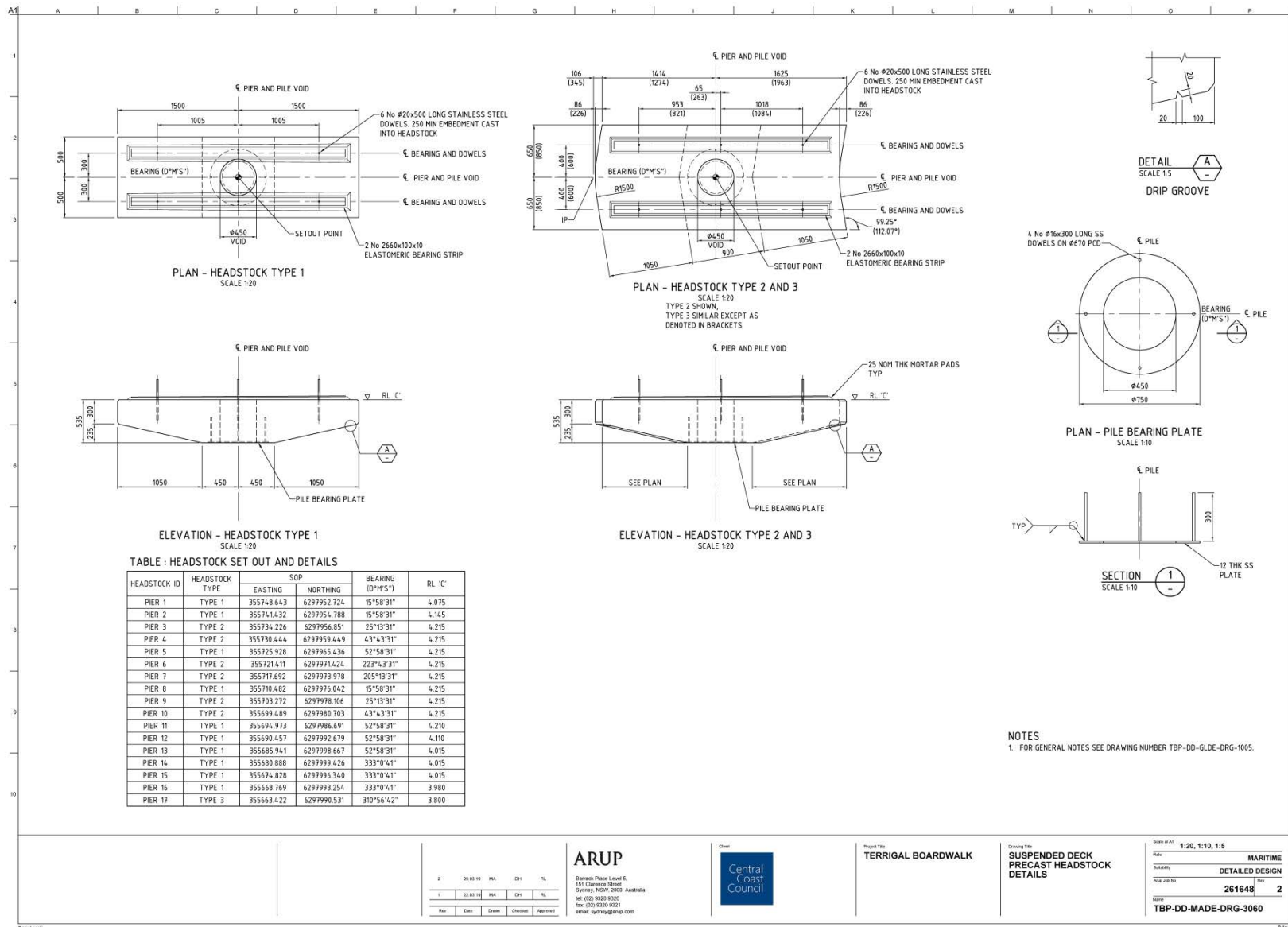
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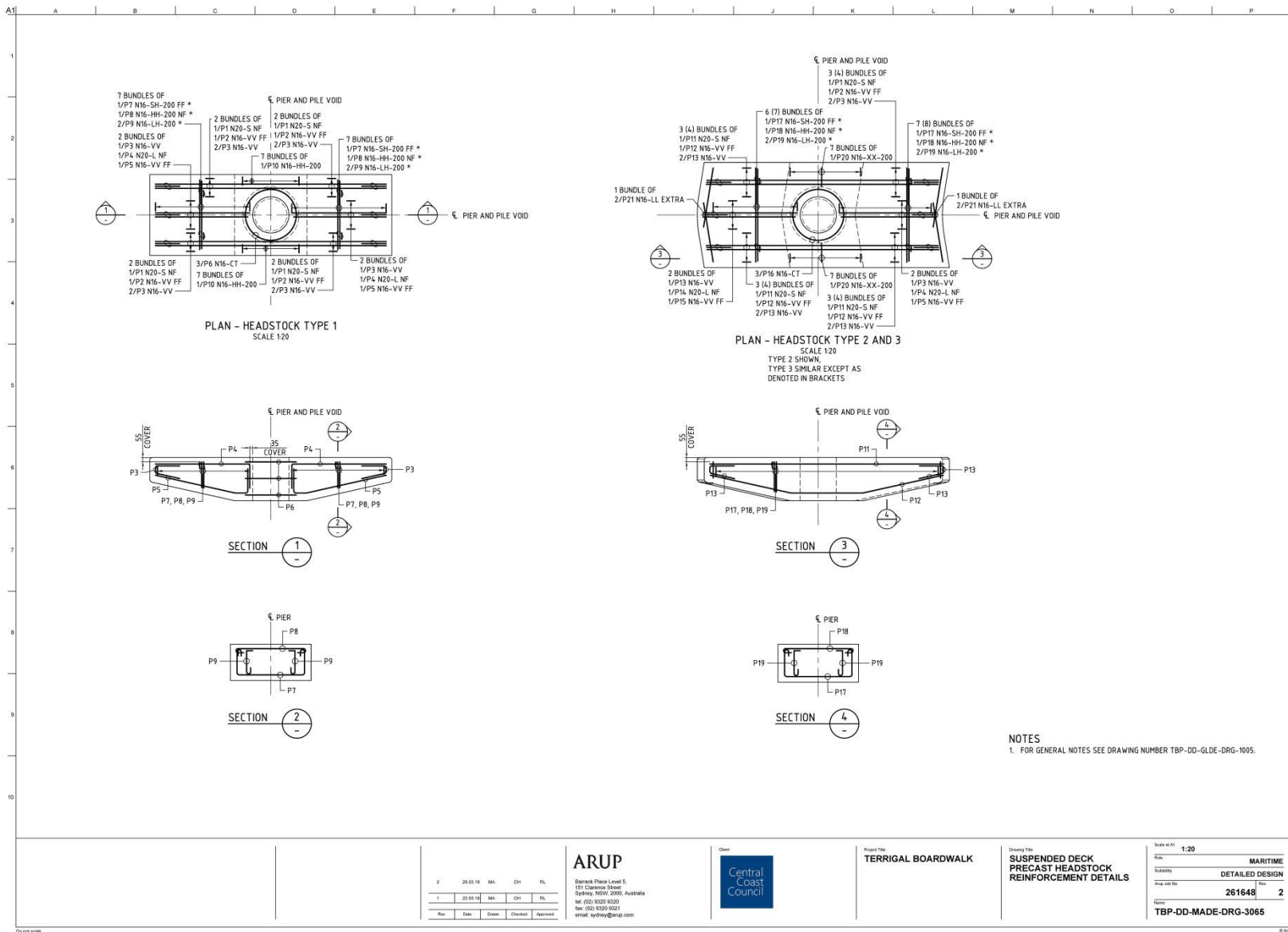


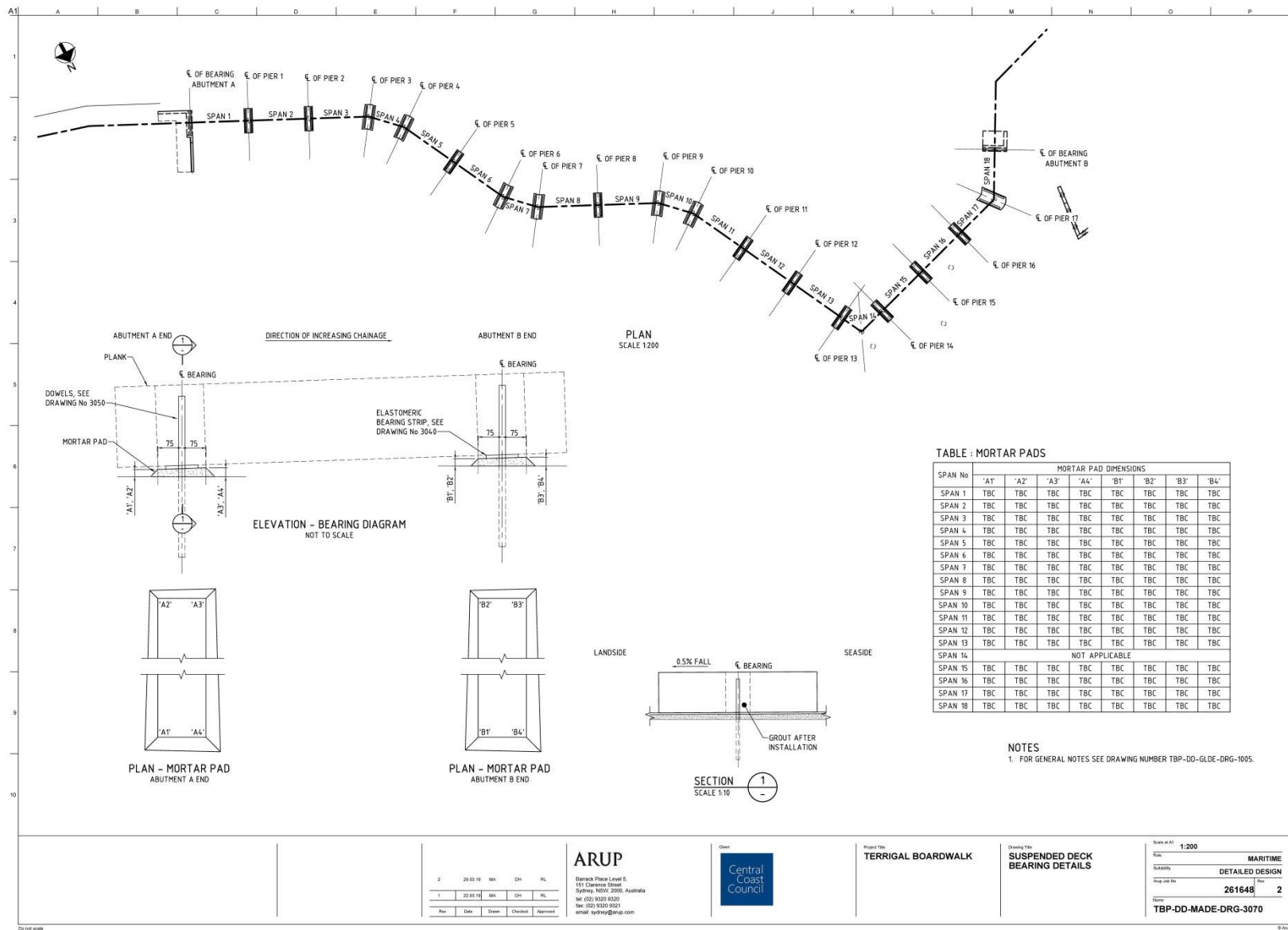


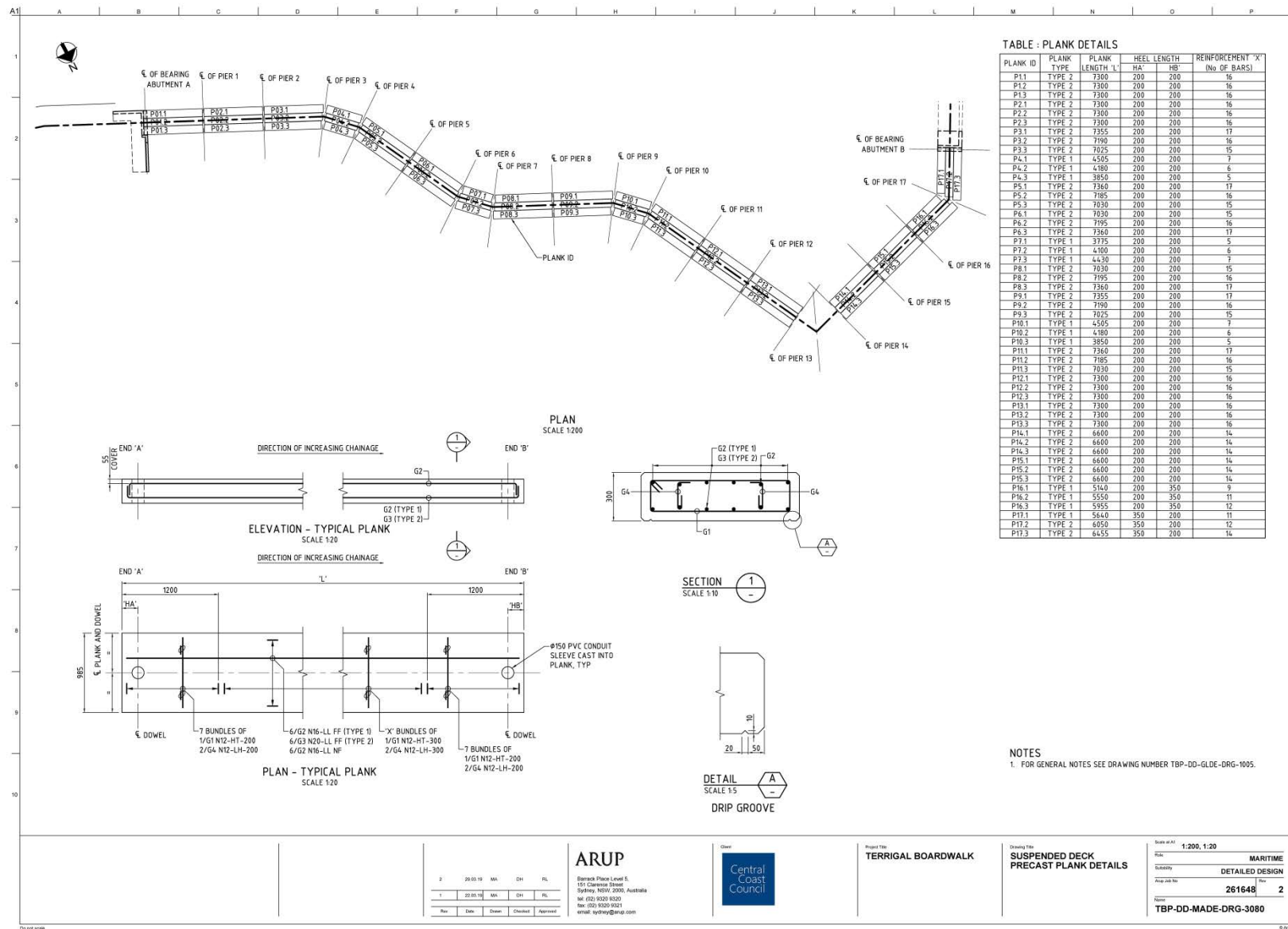




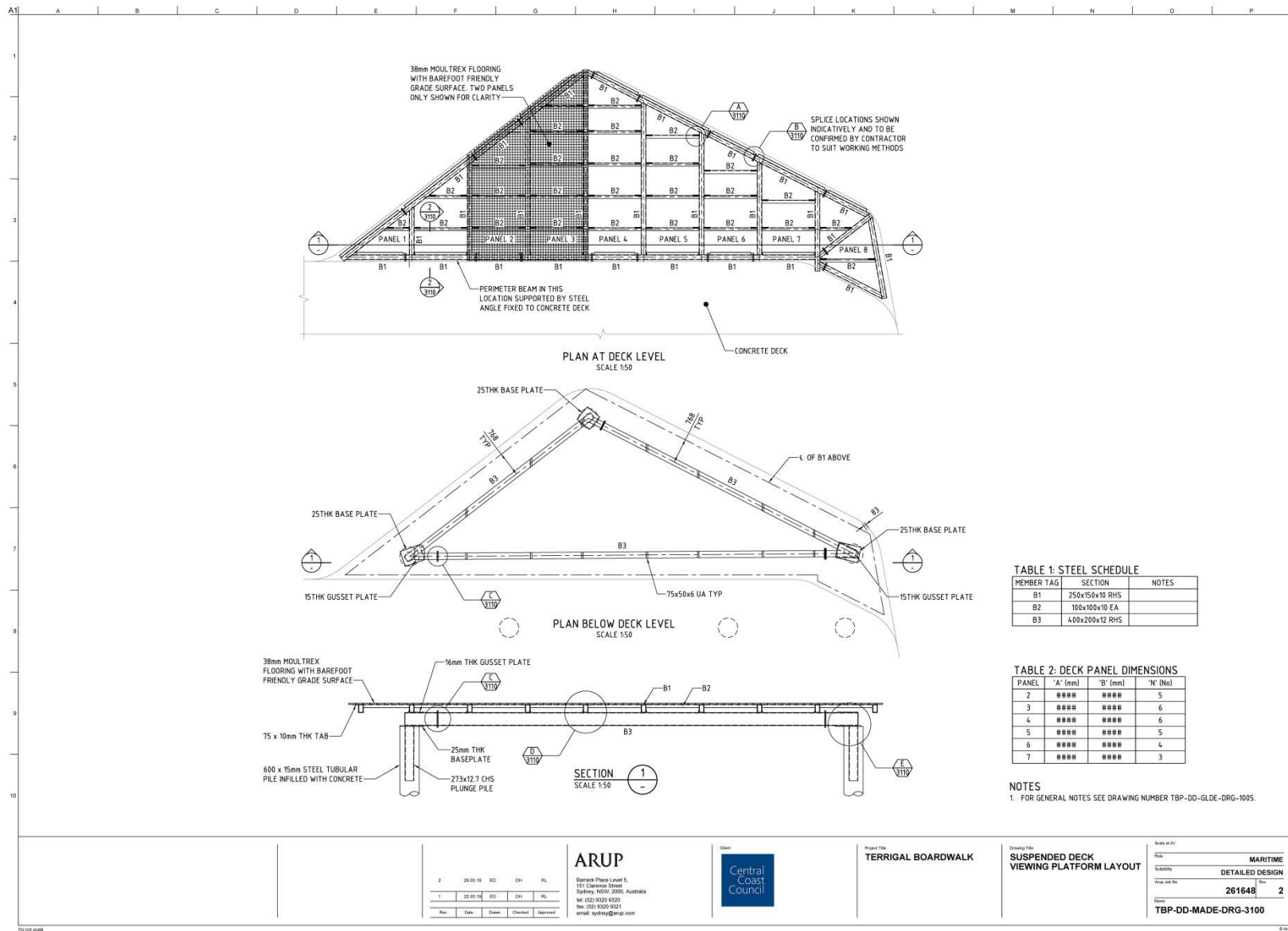


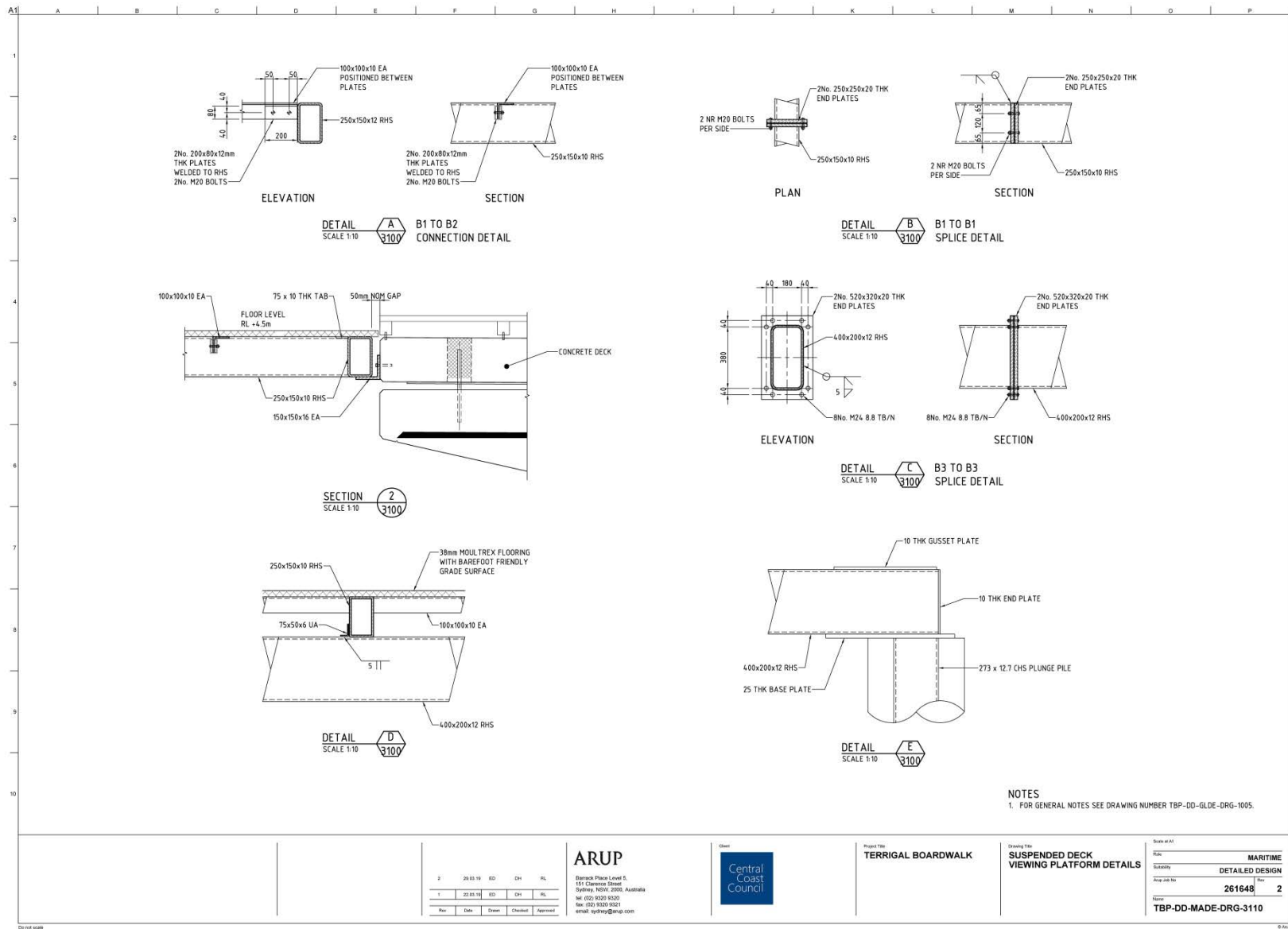


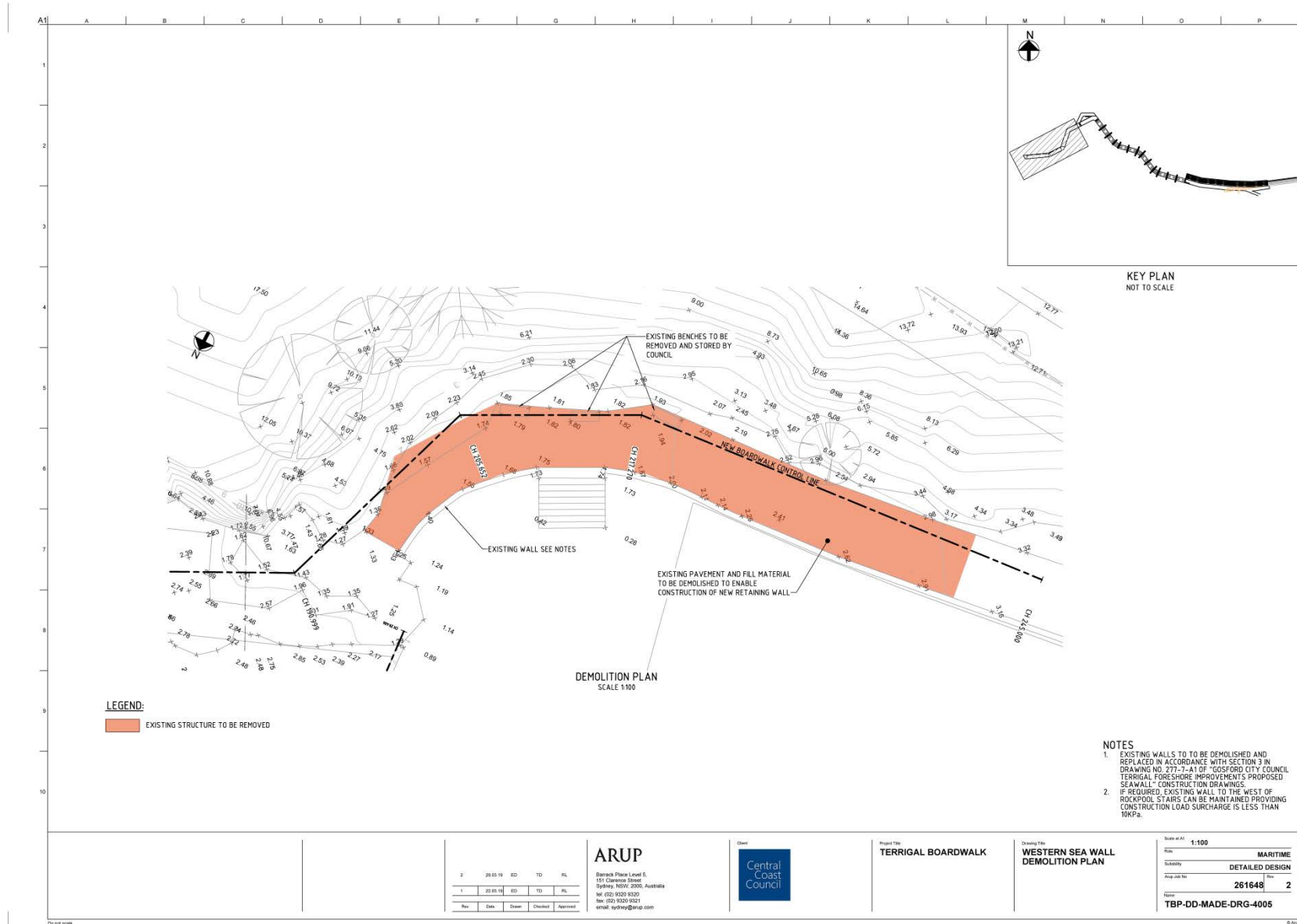


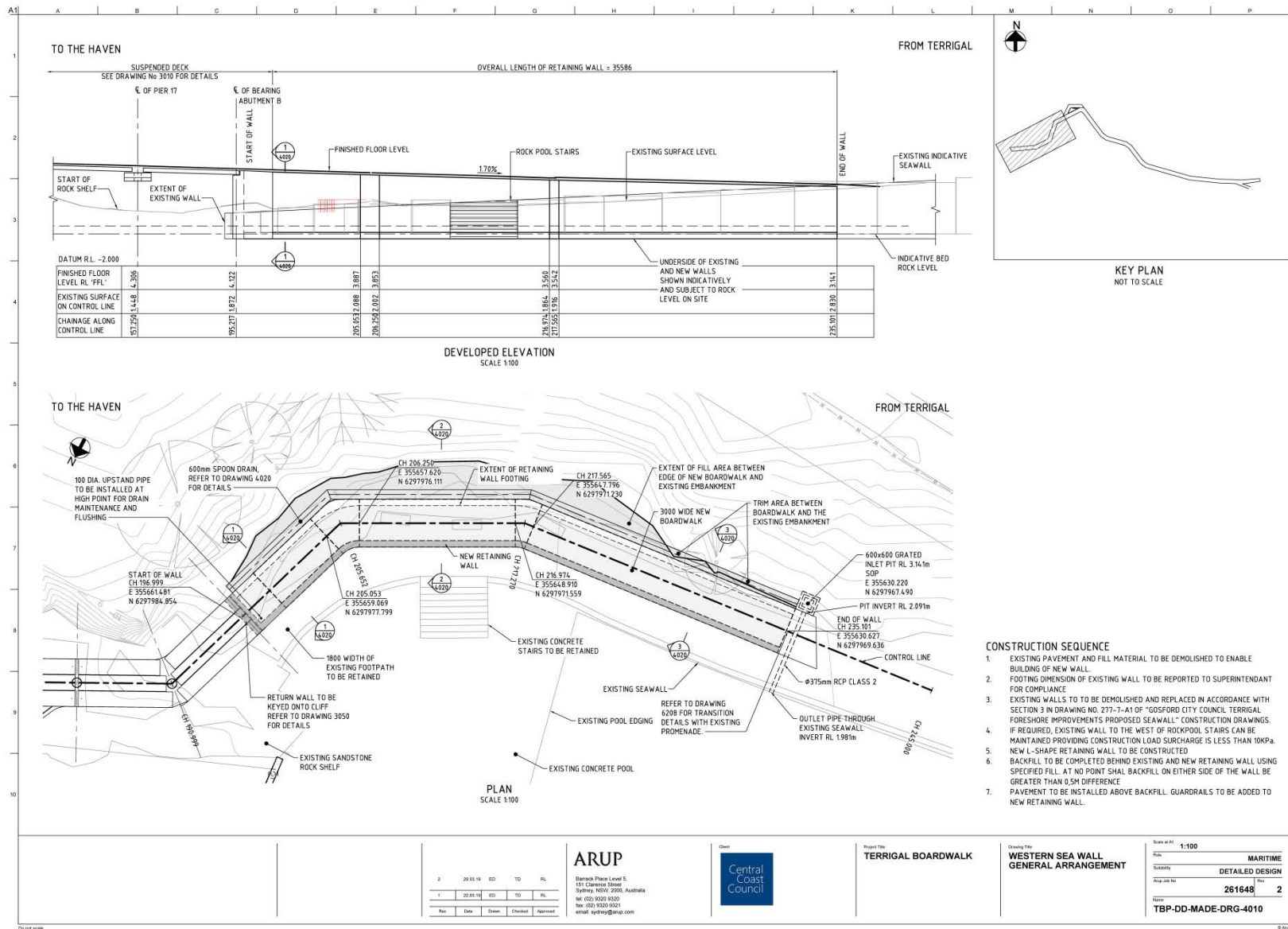


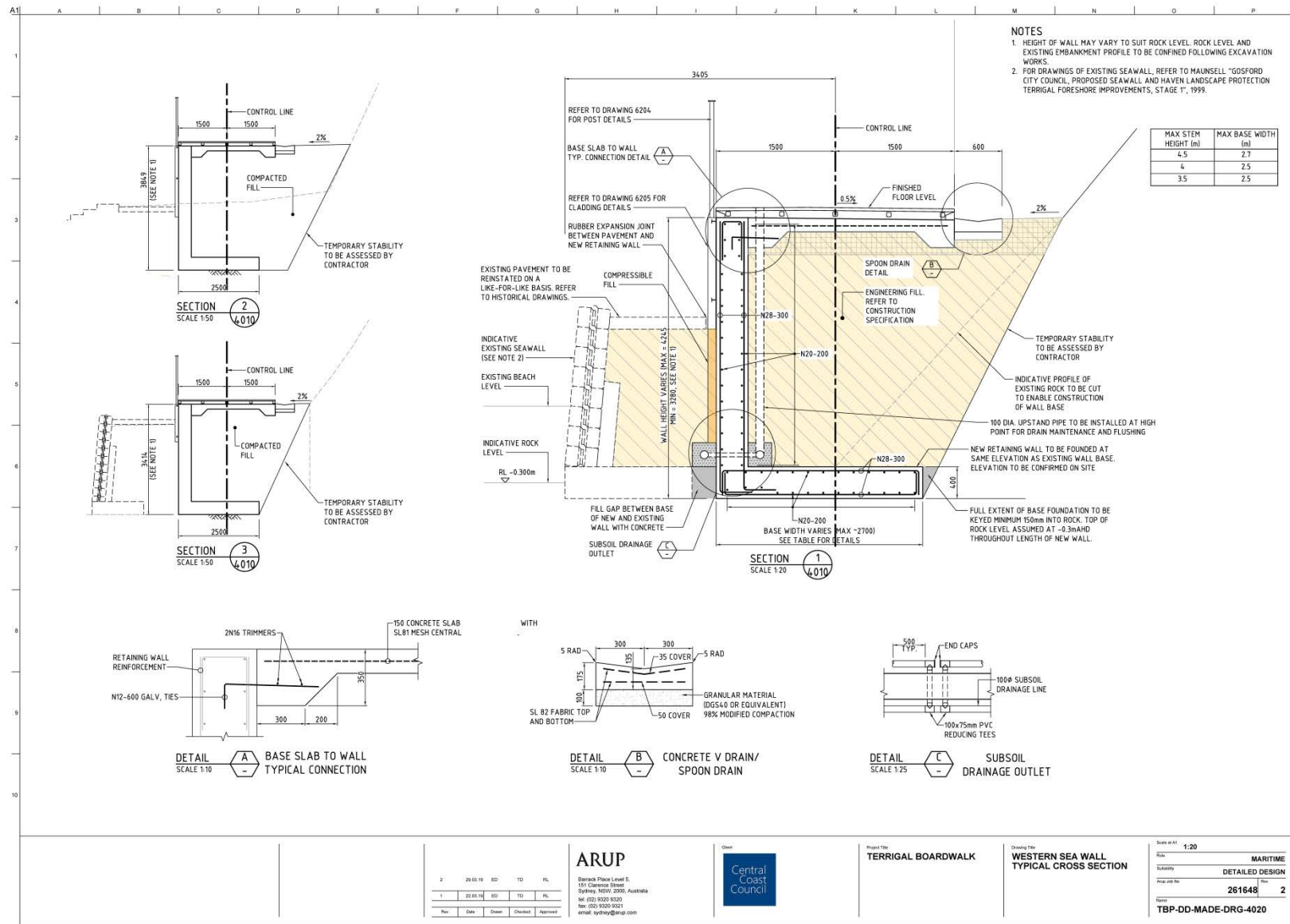


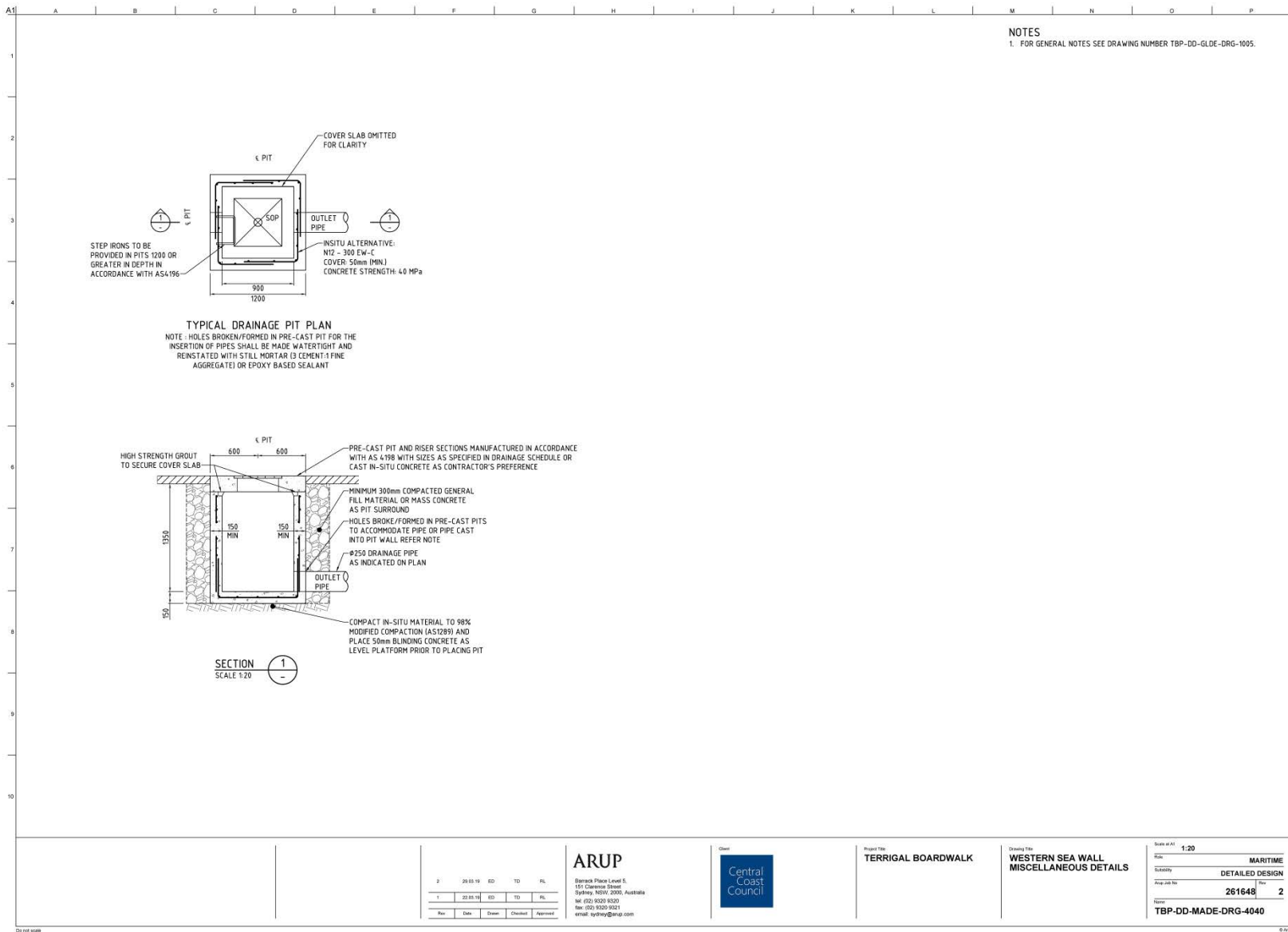


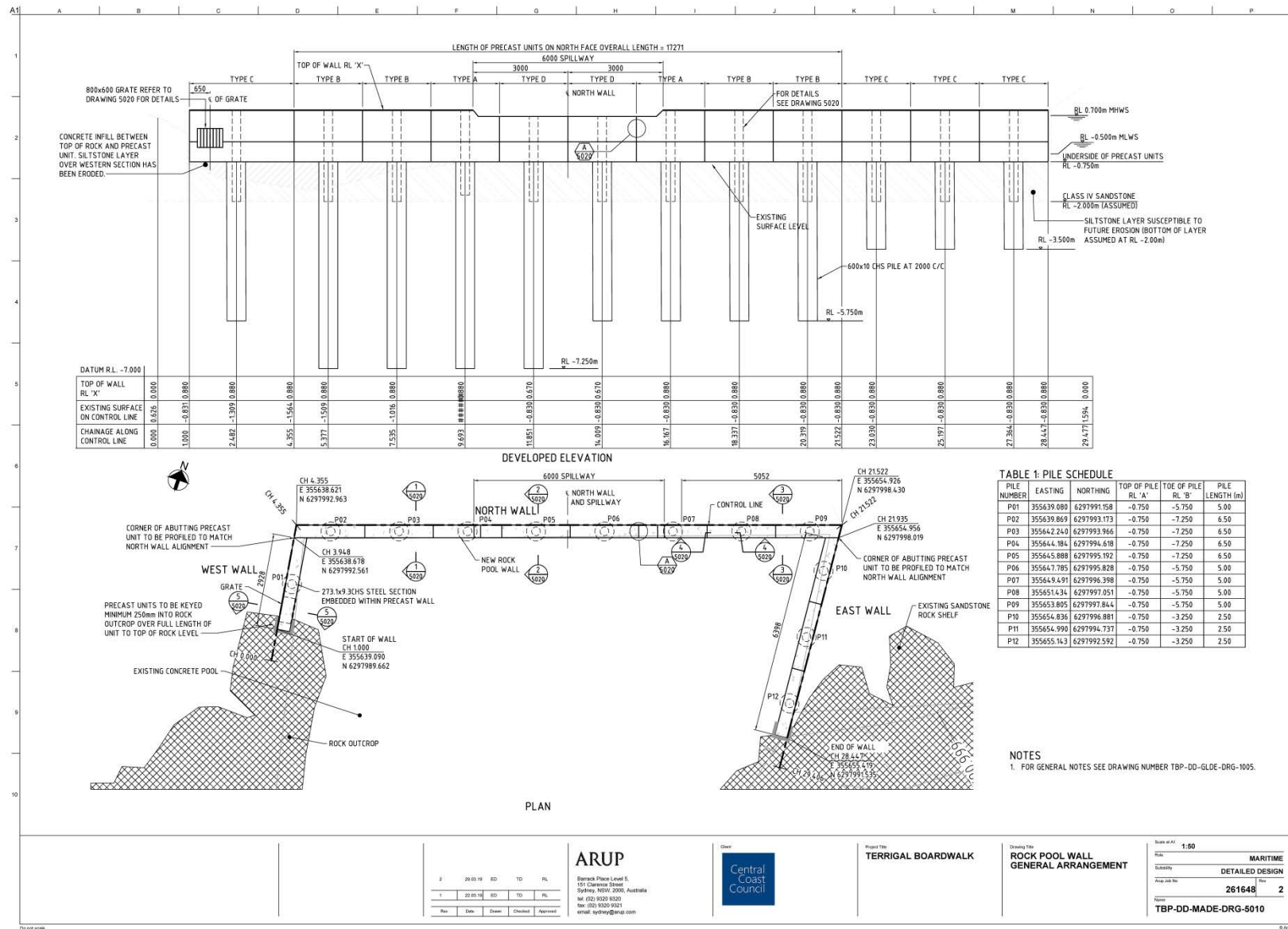


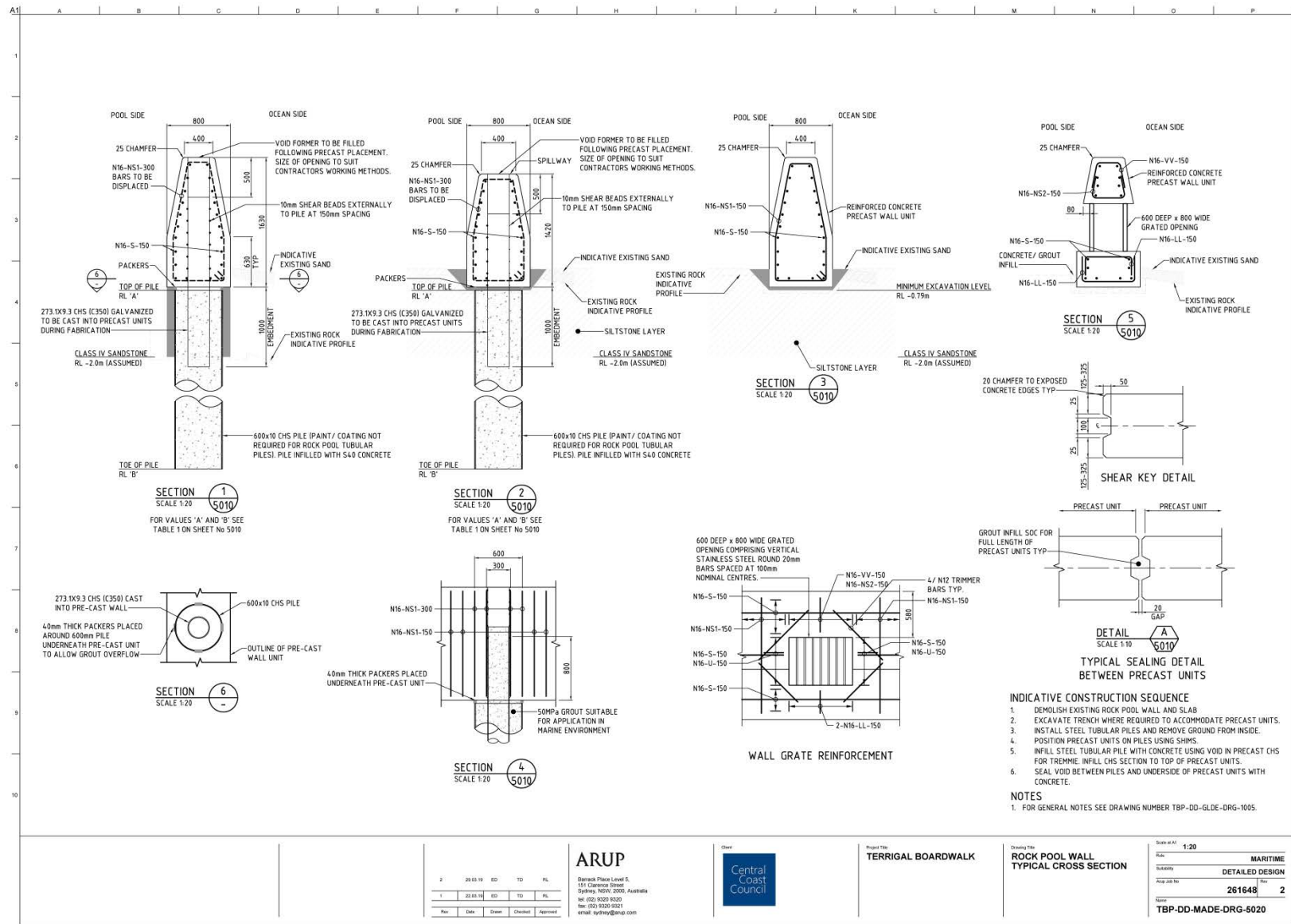


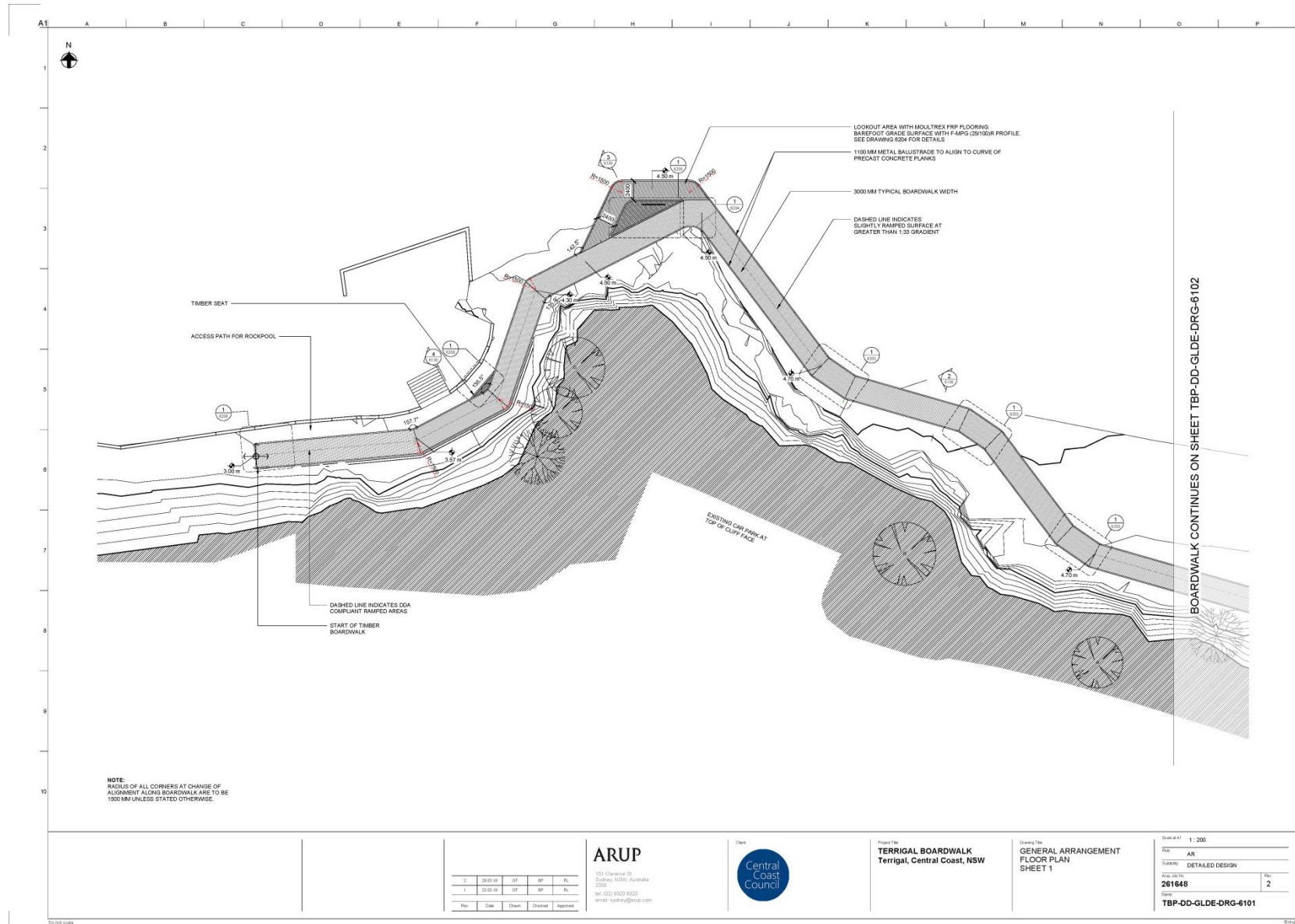


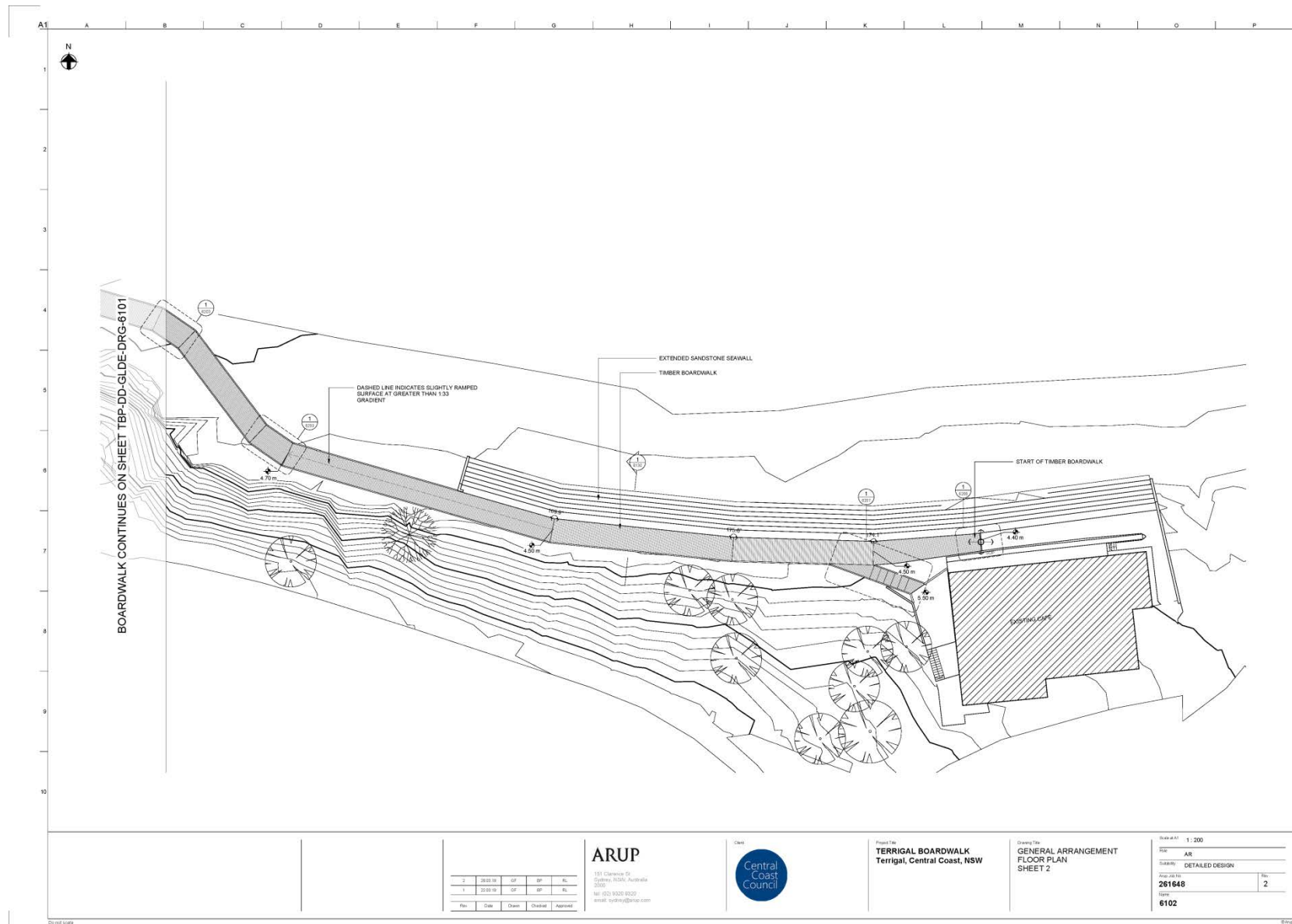


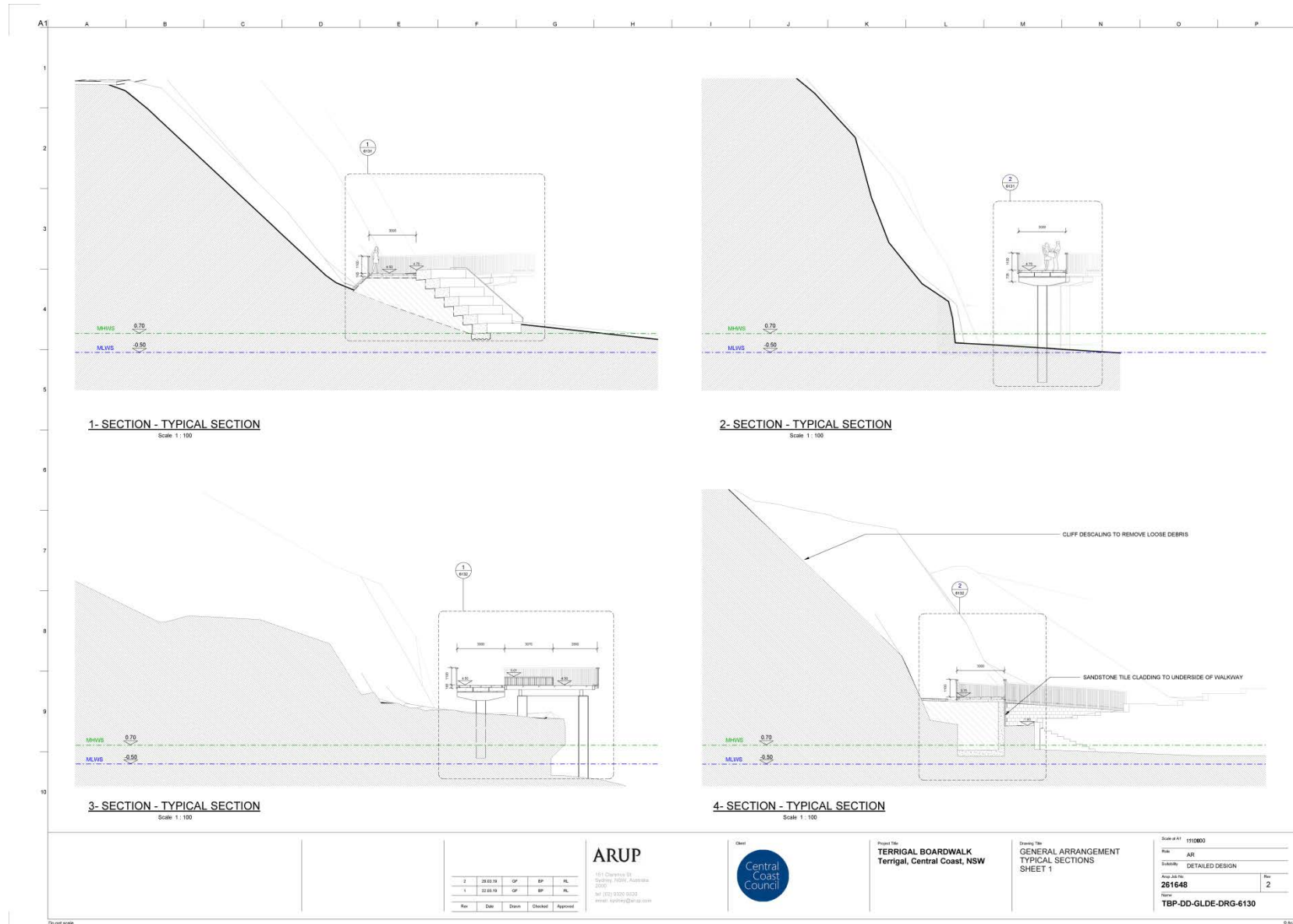


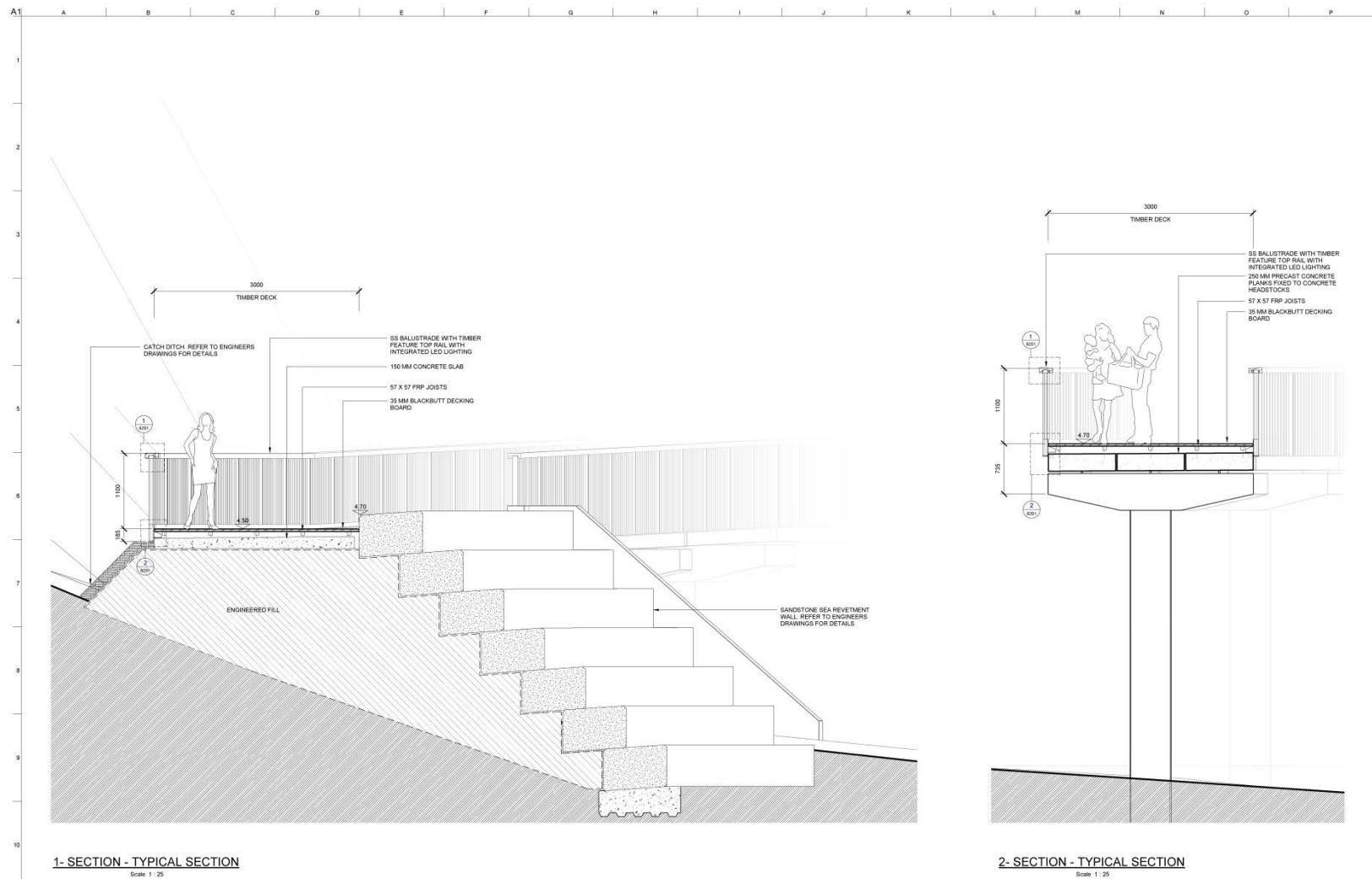




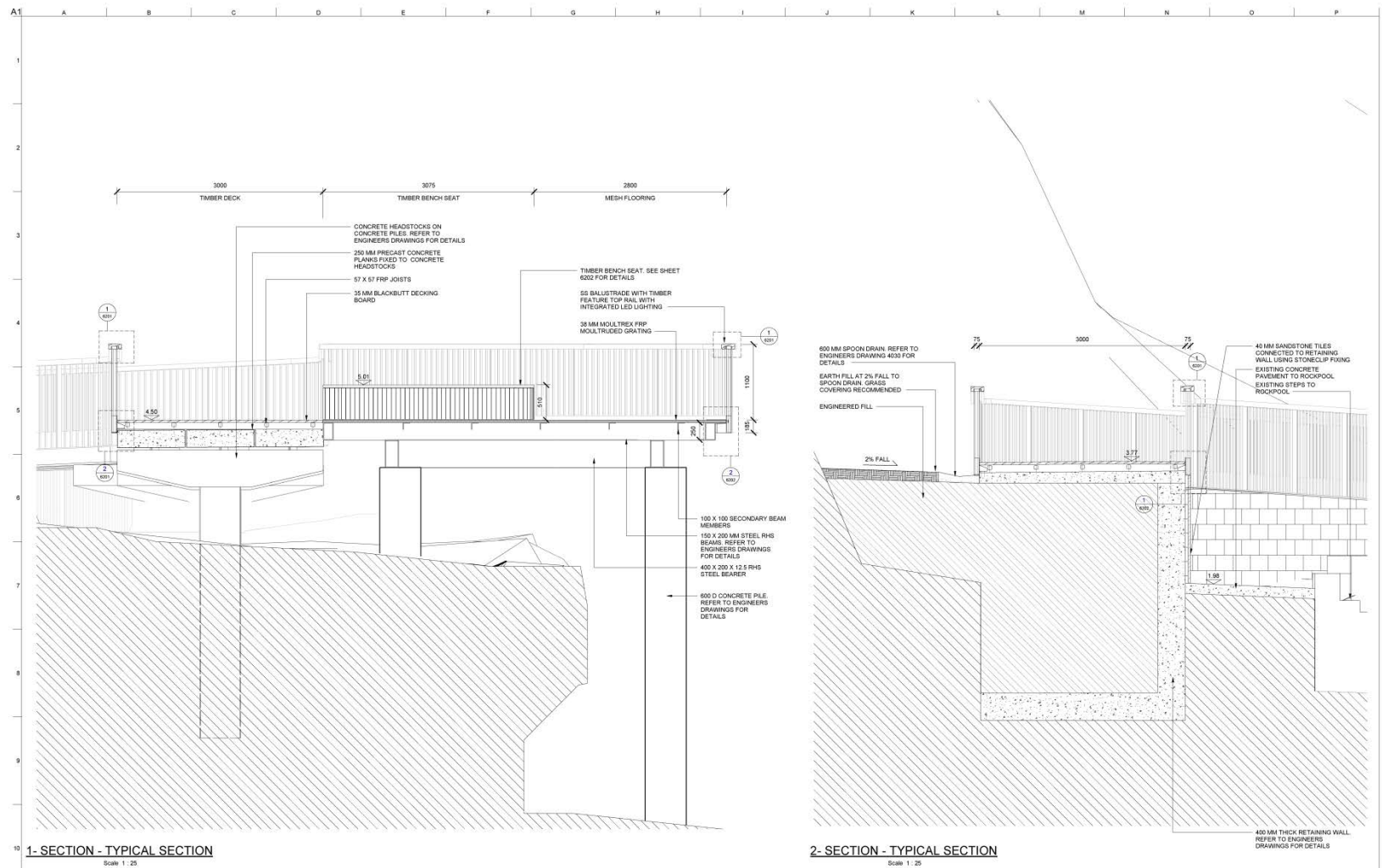








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2	20.03.18	GP	BP	RL							
1	22.03.18	GP	BP	RL							
Rev	Date	Drawn	Checked	Approved							



1- SECTION - TYPICAL SECTION

Scale 1:25

2- SECTION - TYPICAL SECTION

Scale 1:25

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Rev	Date	Drawn	Checked	Approved
2	28.03.18	GP	BP	RL
1	22.03.18	GP	BP	RL

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Client



Project Title

TERRIGAL BOARDWALK
Terrigal, Central Coast, NSW

Drawing Title

GENERAL ARRANGEMENT
TYPICAL SECTIONS
SHEET 3

Scale of A1

1:25

Rev

AR

Subsidiary

DETAILED DESIGN

App. Job No.

261648

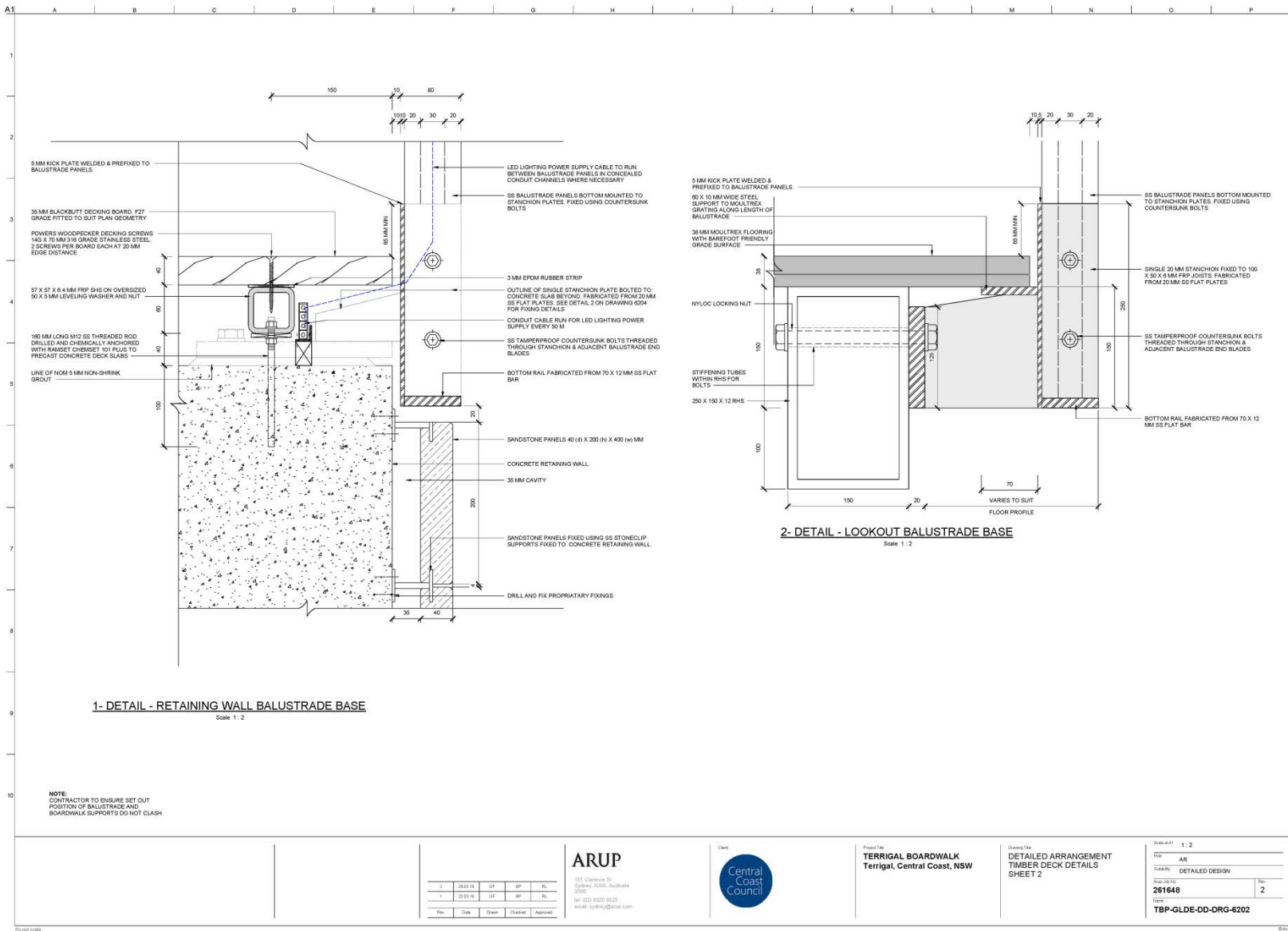
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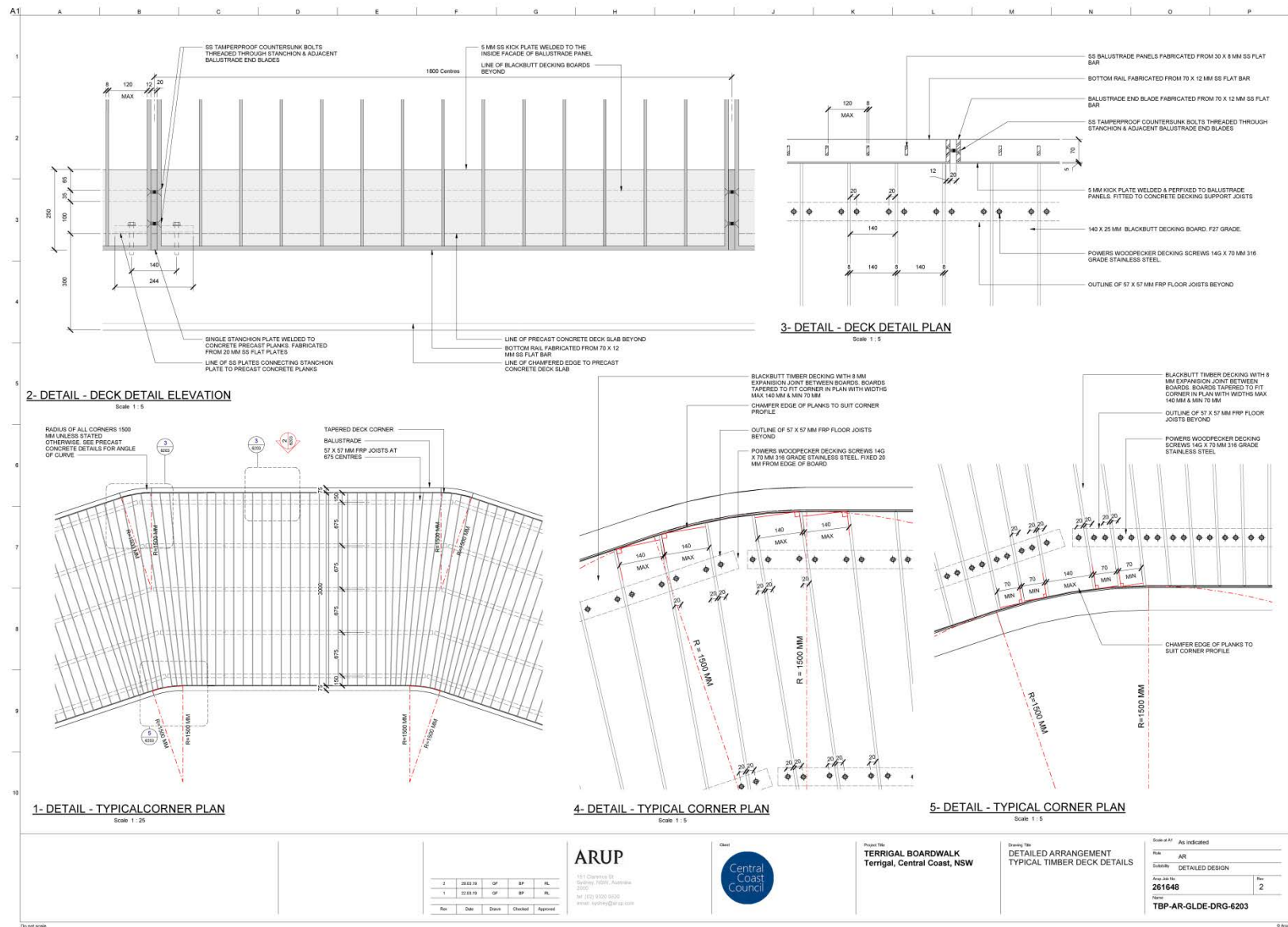
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TBP-DD-GLDE-DRG-6132



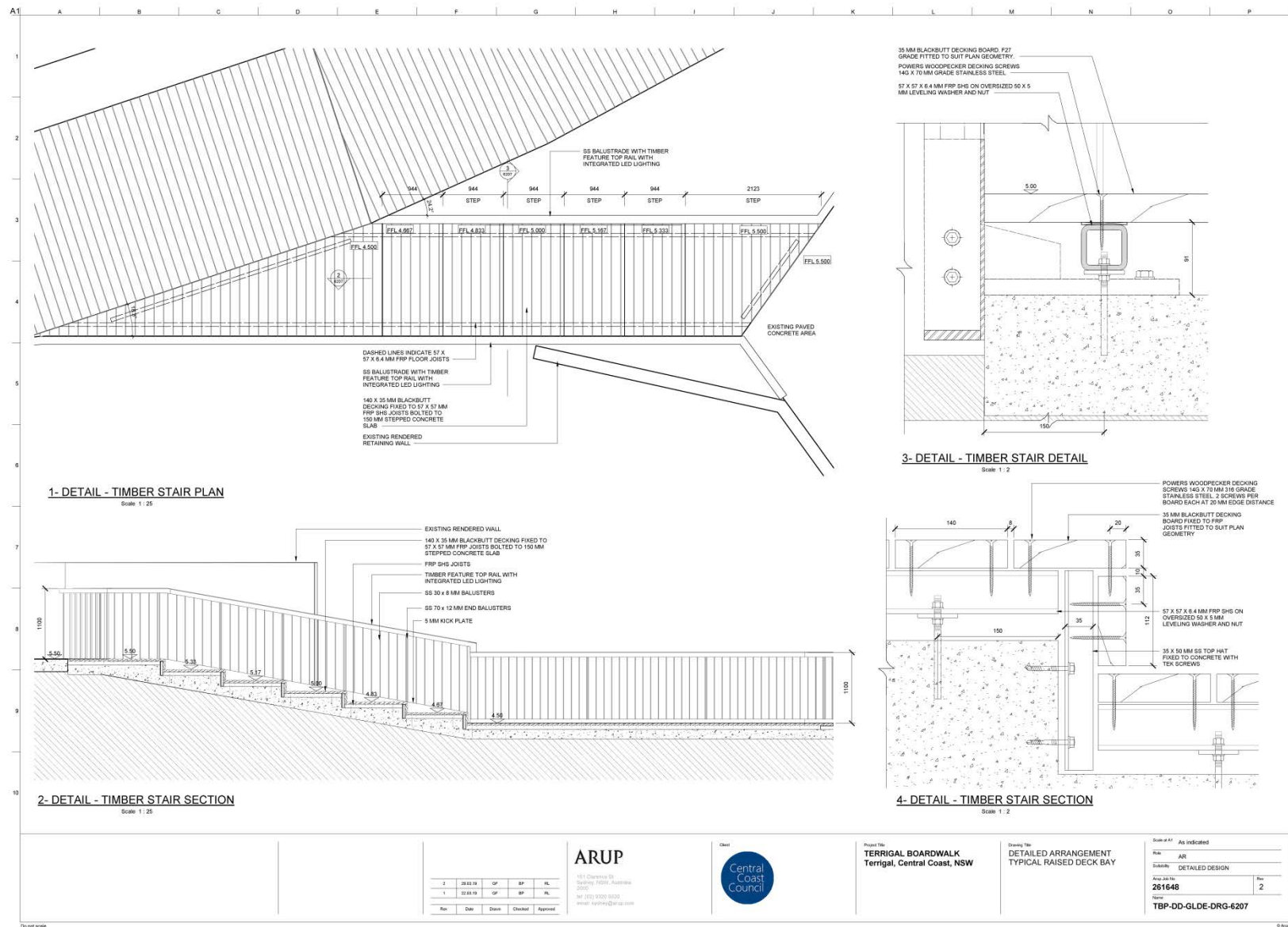
















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INTRODUCTION

Arup has developed this presentation to illustrate the preferred concept design for the Terrigal Boardwalk, which will connect Terrigal Beach Promenade to the Haven boardwalk.

It is Central Coast Council's ambition that the boardwalk would become a tourist attraction and a destination enhancing experience which compliments the natural coastal environment. This in addition to the boardwalk's key functional requirement of improving the amenity and accessibility for locals and tourists visiting the region.

The developed concept design features views and lookout platforms that take full advantage of the beautiful coastal views of the area and offers a safe and accessible means of travel for all users. Integrated seating and dedicated viewing platforms, composed of timber and perforated decking, allow people to linger and view the water beneath the viewing platforms.

Critical to the development of the design was to ensure the safety of the future boardwalk users. To do this the design and technical team have further assessed the following specific site constraints:

- » Coastal inundation and wave risk
- » Coastal hazard risk
- » Geotechnical conditions

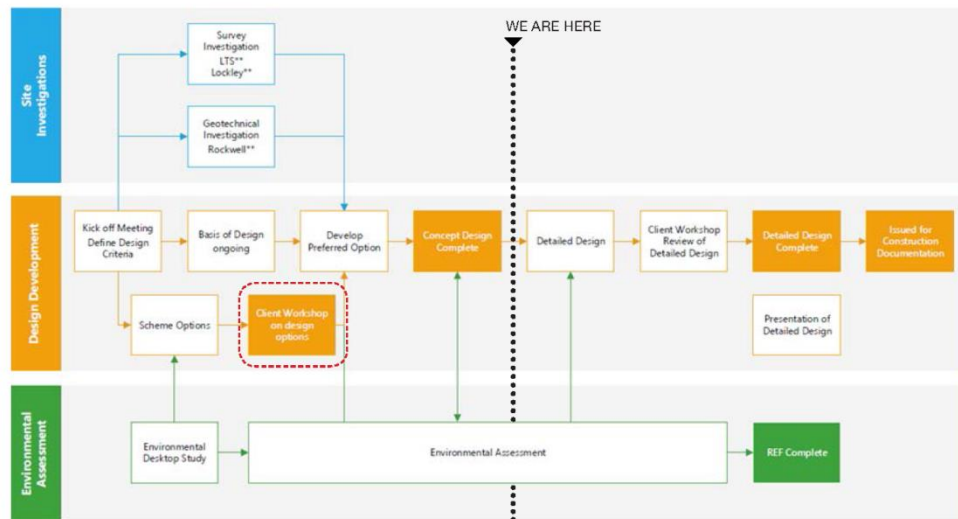
It is these factors, along with the architectural aspirations of the project that have progressed the form, alignment and structure.

2

PROJECT PROGRESS

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2 PROJECT PROGRESS |

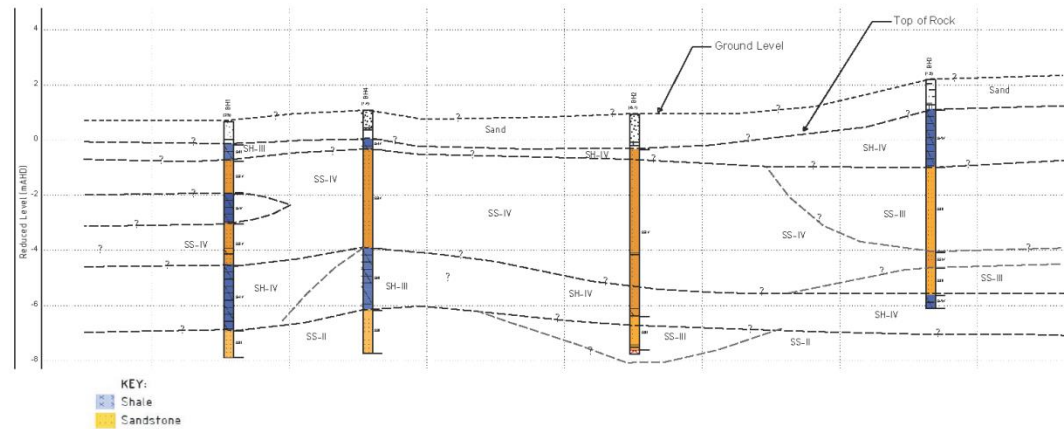


3

CONSTRAINTS & RISKS

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3.1 EXISTING CONSTRAINTS | Geotechnical Investigation



Preliminary Findings:

- » Rock was encountered at approximately 1m depth
- » Rock comprised of interbedded shale and sandstone
- » Based on the laboratory results, rock on first contact is suitable for an allowable bearing pressure of 1500kPa, improving to 8000kPa below RL-7mAHD.
- » Over the landside portion, bored cast in-situ piles are feasible. Temporary casing will be required through the sand to avoid collapse.
- » Over the seaside portion, driven circular piles into the top the wave cut platform, then extended further into the rock by auger to achieve required embedment.

Legend

Ground Investigation

- A BH - Borehole
- S DCP - Dynamic Cone Penetration

3.2 EXISTING CONSTRAINTS | Coastal Hazard Risk



Domain	Risk	Minimum offset from cliff face measured at deck level
1 & 2	Residual risk of minor debris	2m
3 & 4	Residual risk of minor rock fall	3m
5	Risk of rock fall	6m
6, 7 & 8	Risk of rock fall and debris fall	Due to geometric constraints, unable to accommodate adequate offset from the toe of the slope. Slope remediation in the form of descaling and installation of rock netting is required
9	Risk of debris fall is low	No offset required

» Domain 1 & 2

Residual risk of minor debris slides. Minimum offset of 2m from the slope to be maintained to avoid destabilising slope. A 'catch ditch' to be provided along boardwalk as mitigation for any debris fall, and be able to be cleaned out as required. Boardwalk height to be a minimum of 1.5m above the base of the 'catch ditch'.

Drainage path/culvert encountered in Domain 1. Must be maintained through proposed boardwalk without destabilisation of slope

» Domain 3 & 4

Residual risk of minor rock fall. However based on the existing shallow slope angle, similar mitigation measures as Domain 1&2 can be adopted. Minimum offset of 3m from the slope is required.

» Domain 5

Risk of rock fall. Minimum offset of 6m required. Slope remediation, in the form of rock netting attached to the slope will be required where the offset isn't accommodated. Remediation may also include 'dental' treatment of weathered seams with reinforced shotcrete and rock bolts.

» Domain 6, 7 & 8

Risk of rock and debris fall. Due to geometry constraints unable to accommodate adequate offset from toe of slope. Slope remediation, in the form of descaling (i.e. clearing of loose debris/boulders) and installation of rock netting is required.

» Domain 9

Risk of debris fall is low, minimal to no remediation required.

3.3 COASTAL HAZARD ASSESSMENT | Metocean Parameters

Present day and future tide levels at Ettalong Sydney (2018 & 2069 projections)

Tide Level	Present Day (2018)		Year 2069	
	(CD) ¹	(AHD)	(CD)	(AHD)
Highest Astronomical Tide (HAT)	2.1	1.2	2.5	1.6
Mean High Water Springs (MHWS)	1.6	0.7	2.0	1.1
Mean High Water Neaps (MHWN)	1.4	0.5	1.8	0.9
Mean Water Level (MWL)	1.01	0.1	1.4	0.5
Mean Low Water Neaps (MLWN)	0.6	-0.3	1.0	0.1
Mean Low Water Springs (MLWS)	0.4	-0.5	0.8	-0.1
Lowest Astronomical Tide (LAT)	0.0	-0.9	0.4	-0.5

Source: Australian National Tide Tables (2018) for Fort Denison.

(1. CD = Chart Datum which approximates to LAT and is about 0.93m below AHD)

2. Sea level rise adopted as 0.41m for 2069 (interpolated from Gosford City Council Coastal Zone Management Plan 2017)

Extreme water levels adopted for Terrigal Beach (2018 & 2069 projections)

Average Recurrence Interval (ARI) (years)	Present Day (2018) Extreme Still Water Level		2069 Extreme Still Water Level	
	m CD ¹	m AHD	m CD	m AHD
20	2.34	1.41	2.75	1.82
50	2.39	1.46	2.80	1.87
100	2.42	1.49	2.83	1.90
500 (extrapolated)	2.50	1.57	2.91	1.98

Source: Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study. This study assumes the Fort Denison extreme water levels to be representative of the conditions between Patonga and Forsters Beach.

(1. CD = Chart Datum which approximates to LAT and is about 0.93m below AHD)

Offshore and nearshore wave parameters adopted for Terrigal Beach

Average Recurrence Interval (ARI) (years)	Offshore Hs ¹ [m]	Nearshore Hs ¹ [m] (0.35 coefficient)	Tp ² [s]
1	4.8	1.7	9.6
50	6.6	2.3	11.2
100	7.0	2.5	11.6
500	No information available, assumed depth limited at boardwalk location		

Source: Open Coast and Broken Bay Beaches Coastal Processes and Hazard Definition Study. Offshore wave conditions from the East are adopted. The nearshore wave coefficient of 0.35 for Southern Terrigal Beach is adopted as per refraction / diffraction analysis conducted by Lawson and Treloar (1984).

(1. Hs = significant wave height, defined as the average of the highest 1/3 of waves generated during the storm duration)

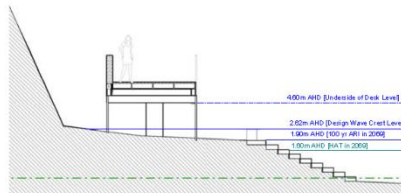
2. Tp = peak wave period, defined as the wave period with the highest frequency in the wave spectrum)



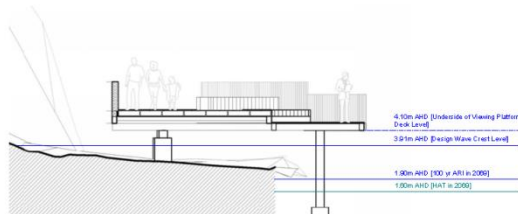
Aerial image of Terrigal Beach waves from the SE diffracting around the Terrigal headland

3.4 COASTAL HAZARD ASSESSMENT | Wave Crest Assessment

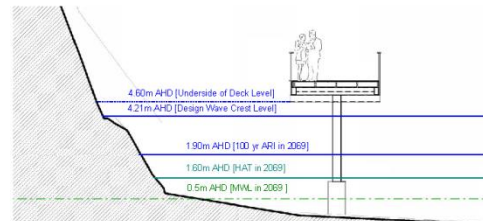
CROSS SECTION 1 - WALKWAY



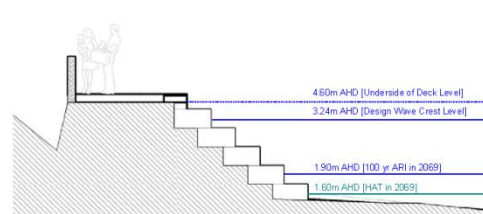
CROSS SECTION 2 - ROCK PLATFORM



CROSS SECTION 3 - TERRIGAL BEACH



CROSS SECTION 4 - HAVEN SEAWALL



Design Considerations:

Wave Loading

Wave loading has been considered on the piles of the boardwalk, and on the structure itself (breaking wave load)

Scour of Seawall

Extension of the seawall along the beach requires an assessment of scour at the toe of the seawall

Opportunity to design the seawall to rock to avoid scour potential

Overtopping

The potential for wave overtopping is considered at each location along the boardwalk

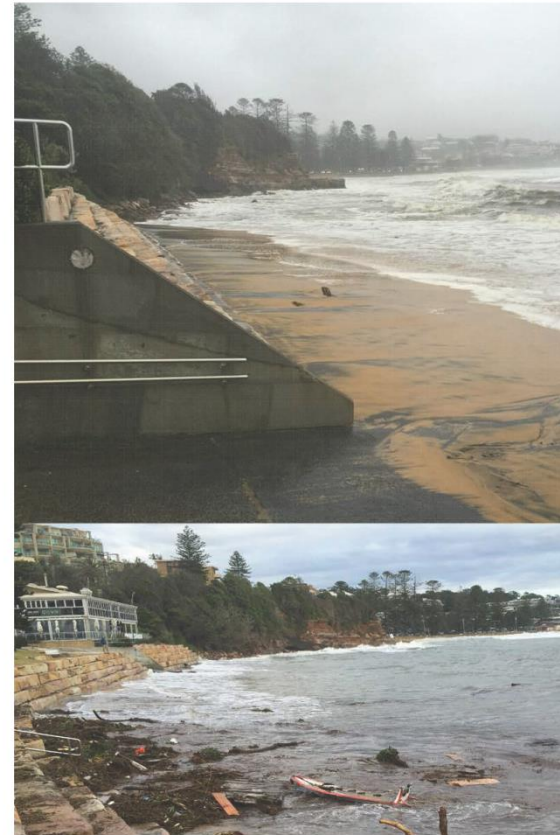
Drainage design required at the Haven for overtopping of the seawall

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3.5 COASTAL HAZARD ASSESSMENT | Wave Climate



Calm wave conditions at Southern Terrigal Beach (Aerial photo from June 2018)



South Terrigal Beach following the storm in June 2016

3.6 EXISTING CONSTRAINTS | Environmental Constraints Map



Public Consultation 24 November 2018 Concerns:

1. The loss of public beach at the Haven from the extension of the sandstone wall
2. Impacts to marine ecology from construction of the boardwalk
3. Boardwalk is out of scale and character for the area
4. Increased safety issues (e.g. people may be tempted to jump from the boardwalk)
5. May result in sediment transport, erosion and localised scouring

Environmental Constraints

Biodiversity:

1. Coastal headland vegetation (degraded)
2. Intertidal species (macro-algae, molluscs and encrusting sponges)
3. Coastal bird species

Visual:

4. Viewpoint: Terrigal Beach
5. Viewpoint: Terrigal Esplanade
6. Viewpoint: Haven Precinct
7. Viewpoint: Ocean

Sea Level Rise:

8. Sea level rise predicted over 50 years design life

Noise/Air Quality:

9. Short term adverse impacts during the construction period

Socio-economic:

10. Adverse impacts to existing recreational activities on the rock platform and in the vicinity of the boardwalk during construction and operation

Traffic:

11. Minor increase in traffic expected during construction

Access:

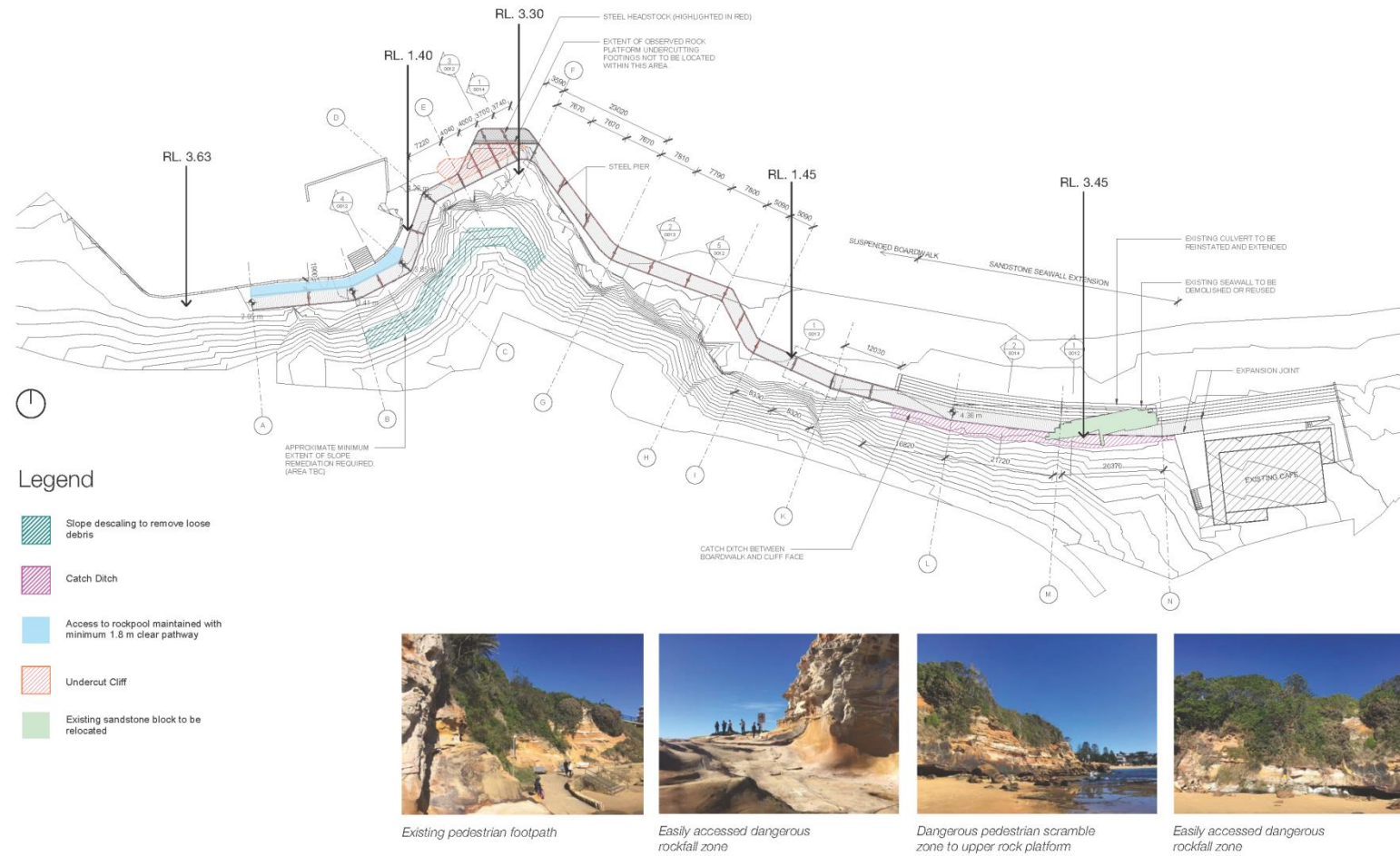
12. Terrigal rock pool would be restricted during construction
13. Adequate parking for construction vehicles would be available

Aboriginal Heritage:

N/A. CCC has followed up with the Local Aboriginal Land Council

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3.7 EXISTING CONSTRAINTS | Site Analysis



4

DESIGN CRITERIA

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4 DESIGN CRITERIA

Functional Requirements:

- » Provide public access (i.e. continuous path) between the existing pedestrian links along Terrigal Beach and the Haven precinct
- » Provide similar functionality to the existing beach footpath, in terms of width and loading requirements
- » Be DDA compliant
- » Minimise or mitigates against potential adverse environmental impacts
- » Provide a minimum 50 year design life
- » Provide for the safety and security of users
- » Minimise maintenance requirements over the design life of the structure
- » Be able to be practically and safely constructed and maintained

Architectural Principles:

- » Statement design that meets the assigned Central Coast Council budget of \$5 million
- » A design that celebrates the natural beauty of the site
- » Simple and appropriate materials within the coastal context
- » Integrate LED lighting into the walkway
- » Provide for a separate standing/viewing platform(s) along the boardwalk with seating
- » Provide suitable areas along the boardwalk that could be used for displaying public art
- » Highlight the significance of the HMAS Adelaide shipwreck (if possible)
- » Refer to Arup Design Basis document for design parameters and criteria



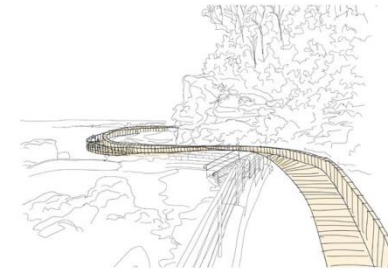
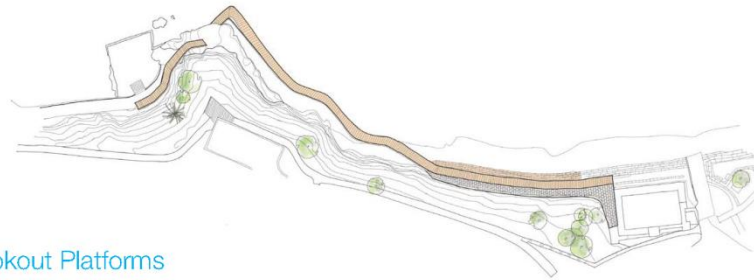
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OPTIONS & EVALUATION RECAP

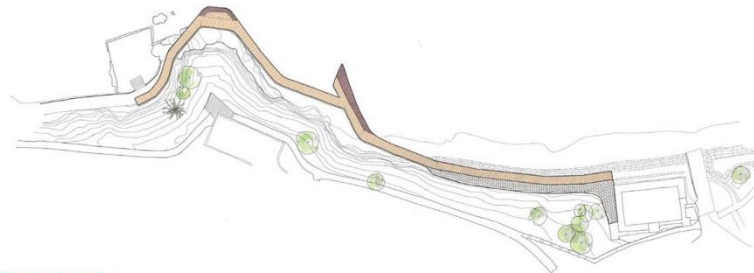
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5 OPTIONS RECAP

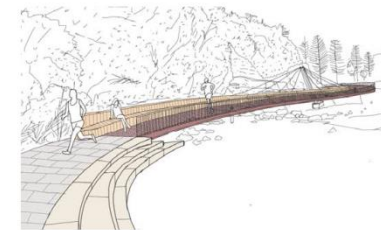
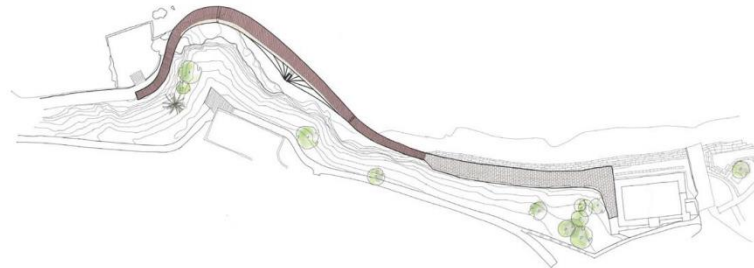
Option 1 | Nature Walk



Option 2 | Views and Lookout Platforms


















Option 3 | Cable Stayed Boardwalk

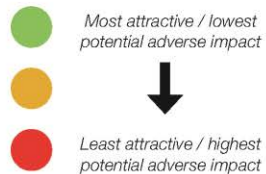


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5 EVALUATION OF OPTIONS RECAP

Factor	Environmental Impact	Capital Cost	Design and Constructibility Risk	Statement Design	User Experience
Option 1	Lowest materials (CO2) and visual impact, but most impact on beach, ecology and coastal processes 		Conventional design and construction 	Much simpler design 	Least amount of dwell space and seating areas 
Option 2	Less impact on beach, ecology and coastal processes than Option 1, but more materials and visual impact 		Involves relatively more over water works 	Can have architectural wow factor 	Maximises amount of dwell space and seating areas 
Option 3	Maximum materials (CO2) and visual impact 		Most complex option for design and construction 	Can have architectural and structural wow factor 	No viewing platforms, but more dwell space 

Legend

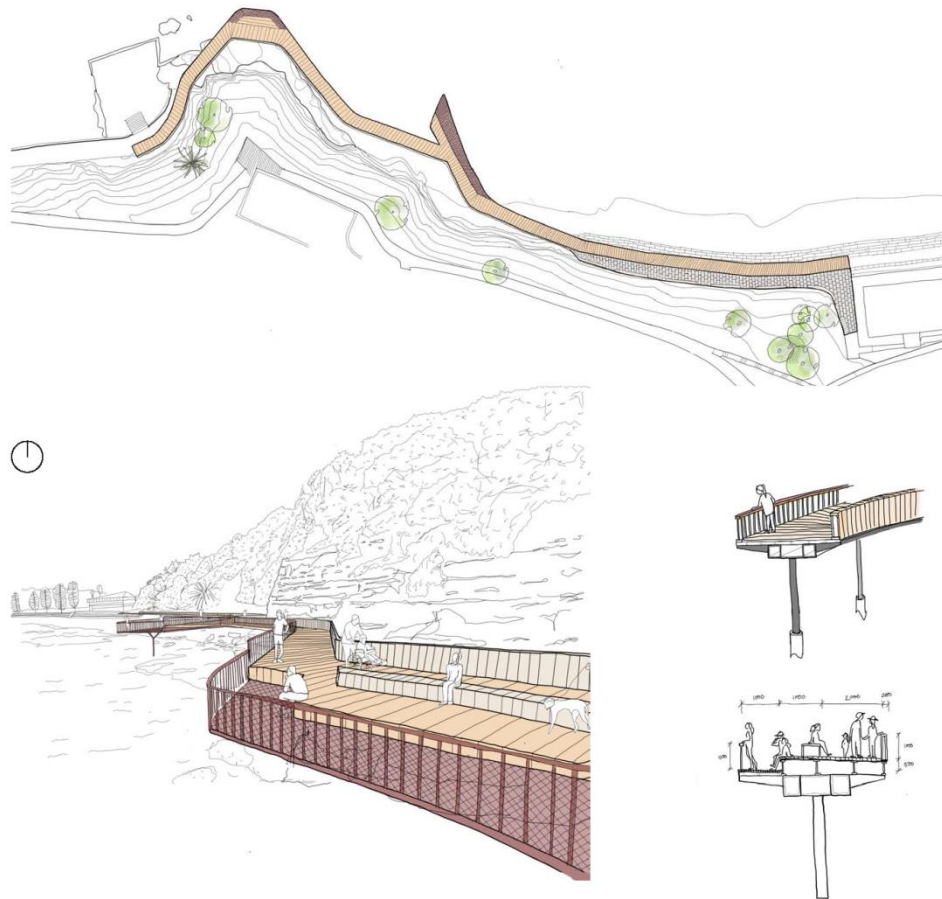


Note the following areas have not been included in the matrix as they are considered minimum functional requirements

- » DDA compliance
- » Operations and Maintenance
- » Safe for public use

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5 OPTION 2 | Views and Lookout Platforms



Option 2 Summary:

Elevated boardwalk with integrated seating and viewing platforms. Composed of timber and perforated metal decking that allows people to view the water beneath the viewing platforms.

Common Theme: Eastern promenade is extended out and widened. Sandstone steps have been added to allow for greater connection down to the sand.

Opportunities:

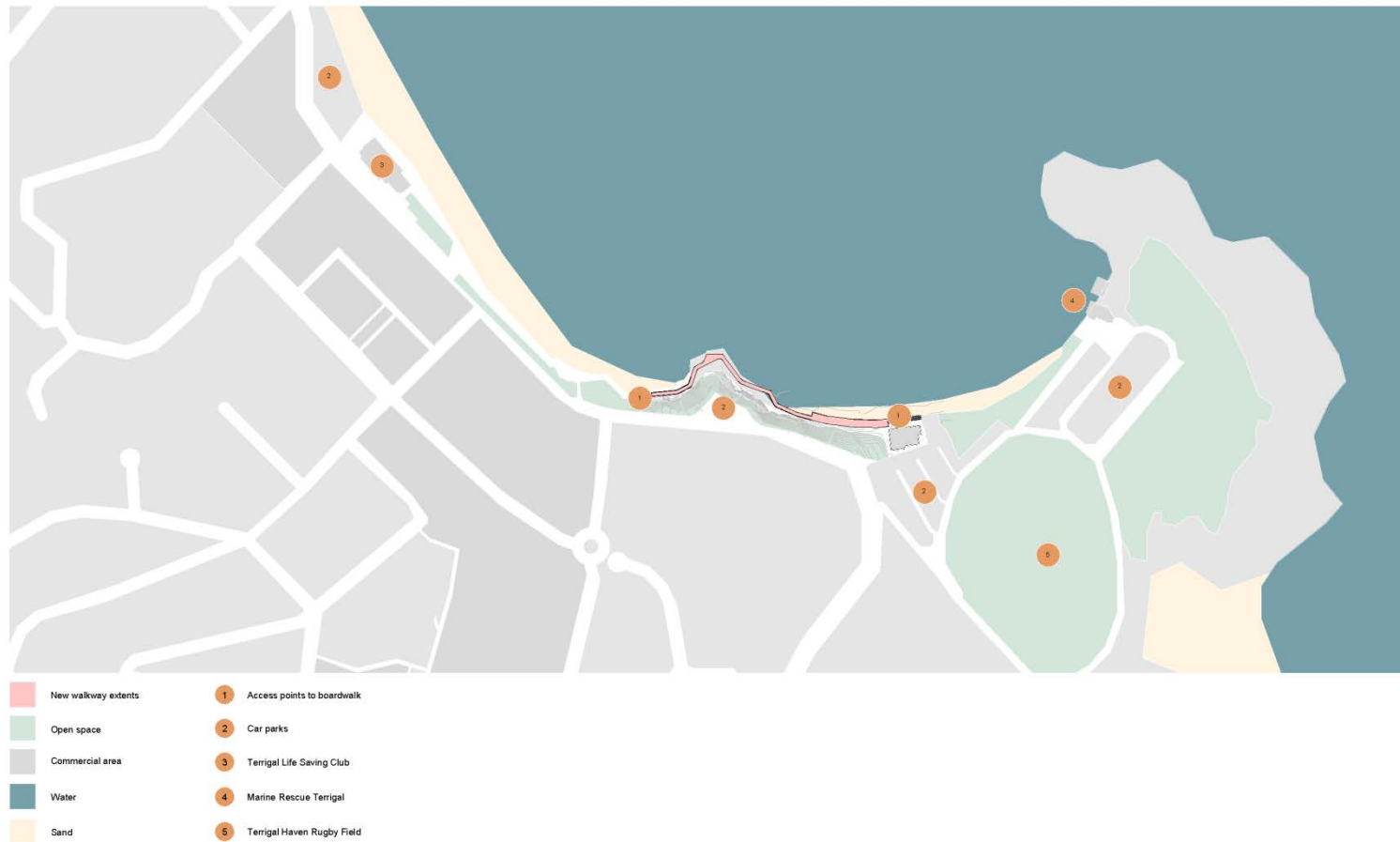
- » Creates viewing opportunities to Terrigal surroundings through dedicated lookout spaces.
- » Use of differing materials signals the two types of boardwalk areas (lookouts and boardwalk path).
- » Opportunity to integrate lighting into design.
- » Enhanced user experience.
- » Existing rock shelf can be used for temporary coastal art installations.
- » Boardwalk prevents people from dangerous access up to rock platform.
- » Accessible means of access along entire boardwalk. Gradual 1:35 ramp takes users up to the main level of the boardwalk from the West.
- » Metal mesh component of boardwalk decreases the environmental impact of overshadowing underneath.

"Lightweight mixed material boardwalk with integrated seating and two viewing platforms. Perforated decks allow for light penetration and views to water and rock formations below."

6

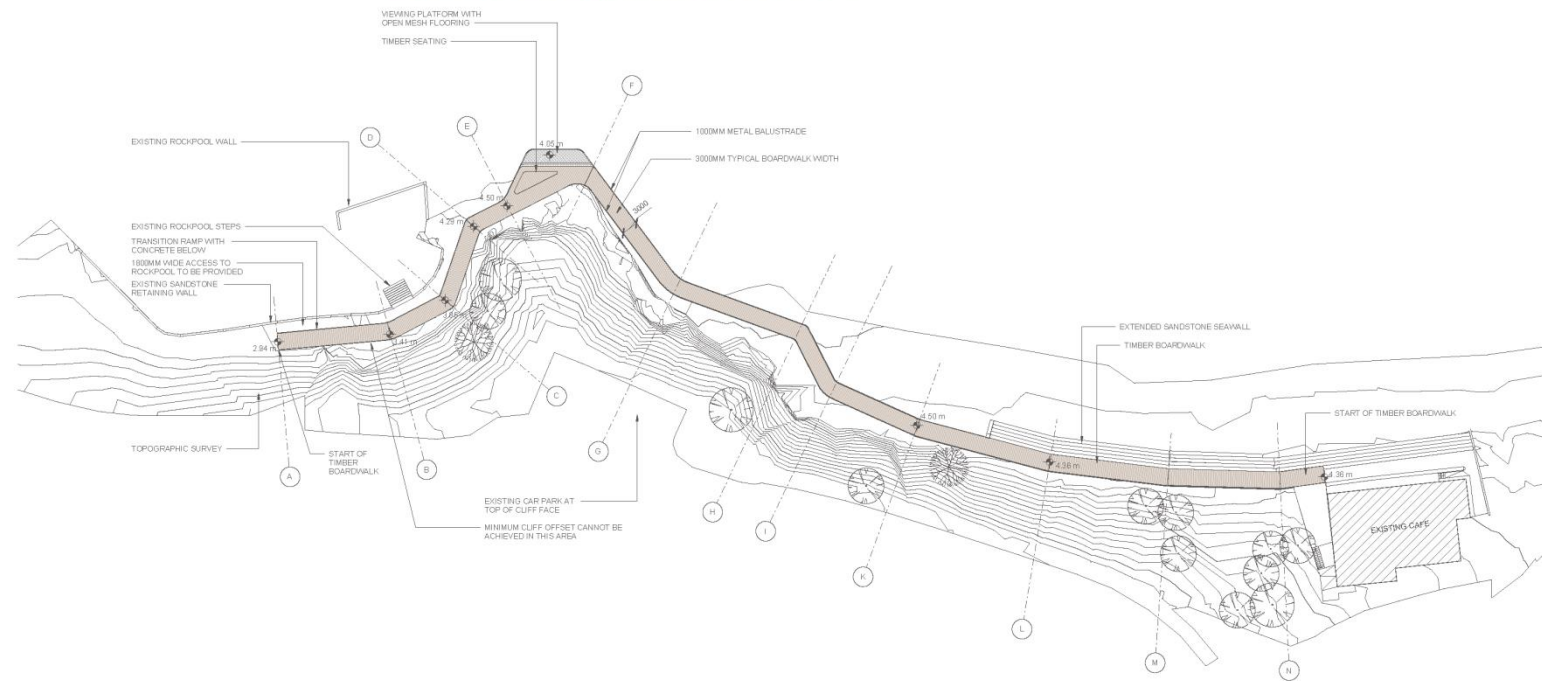
CONCEPT
DESIGN
OCTOBER
2018

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6 CONCEPT DESIGN | [Site Plan](#)

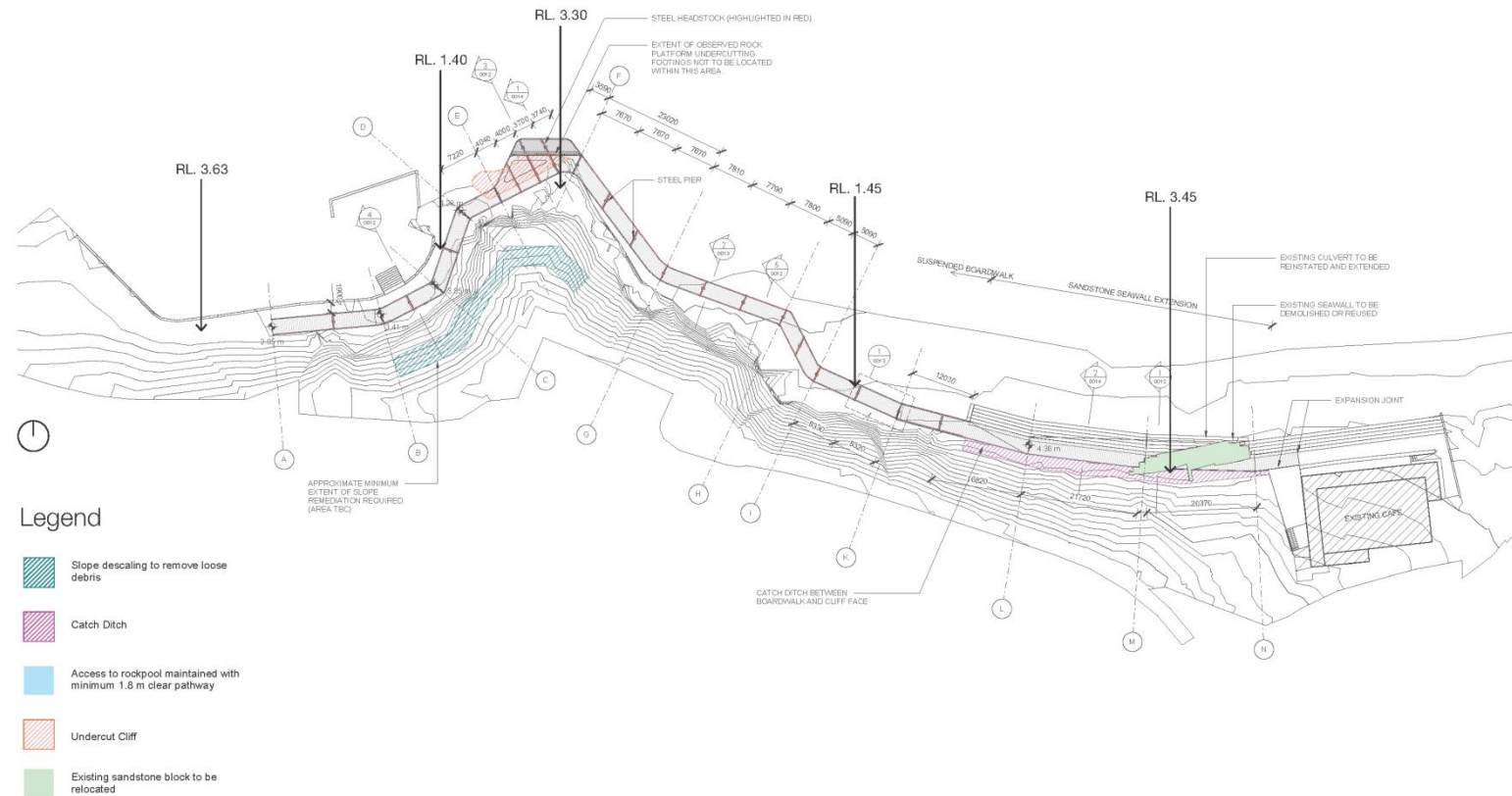
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6 CONCEPT DESIGN | General Arrangement Floor Plan



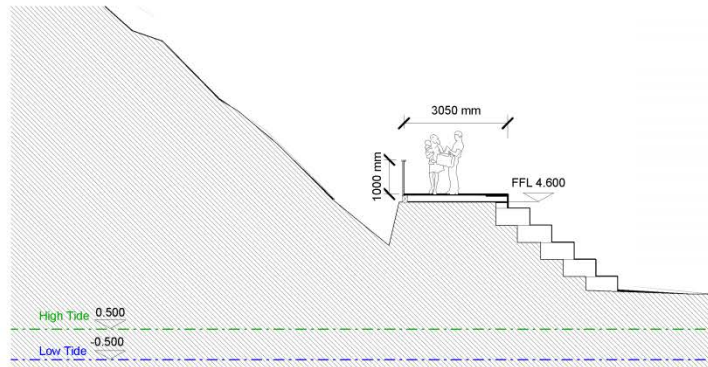
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6 CONCEPT DESIGN | Substructure Plan

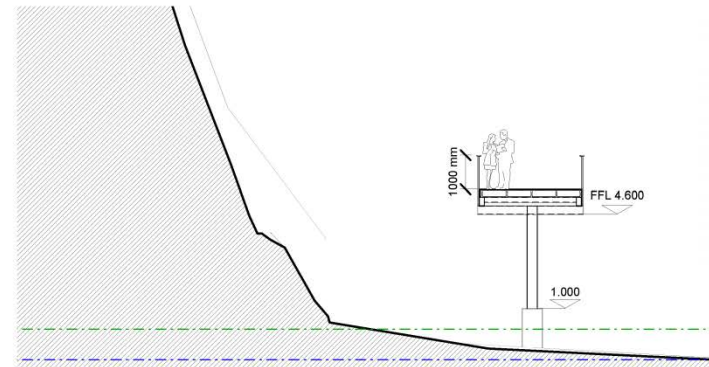


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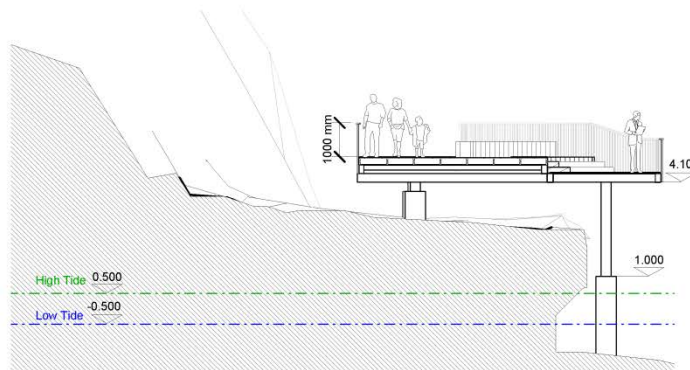
6 CONCEPT DESIGN | Typical Sections



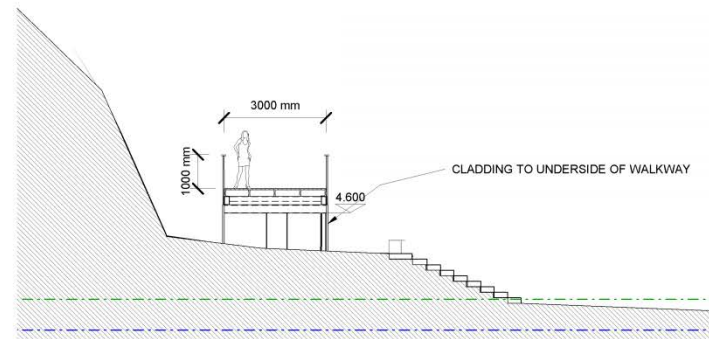
TYPICAL SECTION A



TYPICAL SECTION B

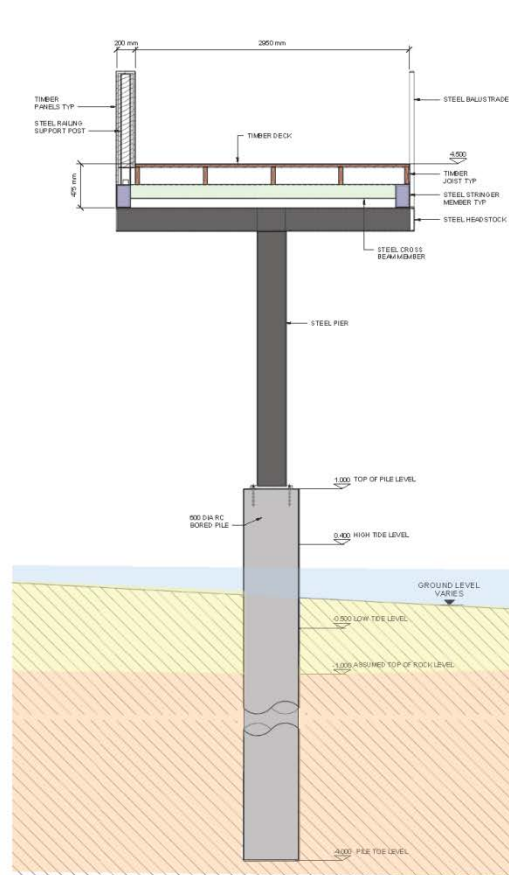


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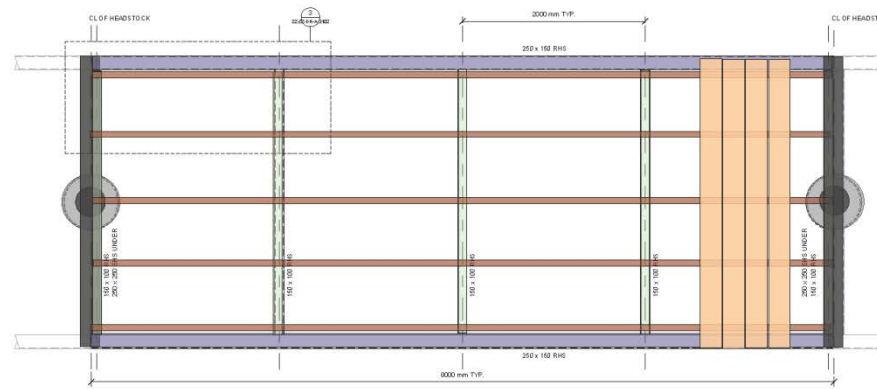


TYPICAL SECTION D

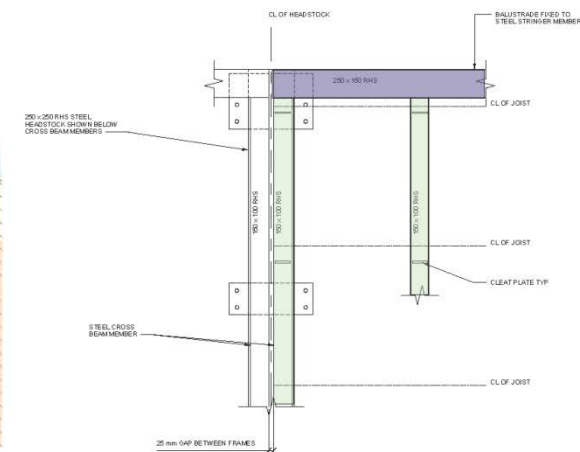
6 CONCEPT DESIGN | Detail Sections



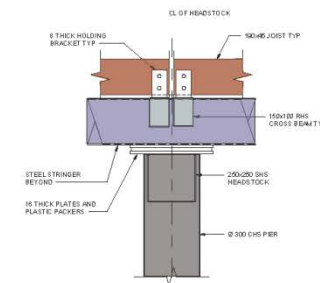
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Scale 1 : 20



1- Plan - TYPICAL FRAMING DETAIL PLAN
Scale: 1:20



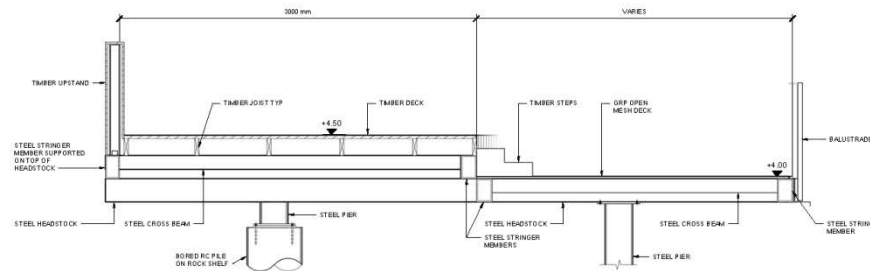
3- Detail - TYPICAL FRAMING DETAIL PLAN AT CORNER
Scale 1:10



4- Section - HEADSTOCK SECTION
Scale 1 : 90

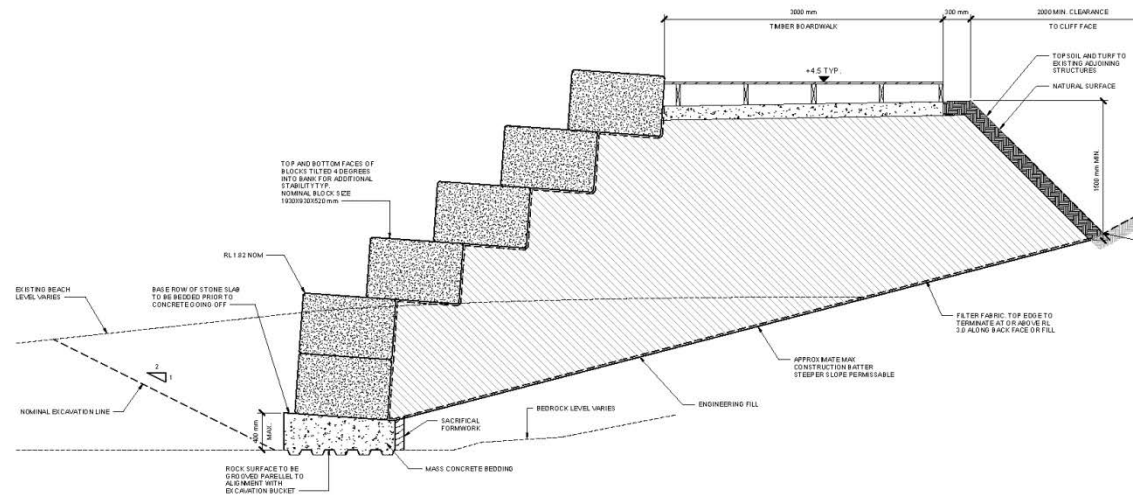
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6 CONCEPT DESIGN | Detail Sections



1- Section - LOOKOUT SECTION

Scale 1:30



2- Section - SLAB ON GROUND DETAIL

Scale 1:30

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6 CONCEPT DESIGN | Visuals

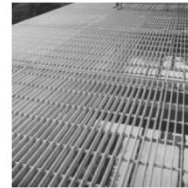


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6 CONCEPT DESIGN | Visuals



6 CONCEPT DESIGN | Material Palette



Aluminium grating



Timber decking



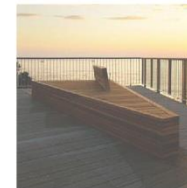
Weathered steel grating



Timber upstand



Fibreglass grating



Timber seating



Sandstone wall

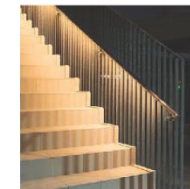


Flat metal balustrade

Three most durable species:

1. Spotted Gum
2. Accoya
3. Blackbutt

(As the timber is exposed to the sun, any timber species will have a degree of greying due to sun exposure.)



Integrated handrail LED lighting



Low level skirting LED lighting

Balustrade can be a choice of:



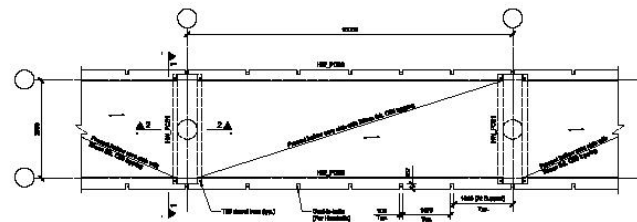
1. Uncoated stainless steel
2. Powdercoated aluminium or steel



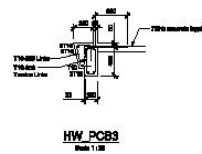
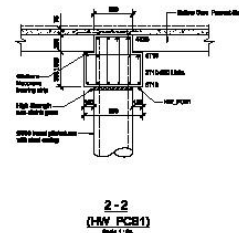
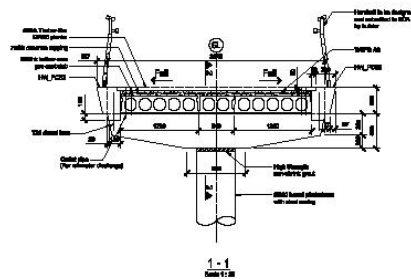
DEVELOPMENT
SINCE CONCEPT
DESIGN

ARUP

7.1 CONCEPT DESIGN | Alternative Deck Option

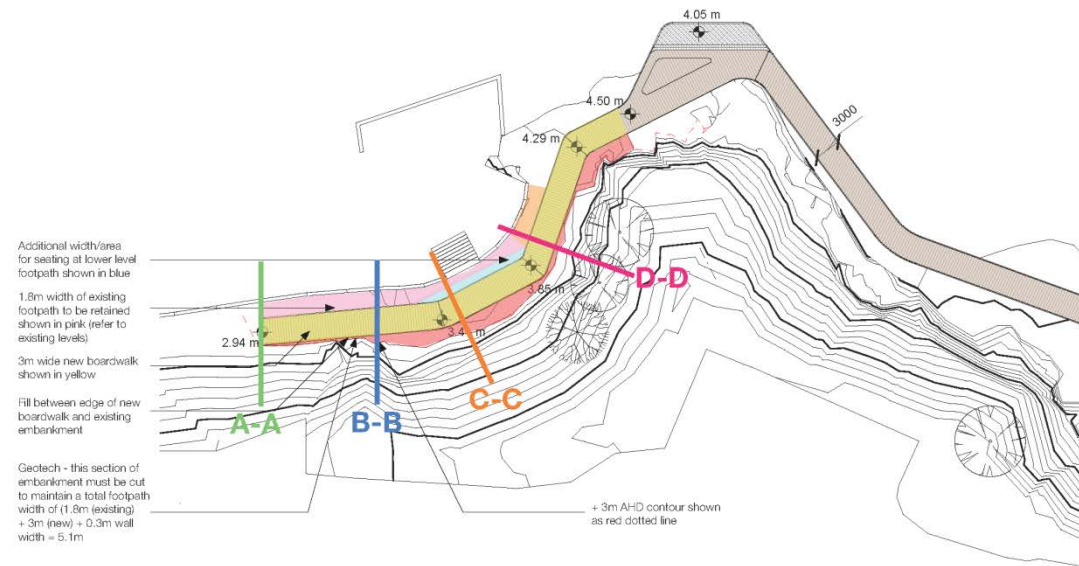


Detail B
Typical part plan of Harbour View Walk
Scale 1:50

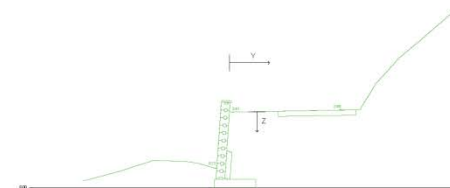


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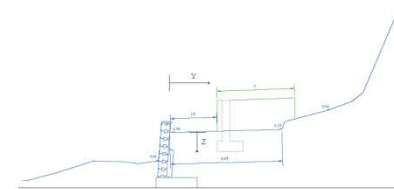
7.2 CONCEPT DESIGN | Western End Layout



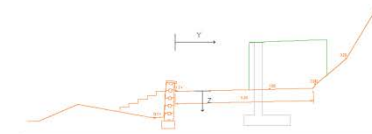
Proposed retained walkway: Section A-A



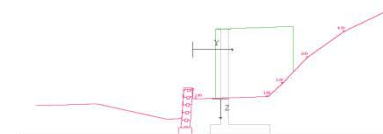
Proposed retained walkway: Section B-B



Proposed retained walkway: Section C-C



Proposed retained walkway: Section D-D

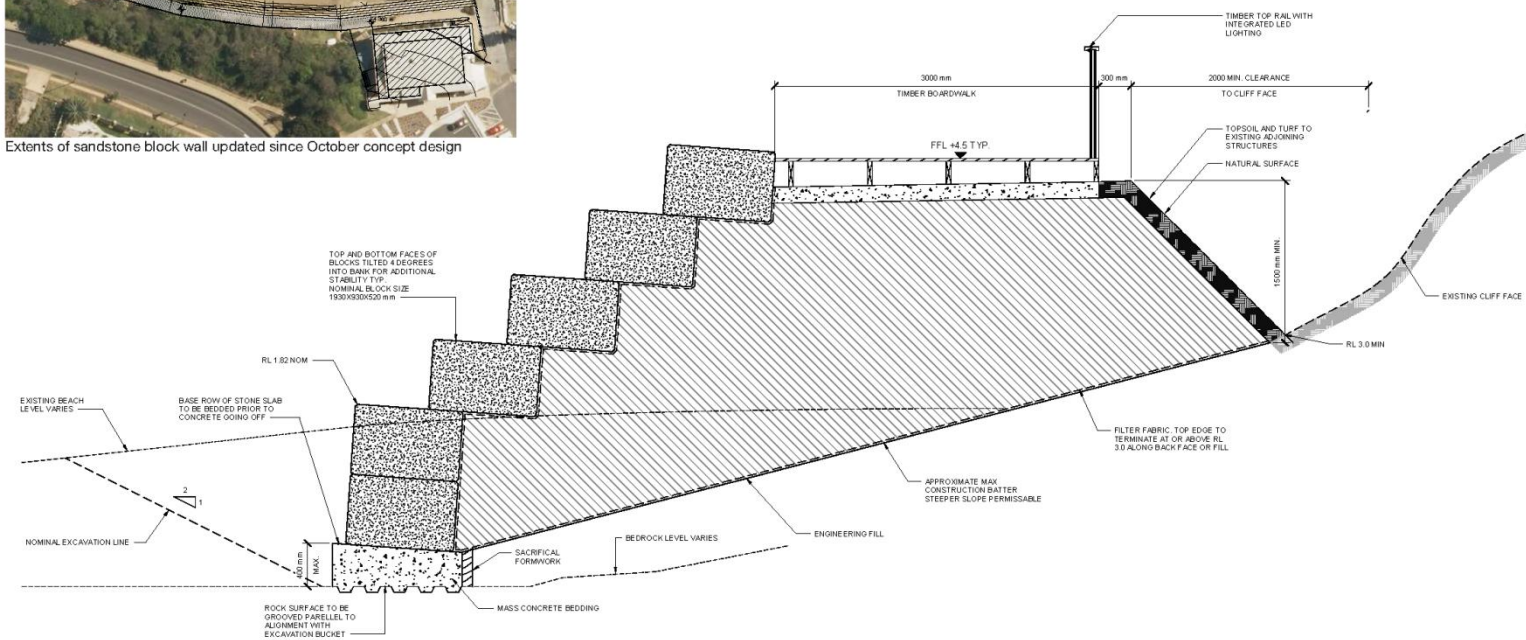


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7.3 CONCEPT DESIGN | Sandstone Block Wall



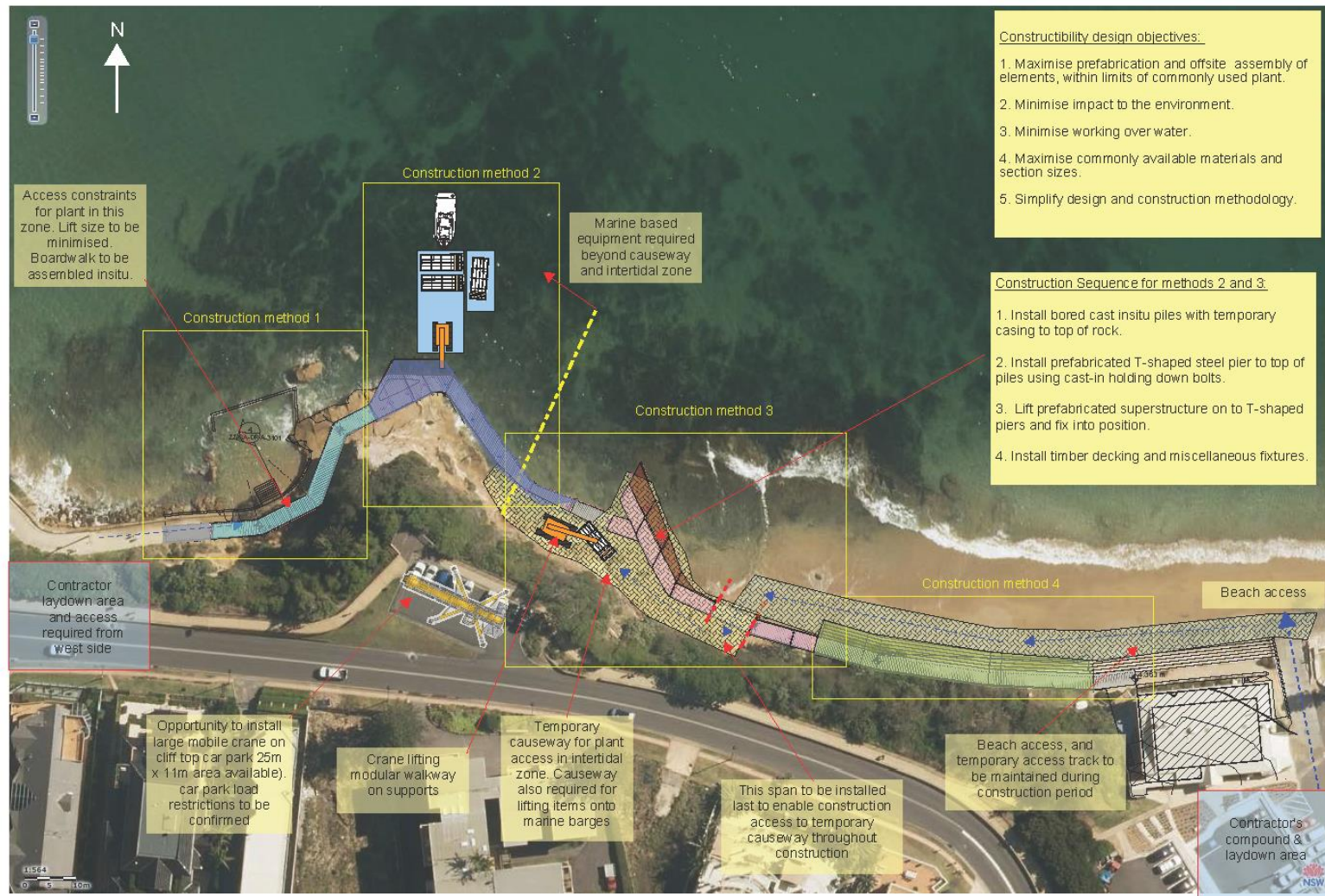
Extents of sandstone block wall updated since October concept design



Sandstone block wall detail

8

CONSTRUCTABILITY



9

KEY RISKS & NEXT STEPS

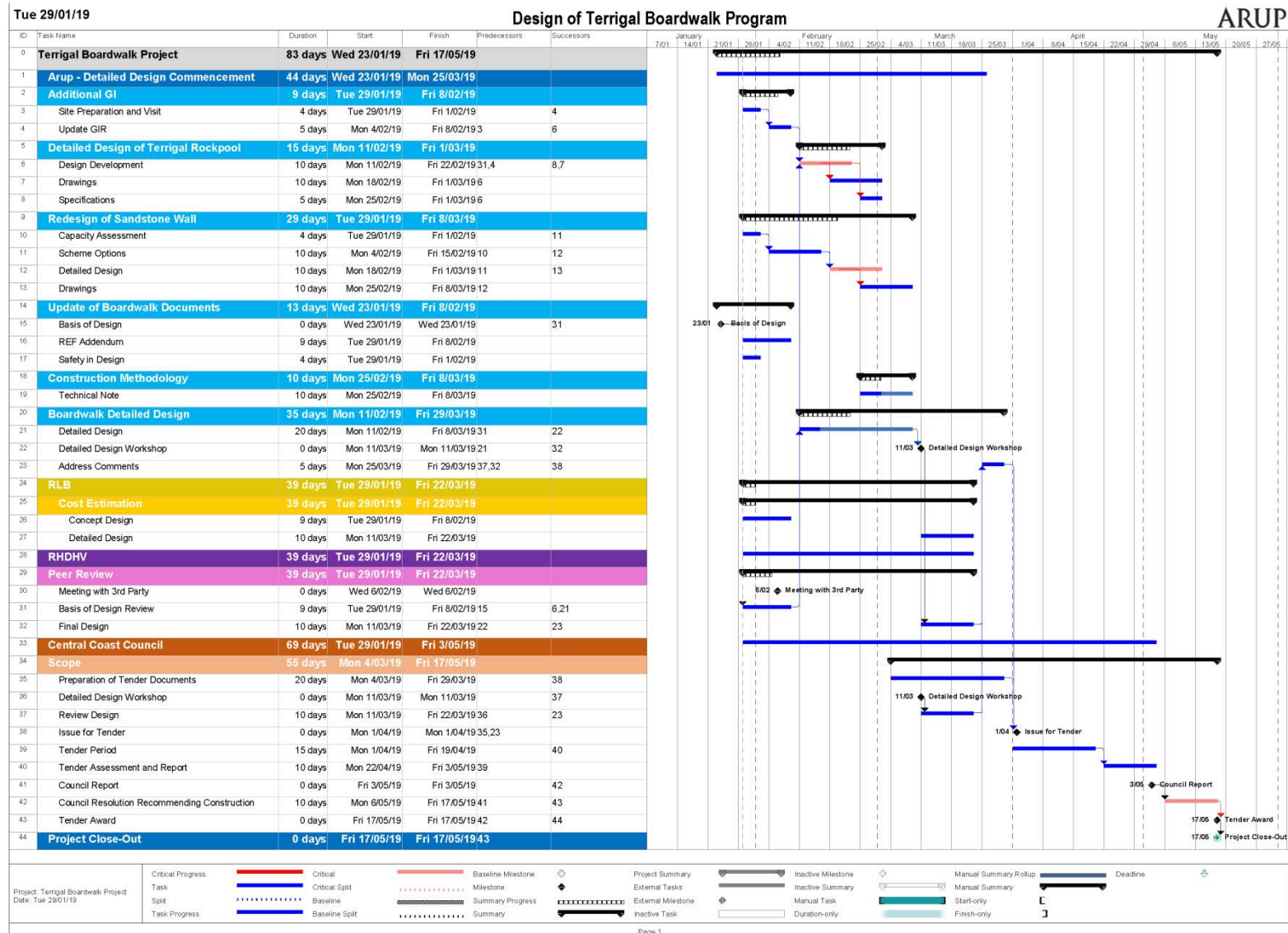
ARUP

8. SUMMARY OF KEY RISKS

No	Type	Risk	Mitigation
1	Commercial	The cost of boardwalk construction greater than what was originally budgeted by Central Coast Council.	Central Coast Council to carry out cost estimates at the end of concept design and during detailed design stages to understand key cost items. Value engineering can then be carried out accordingly.
2	Community	General objection to the boardwalk design being proposed. Construction of boardwalk may not go ahead.	Central Coast Council to carry out a sufficient level of community consultation.
3	Design	Damage to boardwalk during storm event. Underestimate of environmental conditions due to lack of available information. Boardwalk will inherently get damaged due to proximity and level to the sea.	Locate deck level as high as practicable above wave crest height to avoid wave slam and potential damage. Acceptable level of damage to boardwalk elements to be confirmed with Council.
4		Material change in the design from concept to detailed design, requiring the completion of an environmental consistency review and in the worst case, an addendum to the REF.	Environment personnel to be involved during the detailed design stage to review any material changes to the boardwalk design and inform the team of the potential implications of them.
5	Construction	Design difficult and unsafe to build given the challenging environment constraints, resulting in potential cost and programme implications.	Constructability to be considered in the design. Early contractor involvement advised.
6		Unforeseen ground conditions leading to cost and programme escalation. Re-design may be required.	Carry out sufficient amount of geotechnical investigations at design stage. Risk cannot be closed.
7	Operation	Boardwalk under-designed and unable to accommodate the number of future users.	Design to provide adequate space (i.e. width), within the established cost boundaries.

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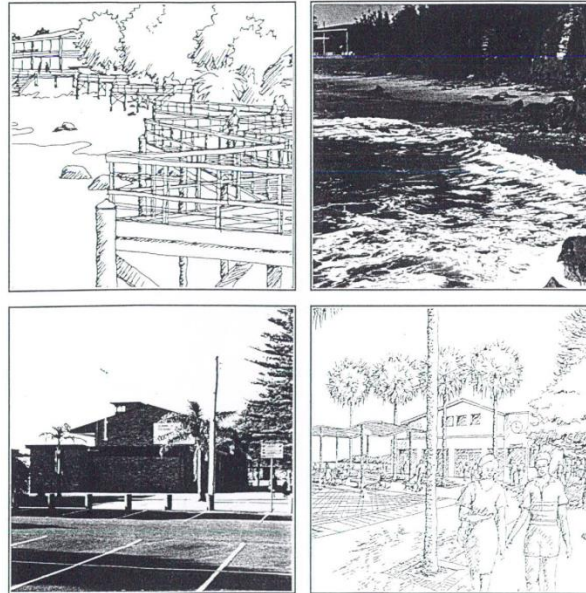
8. NEXT STEPS



ARUP

TERRIGAL FORESHORE IMPROVEMENTS

Landscape Masterplan Report



Prepared for
Gosford City Council

by
CONTEXT Landscape Design • CONYBEARE MORRISON & PARTNERS
346 Kent Street Sydney 2000 • Ph (02) 299 5711 • Fax (02) 262 4785

March 1996
94.531

Terrigal Foreshore Development - Landscape Masterplan Report

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1.0 INTRODUCTION

Terrigal is one of the Central Coast's prime holiday and tourist destinations and is also a local commercial, recreational and cultural centre. Enormous potential exists to promote and develop Terrigal's waterfront experience and further enhance the amenity and setting of this coastal, public asset.

This study has been prepared for Gosford City Council in response to the Consultant's Brief entitled "Terrigal Foreshore Improvements Landscape Masterplan" dated 15th April 1994. It has been prepared by CONTEXT Landscape Design in association with Conybear Morrison & Partners, Architects and Urban Designers, and Patterson Britton & Partners, Engineers.

The Brief requires the preparation of a Landscape Masterplan for the waterfront area from Terrigal Lagoon to The Haven and detailed design for Stage 1, including the sketch design drawings for the Boardwalk Link, Promenade Link, Gateway to Ash Street and upgrading of The Foreshore Promenade.

The Landscape Masterplan focuses on the development of the environmental, recreational and tourism potential of the Terrigal Waterfront for the benefit and enjoyment of the local residents, the business fraternity and tourists. It aims to conserve the inherent beauty of the natural setting and capitalise on the existing cultural landscape to create a revitalised waterfront befitting Terrigal's landmark status as a desirable residential location and tourist destination.

This masterplan report outlines the objectives, strategies and design opportunities for the development and enhancement of Terrigal Foreshore. It also includes funding and implementation strategies and an estimate of probable costs for the development opportunities identified.

A Steering Committee was established to determine the parameters and direct the study. It was comprised of representatives from each of the following:

Gosford City Council
Central Coast Regional Development Board
Terrigal Chamber of Commerce
NSW Public Works - Coastal Engineering Works
Dept. of Conservation and Land Management

Regular meetings were held to ensure that balanced and comprehensive viewpoints were obtained in the evaluation of the masterplan options and all issues involved.

Numerous background studies have been reviewed to assist in establishing the directions for the masterplan. These include:

- *Terrigal Waterfront Principles Plan - An Integrated Landscape*
CONTEXT Landscape Design, 1992
- *Terrigal Haven Landscape Masterplan Report*
Tract Consultants, 1991
- *Terrigal Haven Plan of Management*
Tract Consultants, 1990
- *Terrigal Centre Study*
Forsite, 1989
- *Draft Terrigal Trunk Drainage Study / Management Study / Management Plan*
Webb, McKeown and Associates, 1993
- *Geotechnical Study Cliff Face 1994*
Coffey Engineers

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- *Terrigal Town Centre Workshop 1991*

The Terrigal Chamber of Commerce in October 1991, with the support of Gosford City Council sponsored a workshop related to control over the future development of the Town Centre and other urban design issues. The workshop was attended by representatives of community groups and organisations, residents, architects, planners, landscape architects, representatives of Council and the Chamber of Commerce.

A major unanimous finding of the workshop was for the development of a landscape masterplan for the waterfront that integrated and linked the foreshores from the western edge of Terrigal Lagoon to the beachfront and Haven.

A working group comprising representatives from the above was formed to define the parameters of the Landscape Masterplan. These parameters were subsequently incorporated in the *Terrigal Waterfront Principles Plan - An Integrated Landscape* prepared by CONTEXT Landscape Design in 1992.

This masterplan is compatible with the recommendations of the *Development Control Plan, 1992* for the Terrigal Town Centre.

Study Limitations

The study was undertaken in a six week period from May to June 1994. This resulted in the Draft Landscape Masterplan Report. The Draft Report and associated drawings were placed on public display and were submitted to various authorities and interested groups for comment. Final comments and amendments were incorporated into the document in March 1996.

The study base plan was derived from orthophoto maps as detail surveys were not yet available for the area.

No additional studies related to the Town Centre, such as traffic or parking, were undertaken as part of this Landscape Study.



2.0 OBJECTIVES OF THE MASTERPLAN

In 1992, CONTEXT Landscape Design prepared a set of Landscape Objectives in the *Terrigal Waterfront Principles Plan - An Integrated Landscape*. These objectives and principles amalgamated the updated recommendations resulting from previous Council commissioned studies for the Town Centre and The Haven and acknowledged the recommendations of the *Terrigal Town Centre Workshop, 1992*, and the *Development Control Plan 1992* for the Terrigal Town Centre, which was adopted by Council on 9th February, 1993.

The following Masterplan objectives are based on those landscape objectives, with some minor modifications.

1. CREATE AN INTEGRATED LANDSCAPED WATERFRONT FOR TERRIGAL that will lay the foundations for an enhanced town centre and reinforce its role as coastal residential and tourist focus as well as a local commercial, recreational and cultural centre.
2. PROVIDE A CONTINUOUS WATERFRONT PEDESTRIAN LINK from the western edge of Terrigal Lagoon to the Beachfront and The Haven.
3. CREATE A LANDSCAPED GATEWAY leading into Terrigal Town Centre.
4. INTEGRATE THE WATERFRONT AND TOWN CENTRE by establishing access links and appropriate landscape and urban design treatment.
5. DEVELOP AND ENHANCE THE RECREATION OPPORTUNITIES in the waterfront precinct, promoting appropriate beach side activities. This would include upgrading the promenade and strengthening foreshore links; expanding and improving the picnic areas with new seating and shelter structures; enlarging the Rockpool and providing seating and shelter; and developing a dynamic 'nautical' themed children's play area.
6. UPGRADE AND UNIFY THE IMAGE AND IDENTITY OF TERRIGAL PRECINCT through the establishment of new signage, lighting, paving, street furniture and street tree planting.
7. UPGRADE THE HAVEN and sensitively enhance its potential as a major local recreational facility.
8. RESTORE AND REINFORCE THE INDIGENOUS COASTAL HEATH LANDSCAPE to The Haven and foreshore cliff escarpments, creating an attractive, harmonious setting which is environmentally stable.

3.0 OPPORTUNITIES AND CONSTRAINTS

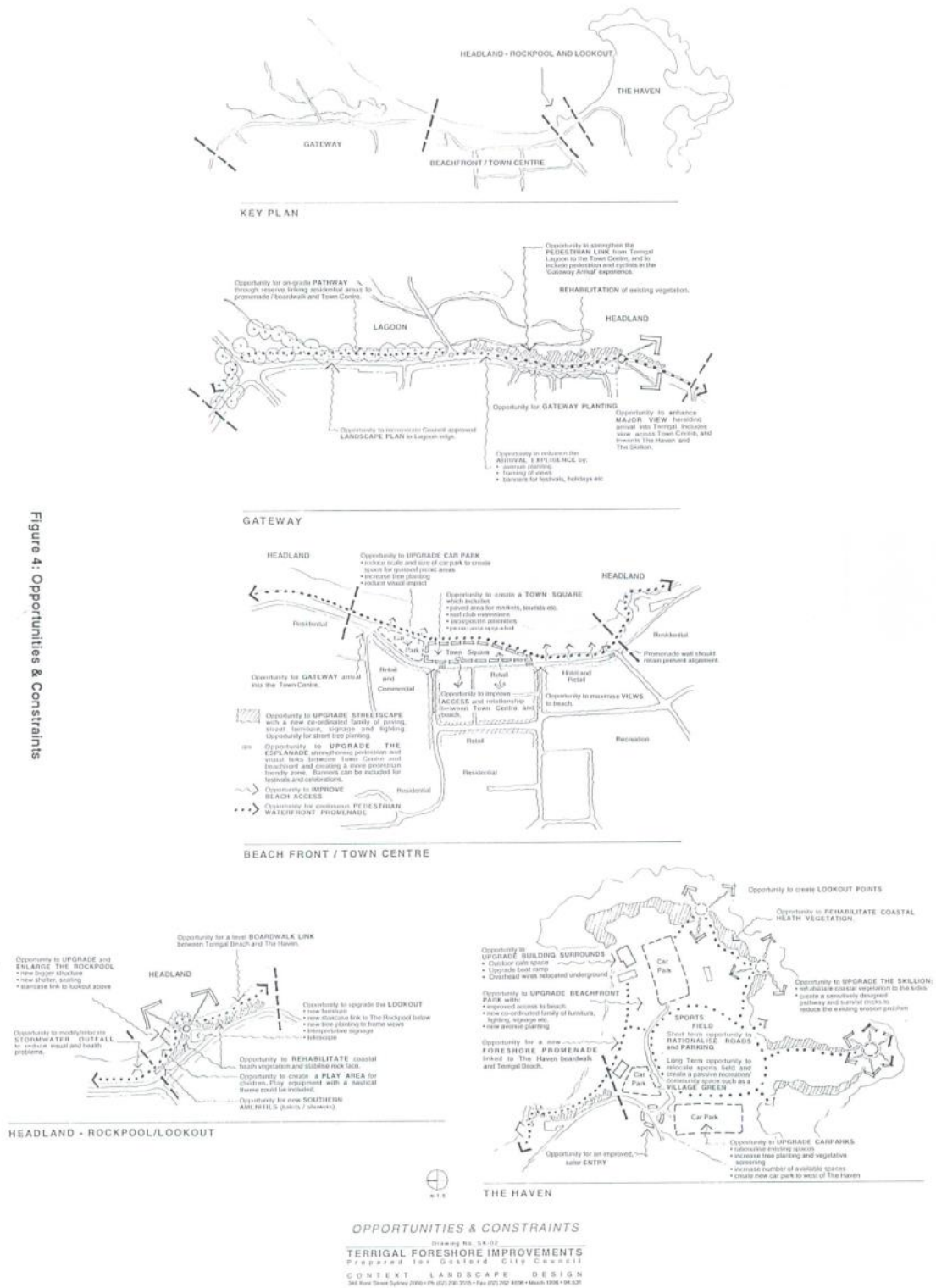
Terrigal represents a unique combination of natural and cultural features. The most notable is the dramatic and unique landmark, The Skillion. Others include the beachfront, lagoon, cliff escarpments and rock platforms. Cultural features include the formal avenue of Norfolk Island Pines along the Esplanade, the Crown Plaza Holiday Inn and the dynamic interaction between the Town Centre and beachfront promenade. The interaction of these features presents a number of opportunities and constraints which must be assessed for successful redevelopment. It is essential to conserve and enhance the inherent qualities of the natural setting, and capitalise on the cultural landscape to ensure a dynamic and unique waterfront revitalisation.

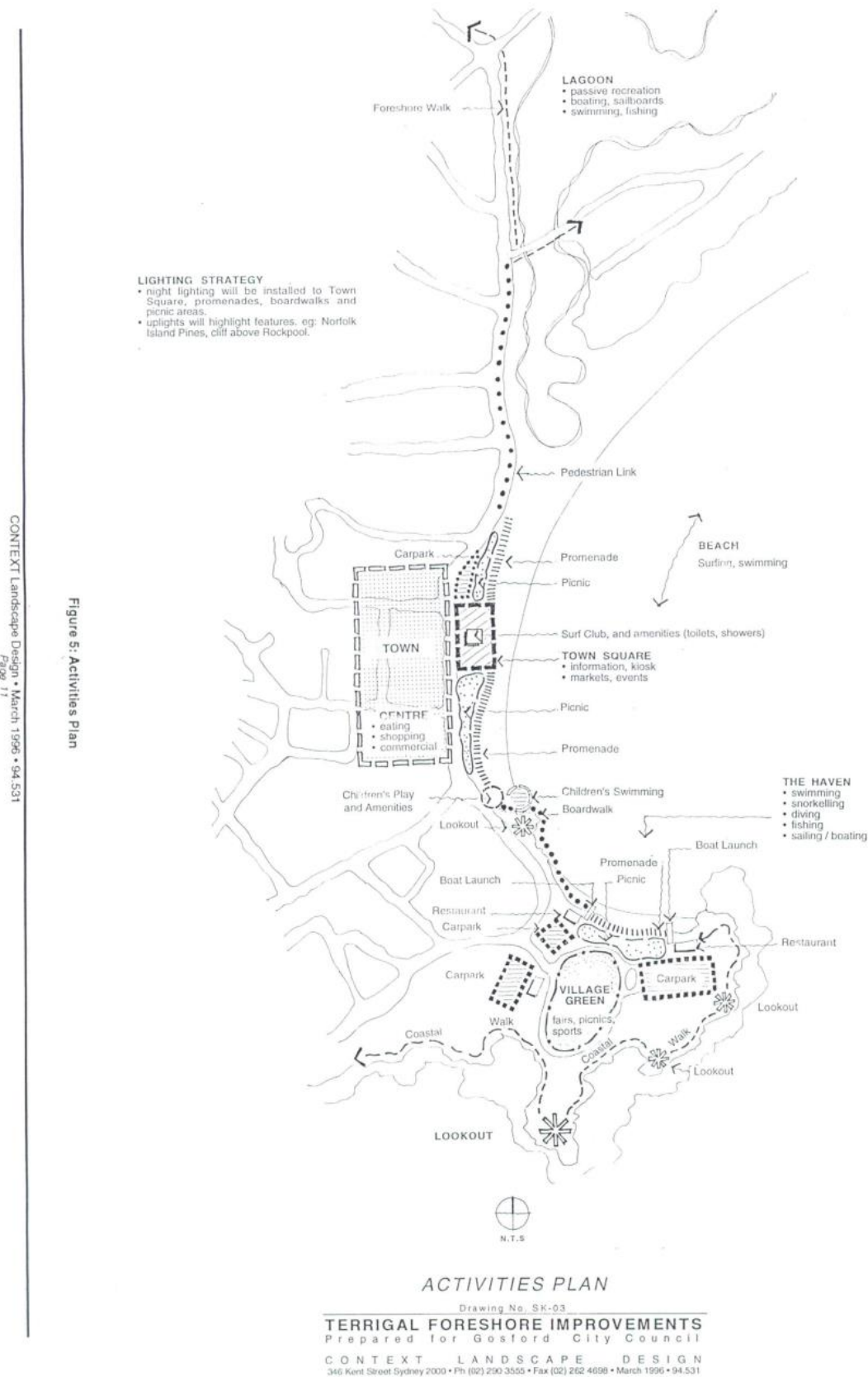
To assess opportunities and constraints within the study area, four major zones have been identified:

1. **Gateway - Terrigal Lagoon to Painters Lane**
Opportunities exist to improve the pedestrian link from the residential areas west of Terrigal Lagoon into Terrigal Town Centre. The motorist arrival experience can also be improved, creating a Gateway arrival which maximises the lagoon edge and headland experiences and enhances views to the ocean and The Haven. Constraints include the existing road width, traffic speed and proximity of the road and cliff.
2. **Beachfront and Town Centre**
Opportunities exist to significantly upgrade the waterfront experience, relocating inappropriate or redundant elements and maximising views, recreation space and community activities. Boardwalks, promenades and pedestrian ways can link the town beach to both Terrigal Lagoon and The Haven creating a continuous waterfront pedestrian experience. Engineering requirements for possible storm and wave action, and potential sand loss must be considered. The visual and pedestrian amenity of the streetscape can be improved and links from the commercial areas to the beachfront can be strengthened. The continued health and wellbeing of existing trees is an essential consideration.
3. **The Headland - Rockpool and Lookout**
Opportunities exist to upgrade and link The Rockpool and lookout, and to rehabilitate the headland cliff vegetation. A new boardwalk around the headland, can provide a valuable and exciting link between Terrigal Beach and The Haven. Constraints include possible cliff instability and any engineering requirements for the boardwalk.
4. **The Haven**
Opportunities exist to upgrade The Haven in accordance with the *Waterfront Principles Plan, 1992*. Some rationalisation of existing roads and carparks would improve the visual amenity of the area. The waterfront can be upgraded by creating a new promenade and enlarging the existing beachfront picnic areas. Rehabilitation of native coastal heath vegetation and the creation of lookouts and coastal walks can further enhance The Skillion and headland experience.

The following diagrams illustrate these opportunities and constraints in more detail.

Figure 4: Opportunities & Constraints





4.0 DESCRIPTION OF THE MASTERPLAN

4.1 THE MASTERPLAN CONCEPT

The Masterplan Study seeks to develop the environmental, recreational and tourism potential of Terrigal Waterfront for the benefit and enjoyment of the local residents, the business fraternity and tourists. In doing so, it also seeks to control the nature and scale of future development and so maintain the local 'village' character of Terrigal.

Terrigal is composed of a number of urban and natural zones lying adjacent to the waterfront. These consist of one urban zone: the **Town Centre**, and three natural zones: the **Gateway**, **Headland** and **Haven**. The essential concept of the masterplan is to upgrade all the zones, enhancing and reinforcing their unique features, and to forge connections between them, maximising the waterfront experience.

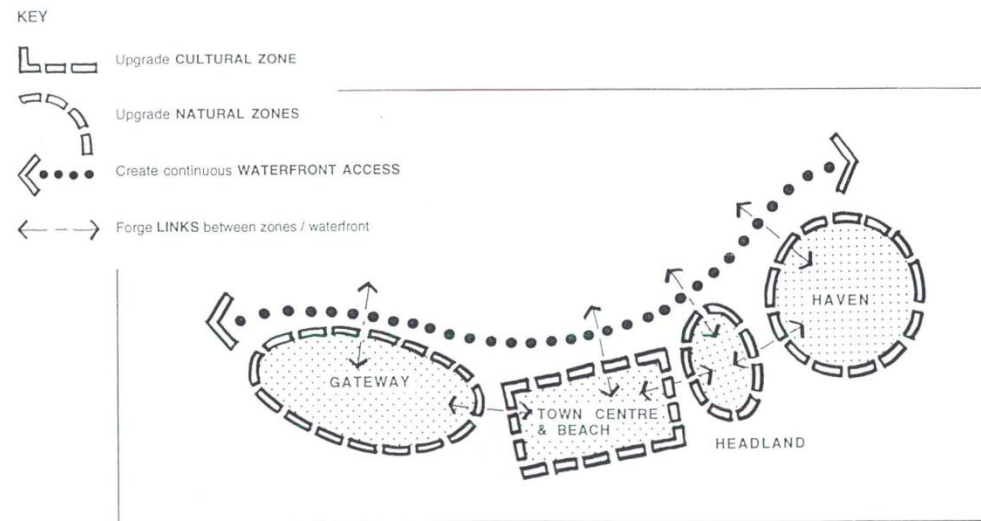


Figure 6: Masterplan Diagrammatic Concept

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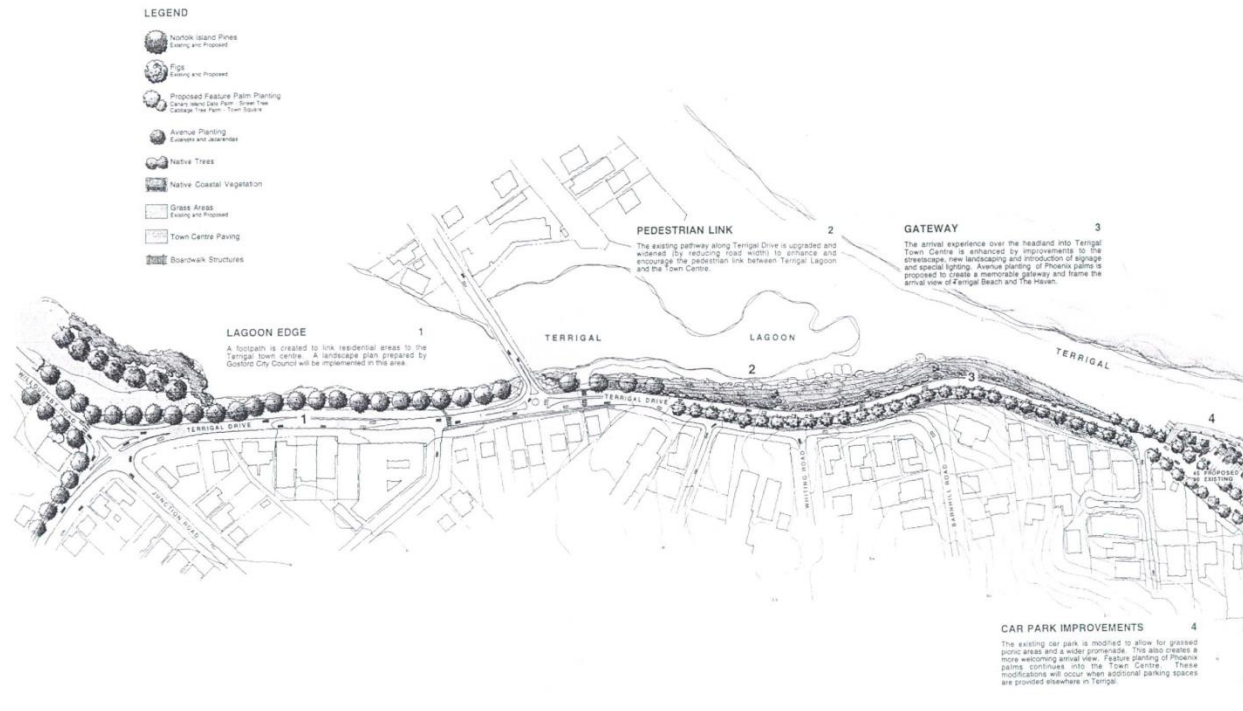


Figure 7: The Landscape Masterplan

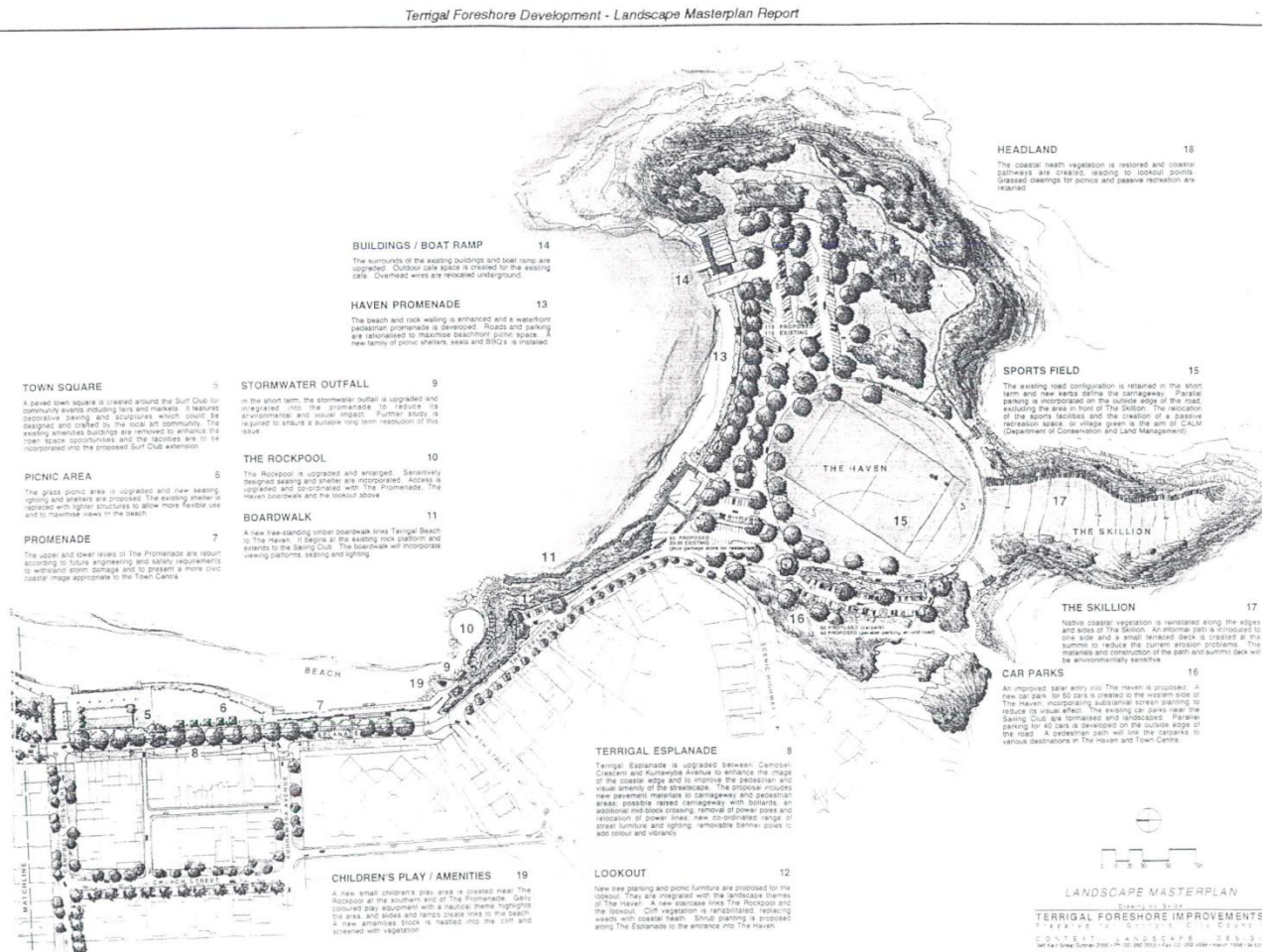


Figure 8: The Landscape Masterplan

4.2 GATEWAY

The Gateway is the area of Terrigal Drive and its environs defined by the Willoughby Road intersection and the carpark to the north of Terrigal Town Centre. It is the main arrival road into Terrigal yet currently it fails to highlight existing features and create a significant Gateway experience.

From Willoughby Road, Terrigal Drive runs adjacent to Terrigal Lagoon, then climbs a small headland to provide panoramic views of Terrigal Beach, the ocean and The Haven, before descending into the Town Centre. The masterplan maximises the opportunities presented by these features to create a dynamic and varied arrival experience.

From Willoughby Road to Ocean View Drive a landscape plan has been prepared by Council and includes planting of Norfolk Island Pines (*Araucaria heterophylla*) and a footpath along the lagoon edge.

In this masterplan the arrival experience over the headland into Terrigal Town Centre is enhanced by improvements to the streetscape, additional landscaping, footpath widening and the introduction of signage, banners and special lighting. Avenue planting of *Phoenix canariensis* (Canary Island Date Palms) is proposed to create a memorable Gateway and frame the arrival views of Terrigal Beach, the Town Centre and The Haven. The road lanes are narrowed to 3.3m each way. This permits a cycle lane of 1.2m each way and the pedestrian footpath to be widened by 1m to 3m. The existing crash barrier along the entrance road should eventually be phased out to allow more environmentally friendly and less visually intrusive traffic control measures. Stabilisation of the cliff on the lagoon side and rehabilitation of the coastal cliff vegetation is also recommended.

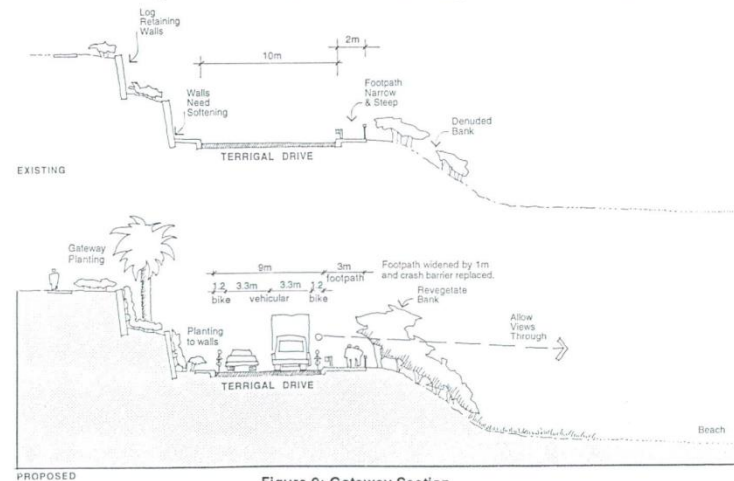


Figure 9: Gateway Section

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Figure 10: Gateway

4.3 BEACHFRONT AND TOWN CENTRE

Terrigal Town Centre and beachfront are the focal point for the identity and street life of the Terrigal community. The masterplan seeks to revitalise this area, recognising the needs and desires of the community, and enhancing the amenity and setting of this asset. The masterplan strengthens the link between the waterfront and Town Centre. The Town Centre is upgraded with street tree planting and a unified theme of street furniture, paving and lighting.

New Gateway planting of *Phoenix* palms defines the arrival into Terrigal Town Centre and is a reference to the man-made impact on the Terrigal environment. The existing carpark is modified, reducing its visual impact and increasing space for grassed picnic areas.

The existing promenade is upgraded and incorporates a co-ordinated range of street furniture and lighting. It is linked to the pedestrian pathway from The Lagoon and to The Haven boardwalk, strengthening the waterfront links. Connections between the beach and Town Centre are also reinforced.

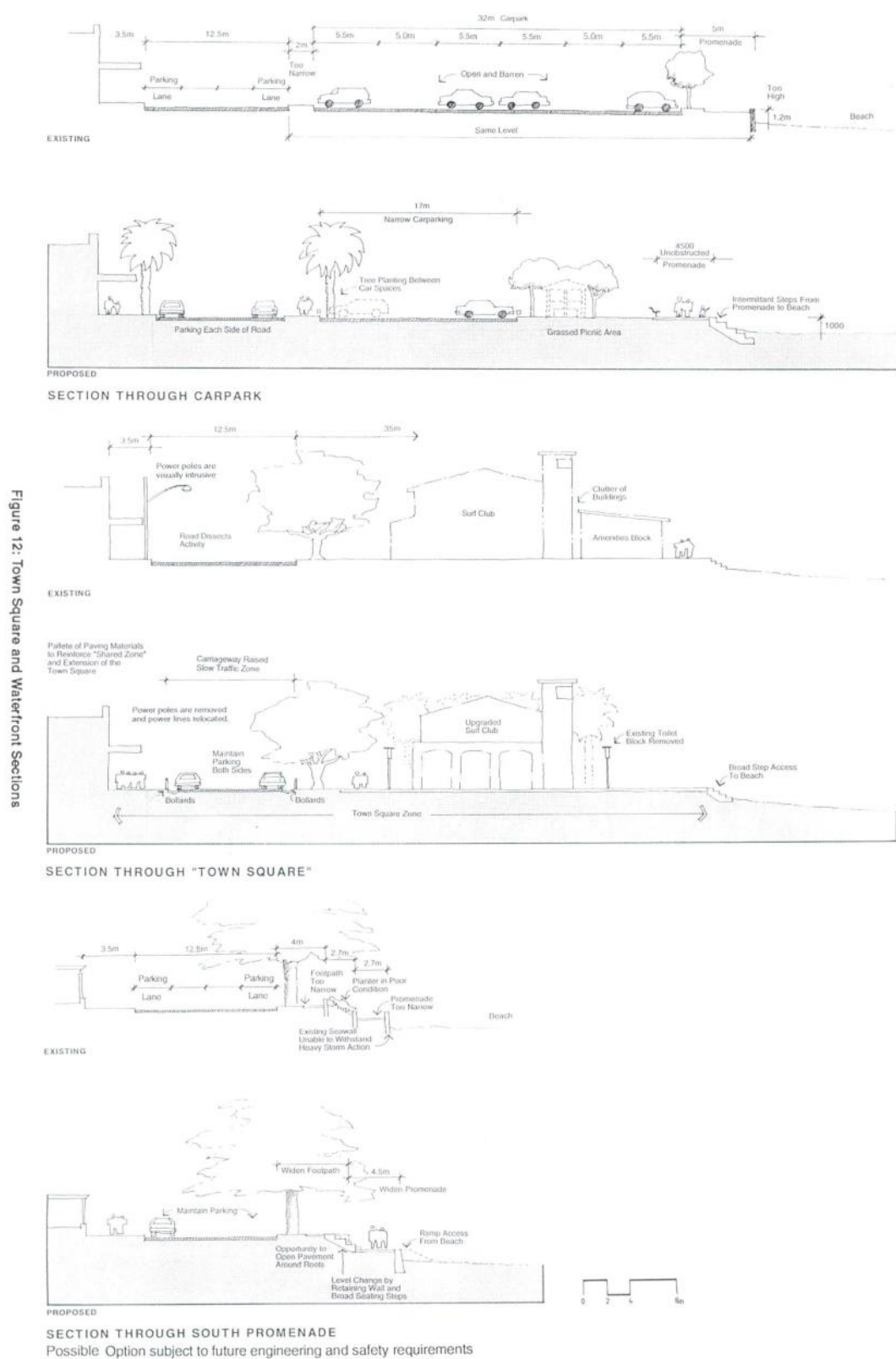
A paved Town Square is created around the Surf Club for community events, including fairs and markets. A new paved area is proposed which is patterned with motifs. These could be a simple geometric pattern, or a more fanciful nautical pattern with sea creatures, waves and nautical themes. These paving patterns and other sculptural elements could be designed and crafted by community art groups. The existing amenities buildings are demolished and the facilities are incorporated into the proposed surf club extension. The existing war memorial in the Town Square is relocated to Rotary Park.

South of the Surf Club the existing grassed picnic area is enlarged and five smaller picnic structures replace the existing shelter. The existing garden bed to the south of the picnic area is removed allowing the promenade and upper level footpath to be widened. Broad stairs provide access to the lower promenade and also provide informal seating.

Terrigal Esplanade is upgraded between Campbell Crescent and Kurrawyba Avenue to enhance the image of the coastal edge and improve the pedestrian and visual amenity of the streetscape and commercial area. All traffic flow and parking lanes are retained, with new pavement materials defining these uses. Possibilities exist to either retain the kerbs, or raise the road surface, with bollards defining pedestrian and vehicular areas. Possible footpath widening, as recommended in the *Development Control Plan, 1992* could occur in the long term. An additional mid-block pedestrian crossing is proposed, in addition to two crossings at Campbell Crescent and Kurrawyba Avenue. All power poles are removed, and the power lines relocated either underground or aerial bundle cabled and mounted to shop facades above the awnings. These measures will strengthen the links between the commercial shop fronts and the beachfront, reduce visual clutter, create a more pedestrian friendly zone, and improve the visual amenity of the streetscape.

Footpath widening is possible along the western side of Church Street, creating space for increased cafe/pedestrian uses. Street tree planting of *Phoenix* palms, Eucalypts and Jacarandas, and upgraded brick paved footpaths are proposed in Campbell Crescent, Church Street and Kurrawyba Avenue to create a unified, pedestrian oriented Town Centre zone.

Removable festival banners are installed for festivals, celebrations and holidays, and add colour and vibrancy to the streetscape. They are mounted on existing streetlights from Ocean View Drive to the northern carpark. Through the Town Centre to the entrance into The Haven locations for removable banner poles and banners will be identified.



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Figure 13: Town Square

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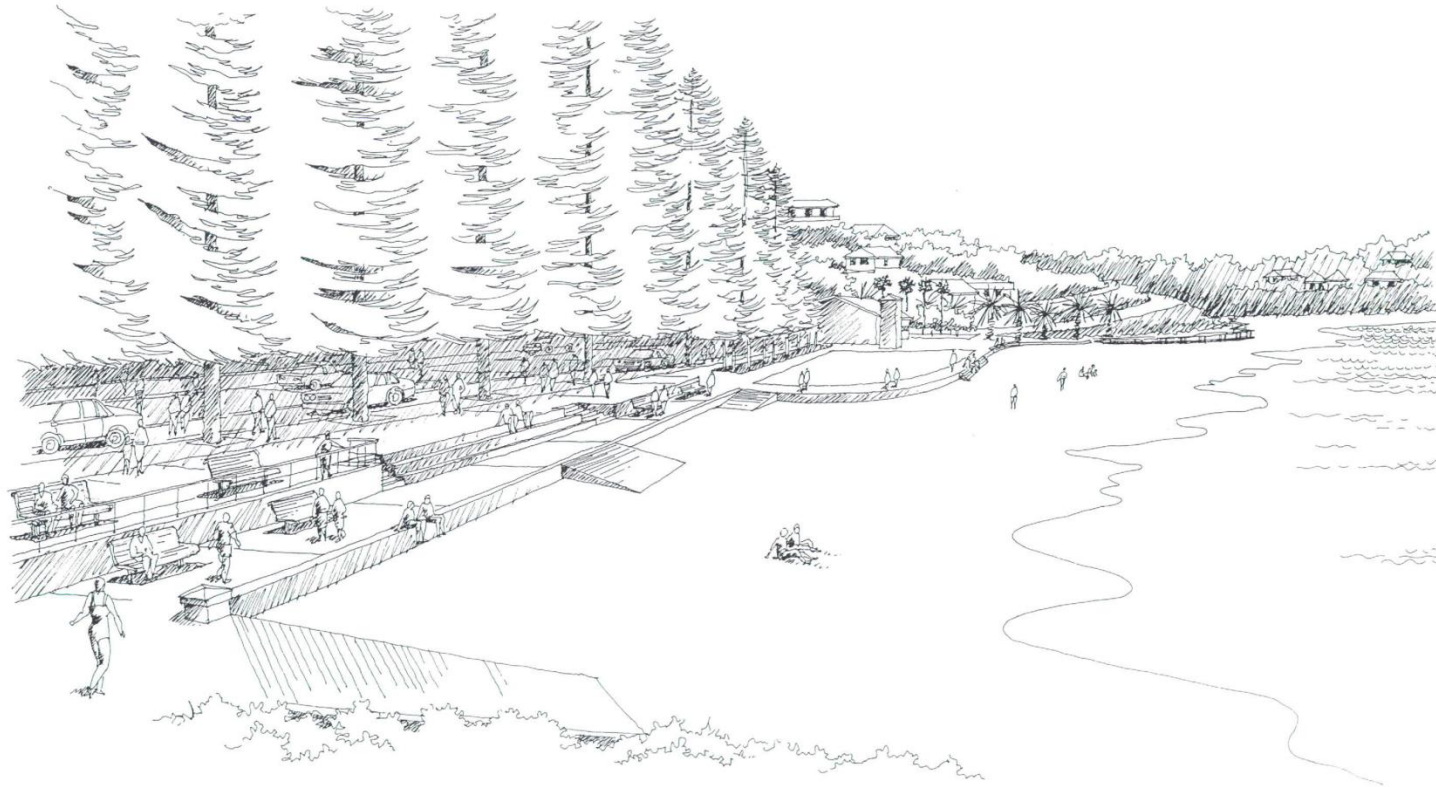


Figure 14: Terrigal Promenade

Possible Promenade Option subject to future engineering and safety requirements

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Figure 15: The Esplanade

4.4 THE HEADLAND - ROCKPOOL AND LOOKOUT

The natural features of this small headland are outstanding. From the lookout are panoramic views to Terrigal Beach and The Haven. Below, the small Rockpool nestles into the rocks and is popular with children and families. The rock platform also affords outstanding views of Terrigal Beach and the Haven. The masterplan proposes enhancing these qualities for greater public use, accessibility and enjoyment.

In the short term, the stormwater outfall is integrated within the proposed upgrading of the beachfront promenade to reduce visual impact. Further study is required to ensure a suitable long term resolution of this issue. A small grassed children's play area is created near the Rockpool and brightly coloured play equipment with a nautical theme is proposed. A new, well lit amenities block is nestled into the cliff and screened with vegetation. The link from the beach promenade to the pool area is upgraded with a 2.3m wide timber boardwalk replacing the existing concrete path. The Rockpool is upgraded and enlarged, to reduce overcrowding in summer. Sensitively designed seating and shelter are provided. A new timber cliff stairway links the Rockpool to the lookout above subject to future environmental and geotechnical considerations.

A new self supporting timber boardwalk is proposed to link Terrigal Beach to The Haven and provide a level pedestrian connection between the two. It begins at the existing rock platform adjacent to the Rockpool and extends to the sailing club. The boardwalk incorporates viewing platforms, seating and lighting. It stands away from the cliff to reduce the risk from any falling rocks. This new link will be an exciting feature of Terrigal's waterfront experience. Detailed reviews of environmental and geotechnical considerations would be required at the detail design stage of the boardwalk.

The cliff will undergo stabilisation and rehabilitation with native heath vegetation. Shrub planting is proposed along The Esplanade to the entrance into The Haven.

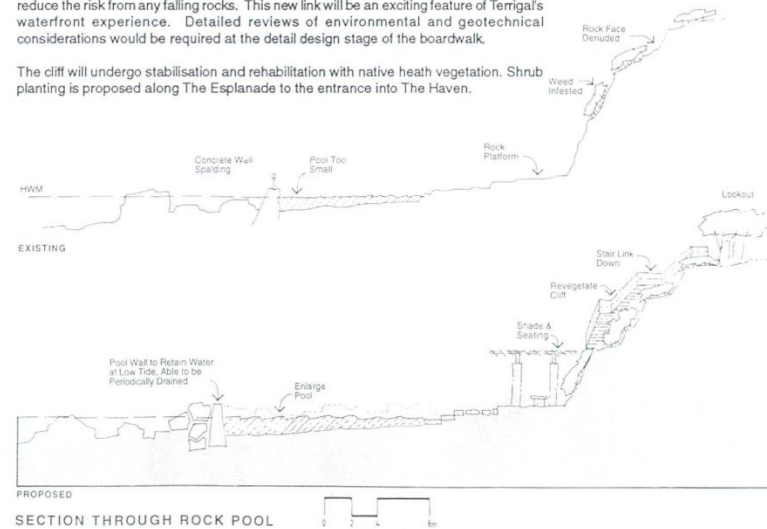


Figure 16: Rockpool Section

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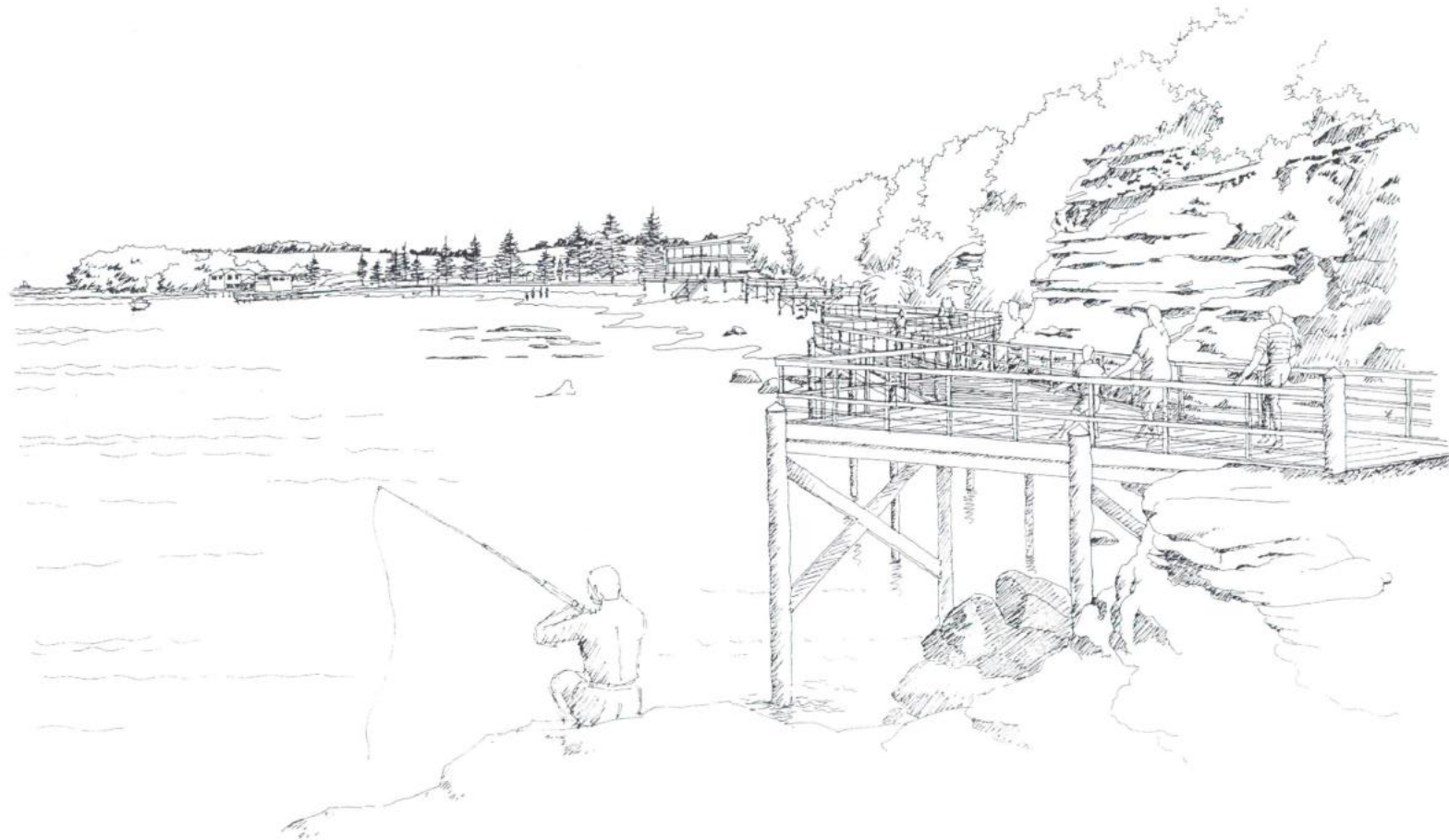


Figure 17: The Haven Boardwalk

4.5 THE HAVEN

The Haven is developed as a major recreational focus consistent with the objectives of the *Terrigal Waterfront Principles Plan, 1992*. The masterplan has sought to reach a balance between the natural systems of The Haven and the provision of compatible recreation facilities. Subtle improvements have been included which are exciting but which do not overwhelm or compromise the most important natural landmark, The Skillion.

An improved, safer entry into The Haven is proposed. A new carpark for 60 cars is created to the western side of The Haven incorporating substantial screen planting to reduce its visual impact. The existing carparks near the Sailing Club are rationalised and landscaped. General upgrading of the Sailing Club environs is proposed, including facilities for outdoor eating, subject to a separate Development Application to Council.

The existing road configuration is retained and formalised around The Haven. New kerbs define the carriageway and parallel parking is incorporated along the outside edge of the road excluding the area in front of The Skillion.

The relocation of the sports facility and the creation of a passive recreation space is the aim of CALM (Department of Conservation and Land Management). The Masterplan therefore recommends the ultimate return of this area to passive recreation. This would be in the form of parkland, incorporating a village green. Associated buildings and clubhouses would also be removed.

Native vegetation is reinstated along the edges and sides of The Skillion. An informal path is introduced to one side and a small deck is located at the summit to reduce the current erosion problem. The pedestrian pathways on The Skillion shall be constructed sympathetically to the environment and surfaced with suitable materials.

On the northern side of The Haven, the beach and existing rock walling is enhanced and a low key pedestrian promenade is proposed. The removal of the one way road between the trailer carpark and the beach is desirable as it would increase beachfront picnic space. Traffic management investigations should be carried out at the detail design stage to determine if this road is necessary for efficient traffic flows in particular the requirements for trailer access and parking. Co-ordinated picnic shelters, seats, and BBQ's are installed. This furniture range will be more 'natural' in character than the 'urban' character of the Terrigal beachfront furniture.

At the eastern end of The Haven beach, the existing buildings, their surroundings and the boat ramp are recommended to be upgraded. Any development of these buildings would be subject to a separate Development Application to Council. Outdoor cafe space could be created and the existing overhead wires relocated underground. The boat ramp needs upgrading to ensure safe use and safe public foreshore access.

Around the headland, extensive areas of coastal heath vegetation are re-established on the existing grass slopes. Some cleared areas are retained for picnicking and other passive recreation. Coastal pathways and lookout points are also established.

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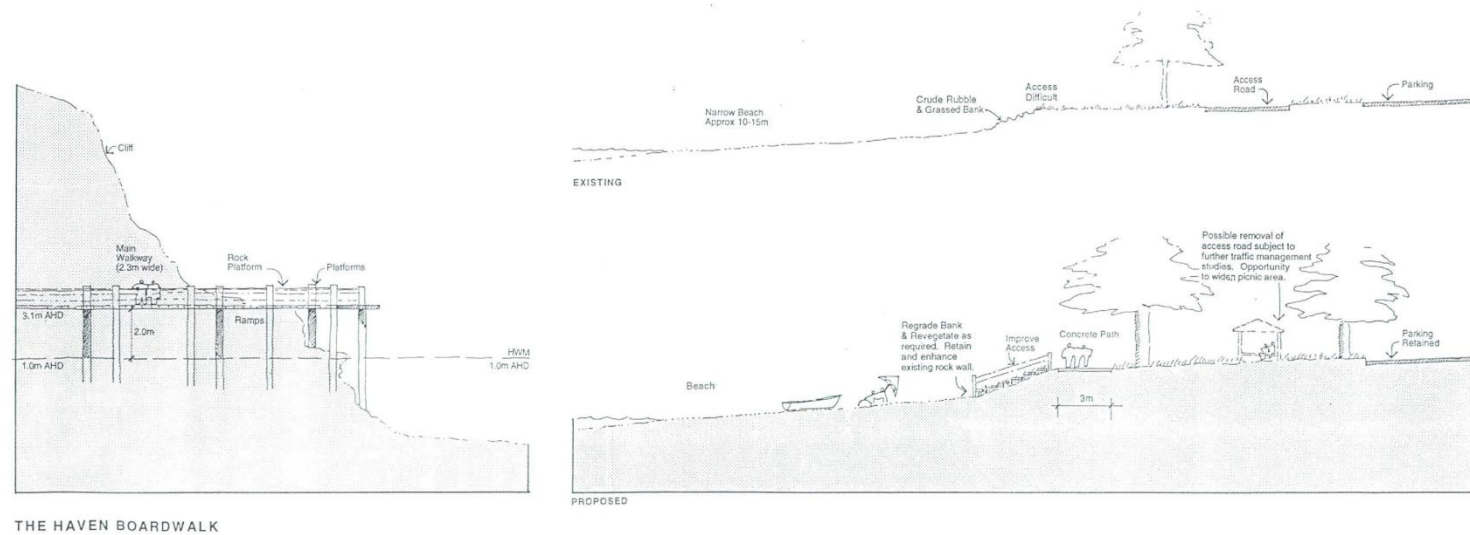


Figure 18: Haven Promenade Section

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Figure 19: The Haven Promenade

4.6 DESIGN DETAILS

i. New Shelters and Facilities

A consistent language of new waterfront structures is proposed. These include:

New Shelters

All new shelters shall be sensitively designed to minimise the visual impact of the structures on the beach areas.

- There are two types of picnic shelters. Firstly, a timber structure with a gabled roof providing rain and sun shelter, and seats and table. It is composed of two divided bays with views to the water. Secondly, a timber structure with a gabled roof and a large seating platform. These structures are proposed along The Promenade, and in The Haven.
- The shade structure around the Rockpool is a simple timber pergola structure with timber benches underneath.

Facilities

- The proposed small southern amenities building is a simple masonry and timber structure, matching the character and materials of the proposed upgraded surf club.
- The new children's play area at the southern end of the beach would incorporate nautical themed, brightly coloured play equipment relevant to its beachside location. Slides and climbing structures would link the grassed play area to the beach.
- The five existing outdoor showers are retained and upgraded to co-ordinate with the proposed range of furniture. Their existing locations are the northern carpark (one), the picnic shelter (one), the surf club (one), the southern end of the promenade (one) and the Haven (one).

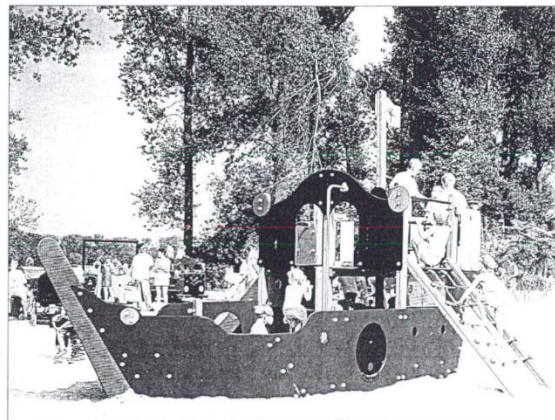
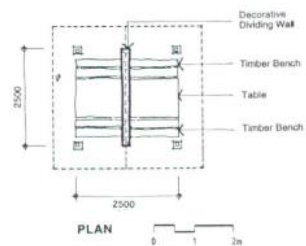
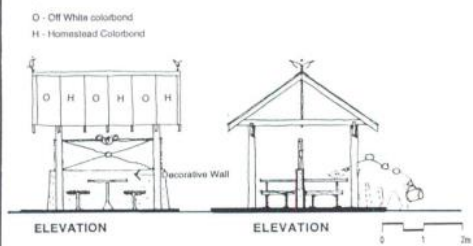
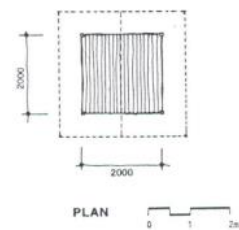
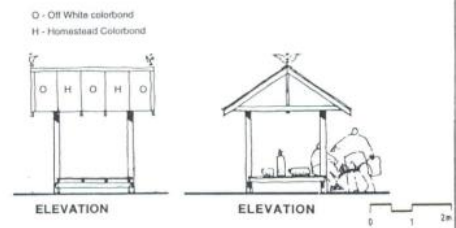


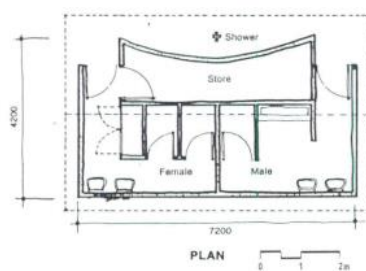
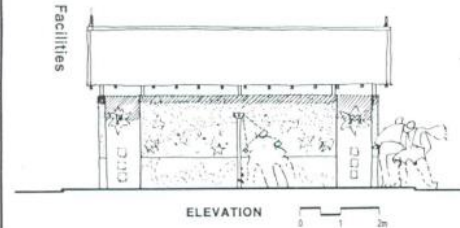
Figure 20: Indicative Children's Play Equipment



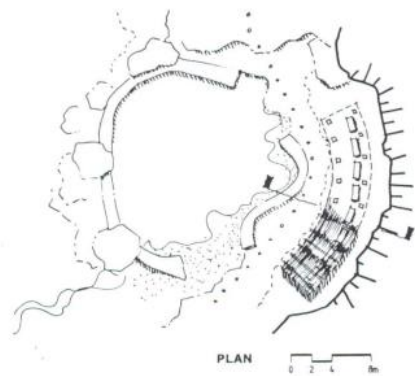
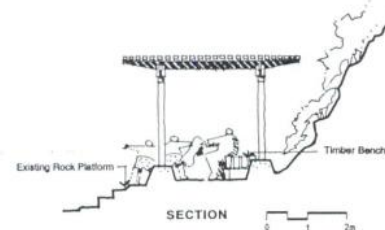
PICNIC SHELTER - TYPE A



PICNIC SHELTER - TYPE B



AMENITIES BLOCK



ROCK POOL SHADE SHELTER

ii. Promenade and Walkways

Terrigal Promenade:

- The detail design of the Terrigal seawall and promenade along the beach from the surf clubhouse to the southern end of the beach shall be prepared by Council's Environmental Section. The design study brief shall be developed in conjunction with the Coastal Section of the Department of Land and Water Conservation. The revised alignment shall closely follow the existing alignment, minimising intrusion into the beach.

Following the design of the seawall, a cross section design along the southern end of Terrigal beach will be determined.

Promenade Pavements:

- Terrigal and The Haven promenades are concrete construction with a decorative aggregate finish and brick trim to co-ordinate with the Town Centre paving. In the Town Square, decorative motifs of ceramic tile or similar are incorporated in the pavement and can be designed and installed by the local art community.

Haven Boardwalk:

- The Haven boardwalk is a self supporting jetty type timber structure designed to coastal engineering specifications (Refer Appendix 2). It commences at the rock platform and follows the cliff in a zig zag pattern to the sailing club. It is designed for disabled access, and incorporates small seating areas, lighting and viewing platforms. The boardwalk would consist of timber piles and superstructure with timber handrailing on both sides. It would have a proposed deck level of RL 3.1m AHD and a clear walkway width of 2.3m. The precise location of the boardwalk will be subject to further geotechnical survey.

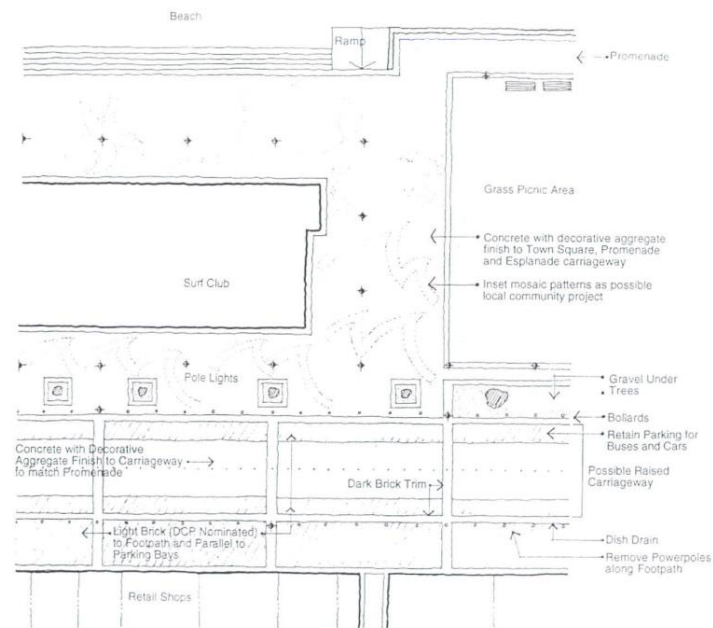
Footpaths:

- All footpaths in The Haven and to The Skillion shall be composed of environmentally sensitive materials. This could include stabilised gravel paths with hardwood timber edging. Steps on The Skillion footpath could be composed of hardwood timber risers with stabilised gravel infill. The summit lookout deck could be hardwood timber.

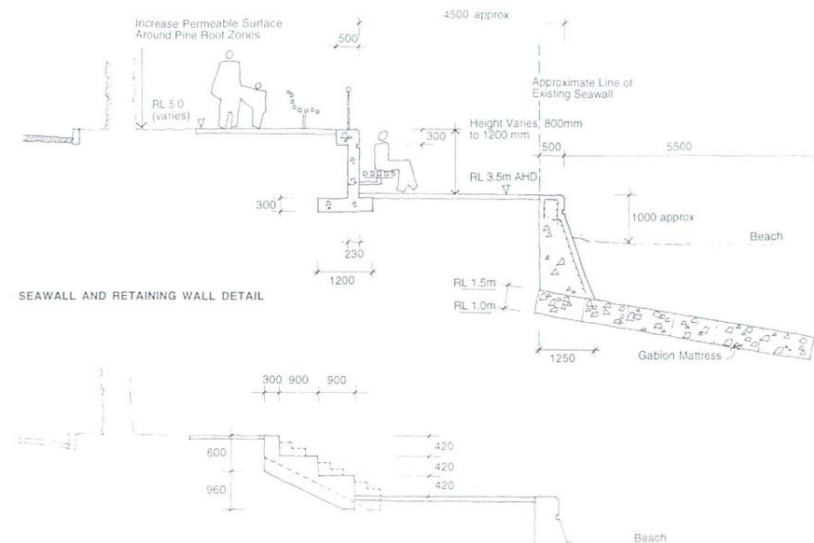
The Esplanade and Town Centre:

- Along The Esplanade, the footpaths and parallel parking bays are paved in brick, in accordance with the *Development Control Plan, 1992*. A darker brick will be incorporated as a decorative trim on The Esplanade and also on The Promenade. The two traffic lanes will be paved in concrete with a decorative aggregate finish. The same brick materials will be used throughout the Town Centre precinct.

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TOWN SQUARE PAVING DETAIL n.t.s.



SEAWALL AND RETAINING WALL DETAIL

STAIRS BETWEEN PROMENADES
PROMENADE DETAIL - TYPICAL SECTIONS n.t.s.
Possible Option subject to future engineering requirements

Figure 22: Promenade Details

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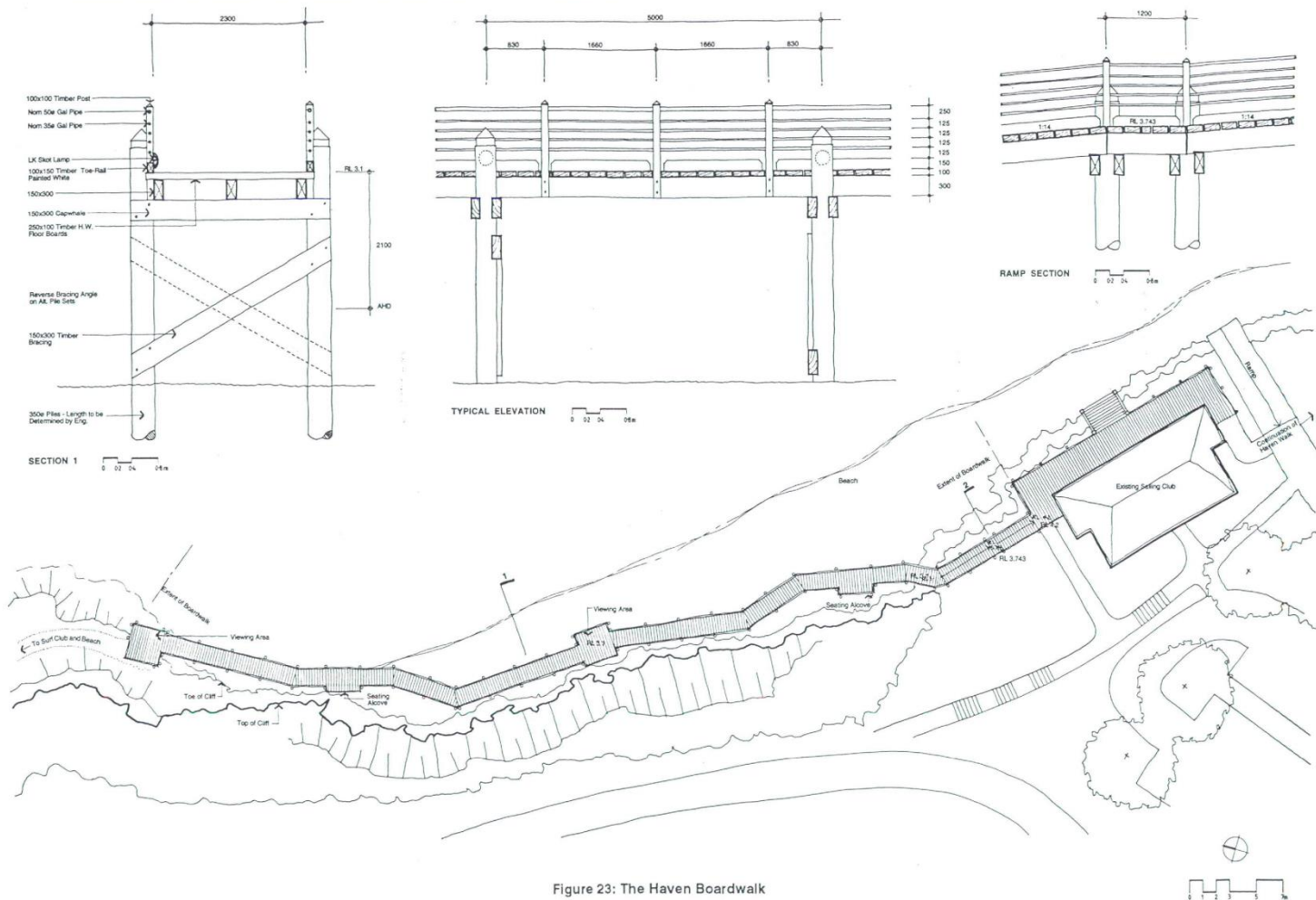


Figure 23: The Haven Boardwalk

iii. Furniture

The *Development Control Plan, 1992*, has recommended a range of street furniture which has been incorporated into this masterplan study. These include:

- **Seats, Bollards and Bins** - Street Furniture Australia
Generally, seating shall be anchored securely and bin liners shall be secured inside bins to minimise vandalism.
CM Plaza 1
CM Plaza 1A
B2 Bollard
LBI Bin
- **Bench** - Zebra Design
3001
- **Tree Grate** - Mascot Engineering
T601:1200/450
- **Lighting** - Louis Poulsen & Co
Orbiter Pole Maxi

Along The Esplanade and the Town Centre precinct the following colours are recommended by the *Development Control Plan, 1992*.

- All timber for seats, benches to be finished with 'Jarrah Colourguard'. It is a waterbased clear finish which contains red pigments designed to protect and enhance the naturally occurring red colouring of Jarrah.
- Metalwork, which includes seat and bench frames, bins, bollards and light standards, to be hot dip galvanised and powdercoated 'Transformer Grey'.
- The following surfaces are not to be painted - brass, bronze, copper, stainless steel or aluminium.

Along the beach front, Promenade, and The Haven, a new colour scheme will be developed in the next design stage. These colours will complement the colours of the Town Centre whilst highlighting the different uses and identity of the beachfront areas.

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iv. Lighting

A lighting concept has been developed with lighting incorporated throughout the beachfront areas of Terrigal and The Haven. All lighting fixtures should be robust and vandal resistant.

The concept includes:

- To brightly light The Esplanade, the Town Square and carparks. This is achieved predominantly with pole mounted lights.
- Along the promenades and boardwalks softer lighting occurs at foot level. This illuminates the walkway but does not impede water views with a 'wall' of light. Lights will be predominantly bollard lights or wall mounted lights.
- Wall mounted lights occur along the Promenade seawall, softly lighting the beach sand below. This is limited to the section of seawall adjacent to the grassed area.
- Feature uplighting highlights the Norfolk Island Pines (subject to further study on the long-term health and amenity of the trees), and the two headlands which define The Haven beach.
- Feature lighting is incorporated into the children's play equipment.
- Underwater lighting of the Rockpool could also be incorporated.

The following fixtures are proposed:

- **Pole Mounted Lights** - Louis Poulsen Lightmakers
Orbiter Pole Maxi (as recommended by the *Development Control Plan, 1992*)
- **Boardwalk and Wall Mounted Lights** - Bega
Flush mounted circular wall light - 120mm diameter and 200mm diameter
- **Bollard Lights** - Louis Poulsen Lightmakers
Waterfront

v. Interpretation / Education

A comprehensive signage and interpretation system is proposed to maximise visitor enjoyment of Terrigal and The Haven. The interpretation of the natural diversity and cultural richness of the area will significantly contribute to the visitor experience. Directional signage will provide further assistance to visitors.

Interpretative signage provides the opportunity to educate and inform the public about natural systems, flora and fauna, and history. For example, along The Haven boardwalk signs could reveal the natural systems at work in the intertidal zone, what sea creatures are found below and describe the ship building history of The Haven. Directional signage would indicate the location of various activities, facilities and routes to other areas.

Signage will be designed to be consistent with the selected range of street furniture. More detailed resolution of fonts, styles and colours will occur in the detailed design stage.

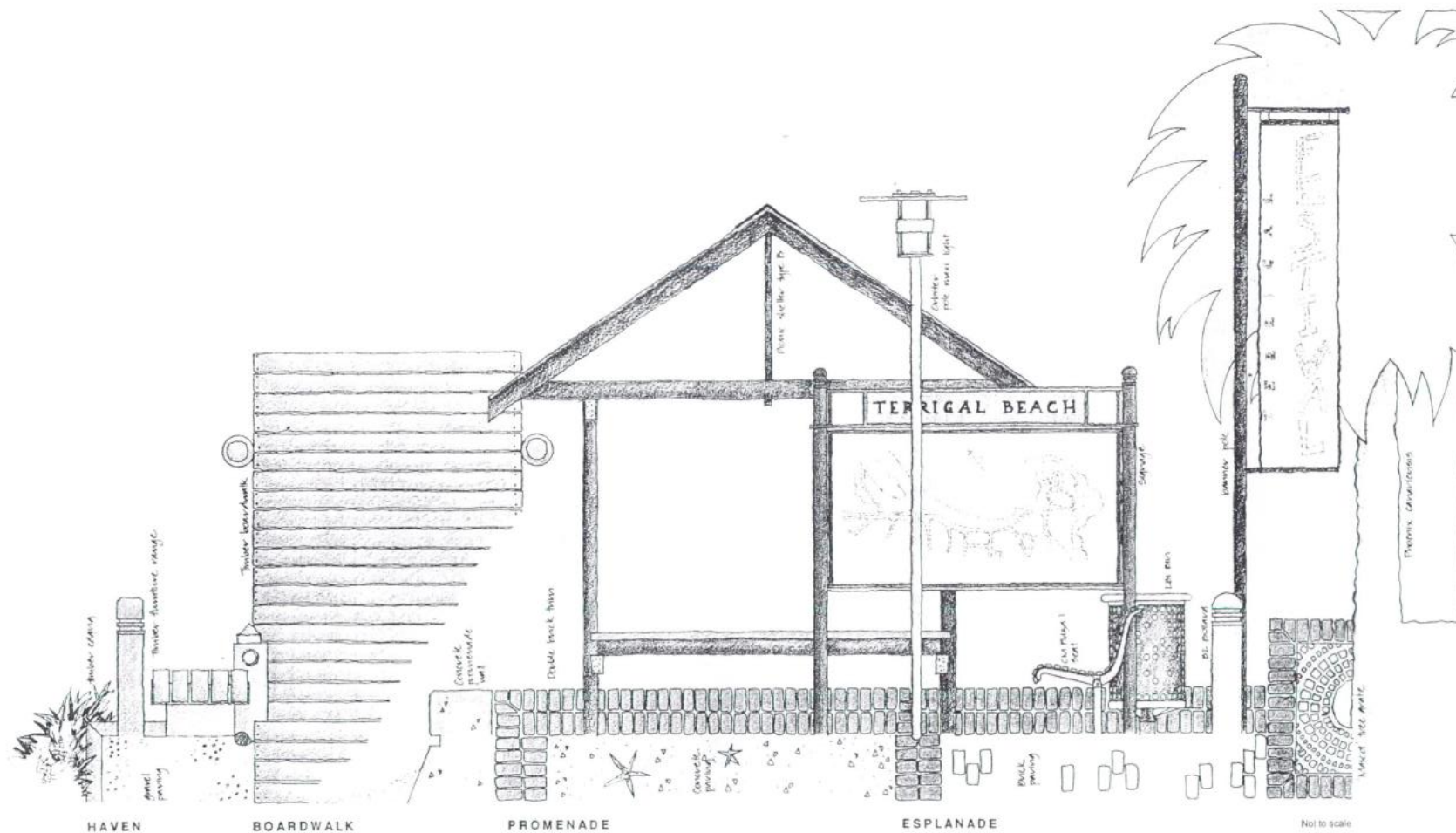


Figure 24: Furniture, Lighting and Signage

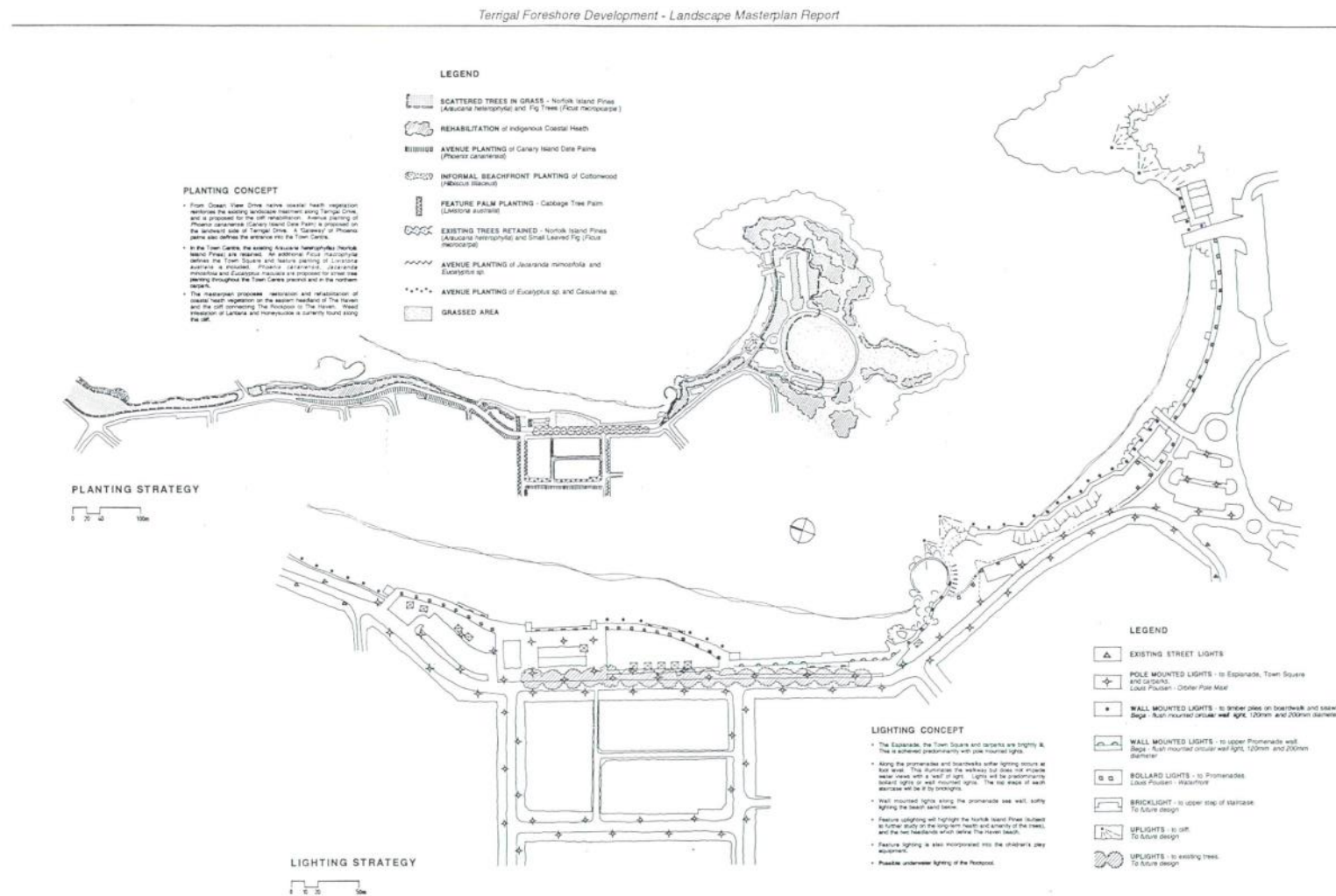


Figure 25: Lighting and Planting Strategies

vi. Planting

The planting strategy proposes street tree planting to the Gateway and Town Centre areas, and native coastal shrub planting to The Haven and cliff escarpments.

- From Ocean View Drive native coastal heath vegetation reinforces the existing landscape treatment along Terrigal Drive, and is proposed for the cliff rehabilitation. Avenue planting of *Phoenix canariensis* (Canary Island Date Palm) is proposed on the landward side of Terrigal Drive. A 'Gateway' of *Phoenix* palms also defines the entrance into the Town Centre. These palms are currently a feature of Church Street and are dotted throughout the Terrigal area. They are appropriate for use considering the man-made impact on the Terrigal environment.
- In the Town Centre, the existing *Araucaria heterophyllas* (Norfolk Island Pines) are retained. An additional *Ficus macrophylla* defines the Town Square and feature planting of *Livistona australis* is included. *Hibiscus tiliaceus* is proposed along the eastern edge of the carpark, providing shade and floral interest for parked cars and picnics. *Phoenix canariensis*, *Jacaranda minosifolia* and *Eucalyptus maculata* are proposed for street tree planting throughout the Town Centre precinct. The islands within the Terrigal carpark shall be planted with salt tolerant shade trees. The species will be determined by Council's Program Manager - Recreation and Bert Hunter.
- The masterplan proposes restoration and rehabilitation of coastal heath vegetation on the eastern headland of The Haven and the cliff connecting The Rockpool to The Haven. Weed infestation of Lantana and Honeysuckle is currently found along this cliff. The following list of recommended species comes from the *Terrigal Haven Plan of Management, 1990*. Some additional species have also been included.

These species reach a maximum height of approximately 3-4 metres due to severe wind pruning by salt-laden winds.

<i>Banksia integrifolia</i>	Coast Banksia
<i>Dianella caerulea</i>	Paroo Lily
<i>Westringia fruticosa</i>	Coast Rosemary
<i>Allocasuarina distyla</i>	Scrub She-oak
<i>Lomandra longifolia</i>	Spiny Headed Mat-rush
<i>Leptospermum laevigatum</i>	Coast Tea-Tree
<i>Kennedia rubicunda</i>	Dusky Coral Pea
<i>Clematis aristata</i>	Travellers Joy
<i>Darwinia fascicularis</i>	-
<i>Hibbertia scandens</i>	Climbing Guinea Flower
<i>Kunzea ambigua</i>	White kunzea
<i>Acacia longifolia</i>	Sydney Wattle
<i>Acacia longifolia</i> var <i>sophorae</i>	-

vii. Crime Prevention

It is important that the proposal complies with environmental planning for crime prevention. Generally, all structures, materials and fixtures should be robust and vandal resistant. All furniture must be anchored securely, with a preference for surfaces and materials from which graffiti can be easily removed. These issues must be addressed at the detail design stages of work.

5.0 ISSUES SUMMARY

The Masterplan Report has identified a number of issues which require more detailed assessment and consideration.

1. Promenade Seawall

The existing promenade seawall, constructed after major storms in 1974, consists of timber front and rear walls. The masterplan proposes upgrading the promenade to ensure it is visually and functionally more successful. Its alignment shall closely follow the existing alignment. The detail design shall be carried out by Council's Environment Section and in conjunction with the Coastal Section of the Department of Land and Water Conservation.

2. Waterfront Buildings

Currently four buildings are located on the Terrigal beachfront including the Surf Club, two amenities facilities and a picnic shelter.

The masterplan supports the upgrading of the existing Surf Club. Extensions to the Surf Club have been proposed by the Club and incorporate the existing amenities blocks into the Surf Club extension. As the building is within the storm hazard zone, all extensions and proposed uses must be essential services only.

The existing picnic shelter is currently underutilised and visually obstructs water views. This structure should be removed and replaced by a number of smaller picnic structures which permit more flexible use and maximise views to the beach as recommended in the *Development Control Plan, 1992*.

An additional amenities building is proposed at the southern end of the beach. It is "carefully sited against the cliff, and of a design character consistent with the other beachfront buildings" as required by the *Development Control Plan, 1992*. A small maintenance shed located in the existing picnic shelter has been relocated within this amenities building. (Refer Section 4.6 New Shelters and Facilities). It shall be well lit to minimise vandalism.

3. Safety Requirements

The construction of the boardwalks, promenades, steps and ramps involves the issue of public safety. Safety precautions need to be considered in the detailed design stage of these structures, and liaison with Council during this process would help ensure the most suitable designs in terms of safety, aesthetics and cost. A comprehensive system of warning signs will need to be established within the signage and interpretation system.

Matters such as risk management, insurance and indemnification of the Crown will also need to be addressed at the detail design stage.

4. Stormwater Management

The current proximity of the stormwater outfall and children's pool poses a potential health and safety problem and requires a satisfactory resolution. However, the scope of this masterplan study does not include recommendations for resolving the conflict. The *Draft Terrigal Trunk Drainage Study, 1993*, has suggested possible alternatives such as a gross pollutant trap near the Bowling Club and a silt trap under Church Street. A more comprehensive assessment of these and other alternatives should occur in the near future to ensure that this issue is adequately and competently resolved.



Figure 26: Existing Stormwater Outfall

5. Carparking and Traffic Management

Generally carparking and traffic management have been excluded from the scope of this masterplan study. Any modifications shown on the masterplan are in line with the recommendations outlined in the *Development Control Plan for Terrigal, 1992* and the *Terrigal Waterfront Principles Plan, 1992*. These include reducing the size and scale of the carpark to the north of Terrigal beach and rationalising carparking in The Haven.

The masterplan acknowledges the future possibility to review traffic management in the Terrigal CBD.

6.0 FUNDING AND IMPLEMENTATION

i. Funding

Possible Funding Sources

Obtaining funding for a project of this scale and nature is a challenge which will be led and managed by Gosford City Council.

Funds for the project may be obtained from:

- Federal Government
- State Government
- Local Government sources: Section 94 Contributions

Federal Sources

Local Capital Works Program "Communities at Work"

- This program is administered by the Commonwealth Office of Local Government in co-operation with State and Territory Local Government Associations.
- This program involves targeted regions and individual Councils that have experienced above average levels of unemployment.
- The program funds projects which:
 - are strategically important to economic and social development
 - involve high local content in terms of labour, goods and services
 - have early commencement dates
- It is expected that local Councils will contribute between 10% to 20% in cash or kind.
- \$350 million was made available Australia wide for 1992-93 financial year under the "One Nation" program.
- Of this, Gosford City Council received approximately \$3.5 million allocated to previously identified capital works projects.

Commonwealth Training and Employment Programs

Two current programs include:

- Job skills for Land Care
- Land Care and Environment Action Program

Job skills for Land Care - 12 month training program involving 25% off job and 50% on job training. An amount is allocated per trainee per week including a sum per participant for administrative and training overheads. Also additional funds are provided per trainee for materials. 12% unemployment criteria has to be met.

Administrative Brokers: can be State, Local Council or private organisations.

Landscape improvements and construction of the boardwalk could be ideal for this funding category. This will require Council's involvement to administer the program.

State Government Sources

Roads Authority Funds

The Roads Authority Funds will bear the full cost of all traffic lane widening necessary to accommodate a cycleway approved by both Council and the RTA as an element of an adopted cycleway strategy plan.

The Roads Authority Funds will bear half cost of an agreed separate cycleway or shared cycleway / footpath constructed along or adjacent to a classified road.

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NSW Coastal Waterways Program

This program is administered by NSW Public Works Coastal Engineers specifically for construction of jetties, boat launching ramps and associated works, eg., carparking. It will fund 50% of all approved works including:

- Pre-construction costs
- Council or any other Federal (but not state) organisation will be required to fund the rest.

Coastal Management Program

This program is administered by NSW Public Works Coastal Engineers. Again the funding is for 50% of all approved works including pre-construction costs. This program could fund items such as the timber boardwalk(s), promenade improvements and associated landscaping.

Note: The eligibility of financial assistance under this Program is conditional on the compliance with the guidelines provided in the *Coastal Management Manual, 1990*. The offer of subsidy depends on the normal budgetary constraints and state-wide priorities.

Local Government Sources

Funding for different stages of the project could also be arranged through the distribution of Section 94 contributions. The availability of NSW State Grants depends on matching Council and/or Federal contributions.

ii. **Implementation**

The successful implementation of the Terrigal Waterfront Landscape Masterplan relies on the commitment to a staged program of works which can be carried out as and when funds become available.

The following stages are proposed as part of the Implementation Program.

Stage 1

- 1.1 Construction of The Boardwalk Link and associated landscaping from The Rockpool to The Haven to terminate at the Sailing Club.
- 1.2 Construction of The Promenade Link to The Rockpool including upgrading of pathways, new landscaping, children's playground, new toilets and lighting.
- 1.3 Carry out improvements to The Haven related to landscape development and planting improvements, improvements to existing access, circulation and parking.
- 1.4 Undertake appropriate measures to maintain the existing Norfolk Island Pines in The Esplanade.

Stage 2

- 2.1 Streetscape improvements to The Esplanade including new paving, new landscaping, lighting and furniture.
- 2.2 Improvements to Terrigal Drive and The Gateway including enhancement of the carpark.

Stage 3

- 3.1 Carry out improvements to The Promenade including the building of the new seawall, upgrading of the Surf Club, creation of the Town Square and integration of new furniture, lighting and signage.

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7.0 ESTIMATE OF COSTS

An outline order of probable cost was prepared based on the sketch masterplan drawings and is summarised below.

Cost calculations are based on March 1996 costs and are works costs only. They do not include allowances for:

- Preliminaries and Site Establishment (allow 8%)
- Contingencies (allow 2.5%)
- Professional Fees (allow 12%)

They are not intended as an accurate commercial assessment. They are intended as a general guide for funding and implementation strategy planning.

A number of non-specific items have also not been included in the costings including utility service relocations / temporary works, legal costs, temporary diversions or works, abnormal ground conditions or further geotechnical surveys. The costs of preparing appropriate environmental assessments of the works has also not been included.

The Summary of Probable Costs is as follows:

STAGE 1 WORKS

Item	Cost
1.1 Boardwalk Link to The Haven, including:	
• Timber pile boardwalk	\$500,000
• Cliff planting rehabilitation	\$32,500
• Timber access deck around Sailing Club	<u>\$45,000</u>
	\$577,500
1.2 Beach Promenade to Boardwalk Link (Children's Pool / Playground Area), including:	
• Upgrade footway to pool (timber)	\$30,000
• New toilet, storage building	\$50,000
(Possibility for inclusion in later stage to minimise anti-social behaviour)	
• Children's playground	\$25,000
• Enlargement of Rockpool	\$15,000
• Timber stairs to lookout	\$15,000
• Timber shade pergola and seating	\$20,000
• Lighting, signage, seats etc.	\$15,000
• Rehabilitation, planting to cliff and slopes	<u>\$22,000</u>
	\$192,000
1.3 Haven Landscape Improvements, including:	
• Minor regrading embankment and planting	\$25,000
• New concrete promenade and steps to beach	\$14,700
• Remove access road and upgrade picnic area (if required)	(\$14,000)
• Picnic shelters, seating, BBQ's, lighting around picnic area	\$50,000
• Upgrading oval road and parking	\$20,000
• Headland rehabilitation planting, pathways, lookout platforms	\$250,000
• General lighting, signage, bins etc.	<u>\$15,000</u>
	\$388,700
• New carparking areas	\$190,000
• Entry road upgrading	<u>\$25,000</u>
	\$215,000

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STAGE 2 WORKS

2.1 Esplanade - Improvements, including:	
• Widen western footpath and brick paving	\$250,000
• Shared traffic zone with new brick and concrete pavement (optional)	(\$200,000)
• New lighting, bollards, seats, bins, signage	\$97,000
• Tree planting - Livistona palms	\$23,000
	\$570,000
2.2 Terrigal Drive - Gateway Improvements, including:	
• New landscape planting adjacent road	\$60,000
• New feature Phoenix palms and Tree rehabilitation planting	\$50,000
• Carpark modifications at beach	\$45,000
• Upgrade picnic facilities adjacent carpark	\$30,000
	\$185,000

STAGE 3 WORKS

3.1 Beach Promenade and Town Square, including:	
• New promenade wall - entire length (subject to future design)	
• New concrete steps and ramps to sand (subject to future design)	
• Upper level retaining wall and sitting steps (subject to future design)	
• New paving to promenade, surf club and town square areas	\$250,000
• Turf to new picnic areas	\$15,000
• New tree planting	\$10,000
• Picnic shelters, lighting, seats, bins, signage, outdoor shower stands, shade shelter etc.	\$250,000
• Irrigation (allow)	\$15,000
	\$540,000

TOTAL ESTIMATED WORKS COSTS	\$2,668,200
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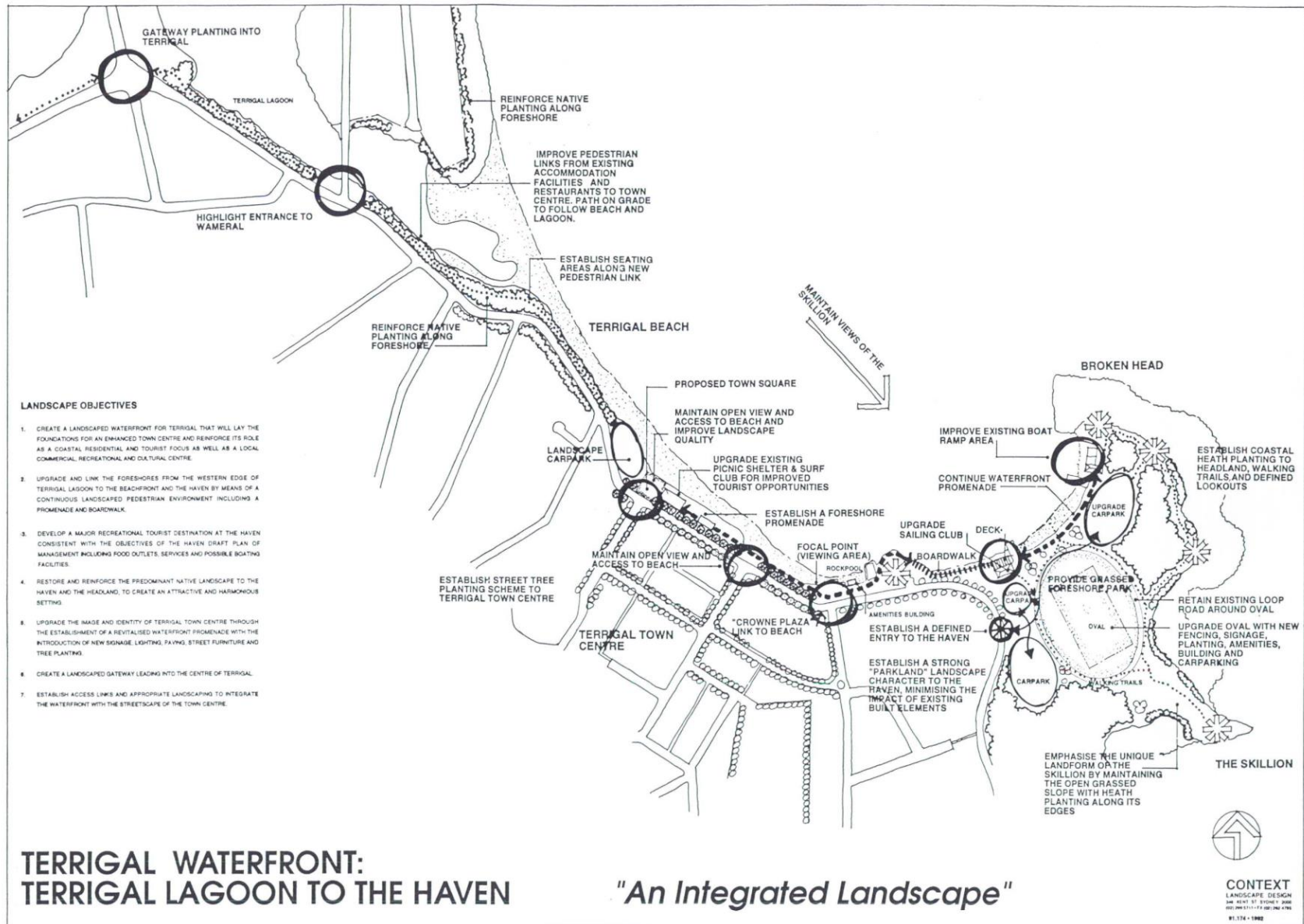
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APPENDICES

Terrigal Foreshore Development - Landscape Masterplan Report

1.0 TERRIGAL WATERFRONT PRINCIPLES PLAN - AN INTEGRATED LANDSCAPE
CONTEXT Landscape Design

CONTEXT Landscape Design • March 1996 • 94.531
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2.0 TERRIGAL FORESHORE ENGINEERING REPORT
Patterson Britton and Partners Pty Ltd

CONTEXT Landscape Design • March 1996 • 94.531
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1

**Patterson Britton
& Partners Pty Ltd**

The boardwalk would consist of timber piles and superstructure with timber handrailing on both sides. It would have a clear walkway width of 2.3 m. The timber piles would either be driven into the sand or potted into a rock socket. In sand, the piles would be driven the necessary founding distance below an anticipated scour level of RL -2 m AHD. In rock, an undersized hole would either be drilled or chiselled about 1 to 1.5 m into the bedrock and the pile driven into the hole to achieve fixity.

The pile spacing would be about 5 m with lateral bracing on each pile set.

The approximate cost of the boardwalk would be about \$800/m² of deck area.

3. LAGOON BOARDWALK

The Lagoon Boardwalk would be a timber jetty type structure similar to the Haven Boardwalk. While the boardwalk would be located at the back of the beach, it may be exposed to waves during a severe storm and as such has to be designed to withstand these loads. The boardwalk design features would be the same as for the Haven Boardwalk.

The proposed deck level is RL 3.1 m AHD. Historical beach profiles should be checked to establish typical backbeach sand levels and ascertain the potential for this deck level to be inundated with sand.

The boardwalk would have a clear walkway width of 2.3 m with a timber handrail on one side. Timber piles would be driven a sufficient distance below the estimated wave scour level of RL -2 m AHD or into bedrock as required. The piles would have a spacing of about 5 m and lateral bracing would be required.

The estimated cost of the boardwalk would be about \$500/m².

4. PROMENADE SEAWALL

The beachfront promenade would consist of a reinforced concrete seawall retaining the lower level and a reinforced concrete retaining wall supporting the upper level. The levels have been maintained the same as the existing promenades but the seawall has been extended up to a 0.5m further seaward.

The relocation of the seawall further seaward would cause an increase in the amount of sand lost from the beach in a severe storm. It is unlikely, however, that the relocation would have a significant influence on the long term sand loss rates from the beach compared to the existing seawall.

The seawall would incorporate a flexible gabion mattress which would gradually lower in severe storms as sand was eroded under its seaward edge. In this way, it would prevent undermining of the seawall. The design scour level is estimated to be RL -2 m AHD immediately seaward of the seawall. The mattress consists of PVC coated wire baskets filled with cobbles. The standard length of the mattress is 6 m.

The seawall would be cast in situ and built on top of the landward end of the mattress to ensure an integral connection between the two.

**Patterson Britton
& Partners Pty Ltd**

The retaining wall for the upper promenade would be reinforced concrete cast in situ. It would have to resist wave runup loads during a severe storm when it could be expected that waves overtop the seawall.

The concrete stairs leading from the beach to the lower promenade would be free standing structures independent of the seawall. This would allow them to slide away from the seawall if undermined during a severe storm without any damage to the seawall. The stairs could be readily reinstated following recovery of sand on the beach.

The estimated costs of the seawall and retaining wall would be:

• seawall	\$1 500/linear m
• retaining wall	\$ 750/linear m
• concrete seating steps	\$ 900/linear m
• concrete stairs between promenade levels	\$ 800/linear m

5. CLIFF STEPS

The cliff steps would be constructed as timber stairs supported on timber poles in order to negotiate the steep slope. Landings would be required at least every eighteen stairs. The clear gap between each stair could not exceed 125 mm. The allowable stair dimensions would be:

• riser	115 - 190 mm
• going	250 - 355 mm
• 2 x riser + going	550 - 700 mm

The estimated cost of the stairs including handrails would be approximately \$1,000/m².

6. BOARDWALK STRUCTURAL DIMENSIONS

Refer to fax from Conybeare Morrison (Tim) dated 15 June 1994. Please note that from a structural point of view the piles can be terminated below the deck level allowing the handrail to be located on the outside line of the piles.

Terrigal Foreshore Development - Landscape Masterplan Report

3.0 GEOTECHNICAL REPORT
Coffeys Engineering

CONTEXT Landscape Design • March 1996 • 94.531
Page 50

Coffey Partners International Pty Ltd

A.C.N. 003 692 019

Consulting Engineers, Managers and Scientists
Environment • Geotechnics • Mining • Water Resources

Coffey Partners International Pty Ltd

S10164/1-AB
1st July 1994

-2-

Your Reference S10164/1-AB CJP:KJZ
Our Reference 1st July 1994
Date55 Downie Street
Maryville NSW 2293PO Box 2195
Dangar NSW 2309
AustraliaFax (049) 62 2986
Telephone (049) 61 3130The Manager,
Context Landscape Design,
346 Kent Street,
SYDNEY N.S.W. 2000

ATTENTION: MR. CHRISTOPHER THOMAS

Dear Sir,

RE: GEOTECHNICAL ASSESSMENT OF CLIFF FACE - TERRIGAL FORESHORE
MASTERPLAN1.0 INTRODUCTION

At the request of Mr. Christopher Thomas of Context Landscape Design and on behalf of Gosford City Council a preliminary geotechnical assessment of cliff face areas associated with the proposed Terrigal Foreshore Masterplan was undertaken by our Mr. Colin Parker, Senior Engineering Geologist, on 17th June 1994. The work has been carried out in general accordance with our Proposal No. SP4386/1 dated 30th May 1994, though the scope of work has been increased to include additional areas other than the cliff line area described in the proposal.

Based on discussions with Mr. Christopher Thomas on 14th June 1994, and provision of a concept drawing of the "Landscape Masterplan" (Drawing No. SK-03) the following areas of foreshore clifflines required a preliminary geotechnical assessment, namely:-

Locality 1

The cliffline area around the headland containing the rock pool. Areas 10 and 12 on Drawing No. SK-03.

Locality 2

The cliffline area above the beach leading to the dive centre/restaurant and boat ramp on The Haven. Area 11 on Drawing No. SK-03.

Locality 3

Potential/existing lookout points on The Haven headland and The Skillion.

Locality 4

The clifflines above the southern edge of Terrigal Lagoon. Area 2 of Drawing No. SK-03.

2.0 SITE OBSERVATIONS AND RECOMMENDATIONS2.1 Locality 1 - Rockpool Headland**Proposal**

It is understood Gosford City Council wish to construct a timber boardwalk around the base of the cliffline at the site of the existing Terrigal rockpool. The boardwalk would extend along the wavecut platform following the existing informal walkway. The wavecut platform is not present on the southeastern side of the headland and in this area it is intended to cantilever a walkway from the cliff base out over the water or have a walkway supported entirely on piers above the water near the base of the cliff.

Site Observations

Site observations revealed the headland to be about 12m high above the wavecut platform. The escarpment of the headland can be described as having the lower half exposing moderately weathered horizontal beds of massive sandstone with interbeds of extremely to highly weathered siltstone/claystone; while the upper half of the escarpment is vegetated with steep slopes of 45° to 65°. Much of the vegetated portion is assessed to contain a thin soil cover over weathered rock extending upwards to road level in The Esplanade.

The rock within the cliffline around the rock pool consists of the following main rock units listed below in increasing elevation above the wavecut platform:-



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- A lower unit of massive sandstone 2m thick.
- A middle unit of thinly bedded siltstone, claystone and sandstone, 5m thick.
- An upper massive sandstone unit 2m thick.
- An upper unit of thinly bedded siltstone and sandstone.

The siltstone/sandstone beds appear to be extremely weathered and are more extensively eroded causing the overlying sandstone joint blocks to fall or slide as wedge failures out of the cliff face. The various beds also thin and "lens out" around the headland. Landslide debris is evident at the rear of the rock pool indicating relatively recent slope failures from the soil covered vegetated slopes onto the wavecut platform.

Geotechnical Assessment

The proposed walkway along the wavecut platform will be at risk of isolated block fall from the cliff face and landslides from the upper vegetated area. Remediating the cliffline to reduce the risk of instability can be undertaken. However, it is unlikely given the geology present, the cliffline exposure and history of instability that the risk of instability can ever be eliminated without major engineering works. Therefore options for the walkway around the cliffline could include a combination of locating the walkway away from the toe of the cliffline (ie. further out on the wavecut platform) and providing some remedial measures to reduce, but not eliminate, the risk of instability. Further geotechnical investigations are required to assess the risk of instability and provide recommendations for remediation. Consultation would also be needed with Council in relation to aesthetic issues arising from the remediation measures to be adopted to achieve a level of risk acceptable to Council.

The section of walkway which is proposed to be cantilevered from the cliffline out over the water will require a detailed geotechnical assessment. Preliminary observations suggest several large potentially unstable sandstone blocks are located above the walkway level and it may be more prudent to support the walkway out from the cliffline on piles founding beneath the water. Surface water is also concentrated on the cliff face in this area and some control of runoff is required.

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2.2 Locality 2 - The Haven Beach

Proposal

The walkway is proposed to be constructed along the rear of the beach at the base of the steep vegetated cliffline.

Observations

The beach at Locality 2 is about 10m to 15m wide at high tide. A sharp slope break to the ocean cliffline is evident at the rear of the beach. The cliffline along the back of the beach has a slope of about 45° up to The Esplanade and vegetation growth covers much of the slope. Evidence of previous landsliding on the cliffline can be observed from areas of rock exposure and low vegetation regrowth. A large landslide deposit 15m wide and 2m thick is evident on the back of the beach.

Geotechnical Assessment

The coastal escarpment at this locality is less likely to experience isolated rock falls compared to the headland area (Locality 1). However, larger scale landsliding of 10m to 15m width could be expected. Positioning the walkway away from the toe of the coastal escarpment will reduce the risk of the walkway being covered by slide debris and placing pedestrians at risk (albeit a very remote risk of personal injury given the low frequency of such slides).

Preliminary observations would suggest positioning the walkway more than 5m from the escarpment toe will significantly reduce the risk. It is important to note that the stability of the escarpment slope is enhanced by the vigorous vegetation growth. Any removal of undesirable vegetation species from the escarpment should be only considered in isolated areas (at any given time) so that suitable replacement trees/shrubs can be established.

2.3 Locality 3 - Various Lookout Points

Five potential lookout points have been shown on the supplied drawings. These lookout points include two clifftop sites on the headland north of The Skillion, a lookout point at the rear of the beach (in an area known as The Village Green), the existing Skillion lookout site and a site immediately southeast of The Haven football field.

Based on the preliminary assessment, all five lookout points present no major geotechnical concerns. However, we would suggest that when the specific lookout points are finalised that a

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further geotechnical assessment is carried out to assess for recommended offsets from the cliff safety fences.

2.4 Locality 4 - Terrigal Lagoon

Proposal

It is proposed to construct a walkway around the southern edge of Terrigal Lagoon. The walkway is to be constructed just above high water mark at the base of the steep escarpment slope (some 15m high) extending down from Terrigal Drive. The escarpment slope has a small bench near the water level at the eastern end of the lagoon upon which the walkway is to be constructed. However, for much of the length of the lagoon walkway the escarpment slope extends directly into the lagoon and the walkway is intended to be constructed as either a cantilevered structure off the escarpment rock face or be piered onto the floor of the lagoon.

Observations

The escarpment slope above the southern shoreline of Terrigal Lagoon slopes steeply up to Terrigal Drive at angles of 30° to 50° with locally steeper slopes. The lower portion of the escarpment slope exposes a sandstone unit while the upper portion is thickly vegetated and is assessed to have a thin soil cover. Evidence of recent slope instability can be observed along the escarpment slope where arcuate shaped sandstone exposures extend up into the vegetated areas suggesting the slide debris has slipped downslope due to excessive ground pressures and/or removal of toe support by erosion of the lower sandstone exposure. The debris from these recent slides is evident on the beach at the eastern end of the lagoon, while the slide debris from the area above the lagoon is likely to have moved onto the floor of Terrigal Lagoon. Several areas of potential instability could be seen at the eastern end of the lagoon while it was not possible to assess instability risk for the area above the lagoon without the use of a boat.

Geotechnical Assessment

Given the steep escarpment slope above the proposed lagoon walkway route and the inferred recent history of instability on the escarpment it is considered that a significant risk exists to the walkway site. This risk is primarily associated with the risk of larger landslides (say 25m³ to 50m³ in size) moving onto the elevated walkway and causing significant damage. It is recommended that considerations be given to relocating the walkway to the northern side of the lagoon and avoid the instability risk of the southern escarpment slope. Remediation measures to effectively stabilise the

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escarpment slope and ensure the integrity of the walkway is assessed to be not practicable given the magnitude of the problem.

If you require any further assistance on these matters please contact our Mr. Colin Parker in our Sydney Office on (02) 888 7444.

Yours faithfully

COFFEY PARTNERS INTERNATIONAL PTY. LTD.COLIN PARKER



Land and Property
Management Authority



Plan of Management

Terrigal Haven

December 2009



Printed by Gosford City Council, 49 Mann Street GOSFORD NSW 2250

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1 Introduction

This Plan of Management has been prepared by Gosford City Council (Council), as Terrigal Recreation (R48416) Reserve Trust, for the Crown land described as Terrigal Haven, adjacent to Terrigal Beach and Foreshore within Gosford Local Government Area. The Haven covers an area of approximately 10.5 ha of Crown land and includes the area known as 'Reserve 48416'. This Reserve was notified by the then state planning agency for Public Recreation on 18 December 1912 with Council appointed as trustee on 24 April 1959.

Terrigal Haven lies on the exposed coast at the northern end of the Gosford Local Government Area. The Haven consists of a small protected bay, sandy beach and adjoining sandstone landforms which support remnants of coastal heathland. The Haven is characterised by a high headland known as Broken Head, of which a prominent feature is the steeply rising narrow rocky outcrop known as the 'Skillion'. Broken Head encloses an area of water which is protected from weather emanating from the southwest, south, southeast and east. The Haven is also partially sheltered from weather from the northeast and north, making it an important overnight destination for sailors moving up and down the NSW coast. It contains a number of permanent swing moorings for commercial vessels and some private boats.

Terrigal Haven and its surrounds are a popular local and tourist destination throughout the year, particularly in the summer months. The Haven is used for several recreational and commercial activities including: diving, fishing, swimming, sailing, football, cricket, canoeing, snorkelling, individual and group fitness activities, sightseeing, picnicking, dogwalking, BBQs and dining in cafes and restaurants,

There are two boat ramps within the Haven, the larger one is used for launching boats, while the smaller one is used by divers, canoes and small water craft.

In February 2007, the Federal Government announced that the HMAS Adelaide, a Royal Australian Navy Guided Missile Frigate, would be decommissioned and gifted to the NSW Government for the purpose of creating an artificial reef and recreational dive site in waters off the coast of Terrigal Haven. The NSW Land and Property Management Authority (LPMA) is responsible for the overall management of the artificial reef site and is developing a separate Plan of Management for this newly gazetted sea based reserve.

The emphasis of the Terrigal Haven Plan of Management is to balance community use and environmental considerations of the reserve with the sound financial management of the Terrigal Haven area. Consequently, the actions outlined in this Plan of Management aim to enhance the natural beauty of the Terrigal Haven area and encourage improvements to those facilities which allow residents and visitors to enjoy the natural environment.

Figure 1.1 illustrates the study area location.

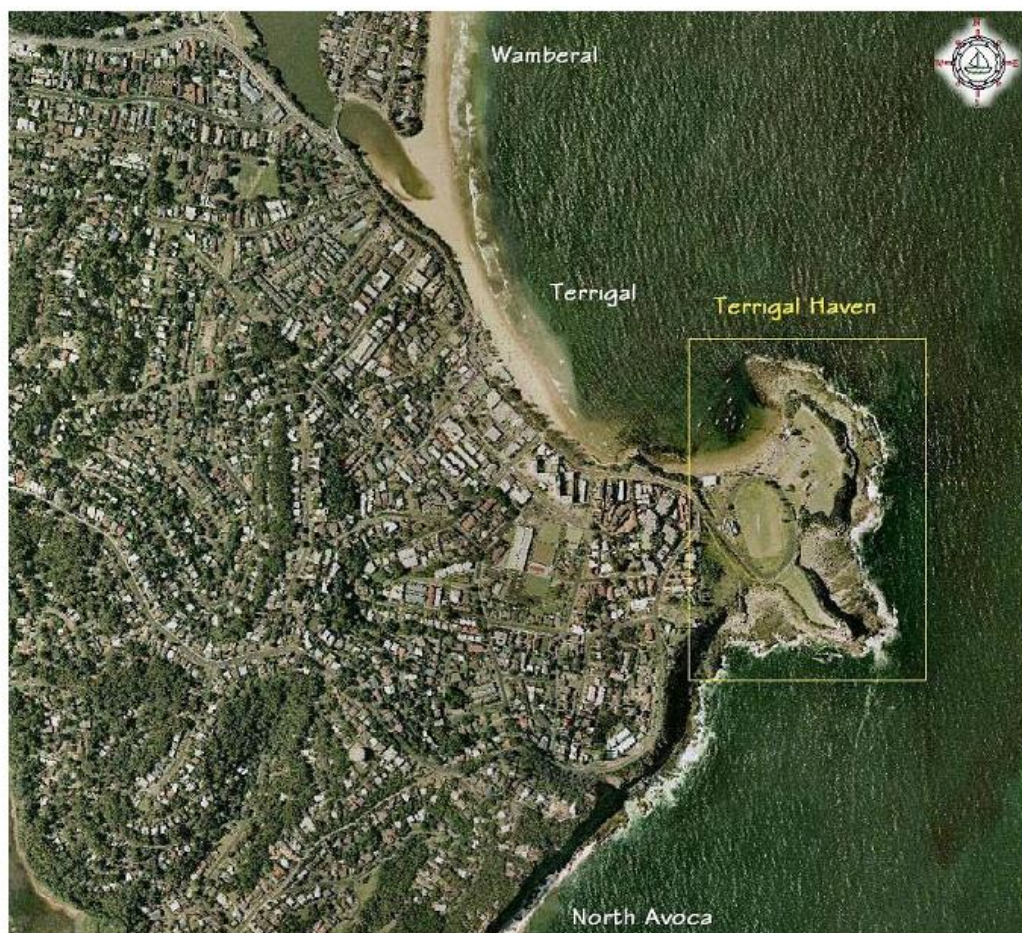


Figure 1.1 Study area location

1.1 BACKGROUND

In October 1991, the Terrigal Chamber of Commerce, with Council's support, convened a workshop and resolved the need to develop a Landscape Masterplan for the waterfront that integrated and linked the foreshores from the western edge of Terrigal Lagoon to the Terrigal beachfront area and the Haven. A working group was formed to develop a Landscape Masterplan. The Masterplan was designed and prepared by Context Landscape Design in March 1996 and subsequently adopted by Council in May 1996 (Appendix 1).

A draft Plan of Management was prepared by Brown & Root in 2001 and reviewed by the NSW Land and Property Management Authority (formerly the NSW Department of Lands) in 2003, with the LPMA recommending that minor amendments be made. As a result, the Terrigal Haven Plan of Management was revised in 2005 by Kellogg Brown & Root Pty Ltd and adopted by the LPMA in May 2006.

This current version of the Plan of Management has been prepared by Gosford City Council, as Trust Manager for Reserve 48416, to reflect the changing environmental and recreational requirements of the Terrigal Haven area. This Plan of Management also intends to create a link with the newly gazetted sea based reserve which will facilitate the establishment of an artificial reef site for the sinking of the ex-HMAS Adelaide. It must, however be noted that the artificial reef project is separate to and not part of this Plan of Management.

1.2 AIM AND APPROACH

The aim of the Plan of Management is to provide a clear, concise and practical framework for the management of Terrigal Haven. The Plan uses a values-based approach to land planning and management. This approach facilitates strategies which will protect and enhance identified key values, whilst identifying opportunities which will ensure longer-term objectives of sustainable management.

1.3 OBJECTIVES

In accordance with the requirements from the LPMA and Council, the objectives for the Plan of Management are as follows:

- to preserve the open space area of the Haven for public recreational use and access while allowing for utilities for water safety and the convenience of the public that are required
- to conserve and reinforce the park's open space area, natural values and items of cultural significance for future users
- to encourage improvements to those facilities which will increase enjoyment of the natural environment by the local and visiting communities
- to identify further opportunities for increased sustainable management of the reserve
- to create a link between this Plan of Management and the newly gazetted sea based reserve which will facilitate the establishment of an artificial reef site for the sinking of the ex-HMAS Adelaide
- to include in the PoM a 'statement of significance' which will:
 - establish the natural significance of the Reserve as a whole
 - incorporate an assessment of significance in all facets, i.e. historic,

- aesthetic, social and scientific
 - consider the precinct as a whole, and in terms of its components.
- to provide policy recommendations for:
 - short and long term management of the Haven
 - broad future objectives for the Haven
 - procedures for compliance with statutory instruments.

1.4 MANAGING CROWN LAND

1.4.1 Requirements of the Crown Lands Act 1989

Requirements of the *Crown Lands Act 1989* include:

- the Plan of Management must be prepared in accordance with the principles for land management under the Crown Lands Act 1989
- existing and proposed uses, developments, leases and management practices must be consistent with the dedicated public purpose of the reservation unless otherwise authorised by the Minister under the Crown Lands Act 1989
- the Plan must address any matters required by the Minister responsible for Crown Lands Act 1989
- there must be a public exhibition of the draft Plan for a minimum of 28 days and submissions must be referred to the Minister (responsible for the Crown Lands Act 1989) within a further 14 days prior to adoption
- once approved by Council and adopted by the LPMA, the Plan of Management process moves into the implementation stage.

1.4.2 Principles of Crown reserve management

Section 11 of the *Crown Lands Act 1989* provides a set of principles for Crown land management as follows:

- environmental protection principles be observed in relation to the management and administration of Crown land
- the natural resources of Crown land (including water, soil, flora, fauna and scenic quality) be conserved wherever possible
- public use and enjoyment of appropriate Crown land be encouraged
- where appropriate, multiple use of Crown land be encouraged
- where appropriate, Crown land should be used and managed in a sustainable manner
- Crown land to be occupied, used, sold, leased, licensed or otherwise dealt with in the best interests of the State consistent with the above principles.

1.4.3 'Public purpose' and Zoning

The *Crown Lands Act 1989* provides for the reservation and dedication of Crown land for public purposes. In the case of Terrigal Haven the public purpose of the reserve is Public Recreation. The Haven area has been zoned 6(a) Open Space - Recreation under Council's Gosford Planning Scheme Ordinance. By this zoning, Council has recognised the importance of the Haven area for open space and recreation and plans

for further development, outside of this Plan of Management, in this area must be submitted to Council for approval and compatibility with its current zone use and objectives. It should be noted that the current Statewide review of Local Environment Plans (LEP) will result in the renaming of this zone to RE1 Public Recreation upon adoption of the revised Gosford LEP by the Minister of Planning.

1.4.4. Additional Purposes

The Minister for the LPMA may authorise Crown reserves to be used for additional purposes, under the *Crown Lands Act 1989* (CLA). Additional uses or purposes may be authorised in a number of ways, including;

- a. under a direct lease, licence, easement, or right of way; (Section 34A, CLA)
- b. notification in the government gazette; (Section 121A CLA) or
- c. by way of an adopted plan of management. (Sections 112, 114 & 115 CLA)

The Minister will cause an appropriate notice to appear in the Government Gazette under those provisions of the Crown Lands Act 1989. In considering whether to grant additional interests or purposes for which a Crown reserve may be used the Minister will consult with current reserve managers, consider the principles of Crown Land Management (see Section 11, CLA) and be satisfied that it is in the public interest to do so.

1.5 METHODOLOGY

The methodology of the preparation and revision of the Terrigal Haven PoM has been to determine the major values and issues affecting the area through site inspection, assessment and analysis of data. The following attributes have been addressed in this report:

- visitor usage and facilities
- locational factors and impacts
- cultural and historical significance
- natural systems influences
- arboricultural and horticultural aspects
- soils and drainage characteristics
- conceptual design considerations
- management and maintenance requirements.

1.6 COMMUNITY CONSULTATION

The original Terrigal Haven Plan of Management evolved through a team-approach with direction from a Stakeholder Group including key Council staff, members from the Terrigal CBD Building Committee, the Coastal Planning Committee (CLP Committee), a representative from the LPMA and a number of key local community stakeholders. A general community display and presentation was also organised to capture the issues and concerns of the public using the Haven as a resource. The 2006 version of the Terrigal Haven Plan of Management was placed on public exhibition by Council and gazetted by the LPMA prior to adoption, providing ample opportunity for community feedback.

In 2007, a further consultation was held with members of the original Stakeholder Group and current operators within the Terrigal Haven area. A number of issues were identified and feedback was provided at this meeting (Appendix 2).

This revised Plan of Management was placed on public exhibition from 7 January 2009 until 18 February 2009, notice of which was given in the Government Gazette, local newspapers and Council's website. The document was publicly exhibited for 42 days to allow opportunity for the community to provide feedback. Officers from the LPMA and Council held an information session for Stakeholders that had previously been involved in the revision process on 17 December 2008. Additional information sessions were held on 17 January 2009 and 28 January 2009 which members of the local community were invited to attend. A total of 56 days, from notification, was allowed to enable interested persons to make written submissions to Council.

Twenty six (26) written submissions were received from individuals and organisations within the local community. Submissions were reviewed by Officers from Council and the Land and Property Management Authority with amendments incorporated into the document where appropriate.

In July 2009, the NSW Land and Property Management Authority notified Council that a further amendment to the Plan of Management would be required to explore additional tourism opportunities that may be available in the area. As a result, due to the significance of this amendment, the plan is required to be re-exhibited, in part, for 28 days to allow the community to provide comment on this amendment prior to the finalisation of this plan. Submissions are required to be received within this timeframe and will be considered by Officers from Council and the Department of LPMA prior to the presentation of the document to Council and the Department of LPMA for adoption.

1.7 STRATEGIC DOCUMENTS USED IN THE PREPARATION OF THE PLAN

The following documents have been used to guide the strategic outcomes of this Plan, ensuring consistency with these values, principles and policies.

- Terrigal Foreshore Development - Landscape Masterplan Report prepared by Context Landscape Design, 1996
- Gosford City Council 'Vision 2025', 2007
- Gosford City Council 'Quality of Life Strategy', 2008
- Gosford City Council 'Disability Action Plan', 2008
- Hunter-Central Rivers Catchment Management Authority 'The Hunter-Central Rivers Catchment Action Plan', 2007
- New South Wales Department of Planning 'Central Coast Regional Strategy', 2008
- Coastal Council of New South Wales 'NSW Coastal Policy 1997'
- Gosford City Council/Wyong Shire Council Central Coast Sportsground Management Strategy, 2007
- Gosford City Council Sportsground Plan of Management, 1995
- Gosford City Council Foreshore Parks Plan of Management, 1996
- Gosford City Council Coastal Management Study and Coastal Management Plan, Gosford City Open Coast Beaches, 1995

Other relevant legislation and policies

The Plan and its management options must comply with the requirements and provisions contained within relevant legislation and policy guidelines, including but not limited to the following:

- Commonwealth Environment Protection and Biodiversity Conservation Act 1999
- Environmental Planning and Assessment Act 1979
- Environmental Planning and Assessment Regulation 2000
- National Parks and Wildlife Act 1974
- Protection of the Environment Operations Act 1997
- Native Vegetation Act 2003
- Threatened Species Conservation Act 1995
- Noxious Weeds Act 1993
- Fisheries Management Act 1994
- Disability Services Act 1993
- SEPP 19 - Bushland in Urban Areas
- SEPP 26 - Littoral Rainforests
- SEPP 71 - Coastal Protection

1.8 LIST OF ABBREVIATIONS IN THIS PLAN

Council	Gosford City Council
DECC	Department of Environment and Climate Change
LALC	Local Aboriginal Land Council
LPMA	Land and Property Management Authority
NPWS	National Parks and Wildlife Service
SEPP	State Environmental Planning Policy

2 Site Assessment

Preliminary site investigations were carried out in September 2001 and included several general reconnaissance surveys and a review of existing literature obtained from the Stakeholder Committee and the Local Gosford Library. Aerial photographs, orthophoto maps and topographic maps were also used to determine the physical character and context of the site.

Supplementary site inspections were carried out in June 2005 and September 2007 as part of the revision of the Plan of Management.

2.1 BIOPHYSICAL ENVIRONMENT

Local context

The Haven and Skillion represent approximately 10.5 ha of Crown land. The Skillion is clearly visible from the Scenic Highway, parts of Terrigal Beach and the main entrance road (Terrigal Esplanade) into the Terrigal Business Centre. It is generally recognised as a prominent landmark and a major element in terms of the visual and historic image of Terrigal. The Haven consists of a small protected bay, sandy beach and adjoining sandstone landforms that provide a wide ranging array of water and land based activities and opportunities. The uses of the Haven relate to and complement the Terrigal Business Centre and it is very important that a link remains between the two.

Regional context

Terrigal Haven forms one small part of a network of Crown land along the New South Wales coastline which represents open space and recreational use. It is just outside the City of Sydney and is one of the first mooring sites north from Sydney that is sheltered from the strong winds that are characteristic of the northern beaches of Sydney.

2.1.1 Land tenure and land use

Current leases and licenses

Terrigal Haven currently comprises three main tenures under the LPMA control and five under Council control. Figures 2.1 and 2.2 illustrate the current leases within the Haven.

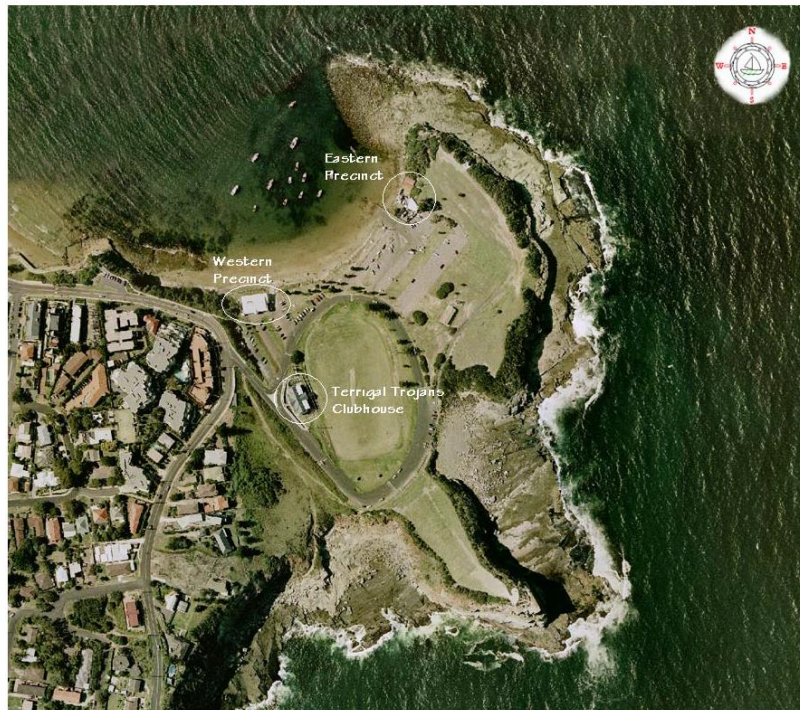


Figure 2.1 - Current leases and licences - Terrigal Haven

Terrigal Haven

Reserve 48416 notified 18 December 1912, addition notified 11 July 1975 comprises Lot 6 DP 805477 and Lot 247 DP 755234, Parish Kincumber, County Northumberland, LGA Gosford, at Terrigal. Terrigal Recreation (R48416) Reserve Trust appointed 23 November 1990. Gosford City Council is the Reserve Trust Manager.

Terrigal Trojans Clubhouse

1. Part of Lot 6 DP805477 - held under lease issued by Council as Terrigal Recreation (R48416) Reserve Trust and LPMA to the Terrigal Trojans Rugby Club.

Western Precinct

2a. Part of Lot 6 DP805477 - held under lease issued by Council as Terrigal Recreation (R48416) Reserve Trust and the LPMA to the Reef Restaurant & Grill. Lease approved for a period of 10 years from 1998 with an option for a further 10 years. Option taken up in 2008.

2b. Part of Lot 6 DP805477 - held under lease issued by Council as Terrigal Recreation (R48416) Reserve Trust and the LPMA to the Cove Café & Grill. Lease approved for a period of 10 years from 2001 with an option for a further 10 years.

2c. Part of Lot 6 DP805477 - held under lease issued by Council as Terrigal Recreation (R48416) Reserve Trust and the LPMA to the Terrigal Dive Centre. Lease approved for a period of 10 years from 1998 with an option for a further 10 years. Option taken up in 2008.



Figure 2.2 - Current Leases and Licences in the Eastern Precinct of Terrigal Haven

Eastern Precinct

3a. Reserve 96999 for Non-Profit Making Organisation notified 7 October 1983. Terrigal Haven Coastal Patrol (R96999) Reserve Trust appointed 23 November 1990. Royal Volunteer Coastal Patrol is Corporate Trust Manager.

3b. Proposed licence between Terrigal Recreation (R48416) Reserve Trust and Terrigal Sea Rescue Services Inc. Formerly occupied by Power Surf Rescue under an agreement with the Trust.

3c. Crown Licence 361496 issued to Terrigal Sea Rescue Services Inc 2 December 2003. Site revoked from Reserve 48416 for Public Recreation 12 August 1977.

3d. Lot 488 DP 728960 which comprises Reserve 170105 for Future Public Requirements (notified 19 May 1989) and Temporary Licence 410799 held by Zinga Rosa Pty Ltd executed by the Minister on 4 February 2009, due to expire 4 February 2010.

2.1.2 Land uses

An inventory of existing uses has been prepared from anecdotal evidence and observations during the course of the project. The following table outlines those land uses and provides a brief comment on each.

Table 2.1 Inventory of existing Haven land uses

Name of organisation or activity	Comment
Terrigal Trojans Rugby Club	Football training and games using the sports oval within Haven. Clubhouse on western side of Oval utilised for sporting and social functions.
Haven Beach Restaurant and Haven Seafoods	Restaurant and Café (fish and chips) situated in the eastern precinct overlooking the Haven Beach.
Reef Restaurant & Grill	Restaurant on the upper level of the old sailing club building adjacent to the entrance of the Haven and the first car park.
The Cove Café & Grill	Café on the lower level of the old sailing club building adjacent to the entrance of the Haven and the first car park.
Terrigal Dive Centre	The dive shop is on the lower level of the old sailing club building and operates scuba diving sessions from within the Haven.
Cricket association	Cricket association conducts training and games on the sports oval during the summer period.
Special events	Events that have occurred in the oval and/or adjoining areas of the Haven since 2005 include: <ul style="list-style-type: none"> • 2008 World Laser Championships • Terrigal Food and Wine Fair • Five Lands Walk • Gosford Hospital Super Test (Cricket Match) • NSW Outrigger Canoe Championships • Aboriginal Chronic Care Health Check Day • Aboriginal Dawn Ceremony Whale Dreaming • NSW Country Schools Representative Rugby Match • The Cluster Filmfest • wedding ceremonies (approx 20 per summer) • baptism ceremonies • approx 97 sporting events including training, competitions and school events (per annum).
Educational use/activities	School groups (sports); marine studies.
Volunteer coastguard activities	Volunteer coastguard services operating off the Haven; Royal Volunteer Coastal Patrol, Council's Lifeguard Service, Terrigal Sea Rescue Services.
NSW Maritime (offshore moorings)	Approximately 17 moorings within the Haven.
Conference activities	Conferences and other corporate activities (teambuilding activities etc).
Terrigal Beach Surf Lifesaving Club	Boating, nipper, training and education activities. Provision of rescue services.
General activities (active and passive)	Commercial fishing; recreational fishing; swimming/wading; walking/strolling/jogging/surfing; dog walking; sightseeing; picnicking/BBQs; cycling; jetskiing/powerboating; use of trig station; small watercraft activities; catamaraning/sailing; kite-flying; individual and group fitness training.

Lot 5 DP805477 - Pump Station

A small piece of land, adjacent to the Terrigal Haven Foreshore Reserve, is held by Council for the purposes of a Pump Station.

2.1.3 Adjacent land use

The land use adjacent to the Haven is highly developed with both commercial and residential zones. Within the Terrigal CBD, land is privately owned and leased to individual commercial and retail ventures. Commercial and retail premises include the following:

- food outlets (e.g. cafés/restaurants/supermarkets)
- services (e.g. banks/post office/hairdresser/dentist/optometrist/laundrette)
- other specialist shops (clothing boutiques/gift shops)

Seaward of Terrigal Haven lies a newly gazetted reserve over submerged Crown lands seaward of the Mean High Water Mark. The sea based reserve will facilitate the establishment of an artificial reef from the scuttling of the ex-HMAS Adelaide and will comprise a major attraction to the area and to this reserve.

2.1.4 Traffic access and circulation

Traffic and Transport Surveys Pty Ltd (1998) prepared a Terrigal CBD Traffic Report which outlined some of the existing traffic conditions. The main road through the Terrigal CBD and up to the Haven is the Terrigal Esplanade, which passes along the beachfront. Terrigal Esplanade joins the Scenic Highway after it passes the Haven and curves back around behind the hill at the Haven.

At present there is no separate cycleway in the Terrigal CBD, the cycleway is integrated into the travel lane.

The level of pedestrian activity and traffic generated by the beach and other recreational activities has major effects on the capacity of the present traffic arrangements. The effects are so great that the available traffic capacity is severely reduced during periods of high recreational activity such as during weekends and holiday periods.

The Haven currently has an entrance from Terrigal Esplanade that leads into the Haven via a one way route around the existing sports field. There are two main car parking areas with approximately 150 car spaces and a smaller car park adjacent to the Skillion which contains approximately 15 car spaces. There is also a road which extends to the Haven Beach Restaurant and car park at the eastern side of the Haven.

A multi-level parking station at Wilson Road in the Terrigal CBD was opened in July 2006, providing free 24 hour public parking. There are two public entry points and 330 parking spaces available in the station. The parking station is approximately 300 metres (or a 10 minute walk) from the entrance to the Haven.

2.1.5 Flora and Fauna

This section provides a brief overview of the Review of Environmental Factors (REF) prepared for the Terrigal Foreshore Improvements Proposal (KBR, 2002) and makes reference to a flora and fauna survey of the Haven conducted by Payne in 1999 and to

vegetation mapping of the Gosford LGA undertaken by East Coast Flora Survey (Bell 2004). A further detailed summary and vegetation mapping is provided as Appendix 3.

The wider locality of Terrigal Haven is urban in nature, and much of the Haven and vicinity has been disturbed as a result of urban development. Native terrestrial vegetation within the Haven is restricted to small, narrow patches. These occur in areas isolated by urban development, on the cliff tops and sides of Haven Headland and the Skillion.

Other vegetation within the Haven consists largely of planted trees and shrubs associated with landscaping works.

Plant communities

Three main plant communities have been identified within the study area based on previous vegetation mapping including:

- Coastal Headland Low Forest
- Coastal Headland Grassland
- Coastal Headland Shrubland.

A detailed description of these plant communities and location within the Haven is provided in Appendix 3.

Flora of conservation significance

Several threatened flora species listed under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act) have been recorded or are likely to occur within a 10 km radius of the study area (KBR 2002). Of these, the study area provides potential habitat for the following threatened flora species:

- Bynoe's Wattle, *Acacia bynoeana*
- Thick-lipped Spider-orchid, *Caladenia tessellata*
- Sand Spurge *Chamaesyce psammogeton*
- Camfield's Stringybark, *Eucalyptus camfieldii*
- Magenta Lilly Pilly *Syzygium paniculatum*.

Two of the three vegetation communities recorded within the study area are not currently listed as endangered ecological communities (EEC) on the TSC Act or the EPBC Act (they are Regionally Significant Vegetation). However, Coastal Headland Grassland is a component of *Themeda Grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner bioregions*, which is listed as an EEC under Schedule 1 (Part 3) of the TSC Act. The floristics of the Coastal Headland Grassland community recorded within the study area are consistent with this determination. The EEC is shown as map unit E51a in Appendix 3.

There is also the potential that some sections of Coastal Headland Shrubland recorded as littoral rainforest are components of the *Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions*, which is an EEC listed under the TSC Act.

Given that two EECs potentially occur within the area protection of the stands of Coastal Headland Grassland and sections of littoral rainforest will now be an important issue for management of the study area.

Significant trees

A number of trees listed as 'significant' under Council's Significant Tree Register occur within the Terrigal area, particularly along Terrigal Esplanade. Of these, Norfolk Island Pine *Araucaria heterophylla*, has been planted at various locations within the study area.

Threatened fauna species

No threatened fauna species (listed under either the EPBC Act or the TSC Act) have been recorded within the study area during the field investigations undertaken by KBR or by Payne (1999).

No endangered populations of fauna, as listed under the TSC Act, have been identified as occurring within the wider locality of the study area (NPWS 2008). The EPBC Act also does not list threatened populations.

Numerous threatened and migratory fauna species (listed under the TSC and EPBC Acts) have been recorded or are likely to occur within a 10 km radius of the study area. Whilst some of these species could occur on the site on a transient basis during foraging activities, none are likely to reside permanently (for nesting, breeding, or roosting) owing to the levels of human activity in the Haven and the lack of suitable habitat.

The following list indicates threatened fauna species that might occur within or transiently above (in flight) the study area:

- Lesser Sand-plover *Charadrius mongolus* – sandy beaches
- White tern *Gygis alba* – airspace over site (i.e. may occur throughout site)
- White-bellied Sea-eagle *Haliaeetus leucogaster* – airspace over site, coastal cliffs
- White-throated Needletail – airspace over site (i.e. may occur throughout site)
- Swift Parrot *Lathamus discolor* – street trees, parks, gardens
- Littlejohn's Tree Frog *Litoria littlejohni* – heathland
- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* – stormwater channels, buildings
- Black-faced Monarch *Monarcha melanopsis* – heathland
- Satin Flycatcher *Myiagra cyanoleuca* – low open forest
- Large-footed Myotis *Myotis adversus* – bridges, buildings
- Powerful Owl *Ninox strenua* – heathland, large trees in public/private gardens
- Osprey – *Pandion haliaetus* - airspace over site
- Red-tailed Tropicbird *Phaethon rubricauda* – airspace over site (i.e. may occur throughout site)
- Little Shearwater *Puffinus assimilis* – airspace over site (i.e. may occur throughout site)
- Rufous Fantail *Rhipidura rufifrons* – heathland, parks, gardens
- Regent Honeyeater *Xanthomyza phrygia* – trees in streets, gardens.

Schedules 4 and 5 of the *Fisheries Management Act 1994* list threatened species (endangered or vulnerable), populations and ecological communities under the Act. The following species are listed as endangered or vulnerable and have the potential to occur within the marine areas of the Haven:

- Grey Nurse Shark *Carcharias taurus*
- Great White Shark *Carcharodon carcharias*
- Black Cod *Epinephelus daemeli*.

NSW Fisheries has identified the following protected species that have the potential to occur within marine areas of the Haven:

- Estuary Cod *Epinephelus coioides*
- Common Sea Dragon *Phyllopteryx taeniolatus*.

2.1.6 Indigenous and non-indigenous heritage

Indigenous heritage sites have been identified within the Terrigal Haven area however due to the sensitive nature of the information, specific details cannot be provided. It is recognised that the actions in this Plan of Management and the concept plan must be consistent with appropriate management of these culturally significant sites.

Although no field searches have been undertaken, investigations into non-indigenous heritage sites suggest that there are no heritage listed buildings or other non-indigenous heritage sites in the Terrigal Haven area.

Offshore shipwrecks

According to The Heritage Branch of the NSW Department of Planning's records, there are 104 shipwreck sites in the Central Coast region. Of these, there are currently three identified shipwreck sites located in the vicinity of Terrigal Haven.

The *Lord Ashley*, a 435 ton screw-driven steamship travelling from Newcastle to Melbourne, sprang a leak and was wrecked on Terrigal Reef on 8 September 1877.¹ The *Lord Ashley* was built in the United Kingdom in 1857 and initially operated on the trans-Tasman route to New Zealand.² The *Yambacoon*, a 184 ton screw-driven steamship travelling from Newcastle to Sydney, collided with rocks around the Skillion and sank on 24 February 1917 as a result of the failure of the vessel's steering gear. The *Galava*, a 412 ton steam collier, trading between Sydney and Newcastle, foundered and sank three miles off the coast of Terrigal on 9 February 1927. The *Galava* was built in Workington, in the United Kingdom, with a length of 141ft 4in. breadth 23ft 9in. and a depth of 10ft 6in.³

In addition to these identified sites there are two sites that have been investigated by the NSW Heritage Office within the Haven and reported in the document 'Investigation of Shipwreck Remains, Terrigal Haven, NSW' (December 1997). It is stated within the report that 'One site lies in approximately three metres of water in the Haven, the other

¹ Berry, G., 1994, Shipwrecks of the New South Wales Central Coast: Volume 1 1800-1899, Central Coast Shipwreck Research, Tacoma

² The Heritage Branch, NSW Department of Planning, 2009, 'All Shipwrecks in the Central Coast Region', Maritime Heritage Online New South Wales, viewed 18 May 2009
< http://maritime.heritage.nsw.gov.au/public/display_ship_region.cfm?v_row=41 >

³ Parkinson, L., 2003, Terrigal: A History of the Area, The Lazy Lizard, Terrigal

is located within the adjoining beach sands' and that 'While the identity of both sites has not been ascertained, the construction techniques employed would indicate that they date from the mid nineteenth century to early twentieth centuries'.

The ex-HMAS Adelaide

The *HMAS Adelaide* was built in the United States and commissioned in the Royal Australian Navy on 15 November 1980. *HMAS Adelaide* was the first guided missile frigate to be home ported in Western Australia. *HMAS Adelaide* participated in the 1990/91 Gulf War as part of operation DAMASK, Australia's participation in the international coalition against Iraq's invasion of Kuwait. More recently, the ship was deployed for peacekeeping operations in East Timor in 1999 and to the Persian Gulf as part of the International Coalition against Terrorism in 2001 and 2004.

The NSW Land and Property Management Authority has responsibility for the seabed on which the *ex-HMAS Adelaide* is expected to eventually sit. Consequently, the LPMA has taken on the role of the preparation, scuttling and ongoing management of the artificial reef site. Therefore, a separate Plan of Management is being prepared for the future management of the artificial reef site.

2.1.7 Scenic and visual analysis

Terrigal Haven is considered a local icon given the range of users it attracts and the quality of its landscape. It is a visually prominent site due to its distinctive bowl and prominent headland. The Haven has high scenic value due to its coastal setting, grassed areas, rising landforms, limited built form and vegetation including coastal heath and littoral rainforest. The Haven creates a sense of space through its continuous grasslands and the shape of the headland. The area around the Haven is typical of a coastal headland and beachside landscape in the Sydney basin. The Haven itself is a sheltered body of water with surrounding rocky sandstone cliffs. There is a grassed embankment behind the beachfront sand area that stretches along the length of the Haven Beach. There are large Norfolk Island Pines located on this grass strip, which add charm to the bay.

Terrigal Haven provides a hub of activity by the moorings of fishing trawlers. The water environment of the Haven is dominated by boat moorings of which can fluctuate up to approximately 20 at any one time. The Haven provides two boat ramps for use, the larger one for yachts and power boats and the smaller one for canoes/kayaks and other smaller watercraft.

The Haven also has a number of modest timber and brick buildings along the foreshore, which compliment the low key character of the area. The previous Sailing Club, constructed in the 1970s, is now home to the Terrigal Dive Shop and The Cove Café & Grill (lower level) and the Reef Restaurant & Grill (upper level). The Haven Beach Restaurant and Haven Seafoods is also along the Haven beach area at the eastern most tip of the Haven. A number of other buildings are present along the beachfront at the eastern end. One is home to the Volunteer Coastal Patrol and another two lots are used by Terrigal Sea Rescue. At the centre of the Haven is the oval, which provides for a number of formal sporting events, casual use and special events/seasonal events throughout the year.

2.1.8 Services and utilities

Services that exist within the Haven include the following:

- gas main
- sewerage main
- water main
- electricity - including overhead and underground lines in the vicinity of the foreshore area and underground power around the perimeter of the oval with flood lights.

2.2 HISTORIC CONTEXT

2.2.1 Haven naming

There is some conflict of opinion over the origins of the name 'Terrigal'. Some believe the name was derived from the Aboriginal word 'Tarriga', meaning a place of wild figs, while others believe it to be from the Aboriginal word 'Tarragal' meaning a place of little birds. There have been a number of variations on the spelling of the suburb prior to the accepted contemporary name of 'Terrigal' including Tarrygal, Tarrigal etc.

Terrigal Haven itself has been known by a number of names since the time of European settlement including Point Willoughby, Broxmouth Ville Common, Fishermen's Beach and Tarragal Village Reserve. Additionally, the Aboriginal people of the area named the Skillion within the Haven 'Kurrawyba' meaning 'big rock jutting out into the sea'.

2.2.2 Settlement

The original habitants of the Terrigal area are believed to be the Darkinjung tribe and the coastal Gurringai tribe. It is thought that the Nora clan of the Darkinjung tribe inhabited the Terrigal area.⁴

John Murray Gray (Deputy Harbour Master and Chief Pilot, Port Jackson) was the first to be granted land at Terrigal Haven by Governor Brisbane in 1825 (although the deeds were not authorised until 1833 by Governor Bourke). Gray quoted that Terrigal was 'one of the few havens from the bad southerlies experienced on the coast'. The Haven was a point of refuge between the reef to the north and Broken Head.

A chronology detailing the development of the Terrigal Haven area from the 1800's to the present day may be found in Appendix 4.

⁴ Parkinson, L., 2003, Terrigal: A History of the Area, The Lazy Lizard, Terrigal

3 Basis for Management

3.1 STATEMENT OF SIGNIFICANCE

Terrigal Haven is of regional significance in terms of environmental, biodiversity, scenic, historic, cultural, recreational and tourist based values. It exhibits a wide range of coastal environments of outstanding beauty within a discrete area. It is a tourist destination with a long history and has a mixture of natural and human elements of great charm.

3.2 VALUE MANAGEMENT

One of the main aims of the Plan of Management is to identify the values and significance of the Haven in terms of its characteristics in order to determine the appropriate management concepts for its future development. The identification of key values may otherwise be interpreted as determining 'why Terrigal Haven is important' to the owners, managers and users of the land. In this case, this includes the NSW Land and Property Management Authority, Gosford City Council (as Reserve Trust Managers) and the community.

The process of identification of key values involved community consultation throughout the development of the original Terrigal Haven Plan of Management and the Stakeholder meeting held at Terrigal Surf Club on 14 November 2007.

3.3 VALUES

Access and Circulation Value

- Pedestrian access
- Controlled vehicular access
- Car Parking
- Access to the Pacific Ocean
- Pedestrian connections to Terrigal CBD

Recreation/Tourism Value

- Retention of passive recreation and tourism
- Management of multiple land and water uses for the Haven
- Management of visitor numbers to Terrigal Haven
- Designated recreational space for passive uses such as picnicking and walking
- Designated recreational space for a dog exercise area (as determined by Council policy)
- Recreational facilities for passive uses (seating and picnic facilities)
- Designated formal eating areas
- Provision of appropriately themed waterfront buildings
- Provision of tourism services and facilities
- Access to the ex-HMAS *Adelaide* artificial reef site

Environmental/Biodiversity Value

- Shoreline protection
- Preservation of existing marine ecosystems
- Conservation of biodiversity
- Rehabilitation of Endangered Ecological Communities, Regionally Significant Vegetation and other remnant native vegetation
- Protection of biodiversity through feral animal control

Historic/Cultural Value

- Protection of indigenous culture and heritage
- Protection of non-indigenous culture and heritage

Active Open Space Value

- Haven Oval primarily designated for use by organised sporting and community groups
- Restricted special event use of Haven Oval by private/commercial entities
- Restricted use of Haven Oval during severe weather conditions
- Designated spectator areas
- Effective maintenance

Scenic Value

- Retain natural landscape quality
- Preservation of views to the Pacific Ocean
- Embellish natural vantage points
- Effective maintenance

Utility Value

- Improved drainage infrastructure
- Control of run-off from foreshore areas
- Provision of underground electrical wiring

3.4 DESIRED OUTCOMES

The desired outcomes of the reserve have been determined through community consultation and interpretation of the identified key values. These desired outcomes may be viewed as guiding principles for the management of the reserve.

Access and Circulation Value

- Maintain and improve pedestrian access within the reserve for all abilities, where appropriate.
- Provide controlled vehicular access within the reserve.
- Investigation into drop off/let down bays.
- Construct raised pedestrian crossings for oval access.
- Review and/or formalise existing car parks and circulation.
- Construct additional car park.

- Improve access to the Pacific Ocean.
- Strengthen pedestrian connections to Terrigal CBD.
- Promote increased utilisation of Wilson Road Car Park.

Recreation/Tourism Value

- Provide safe, designated recreational space for passive use.
- Encourage tourism within the Terrigal Haven area and Terrigal CBD.
- Improve the condition and availability of recreational facilities for passive and active use.
- Maintain levels of visitation while encouraging multiple uses of the reserve.
- Provide designated recreational space for dog exercise area in line with Council policy.
- Provide designated facilities and areas for formalised dining opportunities.
- Provide appropriately themed waterfront buildings incorporating services which are ancillary to the purpose of the reserve (e.g. restaurants, kiosks, recreation booking centres, aquatic services etc).
- Provide tourism and related opportunities which are ancillary to the purpose of the reserve and the adjacent sea based reserve.
- Investigate and implement measures for providing access to the ex-HMAS Adelaide artificial reef site such as an appropriate waterfront structure.

Environmental/Biodiversity Value

- Implement measures for shoreline protection.
- Protection and preservation of marine ecosystem.
- Protection of local flora and fauna species and their habitats.
- Rehabilitation of Endangered Ecological Communities, Regionally Significant Vegetation and other remnant native vegetation.
- Protect and provide interpretation for natural values of the Haven.

Historic/Cultural Value

- Investigate items of indigenous and non-indigenous cultural heritage significance within the reserve.
- Protect and provide interpretation, where appropriate, for any items of indigenous and non-indigenous cultural heritage significance within the reserve.

Active Open Space Value

- Undertake regular maintenance on the Haven Oval.
- Maintain high level of ground quality.
- Reduce impact of drought conditions on the Haven Oval.
- Formalise designated spectator area.

Scenic Value

- Undertake regular maintenance of the reserve.
- Preserve existing views to the Pacific Ocean from all points within the Haven.
- Construction of walkways and viewing decks.

Utility Value

- Improve reserve drainage.
- Design and implement stormwater management scheme.
- Implement measures to control runoff from passive reserve areas.
- Placement of all existing power lines underground.

3.5 CONCEPTS CURRENTLY IDENTIFIED FOR THE HAVEN

In undertaking the current review of the Terrigal Haven Plan of Management a number of concepts have been identified in line with the changing recreational and environmental needs of the Terrigal Haven area.

The concept plan provided in this document represents the main elements for the future use and development of the Haven. The concept plan is an adaptation of the 1996 and 2005 Landscape Masterplans. Cost estimates for each of the options are summarised in the Action Plan Table provided in Section 6.

The concept plan was put on display during the 2007 and 2008 Stakeholder Meetings and 2009 community information sessions and available for review on Council's and LPMA's website during the Public Exhibition period.

The following is a brief overview of key concepts as outlined on the concept plan:

- Investigation into CBD access improvements.
- Car Parking and access.
- Coastal Walkway.
- Foreshore stabilisation works.
- Investigation into and possible embellishment of Eastern and Western Commercial and Community Precincts.
- Provision of infrastructure for access to water based recreational activities.
- Provision of a Precinct Playground.
- Embellishment of the Skillion Summit.
- Stabilisation of banks adjacent to the Skillion.
- Ex-HMAS Adelaide Memorial.
- Investigation into and provision of tourism and related opportunities in the south-western section of the reserve.
- Improvements to the Haven Oval.
- Protection of remnant native vegetation including Endangered Ecological Communities and Regionally Significant Vegetation.
- Provision of interpretative signage
- Undergrounding of Power Lines.

3.6 COMMUNITY DISPLAY COMMENTS

The comments received at the stakeholder and community displays of the concept plan held in 2007, 2008 and 2009 indicated that most were in favour of improvements to the existing facilities at the Haven. The stakeholders and general public that attended these meetings did not want to see too many major changes, but rather an upgrading of what already exists.



4 Management Strategy

The management strategy and concept plan for Terrigal Haven have been formulated through an amalgamation of the requirements and stated aims of the various stakeholders: NSW Land and Property Management Authority, Gosford City Council and the community. The primary objective of the management strategy is to address the key values of the reserve, and outline methods for achieving desired outcomes. The concept plan maps these measures out.

4.1 MANAGEMENT OPTIONS

Access and Circulation Value

- Pedestrian access within the reserve is a key priority. The movement of pedestrians within the reserve should take priority over all other movements, including service and private vehicles, bicycles and other vehicular transport modes.
- Construct a walkway extending from the eastern boat ramp around the perimeter of the Haven including a formalised access path to the summit of the Skillion.
- Investigation into provision of drop off/let down bays.
- Investigate options to enhance access by public transport.
- Construct promenade on the beachfront.
- Vehicle access within the reserve is to remain controlled through the use of speed reduction measures and retention of one way traffic.
- Investigate the potential redesign of the Haven entry to enhance access value.
- Formalise and landscape car parking adjacent to the Haven entry to increase parking provision.
- Investigate redesign of existing eastern car park to determine possibility of redesign and upgrade and implement any viable changes which may increase parking potential.
- Formalise car park on the northern side of the Skillion and create accessible pathway.
- Formalise parking on the eastern and western boundaries of the Oval.
- Construct a new car park at the southern end of the oval utilising environmentally sensitive design and incorporating a pedestrian boardwalk.
- Investigate and implement actions which will strengthen pedestrian access to the Terrigal CBD and Wilson Road Car Park to ensure viable long term access management.
- Undertake further geotechnical studies to determine the viability of a cliff based structure linking the Haven to Terrigal CBD.
- Investigate options for formalising community access to coastal waters for the purpose of undertaking water based activities such as diving, snorkelling, recreational fishing and charter boat operations. Investigate the environmental impacts of the potential construction of such infrastructure. Construct appropriate infrastructure to assist with long term access management.

Recreation/Tourism Value

- Retain current recreation areas for their designated purpose (e.g. passive recreation on foreshore reserve, active recreation on the Haven Oval).
- Retain existing dog exercise area as per Council's Dog Exercise Area Policy.
- Liaise with NSW Maritime and other relevant stakeholders to investigate options to increase safety for all water users within the Haven area. Implement appropriate measures as required.
- Investigate the potential for refurbishing existing buildings in both the Eastern and Western precincts to accommodate commercial premises (such as restaurants, kiosks, recreation booking centres, or other uses which are ancillary to the purpose of the reserve) to assist with sustainable management of the Haven area, while incorporating bases for community organisations. Implement recommended actions as required.
- Construct decks to accommodate outdoor dining and beach access in the Western Precinct.
- Design and construct a playground that offers a high level of accessibility that caters for a broad range of ages and capabilities and is complementary to the facilities and infrastructure within the Haven whilst ensuring minimal environmental impact.
- Investigate tourism and related opportunities in the south western section of the reserve. Implement actions as required.
- Investigate options for formalising community access to the ex-HMAS Adelaide artificial reef site via an appropriate waterfront structure. Implement recommended actions as required.

Environmental/Biodiversity Value

- Undertake stabilisation works to the foreshore area utilising environmentally sensitive materials to reduce erosion and rehabilitating the eroded foreshore reserve whilst ensuring workable long term management options.
- Undertake stabilisation and rehabilitation works to the left and right banks of the Skillion utilising environmentally sensitive design and materials to prevent further erosion and reclaim eroded foreshore car park area.
- Reestablishment of native coastal vegetation along the edges of the headland and Skillion as required.
- Rehabilitation of Endangered Ecological Communities, Regionally Significant Vegetation and other remnant native vegetation.
- Construction of coastal walkway to assist with protection and promotion of natural values, including the Endangered Ecological Communities, through controlling pedestrian and vehicular access.
- Erection of interpretative/educational signage to provide information on significant local flora, fauna and marine life.
- Ensure compliance with environmental legislation when undertaking any proposed works.
- Undertake feral animal control in accordance with State and Commonwealth Government legislation to best practice standards for the location and its users, as required.

Historic/Cultural Value

- Undertake a comprehensive investigation into indigenous cultural and heritage sites prior to any future proposed development.
- Erection of interpretative/educational signage detailing information on offshore shipwrecks and relevant local cultural heritage.
- Investigate appropriate location for a memorial in honour of the ex-HMAS Adelaide and her crew. Construct environmentally sensitive viewing platform incorporating interpretative/educational signage and relevant relics from the vessel.

Active Open Space Value

- Upgrade oval drainage to improve surface drainage quality and design and implement stormwater management schemes to provide an alternate water source for oval irrigation.
- Extend the existing retaining wall and install additional retaining walls to create a more user friendly spectator area.
- Comply with recommendations as outlined under the Central Coast Sportsground Management Strategy (SMS) to ensure accurate management of the playing field surfaces during severe weather conditions.

Scenic Value

- Investigate options for the redesign of the platform at the summit of the Skillion. Implement any relevant changes which will enhance the visual amenity of the summit.
- Construct viewing platforms at various points along the coastal walkway.
- Include regular maintenance of the Haven area on Council's Works Schedule. Including both passive and active areas.
- Ensure compliance with Council's Development Control Plans and the Local Environmental Plan when undertaking any proposed development works.

Utility Value

- Extend stormwater outlet across beach and have an underwater discharge point.
- Install sand link drainage on the Oval.
- Provision of alternate water sources for the Oval.
- Overhead powerlines to be relocated underground to increase accessibility to the boat ramp and improve the aesthetics of the foreshore reserve area.

4.2 GOSFORD CITY COUNCIL COMMUNITY LAND MANAGEMENT

As Trust Manager of the reserve, Gosford City Council will be responsible for the implementation of the management strategy. As Terrigal Haven is a reserve under the care, control and management of Council it is essential that this Plan of Management remain consistent with the existing management regime which has been developed by Council for the management of Crown reserves and community land.

4.2.1 Planning

- To balance community use and environmental considerations of the reserve with the sound financial management of the Terrigal Haven area.
- Council will continue to further its knowledge of community demand and visitor preferences in order that existing facilities and spaces are managed to reflect the wide range of community needs.

4.2.2 Management

- Council will exercise its powers under the Local Government Act 1993 and Crown Lands Act 1989 to control the use of, and access to, Terrigal Haven.
- To encourage community involvement in the development and management of recreational facilities.
- To provide improved protection from the sun in open space areas used for passive recreation.

4.2.3 Development and Improvement

- The provision of quality open spaces commensurate with use and function is central to Council's Open Space and Leisure Services section planning.
- The provision of recreational facilities is to be incorporated with the protection of the environment.
- Council approval is required prior to any development on open space or improvements to existing facilities.
- Council will actively pursue external funding opportunities such as State and Federal Government grants in making improvements, and will encourage community groups to do the same.
- Additional funding opportunities will also be explored, in conjunction with the LPMA, regarding improvements to facilities and enhancement of the commercial and community precincts.
- Future playgrounds will be designed with safety softfall surfaces, such as synthetic grass or safe fall material to decrease the risk of injury, and shade structures to protect users.
- Design plans will be developed for new projects where required.
- Adequate car parking will be provided where logistically possible.
- All new playground equipment will comply with the current Australian Standards.
- Any new facilities to be funded (solely or partially) by Council will be approved through inclusion in Council's Capital Works Program, or allocated funds from Section 94 contributions (if appropriate).
- Nothing in this plan prevents Council from upgrading existing facilities and utilities.

4.2.4 Fees and Charges/Conditions of Hire

- Council will apply various fees and charges for use of Council facilities in order to:
 - Maximise opportunities for use of facilities
 - To allocate and regularise use
 - To contribute to cost recovery
 - To improve fairness and equity
- Such fees will be reviewed annually in line with Council's review of fees and charges
- Facilities are approved for use based on the conditions of hire as determined by Council's Open Space and Leisure Services section. Failure to comply with these conditions may result in forfeiting the opportunity for future use of Council facilities and loss of the security deposit.

4.2.5 Maintenance

- In order to maintain open spaces efficiently and within budget, maintenance standards and priorities will be reviewed on an ongoing basis.
- A cohesive approach to the management of open space reserves will be developed, ensuring communication between the various sections in Council responsible for different facilities.
- The reserve will be available to the community in a safe and accessible condition.
- Variety in the playground equipment will be sought, both in suiting different age groups and abilities and in the type of equipment.
- Regular maintenance and inspections will occur to ensure reserves meet safety requirements.
- Maintenance cycles match the level and type of use of a reserve. Wherever possible, users should be encouraged to help, for example keeping the reserve tidy by placing their rubbish in the bins provided.
- Garbage bins should be minimised to discourage the dumping of rubbish, particularly household rubbish. However, rubbish bins on the site should promote litter control.
- The grass will be regularly mowed to create a safe and tidy appearance, in accordance with Council's maintenance schedule.
- The trees will be subject to regular inspections to maintain safety standards.
- Council will take steps to prevent undesirable use of the park. For example, where possible slip rails/gates will be erected to keep vehicles out.
- Nothing in this plan prevents Council from maintaining existing drainage easements, pipelines and the like.

4.2.6 Use/Activities/Facilities

Facilities

- Recreation facilities that would be considered to be suitable include but are not restricted to:
 - Recreation facilities which promote or are ancillary to the use and enjoyment of a park as a public park, and for public recreation

- Facilities used for passive recreation activities such as playground equipment and picnic facilities
- Facilities which will assist with the sustainable management of the reserve whilst remaining ancillary to the purpose of the reserve (e.g. Booking centre for water based recreation activities).
- Facilities used to conduct sport & recreation activities
- Cycleway facilities
- Jetties, marinas, boatramps and wharves
- Fish cleaning tables and fishing platforms
- Tidal pools
- Boardwalks
- Floodlighting for sporting facilities
- Ancillary facilities such as parking, pathways, fencing, bubblers, barbecues, seating and shelter
- Amenity facilities for parks with a district-wide use

Signage**Permanent**

- Permissible signage includes signs which are erected by Council to regulate various activities under Section 632 of the Local Government Act, signs which indicate the name of reserve and/or facilities contained within it, directional signs, traffic signs and interpretative/educational signage. Any other signage requires prior Council approval.

Temporary

- Temporary signs would include items such as banners used by community groups. Some temporary signs may still require Council approval.

Other Uses Considered Suitable

- Miscellaneous and utility mains & plant, and drainage facilities.
- Right of entry and access for plant maintenance purposes.

Permissible Activities Requiring Council Approval

Activities which would be permissible subject to the relevant Council approval include but are not restricted to:

- fetes
- cultural activities
- exhibitions/demonstrations
- celebrations/gatherings
- commercial photos/filming
- commercial activities of an educational nature and/or encourage active participation in a healthy lifestyle (e.g. personal training)

Any activities to be conducted on Terrigal Haven Oval must comply with the Sportsground Management Strategy to ensure safety and the longevity of the oval for the benefit of sporting groups, other community user groups and the community as a whole.

Permissible Activities Generally Not Requiring Council Approval

- Walking, informal use of recreation facilities, picnics, kite flying etc.
- If the reserve is to be reserved for a particular purpose such as a large picnic, a special event application is required to be submitted.

Activities Which Are Not Permissible

- Any activity which could be considered dangerous and/or which may unreasonably disrupt other users of the park and/or adjoining neighbours is not permissible. Examples of activities which are not permissible include, but are not limited to, off road trail bike riding, abseiling (with the exception of emergency services), horse riding, camping and any organised sport undertaken outside the Haven Oval area.
- Use of the park for commercial activities which are not ancillary to the recreational purpose of the reserve or adjoining coastal waters.

Sale of Alcohol

- The sale of alcohol requires the approval of the NSW Office, Liquor, Gaming and Racing through the issue of a Licence. The licence must be produced for Council in each instance when making application for the use of a passive recreation area if the sale of alcohol is intended.
- Applicants are required to comply with any requirements of the Licensing Authority
- The consumption or supply of alcohol on reserves under Council's care, control and management requires a permit from Council's Open Space and Leisure Services section.
- For further details concerning the sale, supply and consumption of alcohol refer to Council Policy R1.06 Consumption of Alcohol (Functions Licences).

4.2.7 Leases and Licences

Council will consider granting leases and licenses of land under the care, control and management of Council subject to the *Crown Lands Act 1989*.

Development should be for a purpose which promotes or is ancillary to the use and enjoyment of a park as a public park and for public recreation.

- Period will not exceed 20 years (including any period for which the lease or licence could be renewed by the exercise of an option).
- If the period is to exceed 5 years, additional requirements apply. Council will comply with the provisions of the Conveyancing Act 1919 and the Crown Lands Act 1989 for the granting of leases and licences for a period of more than 5 years.

4.2.8 Reserve Users

- Users will be encouraged to visit and help maintain the reserve. This may involve routine maintenance such as the correct disposal of rubbish, or the holding of special events, and participation in the design and management of particular areas or networks or areas.
- Users will be encouraged to report any vandalism, delinquent behaviour or littering to Council or the Police Service of NSW.

4.2.9 Erosion Control Works

Council may undertake erosion control works on foreshore reserve areas, if required, to ensure the future upkeep of the asset. Recent developments at foreshore reserves include the erection of sea walls and increased tree planting for the purposes of foreshore protection.

5 Planning Principles

5.1 PLANNING INSTRUMENTS AND LEGISLATION

There are a number of Federal, State and Local Government Planning Policies and Instruments that contain principles to take into account in the future management and development of the Haven.

Additionally, there are a number of authorities, who have Acts of Parliament under their administration, that require consultation when future development is proposed for the Haven.

The relevant Planning Acts, Policies and Instruments are listed below and the provisions contained in them would need to be complied with for any new development within the Haven. A further detailed summary of these Acts, Policies and Instruments is provided as Appendix 5.

LEGISLATION

- Crown Lands Act 1989
- Environmental Planning and Assessment Act 1979
- Environmental Planning and Assessment Act Regulations 2000
- National Parks and Wildlife Act 1974
- Commonwealth Environment Protection and Biodiversity Conservation Act 1999
- Protection of the Environment Operations Act 1997
- Native Vegetation Act 2003
- Threatened Species Conservation Act 1995
- Noxious Weeds Act 1993
- Fisheries Management Act 1994
- Disability Services Act 1993

PLANNING POLICIES AND INSTRUMENTS

- Gosford Planning Scheme Ordinance
- DCP 55 - Terrigal Town Centre (Amendment 1)
- DCP 89 - Scenic Quality
- SEPP 19 - Bushland in Urban Areas
- SEPP 26 - Littoral Rainforests
- SEPP 71 - Coastal Protection
- Central Coast Regional Strategy
- NSW Coastal Policy

Council Policies

- D1.04 - Environmental Assessment Procedure
- D2.07 - Environmental Policy
- D6.44 - Landscape and vegetation management policy

- R0.18 - Biodiversity Management
- R1.02 - Allocations - Seasonal Use
- R1.04 - Closure of Sporting Fields
- R1.06 - Consumption of Alcohol (Functions Licence)
- R1.07 - Playing Fields and Amenities (General Use)
- R1.09 - Public Amenities Buildings (Design or Erection)
- R1.12 - Advertising on Sportsgrounds
- T4.03 - Erection of street banners
- Schedule 1 - Tree Preservation Order

5.2 DEVELOPMENT ASSESSMENT GUIDELINES

The following guidelines represent the factors that must be considered by any proponent when submitting a Development Application (DA) to Council in regards to the Haven. These are additional to any necessary provisions of the *Environmental Planning and Assessment Act 1979*.

Future development proposals must address the following:

- a. ensure consistency with Crown Lands policies, Council's adopted policies and codes, all environmental planning instruments and the principles of Council's Planning Scheme
- b. environmental and biodiversity sustainability
- c. protection of identified values
- d. public accessibility, equity, exclusivity and alienation of Crown land
- e. public demonstration of a clear connection with the Haven's designated purpose, role and setting
- f. consistency with the character and scale of the Haven's existing recreational facilities
- g. protection of views to and from the Haven
- h. maintenance of the amenity and public safety in relation to noise emissions and pollutants (water and air)
- i. minimisation of traffic hazards and pedestrian conflicts in relation to vehicular and parking access, service and delivery areas
- j. ensure appropriate native planting
- k. protection of visual and environmental amenity
- l. development proposals which may directly or indirectly threaten the natural coastal heathland and grasses and/or other identified values
- m. development which may adversely affect scheduled heritage items. Development in the vicinity of a heritage item should complement its character and integrity
- n. proposed changes to any lease boundaries must address identified values associated with each parcel of land.

6 Action Plan

6.1 FINANCIAL MANAGEMENT

Special funding may be available from Government sources in order to implement or assist in the implementation of the Terrigal Haven Plan of Management. As the LPMA is the responsible authority for Crown land, funding for the works may be applied for by Council (as trustees) for the works proposed, from the Public Reserves Management Fund. Council, as trustee, may have to match these funds to make up the estimated costs. In addition, Council will continue to pursue avenues for funding through its own programs, including the Capital Works Program, to assist with achieving the desired outcomes of this Plan.

It is important to note that as with the development of any infrastructure, an important aspect associated with the implementation of the plan is to ensure that ongoing maintenance cost is minimised and that opportunities for required reserve enhancements are realised. Therefore additional opportunities for funding may be sourced by the LPMA or Council to assist with the management of the asset. This may comprise investigating the viability of obtaining financial benefit from the leasing of properties currently situated on the reserve. Leasing of these properties is required to comply with all statutory instruments and relevant legislation and would have to provide a service ancillary to the purpose of the reserve, unless otherwise authorised.

6.2 ACTION PLAN TABLE

The following table outlines the preferred management options for the Haven, and is aimed at providing tangible means in which the desired outcomes of the Plan of Management may be achieved. These options need to be managed to ensure minimal impact on social, aesthetic, cultural and ecological factors. The table outlines the management actions required, the roles and responsibilities required to complete the action and the estimated cost to fulfil those actions.

Table 6.1 Action Plan

Management Action	Responsibility	Priority	Desired Outcome	Estimated Cost*
Access and Circulation Value				
Clarify circulation within eastern car park for improved circulation and designation of parking areas	Council	Short	Review and/or formalise existing car parks and circulation	\$15,000
Improve existing car park adjacent to the entry of the Haven and the Reef Restaurant	Council	Short	Review and/or formalise existing car parks and circulation	\$300,00
Provision of new car park and footpath for events or general visitation	Council	Short	Construct additional car park	\$1,300,000
Provision of formalised car parking on the eastern boundary of the oval	Council	Short	Review and/or formalise existing car parks and circulation	\$10,000
Provision of formalised car parking on the western boundary of the oval	Council	Short	Review and/or formalise existing car parks and circulation	\$10,000
Provision of drop off/pick up zone	LPMA/Council	Short	Review and/or formalise existing car parks and circulation	To be determined
Improve existing car park and footpath adjacent to the Skillion	Council	Short	Review and/or formalise existing car parks and circulation	\$70,000
Provision of additional car parking at the base of the Skillion	Council	Short	Construct additional car park	\$150,000
Provision of raised pedestrian crossings for oval access	Council	Short	Review and/or formalise existing car parks and circulation	\$100,000
Provision of walkway along headland with designated vantage/lookout points and interpretative/educational signage	Council	Short	Maintain and improve pedestrian access within the reserve for all abilities, where appropriate	\$400,000
Provide summit walk in a heathland setting using sensitively designed path in those areas of erosion to reach summit				
Investigation into and potential provision of infrastructure for access to water based recreation activities	LPMA/Council	Short	Improve access to the Pacific Ocean	\$300,000
Investigation into and provision of improved access to the CBD (Estimated cost based on investigation only - Cost of implementation to be determined)	Council	Medium	Strengthen pedestrian connection to Terrigal CBD	\$40,000
Provision of a promenade along beachfront and controlled access to the beach	Council	Medium	Maintain and improve pedestrian access within the reserve for all abilities, where appropriate	\$400,000
Lower grades for entry/exit and improve provision for left turning traffic	Council	Medium	Review and/or formalise existing car parks and circulation	\$100,00
Incorporate low bollards and landscaping adjacent to joint use pedestrian zone	Council	Long	Maintain and improve pedestrian access within the reserve for all abilities, where appropriate	\$200,000

Table 6.1 Action Plan

Management Action	Responsibility	Priority	Desired Outcome	Estimated Cost*
Recreation/Tourism Value				
Investigation into and possible embellishment of Eastern Commercial and Community Precinct	LPMA	Short	Provide appropriately themed waterfront buildings incorporating services which are ancillary to the purpose of the reserve	To be determined
Investigation into and possible embellishment of Western Commercial and Community Precinct	LPMA/Council	Short	Provide appropriately themed waterfront buildings incorporating services which are ancillary to the purpose of the reserve	To be determined
Upgrade of rockpool as part of CBD improvement works	Council	Short	Provide safe, designated recreational space for passive use	\$400,000
Provision of a memorial for the ex-HMAS Adelaide incorporating a viewing platform	Council/LPMA	Short	Investigate and implement measures for providing access to the ex-HMAS Adelaide artificial reef site	To be determined
Investigation into and possible provision of tourism and related opportunities in the south western area of the reserve	LPMA	Short	Provide tourism and related opportunities which are ancillary to the purpose of the reserve and the adjacent sea based reserve	To be determined
Provision of a variety of naturally shaded areas	Council	Short	Provide safe, designated recreational space for passive use	\$60,000
Improved picnic/BBQ facilities	Council	Medium	Improve the condition and availability of recreational facilities for passive and active use	\$200,000
Provision of Precinct Playground at the site of the former clubhouse	Council	Medium	Provide safe, designated recreational space for passive use	\$1,000,000
Maintenance of Dog Exercise Area	Council	n/a	Provide designated recreational space for dog exercise area as per Council Policy.	\$50,000 p.a.

Table 6.1 Action Plan

Management Action	Responsibility	Priority	Desired Outcome	Estimated Cost*
Environmental/Biodiversity Value				
Foreshore Stabilisation Works	Council	Short	Implement measures for shoreline protection	\$800,000
Bank stabilisation to the left and right of the Skillion	Council	Short	Implement measures for shoreline protection	\$600,000
Retain native coastal species including grassland and heath	Council	Short	Protection of flora and fauna and their habitats	\$15,000
Provision of car park landscaping utilising native species	Council	Short	Protection of flora and fauna and their habitats	\$30,000
Reinstatement and rehabilitation of coastal heathland to form an 'envelope' surrounding the Haven	Council	Medium	Protection of flora and fauna and their habitats	\$30,000
Provision of continuous planting of appropriate tree species around existing oval and perimeter	Council	Medium	Protection of flora and fauna and their habitats	\$100,000
Ensure protection of remnant native vegetation including Endangered Ecological Communities and Regionally Significant Vegetation	Council	n/a	Rehabilitation of Endangered Ecological Communities and Regionally Significant Vegetation	To be determined
Historic/Cultural Value				
Recognition of Aboriginal significance via interpretative signage	Council	Medium	Protect and provide interpretation, where appropriate, for any items of indigenous or non-indigenous cultural heritage significance within the reserve	\$5,000
Recognition of offshore coast shipwrecks via interpretative signage	Council	Medium	Protect and provide interpretation, where appropriate, for any items of indigenous or non-indigenous cultural heritage significance within the reserve	\$5,000

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Terrigal Haven Plan of Management December 2009

Table 6.1 Action Plan

Management Action	Responsibility	Priority	Desired Outcome	Estimated Cost*
Active Open Space Value				
Provision of picnic shelters to the perimeter of the Oval	Council	Short	Formalise designated spectator area	\$100,000
Oval drainage to be improved and stormwater management scheme to be designed	Council	Medium	Maintain high level of ground quality	\$300,000
Spectator area to be re-contoured	Council	Medium	Formalise designated spectator area	\$200,000
Scenic Value				
Embellishment of viewing platform at the summit of the Skillion	Council	Short	Preserve existing views to the Pacific Ocean from all points within the Haven	\$200,000
Utility Value				
Undergrounding of Power	Council	Short	Placement of all existing powerlines underground	\$150,000
Extend stormwater outlet across beach and provide underwater discharge point	Council	Medium	Improve reserve drainage	\$300,000
Appropriate drainage system to be used and soft engineering options to be introduced wherever practical				
Provision of alternate water sources	Council	Medium	Design and implement stormwater management scheme	\$165,000

*Notes:

1. These cost estimates are exclusive of GST.
2. These cost estimates are current at the time the plan was prepared (November, 2008).
3. These costs have not allowed for project establishment and/or formal contractual arrangements between Contractors and Council. These estimates will be subject to changes for different work delivery methods and/or specific work packages.

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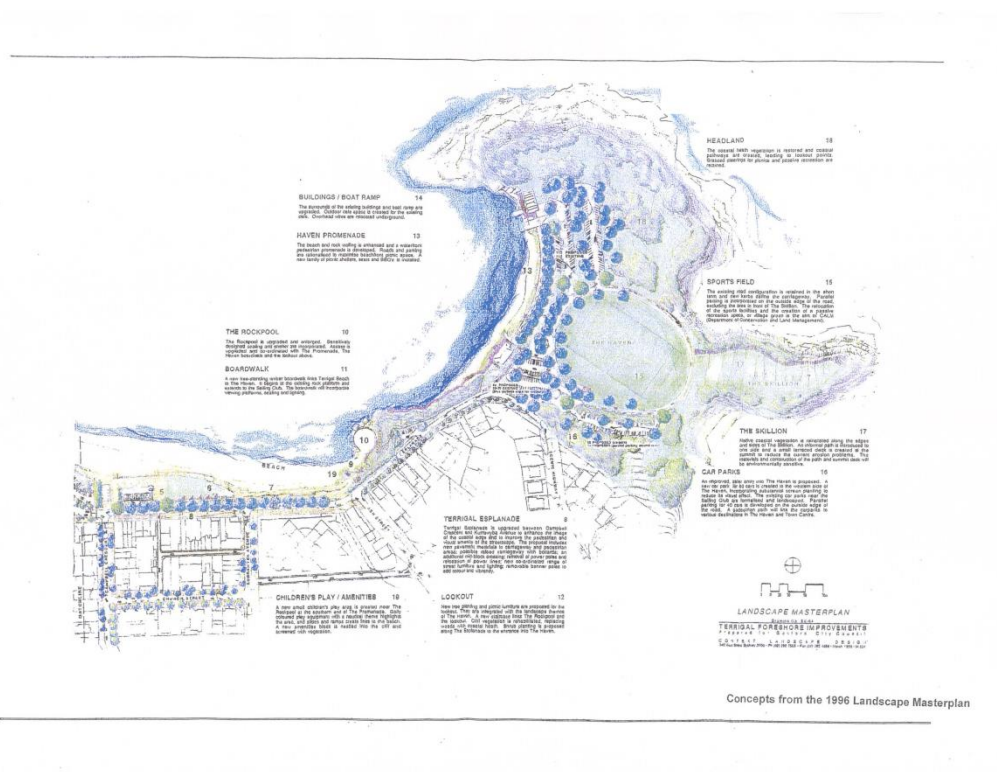
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Appendix 1

1996 Landscape Masterplan



Appendix 2

Minutes Stakeholder Meeting

MINUTES
TERRIGAL HAVEN PLAN OF MANAGEMENT
REVISION 2007/08
STAKEHOLDER MEETING

Held at
Terrigal Surf Life Saving Club
On Wednesday 14 November 2007

MEETING COMMENCED at 4.20pm

FACILITATOR: Kellogg, Brown and Root (KBR)

ATTENDANCE: Gosford City Council (Council)
NSW Department of Lands (Lands)
NSW Maritime
Central Coast Artificial Reef Project Committee (CCARPC)
Community Environment Network (CEN)/Central Coast Marine
Discovery Centre Working Group
Terrigal Dive Centre
Haven Beach Seafoods and Restaurant
Reef Restaurant and Grill
Royal Volunteer Coastal Patrol
Professional Fishermen's Coop
Terrigal Trojans Rugby Club
Central Coast Cricket Association
Gosford City Sports Council

APOLOGIES: NSW Department of Environment & Climate Change
Terrigal Chamber of Commerce
Central Coast Tourism
Terrigal Sea Rescue Services
Terrigal Surf Life Saving Club
Andrews Neil

INTRODUCTION

Council's Manager of Open Space and Leisure Services (OS&LS) provided rationale on the current revision of the Terrigal Haven Plan of Management and briefly outlined the proposed amendments. Manager OS&LS introduced the consultant from KBR and facilitator of the stakeholder meeting. The facilitator provided a history on the HMAS Adelaide and opened the floor for discussion on the proposed amendments.

MATTERS LISTED FOR DISCUSSION

1. TIMEFRAME FOR REVISIONS

Terrigal Trojans representative enquired as to whether Council has a timeframe for the completion of the revision of the Terrigal Haven Plan of Management. Manager OS&LS stated that the aim is to have the revisions completed prior to the sinking of the HMAS Adelaide. A representative from Lands suggested that until State Departments have met and determination of the management of the HMAS Adelaide

has been made, adoption of a revised Plan of Management would not be considered. Therefore a designated timeframe could not be determined at this stage.

2. EXPECTED USAGE OF THE HAVEN AS A RESULT OF THE HMAS ADELAIDE

A representative from the Royal Volunteer Coastal Patrol asked if Council had any indication as to the expected increase in use of the Haven area as a result of the sinking of the HMAS Adelaide. Council's Manager OS&LS stated that at this stage expected increase in usage is unknown due to a number of variables including the management of the HMAS Adelaide. The Manager OS&LS advised that Council was, however, aware of the physical limitations of the site.

3. PREVIOUS INVOLVEMENT IN THE ORIGINAL TERRIGAL HAVEN PoM

Of the 21 attendees, 7 had been involved at various stages throughout the previous Terrigal Haven Plan of Management process. Primarily Council Officers that were involved after the plan had been adopted by Council and prior to adoption by NSW Department of Lands.

4. HISTORY & TIMFRAME ON THE SINKING OF THE HMAS ADELAIDE

The representative from Terrigal Dive Centre provided feedback on the history and expected timeframe for the sinking of the HMAS Adelaide. Information was provided on the background on lobbying that had taken place within the last 7-8 years to secure an offshore shipwreck site. HMAS Brisbane was lost to Maroochydore, HMAS Canberra was delegated to Victoria and the Adelaide was finally secured for Terrigal. It was advised that the representative from Terrigal Dive Centre had been informed that the Adelaide would be handed to the State Government on 30 June 2008 and would take approximately 5 months to strip.

5. EXPECTED IMPACTS ON THE HAVEN AREA

The facilitator enquired as to the expected impacts that may result due to the Adelaide. The representative from Terrigal Dive Centre suggested that the primary impact would be dive boats usage of the area. A representative from the Reef Restaurant enquired as to whether there will be restrictions on the number of dive operators that would be allowed to operate. Discussion occurred regarding the current circumstances with the HMAS Brisbane (4 Licences available - currently only 3 operators) however until the management of the Adelaide is determined this is an unknown.

6. DISCUSSION ON THE VIABILITY OF A JETTY OR FLOATING PONTOON

The following points were raised and discussed amongst the group:

- Construction of a pontoon
- Size of the boat will dictate whether a jetty or floating pontoon is required
- Need to keep boats away from current diving areas and moorings
- Jetty may see inexperienced boaters tying up to a jetty in bad weather and creating a lot of damage
- Jetty would be a more preferable option for divers for loading equipment
- Any proposal would have to be put to Council for consideration
- DA Requirements - ownership would need to be determined
- Compliance with Council Policy's and DCP's is essential
- Council is not responsible for catering for commercial operators. Council's role is to manage the reserve appropriately for NSW Department of Lands.

7. PERCEIVED IMPACT ON SPORTING CODES

A representative from the Terrigal Trojans believes the proposed jetty/pontoon will not affect their club so long as appropriate infrastructure is available to support the expected increase in use of the Haven area.

The representative from Central Coast Cricket Association (CCCA) suggested that all views must be considered for the Plan of Management, not simply the sinking of the HMAS Adelaide. This should include safety aspects, parking and special events. Although the usage by cricket within Terrigal Haven has been limited, the CCCA representative suggests that Council should be focusing on aspects such as amenities, ground pitch etc.

8. PARKING/TRAFFIC

Questions were put forward regarding parking at the south-western end of the oval on the hill. Council's Coordinator Natural Open Space provided an explanation on the Endangered Ecological Communities which need to be protected and that the optimal position for a formalised car park would be the site on the hill which had already been disturbed. Council's Manager OS&LS stated that preliminary discussions had occurred regarding a formalised walkway behind the proposed car park which would have interpretative and educational signage regarding the EEC's.

A representative from the Reef Restaurant enquired as to whether car parking near the Reef Restaurant and Grill will be formalised. Discussion occurred on the usage of the trailer parking on the eastern side of the Haven. Council's Manager OS&LS suggested that a review of the current car parks may need to be undertaken to optimise parking within the Haven. The facilitator enquired as to whether Council has a timeframe for formalising the car parks. Council's Manager OS&LS advised that funding is required to implement Terrigal Haven Plan of Management actions. Manager OS&LS stated that the Terrigal Haven Plan of Management is part of the Civic Infrastructure Strategy and if approved, works to be undertaken in the Haven will be prioritised and implemented. A representative from Lands suggested that parking concerns would not be dependant on the sinking of the Adelaide. The representative from CEN suggested it would be a shame to place a car park at the south-western location in the Haven as it is a prime viewpoint. Manager OS&LS advised that Council encourages and urges greater use of the Wilson Road car park. Discussion occurred on greater signage for access into Terrigal CBD and Terrigal Haven. Manager OS&LS advised that the message is being passed on to the Traffic Committee. A representative from Lands stated that access issues are a common problem with Crown Reserves and various options have and may be considered such as the establishment of boardwalks and shuttle bus runs. Consideration of options needs to be included in the Plan of Management. The representative from CEN suggested the option of let down bays.

8. PEDESTRIAN ACCESS

Council's Manager OS&LS advised that he is aware of previous discussions having occurred regarding increased pedestrian access. Discussion occurred regarding the possibility of a boardwalk from the CBD to the Haven. Council's Coordinator Parks, Playgrounds and Foreshores advised that previous geotechnical consultants deemed the cliff-face too unstable. Council's Coordinator Active Open Space advised that the Plan of Management allows for further embellishment of the current access paths. The representative from the Haven Beach Seafoods and Restaurant expressed concern over access for the aged and families. Council's Manager OS&LS advised that potential works should ultimately accommodate for varying levels of access due to Council's stance on accessibility for all ages and abilities. The representative from Haven Beach Seafoods & Restaurant enquired as to whether access could be

formalised at the eastern end of the Haven. An Officer from Lands suggested that when the Crown is negotiating leases it may be put forward as a consideration for potential development.

8. GENERAL DISCUSSION

- Discussion regarding the potential inclusion of fitness equipment in the Haven.
- Discussion on an increase of lighting at the Haven.
- Discussion on the dog area remaining in the Haven.
- Discussion on alternate water source issue within the Haven. Council's Coordinator Active Open Space advised this is a priority for their service unit but is having difficulty with the logistics of storage.
- Further discussion occurred on the location of the proposed floating pontoon/jetty.
- Discussion on additional amenities for both divers and patrons of the Haven Restaurant. Suggestion put forward for a signage review to be undertaken to assist with general public locating amenities.
- Discussion on commercial operators (i.e. Personal Trainers) and potential charging of fees. Question raised as to where this income will go. Council's Manager OS&LS advised that any income generated from commercial licensing fees would be placed in a sinking fund for maintenance of the asset.
- Discussion occurred on a proposed Marine Discovery Centre. The representative from CEN (also representing the Central Coast Marine Discovery Centre Working Group) advised that a location is being sought within the Terrigal area and believes an educational component should be focused on within the area.

Council's Manager OS&LS requested that any additional suggestions or feedback be forwarded through to Council's Open Space and Leisure Officer.

MEETING CONCLUDED at 5.55pm

Appendix 3

Environmental and Biodiversity Values

Topography, geology, landforms and soils

Soil types and topography have been referenced from a number of sources including Gosford Soil Landscapes map (Murphy 1993) and a number of specific geotechnical assessments by Coffey Partners.

Terrigal Haven is made up of two distinct soil landscapes. The Narrabeen soil landscape is found along the beach and foreshore areas, and the Erina soil landscape is found behind the foreshore and along the headland.

The Narrabeen soil landscape is characterised by beaches and coastal foredunes on marine sands. Beaches are generally made up of loose coarse shelly brownish yellow beach sand, while foredunes consist of loose medium yellowish brown quartz sand. The Haven Beach is approximately 220 m long and 15 m wide.

The Erina soil landscape is characterised by undulating to rolling rises and low hills. Ridges and crests are moderately broad and valleys moderately narrow. Slopes are gently to moderately inclined. Three main soil types occur: soils formed on shale; soils formed on sandstone; and deep soils formed on weathered coarse sandstone.

The geology of the area is the Terrigal Formation of the Narrabeen Group, which forms relatively steep coastal cliffs below Hawkesbury Sandstone and consists of generally fine to medium grained quartzose to lithic-quartz ironstone banded sandstone in beds of 5 m to 30 m thick, with interbeds of siltstone. These interbeds of siltstone are some 5 m to 15 m in thickness, which preferentially weather and erode leading to the development of potentially unstable overhangs.

Cliff face morphology appears to be related to the local geology. Sandstone outcrops extensively in the base of the cliffs at Terrigal Beach and cliff face slopes tend to be vertical or near vertical. Basal erosion by waves of coastal cliffs is of prime importance for slope stability.

Terrigal headland can be described as having the lower half exposing moderately weathered beds of massive sandstone with interbeds of extremely to highly weathered siltstone/claystone, while the upper half of the escarpment is vegetated with steep slopes of 45-65 degrees. Much of the vegetated portion contains a thin soil cover over weathered rock.

The area south of the rockpool exists as a 6 m high sandstone face, above which is a vegetated soil covered slope. The slope contains a number of scattered sandstone boulders together with some fill and rubbish materials on the upper part of the slope. Landslide debris is evident at the rear of the rockpool indicating slope failures from the soil covered vegetated slopes onto the wavecut platform.

Historically, the sand at The Haven contained heavy concentrations of mineral sands which resulted in the mining of these sands and the importation of clean sand.

Climate

Climatic information has been obtained from the Bureau of Meteorology. Temperature and rainfall data has been sourced from the Norah Head Lighthouse station, approximately 20 km north of Terrigal.

The climate of the area is classed as being warm temperate with a maritime influence. Terrigal experiences warm to hot summers, with temperatures generally between 16 and 28 degrees Celsius, and cool to cold winters with temperatures reaching as low as 3 degrees Celsius at times.

On average, the region has fairly uniform rainfall throughout the year. However, totals from month to month and from year to year are quite variable and the rain tends to fall in concentrated bursts.

The primary rain-producing mechanisms in the region are:

- major storms (cyclones) - strong winds and heavy rainfall along the coast occurring up to six times per year with the frequency being greatest in autumn and winter months
- thunderstorms - localised heavy falls (heavy rainfall, strong gusty winds, lightning and thunder, and hail) occurring about once per month in winter and three to four times per month in summer.

Light southerly to south westerly or north easterly winds are the most frequent winds throughout the year. There are occasional stronger southerly winds in the summer months. Westerly and north westerly winds occur periodically throughout the year but predominate in autumn and winter.

Coastal processes and hazards

A coastal management study and coastal management plan was prepared in 1995 for Council by WBM Oceanic Australia and the planning workshop. This study indicates that Terrigal has a history of property and beach damage as a result of severe storms.

The coastline at Terrigal experiences a moderate to high energy but highly variable wave climate. Dominant wave direction is from the southeast.

Generally erosion occurs during storms when increased wave height results in wave attack, and sand is transported offshore from the beachface to the near shore region. Following storm conditions, sand is slowly transported back onshore, eventually building up the beachface once again. The time taken for beach erosion may vary from a few hours to a few days, while beach building following a storm event may take several months to several years.

The Haven provides protection from the predominant southerly weather and waves and anchorage for a small commercial fishing fleet and other small vessels. The small beach and boat ramps are largely unaffected by most storms and associated coastal processes, although they are exposed to less frequent storms and swell generated from the northeast. The storm tides in 1974 caused some damage to the foundations of the old sailing club, now the dive shop and Galley restaurant.

The Skillion may be inundated by waves during large storms from the South, resulting in inundation of the recreation area behind. While the foreshore of the Haven is generally protected from storm erosion, a severe storm event can result in damage to the back-beach earthen embankment. Rocks, gravel and debris transported by waves were also deposited on the recreation area in the 1974 storms.

Flora and Fauna

Plant communities

Three main plant communities have been identified within the study area based on previous vegetation mapping, including:

- Coastal Headland Low Forest
- Coastal Headland Shrubland
- Coastal Headland Grassland.

Coastal Headland Low Forest (E51c)

Coastal Headland Low Forest (map unit E51c, as mapped by Bell 2004) occurs within an area bounded by the Scenic Highway and the cliff top on the south western area of Broken Head. Coastal Headland Low Forest occurs on coastal clay headlands and slopes exposed to onshore winds and forms a complex of merging vegetation types dependant on local soil conditions and disturbance history, including Coastal Headland Shrubland and Grassland. Typical canopy species

within this community include *Eucalyptus capitellata*, *Eucalyptus paniculata* subsp. *paniculata*, *Eucalyptus umbra* and *Angophora costata*, which occur over a sparse shrub layer and a normally well developed herb layer (Bell, 2004).

Coastal Headland Shrubland (E51b)

Coastal Headland Shrubland (map unit E51b, as mapped by Bell 2004) occurs in narrow broken strips along the cliff face and cliff tops of Broken Head and the Skillion. Coastal Headland Shrubland occurs on coastal clay headlands and slopes in areas subjected to high levels of coastal exposure yet are still protected to some degree. Shrublands of species such as She-oak *Allocasuarina distyla*, Coast Rosemary *Westringia fruticosa*, Ball Honeymyrtle *Melaleuca nodosa*, Large-leaf Hop-bush *Dodonaea triquetra* and Finger Hakea *Hakea dactyloides* occur. Cliff top vegetation occurs as isolated patches surrounded by mown grasses, whereas cliff face vegetation forms a contiguous stretch of vegetation from Haven Beach in the north to the Skillion in the south.

Species recorded are those typically found in coastal environments within the Sydney, Gosford and Newcastle regions. Dominant upper stratum species are Coastal Banksia, *Banksia integrifolia*; Swamp Oak (dwarf form), *Casuarina glauca* and Coastal Tea-Tree, *Leptospermum laevigatum*. Dominant understorey species include Coastal Rosemary, *Westringia fruticosa*; Spiny-headed Mat-rush, *Lomandra longifolia* and Kangaroo Grass *Themeda australis*. Other species include Tick Bush *Kunzea ambigua* and the exotic weed Lantana, *Lantana camara*, which occurs occasionally.

On the north western side of Broken Head, a narrow belt of littoral rainforest occurs, beyond the boat ramp eastward along the cliffline. The previously mapped littoral rainforest grades into Coastal Heath/Shrubland on the northern side of Broken Head.

Dominant upper stratum native species are Tuckeroo, *Cupaniopsis anarcardioides*; *Guoia semiglauc*; Flintwood, *Scolopia brauni*; Red-fruited Olive Plum, *Cassine australis* and Coastal Banksia, *Banksia integrifolia*. The exotic street tree Norfolk Island Hibiscus, *Lagunaria patersonii*, is a major weed in the canopy layer throughout this community and through other areas of clifftop vegetation.

The shrub layer comprises individuals of Coffee Bush, *Breynia oblongifolia*; Hairy Clereodendrum, *Clereodendrum tomentosum*; Boobialla, *Myoporum boninense* subsp. *australe*; Muttonwood, *Rapanea variabilis* and Common Hopbush *Dodonaea triquetra*.

Common groundcover species are Spiny-headed Mat Rush, *Lomandra longifolia*; New Zealand Spinach, *Tetragonia tetragonioides* and Kangaroo Grass, *Themeda australis*. Introduced species have colonised the groundcover layer, with Kurnell Curse, *Hydrocotyle bonariensis*; Japanese Honeysuckle, *Lonicera japonica*; Fireweed, *Senecio madagascariensis*; Vasey Grass, *Paspalum urville* and Buffalo Grass, *Stenotaphrum secundatum*, occurring commonly.

Other species that may occur include Swamp Oak (dwarf form), *Casuarina glauca*; Mirror Bush, *Coprosma repens*; Coastal Rosemary, *Westringia fruticosa* and Red Bloodwood, *Corymbia gummifera* (dwarf form).

Coastal Headland Grassland (E51a)

Stands of native grassland dominated by Kangaroo Grass, *Themeda australis*, occur in some parts of the open space areas of Broken Head and the Skillion, with a large stand occurring on the southern slopes adjacent to the Skillion. This community has been mapped as Coastal Headland Grassland (map unit E51a, as mapped by Bell 2004).

Evidence suggests that the Haven is the largest Coastal Headland Grassland on the Terrigal Formation geological unit (Robinson M 2000, unpublished data). There are a number of areas of remnant Kangaroo Grass and small localised patches or tussocks of native grass scattered in the exotic grassland above the existing clubhouse and on the Skillion. These patches of native grass are likely to regenerate naturally if mowing was to cease and weed control undertaken.

Within this area, some small areas have been planted with native species, including Norfolk Island Pine (*Araucaria heterophylla*, which is not indigenous to the area), Coast Banksia and Spiny-headed Mat Rush.



Vegetation Mapping (Bell 2004)

Intertidal zone

A marine biology assessment was prepared in 1999 by Laxton Environmental Consultants for the area between the rockpool and Broken Head. The following is a summary of the marine biology investigation.

The intertidal rock shelf and reef areas along this section of coastline exhibit ecological values typical of central NSW rocky shores exposed to high wave energy. Intertidal sandy shores were found to be inhabited by small numbers of animals or few species, mainly polychaete worms and small crustaceans. They provide habitats for a diverse array of flora and fauna dominated by green algae *Ulva* sp., Neptune's Necklace, *Hormosira banksii*; Cunjevoi, *Pyura solonifera*; red coralline algae, barnacles and littorinid molluscs (periwinkles).

These productive rocky shores also provide feeding and nursery habitats for a range of fish and crustacean species, many of which are of commercial and/or recreational fishing significance.

Subtidal sandy bottoms in the Haven were either inhabited by seagrasses or consist of exposed sand. Two species of seagrass were present (Ribbonweed *Zostera capricorni* and Paddleweed *Halophila ovalis*). The Haven is only one of two places on the NSW open coast that seagrasses grow. Seagrasses in the Haven are periodically subjected to mass mortality by smothering by detached kelp or from overgrowing by algae.

Some shorebird species, such as the Pied Oystercatcher *Haematopus longirostris*, Sooty Oystercatcher *Haematopus fuliginosus*, Little Tern *Sterna albifrons* and Hooded Plover *Thinornis rubricollis* could theoretically occur periodically within the littoral zone of the Haven. However, the current high levels of human activity in the area would preclude the presence of these species, certainly for nesting and breeding, except on rare occasions.

Fauna habitats

The study area is likely to provide only marginal low quality habitat for native terrestrial fauna species, for the following reasons:

- vegetation within the study area occurs only in small, narrow patches (unlikely to be suitable habitat for larger ground-dwelling mammals, reptiles or birds)
- there are no aquatic habitats to support native frogs, reptiles, or freshwater crustaceans and fish
- the likely presence of feral ground-dwelling predators, such as the red fox, feral cat, and domestic dogs
- potential habitat patches are surrounded by large tracts of cleared grass and/or urban development (i.e. roads, residential areas and structures) and are not connected to any larger, contiguous tracts of vegetation that may form part of a fauna movement corridor
- significant numbers of people utilise the study area on a daily basis and undertake recreational activities within this area. This is likely to disturb native fauna to some extent.

Consequently, native fauna diversity within the Haven is expected to be low. Fauna species (including a number of threatened species, such as the Regent Honeyeater, *Xanthomyza phrygia*) are known to occur in urban areas (including street trees, parks and gardens) and may therefore potentially occur throughout most of the study area. However, these species would only occur on a transient basis, and rarely, if at all.

The small pockets of littoral rainforest would provide dense canopy protection and seasonal food sources (i.e. flower, nectar and fruit) for a narrow suite of locally occurring bird species. Heathland provides scattered trees and dense understorey vegetation.

Fauna species

Payne (1999) recorded six fauna species within the study area, including the Australian Magpie, *Gymnorhina tibicen*; Caspian Tern, *Sterna caspia*; Feral Pigeon, *Columba livia*; Little Wattlebird, *Anthochaera chrysoptera* and the Silver Gull, *Larus novaehollandiae*. All these species occur commonly on a local and regional scale (Pizzey and Knight 1997). A much larger suite of fauna species, particularly birds, is likely to utilise the study area, at least on a temporary basis.

The National Parks and Wildlife Service (NPWS) have indicated that individuals of the Little Penguin, *Eudyptula minor*, use the Haven seasonally during moulting periods. Although no penguins, burrows or tracks were seen during site inspections, penguins were heard calling in the nearby coastal waters and they are known to forage in the waters around the cliff face. Penguins moult under the shelter of rocks or bushes or in burrows, favouring sites close to the sea. Moulting is completed in April and usually lasts 17 – 18 days with breeding beginning in August.

Feral Animal Control

Feral animals impact on native species by predation, competition for food and shelter, destroying habitat, and by spreading diseases. In Australia, feral animals typically have few natural predators or fatal diseases and some have high reproductive rates. As a result, their populations have not naturally diminished and they can multiply rapidly if conditions are favourable¹.

Terrigal Haven has been the subject of feral animal invasion, particularly in the form of the feral European rabbit (*Oryctolagus cuniculus*). 'Competition and grazing by the feral European rabbit' is listed by the NSW Department of Environment, Climate Change and Water as one of the key threatening processes in NSW². In addition, 'Competition and Land Degradation by rabbits' is listed as the number one key threatening process by the Australian Government's Department of Environment, Water, Heritage and the Arts³.

It is the responsibility of Council, as land manager, to control declared pest species on the reserve.

¹ Australian Government Department of the Environment, Water, Heritage and the Arts (2009), 'Feral Animals in Australia', viewed 18 November 2009, <<http://www.environment.gov.au/biodiversity/invasive/ferals/index.html>>

² NSW Department of Environment, Climate Change and Water (2009) 'List of Key Threatening Processes', viewed 18 November 2009, <<http://www.environment.nsw.gov.au/threatenedspecies/KeyThreateningProcessesByDoctype.htm>>

³ Australian Government Department of the Environment, Water, Heritage and the Arts (2009), 'Feral Animals in Australia', viewed 18 November 2009, <<http://www.environment.gov.au/biodiversity/invasive/ferals/index.html>>

Appendix 4 Chronology¹

¹ Information in the following chronology was sourced from Liz Parkinson's *Terrigal: A History of the Area* (2003), Gwen Dundon's *The Shipbuilders of Brisbane Water NSW* (1997) and the Gosford City Council website. Please refer to reference list for further details.

1800's

In 1825, 640 square acres of land encompassing Terrigal Haven and its surrounds, was promised to John Murray Gray by Governor Thomas Brisbane. Although John Murray Gray had yet to receive finalised deeds for the grant, he took possession of the land and as he chose to remain in Sydney rather than residing at Terrigal, he set a number of convicts to work at the Haven to assist with clearing and improving his land.

In 1831 Gray began having difficulty trying to run his property from afar whilst it was under the control of wayward convicts. Even though a sizeable grant, Gray's land would not have been seen to be of much value at this time due to the inability to lay crops, inappropriateness for extensive livestock grazing and difficulty in negotiating the steep landforms. As a result, Gray was experiencing financial difficulty and finally took a mortgage out on the land.

Finalised deeds for 'Broxmouth Ville', as Gray's property was to be known, were authorised by Governor Bourke in 1833. However with John Murray Gray unable to make repayments on his grant, William Poudray was able to foreclose on Gray's land in 1839.

Due to the depression, land value plummeted and William Poudray, along with many other landholders, became indebted to the Bank of NSW who foreclosed on his property. As economic recovery commenced after the depression, Gray's grant was placed on the market by the Bank of NSW and purchased by George Alfred Lloyd in 1850 who added his new purchase to the 300 acres of land he had previously acquired in Terrigal.

In 1855 Lloyd decided to return to England and as a result chose to subdivide his land at Terrigal. 40 acres of this land was designated as a town common known as 'Broxmouth Ville Common' and encompassed what is now known today as Terrigal Haven.

In 1870 Tom Davis, a shipbuilder and timber dealer, leased an area of 'Broxmouth Ville Common' from the government and established a sawmill and shipyard. Next to the shipyard site was a rain filled lagoon that supplied the water for the sawmill's boilers (this is now the site of the Haven Oval). A tramway ran the sawn timber, including a variety of hardwood timber, to the jetty at Cockrone Lagoon where it was shipped to various destinations. Davis employed approximately 120 men who lived on the land and was therefore the major employer of labour in the locality at the time.

Davis was also a renowned shipbuilder whose ships included the Terrigal Jack (ketch, 1869), Terrigal (ketch, 1870), Terrigal Packet (schooner, 1874), Venture (schooner, 1875), Wonga Wonga (schooner, 1876), Electric Light (steamship, 1880), Bowra (steamship, 1883), Tweed (steamship, 1889), Byron (steamship, 1891) and the General Gordon (paddle wheel steamship, 1886). Prior to construction of the first bridge at the Hawkesbury River, the General Gordon was used to ferry railway passengers across the river.

In addition to his shipbuilding and timber trading activities, Tom Davis was reputed to have grown sugar cane on the Skillion slope and earlier David Wilson may have grown wheat there but this has not yet been verified.

After Tom Davis' death in 1893, his widow Susannah surrendered her family's rights to the 15 acre Broxmouth Ville Common to the Commercial Bank of Australia.

Tourism in Terrigal was promoted at the end of the 19th Century due to the focus on health and leisure and the opening up of the area to the general public with the completion of the railway line from Sydney to Newcastle in 1889 and the development of the roads.

1900's

Tourism

Early in the 20th century, Terrigal itself was being promoted as a 'new marine township' and was being subdivided into 1-6 acres, 8 and 18 acre blocks of land. At this time, Terrigal was becoming recognised as a good surfing and fishing area. With this came the development of surfing sheds, clubrooms, safe swimming, shelter sheds and a golf links at the Skillion. The fishing was promoted for snapper, bream, and deep sea fish. The fishing interest brought with it, motorboat launching, rowing boats and the areas that were recognised as good areas for fishing were the beach, the lagoon, and the rock face. The Skillion itself also became a well-known and much visited tourist landmark.

The 1928 Erina Shire Holiday and Touring Guide², in promoting visitation to the area, proclaimed that:

Visitors are well catered for by many boarding houses, cottages to let, stores, post office, picture show, public hall (in which many social gatherings are held), Public School, and churches. There is a Progress Association, and a Surf Club whose members regularly patrol the beach, and have a surf boat.

No person should come to Erina Shire without seeing Terrigal, THE show place. In addition to Terrigal's paramount attractions in summer, it also has a notable appeal as a winter resort. It is protected from the cold westerly and southerly winds by ranges of tree-clad hills, and is acclaimed "the sunniest winter spot in New South Wales." (p. 71)

In the late 1950's, the Florida Hotel and the Terrigal Hotel were constructed enhancing the tourist trade of the Terrigal area. The Florida Hotel brought not only tourists to the area due to its premium accommodation but was also widely renowned for its conference facilities and as a result drew businessmen from afar. From the 1950's through to the 1980's growth was also enhanced in Terrigal due to the development of the Newcastle freeway.

Terrigal Haven

In 1912, two acres of land were granted by the Lands Department for the construction of the Terrigal School at the Haven. This one room timber building existed at the Haven until 1937 when the Department of Education recommended its relocation due to the number of fisherman and campers living adjacent to the small building and concerns over the resultant safety of the children attending the school.

In the 1920's and 30's Terrigal was the site of a number of car rally's with participants utilising the Haven as part of their course and even driving to the summit of the Skillion. Also in the 1930's, Erina Shire Council utilised the area at the base of the Skillion as a quarry. Rocks and stones were taken to various worksites within the locality including ones at Terrigal Esplanade and Ocean View Drive.

From the 1940's until 1974, a major caravan park was located at Terrigal Haven. The 1954 'Summer Tourist Guide - The Beautiful Gosford District' describes the area as:

Under the lee of the famous Skillion and running down to the sheltered sand-beach of the Haven is the Terrigal camping area, where hundreds of caravans and camps are settled from November to April each year.³

² Gosford City Council, 2009, 'Erina Shire Holiday and Touring Guide 1928', Gosford District Guides 1900s - 1960s, viewed 18 May 2009, <http://www.gosford.nsw.gov.au/library/local_history/Tourist%20Guides/index_html>

The camping facility was however removed after extensive property damage resulted from the severe storms of 1974.

Current day

The demand for recreational use of the Haven has grown steadily as a result of the improved road system connections to Sydney and the development of the Crowne Plaza on Terrigal Esplanade. This development has added a major source of recreation demand at Terrigal over the last 15 years.

This demand for recreation also brings with it a demand on the natural resources of the Haven. It is therefore essential that a relevant Plan of Management is adopted for the Haven to ensure future development of the Haven is Ecologically Sustainable.

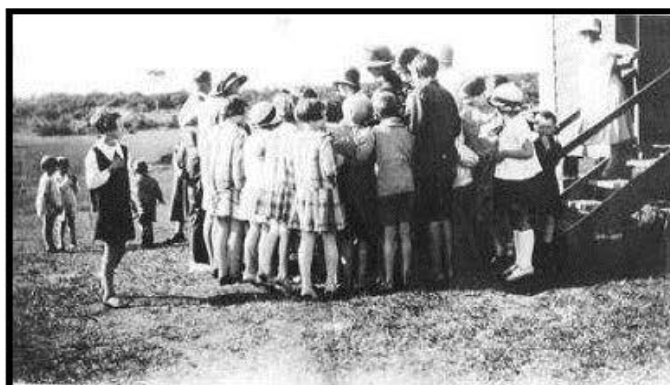
³ Gosford City Council, 2009, 'The Beautiful Gosford District 1954', Gosford District Guides 1900s - 1960s, viewed 18 May 2009, <http://www.gosford.nsw.gov.au/library/local_history/Tourist%20Guides/index_html>



Terrigal Haven with remains of Thomas Davis' Sawmill c. early 1900's
Source: Gosford City Council Library



Fishermen's Beach, site of Davis' Shipbuilding Activities. Lobster pots in foreground
c. 1909-12
Source: Gosford City Council Library



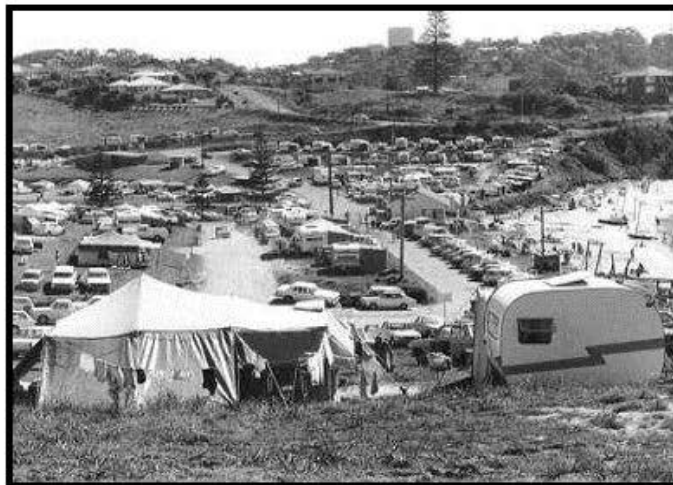
School children at the public school, Terrigal Haven c. early 1920's
Source: Gosford City Council Library



Austin motor car at Rally, The Skillion, Terrigal c. 1920's
Source : Gosford City Council Library



Picknickers at The Skillion, Terrigal c. 1920's
Source : Gosford City Council Library



Busy Summer Scene at the Camping Ground, Terrigal Haven c. 1970
Source : Gosford City Council Library

Appendix 5

Planning Instruments and Legislation

Planning Instrument	Year / Policy No.	Policy statement/objectives
Commonwealth and NSW Legislation		
NSW Crown Lands Act	1989	<p>The objects of this Act are to ensure that Crown land is managed for the benefit of the people of New South Wales and in particular to provide for:</p> <ul style="list-style-type: none"> • a proper assessment of Crown land, • the management of Crown land having regard to the principles of Crown land management contained in this Act, • the proper development and conservation of Crown land having regard to those principles, • the regulation of the conditions under which Crown land is permitted to be occupied, used, sold, leased, licensed or otherwise dealt with, • the reservation or dedication of Crown land for public purposes and the management and use of the reserved or dedicated land, and • the collection, recording and dissemination of information in relation to Crown land.
NSW Environmental Planning & Assessment Act	1979	<ul style="list-style-type: none"> • to encourage: <ul style="list-style-type: none"> ◦ the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment, ◦ the promotion and co-ordination of the orderly and economic use and development of land, ◦ the protection, provision and co-ordination of communication and utility services, ◦ the provision of land for public purposes, ◦ the provision and co-ordination of community services and facilities, and ◦ the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and ◦ ecologically sustainable development, and ◦ the provision and maintenance of affordable housing, and • to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and • to provide increased opportunity for public involvement and participation in environmental planning and assessment.
NSW Native Vegetation Act	2003	<ul style="list-style-type: none"> • to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State • to prevent broadscale clearing unless it improves or maintains environmental outcomes • to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation • to improve the condition of existing native vegetation,

Planning Instrument	Year / Policy No.	Policy statement/objectives
		<p>particularly where it has high conservation value</p> <ul style="list-style-type: none"> to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.
NSW National Parks and Wildlife Act	1974	<p>Under the NSW <i>National Parks and Wildlife Act 1974</i> (NP&W Act), the National Parks and Wildlife Service (NPWS, now part of DECC) are responsible for the preservation and protection of relics and Aboriginal places in national parks, historic sites, nature reserves, state game reserves, Aboriginal areas, protected archaeological areas, state recreation areas and regional parks.</p> <p>As recommended by NPWS, the following steps would be a minimum to the assessment of Aboriginal Heritage within the Haven:</p> <ul style="list-style-type: none"> consult with the Local Aboriginal Land Council (LALC) to identify the location of Aboriginal sites. They may be aware of sites that have not been registered with NPWS contact the Aboriginal Sites Registrar at NPWS and request a site search to obtain a listing of registered Aboriginal sites. The Register only includes those Aboriginal sites which have been reported to NPWS undertake an assessment of the known Aboriginal site/s and/or undertake survey of the subject land to locate Aboriginal sites. Test excavations may be required as part of this investigation to verify the location of Aboriginal sites. Such excavations need to be undertaken before the DA is submitted. A permit is required from NPWS for such investigation and if all information is attached to the application the processing time is eight weeks.
NSW Threatened Species Conservation Act	1995	<ul style="list-style-type: none"> to conserve biological diversity and promote ecologically sustainable development to prevent the extinction and promote the recovery of threatened species, populations and ecological communities to protect the critical habitat of those threatened species, populations and ecological communities that are endangered to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed to encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.
NSW Noxious Weeds Act	1993	<ul style="list-style-type: none"> to reduce the negative impact of weeds on the economy, community and environment of this State by establishing control mechanisms to: <ul style="list-style-type: none"> prevent the establishment in this State of significant new weeds, and restrict the spread in this State of existing significant weeds, and reduce the area in this State of existing significant

Planning Instrument	Year / Policy No.	Policy statement/objectives
		weeds, • to provide for the monitoring of and reporting on the effectiveness of the management of weeds in this State.
NSW Fisheries Management Act	1994	• to conserve fish stocks and key fish habitats • to conserve threatened species, populations and ecological communities of fish and marine vegetation • to promote ecologically sustainable development including the conservation of biological diversity and consistently with these objects • to promote the viable commercial fishing and aquaculture industries • to promote quality recreational fishing opportunities • to appropriately share fisheries resources between the users of those resources and • to provide social and economic benefits for the wider community of New South Wales.
Environment Protection and Biodiversity Conservation Act	1999	The <i>Environment Protection and Biodiversity Conservation (EPBC) Act 1999</i> provides for the protection of the environment and the conservation of biodiversity for those aspects of the environment that are matters of national environmental significance. Matters of environmental significance under this Act fall under the following categories: <ul style="list-style-type: none"> • World Heritage properties • wetlands of international importance • listed threatened species and ecological communities • listed migratory species • nuclear actions • Commonwealth marine environment • Commonwealth land • land clearing. If any future Development Applications (DA) for the Terrigal Haven have the potential to impact any of the above mentioned aspects, then, a referral to Environment Australia will be required for Commonwealth approval.
NSW Disability Services Act	1993	• to ensure the provision of services necessary to enable persons with disabilities to achieve their maximum potential as members of the community • to ensure the provision of services that: <ul style="list-style-type: none"> ○ further the integration of persons with disabilities in the community and complement services available generally to such persons in the community ○ enable persons with disabilities to achieve positive outcomes, such as increased independence, employment opportunities and integration in the community ○ are provided in ways that promote in the community a positive image of persons with disabilities and enhance their self-esteem • to ensure that the outcomes achieved by persons with disabilities by the provision of services for them are taken into account in the granting of financial assistance for the provision of such services • to encourage innovation in the provision of services for persons with disabilities • to achieve positive outcomes, such as increased

Planning Instrument	Year / Policy No.	Policy statement/objectives
		<p>independence, employment opportunities and integration in the community, for persons with disabilities</p> <ul style="list-style-type: none"> to ensure that designated services for persons with disabilities are developed and reviewed on a periodic basis through the use of forward plans.
Australian Standards		Collection 005 of the Australian Standards contains 22 Australian Standards assembled to provide a guide to the range of standards available concerning access and mobility for people with disabilities. The standards cover, amongst other things, design for access and mobility, tactile ground surface indicators, parking facilities, public information symbols and other selected topics.
State policies/strategies		
Central Coast Regional Strategy	2008	The release of the final Central Coast Regional Strategy establishes the necessary planning framework to deliver a prosperous and sustainable future for the Region's current and future residents.
NSW coastal policy	1997	<ul style="list-style-type: none"> Protecting, rehabilitating and improving the zone's natural environment; Recognising and accommodating the zones natural processes Protecting and enhancing its aesthetic qualities Protecting and enhancing its cultural heritage Providing for ecologically sustainable development and use of resources Providing for ecologically sustainable human settlement Providing for appropriate public access and use Providing information to enable effective management Providing for the zones integrated planning and management.
SEPP 19 Urban Bushland	19	General aim is to protect and preserve bushland within the urban areas because of its value to the community as part of natural heritage, its aesthetic value and its value as a recreational, educational and scientific resource.
SEPP 26 Littoral Rainforest	26	Mechanism that provides for the consideration of development applications that are likely to damage or destroy littoral rainforest areas and reserve their natural state.
SEPP 71 Coastal Protection	71	General aim is to provide for the protection and management of the natural, cultural, recreational and economic attributes of the New South Wales coast.
Council Planning Instruments and Policies		
Gosford Planning Scheme Ordinance		The objective of the zone is to identify and make provision for land for the purposes of leisure and recreation to promote community benefits and contribute to the amount and distribution of public open space areas at acceptable levels and at standards which meet the needs of the community. Development for the purposes of 'recreation areas' and exempt development do not require consent from Council under the ordinance. Development that needs consent from Council include; camping grounds or caravan parks, community facilities, roads and utility installations. Development that is prohibited includes any not included in

Planning Instrument	Year / Policy No.	Policy statement/objectives
		the above.
Erection of street banners	T4.03	Council will give permission for the erection of banners advertising Tourist, Social, Cultural and other major events within Gosford City on permanent posts provided by Council.
Environmental assessment procedure	D1.04	To ensure that all activities/works undertaken by Council are assessed in accordance with the requirements of Part 5 of the Environmental Planning and Assessment Act, 1979.
Environmental Policy	D2.07	To effectively integrate the principles of ecological sustainability into all council and community functions so as to achieve a clean, healthy and ecologically sustainable environment for the City of Gosford.
Biodiversity Management	R0.18	Allows Council to conserve the diversity and abundance of locally occurring native plants and animals and microorganisms in Gosford City at the genetic, species and ecosystem level.
Allocations - Seasonal Use	R1.02	Enables Council to control and manage the use of sports grounds within the local government area. Ensures the allocations of venues/fields is undertaken in a fair and equitable manner. Provides additional guidelines that relate specifically to the allocation of Gosford City Council (GCC) sports grounds. Ensures maximum usage of currently available sports grounds without creating overuse of venues /fields. Encourages co-operation between user codes.
Closure of Sporting Fields	R1.04	Allows Council to maintain the condition of all sporting fields.
Consumption of Alcohol (Functions Licences)	R1.06	Enables Council to control and manage the consumption of alcohol at Council owned sporting venues and other recreation areas.
Playing fields and Amenities (General Use)	R1.07	Controls the use of playing fields and amenities, in accordance with the PoM, under Local Government Act.
Public Amenities Buildings (Design or Erection)	R1.09	Controls the design and erection of facilities on, or adjacent to, sporting fields.
Advertising on Sportsgrounds	R1.12	Encourages sponsorship funding to be used in the maintenance and embellishment of the sporting grounds.
Landscape and vegetation management policy	D6.44	To achieve a physical environment which capitalises on the landscape qualities of the natural topography and vegetation of the Central Coast and accommodates appropriate development.
Tree preservation order	Schedule 1	Syzygium paniculatum (Magenta Lillypilly) which was found within a 5km radius of the Haven is found in Schedule 1 of the Tree Management Policy. This was found at Avoca Lake and can potentially be found at the Haven. Araucaria heterophyllas (Norfolk Island Pines) - A number of these species exist within the Haven and are an important tree species to Terrigal in terms of a historic landmark to Terrigal.

Planning Instrument	Year / Policy No.	Policy statement/objectives
Terrigal Town Centre (Amendment 1)	DCP No. 55	To provide for a coordinated pattern to that of the Terrigal CBD village atmosphere.
Scenic quality	DCP.No. 89	Key contents of DCP: <ul style="list-style-type: none"> -Protection of vegetated ridgelines and upper slopes -New development to have regard to character of area both built and natural - Retention of non-urban breaks between urban areas - Ensuring built environment does not dominate landscape features in non-urban areas. <p>Terrigal Beach and Skillion is of Regional Scenic Quality Significance. Careful attention to siting and scale of urban elements so as to not overpower natural elements of the Haven. Maintenance of co-dominance of landscape and development with regard to Scenic Protection and Conservation.</p>
Business Use of Public Footpath	A5.09	To encourage the establishment of appropriate outdoor dining areas throughout Gosford Local Government Area, which promote a safe, attractive and vibrant environment for local residents and visitors to the area.

Source: policies, codes and environmental planning instruments.

Central Coast Council
Terrigal Boardwalk
Review of Environmental Factors

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Final | 30 October 2018



This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 261648-00

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Document Verification

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Abbreviations

Term	Meaning
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AS	Australian Standard
BC Act	<i>Biodiversity Conservation Act 2016</i>
BS	British Standard
CBD	central business district
CD	chart datum
CEMP	Construction Environmental Management Plan
Council	Central Coast Council
DCP	development control plan
DDA	<i>Disability Discrimination Act 1992</i>
EPA	Environmental Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
ESD	ecological sustainable development
HAT	highest astronomical tide
ISEPP	<i>State Environmental Planning Policy (Infrastructure) 2007</i>
LALC	Local Aboriginal Land Council
LAT	lowest astronomical tide
LEP	Local Environment Plan
LGA	Local Government Authority
LLS	Local Land Services
mbgl	metres below ground level
MNES	matters of national environmental significance
MWL	mean water level
OEH	Office of Environment and Heritage
PWD	Public Works Department
RE1	land zoned for public recreation
REF	Review of Environmental Factors
SEPPs	State Environmental Planning Policies
The proposal	The proposed Terrigal Beach promenade to The Haven boardwalk
UL	unzoned land

Executive Summary

This review of environmental factors has been prepared to assess the environmental impacts of a proposed boardwalk to connect Terrigal Beach with The Haven precinct (the 'proposal').

Central Coast Council is the proponent for proposal and is also the determining authority for the Review of Environmental Factors under division 5.1 of the *Environmental Planning and Assessment Act 1979*.

Background

As a result of improved infrastructure and increased developer interest, Terrigal has become substantially more urban and a consolidated regional tourist attraction. A key tourist attraction and feature of Terrigal is the beach and waterfront area, including both the main Terrigal Beach and The Haven, a smaller beach directly to the east of Terrigal Beach.

At present, the existing rock headland and steep portion of the Scenic Highway/Terrigal Esplanade limits easy access between Terrigal Beach and The Haven precinct. An existing path along the Scenic Highway/Terrigal Esplanade connects Terrigal Beach to The Haven carpark; however, it is steep and moves users away from the foreshore. There is an option to climb over the rocks between Terrigal Beach and The Haven, although this alternative option is considered dangerous.

Proposed Boardwalk

The proposal is to construct an approximate 220 metre boardwalk connecting the existing pathway at the Terrigal rockpool to the west with The Haven precinct at the existing seawall adjacent to the Reef Restaurant to the east.

The proposal is located between the Terrigal Central Business District and cafes, sporting fields and parkland at The Haven. Upon completion, the boardwalk is hoped to become a tourist attraction and a destination enhancing experience which compliments the natural coastal environment.

Consultation

Central Coast Council will complete consultation as part of the proposal's Community Engagement Plan. The plan covers the design, planning, pre-construction and construction stages of the proposal, targeting the community, relevant government agencies and other key stakeholders.

Assessment

The proposal has been assessed under division 5.1 of the *Environmental Planning & Assessment Act 1979* and the *State Environmental Planning Policy (Infrastructure) 2007*.

This review of environmental factors includes the assessment of key engineering, environmental and planning issues such as sea level rise, landscape and visual, biodiversity and socio-economic impacts.

Relevant Commonwealth, State and local environmental planning provisions have also been assessed.

Mitigation measures identified in this review of environmental factors aim to minimise the potential impact from the works during the construction and operational stages of the proposal.

Conclusion

This review of environmental factors recommends mitigation measures to ensure that the construction and operation of the boardwalk occurs without significant environmental impact.

Therefore, it is recommended that the proposal be approved under division 5.1 of the *Environmental Planning & Assessment Act 1979* by Central Coast Council.

1 Introduction

This review of environmental factors (REF) assesses the impacts of building and operating a new 220 metre boardwalk between Terrigal Beach and The Haven precinct (the 'proposal'). Guided by the REF, Central Coast Council ('Council') will determine if the proposal should proceed in accordance with its authority under division 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

1.1 Background

Improved infrastructure and increased developer interest means Terrigal has become substantially more urban and a regional tourist attraction. However, the existing rock headland and steep roadway limits easy access between the beach and The Haven precinct. An existing path along the Scenic Highway/Terrigal Esplanade connects Terrigal Beach to The Haven carpark; however, it is steep and moves users away from the foreshore. There is an option to climb over the rocks between Terrigal Beach and The Haven, although this alternative option is considered dangerous.

This proposal intends to improve the amenity and accessibility for tourists visiting the region. It is Council's ambition for the boardwalk to become a tourist attraction and a destination-enhancing experience that compliments the natural coastal environment.

1.2 Scope of the REF

This REF has been prepared to allow Council to fulfil its obligations as a determining authority under section 5.5 of the EP&A Act insofar as "examining and taking into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity". The REF has been prepared to address the factors set out under clause 228 of the supporting *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) and the objects of the EP&A Act, including supporting ecologically sustainable development.

The assessment has also been undertaken in accordance with the requirements of all relevant State and Commonwealth legislation including the NSW *Biodiversity Conservation Act 2016* (BC Act), the NSW *Fisheries Management Act 1994* (FM Act) and the Commonwealth *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act).

The findings of this REF will be considered when assessing the significance of the proposal's impact. Specifically, where there is expected to be a significant environmental impact:

- Then the Minister of Planning would need to approve the proposal in accordance with division 5.2 of the EP&A Act. This would require Council making a development application to the Minister as supported with an environmental impact statement.

- If there is a significant impact on a threatened species listed (and protected) under the BC Act or FM Act, then Council would need to prepare either a species impact statement pursuant to section 1.7 of the EP&A Act or a Biodiversity Development Assessment Report pursuant to section 7.8 of the BC Act. The species impact statement would be prepared in accordance with section 7.6 of the *Biodiversity Conservation Regulation 2017* and any specific requirements set out by the Office of Environment and Heritage. The species impact statement would need approving (agreeing) by the Office of Environment and Heritage.
- On a matter of national environmental significance then Council would need to refer the proposal to the Commonwealth Department of Environment and Energy for a decision as to whether assessment and approval is needed under the EPBC Act.

An outline of the information provided in each chapter of this REF is provided in Table 1.

Table 1: Summary of the issues addressed in each chapter

Issues addressed	
Chapter 1	Proposal identification and the REF's purpose
Chapter 2	Site location and context
Chapter 3	Description of the proposal's need, objectives, options considered, preferred option, delivery timeframe and proposed construction methodology
Chapter 4	The statutory planning framework under which the proposal would be built
Chapter 5	The stakeholder and community consultation carried out in support of the proposal
Chapter 6	The environmental impact assessment of key issues including a description of the safeguards and management measures that would be used to mitigate the proposal's adverse impacts, and any licences and approvals needed to deliver the proposal
Chapter 7	Assessment of the proposal's consistency with the factors set out in clause 228 of the EP&A Regulation
Chapter 8	The justification for progressing with the preferred proposal and conclusions
Chapter 9	References
Appendix A	Survey and Geotechnical Investigations – Information Flyer
Appendix B	Landscape and Visual Assessment
Appendix C	Threatened Species Assessment
Appendix D	Darkinjung Local Aboriginal Land Council – Formal Response

2 Site Location and Context

The proposal is located between the Terrigal Beach promenade and The Haven precinct, as outlined by the red dotted line on Figure 1. It is located across four *reserves* on Crown Land, including Lot 1/DP 1060783 (Kincumber Recreation R48956 Reserve Trust) and Lot 6/DP 805477 (Central Coast Council R48416 Reserve Trust). The other two Crown Land lots north of the established *reserves* were unable to be established at the time of writing (refer to Figure 2).

The proposal footprint is partially unzoned land (UL) and partially zoned for public recreation (RE1) use in the Gosford Local Environmental Plan (LEP) 2014.

The broader area is characterised by coastal and landside recreation infrastructure, newer and older-style apartments and resorts, residential dwellings and local businesses and cafes. Section 6.3 provides for more information regarding the surrounding land uses and community facilities near the proposal footprint.



Figure 1: Site location (Central Coast Council, 2017a)

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Figure 2: Crown Land boundaries

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3 Proposal Description

3.1 Strategic Need for the Proposal

In October 1991, the Terrigal Chamber of Commerce, with Gosford City Council's support, convened a workshop and resolved the need to develop a Landscape Masterplan for the waterfront that integrated and linked the foreshores from the western edge of Terrigal Lagoon to the Terrigal beachfront area and The Haven precinct. A working group was formed to develop the Landscape Masterplan, which was delivered in 1996. Following the Landscape Masterplan was a feasibility study of the proposed boardwalk in 1998, both of which were adopted by Gosford City Council in 2009 as part of the Terrigal Haven Plan of Management. The aim of the Plan of Management was to provide a clear, concise and practical framework for Terrigal Haven, leading to strategies to protect and enhance identified key values while identifying opportunities that would ensure longer-term objectives of sustainable management.

The Plan of Management, in adopting the 1996 landscape masterplan, highlighted the potential need for a boardwalk (refer to Figure 3), stating the following:

"A new free-standing timber boardwalk links Terrigal Beach to The Haven. It begins at the existing rock platform and extends to the Sailing Club. The boardwalk will incorporate viewing platforms, seating and lighting."

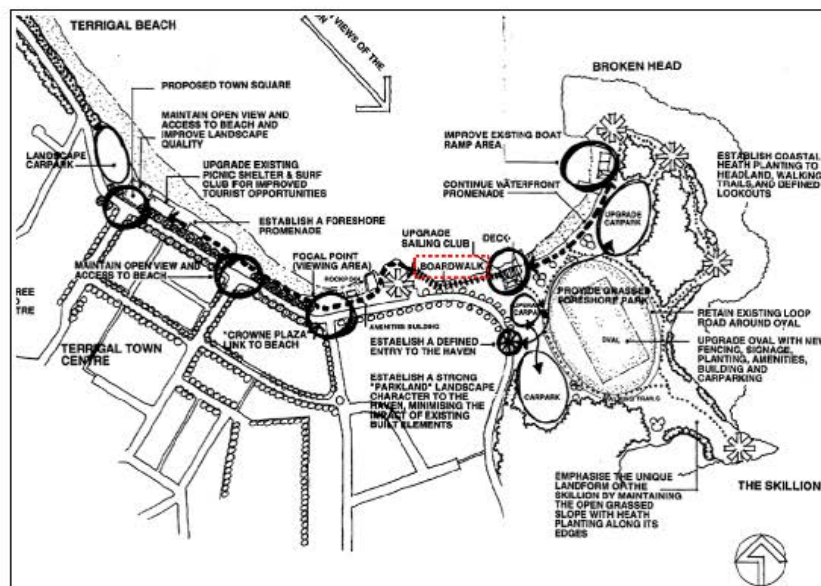


Figure 3: Extract adopted from the Gosford City Council 'Terrigal Foreshore Improvements Landscape Masterplan' (2009)

The most recent advancement in the proposition of a boardwalk was the development of a preliminary boardwalk design and associated render images in September 2017 (refer to section 3.3).

The design of the proposal is now being carried out as part of the Investigation into Terrigal Town Centre Public Domain Improvements approved by the Council's Operational Plan 2017-18 (Central Coast Council, 2017b). This plan has considered 'One Central Coast'; a 10-year Community Strategic Plan 2018-2028 developed by Council through engagement with the community to help set the priorities and confirm strategies and activities that best achieve the community's desired outcomes for the future.

3.2 Proposal Objectives

The proposal's functional requirements presented below are intended to support Council's objective of improving amenity and accessibility for locals and tourists visiting the region by creating a boardwalk that enhances the visitor experience through complimenting the natural coastal environment.

The functional requirements have been used to define the proposal's objectives and guide its design. These objectives are:

- Provide public access along the foreshore.
- Be accessible, safe and secure for all users.
- Avoid and minimise potential adverse environmental impacts.

3.3 Options Development

This section describes the options Council developed and considered for the proposal that were based on:

- Developing a preliminary design and associated render images in 2017.
- Reviewing key design components from local and international examples to develop ideas and initial thoughts for a concept design.
- Holding workshops that considered:
 - Relevant design criteria, including boardwalk functional requirements and architectural principles.
 - Design constraints (environmental, geology, geohazard, coastal risk/hazard) based on baseline studies and a site visit to support to preliminary concept design development.
- Developing three boardwalk options summarising the respective opportunities and constraints.
- Completing a multi-criteria analysis workshop attended by a mix of people with different technical backgrounds to assess the benefits, impacts and value of each option against the proposal's objectives relative to a baseline of doing nothing, while also considering the engineering/constructability and tourist attraction value.

3.4 Options Analysis

This section describes how each of the three options performs against the proposal's objectives relative to the do-nothing option.

Do nothing

The option of doing nothing would involve business as usual access between Terrigal Beach and The Haven precinct. Community members would be required to walk along Scenic Highway/Terrigal Esplanade between the two areas, which involves a steep ascent and descent. At low tide, some community members may continue to scramble over the rocks, leading to ongoing safety risks. As such, this option does not meet the objectives of providing a safer and more accessible route between Terrigal Beach and The Haven. While, this option avoids any environmental impact, it was discounted as it was concluded that any development impact could be managed to minimise impacts to an acceptable level against the community benefit provided by building a boardwalk.

Do something options

Three options were developed for consideration. These included:

- **Option 1: Nature Walk**
 - Light weight timber boardwalk that would follow the natural cliff line around the headland.
- **Option 2: Views and Lookout Platforms**
 - Elevated boardwalk with that would integrate seating and viewing platforms. Composed of timber and perforated metal decking that would allow people to view the water beneath the viewing platforms.
- **Option 3: Cable-Stay Boardwalk**
 - Cable stayed boardwalk that would include a striking support mast. Mast would be visible only from The Haven, allowing for fewer piles and intermediate support structures.

3.5 Preferred Option

All options considered would address Council's proposal objectives of providing public access along the foreshore and being accessible, safe and secure for all users. With regards to avoiding and minimising potential adverse environmental impacts, the appropriate environmental safeguards would have been considered for all proposed boardwalk designs. However, Option 3 would likely have had the highest environmental impact given the greater visual impact and increased need for materials.

In addition to the key objectives, consideration was also made to value for money and the likely engineering performance. Based on these factors, Option 3 was discounted given its expected relatively higher construction cost and inherent engineering complexities.

Based on the above outcomes and consideration of which option best meets the Ecologically Sustainable Development (ESD) principles (refer section 7.2), it was decided that Option 2 would be taken forward as the preferred option. Option 2 was then developed into a concept design accounting for all known constraints in the area (e.g. coastal hazard risk, geohazard, geotechnical and environmental).

3.6 Delivery Timeframe

The proposed delivery timeframe is as follows.

Planned determination of proposal	Late 2018 – Early 2019
Appointment of contractor	Early 2019
Construction period	Early-mid 2019
Completion	Late 2019

3.7 Concept Design

The proposal's likely form and structure has been detailed in Table 2.

Table 2: Concept design details

	Details
Length	Approximately 220 metres
Route	Terrigal Beach to The Haven
Materials/finishes	The materials/finishes on the proposal are not confirmed, however expected to be a combination of the following: <ul style="list-style-type: none"> • Decking (Blackbutt, Spotted Gum or Grey Ironbark) • Perforated/mesh flooring (Aluminium, Fibreglass) • Balustrade (Flat metal balustrades – stainless steel, Flat metal balustrades – powder coat aluminium)
Urban design	New landscape planting to be integrated into the eastern end of boardwalk within the existing setting
Ancillary components	There are likely to be two laydown areas/site compounds required during the construction (refer section 3.8)

Figure 4 and Figure 5 show the preferred option within the existing landscape at Terrigal.

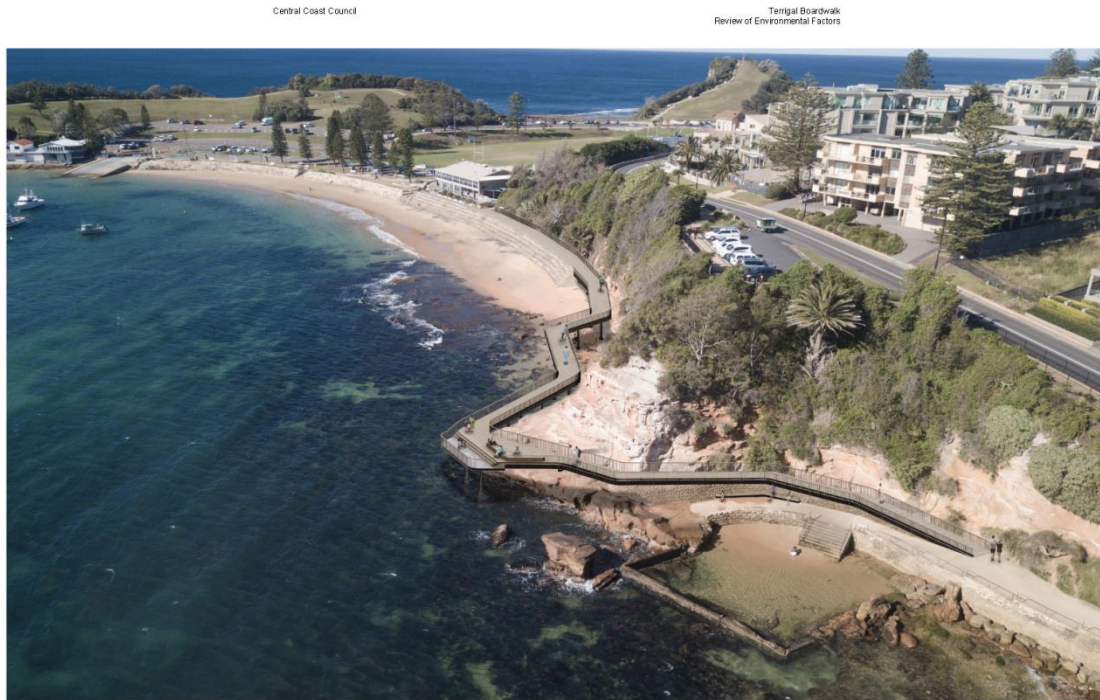


Figure 4: Visualisation of the proposal looking south-east

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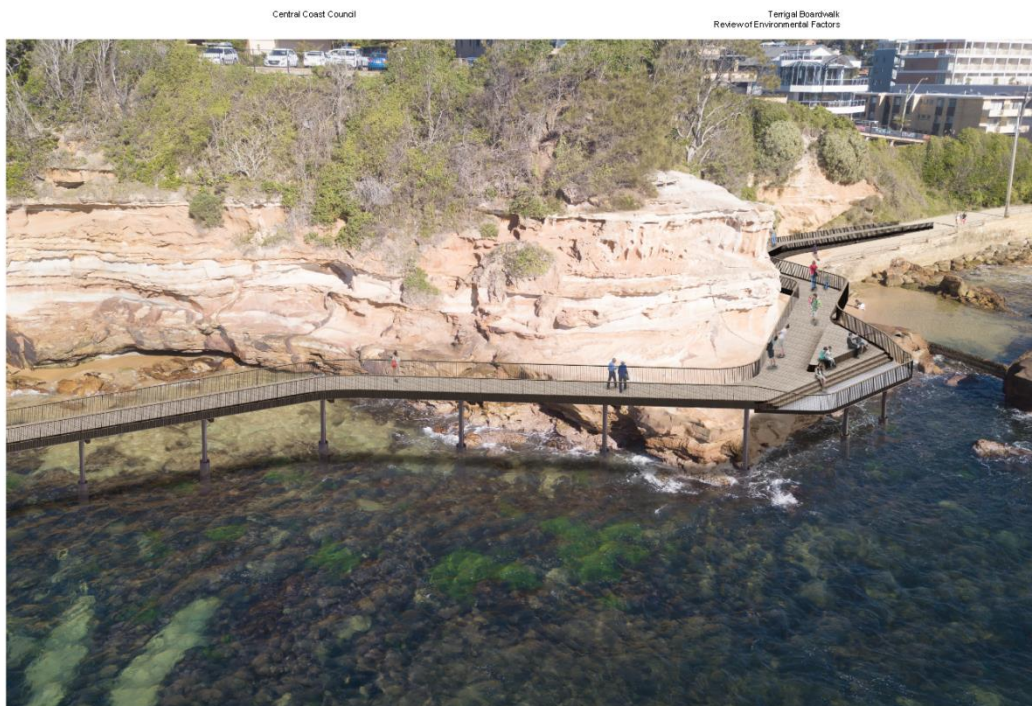


Figure 5: Visualisation of the proposal looking south-south-west showing the lookout over the rock platform

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3.8 Construction Method

Table 3 identifies all the likely activities that would take place during construction across the four distinct zones presented in Figure 6, taking into consideration the access constraints along the Haven foreshore.

3.8.1 Early works

Indicatively, two laydown areas would be used to temporarily store construction materials, equipment and take receipt of prefabricated sections of the boardwalk. The establishment of these laydown areas would form the basis of the early works required for the construction. The main works are expanded on in Table 3.

- Laydown Area 1: The Haven precinct carpark (or a nearby location).
- Laydown Area 2: within an enclosed area at the western end of the proposal.

Specific laydown areas would be confirmed during the detailed design with contractor-input. If they substantially differ from the above locations, then Council would carry out a consistency assessment or prepare an addendum REF to ensure any supplementary impacts are considered and safeguarded against. The laydown areas would be established before the main works (e.g. they would form early works).

3.8.2 Main Works

Table 3 summarises the method of main works, which may vary based contractor inputs and recommendations made. Access to the site would be via the existing local state and local roads in proximity to the site. Vehicles would deliver materials as required to the respective laydown areas detailed previously.

The barge is expected to contain the equipment needed to complete the main works (e.g. piling). Construction personnel are likely to be transported to the barge from the laydown areas (on land), and vice versa, via a small boat that would use the ramp at The Haven. Works are expected to be carried out during standard work hours (i.e. 7am to 6pm Monday to Friday; 8am to 1 pm Saturdays). However, certain activities like piling may need to be undertaken during the night-time period while the wave climate is more favourable (refer to section 6.5).

The boardwalk would incorporate LED lighting, so some interaction with electrical infrastructure (e.g. utilities, conduits, cables, trenches) may be required. Locations where activities would occur would be established during the detailed design phase, however it is expected to be largely within the proposal footprint. Any damage to existing utilities resulting from the construction of the proposal, aside from that resulting from normal wear and tear must be repaired.

To account for potential cumulative impacts, a conservative assumption has been made that any works within each zone may occur at the same time. Although this event is considered unlikely, it ensures that a worst-case assessment has been used to assess the proposal's impacts.

Table 3: Construction methodology for each defined construction zone

Areas within the construction zones	Brief description of the proposed works
Construction Zone 1 <ul style="list-style-type: none"> • Terrigal rockpool • Existing footpath onto the rock platform at western end of proposal 	<ol style="list-style-type: none"> 1. Closure of the Terrigal rockpool 2. Carry out cliff stabilisation and remediation works 3. Install piles to rock 4. Assemble and install boardwalk steelwork and decking
Construction Zone 2 <ul style="list-style-type: none"> • Rock platform area • Barge footprint in the ocean 	<ol style="list-style-type: none"> 1. Establishment of marine plant into fixed position north of the rock platform, if required 2. Install piles into rock and prefabricated steel pier 3. Lift prefabricated boardwalk superstructure to the piers and fix into position 4. Install decking and other fixtures as required
Construction Zone 3 <ul style="list-style-type: none"> • Intertidal zone between the rock platform and the proposed sandstone wall extension 	<ol style="list-style-type: none"> 1. Establishment of temporary causeway over the intertidal zone to enable land-based access 2. Install piles into rock and prefabricated steel pier 3. Lift prefabricated boardwalk superstructure to the piers and fix into position 4. Install decking and other fixtures as required
Construction Zone 4 <ul style="list-style-type: none"> • Beach area at eastern end of proposal • Existing sandstone wall at the Haven precinct 	<ol style="list-style-type: none"> 1. Establishment of platform to enable access for land-based plant along beach 2. Remove part of existing seawall for realignment and extension 3. Excavate sand to top of rock level and install sandstone blockwork wall 4. Fill behind new blockwork wall in staged increments 5. Reinstate drainage and culvert 6. Install footpath and miscellaneous items

Note: Along the entire length of the boardwalk the coastal headland and associated flora lies within the construction footprint.



Figure 6: Proposed construction methodology

4 Legislative and Planning Framework

The planning framework for this proposal is defined by a range of environmental planning instruments. This chapter outlines the intent and applicability of the instruments, and the State and Commonwealth legislation that define the planning pathway.

4.1 Environmental Planning and Assessment Act 1979

This proposal will be determined under the EP&A Act pursuant to its classification under *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP). Chapter 1 describes the purpose of the REF and the process of determination under the EP&A Act.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by State Environmental Planning Policy (Coastal Management), State Environmental Planning Policy (State and Regional Development) 2011 or State Environmental Planning Policy (Major Development) 2005. As such, it remains permissible as development without consent under ISEPP.

Relevant State Environmental Planning Policies (SEPPs) and Local Environmental Plans (LEPs) that apply to the proposal are detailed further in section 4.1.1 and 4.1.2.

4.1.1 State Environmental Planning Policies

The relevant SEPPs, and how the applicable requirements have been addressed in the REF, are detailed in Table 4.

Table 4: Relevant State Environmental Planning Policy

Policy	Relevance to the Proposal	Addressed in this REF
<i>State Environmental Planning Policy (Infrastructure) 2007</i>	<p>Division 12 Clause 66(1)(a)(i) of the ISEPP identifies that development of a raised walking path (including boardwalk) to be carried out by or on behalf of a public authority is exempt development (i.e. does not require planning approval). It is noted that the proposal will likely comply with Division 12 Clause 66(3)(a) i.e. that the proposal will comply with the requirements of Clause 20.</p> <p>However, the applicability of Division 12 Clause 66(3)(b) and (c) cannot be confirmed without further environmental</p>	<p>As detailed in section 5.4, consultation under ISEPP is not required for the proposal.</p> <p>Investigations pertinent to Division 12 Clause 66(3) (b) and (c) have been undertaken as part of this REF. Refer to section 6.4 for an assessment of the potential impacts to native vegetation, and section 6.2 for an assessment of the potential impacts to stormwater run-off and erosion.</p>

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Policy	Relevance to the Proposal	Addressed in this REF
	<p>investigations (i.e. this REF).</p> <p>As such, consistent with the precautionary principle (refer to section 7), the development has been progressed as permitted without consent where division 5.1 of the EP&A Act applies.</p> <p>Part 2, Clause 16 of the ISEPP contains provisions to consult with public authorities prior to the commencement of certain types of development.</p>	
<i>State Environmental Planning Policy (Coastal Management) 2018</i>	<p>This SEPP seeks to balance social, economic and environmental interests by promoting a coordinated approach to coastal management. The proposal is in an area classed as both a Coastal Environment Area and a Coastal Use Area, and therefore Part 2, Division 3 and Division 4 apply. These provisions identify what the determining authority (i.e. Council) must consider when approving a project, including whether the proposal is likely to cause adverse impacts on a number of environmental considerations.</p>	<p>The environmental considerations specified in Division 3 and 4 have been considered in the following sections:</p> <ul style="list-style-type: none"> • Potential biophysical, hydrological and ecological impacts have been considered in section 6.4. • Potential coastal environmental values and natural coastal processes have been considered in section 6.2. • Potential impacts to the water quality of the marine environment have been considered in section 6.4. • Potential impacts to marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms have been considered in section ##### • Potential impacts to existing public open space and safe access to and along the foreshore have been considered in section 6.8. • Potential impacts to visual amenity and scenic qualities of the coast have been considered in section 6.3. • Potential impacts due to overshadowing and loss of views have been considered in section 6.3. • Potential impacts to Aboriginal cultural heritage, practices and places have been considered in section 6.7. • Potential impacts to cultural and built environment heritage have been considered in section 6.9. • Potential impacts to use of the surf zone have been considered in section 6.8.

4.1.2 Local Environmental Plans

The proposal is in the Central Coast local government area (LGA), which has recently been formed due to the merger of the previous Gosford City and Wyong Shire LGAs. Local development control and land use zoning and planning is governed under the Gosford LEP 2014 and further guided by the associated Gosford Development Control Plan (DCP) 2013.

As the proposal is development without consent it is not subject to local environmental planning policy or development control. However, the LEP is useful in identifying the proposal's consistency with the land use policy as described in Table 5.

Table 5: Relevant LEP land use zoning policies

Public Recreation (RE1) Objectives	Proposal consistency
<ul style="list-style-type: none"> To enable land to be used for public open space or recreational purposes. To provide a range of recreational settings and activities and compatible land uses. To protect and enhance the natural environment for recreational purposes. To identify areas suitable for development for recreation, leisure and cultural purposes. To ensure that development is compatible with the desired future character of the zone. 	The proposal would enable the land to be better used for public amenity through enhancing the natural environment.
Unzoned Land (UL) Objectives	Proposal consistency
<ul style="list-style-type: none"> Need to consider the objectives for development and be satisfied that it is appropriate and compatible with permissible land uses in the zones of the adjoining land. 	As stated above for RE1, the proposal is consistent with the objectives of that land use.

4.2 Other Relevant Legislation

The relevant legislation and how the applicable requirements have been addressed in the REF are detailed in Table 6 and Table 7.

Table 6: Relevant Commonwealth legislation

Legislation	Relevance to the proposal	Addressed in this REF
<i>Disability Discrimination Act 1992</i> (DDA)	This Act aims to eliminate, as far as possible, discrimination against persons on the ground of disability in areas including access to premises and the provision of facilities, services and land.	A primary objective of the proposal is to be accessible for all users, which would achieve DDA compliance along the boardwalk (refer to section 3.2).
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Under this Act, an action will require approval from the Minister if it has, will have, or is likely to have, a significant impact on a matter of national environmental significance (MNES). MNES include: <ul style="list-style-type: none"> • World Heritage properties. • National Heritage places. • Ramsar Wetlands. • Nationally threatened species and ecological communities. • Migratory species. • Great Barrier Reef Marine Park. • Commonwealth marine areas. • Nuclear actions, including uranium mining. 	The biodiversity assessment undertaken in section 6.4 has considered the potential for the proposal to impact listed threatened or endangered species and communities listed under the EPBC Act. Furthermore, a review of the online database for MNES (known as the Protected Matters Search Tool) indicated that there are no other recorded MNES within 10km of the proposal. Therefore, it is not anticipated that any MNES would be impacted by the proposal.

Table 7: Relevant state legislation

Legislation	Relevance to the proposal	Addressed in this REF
<i>Biodiversity Conservation Act 2016</i>	This Act provides the legislative policy to maintain a healthy, productive and resilient environment. It aims to conserve biodiversity and ecological processes at a state level by establishing a framework for assessing and protecting environmental and public interests.	A biodiversity assessment has been undertaken in section 6.4. This includes consideration of threatened species listed under the Act that have been recorded in the study area. The study determined that there are no threatened species or ecological communities, as defined in the BC Act or EPBC Act were directly observed on the site
<i>Coastal Management Act 2016</i>	This Act provides for the protection of the coastal environment for the benefit of both present and future generations. The proposal is in an area classed as both a Coastal Environment Area and a Coastal Use Area, and therefore Part 2 (Division 3 and 4) of the State Environmental Planning Policy (Coastal Management) 2018 applies (refer to 6.2). These provisions identify what the determining authority (i.e. Council) must consider when approving a project, including whether the proposal is likely to cause adverse impacts on a number of environmental considerations.	An assessment of the proposal's potential impacts on items noted in the Coastal SEPP has been carried out in the following sections; Aboriginal heritage (section 6.7), visual amenity (section 6.3) and biodiversity (section 6.4). These assessments conclude that no significant adverse impacts against the items identified in Part 2 (Division 3 and 4) are anticipated.
<i>Crown Lands Management Act 2016</i>	Relevant licences and leases for works undertaken on Crown Land lots are issued under the Act.	The respective licences and leases expected to be required are presented in section 0.
<i>Fisheries Management Act 1994</i>	This Act provides the legislative framework to protect fish, stocks and habitat as well as provide regulatory controls for fishing and management strategies. As the proposal involves works in the marine environment, Department of Primary Industries (DPI) Fisheries have been consulted (refer to Chapter 5) to determine if any approvals or licences are required under the Act. Preliminary feedback received noted that a licence under section 199 of the Act would be required should dredging or reclamation be required for construction of the works.	<p>Consideration of fish habitat and potential management strategies are included in the biodiversity assessment in section 6.4.</p> <p>At present, no dredging or reclamation has been proposed as part of the construction methodology outlined in Chapter 3. However, should this change during detailed design, The DPI Fisheries would be consulted regard the need for a licence under section 199 of the Act.</p> <p>Under Part 7 of the Act a permit would be required for harming marine vegetation. The works are likely to result in removal of macroalgae for the piling works.</p> <p>The project is unlikely to result in any significant impacts to threatened species and ecological communities listed in the FM Act.</p>

Legislation	Relevance to the proposal	Addressed in this REF
<i>Local Land Services Act 2013</i>	This Act established 11 regional Local Land Services (LLS). The proposal falls within the Greater Sydney LLS. Under the Local Land Services State Strategic Plan (2016), a key strategy is managing Crown Land for environmental, social and economic outcomes. Examples include preparing plans of management, controlling weeds and pests, and enhancing biodiversity. Weeds such as Climbing Asparagus Fern <i>Asparagus aethiopicus</i> and Lantana <i>Lantana camara</i> were observed on site, and therefore management measures to control the spread of weeds have been proposed	Mitigation measures to avoid the spread of weeds during construction are presented in the biodiversity assessment in section 6.4.
<i>Marine Pollution Act 2012</i>	This Act protects the sea and waters from oil and other noxious substances pollution discharged from vessels, and sets out provisions to prevent pollution in the marine environment. As construction would be required in the marine environment, the requirements of this Act apply.	The potential impacts of the proposal on the marine environment have been considered in the biodiversity assessment in section 6.4. Providing management measures are implemented and monitored, the risk of oil or noxious liquid spills into the marine environment is considered to be low.
<i>Protection of the Environment Operations Act 1997 (POEO Act)</i>	This Act is administered by the NSW Environment Protection Authority and focuses on environmental protection and provisions for the reduction of water, noise and air pollution and the storage, treatment and disposal of waste. Introduces licencing provisions for scheduled activities that are of a nature and scale that have a potential to cause environmental pollution. Also includes measures to limit pollution and manage waste The proposal is not a scheduled activity under Schedule 1 of the Act, and therefore it is not anticipated that an Environmental Protection License would be required	The potential for impacts associated with pollution and waste disposal are considered in waste management (section 6.9) and hazards and risk (section 6.2), and appropriate mitigation measures to avoid pollution have been provided.
<i>Waste Avoidance and Resource Recovery Act 2001</i>	This Act provides a legal framework concerning the minimisation, recycling and reuse of waste in NSW. The waste management hierarchy principles in order of priority as outlined in the Act are: <ul style="list-style-type: none"> Avoidance of unnecessary resource consumption. Resource recovery (including reuse, reprocessing, recycling and energy recover). Disposal. 	The construction of the proposal would require materials and generate new waste streams. The potential impacts of the proposal on waste have been considered in section 6.9. Construction waste would be managed in accordance with the hierarchy.

4.2.1 Crown Lands Management Act 2016

The proposal is located across four Crown Land lots, of which one the Council is Reserve Trustee (see section 2). Given that this land is a Crown Reserve under the *Public Land* provisions of the *Local Government Act 1993*, a lease (to allow Council to locate the boardwalk on the land for a fixed period) or licence (to allow construction to temporarily take place) would be required by Council (as the proponent).

The non-council Crown Land managers will either likely fall under the Category 1 or Category 2 classification defined under the *Crown Lands Management Act 2016*. This classification will define who will issue licences and leases on the three other lots. If the work takes place under a Category 2 Crown Land manager then the Minister would likely need to approve the licence. The Minister would also likely need to approve any lease given the intended design life being longer than 10 years. These licences and leases would be approved in accordance with *Crown Lands Management Act 2016*, *Crown Land Legislation Amendment Act 2017* and *Crown Land Management Regulation 2018*.

Given that a leaseholder of a Crown Land Reserve has the effective control of the leased area, Council would need to also consider whether there are any existing leases and/or licences that need surrendering, as an existing and proposed lease/licence cannot operate simultaneously.

Consultation with the Department of Industry – Crown Lands and Water indicated that if Council requires structures to be erected on Crown Land not under Council management then an appropriate tenure or reserve addition will need to be sought. It is understood that a licence is usually the preferred tenure for structures below the high tide water level. However, it was also detailed that there is the opportunity to apply for an adjustment to Council's existing boundary *reserve*.

It is recommended that Council continue to liaise with the Department of Industry throughout the design development process.

5 Consultation

This Chapter discusses the consultation carried out to date and any future proposed consultation.

5.1 Previous Consultation

Council first consulted on the proposal in 2009 in preparing the Terrigal Haven Plan of Management.

5.2 Community Engagement Plan

Council continues to consult on the proposal as guided by a Community Engagement Plan. The objectives of this plan are to:

- Encourage the community and stakeholders to view and provide feedback on the design.
- Communicate the benefits and features of the boardwalk, as well as its predicted impacts.
- Report back to the community on the outcomes of community consultation and next steps.
- Inform stakeholders of proposed timelines and expected temporary impacts during construction.

A summary of the Community Engagement Plan is detailed in Table 8. It covers the design, planning, pre-construction and construction stages of the proposal; and the mechanisms for targeting the community, relevant government agencies, and other key stakeholders.

Under the plan, the broader community was made aware of the proposal in May 2018. The flyer was developed to inform the community of the survey and geotechnical investigations that were being carried out to support the proposal (see **Appendix A**).

Since then, Council started consultation with the Darkinjung Local Aboriginal Land Council (DLALC) in early September 2018 to establish if the proposal would impact on any areas considered to have significance to the Aboriginal people. The outcomes of that consultation are detailed in section 6.7.

5.3 Agency Consultation

During preparation of this REF, the following consultation was undertaken with government agencies:

- Council consulted with Roads and Maritime Services (Roads and Maritime) in June 2018. Roads and Maritime confirmed that following an inspection of the site, there were no navigational concerns regarding the proposal. This was taken into account when considering the requirement for ISEPP consultation, as detailed in section 5.4.
- Council consulted with NSW Department of Primary Industries (DPI) DPI Fisheries in July 2018. DPI Fisheries requested more information regarding the aquatic habitats situated in the proposal footprint, which has been taken into account when undertaken the biodiversity assessment in section 6.4. DPI Fisheries also requested that further information on whether dredging and reclamation would be required once the detailed design is available, in order to determine whether a licence would be required to undertake the works under section 199 of the *Fisheries Management Act 1994*.
- Council consulted with NSW Department of Industry – Crown Lands & Water in June 2018, who noted that no consent or approvals would be required for the proposal if the construction footprint and proposal would be wholly contained within Lot 1/DP 1060783 (Kincumber Recreation R48956 Reserve Trust). The Department requested to be kept informed as the development progresses.

5.4 ISEPP Notification and Consultation

Part 2, Clause 16 of the ISEPP contains provisions to consult with public authorities prior to the commencement of certain types of development, if certain circumstances apply as outlined in Clause 16(2).

It was determined that ISEPP consultation was not required for the following reasons:

- The proposal is not adjacent to land reserved under the *National Parks and Wildlife Act 1974* or on land in Zone E1 National Parks and Nature Reserves.
- The proposal is not adjacent to an aquatic reserve or marine park declared under the *Marine Estate Management Act 2014*, nor is development in the foreshore area within the meaning of the *Sydney Harbour Foreshore Authority Act 1998*.
- The proposal does not comprise a fixed or floating structure over navigable waters, as confirmed with the Roads and Maritime Services.
- The proposal is not for the purposes of a health services facility, correctional centre or group home, nor is it for residential purposes in bush fire prone land.
- The proposal would not increase the amount of artificial light in the night sky and is on land within the dark sky region.

- The proposal is not on defence communications facility land.
- The proposal is not on land in a mine subsidence district.

5.5 Planned Future Consultation

Council is planning to display various materials relating to the proposal including the concept design, this REF and other visual aids for a four-week period beginning early November 2018. The materials would be made available online, at the Council's offices and at several dedicated pop-up-stands in the local area. Council would collate all feedback it receives and prepare a community engagement report that summarises and responds to the questions and concerns.

Regular project updates would be provided to the community and key interest groups regarding key progress milestones, through flyers, website announcements or letterbox drops.

Furthermore, as the proposal progresses, it is recommended that Council keep relevant government agencies such as Roads and Maritime, DPI Fisheries and NSW Department of Industry – Crown Lands & Water informed.

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Table 8: Summary of the Council's Community Engagement Plan

Stage	Timing	Key purpose of engagement	Key messages	Key engagement activities	Stakeholders targeted
Design	Early 2018	Consult and inform	Seek feedback on design options and agreed concepts	<ul style="list-style-type: none"> Community information sessions Online consultation tools Project letters One on One meetings with key stakeholders Media 	<ul style="list-style-type: none"> Darkinjung LALC Guringai Tribal Link Aboriginal Corp. Terrigal Beach Preservation Group Terrigal – Wamberal Life Saving Club Terrigal View Club Terrigal Country Women's Association Branch Terrigal Rotary Club Terrigal – Wamberal RSL Sub-Branch Terrigal Trotters Terrigal Beach Markets Local Real Estate Agents Lighthouse 2 Skillion Walk Organisers Brisbane Water Police Terrigal Area Residents Association Local Members of Parliament Community Environment Network State Government Agencies Crowne Plaza Hotel Diving Club Local Property Owners Personal trainers in the area Diverse range of retail outlet, residents and tourists

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Stage	Timing	Key purpose of engagement	Key messages	Key engagement activities	Stakeholders targeted
Planning	Ongoing	Collaborate	Seek formal approvals for planned works	Written correspondence	<ul style="list-style-type: none"> NSW Fisheries NSW Crown Lands NSW Roads and Maritime Services
Pre-Construction	ASAP	Inform	<ul style="list-style-type: none"> Scope of works Timing Construction impacts Identify Central Coast Council contact 	<ul style="list-style-type: none"> Website Letterbox drop Media Electronic signboard 	<ul style="list-style-type: none"> Affected business owners Affected residents Foreshore users Darkinjung LALC Guringai Tribal Link Aboriginal Corp.
Construction	Early 2019	Inform	<ul style="list-style-type: none"> Update timing of works Reinforce construction impacts Identify Contractor 	<ul style="list-style-type: none"> Website Letterbox drop Media 	<ul style="list-style-type: none"> Affected business owners Affected residents Foreshore users

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6 Environmental Assessment

6.1 General

This Chapter of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act.
- The factors specified in the guidelines Is an EIS required? (DUAP 1995) as required under clause 228(1) of the EP&A Regulation. The factors specified in clause 228(2) of the EP&A Regulation are also considered in section 7.1.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

Also detailed in this Chapter of the REF is how the proposal would be managed through environmental management plans and specific safeguards, to reduce potential adverse environmental impacts throughout detailed design, construction and operation. Safeguards and mitigation measures have been developed in accordance with Clause 228 of the EP&A Regulation.

The relevant tables detailed in each respective section include a comprehensive list of safeguards and mitigation measures that include “pre-construction”, “construction” and “operation” mitigation measures. This list may not be definitive as any additional measures detailed in the as part of the determination of the proposal must also be included.

6.1.1 Construction Environmental Management

The majority of the mitigation measures outlined in this REF relate to the construction phase. To construct the boardwalk, the successful contractor would be required to prepare a Construction Environmental Management Plan (CEMP). The CEMP would identify the responsibilities for implementing environmental control measures, undertaking environmental reporting requirements, and for compliance monitoring. The CEMP would present all the required actions to be undertaken to fully comply with the mitigation measures presented in this REF, with any other conditions attached to other approvals or permits granted for the proposal.

6.1.2 Safeguards and Management Measures

The general environmental safeguards for the proposal are listed below.

General
Pre-Construction
<ul style="list-style-type: none"> • Council would appoint an appropriately qualified and experienced contractor and project manager to oversee the delivery of the boardwalk. • A project risk assessment including environmental aspects and impacts would be undertaken prior to the commencement of construction. • A CEMP would be prepared by the Contractor prior to construction commences and implemented during construction. • A consultation and stakeholder involvement plan would be implemented during construction as part of the CEMP. The plan would include the names and contact details of a nominated person for the receipt of all complaints.
Construction
<ul style="list-style-type: none"> • Maintain the site in a tidy manner. • Regular inspections by the site-based environmental manager to monitor environmental compliance and performance during construction.

6.2 Physical Environment

This section describes the hydrodynamic and physical environmental impacts on the aquatic and terrestrial environment associated with the proposal.

6.2.1 Existing Environment

Topography

The proposal would run parallel to the coastline along the headland between Terrigal Beach and The Haven. The topography of the headland is of variable steepness along the length of the proposal, and includes a rocky platform adjacent to Terrigal rockpool.

Geology and Geomorphology

Reference to the 1:100,000 geological map of Gosford-Lake Macquarie indicates that the site is underlain by the Terrigal Formation, which is characterised by sandstone with some shale and clay deposits. This is consistent with the encountered conditions observed during the investigation.

The proposal footprint can be classified into three distinct geomorphological zones as shown in Figure 7.

The ground conditions encountered in each zone are summarised in Table 9. The relevant mitigation measures that have considered the existing geology and geomorphology are detailed in section 6.2.3.

Table 9: Summary of ground conditions

Zone	Description	Ground conditions
Zone 1	Wave-cut platform Exposed rock creating the headland between Terrigal Beach and The Haven	Exposed sandstone and shale bedrock of the Terrigal Formation. The wave-cut platform is a sandstone bed approximately 1.6 metre thick. It has minor weathered interbeds of shale resulting in undercutting of the rock platform. The cliff behind the wave-cut platform is approximately 14 metres high. It is formed of soil and/or extremely weathered rock, overlying interbedded weathered layers of sandstone and shale. Vegetation has established on top of the cliff. Notable rockfalls in the area have occurred in 1994, 1997 and 2018.
Zone 2	Tidal Zone	Shallow marine sands overlying the base Terrigal Formation of sandstone and shale bedrock. Exposed rock can be seen in the shallow water.
Zone 3	Beach zone	Shallow marine sands (approximately one metre deep) overlying the Terrigal Formation of sandstone and shale bedrock.

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Figure 7: Distinct geomorphological zones across the proposal

Soils

The proposal may have minor impacts on soil along the headland area south of the proposal, particularly at the western and eastern tie-in areas at Terrigal Beach and The Haven respectively. For completeness, the existing soil conditions have been presented below.

Acid Sulfate Soils

A review of the Gosford LEP 2014 Acid Sulfate Soils map indicated that the proposal footprint is classified as having Class 5 acid sulfate soils, identifying that the proposal not underlain by actual or potential acid sulfate soils.

Contaminated land

There are no contaminated land records, or associated notices or prosecutions issued by the Environment Protection Authority (NSW EPA) on or local to the proposal footprint.

There are no operations on or near the proposal footprint that are listed on the POEO Act register. The area also holds no development history involving activities that present an associated contamination risk. Therefore, the risk of existing contamination at the site is low.

Surface, Groundwater and Flooding

Rainfall within the proposal footprint would either flow over the exposed rock areas or permeate into the marine sands. Rainfall across the remainder of the proposal footprint covering Terrigal Esplanade/Scenic Highway is collected by a kerb and gutter system and discharged unattenuated at the southern end of Terrigal Beach. The quantity, rate and volume of runoff is considered insufficient to have had any coastal process or morphological impact.

Four boreholes were drilled in 2018 along the eastern side of the proposal footprint around the rock platform to the Haven precinct confirmed groundwater to be about 0.5 metres below ground level (mbgl).

Based on flood mapping (Gosford City Council, 2015) the proposal footprint is not located within flood prone land.

Coastal Environment

The coastline at Terrigal is influenced by tidal, wave and storm conditions. Over time, these conditions are expected to change in response to predicted climate change and sea-level rise.

Tides and Storm Conditions

The data in Table 10 is taken from the Australian National Tide Tables (2018) for Fort Denison. The tide levels at this location are assumed to be representative of open coast water levels, and are therefore adopted for the site at Terrigal Beach. This data shows that there is about a 2.1 metre change in tide height in the area, which is not anticipated to change over the next 50-years. However, the maximum height is expected to increase by 0.4 metres as a result of climate change.

Table 10: Tide levels at Fort Denison shown at metres above chart and Australian height datum.

Tide Level	Present Day (2018)		Year 2069	
	(CD ¹)	(AHD)	(CD)	(AHD)
Highest astronomical tide (HAT)	2.1	1.2	2.5	1.6
Mean water level (MWL)	1.01	0.1	1.4	0.5
Lowest astronomical tide (LAT)	0.0	-0.9	0.4	-0.5

CD = Chart Datum which approximates to LAT and is about 0.93m below Australian Height Datum (AHD).

During extreme weather events, there can be an additional increase in average sea level height due to storm surge. At the open coast, storm surge can cause the water level to rise up to 0.6 metres above the highest astronomical tide (Worley Parsons, 2004).

Waves

The coastal processes experienced at Terrigal are largely influenced by the offshore wave climate from the east. Using model and study data (Worley Parsons, 2004 and Lawson and Treloar, 1984) it is predicted that during a 100-year storm event, the peak wave period can rise to 11.6 seconds, with a significant wave height at the site of 2.5 metres.

Sea Level Rise

Council adopts a medium local sea rise projection for determining future hazards when planning for development in the LGA. This projection is based on a prediction of how concentrations of greenhouse gases in the atmosphere will change in the future because of human activities. Therefore, the proposed height of the boardwalk has been increased by about 0.5 metres to account for the projected sea level rise over the next 50 years.

Coastal Hazard

General

Net sediment transport in the region where waves break and at the shoreline of Terrigal Beach primarily results from two processes. These processes are termed longshore sediment transport and onshore/offshore (cross-shore) sediment transport. Windblown sand (aeolian transport) as well as stormwater systems and lagoon entrances may also contribute to the movement of sediment on the beach.

Longshore Sediment Transport

During storm events, Terrigal Beach experiences net northerly alongshore sediment transport offshore over the reef systems. Due to rip currents during storms, sand is transported offshore to the reef where it cannot return to the active beach system. As a result, Terrigal Beach is assumed to experience long term recession.

Onshore/Offshore Sediment Transport

The onshore movement of sand under low swell conditions would also be prevented by these reef systems. It should be noted however, that local rips may occur at any location along the beach.

Aeolian Sediment Transport

Terrigal Beach is not expected to experience any significant aeolian sediment transport due to the proximity of development and vegetation to the beach.

Sediment Transport at Stormwater Systems

At the south end of Terrigal Beach, a box culvert with seven openings and surrounding rock protection provides local scour, but has minimal impact on coastal processes.

Bushfire Risk

A review of the NSW Rural Fire Service mapping indicates that part of the proposal footprint is located within bushfire prone land. However, the risk of a bushfire impacting upon the proposal is considered to be low.

6.2.2 Impact Assessment

Construction

Hydrodynamic Effects

The proposal involves activities that would cause physical disturbance to the aquatic environment. These include piling and the installation of the prefabricated superstructure elements using a barge mounted crane. The scale of the disturbance would be minimal and insufficient to cause any dynamic changes in current speed, wave characteristics or flushing.

Localised Sediment Disturbance, Turbidity and Smothering

The proposal construction footprint is within an area of subtidal sand and sub-benthic sediment. As such, the proposed pile installation and use of temporary jack-ups would cause limited sediment disturbance over a small area and this would only occur where work takes place over the sub-benthic sediment.

Locally, the distributed coarser sediments would settle out of suspension almost immediately while the finer sediments could mobilise over a greater area as they would remain buoyant in the water column.

As most of the sediment is expected to settle out of suspension within a few minutes there is expected to be no risk of turbidity. Also, the small amount of sediment generated under the proposal would mean there is no predicted or expected smothering impacts. Any impacts would be further limited by the proposal to undertake the piling work at night under calm conditions, when there would be the least water movement.

Accidental Spills

The materials required for the proposal would be generally inert and harmless except for the small quantities of welding materials, lubricants, solvents, fuels and oils. As such, there would be some potential for:

- Accidental spills, including:
 - Accidents during loading, unloading and installation work.
 - Leaks and drips from poorly maintained machinery and equipment.
 - The mismanaged storage of waste materials, including potential for debris to enter the water.
- These risks would be greater when undertaking work over, or in, the ocean namely:

- Drilling / hammering the piles.
- Transferring equipment and machinery.
- Installing the substructures and superstructures.

The principal impact from any spills would be pollution and water quality impacts on the aquatic environment. The impact would depend on the quantity and type of material spilt. However, providing relevant standard controls are implemented the impacts are expected to be minimised.

Accidental material spill within the ancillary facility may occur from storing, handling and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels.

Erosion and Scour

Any work taking place in the aquatic environment has the potential to cause erosion and scour impacts. This is caused from introducing new structures typically on, or close to, the ocean floor, as this may alter sediment transport patterns.

During construction of the proposal, the temporary use of jack-ups during lifting and piling work would be the only equipment that would impact on the ocean floor. However, the associated equipment would only be in place for a few weeks. Some localised impacts are expected within a few metres of where jack and/or anchor point would be temporarily installed, however this would be an insufficient amount of time to cause any material scour or erosional impacts. The number of jack-ups/anchors would be reduced to the minimum required, and where possible, the placement of these locations would be selected to avoid areas of sensitive habitat.

Terrestrial Impacts

There are unlikely to be any earthworks proposed, with the extent of excavation limited to the tie-in area at The Haven. As such, the potential for causing soil erosion or sediment laden runoff would be minor.

Accidental spills within the site compound may occur from storing, handling and/or transferring the required small volumes of welding materials, lubricants, solvents, fuels, oils and diesels.

No operational impacts to terrestrial soils are anticipated, as no significant change to existing operations is proposed.

Operation

Erosion and Scour

Piles would be installed into rock along the foreshore. As water flows around these structures there is the potential to create local scour and erosion. However, the conditions under which erosion and scour occur in the aquatic environment vary depending on local sediment conditions and hydrodynamics. In this location, the only expected impacts would be limited to within a few metres of each pile.

Accidental Spills

There is always the potential for an accidental spill or discharge during operation. While this is the case, it would be managed under standard controls. As such, the impacts are expected to be safeguarded against and therefore minimised.

6.2.3 Safeguards and Management Measures

Sea Level Rise
Operation
<ul style="list-style-type: none"> The boardwalk would be elevated to a height of 4.5m AHD to avoid impacts of wave, tidal, storm and future sea level rise conditions. During extreme inundation events, the boardwalk would be closed.
Water Quality
Construction
<ul style="list-style-type: none"> Water quality control measures would be implemented to prevent any materials leaving the established site (e.g. sediment entering drain inlet). All fuels, chemicals and liquids would be stored in an impervious bunded area a minimum of 40m away from flooded or poorly drained areas. Measures would be implemented to ensure debris is not tracked off site and onto public roads e.g. vehicle wash downs, street sweeping etc. Emergency spill kits would be kept on site at all times. All staff to be made aware of the location of the spill kit and be trained in its use.
Erosion and Sediment Control
Construction
<ul style="list-style-type: none"> Erosion and sediment control measures would be implemented and maintained to: <ul style="list-style-type: none"> Mitigate the risk of rockfall during construction Prevent sediment moving off site and sediment-laden water entering any water course, drainage lines, or drain inlets. Reduce water velocity and capture sediment on site. Minimise the amount of material transported from site to surrounding pavement surfaces. Divert clean water around the site. Erosion and sedimentation controls would be checked and maintained on a regular (including clearing of sediment from behind barriers) by the appointed Site Construction Contractor. Erosion and sediment control measures would not be removed until the works are complete or areas are stabilised.

6.3 Landscape and Visual

This section describes the proposal's impacts on the landscape character and visual amenity of the area. The full landscape and visual assessment is provided in **Appendix B**.

6.3.1 Method

The study area covers the theoretical extent (zone) of the proposal's visual impact, roughly 350 metres around the proposal footprint.

Landscape character is a composition of the built, natural and cultural aspects that make up an area and provide a sense of place. Visual amenity relates to how people relate to an area's landscape character.

The landscape can be divided into distinct zones with similar characteristics. Viewpoints representative of sensitive locations within the landscape are then selected.

An impact assessment is made by defining how sensitive the characteristics of the landscape are to the scale of changes (magnitude) introduced by the proposal. Also considered are how sensitive the visual receivers are to the impacts on the landscape character. In combination, this defines an impact rating based on the following combination of the sensitivity of the landscape character (zone) and magnitude of change introduced by the proposal.

Table 11: Landscape character and visual amenity impact ratings

	High	Moderate	Low	Negligible
High	High Impact	High Moderate Impact	Moderate Impact	Negligible Impact
Moderate	High -Moderate Impact	Moderate Impact	Moderate - Low Impact	Negligible Impact
Low	Moderate Impact	Moderate - Low Impact	Low impact	Negligible Impact
Negligible	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact

Source: Roads and Maritime (2013)

6.3.2 Existing Environment

Terrigal is characterised by a north facing beach foreshore (Terrigal Beach and Haven Beach) with headland that extends the extent of the proposal. The surrounding area includes retail, commercial, residential at Terrigal CBD and along the Scenic Highway/Terrigal Esplanade with extensive public recreational land uses extending from Broken Head to the Skillion.

Landscape Character Zones

The study area was divided into four landscape character zones (LCZ) as shown in Figure 8.



Figure 8: Landscape Character Zones

A description of the land use characteristics and sensitivity to change for each of the LCZs identified is detailed in Table 12.

Table 12: Landscape character zones

Zone	Land use characteristics	Sensitivity to change
LCZ 1: The Haven Open Space	<ul style="list-style-type: none"> Flanked by Broken Head and The Skillion headlands. Large area of well used turf open space comprising playing fields, car parking and café. Open landscape with extensive views towards the ocean, particularly from the elevated headlands either side. The headlands include stands of dense coastal vegetation. 	<u>High</u> sensitivity: <ul style="list-style-type: none"> A scenic and popular area of open space.
LCZ 2: The Haven Beach and Rock Platform	<ul style="list-style-type: none"> Approximately 200m long steep, open and sandy beach, tucked between Broken Head and the rock platform that separates it from Terrigal Beach. The beach faces north to northwest and is a popular for launching boats for fishing, recreation and diving. The beach is backed by several car parks, an oval and café, as well as dense vegetation along the western cliff face. A large stepped sandstone seawall extends along much of the beach. The exposed rock face and intertidal zone around the rock platform contribute strongly to the scenic nature of the landscape. 	<u>High</u> sensitivity: <ul style="list-style-type: none"> Little existing built form is present.
LCZ 3: Terrigal Esplanade Residential Development	<ul style="list-style-type: none"> Multi-storey apartment buildings along the southern side of the Scenic Highway/Terrigal Esplanade, facing the ocean. 	<u>Moderate</u> sensitivity: <ul style="list-style-type: none"> Multi-storey apartment buildings have a sensitivity to change in the landscape.
LCZ 4: Terrigal Beach	<ul style="list-style-type: none"> Terrigal Beach is a 2.8km long stretch of sand that trends southwest from the rocks on the north side of Wamberal Lagoon and finishes at the rocks on the southern end of Terrigal Beach. A foreshore reserve lies between the road and the beach and contains Terrigal Surf Life Saving Club (built in 1924), car parking and a park. A shopping centre and a large resort backs the southern half of the beach. 	<u>Moderate</u> sensitivity: <ul style="list-style-type: none"> LCZ has a scenic setting a sensitivity to change in the landscape.

Viewpoints and Receivers

Figure 9 shows the zone of visual influence or the visual envelope, which is the maximum area over which the proposal would be visible. It extends east and west along the foreshore and is limited to the south by vegetation and topography of the headland.

The figure does not include the extents from which the proposal would be visible from the ocean. This viewpoint would be presented as part of additional imagery provided to the community during the consultation period (refer to section 5).



Figure 9: Visual envelope

Five viewpoints (refer to Figure 10) were selected to represent the range of sensitive receivers in the visual envelope.



Figure 10: Viewpoints assessed

A description of the viewpoints and sensitivities are detailed in Table 12. Also presented in the figures following Table 12 is the approximate location of the proposal (indicated in yellow), with the extended sea wall in grey.

For all viewpoints, it should be noted that the selection of appropriate materials and finishes for the boardwalk would help integrate the structure into the landscape and likely reduce the visual impact.

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Table 13: Viewpoint and receiver sensitivities

Viewpoint and location	Direction	Receiver representation and sensitivity
VP1 The Haven beach (Reef Restaurant)	West	<u>High sensitivity:</u> <ul style="list-style-type: none"> Existing view takes in the restaurant, sandstone sea wall and extends along the sand to the western end of the beach, ending at the cliff backed rock platform. The existing coastal rocks in this location are exposed at low tide, with the view changing subtly during the day. View is scenic with limited built form visible along the western stretch of beach.
VP2 Outlook from the rock platform between Terrigal and The Haven beaches	East	<u>High sensitivity:</u> <ul style="list-style-type: none"> The outlook extends over the rocky intertidal zone along the partly vegetated cliff line, beach and Reef Restaurant to the open space of The Haven. The mix of sand, rock and ocean is highly picturesque. There is no existing path connecting the two sides of the beach which makes accessibility to the rock platform challenging and dangerous at times, including the risk of rockfall.
VP3 The ramped path leading to the Terrigal rockpool and rock platform at the southern end of Terrigal Beach	East	<u>High sensitivity:</u> <ul style="list-style-type: none"> The partially vegetated sandstone cliff rises behind the path and blocks views beyond it. The mix of sand, rock and ocean is highly picturesque.
VP4 Pedestrians and cyclists from the elevated path alongside Scenic Highway/Terrigal Esplanade at the southern end of Terrigal Beach	North-east	<u>Moderate sensitivity:</u> <ul style="list-style-type: none"> Panoramic ocean views extend over the vegetated sandstone cliff in the foreground towards the Terrigal rockpool, rock platform and the ocean off Terrigal Beach. The mix of sand, rock and ocean is picturesque although some built form is visible.
VP5 Beach users looking west along Terrigal Beach	East	<u>Moderate sensitivity:</u> <ul style="list-style-type: none"> The existing view takes in an existing sandstone retaining wall, lighting columns, footpath, Terrigal rockpool, rock platform and sandstone cliffs separating Terrigal from The Haven Beach. The elevated topography of Broken Head is in the background. The view is scenic with some limited built form visible.

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Viewpoint 1 – Looking west along The Haven Beach towards the rock platform and Terrigal Beach



Viewpoint 2 – Looking east towards The Haven from the rock platform

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Viewpoint 3 – Existing view west from ramped pathway along southern end of Terrigal Beach



Viewpoint 4 – Existing view north west from path along Terrigal Esplanade

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Viewpoint 5 – Existing view west from Terrigal Beach

6.3.3 Impact Assessment

Construction

Certain landscape character and visual impacts would first occur during construction because of the introduction of equipment, work platforms, mobile cranes and construction equipment along the road corridor.

This work would have the greatest impact on the values associated with LCZ 2 and LCZ 4 where the effects would be:

- Loss of the composition of the landscape character and its setting.
- Removal of components and the visual separation along the shoreline and connection between Terrigal Beach and The Haven.
- Temporary introduction of machinery and equipment into the landscape, affecting the overall amenity and setting.

Construction of the proposal would temporarily affect the visual amenity of most the receivers in Table 15. This would be most notable for those residents overlooking the construction works (VP1) who may be affected for up to six months. The magnitude of impact would depend on the stage of construction and proximity of the work. It is expected that the greatest amenity impacts would take place during the drilling phases and when the prefabricated boardwalk structures are being lifted into place.

Operation

Landscape Character Assessment

Table 14: Landscape character assessment

Zone	Description of changes to LCZ	Sensitivity	Magnitude	Impact
LCZ 1	Located outside of this LCZ and is not expected to impact the spatial quality of The Haven open space.	High	Negligible	<u>Negligible</u>
LCZ 2	<p>The boardwalk and associated sea wall would likely form prominent new built form elements along the western end of the beach and adjacent rock platform.</p> <p>While improving access to the beach, the boardwalk would alter the existing natural setting, reducing the visibility of the rock platform from the eastern end of the beach and spatially dividing the western end of the beach from the adjacent cliff.</p> <p>Access would be reduced to a small section of the beach. There would also be a slight increase in overshadowing beneath and adjacent to the boardwalk structure.</p>	High	Moderate	<u>Moderate/High</u>
LCZ 3	The proposal is located at a lower elevation to these dwellings, obscured by vegetation and topography.	Moderate	Negligible	<u>Negligible</u>
LCZ 4	The boardwalk and associated retaining walls would form prominent new built form elements along this section of the cliff and rock platform.	Moderate	Moderate	<u>Moderate</u>

Overall, the landscape character assessment indicates that the proposal would have the greatest impact on LCZ 2, with moderate impacts at LCZ 4 and negligible impacts at the other two established character zones.

Visual Impact Assessment

Table 15: Visual impact ratings

ID	Viewpoint location	Type of receiver	Sensitivity	Magnitude	Impact rating
VP1	The Haven Beach (Reef Restaurant)	Tourists, residents, restaurant customer	High	Moderate	<u>Moderate/High</u>
VP2	Outlook from the rock platform between Terrigal and The Haven beaches	Tourists, residents,	High	Low	<u>Moderate</u>
VP3	The ramped path leading to the Terrigal rockpool and rock platform at the southern end of Terrigal Beach	Tourists, residents,	High	Low	<u>Moderate</u>
VP4	Pedestrians and cyclists from the elevated path alongside Scenic Highway/Terrigal Esplanade at the southern end of Terrigal Beach	Pedestrians, cyclists	Moderate	Low	<u>Moderate/Low</u>
VP5	Beach users looking west along Terrigal Beach	Tourists, residents,	Moderate	Moderate	<u>Moderate</u>

Overall, the visual impact assessment indicates that the proposal would have the greatest impact on VP1, with moderate or moderate/low impacts at the other four established viewpoints.

6.3.4 Safeguards and Management Measures

Landscape and Visual
Construction
<ul style="list-style-type: none"> • Locate storage areas and associated ancillary works in cleared or otherwise disturbed areas. • Retain and protect existing trees and vegetation adjacent to the works where possible, minimising clearing where possible. • Restore all areas disturbed by construction to existing condition. • Trim headland trees (if required) rather than remove them. Works to be undertaken by a qualified arborist.
Operation
<ul style="list-style-type: none"> • Limit visual contrast and reflectivity of boardwalk structure through appropriate colour choice for built form materials. • Minimise boardwalk deck thickness where possible to decrease visual profile. • Ensure the size and number of supporting columns is minimised where possible. • Ensure any infill to base of columns compliments the colour and texture of the existing rock. • Ensure retaining walls and sea walls visually integrate with existing landscape through appropriate selection of materials. • Provide high quality finishes to boardwalk to facilitate long term durability of the design for effect with minimal maintenance. • Ensure components are considered as a whole, creating a cohesive design language. • Provide new landscape planting to integrate into the eastern end of boardwalk with existing setting. • Plant selection to consider longevity and ongoing maintenance.

6.4 Biodiversity

This section summarises the proposal's marine and terrestrial biodiversity impacts.

6.4.1 Method

The biodiversity values of the site were assessed using desktop methods and an ecological site inspection. Desktop methods included:

- Searches of the Office of Environment (OE) BioNet database for threatened species records within 5km of the proposal footprint.
- EPBC Act Protected Matters Search Tool for a 5km buffer from the proposal footprint.
- Review of recent aerial photography obtained from the NSW Government (2016).

The site inspection was completed on the 13 June 2018 by an Arup terrestrial ecologist and a marine ecologist. During the site inspection, the proposal footprint and surrounds was traversed on foot, with a focus on the intertidal areas of the site. Due to limitations associated with safe access on the headland area, most of the vegetated areas on the headland were not able to be accessed directly. All the observations on terrestrial vegetation communities and fauna habitats were completed from the existing pathway on top of the slope or from the beach and lower rock outcrop.

The marine surveys involved traversing the intertidal zone during low tide on foot. All marine habitats were recorded, with a focus on the species and coverage of any seagrass or macroalgae communities.

The results of the desktop and field investigations have been used to describe the ecological features of the proposal footprint. Maps of the terrestrial and marine vegetation communities and habitats have been prepared using GIS and the results of the site inspection. This baseline information has been used to complete an assessment of the likelihood of occurrence of threatened species, listed under the BC Act and the EPBC Act.

6.4.2 Existing Environment

The proposal is located in the Wyong sub-bioregion, within the Sydney Basin bioregion as defined by the Interim Biogeographic Region of Australia framework. Surrounding land include areas of urban development and public open space, with areas of steep rocky headlands and coastal cliffs where native vegetation and habitats have been retained. Terrigal Beach is located adjacent to the proposal, to the north-west.

The proposal is located in a coastal environment, with the alignment traversing a stretch of sandy beach, intertidal rock pools and across a sandstone headland. These intertidal areas are largely intact and have not been subject to historical disturbance associated with previous development. On the eastern edge of the intertidal zone there is an existing tidal swimming pool, with a constructed wall extending seaward and constructed rock steps.

The terrestrial biodiversity elements of the proposal footprint consist of small patches of native vegetation on steep, sandstone cliffs. There has been previous development on the headland for transport infrastructure, with a road and footpath along the southern boundary of the proposal. Due to this disturbance, there is high weed and exotic cover within the coastal headland vegetation communities retained in the proposal footprint.




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Native Vegetation


The native vegetation cover within the proposal footprint is contained to small patches on steep slopes and upper crest of the headland. The condition of the vegetation communities across the proposal footprint can generally be described as a degraded condition. A summary of the vegetation communities identified within the proposal footprint is provided in Table 16 and Figure 11.

Table 16: Vegetation communities within the proposal footprint.

Vegetation community	Description	Photograph
Managed native and exotic grasses	On the eastern side of the proposal footprint, there is shallow slope of mown grass. The area likely contained Prickly Couch <i>Zoysia macrantha</i> and Green Couch <i>Cynodon dactylon</i> .	
Coastal headland heath	There is a small patch of coastal headland heath located on the most seaward edge of the proposal footprint. Access to this area was limited, however species belonging to <i>Allocasuarina</i> , <i>Melaleuca</i> , <i>Banksia</i> , <i>Leptospermum</i> and <i>Kurzea</i> were present.	
Mixed open forest and shrub land	This vegetation community is the most common throughout the proposal footprint. Native trees observed include Sweet Pittosporum <i>Pittosporum undulatum</i> , Coastal Banksia <i>Banksia integrifolia</i> , <i>Melaleuca</i> sp. and Tuckeroo <i>Cupaniopsis anacardioides</i> .	

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Vegetation community	Description	Photograph
Exotic and native grasses, vines and sedges	This vegetation community is not shown in Figure 11, as it only occurs on the steep seaward facing slopes of the headland. This area contains a mixture of native and exotic grasses, vines, sedges and forbs. There are large areas that are covered by <i>Aloe sp.</i>	

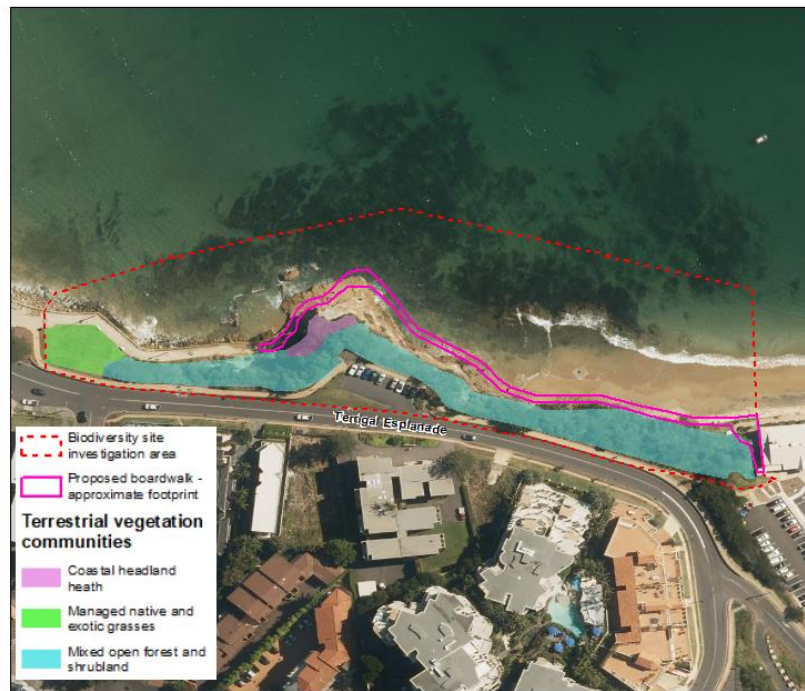


Figure 11: Terrestrial vegetation communities

Native Fauna and Habitats

During the site investigation, only common, least concern birds and lizards were directly observed foraging within the area of terrestrial vegetation on the headland and on the beach. Despite the small size and generally poor condition of this vegetation there are still some habitat resources that may support common, urban-adapted species.

The native vegetation within the proposal footprint is a small, fragmented patch of habitat, with limited connectivity to other habitat areas. The patch may provide some connectivity values as a stepping stone for more mobile species that are well adapted to urban environments.

Marine Ecology

The marine environment within the study area provides a range of habitats including:

- Coastal headland vegetation (degraded and dominated by weed species).
- Open exposed and intertidal sand.
- Intertidal/subtidal bedrock and boulders (highly diverse marine flora and fauna).
- Exposed sandstone (with scattered benthic species).

These features provide a diverse assortment of habitat for coastal bird species and intertidal species (dominated by macroalgae, molluscs and encrusting sponges). The Terrigal sandstone headland is surrounded by a typical intertidal community that are common along semi-exposed coast line of Central Coast NSW.




Surrounding the sandstone headland are diverse intertidal habitats dominated by macroalgae beds, from the rock pool around the front extending to the east of the headland. Closer to the beach area of the headland there are sand deposits with boulders covered in encrusting coralline algae, and some macroalgae attached to the boulders and progressing towards the exposed beach. To the east of the headland, large ascidian beds dominate the exposed bed rock between the exposed beach and subtidal macroalgae beds. Note that no seagrass meadows were observed during the site investigation, nor are they known to occur in this area.

The marine and intertidal habitat communities are described in Table 17 with their distribution in the proposal footprint shown in Figure 12.

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Table 17: Marine habitat community descriptions.

Marine intertidal communities	Description	Photograph
Diverse Macroalgae beds	<p>These macroalgae beds on boulders and bed rock are dominated by:</p> <ul style="list-style-type: none"> • Green strap algae (<i>Caulerpa filiformis</i>). • <i>Sargassum</i> sp. • Fan brown algae (Dictyotaceae – Padina). • Coralline algae. <p>Amongst the algae were fish, a range of gastropods, octopus and crustaceans.</p>	
Sand deposits with boulders	<p>This region was a transition habitat between the macroalgae beds with greater regions of exposed and mobile sands utilised by fish coming in with the tide to access habitat and feeding grounds in and amongst the boulders. Macroalgae is less prevalent here and dominated by encrusting coralline algae.</p>	
Ascidian beds	<p>Further east of the headland there are large ascidian beds (<i>Pyura stolonifera</i>) that cover exposed bedrock within the intertidal section before the beach area.</p>	

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Marine intertidal communities	Description	Photograph
Exposed sand stone walls	Along the wall of the sand stone headland there are washed out crevasses containing a host of gastropods, barnacles, limpets and chitons.	
Sand (beach)	The sand is composed of mobile exposed sands with no marine vegetation cover.	

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Figure 12: Marine and intertidal communities

Threatened Species and Ecological Communities

No threatened species or ecological communities, as defined in the BC Act, FM Act or EPBC Act were directly observed on the site. An assessment of the potential for threatened species previously recorded within 5km of the proposal footprint in the BioNet database to occur within the proposal footprint has been carried out. The criteria for likelihood of occurrence in the proposal footprint is summarised in Table 18, and is based on the type, quality and size of the habitat features in the proposal footprint. The full assessment of potential species is provided in **Appendix C**.

Details on the habitat characteristics of each species used in the assessment in Table 18 has been taken from the OEH species profiles website.

Table 18: Likelihood of occurrence criteria

Likelihood	Criteria
Recorded	The species was observed in the study area during the current survey.
High	It is highly likely that a species inhabits the study area and is dependent on identified suitable habitat (i.e. for breeding or important life cycle periods such as winter flowering resources), has been recorded recently in the locality (10km) and is known or likely to maintain resident populations in the study area. Also includes species known or likely to visit the study area during regular seasonal movements or migration.
Moderate	Potential habitat is present in the study area. Species unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration. The species is unlikely to be dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on habitat within the study area, or habitat is in a modified or degraded state. Includes cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded.
Low	It is unlikely that the species inhabits the study area and has not been recorded recently in the locality (10km). It may be an occasional visitor, but habitat similar to the study area is widely distributed in the local area, meaning that the species is not dependent (i.e. for breeding or important life cycle periods such as winter flowering resources) on available habitat. Specific habitat is not present in the study area or the species are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded.
Negligible	Suitable habitat is absent from the study area.

No threatened species have been assessed as having a high likelihood of occurrence within the proposal footprint (see **Appendix C**). This is largely due to the very small area of good quality, terrestrial habitat within the proposal footprint located on the upper slopes and crest of the headland area.

There are five species that have been assessed as having a moderate likelihood of occurrence within the proposal footprint. These species are known to occur in coastal habitats, particularly beaches, dunes and coastal headlands and include:

- Coast Headland Pea *Pultenaea maritima*.
- Sand Spurge *Chamaesyce psammogeton*.
- Pied Oystercatcher *Haematopus longirostris*.
- White-bellied Sea-eagle *Haliaeetus leucogaster*.
- Grey-headed Flying-fox *Pteropus poliocephalus*.

Potential habitat for Sand Spurge is located on the beach and lower slopes of the headland, where it joins the beach and sand exists for growth. Coast Headland Pea may occur in the area of coastal headland heath.

Pied Oystercatchers may forage and nest on the beach during low tide, but are less likely to use the rocky headland areas of the proposal footprint.

White-bellied Sea-eagles may forage over the site, and there is a potential for a nest to be established in some of the larger trees on the headland. No nests were observed during the site investigation and there are no historical records of nesting within or adjacent to the site..

Grey-headed Flying Foxes may also be transient visitors to the site, with foraging resources present in the form of flowering or fruiting trees. There are no known roosts within close proximity to the proposal footprint. The nearest, known flying-fox camp is located approximately 1.5km to the south-west of the site.

Within the marine environment there is a low likelihood that Black Rock Cod *Epinephelus daemeli* would occur in the rocky intertidal area. Impacts to this habitat would be restricted to the installation of piles only.

Weeds and Pests

The patch of native and exotic vegetation on the slope and crest of the headland had a relatively high cover of weed and exotic species. The following Weeds of National Significance were directly observed during the ecological site inspection:

- Climbing Asparagus Fern *Asparagus aethiopicus*.
- Lantana *Lantana camara*.

6.4.3 Impact Assessment

The proposal is unlikely to result in a significant affect threatened species that have been assessed to have a moderate likelihood of occurrence within the proposal footprint. The results of this assessment against the requirements of Section 7.3 of the BC Act are provided in Table 19.

Table 19: Test of significance of impacts on threatened species

Criteria	Proposal response
In the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction	<p>The proposed development is not expected to have an adverse impact on any threatened species that are considered to have a moderate likelihood of occurrence within or adjacent to the proposal footprint.</p> <p>The construction of the boardwalk would not impact on any of the coastal heath or open forest communities on the headland, that may provide habitat for Sand Spurge and Coast Headland Pea.</p> <p>Impacts to foraging and roosting areas for Pied Oystercatcher are minor, with some impacts to the sandy beach at the toe of the headland only.</p> <p>Nesting and roosting resources for White-bellied Sea-eagle would also not be directly impacted, and the proposal would not impact on the ability of this species to forage in surrounding waters.</p> <p>There would also be no loss of foraging resources for any Grey-headed Flying-foxes that may visit the proposal footprint.</p>
In the case of an endangered ecological community or critically endangered ecological community, whether the proposed	There are no endangered or critically endangered ecological communities located within the proposal footprint.

Criteria	Proposal response
<p>development or activity:</p> <ul style="list-style-type: none"> is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction 	
<p>In relation to the habitat of a threatened species or ecological community:</p> <ul style="list-style-type: none"> the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality, 	<p>The construction of the boardwalk would not directly impact on any of the terrestrial habitat resources within the proposal footprint. There would be some loss of bare sands on the beach and the rocky headland, through the installation of the piled structure. These areas do not provide important resources for any threatened species.</p> <p>The proposal would not result in any fragmentation or isolation of terrestrial habitats.</p>
Whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),	There are no areas of outstanding biodiversity value that would be impacted by the proposal.
Whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process	<p>The proposal may result in an increased impact associated with the following key threatening processes:</p> <ul style="list-style-type: none"> Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments. Invasion and establishment of exotic vines and scramblers. Invasion, establishment and spread of Lantana. <p>These impacts are related to the construction phase of the proposal and can be managed as part of the Construction Environmental Management Plan for the proposal. Measures would need to be included for the management of litter and debris being released into the marine environment, and weed management to avoid the spread of Lantana and exotic vines and scramblers.</p>

The proposed development of the boardwalk around the Terrigal headland would result in some minor, direct impacts to the identified biodiversity features of the proposal footprint. All the direct impacts would occur within the intertidal and tidal zones of the proposal footprint, and on top of the lower rocky headland. The majority of the proposal footprint impacting on bare sands in the beach and the bare rock of the headland.

Based on the current footprint the proposal would result in the following approximate areas of impacts to tidal communities:

- Beach: 234 m²
- Sandstone headland: 125 m²
- Mixed sand and boulder: 92 m²
- Macroalgae beds: 98 m²

Based on the current footprint, impacts to the ascidian beds would be avoided.

The construction of the boardwalk would result in impacts to the intertidal zone. There is high potential to damage sections of the intertidal reach due to the required access needed to install piles and supporting structures. While various standard measures can be used to reduce the impact to the intertidal zone during construction not all impacts could be mitigated to the extent that some intertidal habitat would be lost. Over time however, the vegetation would re-establish, while additional habitat would likely establish on the boardwalk piers.

There will also be some longer-term impacts associated with shading underneath the boardwalk reducing light penetration to the macroalgae beds. Impacts could be further minimised if the designs consider ways to reduce shading (e.g. allowing light to filter through planks or using transparent material). Shading is expected to be incorporated into the design (refer to section 3.5). In addition, most of the boardwalk structure would sit closer to the rock wall where there is more open sand and the intertidal boulders rocky outcrop habitat becomes sparse. The greatest areas of impact are immediately around the sandstone outcrop where the dense and diverse intertidal/subtidal area is located. This area of shading in the macroalgae beds a maximum of 98 m². Due to the height and width of the structure, shading will not be complete and it is likely the macroalgae beds will be able to persist.

The proposal would have negligible impacts to terrestrial habitats, with some minor loss of native vegetation communities including the mixed open forest and shrubland along the cliff face from the proposed extension of the sea wall at the Haven precinct. This vegetation community is already disturbed by previous development and weed cover.

Once completed, the boardwalk structure would likely have minimal impact on the coastal vegetation and intertidal habitat.

6.4.4 Safeguards and Management Measures

Biodiversity	
Pre-Construction	
<ul style="list-style-type: none"> Carry out a pre-clearing fauna survey to identify any nests or roosts within the proposal footprint. Prepare a weed management plan for the removal and treatment of any weeds of national significance within the proposal footprint. 	
Construction	
<ul style="list-style-type: none"> If vegetation clearing is required, coastal headland species native to the region should be reinstated and where possible weed species should be removed. These actions would improve the habitat value of this stretch of vegetation. Avoid where possible impacting on the diverse macroalgae beds and minimise impact by relocating vegetated/ habitat boulders in positions where piles and or temporary footings may be located. Accessing the site during high tide and or low tide where minimal impact through bumping and or disturbing the macroalgae beds may occur. Use minimal piles where possible. Consider one large pile vs multiple pile for each support location. Have a longer distance between pile locations. Minimise the spread of access paths commit to one or two access locations to reduce impact extending outside access areas. Avoid work during rough weather conditions inclusive of wind and wave action. Remove and all temporary structures that may damage the surrounding areas during rough conditions and or once construction of a section is complete remove all temporary structures to reduce macroalgae and or marine fauna inhabiting the temporary structures. 	

6.5 Noise and Vibration

This section summarises the proposal's noise and vibration impacts.

6.5.1 Existing Environment

Ambient noise is largely influenced and dominated by crashing waves, road traffic along the Scenic Highway/Terrigal Esplanade, and general urban activity. Noise levels and local to the proposal footprint is affected by the sea-state, the strength of the waves and the direction of the wind. Typically, noise levels are far lower at night and in the early morning when the sea is calmer and urban activity is lower.

The noise sensitive receivers in the area include:

- Residential property along Scenic Highway/Terrigal Esplanade.
- Public open space, most notably including the foreshore and beach front at Terrigal Beach and The Haven.
- Community facilities at The Haven (recreational fields).
- Commercial properties at The Haven (Reef Restaurant).
- Marine mammals in the ocean.

6.5.2 Impact Assessment

Construction

During construction, noise would be generated from a range of activities. Likely key sources of construction noise would be generated during the piling works, and while mobile cranes, excavators and trucks are being used. Of these, the vibration generating activities are likely to be the piling activities, however none of the above receivers or respective in proximity to the site buildings are at risk of being sensitive to vibration impacts.

Indicatively, there are four construction zones where similar activities could be potentially taking place concurrently (refer to section 3.8). Noise would also be generated in establishing and operating the laydown areas, although this is expected to be completed prior to the main works commencing.

It is expected that during the construction period there may be intermittent noise impacts upon the receivers identified, particularly if activities across the established construction zones (see section 3.7) are occurring concurrently. It should be noted that the majority of noise generation would occur along the foreshore, so the headland between the residential receptors is likely to result in some natural noise mitigation.

Construction works are expected to be carried out during standard work hours (i.e. 7am to 6pm Monday to Friday; 8am to 1 pm Saturdays). However, certain activities like piling may need to be undertaken during the night-time period while the wave climate is more favourable, which may have sleep disturbance.

It is recommended that the contractor complete a construction noise assessment when the proposed methodology is established to ensure that noise impacts are minimised where practical.

Operation

There are expected to be no operational noise impacts.

6.5.3 Safeguards and management measures

Noise and Vibration
Construction
<ul style="list-style-type: none"> Works are to be carried out during standard work hours (i.e. 7am to 6pm Monday to Friday; 8am to 1 pm Saturdays) where possible. Outside of standard hours work should be minimised where possible. If required, (e.g. for piling) it should be approved by Council. Preparation of a Construction Noise and Vibration Management Plan to be incorporated into the CEMP to manage noise during the construction stage. Work would be undertaken in accordance with the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009). Surrounding residences and businesses would be provided with reasonable notice (minimum of one week) of the proposed work (including proposed starting date, work methods and duration) according to the Council's community liaison and notification policies. Vehicle and plant parking areas, materials stockpiles and equipment storage areas would be in areas away from (where practically possible) surrounding receptors. Noise intensive works would occur at the least sensitive times of the day, wherever possible. Workside construction training would alert construction workers to noise concerns and include education on noise sensitive issues and reducing noise where possible. Trucks with mufflers would be maintained in good working order. Smaller equipment options or rubber-tracked equipment would be selected where equipment is fit-for-purpose and it is economically feasible. Equipment would be maintained according to manufacturer's specifications, to reduce adverse noise impacts. Alternative work practices would be considered which generate less noise in high impact locations, for example using electric equipment instead of diesel or petrol-powered equipment. Plant and equipment would be turned off when it is not being used. Equipment would be fitted with silencers, acoustical enclosures and/or other noise attenuation measures, where feasible. Consultation would be undertaken with landowners and business owners to determine any specific vibration requirements. Appropriate construction methods and schedules that comply with the agreed vibration requirements and Standards BS 6472-1992 and AS 2436-1981 would be developed.

6.6 Traffic and Access

This section describes the land and maritime based traffic, transport and access impacts associated with the proposal.

6.6.1 Method

A review of the existing road infrastructure and carparking at and in proximity to the proposal was completed.

6.6.2 Existing Environment

The proposal is surrounded by several arterial roads; the most significant of which is the Scenic Highway/Terrigal Esplanade that connects Terrigal Beach and The Haven precinct. This road is likely to be busy during peak periods, such as summer holidays, with an increasing number of visitors using the recreational facilities such as the boat ramp and football field.

There is car parking at The Haven precinct and at the top of the rock-face, with on-street parking also available in the CBD.

There are footpaths in areas along the eastern peninsula near The Haven precinct, and between Terrigal Beach and The Haven precinct. These range from formalised footpaths connecting local roads to beaches and informal walking trails along the coastal fringe, which are used by beach visitors and surfers.

There is a cycleway along Scenic Highway/Terrigal Esplanade and a secure Taxi Rank at the Crowne Plaza Terrigal in proximity to the proposal and laydown areas.

6.6.3 Impact Assessment

Construction

The construction period would generate a small number of heavy and light vehicle (worker) movements around the proposal. The workers would typically arrive and leave site during the week, and potentially at the weekend or in the evening if there are out of hours work. Heavy vehicle movements would involve the mobilisation and demobilisation of equipment between the site and laydown areas. There would be occasional deliveries and potentially the need for occasional semi-trailer movements to deliver oversized equipment such as prefabricated boardwalk sections.

Construction traffic would have limited impact on the road network. However, more significant would be any traffic management controls, temporary diversions and road closures. However, there are not expected to be any traffic diversions within the Terrigal CBD.

Adequate parking for construction vehicles would be available, particularly at areas at and proximate to The Haven precinct. Depending on the location of the eastern laydown area and the traffic management controls implemented, there may be a minor loss of public parking.

It would be expected that skip bins would be used for waste collection to eliminate the need for dump trucks to be positioned at the site all day.

Operation

Pedestrian access between Terrigal Beach and the Haven precinct would be maintained once the boardwalk is open. Increased accessibility to Terrigal Beach would be provided to a wider demographic of the community through the proposal.

6.6.4 Safeguards and Management Measures

Traffic and Access
Construction
<ul style="list-style-type: none"> A Traffic Management Plan would be prepared by the Construction Contractor in accordance with Council's requirements. Notification of surrounding properties of construction activities and the identified construction routes and site access points throughout construction. Public notification about the timing of the construction of the boardwalk would be undertaken through local newspapers and Council's website, and placed on notices at formal carparks at The Haven precinct. No idling of trucks to occur on public roads prior to 7am (Monday- Friday) and 8am (Saturday). Designated construction haulage routes would be determined in advance of construction to minimise impacts on local roads and nearby sensitive receivers e.g. residential areas. Signage would be placed at entrances/exits to alert truck drivers to the designated entry and exit points.

6.7 Aboriginal Heritage

This section summarises the potential Aboriginal heritage impacts.

6.7.1 Method

The desktop assessment included a basic search of the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) database on 16 May 2018, to identify any heritage items near the site.

In addition, a review was undertaken of an Aboriginal Heritage Impact Assessment for previous works to The Haven precinct provided by Council (Darkinjung Local Aboriginal Land Council, 2009). This provided useful context regarding the potential for sites and objects of significance to the Aboriginal people near the works.

6.7.2 Existing Environment

The proposal falls within the Darkinjung Local Aboriginal Land Council (DLALC) boundary, which extends from the Hawkesbury River to the south, Lake Macquarie to the north, the McDonald River and Wollombi to the west, and the Pacific Ocean to the east. The site has a long history of Aboriginal occupation, with Aboriginal sites being found through the LGA, including surface scatters, rock art, caves and shelters, engravings, middens and artefacts. The Haven is a significant area to the local Darkinyung people, supported by the 2009 Aboriginal Heritage Impact Assessment which indicated that The Haven has registered Aboriginal sites.

The AHIMS search identified that there are no previously recorded Aboriginal objects and items. However, there are typical landscape features at the site (e.g. rocky outcrop, cliff face, rock art) that are known to have significance to Aboriginal people.

6.7.3 Impact Assessment

Construction

Council commenced consultation with the DLALC in early September 2018 to identify if the proposal would impact on any areas considered to have significance to the Aboriginal people. The Council received formal feedback from the DLALC in October 2018 that detailed appropriate safeguards that should be implemented during the construction phase of the proposal (see **Appendix D**). However, the DLALC also indicated that given the Aboriginal Heritage Impact Assessment for previous works to The Haven precinct was completed in 2009, an additional impact assessment of the area should be undertaken.

As a result, a site visit was undertaken on 23 October 2018 by culture and heritage officers representing the DLALC. The Aboriginal heritage due diligence assessment indicated that the proposal does not have the potential to harm Aboriginal objects or places.

This consultation process ensured that Council acted in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.

6.7.4 Safeguards and Management Measures

Aboriginal Heritage
<ul style="list-style-type: none"> The DLALC to complete an updated Aboriginal Heritage Impact Assessment that considers the proposal footprint. An unexpected heritage finds procedure should be developed prior to construction works taking place. In the case of Aboriginal cultural heritage sites or material being discovered, work should cease. The area should be avoided and the Office of Environment & Heritage (OEH), along with DLALC, should be contacted immediately. The DLALC to be notified before any works or earth movement. Contact to be made via email to the cultural & heritage team 30 days prior to works commencing. The DLALC to be engaged for monitoring of earth movement and works.

6.8 Socio-Economic

This section describes the potential socio-economic impacts.

6.8.1 Method

The assessment considered the community, business and industry impacts and benefits from the proposal. Specifically, it considered impacts on:

- The local community in terms of its adoption or opposition to the proposal based on its characteristics and profile.
- Social amenity and infrastructure in the area.
- The community's values such as amenity, character, health and safety, cohesion, environment, sense of place, fears and aspirations.

6.8.2 Existing Environment

The proposal is in the Central Coast LGA. About 328,000 people were living in the LGA at the time of the 2016 census (Australian Bureau of Statistics, 2018). The local demographic helps define the area's community cohesion and values. It also assists in profiling how adaptable the community is likely to be to the change.

The demographic of the area demonstrated people in the Central Coast LGA to be largely consistent with the state and national averages, but with a slightly older age demographic who have little reliance on public transport to travel to and from work. The demographic is typical of a community that is actively engaged and can mobilise in response to changes that would affect them as a collective of individuals. This has been confirmed through the consultation response from the community described in Chapter 5.

In addition to the above details, census data indicates that 5.4% of the NSW population in 2016 reported needing help in their day to day lives due to a disability (ABS, 2016). Although this statistic is not Central Coast specific, it does support Council's argument and need for providing safe and accessible access between Terrigal Beach and The Haven (refer to section 3.2).

Terrigal is a major suburb in the Central Coast region of NSW, located around 12 kilometres east of Gosford on the Pacific Ocean. Its unique combination of water, landscape, beach lifestyle and public spaces makes it a well-visited destination by those travelling in the Central Coast. At present, Terrigal offers a range of land uses, focussed on residential, tourism, retail, recreational, cultural and hospitality facilities. The proposal footprint is largely used for recreational purposes, reflecting its zoning designation (refer to section 2). The area is used for:

- Ocean swimming.
- Stand-up paddle boarding, surfing and other recreational water sports.
- Recreational boating and fishing.
- Walking.

- General amenity value (with people sitting along the foreshore).

The community facilities near the proposal footprint include:

- Terrigal Beach, Terrigal rockpool and The Haven Beach.
- Terrigal boat ramp.
- The Haven car park.
- Cafés and restaurants, including Reef Restaurant, Splash Café and Restaurant, and Haven Beach Café.
- Hotels, holiday rentals, shops and cafes on the Scenic Highway/Terrigal Esplanade at Terrigal including the Crown Plaza.
- Terrigal Rugby Club and associated sporting fields.
- Public parkland associated with Broken Head and the Skillion.

6.8.3 Impact Assessment

Construction

There would be temporary amenity impacts on the local community including residents, businesses, workers, visitors and tourists, generated from construction activity in the area, principally relating to temporary noise, vibration, visual and traffic and transport impacts.

The existing walkway between the precincts would remain open during construction. However, access to the rock face, tie-in area at the Terrigal rockpool and parts of the beachfront at The Haven would be restricted, resulting in a temporary loss of access and amenity for regular users (residents) and tourists. It is also expected that a traffic access route adjacent to the Reef Restaurant would be created, impacting on access to the foreshore at The Haven. Signage and notification on Council's website would advise the community of any access interruptions.

This may be potential negative temporary impacts on local business (e.g. Reef Restaurant) from loss of carparking, residential properties on the Scenic Highway/Terrigal Esplanade from noise/air quality impacts, and user experiences when attempting to access the community spaces (e.g. Terrigal rockpool, The Haven boatshed, sporting facilities at The Haven) from a lack of access. However, due to the minor nature of the works and the limited construction period, this impact is expected to be minor.

Coastal recreation activities that currently occur in the vicinity including fishing, paddle boarding, surfing and swimming may be temporarily impacted through the creation of an exclusion zone preventing these coastal activities from taking place.

Operation

Once the boardwalk is open there would be public access restrictions to parts of the rock platform, and areas of the sand in the western portion of the beach at The Haven on safety grounds. This would be offset by the creation of viewpoints and places to stop and sit along the boardwalk. Overall, while the proposal would restrict access to certain areas of safety grounds it would make the foreshore more accessible to a wider demographic including older people and people with mobility difficulties.

It is expected that the boardwalk would attract people to the area resulting in associated benefits to the community, local businesses and facilities. However, the additional tourists/visitors are not expected to result in undue stress to public amenity (e.g. community facilities, car parking spaces).

6.8.4 Safeguards and Management Measures

Socio-Economic	
Construction	
	<ul style="list-style-type: none"> Measures to safeguard against the proposal's noise (refer to section 6.5), traffic (refer to section 6.6) and air quality (refer to section 6.9) impacts be used to minimise the above impacts. No additional or supplementary measures are therefore proposed.

6.9 Other Impacts

Standard safeguards and management controls that are proven effective at mitigating any impacts can be put in place for the areas detailed in Table 20.

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Table 20: Other environmental issues

Aspect	Existing Environment	Impact Assessment
Air Quality	<p>The boardwalk traverses a natural coastal setting that offers no major air pollution sources.</p> <p>The area receives consistent sea breezes that prevent any build up air pollution in the local air shed.</p> <p>There are no point source industries locally that would contribute to atmospheric pollution. The key air pollution sources would be vehicle emissions from the Scenic Highway/Terrigal Esplanade.</p> <p>Terrigal Formation (sandstone with some shale and clay deposits) is present in the proposal footprint.</p>	<p>During construction, there may be some minor air quality impacts resulting from the exhaust emissions of construction vehicles and equipment. However, any such impacts would be short-term, minor and localised, and unlikely to result in any significant impacts.</p> <p>Potential sources of dust during the works would be generated through the earthworks. Given then sandstone geology at the site, there may be a greater risk of dust generation. However, it is assessed that the dust impacts would be generally minor and manageable through the implementation of appropriate mitigation measures to minimise off site impacts.</p> <p>There are not expected to be any odorous sources during construction and/or operation.</p>
Non-Aboriginal Heritage	<p>A review of Commonwealth, State, local and agency non-Aboriginal heritage registers carried out in May 2018 confirmed there to be no items or objects within or close to the site.</p> <p>Based on the history of the area, there is considered to be a low archaeological potential.</p>	<p>No non-Aboriginal heritage impacts are expected.</p>
Waste Management	<p>There is an obligation on Council to minimise waste generation and resource consumption, while promoting the use of recycled materials. Council is also obliged to recuse any materials such as excavated sediment (sand), rock and spoil.</p>	<p>The construction works would result in the generation of the following waste materials:</p> <ul style="list-style-type: none"> • Minor vegetation removal required along the cliff-face. • Left-over construction material (e.g. off-cuts from boardwalks). • Personal waste from construction personnel. <p>Waste generated at the site would be managed in accordance with the provisions of the Protection of the Environment Operations (Waste) Regulation 2005.</p>
Cumulative Impacts	<p>A review of the Central Coast Council planning application database and Department of Planning's major projects registers indicates that there are no other committed or approved development near the proposal footprint that would take place at the same time construction of the boardwalk is planned. However, it is understood that the Terrigal rockpool will be upgraded in 2019.</p>	<p>There may be some cumulative impacts (e.g. visual, noise, air quality, socio-economic) if the Terrigal rockpool upgrade works occur concurrently with the proposal.</p>

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6.9.1 Safeguards and Mitigation Measures

Air Quality
Construction
<ul style="list-style-type: none"> All construction vehicles and equipment would be maintained in good working condition in accordance with the manufacturer's specifications. Dampen larger exposed soil surfaces where required to prevent dust impacts, such as around car parks. Exposed surfaces would be revegetated at the completion of the construction works.
Non-Aboriginal Heritage
Construction
<ul style="list-style-type: none"> An unexpected heritage finds procedure should be developed prior to construction works taking place. If previously unidentified European heritage archaeological items are uncovered during the works, all works must cease in the vicinity of the material/find and Council staff notified immediately.
Waste Management
Construction
<ul style="list-style-type: none"> Resource management hierarchy principles would be followed (NSW EPA, 2014): <ul style="list-style-type: none"> Avoid unnecessary resource consumption as a priority. Avoidance is followed by resource recovery (including reuse of materials, reprocessing, Recycling and energy recovery). Disposal is undertaken as a last resort. Each subcontractor must ensure that they would monitor and report on all waste generated during the construction phase. Waste material would not be left on site once the works have been completed. Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day. Waste generated at the site would be managed in accordance with the provisions of the <i>Protection of the Environment Operations (Waste) Regulation 2005</i>.

7 Environmental Factors Considered

7.1 Assessment of Clause 228 Factors

Clause 228 of the EP&A Regulation provides those factors that must be taken into account concerning the impact of an activity of the environment. These factors are assessed in Table 21 in relation to the proposal.

Table 21: Assessment of Clause 228 factors

Clause	Impact			
	N/A	Negative	Nil	Positive
<i>(a) any environmental impact on a community</i>			✓	
Comment The proposal would provide a significant contribution to the amenity and accessibility within Terrigal. Any environmental (inclusive of visual) impacts during construction would be short-term, and are unlikely to cause a material change to the existing environment.				
<i>(b) any transformation of a locality</i>				✓
Comment The boardwalk would significantly add to the local amenity of the existing residents and visitors through development of a safe and accessible link between Terrigal Beach and The Haven precinct.				
<i>(c) any environmental impact on the ecosystems of the locality</i>			✓	
Comment The construction of the boardwalk is likely to have impacts on the intertidal species within the proposal footprint (e.g. macroalgae, molluscs and encrusting sponges). Over time however, the vegetation would re-establish, while additional habitat would establish on the boardwalk piers.				
<i>(d) any reduction of the aesthetic recreational, scientific or other environmental quality or value of a locality</i>			✓	
Comment During construction, there would be a negative impact through removing access to the Terrigal rockpool and rock platform, and minimising the beach area available at the Haven precinct. It is also likely that there would be impacts on the intertidal species within the proposal footprint (e.g. macroalgae, molluscs and encrusting sponges). However, once constructed, the proposal would add to the aesthetic value of area. Further, over time, the marine vegetation would re-establish, while additional habitat would establish on the boardwalk piers.				
<i>(e) any effect on a locality place or building having aesthetic anthropological archaeological architectural cultural historical scientific or social significance or other special value for present or future generations</i>			✓	
Comment There is low potential of the site having aesthetic anthropological, archaeological architectural cultural historical scientific or social significance or other special value for present or future generations. There are no recorded indigenous sites or place identified near the site. Mitigation measures are recommended that cover the construction stage should any indigenous or non-indigenous items or relics are uncovered during the construction stage.				
<i>(f) any impact on the habitat of protected fauna</i>	✓			

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Clause	Impact			
	N/A	Negative	Nil	Positive
<i>(within the meaning of the National Parks and Wildlife Act 1974)</i>				
Comment The site does not contain habitat of protected fauna (within the meaning of the <i>National Parks and Wildlife Act 1974</i>).				
<i>(g) any endangering of any species of animal, plant or other form of life whether living on land in water or in the air</i>			✓	
Comment The construction of the boardwalk is likely to have impacts on the intertidal species within the proposal footprint (e.g. macroalgae, molluscs and encrusting sponges). Over time however, the vegetation would re-establish, while additional habitat would establish on the boardwalk piers.				
<i>(h) any long-term effects on the environment</i>			✓	
Comment Based on the assessments completed as part of this REF, no long-term effects on the environment are expected from the boardwalk.				
<i>(i) any degradation of the quality of the environment</i>			✓	
Comment The quality of the environment is likely to experience some minor disturbance during the construction period, but is expected to re-establish after this period.				
<i>(j) any risk to the safety of the environment</i>				✓
Comment The proposal would not add to the safety risk of the area, rather it would provide a safer and more accessible access between Terrigal Beach and the Haven precinct for the benefit of future residents and visitors.				
<i>(k) any reduction in the range of beneficial uses of the environment</i>				✓
Comment The boardwalk would enhance the natural environment through developing a safe and accessible means for residents and visitors to get from Terrigal Beach to The Haven precinct. Any coastal recreation activities (e.g. swimming, paddle boarding) would not be impacted upon during operation.				
<i>(l) any pollution of the environment</i>			✓	
Comment The proposal is unlikely to result in pollution of the environment. Potential impacts (including air quality, noise, and contamination) would be managed through compliance with a Construction Environmental Management Plan (CEMP).				
<i>(m) any environmental problems associated with the disposal of waste</i>		✓		
Comment There are unlikely to be any significant environmental problems associated with the disposal of construction waste. Once operational, the boardwalk would not generate significant waste disposal other than typical general waste which would be managed with garbage bins and recycling solutions.				
<i>(n) any increased demands on resources (natural or otherwise) that are or are likely to become in short supply</i>			✓	
Comment				

Clause	Impact			
	N/A	Negative	Nil	Positive
The proposal would not result in increased demands on resources beyond which can be supplied.				
<i>(o) any cumulative environmental effect with other existing or likely future activities</i>			✓	
Comment No cumulative environmental impacts are expected.				
<i>(p) any impact on coastal processes and coastal hazards including those under projected climate change conditions</i>			✓	
Comment The proposal is unlikely to cause any impacts on coastal processes and coastal hazards and any related climate change impacts.				

7.2 Principles of Ecologically Sustainable Development

Council is committed to ensuring that this proposal is implemented in a manner that is consistent with the principles of Ecologically Sustainable Development (ESD) outlined in Section 6(2) of the *NSW Protection of the Environment Administration Act 1991* and Schedule 2 of the Regulations (Gosford City Council, 2017).

The boardwalk is a coastal enhancement proposal that would substantially improve natural value of the area through providing more accessibility. The ESD principles are assessed in Table 22.

Table 22: Assessment of Ecological Sustainable Development

ESD Principles	Comment on Proposed Activity
<p>a) the precautionary principle—namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</p> <p>In the application of the precautionary principle, public and private decisions should be guided by:</p> <ul style="list-style-type: none"> (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and (ii) an assessment of the risk-weighted consequences of various options. 	<p>This REF has assessed key engineering, environmental and planning issues which concludes that the proposal is unlikely to lead to irreversible damage to the environment.</p> <p>Mitigation measures have been presented that would reduce potential impacts during the construction stage, which was assessed for a worst-case event (refer section 3.7).</p> <p>Mitigation measures have been presented that would reduce potential impacts during the operation stage (e.g. allowing light to filter through boardwalk, designing the boardwalk at an appropriate height to account for sea-level rise and wave impacts etc.)</p>
b) inter-generational equity—namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or	The boardwalk would enhance the natural landscape through providing greater, and safer accessibility along

enhanced for the benefit of future generations.	the Terrigal foreshore for future residents and visitors. The boardwalk would also function as a place of social interaction and break-out area that would contribute to the amenity of future populations.
c) conservation of biological diversity and ecological integrity—namely, that conservation of biological diversity and ecological integrity should be a fundamental consideration.	While various standard measures can be used to reduce the impact to the intertidal zone during construction not all impacts could be mitigated to the extent that some intertidal habitat would be lost. Over time however, the vegetation would re-establish, while additional habitat would likely establish on the boardwalk piers. Once completed, the boardwalk structure would likely have minimal impact on the coastal vegetation and intertidal habitat. Further, the boardwalk would be architectural designed to allow light to filter through, contributing to the conservation of ecological integrity.
d) improved valuation, pricing and incentive mechanisms—namely, that environmental factors should be included in the valuation of assets and services, such as: (iii) polluter pays—that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement, (iv) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste, (v) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.	The proposal is unlikely to result in significant environmental impacts and the generation of significant pollution.

7.3 Consideration of National Environmental Significance Factors

A review of the Protected Matters Search Tool indicated that no MNES would be impacted by the proposal. Therefore, the proposal is not considered a controlled action under the EPBC Act, and a referral to the Commonwealth Department of Environment and Energy is not required.

8 Conclusion

8.1 Justification

With improved infrastructure and increasing developer interest, Terrigal has become an area popular for tourists.

The existing rock headland and steep roadway currently prevents easy access between Terrigal Beach promenade and The Haven precinct. An existing road side path connects these destinations, although it is steep and results in a disconnected journey which displaces persons from a direct marine foreshore experience.

The proposal is intended to improve the amenity and accessibility for tourists visiting the region.

8.2 Objects of the EP&A Act

This REF has been prepared to assess the environmental impacts of the proposal in accordance with division 5.1 of the EP&A Act and has assessed those matters listed in Clause 228 of the EP&A Regulation.

The proposal would not result in a significant impact on any Areas of Outstanding Biodiversity Values, declared critical habitat, threatened species, populations or ecological communities or their habitats. Therefore, a Species Impact Statement or Biodiversity Development Assessment Report is not required.

The REF has been prepared in accordance with *State Environmental Planning Policy (Infrastructure) 2007* and key Commonwealth, State and local planning provisions, policy and strategy.

The REF has assessed key engineering, environmental and planning issues including landscape and visual, water quality and quantity, heritage, traffic and access, geotechnical and contamination based on a number of supporting technical studies. The REF includes mitigation measures and safeguards to ensure that construction and operation of the boardwalk occurs with minimal environmental impact.

In this regard, an Environmental Impact Statement is not required.

8.3 Conclusions

The proposed Terrigal Beach promenade to The Haven boardwalk is intended to improve the amenity and accessibility for tourists visiting the region. It is anticipated that upon completion, the boardwalk would become a tourist attraction and a destination enhancing experience which compliments the natural marine environmental assets.

9 References

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Appendix A

Survey and Geotechnical
Investigations – Information
Flyer



Survey and geotechnical investigation works

Terrigal Boardwalk

What's Happening

Council contractors are undertaking a detailed survey of four sites in Terrigal as the first step in the process of investigating the possibility of creating a Boardwalk from The Haven to the Terrigal Esplanade.

The survey works will include the position and level of all current structures, site features, pavement, kerb levels, street furniture, stormwater pits, existing trees, property boundaries and current services. A CASA certified drone will also be used at times of low tide to enhance the survey work. Public access to parts of the Surf Club car park and to the proposed boardwalk area will be restricted for geotechnical works starting on May 21 and finishing on May 24.

The immediate area around the site will be cordoned off at times to facilitate the works and signage will be in place. Thank you for your patience as these works are carried out.

Timeframe

Survey Works Tuesday 15 May to Wednesday 16 May
Geotechnical Works: Monday 21 May to 24 May

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Appendix B

Landscape and Visual Assessment

Landscape and Visual

This section provides a Landscape Character and Visual Impact Assessment (LCVIA) of the proposal. It also identifies mitigation measures and design recommendations to avoid, minimise or improve potential landscape character and visual amenity outcomes.

It should be noted that this assessment covers only operational phase impacts. There are likely to be increased landscape character and visual impacts during the construction phase of the proposal due to various construction activities as described previously in section 3.7, although these would be of a temporary nature only, and have therefore not been assessed.

A1.1 Methodology

A1.1.1 Study Area

The study area for this LCVIA has been selected to cover the main geographical extent of potential visual and landscape character impacts of the proposal. The area of study extends approximately 350m in all directions from the centre of the boardwalk alignment.

A1.1.2 Landscape Character Assessment

Landscape character can be defined as the aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. It includes all aspects of a tract of land – built, planted, natural topographical and ecological features.

Landscape Character Zones

To enable the assessment of impacts on landscape character, landscape character zones (LCZs) are determined for the relevant area of study. LCZs are defined as areas having a distinct, recognisable and consistent pattern of elements making one LCZ different from another.

Impact Rating

The overall impact rating of the proposal on any given LCZ is based on themes of magnitude and sensitivity. The severity of these impacts is calculated using the matrix shown in Table 12, taken from the Roads and Maritime Guidelines for Landscape Character and Visual Impact Assessment (Roads and Maritime Services, 2013).

Sensitivity – The degree to which a particular landscape type can accommodate change arising from a development, without detrimental effects on its character. This includes factors such as:

- Existing land use.
- The pattern and scale of the landscape.

- Visual enclosure, openness of views and distribution of visual receivers.
- The value placed on the landscape.

Areas with a high sensitivity to change include zones with significant landscape features, landscape types with inherent natural values and landscapes with heritage or cultural values. Lower sensitivity is often associated with built up urban environments such as industrial areas.

Magnitude – the magnitude of the effects of the development within the landscape. Consideration is given to:

- Existing built form in the landscape and how closely the development matches this in mass, scale and form.
- The scale or degree of change to the landscape resource.
- The nature of the effect and its duration including whether it is permanent or temporary.

A1.1.3 Visual Impact Assessment

While landscape character assessment seeks to identify impacts on the physical character of the study area, visual impact assessment is concerned with a proposal's effects on public and private visual receivers.

Viewpoint Selection

Following a thorough desktop study and site visit, representative viewpoints with the potential to be visually affected by some element of the proposal are identified and selected for further analysis. Viewpoints are selected to illustrate:

- A range of receiver types including public and private domain views (residents, motorists and users of public open space).
- A range of view types including elevated, panoramic and filtered views.
- A range of viewing distance from the proposal.
- Any key or protected views identified within relevant planning literature.

Limitations

It should be noted that selected viewpoints are by no means an exhaustive list of all receivers that might be impacted by the proposal. They have been selected to be representative of the spread and type of receivers throughout the study area.

Impact Rating

The overall impact rating of the proposal on any given viewpoint is based on themes of magnitude and sensitivity. The severity of these impacts is calculated using the matrix shown in Table 12.

Sensitivity – Each visual receiver type has an inherent and varied sensitivity to change in the visual scene based on the personal context in which their view is being experienced. This sensitivity has a direct bearing on the perception of visual impact experienced by the receiver and qualifies the quantitative impacts. The number of viewers also has a bearing on sensitivity. Viewpoints have a varied number of potential receivers depending on whether the viewpoint is public or private, the popularity of the viewing location and its ease of accessibility.

Views from public reserves and open space are often given the highest weighting due to the increased number of viewers impacted.

Examples of sensitivity levels:

- Negligible – Vacant lot, uninhabited building, car park.
- Low – Minor or major roads, service providers, industrial areas.
- Moderate – Residential properties with limited views, some commercial properties, scenic public roads (e.g. official tourist routes).
- High – Public open space, public reserves, living areas or gardens/balconies of residential properties with direct views of proposal.

Magnitude - a measure of the magnitude of the visual effects of the development within their setting. A series of quantitative assessments are studied to give an overall magnitude rating, including distance from development, quantum of view, period of view and most importantly, scale of change.

Table 23: Overall impact rating as a combination of sensitivity and magnitude (Roads and Maritime guidelines for landscape character and visual impact assessment) (Roads and Maritime Services, 2013)

	High	Moderate	Low	Negligible
High	High Impact	High Moderate Impact	Moderate Impact	Negligible Impact
Moderate	High - Moderate Impact	Moderate Impact	Moderate - Low Impact	Negligible Impact
Low	Moderate Impact	Moderate - Low Impact	Low impact	Negligible Impact
Negligible	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact

A1.2 Site Context

Land Use

As seen in Figure 13, the proposal is located to the northeast of Terrigal's CBD. The surrounding area contains retail, commercial, residential and public recreational land uses.

The Scenic Highway/Terrigal Esplanade south of the proposal is predominately residential, featuring brick apartment buildings.

The Terrigal CBD features a mix of low to medium density commercial and retail properties. The Haven forms a large area of public open space to the east of the proposal with a large carpark that services beach goers.

In the ocean off the coast of Terrigal lies the Ex-HMAS Adelaide artificial reef, a reserve gazetted over submerged Crown Lands.



Figure 13: Land zoning

Landform and Topography

The character of the area along the proposal alignment presents a Hawksbury sandstone coastal landscape, heavily influenced by the ocean. The alignment is bordered to the south by an inclined cliff line with variable steepness.

As the proposal extends around the headland, the rock face becomes very steep. There are rocky outcrops and Terrigal rockpool at the base of the slope and within the intertidal zone between the beach and the headland.

The Haven is flanked by two rocky headlands known as The Skillion and Broken Head. They are considered as local landmarks, exhibiting rock from the Triassic period and visible from many surrounding locations. The typical inner bay landform and rolling waves are drawcard for surfers and visitors.

Vegetation

Remnant vegetation and planted native species from the Coastal Headland Low Forest, Coastal Headland Grassland and Coastal Headland Shrubland plant communities can be seen around Terrigal, however most remnant vegetation has been removed along the coastline for development.

Native and exotic grasses, groundcovers, shrubs and trees can be found along the cliff line adjacent to The Haven Beach. The native species identified include Scrub she-oak (*Allocasuarina distyla*), Coastal rosemary (*Westringia fruticosa*), Prickly-leaved paperbark (*Melaleuca nodosa*), Common hop bush (*Dodonaea triquetra*), Finger hakea (*Hakea dactyloides*), Lomandra species and Banksia species.

A1.3 Landscape Character Assessment

To enable the assessment of potential landscape character impacts of the proposal, the following LCZs presented in Figure 8 have been determined within the study area:

- LCZ 1: The Haven open space.
- LCZ 2: The Haven Beach and rock platform.
- LCZ 3: Terrigal Esplanade residential development.
- LCZ 4: Terrigal Beach.

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Figure 14: Landscape Character Zones

LCZ1: The Haven Open Space

This zone is flanked by Broken Head and The Skillion headlands and is characterised by a large area of well used turfed open space comprising playing fields, car parking and café. The landscape is open with extensive views towards the ocean, particularly from the elevated headlands either side. The headlands include stands of dense coastal vegetation. As a scenic and popular area of open space, it has a **High** landscape sensitivity.

The proposal is located outside of this LCZ and is not expected to impact the spatial quality of The Haven open space, leading to a **Negligible** magnitude rating.

While the boardwalk may be visible from some locations within the parkland, no impact on the landscape character of this LCZ is expected.

Sensitivity	High
Magnitude	Negligible
Impact Rating	Negligible

LCZ2: The Haven Beach and Rock Platform

This LCZ comprises an approximately 200m long steep, open and sandy beach, tucked between Broken Head and the rock platform that separates it from Terrigal Beach. The beach faces north to northwest and is a popular for launching boats for fishing, recreation and diving. The beach is backed by several car parks, an oval and café, as well as dense vegetation along the western cliff face. A large stepped sandstone seawall extends along much of the beach. The exposed rock face and intertidal zone around the rock platform contribute strongly to the scenic nature of the landscape. Little existing built form is present and the LCZ is considered to have a **High** sensitivity.

The boardwalk and associated sea wall would likely form prominent new built form elements along the western end of the beach and adjacent rock platform. While improving access to the beach, the boardwalk would alter the existing natural setting, reducing the visibility of the rock platform from the eastern end of the beach and spatially dividing the western end of the beach from the adjacent cliff. Access would be reduced to a small section of the beach. There would also be a slight increase in overshadowing beneath and adjacent to the boardwalk structure. Overall, a **Moderate** magnitude of change is expected, leading to a **Moderate/High** landscape character impact rating.

Sensitivity	High
Magnitude	Moderate
Impact Rating	Moderate/High

LCZ 3: Terrigal Esplanade Residential Development

The character of this area is defined by multi-storey apartment buildings along the southern side of the Scenic Highway/Terrigal Esplanade, facing the ocean. These dwellings have a scenic setting and a **Moderate** sensitivity to change in the landscape.

The proposal is located at a lower elevation to these dwellings, obscured by vegetation and topography. The proposal would have a **Negligible** effect on the spatial quality of this zone and hence no impact on landscape character.

Sensitivity	Moderate
Magnitude	Negligible
Impact Rating	Negligible

LCZ 4: Terrigal Beach

Terrigal Beach is a 2.8km long stretch of sand that trends southwest from the rocks on the north side of Wamberal Lagoon and finishes at the rocks on the southern end of Terrigal Beach.

The beach has long been a popular holiday destination for Sydneysiders, backed by increasing residential development since the 1960s. A foreshore reserve lies between the road and the beach and contains Terrigal Surf Life Saving Club (built in 1924), car parking and a park. A shopping centre and a large resort backs the southern half of the beach. This LCZ has a **Moderate** sensitivity to change in the landscape.

The proposal would be located at the southern eastern tip of the beach, connecting to the existing footpath adjacent to a Terrigal rockpool. The boardwalk and associated retaining walls would form prominent new built form elements along this section of the cliff and rock platform. The structure would alter the existing natural setting, reducing the visibility of the rock platform and reducing access to the rocks. It should be noted that the current access to the rock platform is a safety concern due to cliff instability. Overall, a **Moderate** magnitude of change is expected, leading to a **Moderate** landscape character impact rating in this LCZ.

Sensitivity	Moderate
Magnitude	Moderate
Impact Rating	Moderate

A1.4 Visual Impact Assessment**A1.4.1 Existing Visual Environment**

The visual character of the study area is defined by its topography, open space, sweeping ocean views and medium density built form. The rock platform and steep cliff line between Terrigal and The Haven beaches forms a major visual feature of the area, creating distinct east/west visual separation. The exposed rock face and intertidal zone strongly contribute to the scenic nature of the views to and from this location.

Key relevant views within the study area include:

- Scenic local foreshore views west along The Haven Beach towards the cliff and rock platform.
- Sweeping panoramic ocean views from the Reef Restaurant.
- Scenic views out from the rock platform towards Terrigal and The Haven beaches.
- Foreshore views east along Terrigal Beach.

A1.4.2 Visual Envelope

The approximate extent of visibility of the proposal is indicated in the visual envelope diagram, Figure 9. Visibility of the proposal extends east and west along the foreshore and is limited to the south by vegetation and local topography. The figure does not include the extents from which the proposal would be visible from the ocean.



Figure 15: Visual envelope

Selected Viewpoints

After a site visit, the following key viewpoints were selected for further analysis as shown in Figure 10:

1. The Haven Beach near the Reef Restaurant – looking west
2. Rock platform - looking east
3. Terrigal Beach footpath – near the Terrigal rockpool
4. Terrigal Esplanade footpath – looking east
5. Terrigal Beach footpath – looking east

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Figure 16: Viewpoints assessed

A1.4.3 Viewpoint 1

This viewpoint is representative of the view west from The Haven Beach in vicinity of the Reef Restaurant. The existing view takes in the restaurant, sandstone sea wall and extends along the sand to the western end of the beach, ending at the cliff backed rock platform. The existing coastal rocks in this location are exposed at low tide, with the view changing subtly during the day. The view is scenic with limited built form visible along the western stretch of beach and can be considered to have a **High** visual sensitivity.

The proposed enlarged sea wall would extend further west along The Haven Beach, although would be mostly continuous with the existing sandstone seawall. The boardwalk, however, would be visible curving around the face of the sandstone cliff, introducing a new structure into the landscape and reducing the natural setting of the rock shelf. The supporting columns would also be visible as well as the viewing gallery jutting into the ocean. A **Moderate** magnitude of change is expected.

Overall, a **Moderate/High** visual impact is expected on this viewpoint due to the increase in built form and the reduction in visibility of the cliff and rock platform. It should be noted that the selection of appropriate materials and finishes for the boardwalk would help integrate the structure into the landscape and likely reduce the visual impact.

Sensitivity	High
Magnitude	Moderate
Impact Rating	Moderate/High

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Viewpoint 1 – Looking west along The Haven Beach towards the rock platform and Terrigal Beach. The approximate location of the proposal is indicated in yellow, with the extended sea wall in grey.

A1.4.4 Viewpoint 2

This view is representative of the outlook from the rock platform between Terrigal and The Haven beaches. The outlook extends east over the rocky intertidal zone along the partly vegetated cliff line, beach and Reef Restaurant to the open space of The Haven. The mix of sand, rock and ocean is highly picturesque and the viewpoint is considered to have a **High** visual sensitivity.

It should be noted that there is no existing path connecting the two sides of the beach which makes accessibility to the rock platform challenging and dangerous at times, including the risk of rockfall.

The proposal would be visually prominent from this viewpoint, extending along the cliff line with associated railings, support columns and viewing decks. Although reducing the natural quality of this section of the coastline, the proposal would provide new viewing opportunities, with panoramic ocean views. Due to the provision of these replacement views, the proposal is considered to have a **Low** magnitude of change from this viewpoint.

Overall, a **Moderate** visual impact is expected on this viewpoint due to the increase in built form and the reduction in visibility of the cliff and rock platform. It should be noted that the creation of new viewing opportunities through the provision of platforms within the proposal concept design, helps reduce the overall level of visual impact experienced. It should be noted that the selection of appropriate materials and finishes for the boardwalk would help integrate the structure into the landscape and likely reduce the visual impact further.

Sensitivity	High
Magnitude	Low
Impact Rating	Moderate

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Viewpoint 2 – Looking east towards The Haven from the rock platform. The approximate location of the proposal is indicated in yellow, with the extended sea wall in grey.

A1.4.5 Viewpoint 3

This viewpoint is representative of the view available from the ramped path leading to the Terrigal rockpool and rock platform at the southern end of Terrigal Beach. The partially vegetated sandstone cliff rises behind the path and blocks views beyond it. The mix of sand, rock and ocean is highly picturesque and the viewpoint is considered to have a **High** visual sensitivity.

The proposal would be visually prominent from this viewpoint, extending along the cliff line with associated railings, support columns and viewing decks. The proposal would introduce a new structure into the landscape, reducing the natural quality of the rock platform, although due to the presence of the existing path in the foreground of the view, the proposal is considered to have only a **Low** magnitude of change.

Overall, a **Moderate** visual impact is expected on this viewpoint due to the increase in built form and the reduction in visibility of the cliff and rock platform. It should be noted that the selection of appropriate materials and finishes for the proposal would help integrate the structure into the landscape and likely reduce the visual impact further.

Sensitivity	High
Magnitude	Low
Impact Rating	Moderate

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Viewpoint 3 – Existing view west from ramped pathway along southern end of Terrigal Beach. The approximate location of the proposal is indicated in yellow.

A1.4.6 Viewpoint 4

This viewpoint is representative of the view available to pedestrians and cyclists from the elevated path alongside Scenic Highway/Terrigal Esplanade at the southern end of Terrigal Beach. Panoramic ocean views extend over the vegetated sandstone cliff in the foreground towards the Terrigal rockpool, rock platform and the ocean off Terrigal Beach. The mix of sand, rock and ocean is picturesque although some built form is visible. The viewpoint has a **Moderate** visual sensitivity.

The proposal would be visible beneath the viewer extending along the cliff line with associated railings, seating and viewing decks. The proposal would reduce the natural quality of the rock platform, although due to the presence of the existing path in the foreground and the lower elevation of the structure compared to the viewer, the proposal is considered to have only a **Low** magnitude rating.

Overall, a **Moderate/Low** visual impact is expected on this viewpoint due to the slight increase in built form and the reduction in visibility of the cliff and rock platform. It should be noted that the selection of appropriate materials and finishes for the boardwalk would help integrate the structure into the landscape and likely reduce the visual impact further.

Sensitivity	Moderate
Magnitude	Low
Impact Rating	Moderate/Low

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Viewpoint 4 – Existing view north west from path along Terrigal Esplanade. The approximate location of the proposal is indicated in yellow.

A1.4.7 Viewpoint 5

This viewpoint is representative of the view available to beach users looking west along Terrigal Beach. The existing view takes in an existing sandstone retaining wall, lighting columns, footpath, Terrigal rockpool, rock platform and sandstone cliffs separating Terrigal from The Haven Beach. The elevated topography of Broken Head in the background. The view is scenic with some limited built form visible and can be considered to have a **Moderate** visual sensitivity.

The proposal would be visible curving around the face of the sandstone cliff with associated supporting columns visible beneath the structure, as well as the viewing platform jutting into the ocean. Existing views towards The Haven Beach may be partially obstructed. The proposal would introduce a new structure into the landscape, leading to a **Moderate** magnitude of change in the view.

Overall, a **Moderate** visual impact is expected on this viewpoint due to the increase in built form and the reduction in visibility of the cliff and rock platform. It should be noted that the selection of appropriate materials and finishes for the boardwalk would help integrate the structure into the landscape and likely reduce the visual impact.

Sensitivity	Moderate
Magnitude	Moderate
Impact Rating	Moderate

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Viewpoint 5 – Existing view west from Terrigal Beach. The approximate location of the proposal is indicated in yellow.

A1.5 Mitigation

The purpose of mitigation is to avoid, reduce or where possible remedy or offset any significant adverse effects on the environment arising from the proposed development.

Construction Phase

- Locate storage areas and associated works in cleared or otherwise disturbed areas.
- Consider aesthetics of site hoardings. Preference for neutral colours and designs in proximity to open space to help them blend into surrounding environment.
- Maintain site hoarding and perimeter site areas regularly to include the prompt removal of graffiti.
- Retain and protect existing trees and vegetation adjacent to the works where possible. Minimising clearing where possible.
- Trim rather than remove trees. Works to be undertaken by a qualified arborist.
- Restore all areas disturbed by construction to existing condition.

Operation Phase

- Limit visual contrast and reflectivity of boardwalk structure through appropriate colour choice for built form materials.
- Minimise boardwalk deck thickness where possible to decrease visual profile.
- Ensure the size and number of supporting columns is minimised where possible.
- Ensure any infill to base of columns compliments the colour and texture of the existing rock.
- Ensure retaining walls and sea walls visually integrate with existing landscape through appropriate selection of materials.
- Provide high quality finishes to boardwalk to facilitate long term durability of the design for effect with minimal maintenance.
- Ensure components are considered as a whole, creating a cohesive design language.
- Provide new landscape planting to integrate eastern end of boardwalk with existing setting.
- Plant selection to consider longevity and ongoing maintenance.

Appendix C

Threatened Species Assessment

Threatened Species

Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
Plants				
Biconvex Paperbark <i>Melaleuca biconvexa</i>	V	-	V	Negligible Generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects
Coast Headland Pea <i>Pultenaea maritima</i>	V	-	-	Moderate Occurs in grasslands, shrublands and heath on exposed coastal headlands and adjoining low coastal heath.
Coast Groundsel <i>Senecio spathulatus</i>	E	-	-	Negligible Grows on frontal dunes
Camfield's Stringybark <i>Eucalyptus camfieldii</i>	V	-	V	Negligible Poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges.
Magenta Lilly Pilly <i>Syzygium paniculatum</i>	E	-	V	Negligible grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest.
Narrow-leaf Wilsonia <i>Wilsonia backhousei</i>	V	-	-	Negligible Occurs on the margins of salt marshes and lakes.
Sand Spurge <i>Chamaesyce psammogeton</i>	E	-	-	Moderate Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (<i>Spinifex sericeus</i>) and Prickly Couch (<i>Zoysia macrantha</i>)
Amphibians				
Green and Golden Bell Frog <i>Litoria aurea</i>	E	-	V	Negligible Occurs in marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha spp.</i>) or spikerushes (<i>Eleocharis spp.</i>).
Fish				

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
Black Rock Cod <i>Epinephelus daemeli</i>	-	V	V	Low Suitable habitat within the rocky reefs, caves and gutters.
Birds				
Black-necked Stork <i>Ephippiorhynchus asiaticus</i>	E	-	-	Negligible Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries.
Barking Owl <i>Ninox connivens</i>	V	-		Negligible Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. Requires hollows for breeding.
Black-browed Albatross <i>Thalassarche melanophris</i>	V	-	V, M	Low – may flyover or visit Inhabits antarctic, subantarctic, subtropical marine and coastal waters over upwellings and boundaries of currents.
Flesh-footed Shearwater <i>Ardenna carneipes</i>	V	-	M	Low – may flyover or visit Pelagic species of the open ocean.
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	V	-	-	Negligible Tall mountain forests in spring and summer, and lower altitude eucalypt forests and woodlands in autumn and winter.
Eastern Osprey <i>Pandion cristatus</i>	V	-	M	Moderate Occurs in coastal areas, especially the mouths of large rivers, lagoons and lakes. Forages on fish in open, clear water. The nearest known Eastern Osprey nest is at Brendan Franklin Oval near Terrigal Lagoon.
Little Eagle <i>Hieraaetus morphnoides</i>	V	-	-	Negligible Occupies open eucalypt forest, woodland or open woodland.
Little Lorikeet <i>Glossopsitta pusilla</i>	V	-	-	Negligible Forages primarily in the canopy of open <i>Eucalyptus</i> forest and

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
				woodland, yet also finds food in <i>Angophora</i> , <i>Melaleuca</i> and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity
Little Shearwater <i>Puffinus assimilis</i>	V	-	-	Low – may flyover or visit Pelagic species of the open ocean.
Masked Owl <i>Tyto novaehollandiae</i>	V	-	-	Negligible Lives in dry eucalypt forests and woodlands from sea level to 1100 m.
Providence Petrel <i>Pterodroma solandri</i>	V	-	-	Low – may flyover or visit Pelagic species of the open ocean.
Pied Oystercatcher <i>Haematopus longirostris</i>	E	-	-	Moderate Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish.
Powerful Owl <i>Ninox strenua</i>	V	-	-	Negligible Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest, but generally requires large tracts of habitat.
Red-tailed Tropicbird <i>Phaethon rubricauda</i>	V	-	M	Low – may flyover or visit Marine species that breeds in coastal cliffs and under bushes in tropical Australia
Regent Parrot <i>Polytelis anthopeplus monarchoides</i>	E	-	V	Negligible Principal foraging habitat is mallee woodlands, though foraging also occurs in riverine forests and woodlands.
Shy Albatross <i>Thalassarche cauta</i>	V	-	V, M	Low – may flyover or visit Pelagic or ocean-going species inhabits subantarctic and subtropical marine waters, spending the majority of its time at sea.
Sooty Owl <i>Tyto tenebricosa</i>	V	-	-	Negligible Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
				well as moist eucalypt forests.
Sooty Oystercatcher <i>Haematopus fuliginosus</i>	V	-	-	Moderate Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.
Square-tailed Kite <i>Lophoictinia isura</i>	V	-	-	Negligible Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.
Sooty Tern <i>Onychoprion fuscata</i>	V	-	-	Low – may flyover or visit Marine species, that roosts on offshore islands or coral cays.
Southern Giant Petrel <i>Macronectes giganteus</i>	E	-	E, M	Low – may flyover or visit Pelagic species that nests on Antarctic and subantarctic islands.
Stephen's Banded Snake <i>Hoplocephalus stephensii</i>	V	-	-	Negligible Rainforest and eucalypt forests and rocky areas up to 950 m in altitude.
Swift Parrot <i>Lathamus discolor</i>	E	-	CE	Negligible Migrates to mainland Australia from Mar-Oct. On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.
Wandering Albatross <i>Diomedea exulans</i>	E	-	V, M	Low – may flyover or visit Pelagic species that nests on Antarctic and subantarctic islands.
White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	V	-	-	Moderate Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest. Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat.
Wompoo Fruit-dove <i>Ptilinopus magnificus</i>	V	-		Negligible Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests.

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
Mammals				
Eastern Bentwing Bat <i>Miniopterus schreibersii oceanensis</i>	V	-	-	Negligible Hunts in forested areas. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.
Eastern False Pipistrelle <i>Falsistrellus tasmaniensis</i>	V	-	-	Negligible Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.
Eastern Freetail Bat <i>Mormopterus norfolkensis</i>	V	-	-	Negligible Occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range and roosts in tree hollows.
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i>	V	-	-	Negligible Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	V	-	V	Moderate Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.
Koala <i>Phascolarctos cinereus</i>	V	-	V	Negligible Occurs in eucalypt forests and woodlands.
Little Bentwing Bat <i>Miniopterus australis</i>	V	-	-	Low Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas
Humpback Whale <i>Megaptera novaeangliae</i>	V	-	V	Low – pass through adjacent waters Oceanic and coastal species.
Southern Myotis <i>Myotis macropus</i>	V	-	-	Negligible Generally roost in groups of 10

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
				- 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forages over water in rivers and streams.
Southern Right Whale <i>Eubalaena australis</i>	E	-	E	Low – pass through adjacent waters Oceanic and coastal species, but can move inshore for breeding and calving.
Sperm Whale <i>Physeter microcephalus</i>	V	-	-	Negligible Marine mammal, with a preference for deeper water beyond continental shelf.
Spotted-tailed Quoll <i>Dasyurus maculatus</i>	V	-	E	Negligible Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Traverses home range along well vegetated creek lines.
Squirrel Glider <i>Petaurus norfolcensis</i>	V	-	-	Negligible Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.
Yellow-bellied Glider <i>Petaurus australis</i>	V	-	-	Negligible Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils.
Yellow-bellied Sheathtail-bat <i>Saccolaimus flaviventris</i>	V	-	-	Low Forages in most habitats across its very wide range, with and without trees. Can roost in tree hollows, buildings or mammal nests.
Reptiles				
Green Turtle <i>Chelonia midas</i>	V	-	V	Negligible Ocean dwelling species. Requires beaches with dunes for nesting.
Leatherback Turtle	E	-	E	Negligible

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Species name	BC Act	FM Act	EPBC Act	Likelihood of occurrence
<i>Dermochelys coriacea</i>				Ocean dwelling species. Requires beaches with dunes for nesting.

- EPBC Act – Indicates the Commonwealth conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*, coded as Critically Endangered (CE), Endangered (E), Vulnerable (V).
- TSC Act – Indicates the New South Wales conservation status of each taxon under the *Biodiversity Conservation Act 2016* coded as Endangered species (E1), Vulnerable (V).
- FM Act – Indicates the New South Wales conservation status of each taxon under the *Threatened Species Conservation Act 1995* (Repealed), coded as Endangered species (E1), Vulnerable (V).

Appendix D

Darkinjung Local Aboriginal
Land Council – Formal
Response

Central Coast Council

Terrigal Boardwalk
Review of Environmental FactorsLocal Aboriginal Land Council
DARKINJUNG

11 October 2018

168 Pacific Highway Watanobbi NSW 2259

PO Box 401 Wyong NSW 2259

Phone (02) 4351 2930

Fax (02) 4351 2946

ABN 99 583 297 167

Dear Sanjay

RE: Environment Assessment report – proposed Terrigal boardwalk.

Thank you for the opportunity to formally respond to as listed above.

Darkinjung Local Aboriginal Land Council (DLALC) has now reviewed the document and is satisfied with the Environment Assessment. DLALC would like to make the following recommendations

Recommendation:

1. DLALC Must be notified before any works or earth movement, Darkinjung to be contacted via email to cultural & heritage team 30 days before any works commence.
2. Darkinjung to be engaged for Monitoring of earth movement and works.
3. In the case of Aboriginal cultural heritage sites or material being discovered, work should cease. The area should be avoided and the Office of Environment & Heritage along with Darkinjung should be contacted immediately.
4. Please note, under the National Parks and Wildlife Act (1974) it is an offence to harm (destroy, deface or damage) or desecrate an Aboriginal object or Aboriginal Place, or in relation to an object, move the object from the land on which it has been situated. Penalties range from \$275,00 and 1 year imprisonment to \$555,000 and 2 years imprisonment for an individual up to 1,100,000 for a corporation.

Please do not hesitate to contact me on the details listed above should you require any further information in regards to the project.

Kind regards,

A handwritten signature in black ink, appearing to read 'Anthony Freeman'.

Anthony Freeman
Heritage Officer – Culture and Heritagewww.darkinjung.com.auwww.facebook.com/darkinjung

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 261648







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Document Verification

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		Signature			
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Appendix B

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Appendix C

DCP Test Results

Appendix D

Point Load Strength Index Test Results

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Laboratory Test Result Certificates

1 Introduction

1.1 Project overview

The proposed Terrigal Beach promenade to The Haven boardwalk (hereafter referred to as 'the boardwalk') is intended to improve the amenity and accessibility for tourists visiting the region. It is Central Coast Council's ('Council') ambition that the boardwalk would become a tourist attraction and a destination enhancing experience which compliments the natural coastal environment.

1.2 Purpose of the report

A geotechnical investigation has been undertaken by Arup to inform the design of the of the boardwalk. This geotechnical interpretive report presents the following:

- An overview of the existing topographical, geological and geomorphological information of the site.
- Geological and geomorphological mapping of existing site features, to assess the stability of the site, assess current risk levels and identify geotechnical issues and constraints on the proposed boardwalk.
- Factual data obtained during the geotechnical investigation performed by Arup in May 2018.
- Geotechnical interpretation of the ground conditions and engineering design parameters, identified site constraints and recommendations on constructability and detailed design of the boardwalk

1.3 Disclaimer

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties that vary from place to place and can change through time. Geotechnical engineering involves gathering and assimilating the facts about these characteristics and properties in order to understand or predict the behaviour of the ground and groundwater on a particular site under certain conditions.

Arup may report such facts obtained by observation, excavation, probing and sampling, testing or by other means of investigation. If so, they are directly relevant only to the ground and groundwater at the place where, and the time when, the investigation was carried out, and are believed to be reported accurately.

Any interpretation or recommendation given by Arup shall be understood to be based on judgement and experience and not on greater knowledge of the facts than the reported investigations would imply. The information contained within this report shall be considered as for reference only.

Central Coast Council

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This report has been prepared for the use of our Client in connection with the aforementioned project and takes into account particular requirements and instructions. It is not intended for use by any third party and no responsibility is undertaken to any third party.

2 Proposed Structure

Following consultation with the Council, the preferred option to carry through to Concept Design is an elevated boardwalk comprising of timber and perforated decking that would allow people to view the water beneath the viewing platforms. The eastern and western ends of the boardwalk, at The Haven and Terrigal Beach respectively, is to be on grade. While the portion adjacent to the existing rock platform and intertidal zone of The Haven are to be suspended on steel and concrete piers.



Figure 1 - Visualisation of proposed boardwalk (looking south-east)

3 Investigation

3.1 Fieldwork

The fieldwork for the subsurface investigation took place between the 22 May and the 25 May 2018 and comprised of the following:

- Four Boreholes (BH1 to BH4) progressed by auger and diamond core drilling techniques to final depths ranging between 8.29 metres below ground level (mbgl) and 8.80 mbgl. The boreholes were drilled by Rockwell Drilling Services Pty Ltd.
- Nine DCPs were performed on the overlying soil strength material to refusal on rock ranging in depth between 0.40 mbgl to 0.82 mbgl.

Prior to the ground investigation the site was cleared of services using electronic locating equipment from specialist sub consultants Down Under Detection Services Pty Ltd.

The fieldwork was carried out under the direction of an Arup geotechnical engineer who was present full time on site. The geotechnical engineer set out borehole locations, directed sub-contractors, logged the encountered subsurface profile and nominated sampling and testing.

The borehole and DCP locations are shown in Figure 3. The borehole logs (including field test results, Point Strength Index test results and groundwater observations) are provided in Appendix B. For details of the investigation procedure reference should be made to the Arup Geotechnical Explanatory Notes provided in Appendix A.

The test locations were set out by taped measurements from existing site features. The surface levels at the test locations have been estimated from spot levels on the provided survey plan (Plan Number: 7650 Issue: A dated 07/07/2017) prepared by Stephen Thorne and Associates Pty Ltd. The site datum is Australian Height Datum (AHD).

The cored rock strength material was assessed by examination of the recovered core and correlation with Point Load Strength Index tests. The recovered rock core was photographed and Point Load Strength Index tests were completed, at an approximate frequency of one test per metre, by the geotechnical engineer on site during the fieldwork. The results of the Point Load Strength Index tests are attached as Appendix D. The core photographs are presented with the borehole logs in Appendix B.

The DCP test results were correlated to density of the overlying the coarse grained material and used to inform the variation in rock levels across the site.

3.2 Groundwater observations

Groundwater observations were made in the boreholes during and on completion of coring. Water has been introduced as part of the coring process which may have obscured groundwater depth measurement in the time period after coring.

3.3 Laboratory testing

Selected samples were submitted to a NATA registered laboratory (Macquarie Geotech Pty Ltd) for soil and rock testing including:

- Particle size distribution (PSD) on two soil samples;
- Aggressivity tests on five core samples; and
- Unconfined compressive strength (UCS) tests on eight core samples.

The test results are presented in Section 4.5

4 The site

4.1 Site location

The extent of the proposed boardwalk is presented in Figure 1 (shown as the red dotted line), located along Terrigal Esplanade, Terrigal, NSW.



Figure 2 - Site location map (Central Coast Council Terrigal Master Plan Concept, 2017)

4.2 Topography

Based on the provided survey contour plan, and observations carried out during the fieldwork, the approximate proposed boardwalk alignment is located along the coastline bordered to the south by an inclined slope with variable steepness. The proposed boardwalk extends out around the headland where the rock face becomes very steep. There are rocky outcrops at the base of the slope and within the intertidal zone between the beach and the headland.

4.3 Existing structures

At the time of fieldwork, the site contained a stacked sandstone revetment wall, and stacked concrete culverts. South-east of the site there is a café/restaurant, the Reef Restaurant & Cove Café positioned at an elevated level of approximately 4.5 mAHD behind the stone wall structure.

4.4 Services

A utilities search has been performed via Dial Before You Dig (DBYD) service. Results of this survey indicated a storm water drainage culvert within the site. Visual Inspection of the Site indicate gas lines in proximity to the beach.

4.5 Subsurface conditions

4.5.1 Geology

Reference to the 1:100,000 geological map of Gosford-Lake Macquarie Special indicates that the site is underlain by the Terrigal Formation. It is described as interbedded laminate, shale and fine to coarse grained quartz to quartz-lithic sandstone; minor red claystone. This is consistent with the encountered conditions observed during the investigation.

For detailed subsurface conditions at each borehole location, reference should be made to the borehole logs in Appendix B. A geological cross section is presented in Drawing 2. The location of the geological section is presented in Drawing 1. A summary of the pertinent subsurface conditions is presented below.

4.5.2 Sand

Marine sand was encountered in all borehole locations. The thickness of sand was between 0.65m and 1.00m. The levels and thickness of sand for each borehole is summarised in Table 1.

4.5.3 Clay

High plasticity residual clay was encountered in three borehole locations. The clay was positioned directly above bedrock and was between 60mm and 200mm thick. The levels and thickness of clay for each borehole is summarised in Table 1

4.5.4 Sandstone

Interbedded sandstone and siltstone was encountered below sand and clay. The Sandstone was assessed to be moderately weathered to slightly weathered and low to medium strength.

The following defects were recorded:

- Horizontal extremely weathered seams up to 100mm thick;
- A number of undulating to planar bedding partings between 0-25 degrees;
- A number of undulating, stepped and planar joints between 15-90 degrees were recorded. Some joints were healed;
- Crushed seam up to 30mm thick typically filled with rock fragments and clay; and One clay seam 30mm thick was recorded.

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The following core-loss was also recorded:

- BH2 at 8.55 150mm.

The core loss zones may be interpreted as representing clay seams, weathered seams or fractured bands of bedrock

4.5.5 Siltstone

Interbedded sandstone and siltstone was encountered below sand and clay. The siltstone was assessed to be highly weathered to moderately and very low to medium strength.

The following defects were recorded:

- Horizontal extremely weathered seams up to 90mm thick: and

One clay seam 40mm thick was recorded

4.6 Summary of stratigraphy

A summary of the stratigraphy encountered is summarised in Table 2 following. Bedrock units are classified based on Pells (1998) rock mass classification system. The siltstone lithology is classified under the Shale rock classification. A geological cross section is presented in Drawing 2.

Table 1 - General stratigraphy encountered

Borehole		BH1	BH2	BH3	BH4
Sand	Depth (mbgl)	0.00 – 0.65	0.00 – 1.00	0.00 – 0.90	0.00 – 0.65
	Thickness (m)	0.65	1.00	0.90	0.65
Clay	Depth (mbgl)	-	1.00 – 1.14	0.90 – 1.10	0.65 – 0.71
	Thickness (m)	-	0.14	0.2	0.06
Class V	Depth (mbgl)	Shale: 2.63 – 3.75	-	-	-
	Thickness (m)	Shale: 1.12	-	-	-
Class IV	Depth (mbgl)	Shale: 5.23 – 7.60, Sandstone: 1.45 – 2.63, 3.75 – 5.23	Sandstone: 1.30 – 7.35	Shale: 1.10 – 3.20, 7.82 – 8.29, Sandstone: 3.2 – 6.25, 6.85 – 7.82	Shale: 1.05 – 1.45, Sandstone: 1.45 – 5.00
	Thickness (m)	Shale: 2.37, Sandstone: 1.18, 1.48	Sandstone: 6.05	Shale: 2.10, 0.47, Sandstone: 3.05, 0.97	Shale: 0.4, Sandstone: 3.55
Class III	Depth (mbgl)	Shale: 0.85 – 1.45	-	-	Sandstone: 5.00 – 7.25
	Thickness (m)	Shale: 0.60	-	-	Sandstone: 2.55
Class II	Depth (mbgl)	Sandstone: 7.60 – 8.55	-	-	Sandstone: 7.25 – 8.80
	Thickness (m)	Sandstone: 0.95	-	-	Sandstone: 1.55

4.7 Groundwater

Groundwater was typically encountered between 0.5mbgl in line with sea level. Water was introduced during core drilling and can obscure groundwater measurements during the course of fieldwork.

Water flush returns were typically 100% except in BH2 where the flush returns varied between 80-100%. This indicates a relatively impermeable rock mass. Ground water levels were measured after drilling. The water level was typically measured at between 0.9 mbgl and 2.00 mbgl.

Table 2 - Groundwater depths

Borehole ID	Encountered groundwater depth during drilling (mbgl)	Measured groundwater depth after drilling (mbgl)
BH1	0.5	1.5
BH2	0.5	0.9
BH3	Not recorded	2.0
BH4	Not recorded	1.0

4.8 In-situ testing

4.8.1 SPT tests

Standard Penetrometer Tests (SPTs) were undertaken almost continuously on the soil strength material in boreholes until reaching refusal on the underlying bedrock. The SPT tests show the coarse grained material to range in density between very loose to medium dense with the density typically increasing with depth. The SPT results are presented in the borehole logs in Appendix B. A summary of the density correlation with depth is presented in Table 3.

Table 3 - Summary of SPT results

Depth of SPT test (mbgl)	Borehole ID			
	BH1	BH2	BH3	BH4
0-0.45	VL	VL	VL	VL
0.5-0.95	VL	VL-MD	VL	VL-L (refusal)
1.00-1.45	-	MD (refusal)	MD (refusal)	-

4.8.2 DCP tests

A total of nine Dynamic Cone Penetrometer (DCP) tests were undertaken at the locations indicated on Figure 3 until refusal on bedrock. The DCP tests show that the sand was very loose to very dense, with density generally increasing with depth. Depth of refusal is indicative of depth to bedrock. The DCP logs are presented in Appendix C.

A summary of the correlated density with depth is presented in Table 4 below.

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Table 4 - Summary of DCP test results

Depth (mbgl)	DCP ID								
	DCP 1	DCP 2	DCP 3	DCP 4	DCP 5	DCP 6	DCP 7	DCP 8	DCP 9
0-0.1	VL	VL	L	VL	VL	VL	VL	VL	VL
0.1-0.2	VL	VL	L	VL	VL	VL	L	VL	VL
0.2-0.3	VL	VL	MD	VL	VL	L	L	VL	L
0.3-0.4	MD	MD	VD	L	MD	MD	MD	L	L
0.4-0.5	D	MD		L	D	MD	MD	VD	MD
0.5-0.6	VD	D		MD	VD	MD	VD		MD
0.6-0.7	VD	VD		VD		VD			D
0.7-0.8		VD				VD			VD

4.8.3 Point load strength index

A total of 78 point load strength index tests were undertaken on rock core samples recovered from boreholes.

The point load tests indicated the $I_s(50)$ index strength ranged from 0.02 MPa to 0.74 MPa and 0.04MPa to 1.11MPa for diametral and axial tests respectively.

A plot of $I_s(50)$ index strength versus reduced level is presented in Figure 3. The profile of $I_s(50)$ with depth can be seen to be relatively uniform. The point load test results indicate that the rock core strength ranged from very low to high but was typically low to medium strength. There is a general trend of increase of rock strength with depth.

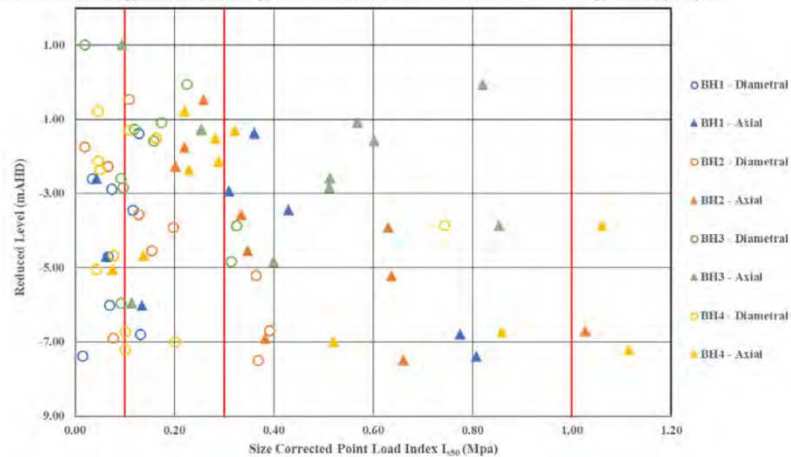


Figure 3 - Point load index strength vs reduced level

4.9 Laboratory test results

4.9.1 Particle size distribution tests

Particle size distribution (PSD) tests were completed for two samples. The test results indicate the two samples consist of predominately medium sized sand with one sample (BH1 0.5m to 0.65m) containing up to 22% fine grained material. Results of the PSD test are shown in Figure 4.

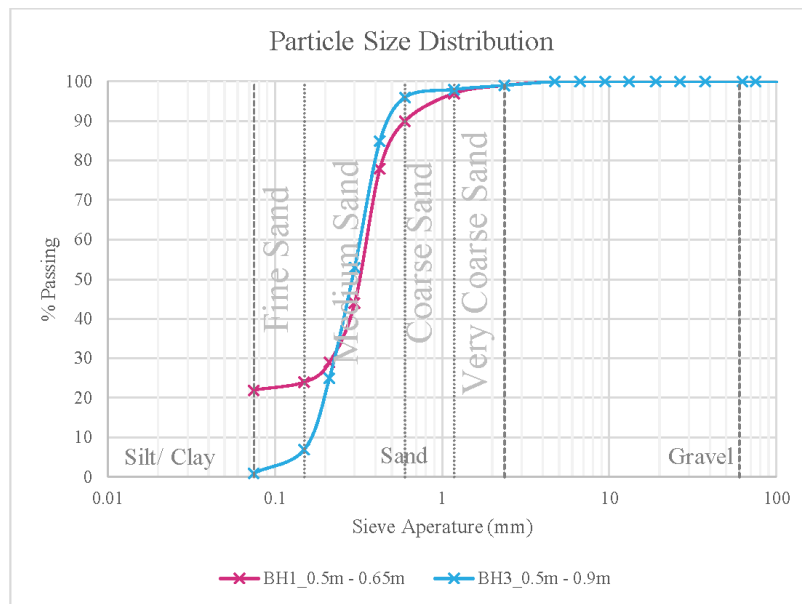


Figure 4 - Results of particle size distribution

4.9.2 Uniaxial compressive strength tests

A total of eight cored samples were tested for uniaxial compressive strength (UCS). Seven of the tests were performed in sandstone and one test was performed in siltstone. Testing results indicate sandstone to be of medium strength and siltstone to be of upper bound of very low strength. The test results by rock mass classification are summarised in Table 5.

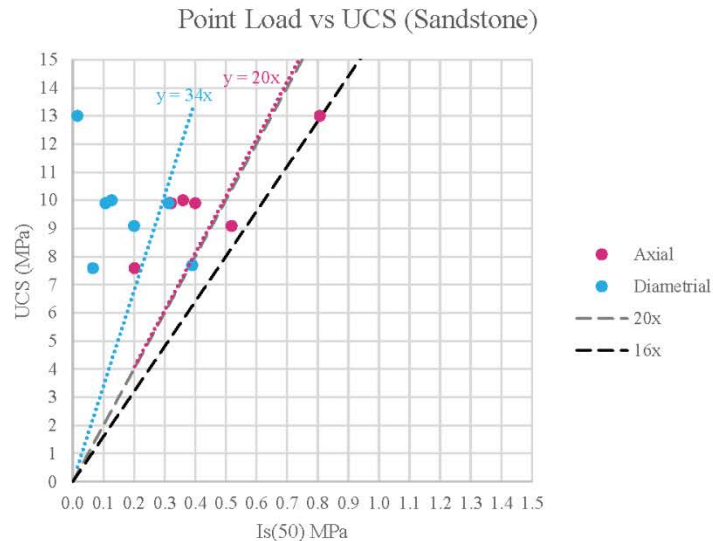
Table 5 - Summary of UCS testing

UCS Test Summary	Sandstone Class II	Sandstone Class III	Sandstone Class IV	Shale Class IV
Number of UCS Tests	2	2	3	1
Min UCS (MPa)	9.1	7.7	7.6	1.9
Max UCS (MPa)	13.0	9.9	10.0	1.9
Average UCS (MPa)	11.1	8.8	9.2	1.9

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Relationship between point load $Is(50)$ values to UCS for sandstone are shown in Figure 5 - Point load $Is(50)$ vs UCS Figure 5. The recommended correlation factor for $Is(50)$ to UCS is summarised in Table 6.

Figure 5 - Point load $Is(50)$ vs UCSTable 6 - Recommended $Is(50)$ to UCS correlation factor

Rock Mass Lithology Type	$Is(50)$ to UCS Correlation Factor
Shale	20
Sandstone	20

4.9.3 Aggressivity tests

A total of 5 rock samples were tested for aggressivity and are presented in Table 7. The exposure classification for concrete in accordance with AS2159 and AS5100 are shown in Table 8.

Aggressivity testing indicate the bedrock to be typically 'non-aggressive' to 'mild' for concrete piles. However, given the location of the project is situated within an active coastal environment, marine exposure classification is recommended.

Table 7 - Summary of aggressivity tests

BH_ID	BH1	BH2	BH3	BH4	BH4
From (m)	6.00	3.06	2.50	6.00	8.00
To (m)	6.10	3.23	2.60	6.10	8.17
Rock Class ¹	SH-IV	SS-IV	SH-IV	SS-III	SS-II

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BH_ID	BH1	BH2	BH3	BH4	BH4
Sulphate Content (ppm)	12.4	103	16.5	14.4	10.3
Sulphate Content (%)	0	0	0	0	0
Chloride ion content (ppm)	327.9	673.6	124.1	195	31
Chloride ion content (%)	0.03	0.07	0.01	0.02	0
pH	6.1	6	6.9	6.7	6.9

Note: 1. SH = SHALE, SS = Sandstone

Table 8 - Exposure classification

Australian Standard	Surface and Exposure Environment	Exposure Classification
AS2159	Sea water – Tidal/ splash zone	Severe
AS5100-2017	In tidal/ splash zone	C2

4.10 Geological mapping

Geological mapping was undertaken for the project area.

The project area can be classified into distinct geomorphological zones. The ground conditions encountered in each zone are summarised in Table 9 below. Reference should be made to Figure 6 for the location of the geomorphological zones described.



Figure 6 - Geological domains and geomorphological zones

Table 9 - Summary of ground conditions

Geomorphological Zone	Description	Ground conditions
Zone 1	Wave-cut platform	Exposed sandstone and siltstone bedrock. The wave-cut platform is formed by a competent sandstone bed of the Terrigal Formation, approximately 1.6m thick. The platform has

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Geomorphological Zone	Description	Ground conditions
	Exposed rock creating the headland between Terrigal beach and The Haven	minor interbeds of siltstone, which have undergone preferential weathering, resulting in undercutting of the rock platform. The cliff behind the wave-cut platform is approximately 14m high based on the provided 2017 survey plan prepared by Stephen Thorne and Associates. The cliff comprises soil and/or extremely weathered rock, overlying interbedded sandstone and siltstone of the Terrigal Formation, variably weathered. The upper portion of the slope is covered by dense vegetation. Evidence of rockfalls was observed during 1994, 1997 and 2018 site walkover inspections. Sub-surface investigation was not undertaken at this location.
Zone 2	Tidal zone	Shallow marine sand overlying sandstone and siltstone bedrock. Exposed rock can be seen in the shallow water. Sub-surface investigation was not undertaken at this location.
Zone 3	Beach zone	Shallow marine sands (approximately 1m depth) overlying sandstone and siltstone bedrock. Sub-surface investigation undertaken within this zone.

Nine geological domains were delineated based on geological, geomorphological, and slope hazard classifications. Within each geologic domain slope stability hazards are identified. These include:

1. Small rockfall (<0.5m diameter) out of the steeper slope from weathering and root jacking.
2. Rockfall of boulders (0.5m to 2m in diameter) out of the near vertical cliff. Structural controlled from either the cliff face or above the eroding siltstone.
3. Soil debris flows off the crest of the slope.
4. Cliff collapse (up to 10m L x 3m W x 7m H) due to erosion of the weaker siltstone layer at the base of the geologic profile.
5. Landslide. Rotational or translation slides through the soil/residual soil profile

4.10.1 Domain 1

Domain 1 is predominantly a soil slope. The angle of the slope ranges from ~15° at the crest of the slope to around 45° at its steepest point. The average slope angle across the Domain is ~25°.

The slope stability hazards identified within Domain 1 are deep-seated rotational landslides or smaller surficial soil debris slump/flow.

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Figure 7 - Wall and vegetated slope in Domain 1

4.10.2 Domain 2

Domain 2 is predominantly a soil slope above a layer of siltstone. The angle of the slope ranges from $\sim 15^\circ$ at the crest to an average of 35° for most of the slope.

The main slope stability hazard identified within Domain 1 is surficial soil debris slump/flow off the crest or rockfall from root jacking of boulders less than 0.5m in diameter.



Figure 8 - Profile photo of Domain 2 slope

4.10.3 Domain 3

The angle of the Domain 3 slope ranges from $\sim 15^\circ$ at the slope crest to 70° at the beach. The average slope angle across the Domain is $\sim 45^\circ$.

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Slope hazards present in Domain 3 are larger rockfalls ($>0.5\text{m}$ diameter) and debris flows off the crest. The weaker siltstone layers has not been significantly eroded in Domain 3.



Figure 9 - Domain 3 cliff face

4.10.4 Domain 4

Domain 4 captures a natural bend in the cliff face and the focus of drainage from the crest. The angle of the Domain 4 slope ranges from $\sim 10^\circ$ at the slope crest to a maximum angle of 65° at the beach. The average slope angle across the Domain is $\sim 50^\circ$. The weaker siltstone layer in Domain 4 is eroded back to $\sim 2\text{m}$ from the present cliff face. This is likely due to focused wave action or increase groundwater in the bend.

The slope hazards identified with Domain 4 are rockfalls, debris flows, and cliff collapse from wave erosion.

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Figure 10 - Domain 4 cliff face

4.10.5 Domain 5

The angle of the Domain 5 slope ranges from $<10^\circ$ which gradually becomes steeper to reach a maximum angle of 70° at the beach. The average slope angle across the Domain is $\sim 50^\circ$.

The major hazard within Domain 5 is cliff collapse from the wave erosion of the weaker siltstone and undercutting the sandstone. Debris flows off the crest and smaller rockfall are also identified hazards.



Figure 11 - Domain 5 cliff face

4.10.6 Domain 6

Domain 6 represents the cliff nose. This is a moderately to steeply sloping cliff face that extends from Domain 7 to the rock platform. The slope angle gradually

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increases from $\sim 15^\circ$ up to $\sim 65^\circ$ across the Domain. The average slope angle is $\sim 50^\circ$.

Rockfall hazard exists out of the steep cutting.



Figure 12 - Domain 6 (cliff nose) cliff face

4.10.7 Domain 7

Domain 7 has a moderately dipping slope that is relatively consistent across the Domain. The slope angle ranges from $\sim 10^\circ$ at the slope crest to a maximum steepness of 60° . The average slope angle across the Domain is $\sim 40^\circ$.

Debris flows are the main slope hazard present.

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Figure 13 - Domain 7 cliff face

4.10.8 Domain 8

Domain 8 has a moderately sloping cliff face. This Domain includes an existing footpath with benches set a few metres in front of the cliff face. The slope angle of Domain 8 ranges from $\sim 45^\circ$ up to 60° . The average slope angle across the Domain is $\sim 45^\circ$.

The main hazard present in Domain 8 is rockfall and debris flow off the crest.



Figure 14 - Footpath, bench, and cliff face in Domain 8

4.10.9 Domain 9

Domain 9 has a moderately dipping slope. Domain 9 includes an existing footpath at both the crest and toe of the slope. The slope angle ranges from a maximum of

55° at the top of the slope down to ~10° at the base of the slope. The average slope angle is ~35°.

Landslide is the identified hazard in Domain 9.



Figure 15 - View of Domain 9 (vegetated slope) from Domain 8

5 Risk Assessment

A risk assessment of the proposed boardwalk has been carried out in accordance to the Australian Geomechanics Society (AGS) Guidelines for Landslide Risk Management (2007). The assessment is based on the information from our site observations and investigations which has allowed a qualitative assessment to both life and property.

- The assessment looks at risk to property
- Risk to person most at risk and
- Societal risk given the large tourism visitation.

The assessment has assumed that the elements most at risk are:

- The proposed boardwalk

Persons (such as residents, recreational users or Council employees etc) at the base of the slope and cliff face, or on the proposed boardwalk

The proposed boardwalk alignment at the time of writing this report is the concept design.

5.1 Risk to life – person most at risk

The annual probability of loss of life for the person most at risk from cliff regression was estimated using the equation:

$$R(\text{lol}) = P(H) \times P(S|H) \times P(T|S) \times V(D|T)$$

Where:

- H is an identified hazard
- R(lol) is the risk (annual probability of loss of life of an individual)
- P(H) is the annual probability of failure
- P (S|H) is the probability of spatial impact of the failure reaching a person present on the boardwalk taking into account the size of the hazard, travel distance and the length of the boardwalk.
- P(T|S) is the temporal spatial probability that a person is present
- V(D|T) is the vulnerability of the individual loss of life from person present at the time of failure.

5.2 Hazard identification

Five hazards with the potential to impact persons on the boardwalk were identified during the site geologic mapping (Table 10) with respect to each of the nine geologic domains (reference Section 4.10). Representative hazard sizes were estimated from the geologic mapping.

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Table 10 - Identified hazards

Hazard	Description	Extend of slope effected/ size of failure	Trigger
SF	Small rockfall	<0.5m maximum diameter	Annual weather events and tree root jacking
RF	Boulder sized rockfall	>0.5m – 2m	1:10-year weather events and tree root jacking
DB	Soil debris off crest	3m x 5m x 1m	1:10-year rainfall event
CC	Cliff collapse	10m x 3m x 10m	Coastal erosion, Earthquake
LS	Landslide	5m x 10m x 2m	Extreme rainfall event (1:100-year), Earthquake

5.3 Annual probability of the failure event

The annual probability or likelihood $P(H)$ of the five failure events within each respective domain are provided in Table 11. The probabilities are estimated by considering the recurrence of triggering events and are calibrated with observations of recent failure made on site and of historic records (e.g. recent cliff failure at the Skillion).

Table 11 - Annual probability of failure

Domain	Hazard	$P(H)$ Annual probability of failure event
1	SF	1.0
	DB	0.1
	LS	0.01
2	SF	1.0
	DB	0.1
3	RF	0.1
	DB	0.1
4	RF	0.1
	DB	0.1
	CC	0.01
5	SF	1.0
	DB	0.1
	CC	0.01
6	SF	1.0
	RF	0.01
7	DB	0.1
8	SF	0.1
	DB	0.1
9	LS	0.01

5.4 Probability of Spatial Impact

The probability of spatial impact, $P(S|H)$, estimates the likelihood of the failure impacting a person on the boardwalk taking into account the hazard sizes, travel distance, and length of the boardwalk impacted in each domain if a person is present.

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The probability of the hazard reaching the boardwalk is estimated from the mapping and indicative cross-sections define each geologic domain provided in the figures below. Run-out and rockfall bounce are estimated using a 1:1 shadow angle plotted against the planning location of the boardwalk relative to the slope. This will be refined in the detailed design.

The probability that a hazard will impact a person if it reaches the board walk considered the hazard size is defined in Table 1 and the length of boardwalk in the domain. For example, a 1m boulder will only impact a portion of a 20m length of boardwalk.

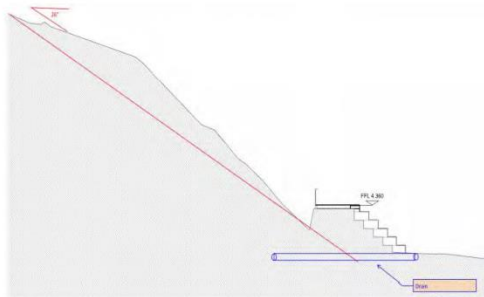


Figure 16 - Slope profile sketch through Domain 1

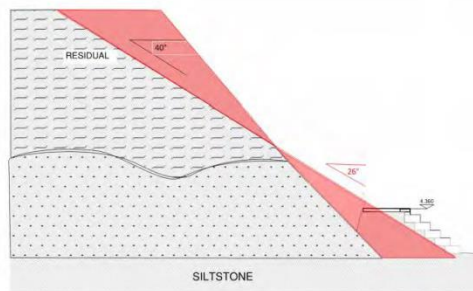


Figure 17 - Profile sketch through Domain 2

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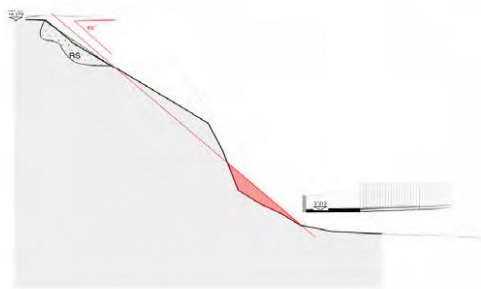


Figure 18 - Profile sketch through Domain 3

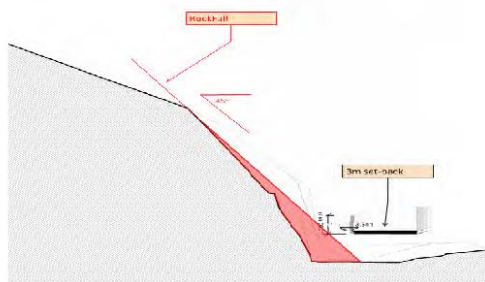


Figure 19 - Profile sketch through Domain 4

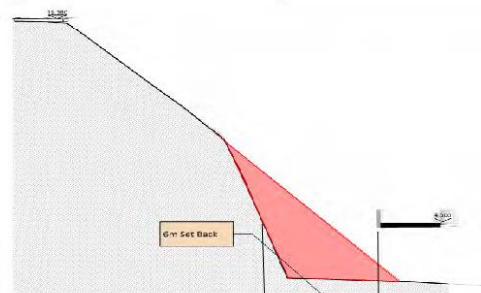


Figure 20 - Profile sketch through Domain 5

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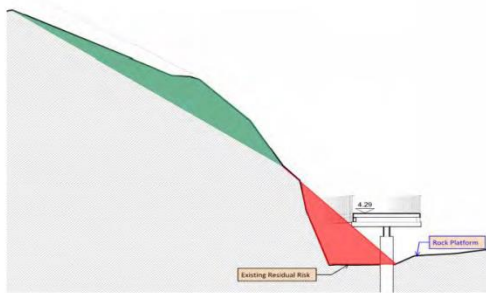
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Figure 21 - Profile sketch through Domain 6



Figure 22 - Profile sketch through Domain 7

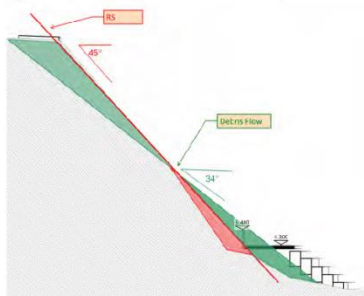


Figure 23 - Profile sketch through Domain 8

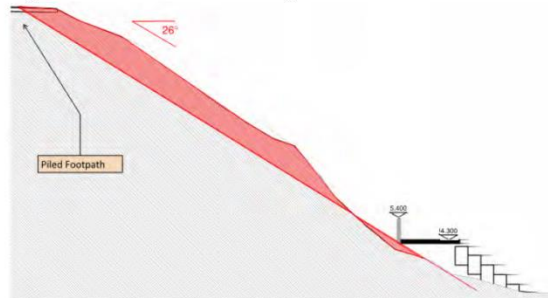


Figure 24 - Profile sketch through Domain 9

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Table 12 - Probability of spatial impact

Domain	Perpendicular Length of Domain	Hazard	Probability of the hazard reaching the boardwalk	P(S H) Probability that a person will be impacted by the Hazard if present
1	45m	SF	0.01	0.001
		DB	0.01	0.001
		LS	0.1	0.022
2	20m	SF	0.01	0.002
		DB	0.01	0.002
3	25m	RF	0.1	0.012
		DB	0.1	0.012
4	10m	RF	0.01	0.003
		DB	0.01	0.003
		CC	0.01	0.010
5	60m	SF	0.001	0.000
		DB	0.001	0.000
		CC	0.01	0.002
6	20m	SF	0.01	0.002
		RF	0.01	0.002
7	30m	DB	0.1	0.010
8	25m	RF	0.1	0.012
		DB	1.0	0.120
9	20m	LS	1.0	0.500

5.5 Vulnerability

The vulnerability (V (D|T)) of a person being killed by a rockfall if present and hit considers the size of the hazard.

A vulnerability of 0.5 is used for a direct impact of boulder >0.5m diameter following application of the AGS 2007 Landslide Guidance for Rockfall applied in Christchurch after the Canterbury Earthquake sequence in 2011.

A vulnerability of 0.10 is used for small rockfall and debris flow impacts.

Table 13 - Vulnerability

Hazard	Description	P(V T) Vulnerability
SF	Small rockfall	0.10
RF	Boulder rockfall	0.50
DB	Soil debris flows off crest	0.10
CC	Cliff collapse	0.50
LS	Large landslide	0.50

5.6 Temporal spatial probability

Considering the person-most-at-risk, the following users of the boardwalk have been considered;

- Council workers carrying out maintenance on the boardwalk 1 hour per day
- Local resident walking on boardwalk daily with average walking rate of 4 seconds per 5m length every day of the year
- Tourist on the boardwalk with single visit of 2 hours.

Table 14 - Temporal spatial probability

Person	Description	P(T S) Temporal spatial probability
Council Worker	1 hour per day	0.027
Resident Walker	10 minutes per day	0.007
Single visit tourist	1 hour over a single visit	0.0002

The Council Worker, with an annual occupancy of 1 hour per day, is considered the person-most-at-risk.

These estimates should be confirmed with Council during detailed design.

5.7 Assessed risk to life – person most at risk

The annual probability of loss of life for the person-most-at-risk across the geologic domains, considering the identified hazards is presented below summarises the risk for life of the person most at risk.

Table 15 - Assessed risk to life for person most at risk

Domain	Hazard	P(H)	P(S H)	P(T S)	V(D T)	R(lol)
1	SF	1.000	0.001	0.027	0.10	10 ⁻⁶
	DB	0.100	0.001	0.027	0.10	10 ⁻⁷
	LS	0.010	0.022	0.027	0.50	10 ⁻⁶
2	SF	1.000	0.002	0.027	0.10	10 ⁻⁵
	DB	0.100	0.002	0.027	0.10	10 ⁻⁶
3	RF	0.100	0.012	0.027	0.50	10 ⁻⁵
	DB	0.100	0.012	0.027	0.10	10 ⁻⁶
4	RF	0.100	0.003	0.027	0.50	10 ⁻⁵
	DB	0.100	0.003	0.027	0.10	10 ⁻⁶
	CC	0.010	0.010	0.027	0.50	10 ⁻⁶
5	SF	1.000	0.0001	0.027	0.10	10 ⁻⁷
	DB	0.100	0.0001	0.027	0.10	10 ⁻⁸
	CC	0.010	0.002	0.027	0.50	10 ⁻⁷
6	SF	1.000	0.002	0.027	0.10	10 ⁻⁵
	RF	0.010	0.002	0.027	0.50	10 ⁻⁷
7	DB	0.100	0.010	0.027	0.10	10 ⁻⁶

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Domain	Hazard	P(H)	P(S H)	P(T S)	V(D T)	R(IoI)
8	RF	0.100	0.012	0.027	0.50	10 ⁻⁵
	DB	0.100	0.120	0.027	0.10	10 ⁻⁵
9	LS	0.010	0.500	0.027	0.10	10 ⁻⁵

AGS (2007) provides guidance for Tolerable Loss of Life Risk for a person-most at risk (Table 16). Considering this is a new development, acceptable risk level is recommended to be at or below 10⁻⁵/annum.

Table 16 AGS Suggested Tolerable loss of life individual risk

Situation	Suggested Tolerable Loss of Life Risk for the person most at risk
Existing Slope (1) / Existing Development (2)	10 ⁻⁴ / annum
New Constructed Slope (3) / New Development (4) / Existing Landslide (5)	10 ⁻⁵ / annum

The calculated risk to the person most at risk considering the conceptual design shows the risk is at acceptable levels (Table 15).

5.8 Assessed risk to life – societal

Recognising the significant tourist population to the Central Coast and Terrigal and assessment of societal risk is considered appropriate. AGS 2007 provides guidance for the person-most-at-risk and recommends following ANCOLD 2003 for Societal Risk.

Only the larger coastal cliff collapse and landslides in Domains 1, 4, 5 and 9 are considered credible hazards that pose a risk to a larger population.

5.8.1 Population at risk

At the time of writing this report, estimates for boardwalk patronage had not been made available to Arup. An assumption of 1 million visitors per annum or 3,650 visitors per day assumptions have been made in order to complete the assessment.

For reference the Coogee to Bondi coastal walk, NSW, and the Twelve Apostles, Vic, have approximately 8,000 and 12,000 visitors per day, respectively.

Table 17 - Summary of assumed boardwalk patronage

Type	Number of people per year	Average time spent on boardwalk	Population per annum
Visitors to Terrigal	1,000,000	10 minutes	20

A population per annum of 20 means with 10 minutes average occupancy means that for every minute of the year there is 20 people on the boardwalk.

These estimates should be confirmed with Council during detailed design.

5.8.2 Cliff collapse event

Considering 20 people on the 255m boardwalk and a 10m cliff collapse/landslide, the population at risk exposed at any one time along the boardwalk is 1 person. Using a vulnerability of 0.5 for fatality from the hazard, the population at risk is 0.5 persons. As the population is less than 1, it suggests that considering societal risk for this failure is not appropriate.

5.8.3 Earthquake event triggering with widespread rockfall and cliff collapse

Considering a population of 20 during widespread rockfall and cliff collapse/landslides across the boardwalk, the populations exposed is conservatively estimated at 10 persons. Using a vulnerability of 0.5, the population at risk from fatality is 5.

A significant earthquake event that could generate ground accelerations to trigger widespread rockfall and cliff collapse across the boardwalk (Peak Ground Acceleration $> 0.5g$) has an annual probability of exceedance approaching 1:10,000 (10^{-5}). The probability of the widespread rockfall, landslide and cliff collapse reaching the boardwalk is 10^{-2} , therefore the frequency of this fatal failure is 10^{-7} .

Plotting five fatalities with a 10^{-7} frequency on the F-N diagram (ANCOLD 2003) shows the Societal Risk is Broadly Acceptable (Figure 25).

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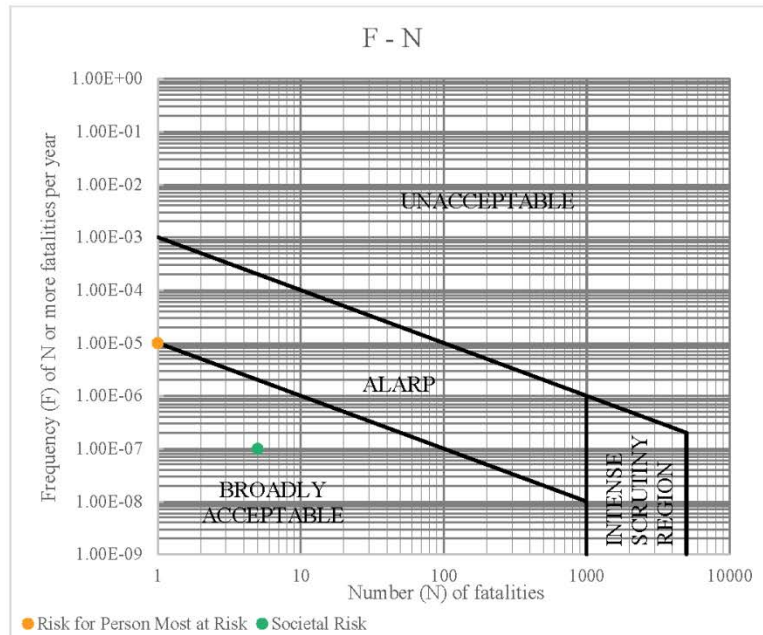
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Figure 25 - Frequency vs Number of Fatalities considering 1M visitors per annum

6 Risk to Property

The proposed boardwalk alignment has been adopted with the setbacks provided for each Domain in Section 3.1 which will provide sufficient buffer should a failure occur and have negligible impact of the boardwalk.

In determining the consequences to the boardwalk, it has been assumed that size of slope failures will be limited to the extents outlined in Table 10 and that there is little detrimental impact on the adjoining sections of the boardwalk, and the rate of failure will be instantaneous. Further the cost of reconstruction and/or repair of the boardwalk has been established on a lineal rate estimated from the current project capital cost of \$4.5M and a boardwalk length of approximately 200m. This results in a unit rate of \$22,500 per metre of boardwalk. Therefore, the following approximate costs of have been adopted for each identified hazard.

Table 18 - Assessed consequences to Property

Hazard	Extend of slope effected/ size of failure	Approximate Cost of damage		Assessed Consequence to property
		Approximate cost	Indicative Value	
Small rockfall	<0.5m	\$22,500	0.5%	Insignificant
Boulder rockfall	>0.5m			
Soil debris flows off crest	3m x 10m x 1m	\$225,000	5%	Minor
Cliff collapse due to erosion of siltstone layer	10m x 3m x 10m	\$450,000	10%	Medium
Landslide	5m x 10m x 2m			

Table 10 summaries the qualitative assessment of each of the geo hazards identified and the assessed consequences to the proposed boardwalk. In accordance with the criteria provided in AGS (2007) Low risk levels would be considered to be 'acceptable', Moderate risk levels would be considered to be 'tolerable'.

Table 19 - Summary of risk to property.

Geohazard	Small rockfall	Boulder rockfall	Soil debris flows off crest	Cliff collapse due to erosion of siltstone layer	Landslide
Affected Domains	1, 2, 3, 8	4, 5, 6, 7	2, 3, 4, 6, 7, 9	5, 6, 7	1, 2, 3
Size of Failure	<0.5m	>1m	10m	20m	20m
Assessed Likelihood	Almost Certain	Possible	Likely	Possible	Rare
Assessed Consequences	Insignificant	Minor	Insignificant	Minor	Medium
Risk	Moderate	Moderate	Moderate	Moderate	Low

7 Geotechnical Design parameters

The following section summarises the strength and deformation parameters for soil and rock units encountered along the proposed boardwalk. The recommendations have been made with consideration of the data collected during the investigation, published relationships and engineering judgement based upon previous experience.

7.1 Design parameters for soils

Limited soil was encountered overlying rock, and therefore limited testing has been carried out. The suggested design parameters have been based on the interpretation of the limited SPT 'N' values and DCP test results and are summarised in Table 20.

Poisson's ratio typically ranges between 0.2 to 0.4 for unsaturated clays and sand. A value of 0.3 has been adopted.

Active, at-rest and passive earth pressures presented below have been derived from representative drained soil parameters and are for level backfill. Modification for the earth pressure coefficients will be required where a sloping backfill is apparent.

The shallow footing capacities for soil included in the table below are based on a specific geometry and are suitable for preliminary design, but require further refinement at subsequent design stages.

7.2 Rock mass characteristics

The behaviour of rock containing discontinuities or planes of weakness within them is controlled by the rock mass rather than the intact condition, the derivation of parameters for rock masses is inherently challenging because of the number of features to consider and their own variability in the field. Therefore, a rock mass classification, as outlined in Section 4.6, has been carried out to allow for the variation of the intact rock quality and the frequency condition to be rationalised along discrete classes.

The rock mass modulus and strength parameters have been adopted based on results of the investigation, published parameters and previous experience with similar materials.

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Table 20 - Summary of soil design parameters

Material type	Consistency	Bulk unit weight (kN/m^3)	Peak friction angle ($^\circ$)	Undrained shear strength (kPa)	Elastic modulus (MPa)	Poisson's Ratio	Ultimate capacity of shallow pad (kPa) ¹	Ultimate end bearing capacity (kPa) ²	Ultimate shaft capacity (kPa)
Marine Sands	Very loose to loose	17	28	-	5 - 10	0.3	-	-	10
	Medium dense	19	33	-	40	0.3	200	200 x z (max 1MPa)	25

Table 20 notes:

1. Assumed depth of shallow footing minimum of 0.5m below a horizontal ground surface and vertically applied load. These values do not account for groundwater table.
2. Minimum of 4 pile diameters in the founding material required to achieve provided bearing capacities, z is the depth below ground.

Table 21 - Summary of earth pressure coefficients

Material type	Drained analysis		
	Active earth pressure coefficient (Ka)	Passive earth pressure coefficient (Kp)	At-rest earth pressure coefficient (Ko)
Marine sands – Very loose to loose	0.36	2.8	0.53
Marine sands – Medium dense	0.29	3.4	0.46

Table 21 notes:

1. Assume horizontal surface in-front and behind a vertical wall.
2. No wall/soil friction has been assumed in earth pressure calculations.
3. In order to mobilise the full passive pressure, displacement is required and therefore must be considered in the design.

Table 22 - Summary of rock design parameters

Unit	Rock Class	Bulk unit weight (kN/m^3)	Poisson's Ratio	Rock Mass Modulus (MPa)	Ultimate end bearing ¹ (MPa)	Ultimate shaft adhesion ^{1,4} (kPa)	Allowable end bearing ^{1,3} (MPa)
Siltstone	I	24	0.2	2000	100	1000	6
	II	24	0.2	1000	60	800	2
	III	24	0.25	600	20	500	1.5
	IV	24	0.25	300	5	150	1
	V	24	0.3	75	3	75	0.7
Sandstone	I	23	0.2	2000	120	3000	8
	II	23	0.2	1200	80	2500	6
	III	23	0.25	800	30	1200	4
	IV	23	0.25	400	10	500	3
	V	23	0.3	75	3	150	1

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Table 22 notes:

1. Ultimate capacities are mobilized at large displacements—generally 5% to 10% of pile diameter (or minimum footing dimension)—and require reduction by ϕ_g for ULS design accordance with AS2159 – 2009 [1]. A lower bound value $\phi_g = 0.40$ is advised for preliminary design, though it may be possible to justify higher values with pile testing during construction.
2. Serviceability capacities are mobilized at displacements of 1% pile diameter (or minimum footing dimension).
3. Where the design is dependent upon end-bearing resistance, piles must extend at least one pile diameter into the founding stratum to develop full design end-bearing and found at least three pile diameters above underlying weaker strata. A minimum of 0.5m embedment in the founding material to achieve shaft resistance.
4. Assumes a rock socket roughness category R2 (grooves of depth 1 mm to 4 mm, width greater than 2 mm, at spacing 50 mm to 200 mm) or better (Walker and Pells [2]).
5. In the event of uplift, only ULS shaft friction can be relied upon and these values must be reduced by a factor of 0.75 in addition to the geotechnical reduction factor, and mechanisms of piston and cone failure must be considered (Pells et al [3]). Cone failure often controls for large tension forces in short rock sockets, particularly near ground surface.

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8 Comments and recommendations

8.1 Construction method

Preliminary constructability assessments have been completed as part of the concept design process. Four distinct zones have been identified, as shown in Figure 26, which take into account access considerations and main construction activities anticipated to be carried out in each zone. The anticipated construction activities are summarised in Table 23, note that this is not an exhaustive list of possible activities.



Figure 26 - Proposed construction methodology

The following construction considerations should be considered as they will impact the ultimate design solution, include additional construction activities than those listed in Table 23, and could have significant cost implications on the project:

- Foundation construction is to be both land and water based, depending on foundation positions. It is recommended that an Early Contractor Involvement (ECI) period be carried out alongside detail design to ensure adequate understanding of the constraints and constructability of the final boardwalk design.
- Locations the barge can access may be limited and consideration of tides will be required. Due to the shallow rock in the water will put limitations on the type of barge and its anchoring locations.
- Vibrations caused by heavy construction equipment either tracking or during excavation may increase the risk of rock fall from the nearby slope and cliff.

Table 23 - Construction methodology for each defined construction zone

	Areas within the construction zones	Brief description of the proposed works
Construction Zone 1	<ul style="list-style-type: none"> Terrigal rockpool Existing footpath onto the rock platform at western end of proposal 	<ol style="list-style-type: none"> Closure of the Terrigal rockpool Carry out cliff stabilisation and remediation works Install piles to rock Assemble and install boardwalk steelwork and decking
Construction Zone 2	<ul style="list-style-type: none"> Rock platform area Barge footprint in the ocean 	<ol style="list-style-type: none"> Establishment of marine plant into fixed position north of the rock platform, if required Install piles into rock and prefabricated steel pier Lift prefabricated boardwalk superstructure to the piers and fix into position Install decking and other fixtures as required
Construction Zone 3	<ul style="list-style-type: none"> Intertidal zone between the rock platform and the proposed sandstone wall extension 	<ol style="list-style-type: none"> Establishment of temporary causeway over the intertidal zone to enable land-based access Install piles into rock and prefabricated steel pier Lift prefabricated boardwalk superstructure to the piers and fix into position Install decking and other fixtures as required
Construction Zone 4	<ul style="list-style-type: none"> Beach area at eastern end of proposal Existing sandstone wall at the Haven precinct 	<ol style="list-style-type: none"> Establishment of platform to enable access for land-based plant along beach Remove part of existing seawall for realignment and extension Excavate sand to top of rock level and install sandstone blockwork wall Fill behind new blockwork wall in staged increments Reinstate drainage and culvert Install footpath and miscellaneous items

8.2 Site preparation

To allow for construction of the on-grade portion of the boardwalk and access track in Construction Zones 1 and 4, adequate preparation. Therefore, it is recommended that the existing sandy subgrade, in Construction Zone 4 be proof rolled to improve the near surface compaction of the soils and assist in identifying any soft or unstable areas and should be completed in the following sequence:

- Removal of vegetation and stripping of any root affected soils if encountered.
- Proof roll the existing soil subgrade with at least eight passes of a minimum 8 tonne deadweight smooth drum roller. The sand subgrade will need to be thoroughly moistened before commencing proof rolling.
- A thin layer of road base (75mm thick) should be provided over the sand subgrade to allow of near surface compaction and prevent shearing during rolling.
- Any soft or unstable areas identified during proof rolling should be locally excavated down to a competent base and replace with engineered fill comprising DGS40 as defined by RMS QA Specification 3051, and compacted to at least 95% Modified Maximum Dry Density (MMDD) using an 8 tonne deadweight drum roller.
- Density tests should be carried out on the engineered fill to confirm the required density is achieved. The frequency of density testing should be in accordance to the requirements for Level 1 control in AS3798.

The temporary causeway material shall comprise of high strength and durable angular rock fill such as good quality sandstone. The rock fill shall have the following parameters:

- Single sized, 300mm crushed rock;
- Saturated Point Load Index (Is(50)) no less than 1.5MPa, and
- Maximum sulfate weight loss of 25%.

The rock fill must not be end dumped and should be placed in maximum 0.6m thick loose layers using a large excavator. Each layer should be rigorously tamped down using the excavator bucket prior to placing of subsequent layers. Once the rock fill has extended up above the tidal variation, the surface should be graded level and heavily compacted with a smooth drum roller. The upper portion of the cause way above the tidal variation should comprise DGS40 material, as referenced above, may be utilised as a working surface.

Further, it is noted that a number of rock under cuts have been identified over the rock platform in Construction Zone 2. Therefore, it is recommended that prior to site works commencing, a qualified geotechnical engineer/engineering geologist inspect the rock platform and identify the location and extend of the rock under

cuttings and these areas be demarcated to prevent surcharging the under cuttings with plant of building materials.

8.3 Foundation options

The following section summarises the geotechnical recommendations for the foundations of the proposed boardwalk.

8.3.1 Shallow foundations

It is recommended that shallow foundation be founded on rock, in order to avoid scour and undermining of the footings if founded in sands. Shallow footings, such as strip footings are feasible for the extension of the sandstone block wall in Construction Zone 4 and proposed retaining wall in Construction Zone 1 may be founded on rock and designed using the suggested ultimate bearing pressures presented in Table 22.

The geotechnical strength reduction factor, Φ_g , for design of pad or strip footings and culvert base slabs, shall be in accordance with AS5100.3-2017 (Tables 5.3.3.3A and 5.3.3.3B) [4]. The range of Φ_g indicated within AS5100.3 for pad footings ranges from 0.35 to 0.65. Based on the current investigation a Φ_g of 0.65 is considered appropriate.

It is recommended that footing excavations are inspected by a suitably qualified and experienced geotechnical engineer or engineering geologist during construction to ensure founding conditions are consistent with those on which design recommendations are based. Any loose or water-softened material should be removed prior to pouring concrete or a blinding layer is provided to the footing base.

8.3.2 Piled foundation

Based on the current design the boardwalk is suspended in parts of Construction Zone 1 and of Construction Zones 2 and 3. Bored cast in place piles are considered most suitable for the foundation of the suspended portion of the boardwalk.

In Construction Zone 1 bored piles can be completed without the use of temporary casing to stabilise the bores during pile construction. However, bored piles located over Construction Zone 3, may require temporary casing when drilling through the existing sandy soils and the temporary causeway fill.

In Construction Zone 4, and potentially the northern portion of Construction Zone 3, piles are anticipated to be installed using a piling equipment mounted on a barge. Sacrificial steel casing will be reamed into the rock surface to seal against water inflows at the seabed level. the soil, if encountered, and rock profile would then be drilled out using conventional bored piling techniques.

It is recommended that concrete be poured using tremie methods, and as such concrete specifications should consider the required workability parameters. Concrete should be poured without delay, preferably immediately following

completion of drilling and inspection, in order to avoid softening of the exposed foundation material.

High strength rock is anticipated on site, therefore, adequately sized piling rigs should be considered. It is noted that site access is constrained in Construction Zone 1 and 2. Smaller piling rigs will be required in this area, which will effect productivity rates and impact overall program.

Bored cast-in-place piles are to be constructed in accordance with AS 2159-2009 [1]. Based on an assessment of the site conditions an average risk rating for the design of bored piles socketed in weathered rock or better is between 2 to 2.5. In Table 4.3.2 (C) of AS2159-2009 [1], an average risk rating between 2 to 2.5 is defined as low risk and a Φ_g of 0.56 can be adopted.

AS2159-2009 requires integrity testing to be undertaken on piles where the adopted Φ_g is greater than 0.4. Based on the current proposed foundations which involves a bored pile with a plunged steel pier, and site access constraints, it is considered that the required amount of integrity testing may be difficult to be completed. The ultimate foundation design must consider these limitations when adopting reduction factors.

It is recommended that a qualified Geotechnical Engineer or Engineering Geologist inspect all piles to confirm that the anticipated ground conditions and design assumptions are satisfied.

Modulus of subgrade reaction, if required for soil for lateral pile support, these can be further developed using the proposed design stiffness parameters as provided in Table 22.

It is recommended to ignore the top 1.5D (AS 2159-2009, [1]) and the depth of any proposed scour when considering the lateral and vertical support to the pile foundation.

The rock platform is located in northern portion of Construction Zone 1 and in Construction Zone 2 may potential be undermined by wave action and erosion of a siltstone band located within the tidal variation height. Therefore, it recommended that the piles in the area, found below the siltstone band.

A serviceability check on the pile foundation under lateral and vertical load is also required, in accordance with AS 2159-2009 [1]. The pile shall be designed for serviceability by controlling or limiting pile movements so that deflections do not exceed the deflection limits. Calculations of lateral deflection and rotation of a pile and a pile group shall be carried out using geotechnical parameters that are appropriately selected and to which no reduction factor is applied. The designer shall select such parameters, taking into account the type of pile, the ground conditions, installation condition of the shaft and base and the direction and type of loading.

Refer to Section 8.5 for the exposure classification of the structures.

8.4 Retaining walls

The following list includes, but not limited to, considerations for the designs of gravity retaining walls:

- Retaining walls shall be assessed for stability and strength with appropriate design factors in accordance with AS5100.3:2017 [4].
- The design of the shallow foundations for the retaining wall shall consider the dimensions of the foundation for bearing capacity, base sliding and overturning failures.
- Where the ground level behind and/or in front of the wall vary, the wall should be assessed in representative sections to capture the variation in height.
- Passive resistance to the wall toe should not be considered in design.
- Groundwater levels over the life of the structure to be considered in design. Adequate drainage to be allowed for and maintenance of the drainage system should also be considered.
- Construction sequencing should be considered in the design, given the offset to the existing slope. This would include temporary batters and over-excavation considerations prior to completion of the wall.
- Method of compaction of the retained soil should be considered so that the structure is not damaged. Compaction pressures should be allowed for in the design. Any surcharge affecting retaining structures should be allowed in the design.

8.5 Exposure classification

Based on the marine environment of the project site, exposure classifications for concrete in accordance with AS2159-2009 (Table 6.4.2 (A)) and AS5100.5-2017 (Table 4.3) are 'Severe' and 'C2' respectively.

8.6 Seismic classification

Based on the advice provided in AS1170.4-2007 'Structural design actions Part 4: Earthquake actions in Australia' we consider the site to be classified as Class Be – Rock (based on Clause 4.2).

8.7 Remediation and stabilisation measures

The current concept alignment has been adopted to minimise the risk to both the boardwalk and the public using the boardwalk, which based on the current assessment, this has been achieved. However, should council wish to further reduce the perceived risks the following stabilisation measures can be consider. The design and implementation of any of the listed remediation works will be further developed as part of the detailed design as required.

- Cliff face scaling – removal of loose surface debris using chains attached to excavators and dragged across the face of the cliff prior to construction of the boardwalk;
- Removal of overground vegetation/unstable trees;
- Support of potentially unstable blocks or wedges with hot dipped galvanised or stainless steel fully grouted rock bolts;
- Support of siltstone bands, weak and/or fractured zones of bedrock with reinforced shotcrete supported by fully grouted rock bolts;
- Support of overhangs or undercuts at the base of cliff faces using cast in-situ underpins.
- In areas of potential soil debris/ or instability of the soil profile, use of erosion protection such as ‘jute mesh’, held in place with pins to promote vegetation growth.

The stabilisation measures outlined above may poorly impact the aesthetic outcome of the project if not completed by experienced contractors. At this stage of design, it is preferred that remediation be limited to cliff scaling and vegetation growth.

8.8 Slope risk management

The following various measures seek to manage and where appropriate maintain risk to ‘acceptable’ levels. These recommendations form an integral part of slope risk management and will also assist in the development of emergency response to safeguard the community from severe coastal storm events.

8.8.1 Monitoring

The identified potential hazards within the site area should be monitored on an annual basis and after periods of prolonged or heavy rainfall and significant storm events in order to assess existing conditions and any indicators of deterioration such as debris/boulders on the beach, rock platform, and/or damage to the proposed boardwalk.

As a basis, the following tentative definition of heavy rainfall and prolonged rainfall are provided as guidance and will be confirmed during detailed design:

- Heavy rainfall: at least 100mm of rainfall in one day; and
- Prolonged rainfall: at least 150mm of rainfall over a 5 day period.

It is recommended that a formal process with adequate documentation and reporting frequency be defined. Should instability occur during the monitoring period the following details must be recorded as part of the monitoring reports.

- Date of incident
- Weather conditions on the day and leading up to the incident

- Location sketch plan,
- Photographs and dimensions of the failed section (ie. block size, tension crack widths, landslide features).

Following an incident, completed monitoring reports should be provided to geotechnical engineers so that additional advice may be provided or assessment of specific stabilisation measures.

In addition, a detailed assessment of the slope should be undertaken by an experienced engineering geologist/geotechnical engineer to assess current conditions against previous monitoring reports.

8.8.2 Stormwater drainage

All existing subsurface drains, sewers and any other water carrying pipelines (eg, drainage pipe observed in Domain 1) must be subject to regular maintenance by asset owners. Maintenance should also include leak and/or damage detection for water carrying pipelines by experienced plumbers.

9 Summary

Preliminary foundation design and constructability recommendations have been completed as part of the concept design process considering ground conditions encountered at site during the investigation.

The currently proposed construction methodology is considered feasible, however early contractor engagement is recommended to provide additional constructability advice and highlight potential site constraints.

The currently documented boardwalk concept alignment has been assessed to be 10^{-5} or less for the person most at risk and 10^{-7} for societal risk which are considered acceptable levels of risk based on AGS (2007) and ANCOLD (2003) respectively. Further, on average the risk to property has been assessed to be moderate. Based on AGS guidelines, moderate risk levels can be tolerated.

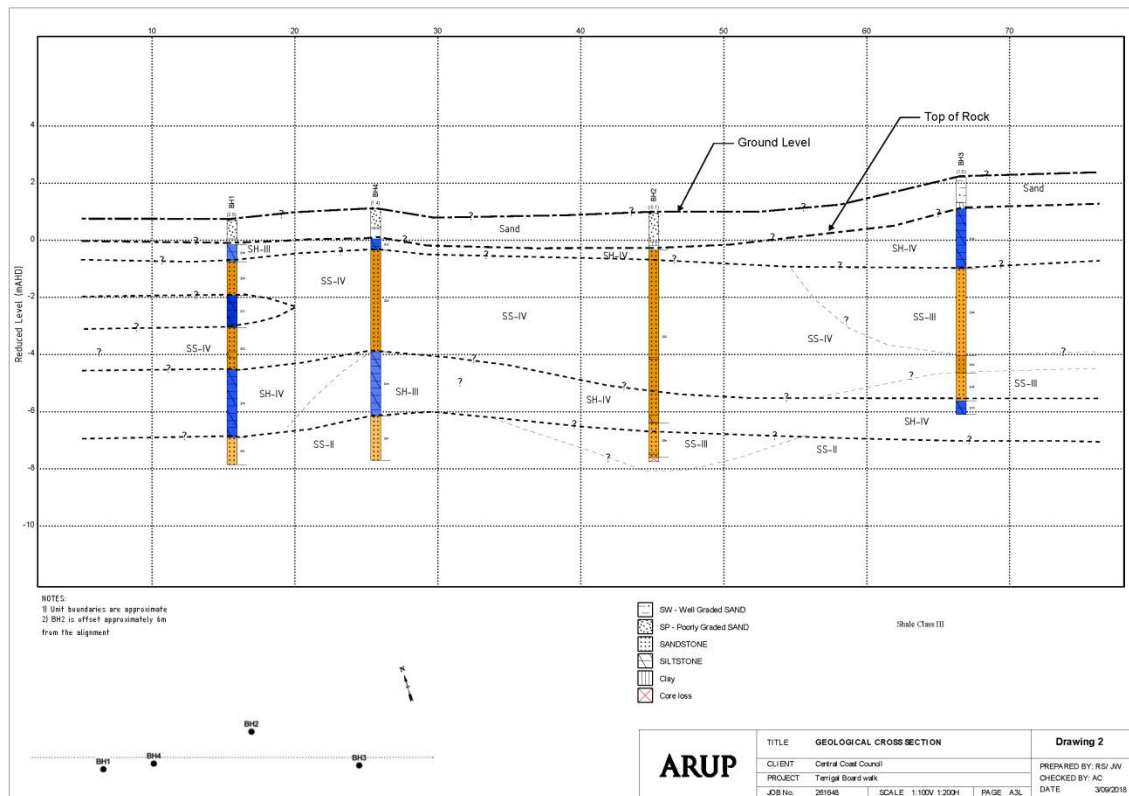
It is considered that the newly constructed boardwalk with ongoing monitoring by Council and intermittent geotechnical assessment are an adequate method of slope risk management.

10 References

- [1] Australian Standard, “AS2159-2009, Piling - Design and Installation,” 2009.
- [2] B. F. a. P. P. J. N. Walker, “Construction of Bored Piles,” *Australian Geomechanics*, 1998.
- [3] P. J. N. M. G. a. W. B. F. Pells, “Foundations on Sandstone and Shale in the Sydney Region,” *Australian Geomechanics*.
- [4] Australian Standard, “AS5100.3-2017, Bridge Design, Part 3: Foundation and soil-supporting structures,” 2017.
- [5] Pells, P.J.N, “SUBSTANCE AND MASS PROPERTIES FOR THE DESIGN OF ENGINEERING STRUCTURES IN THE HAWKESBURY SANDSTONE,” *Australian Geomechanics*, vol. 39, no. 3, 2004.
- [6] Australian Geomechanics Society, “Practice Note Guidelines For Landslide Risk Management,” *Australian Geomechanics Journal and News of the Australian Geomechanics Society*, vol. Volume 42, no. 1, 2007.
- [7] Australian National Committee on Large Dams, “Guidelines on Risk Assessment,” *ANCOLD*, 2003.

Drawings

Drawing 1 – Ground investigation location plan
Drawing 2 – Geological cross section



Appendix A

Geotechnical Explanatory Notes

Geotechnical Explanatory Notes

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The report contains the results of a geotechnical investigation conducted for a specific purpose and client. The results should not be used by other parties, or for other purposes, as they may contain neither adequate nor appropriate information. In particular, the investigation does not cover contamination issues unless specifically required to do so by the Client.

DESCRIPTION AND CLASSIFICATION METHODS

Soil and rock descriptions are generally in accordance with the recommendations of Australian Standards AS 1726-2017 and cover the following properties:

SOIL	Classification Group	ROCK	Rock Name
	Soil Name		Grain Size
	Plasticity		Colour
	Grain Size (and shape)		Fabric and Texture
	Colour		Strength
	Texture and Fabric		Weathering
	Secondary Components		Defects
	Minor Components		Weathering and / or alteration
	Moisture		
	Consistency		
	Structure		
	Origin		
	Other Relevant Information		

CLASSIFICATION OF COARSE GRAINED SOILS (Table 9 AS1726:2017)

Note: Cu = Coefficient of uniformity, Cc = Coefficient of curvature

Major divisions		Group symbol	Typical names	Field classification of sand and gravel	Laboratory classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075 mm)	GRAVEL (more than half of coarse fraction is larger than 2.36 mm)	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤5% fines	Cu >4 1 <Cc <3
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤5% Fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	"Dirty" materials with excess of non-plastic fines, zero to medium dry strength	≥12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	"Dirty" materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36 mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤5 fines	Cu >6 1 <Cc >3
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤5% fines	Fails to comply with above
		SM	Sand-silt mixtures	"Dirty" materials with excess of non-plastic fines, zero to medium dry strength	≥12% fines, fines are silty	NA
		SC	Sand-clay mixtures	"Dirty" materials with excess of plastic fines, medium to high dry strength	≥12% fines, fines are clayey	

Dual classification (e.g. GP-GM) comprising the two group symbols separated by a dash are given to coarse grained soil with fines contents between 5% and 12%.

CLASSIFICATION OF FINE GRAINED SOILS (Table 10 AS1726:2017)

Major Divisions		Group symbol	Typical names	Field classification of silt and clay			Laboratory classification
				Dry strength	Dilatancy	Toughness	% < 0.075 mm
Fine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075 mm)	SILT and CLAY (low to medium plasticity, %)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil				

COMPOSITE SOIL TYPE

As most natural soils are a mixture of basic soil types, the primary soil is described and modified by secondary constituents as follows:

Designation of components	In coarse grained soils				In fine grained soils	
	% Fines	Terminology	% Accessory Coarse fraction	Terminology	% Sand/ gravel	Terminology
Minor	≤5	Add 'trace clay/silt' to description, as applicable	≤15	Add 'trace sand/gravel' to description, as applicable	≤15	Use 'trace'
	>5, ≤12	Add 'with clay/silt to description', as applicable	>15, ≤30	Add 'with sand/gravel' to description, as applicable	>15, ≤30	Add 'with sand/gravel' to description, as applicable
Secondary	>12	Prefix soil name as 'silty' or 'clayey', as applicable	>30	Prefix soil name with 'sandy' or 'gravelly' as applicable	>30	Prefix soil name with 'sandy' or 'gravelly', as applicable

Geotechnical Explanatory Notes

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GRAIN SIZE

Designation	Fines		Sand			Gravel			Cobbles	Boulders
	Clay	Silt	Fine (f)	Medium (m)	Coarse (c)	Fine (f)	Medium (m)	Coarse (c)		
Grain size (mm)	<0.002	0.002 – 0.075	0.075 – 0.21	0.21 – 0.6	0.60 – 2.36	2.36 – 6.7	6.7 – 19	19 – 63	63 – 200	>200

COLOUR

Individual assessment of colour has been made at field moisture condition, or as received, using simple terms like **black, white, grey, red, brown, orange, yellow, green or blue**. No reference has been made to standard colour charts unless specifically stated. These may be modified where necessary using 'pale', or 'dark' or 'mottled'. Borderline colours are described as a combination of colours e.g. **red-brown** etc. If one colour is more dominant this shall be the 2nd term e.g. If brown is dominant then 'red-brown'.

Mottling is described as '(primary colour) mottled (secondary colour)'. Where a soil consists of two colours present in roughly equal proportions the colour description should be 'Mottled (first colour) and (second colour)'.

SOIL MOISTURE CONDITION

Condition	Cohesive	Granular
DRY (D)	Hard and friable or powdery, well dry of plastic limit	Cohesionless and free-running
MOIST (M)	Cool, darkened in colour, can be moulded	Cool, darkened in colour, tends to cohere
WET (W)	Weakened. Free water forms on hands when handling, soil tends to stick together	Tends to cohere

Symbol	Description
w < PL	Moist, dry of plastic limit
w ≈ PL	Moist, near plastic limit
w > PL	Moist, wet of plastic limit
w ≈ LL	Wet, near liquid limit
w > LL	Wet, wet of liquid limit

CONSISTENCY / RELATIVE DENSITY

Soil consistency / relative density is assessed based on a combination of in-situ testing and tactile field assessments. Where no in-situ testing is available, soil consistency is based solely on the tactile field assessment of the Engineer/Geologist.

Designation	Field test	Undrained shear strength kPa
Very Soft (VS)	Exudes between fingers when squeezed	<12
Soft (S)	Moulded by light finger pressure	>12 and ≤25
Firm (F)	Moulded by strong finger pressure	>25 and ≤50
Stiff (St)	Indented by thumb, cannot be moulded by fingers	>50 and ≤100
Very Stiff (VSt)	Indented by thumbnail	<100 and ≤200
Hard (H)	Indented with difficulty by thumbnail	>200
Friable	Can be easily crumbled or broken into small pieces by hand	-

Designation	Density index %
Very loose (VL)	≤15
Loose (L)	>15 and ≤35
Medium Dense (MD)	>35 and ≤65
Dense (D)	>65 and ≤85
Very Dense (VD)	>85

ROCK CLASSIFICATION TABLE (as per AS1726:2017)

Grain Size	Sedimentary	Metamorphic	Igneous		
			Acid	Intermediate	Basic
>2mm	Conglomerate, Breccia, Limestone	Gneiss	Granite	Diorite	Gabbro
0.06 - 2mm	Sandstone, Tuff, Limestone	Schist	Microgranite	Microdiorite	Dolerite
<0.06mm	Mudstone, Siltstone, Shale, Claystone, Limestone	Phyllite, Slate	Rhyolite	Andesite	Basalt

ROCK STRENGTH (as per AS1726:2017)

Designation		Very Low (VL)	Low (L)	Medium (M)	High (H)	Very High (VH)	Extremely High (EH)
Guide to strength	Field test	Material crumbles under firm blows with sharp end of pick. Pieces up to 3cm thick can be broken by finger pressure	Easily scored with knife. A piece of core 150mm long and 50mm diameter may be broken by hand.	Readily scored by knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with single firm blow	Hand specimen breaks with pick after more than one blow; rock rings under hammer	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer
	Point Load Strength Index I_{50} (MPa)	0.03 – 0.10	0.10 – 0.30	0.30 – 1.0	1.0 – 3.0	3.0 – 10.0	>10.0
Uniaxial Compressive Strength (MPa)		0.6 – 2.0	2.0 – 6.0	6.0 – 20.0	20.0 – 60.0	60.0 – 200	>200

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ROCK WEATHERING Based on visual identification as per AS1726:2017

Term		Symbol	Field appearance
Residual Soil		RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered		XW	Rock is weathered to an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water
Distinctly Weathered (DW)	Highly Weathered ¹	HW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
	Moderately Weathered ¹	MW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh		FR	Rock shows no sign of decomposition or staining

1. **Notes:** Where it is not practical to distinguish between highly weathered and moderately weathered, rock, the term 'Distinctly Weathered' may be used. 'Distinctly Weathered' is defined as: 'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. There is some change in rock strength.'

BEDDING STRATIFICATION

Term	Description	Separation of Stratification Planes
Stratification not recognisable	Massive	-
Stratification more than 20 mm apart	Very thickly bedded	>2 m
	Thickly bedded	0.6 - 2 m
	Medium bedded	0.2 - 0.6 m
	Thinly bedded	60 mm-0.2 m
	Very thinly bedded	20 - 60 mm
Stratification planes less than 20 mm apart	Thickly laminated	6 - 20 mm
	Thinly laminated	<6 mm

Table based on Geological Society of London Engineering Group Working Party report on *The Logging of Rock Cores for Engineering Purposes* - Q J Eng Geol Vol 3, 1970, pp1-24.

DEFECT DESCRIPTION

All natural defects are marked on the core using an 'X'.

Defect Type	Description
BP	Bedding plane parting - arrangement in layers of mineral grains of similar sizes, near parallel to surface of deposition along which a continuous observable parting occurs. Generally no microfractures.
JT	Joint - a fracture across which rock has little or no tensile strength and is not obviously related to rock fabric.
SZ	Sheared Zone - zone of multiple closely spaced fracture planes with roughly parallel planar boundaries, usually forming blocks of lenticular or wedge-shaped intact material. Fractures are typically smooth, polished or slickensided; and curved.
FL	Foliation Parting - As for bedding plane parting except discontinuous microfractures may be present near parallel to the layering.
CR	Crushed Seam - zone with roughly parallel, planar boundaries (commonly slickensided) containing disoriented usually angular rock fragments of variable size often in a soil matrix.
WE	Weathered Zone - zone of any shape but commonly with parallel planar boundaries containing moderately to gradational boundaries into fresher rock.
DB	Drilling Break
DL	Drilling Lift
HB	Handling Break
SM	Infilled seam - Seam of soil material usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seam less than 1 mm thick may be described as a veneer or coating on a joint surface.
SS	Sheared Surface - A near planar, curved or undulating surface which is usually smooth, polished or slickensided and which shows evidence of shear displacement.
VN	Vein
CL	Cleavage

Inclination

For specific defects, the orientation of each individual defect is noted in degrees from core normal. If the orientation cannot be measured, a dash (-) is used.

Geotechnical Explanatory Notes

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Defect Spacing

Defect Spacing, as per BS5930:2015		
Spacing/Width (mm)	Descriptor	Symbol
<20	Extremely Close	EC
20-60	Very Close	VC
60-200	Close	C
200-600	Medium	M
600-2000	Wide	W
2000-6000	Very Wide	VW
>6000	Extremely Wide	EW

Shape	
Symbol	Description
PR	Planar – the defect does not vary in orientation
IR	Irregular – the defect has many sharp changes of orientation
CU	Curved – the defect has a gradual change in orientation
UN	Undulating – the defect has a wavy surface shape
ST	Stepped – the defect has one or more well-defined steps
DIS	Discontinuous defect

Roughness	
POL	Polished - shiny smooth surface
SL	Slickensided - grooved or striated surface, usually polished
S	Smooth – smooth to touch. Few or no surface irregularities
RF	Rough – many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
VR	Very rough – Many large surface irregularities (amplitude generally more than 1mm). Feels like coarse than very coarse sand paper

Block Shape Terms (AS1726)	
Term	Description
Blocky	Equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

Infill Type			
Symbol	Description	Symbol	Description
CA	Calcite	MS	Secondary Mineral
X	Carbonaceous material	MU	Unidentified Mineral
KT	Chlorite	Clay	Clay
CT	Carbonate	QZ	Quartz
FE	Iron oxide	MN	Manganese

Coating	
CN	Clean – no visible coating
SN	Stained – no visible coating but surfaces are discoloured
VNR	Veneer – a visible coating of soil or mineral, too thin to measure; may be patchy
CO	Coating – a visible coating up to 1mm thick. Thicker soil material shall be described using defect terms (e.g. infilled seam). Thicker rock strength material shall be described as a vein.

CORE RECOVERY DEFINITIONS

Total core recovery (TCR) is defined as the ratio of total length of core recovered to length of core run drilled (expressed as a percentage).

$$TCR = \frac{L_{\text{core recovered}}}{L_{\text{core run}}}$$

Solid core recovered (SCR) is defined as the ratio of the sum of length of solid core pieces recovered at full diameter to length of core run drilled (expressed as a percentage).

$$SCR = \frac{L_{\text{solid core recovered}}}{L_{\text{core run}}}$$

Rock quality designation (RQD) is defined as the ratio of length of solid core recovered in pieces 100mm or longer to length of core run drilled (expressed as a percentage).

$$RQD = \frac{L_{\text{solid core } > 100\text{mm}}}{L_{\text{core run}}}$$

STANDARD PENETRATION TEST (SPT) REPORTING

The results of SPTs are reported on borehole logs. Typically the test is reported as the number of blows for the seating drive followed by a semi colon (;) and the number of blows of the two increments of the main drive e.g., 5; 10, 15. The N value is reported as the sum of the two values of the main drive, e.g., N= 25.

For a test which is terminated during the main drive, the blows for the seating drive are reported followed by the total number of blows and the total distance driven (mm) e.g., 15; 50/250.

For a test which is terminated during the seating drive, the total number of blows and the distance driven (mm) is reported and the result is suffixed with an "s" to designate the test was terminated during the seating drive e.g., 50/75s.

For a test that is terminated before achieving the full main drive penetration, the N values is determined by extrapolation of the penetration and number of blows recorded and is denoted with "ø".

For a test that is terminated within the seating drive the N value is determined by extrapolation of the penetration and number of blows recorded and is denoted with "øø".

Geotechnical Explanatory Notes

ARUP

SYMBOLS & ABBREVIATIONS

Drilling

Method		Support	
AD	Auger drilling (bit unspecified)	W	Water
AD/V	Auger drilling – Steel 'V' bit	M	Mud
AD/TC	Auger drilling – Tungsten carbide bit	C	Casing
RR	Tricone (rock roller) bit	T	Timbering
WB	Washboring	U	Unsupported
NMLC, BMLC	Triple tube rotary core drilling (52mm, 35mm diameter)		
NH, HQ	Wireline core drilling		
D	Diatube coring		

Field Testing

PL	Point load test (A – axial, D – diametral test)	-----▶-----	Inflow
Is(50)	Point load strength index (MPa)	-----◀-----	Outflow (loss)
q _c	Cone resistance (from CPT)	-----▼-----	Level (date)
CPT	Cone penetration test	-----◀-----	Partial loss
SPT	Standard penetration test		
N	SPT blow count (blows/300 mm)		
R	SPT refusal		
RW	SPT rod weight only causing penetration		
HW	SPT hammer and rod weight causing penetration		
HB	SPT hammer double bouncing		
PT	Pressuremeter test		
PP	Pocket penetrometer, undrained shear strength (kPa)		
V	In situ vane test, peak/residual value (kPa)		

Water – Moisture

W	Wet
M	Moist
D	Dry
S	Standpipe installed to depth shown
P	Piezometer installed at depth shown

Sample Codes

C	Core Sample
B	Bulk Sample
D	Disturbed Sample
AMAL	Amalgamated sample
B	Bulk disturbed
BLK	Block
CBR	CBR mould
CD	Plastic tub for chemical analysis
D	Small disturbed
DEN	Denison sample
DENm	Denison Sampler (modified)
E	Environmental
G	Gas

Soil Properties

CBR	California Bearing Ratio
NMC	Natural moisture content
OMC	Optimum moisture content from compaction test
LI	Liquidity index
LL	Liquidity limit
LS	Linear shrinkage
PI	Plasticity index
PL	Plastic limit
q _u , UCS	Unconfined compressive strength
w	Moisture content (% of dry weight)

J	Jar
K	Amber chemical jar
LB	Large bulk disturbed
LDS	Large disturbed
M	Mazier type
P	Piston
TW	Thin walled push-in
U	Undisturbed – open drive
U100	100mm diameter undisturbed
U63	63mm diameter undisturbed
U76	76mm diameter undisturbed
W	Water

Appendix B

Borehole Logs

GAAP BY Ltd 2018
D.1.1 AUS NON-CO RED LOG (451726)

ARUP		CORED BOREHOLE RECORD				BH1		SHEET 2 OF 2			
CLIENT		Central Coast Council				LOGGED BY		RS			
PROJECT		Terrigal Board walk				CHECKED BY		AC			
						DRILLED DATE		22-May-18			
CONTRACTOR		Rockwell		ANGLE		Vertical		GROUND LEVEL			
DRILL MODEL		Track-mounted		BEARING		-		RL 0.70m			
DRILLER		KM		HOLE DIAMETER		110mm		LOCATION			
LOCATION		Haven Beach, Terrigal		MOUNT		BIT		ELEVATION DATUM			
								Australian Height Datum (AHD)			
								COORDINATE SYSTEM			
								MGA94			
DRILLING		STRATA		MATERIAL DESCRIPTION				DISCONTINUITIES			
CORE LOSS % TCR % (Drill rate) SCR % (ROD %) FLUSH RETURN % (TYPE)	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	ROCK TYPE Grain Size, Texture/Fabric, Colour, Minor Components	WEATHERING	ESTIMATED ROCK STRENGTH Is 50 (MPa)	SPACING (mm)	VISUAL LOG	GENERAL DESCRIPTION		
									Angle, Shape, Roughness, Infill, Thickness		
		0.85 -1.0		Continued from borehole							
		1.45 -1.75		SILTSTONE, grey, thinly laminated	MW						
		2.63 -3.00		SANDSTONE, fine to medium grained, grey	SW					JT 70-80° PLVR BP 15° ST PLS	
		3.75 -4.00		SILTSTONE, grey	MW					BP 10° PLS	
		4.81 -5.00		SANDSTONE, fine grained, grey						BP 15° CN PLS CrO-5° UN RF 20mm Rock Fragments	
		5.23 -5.50		SILTSTONE, grey						JT 85° VN UN RF CrO-100mm Rock Fragments	
		5.41 -5.75		SANDSTONE, fine grained, grey						BP 0-5° UN S JT 85° PLRF BP 0° UN S CrO-1R VR 10mm	
		5.53 -6.00		SILTSTONE, grey, with fine grained sand							
		7.60 -7.75		SANDSTONE, fine grained	SW					J 5M0° Clay 30mm	
		8.55 -8.60		End of borehole at 8.55m Termination: Groundwater.							
NOTES				See explanatory notes for details of abbreviations and basis of descriptions				JOB 261648			

ARUP		BOREHOLE PHOTO RECORD		BH1	SHEET 1 OF 1
CLIENT	Central Coast Council			LOGGED BY	RS
PROJECT	Terrigal Board walk			CHECKED BY	AC
CONTRACTOR	Rockwell	ANGLE	Vertical	DRILLED DATE	22-May-18
DRILL MODEL	Track-mounted	BEARING	-	GROUND LEVEL	RL 0.70mmAHD
DRILLER	KM	HOLE DIAMETER	110mm (Diamond)	LOCATION	355738.0 E 6297959.7 N
LOCATION	Haven Beach,			ELEVATION DATUM	Australian Height Datum (AHD)
				COORDINATE SYSTEM	Map Grid of Australia (MGA)



BH1: 00.85m to 05.00m



BH1: 05.00m to 08.55m

NOTES	JOB 261648
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ARUP		BOREHOLE PHOTO RECORD		BH2		SHEET 1	
CLIENT Central Coast Council				LOGGED BY		RS	
PROJECT Terrigal Board walk				CHECKED BY		AC	
				DRILLED DATE		23-May-18 to 23-May-19	
CONTRACTOR	Rockwell Drilling	ANGLE	Vertical	GROUND LEVEL	RL 0.95mmAHD		
DRILL MODEL	Track-mounted	BEARING	-	LOCATION	355768.4 E 6297958.5 N		
DRILLER	KM	HOLE DIAMETER	110mm (Diamond)	ELEVATION DATUM	Australian Height Datum (AHD)		
LOCATION	Haven Beach,			COORDINATE SYSTEM	Map Grid of Australia (MGA)		

BH2: 01.30m to 06.00m

BH2: 06.00m to 08.70m

NOTES	JOB 261648
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GAAP BY Ltd 2018
D.1.1 AUS NON-CO RED LOG (A51726)

ARUP		CORED BOREHOLE RECORD				BH3		SHEET 2 OF 2			
CLIENT		Central Coast Council				LOGGED BY		RS			
PROJECT		Terrigal Board walk				CHECKED BY		AC			
						DRILLED DATE		22-May-18			
CONTRACTOR		Rockwell		ANGLE		Vertical		GROUND LEVEL			
DRILL MODEL		Track-mounted		BEARING				RL 2.20m			
DRILLER		KM		HOLE DIAMETER		110mm		LOCATION			
LOCATION		Haven Beach, Terrigal		MOUNT		BIT		ELEVATION DATUM			
								Australian Height Datum (AHD)			
								COORDINATE SYSTEM			
								MGA94			
DRILLING		STRATA		MATERIAL DESCRIPTION				DISCONTINUITIES			
DRILLING & CASING CORE LOSS % TCR % (DRIFT #)B SCR % (ROD %) FLUSH RETURN % (TYPE)	SAMPLES & FIELD TESTS	DEPTH (m)	GRAPHIC LOG	ROCK TYPE Grain Size, Texture/Fabric, Colour, Minor Components	WEATHERING	ESTIMATED ROCK STRENGTH Is 50 (MPa)	SPACING (mm)	VISUAL LOG	GENERAL DESCRIPTION		
									Angle, Shape, Roughness, Infill, Thickness		
SPT		1.10		Continued from borehole							
		1.10		SILTSTONE, grey, thinly laminated at 0-5°							
		2									
		3									
		3.20		SANDSTONE, fine to medium grained, grey							
		4									
		5									
		6									
		7									
		8									
		7.82		SILTSTONE, grey, porphyritic, thinly laminated at 0-5°							
		8.29		End of borehole at 8.29m Termination: Groundwater.							
		9									
		10									
NOTES						See explanatory notes for details of abbreviations and basis of descriptions				JOB 261648	

ARUP		BOREHOLE PHOTO RECORD		BH3	SHEET 1 OF 1
CLIENT	Central Coast Council			LOGGED BY	RS
PROJECT	Terrigal Board walk			CHECKED BY	AC
CONTRACTOR	Rockwell	ANGLE	Vertical	DRILLED DATE	22-May-18
DRILL MODEL	Track-mounted	BEARING	-	GROUND LEVEL	RL 2.20mmAHD
DRILLER	KM	HOLE DIAMETER	110mm (Diamond)	LOCATION	355787.1 E 6297946.0 N
LOCATION	Haven Beach,			ELEVATION DATUM	Australian Height Datum (AHD)
				COORDINATE SYSTEM	Map Grid of Australia (MGA)



BH3: 01.10m to 08.39m

NOTES	JOB 261648
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ARUP		NON-CORED BOREHOLE RECORD			BH4		SHEET 1 OF 2			
CLIENT Central Coast Council					LOGGED BY		RS			
PROJECT Terrigal Board walk					CHECKED BY		AC			
CONTRACTOR Rockwell					DRILLED DATE		24-May-18			
DRILL MODEL Track-mounted					ANGLE Vertical		RL 1.10m			
DRILLER KM					BEARING -		355748.0 E 6297957.9 N			
LOCATION Haven Beach, Terrigal					HOLE DIAMETER 110mm		ELEVATION DATUM Australian Height Datum (AHD)			
					MOUNT BIT		COORDINATE SYSTEM MGA94			
DRILLING		STRATA			MATERIAL DESCRIPTION		CONDITION			
DRILLING & CASING	WATER	DRILLING PENETRATION GROUNDWATER LEVELS	SAMPLES	FIELD TESTS	DEPTH (P.L.)	GROUP SYMBOL	GRAPHIC LOG	OBSERVATION		
									SOIL TYPE Plasticity / Grain Size, Colour, Minor Components	WATER / MOISTURE
ADIT HW casing	E	0.5m 0.45m 0.71m 1.05m	SPT 1.0, 2 N=2	SPT 2, 162	0.65 2.0	SW	SAND: fine to coarse, orange BROWN, with shell fragments	M	VL	MAR
								CH	SANDSTONE: fine to medium grained, pale grey. Recovered as CLAY, high plasticity	W
Continued as cored borehole										
NOTES										
See explanatory notes for details of abbreviations and basis of descriptions								JOB 261648		

ARUP		CORED BOREHOLE RECORD				BH4		SHEET 2			
CLIENT		Central Coast Council				LOGGED BY		RS			
PROJECT		Terrigal Board walk				CHECKED BY		AC			
						DRILLED DATE		24-May-18			
CONTRACTOR		Rockwell		ANGLE		Vertical		GROUND LEVEL			
DRILL MODEL		Track-mounted		BEARING		-		RL 1.10m			
DRILLER		KM		HOLE DIAMETER		110mm		LOCATION			
LOCATION		Haven Beach, Terrigal		MOUNT		BIT		ELEVATION DATUM			
								Australian Height Datum (AHD)			
COORDINATE SYSTEM								MGA94			
DRILLING		STRATA		MATERIAL DESCRIPTION				DISCONTINUITIES			
SAMPLES & FIELD TESTS		DEPTH (m)		ROCK TYPE				GENERAL DESCRIPTION			
CORE LOSS %		GRAPHIC LOG		Grain Size, Texture/Fabric, Colour, Minor Components				Angle, Shape, Roughness, Infill, Thickness			
TCR % (Drill Rate)											
SCR % (Rod %)											
FLUSH RETURN % (Type)											

ARUP		BOREHOLE PHOTO RECORD		BH4		SHEET 1	
CLIENT Central Coast Council				LOGGED BY		RS	
PROJECT Terrigal Board walk				CHECKED BY		AC	
				DRILLED DATE		24-May-18	
CONTRACTOR	Rockwell	ANGLE	Vertical	GROUND LEVEL	RL 1.10mmAHD		
DRILL MODEL	Track-mounted	BEARING	-	LOCATION	355748.0 E 6297957.9 N		
DRILLER	KM	HOLE DIAMETER	110mm (Diamond)	ELEVATION DATUM	Australian Height Datum (AHD)		
LOCATION	Haven Beach,			COORDINATE SYSTEM	Map Grid of Australia (MGA)		

BH4: 01.05m to 06.00m

BH4: 06.00m to 08.80m

NOTES

JOB 261648

Appendix C

DCP Test Results

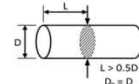
ARUP		DYNAMIC CONE PENETROMETER TEST RESULTS							Date: 22/05/2018	
									Sheet 1 of	
Project Name: Terrigal Boardwalk									Job No.: 261648	
Made by: RS		Comments:								
Test No.	DCP 1	DCP 2	DCP 6	DCP 7	DCP 8	DCP 9	DCP 3	DCP 5	DCP 4	
Surface RL	0.75	1.3	1.3	1.45	1.3	1.3	0.25	0.85	1.3	
Depth below surface (m)	Blows/ 100mm (n)									
0.0 - 0.1	1	1	1	1	1	1	2	1	0	
0.1 - 0.2	↓	↓	↓	2	1	↓	2	1	1	
0.2 - 0.3	1	1	2	2	1	2	3	2	1	
0.3 - 0.4	4	3	4	5	2	2	17/40mm	4	2	
0.4 - 0.5	7	4	5	5	20/50mm	5	refusal	9	2	
0.5 - 0.6	12	6	5	25/50mm	refusal	4		14	5	
0.6 - 0.7	23	12	12	End		6		10/0mm	11/70mm	
0.7 - 0.8	30/50mm	23	22/50mm			8/8mm		refusal	refusal	
0.8 - 0.9	End	12/20mm	End			Refusal				
0.9 - 1.0		bouncing								
1.0 - 1.1										
1.1 - 1.2										
1.2 - 1.3										
1.3 - 1.4										
1.4 - 1.5										
1.5 - 1.6										
1.6 - 1.7										
1.7 - 1.8										
1.8 - 1.9										
1.9 - 2.0										
Remarks:										
1. The procedure used for this test is in accordance with AS1289.6.3.2-1997										
2. 8 blows per 20mm is taken as refusal										
3. Datum is AHD										

Appendix C- DCP Results

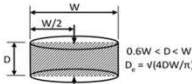
Appendix D

Point Load Strength Index Test Results

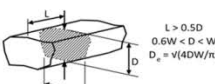
POINT LOAD STRENGTH INDEX TEST RESULTS													SHEET 1 OF 1	
PROJECT NAME			Terrigal Boardwalk											
LOCATION			TEST DATA										RESULTS	
TEST No.	LOCATION ID	Depth (m)	SAMPLE DESCRIPTION	MOISTURE CONDITION	TEST TYPE	L (mm)	D (mm)	W (mm)	GAUGE FACTOR, f	SIZE CORRECTION FACTOR, K	FAILURE LOAD, P (kN)	FAILURE DESCRIPTION	Is (50) MPa	STRENGTH CLASSIFICATION
1	BH1	2.28	Sandstone	F	D	44	51		1.00	1.01	0.33	2	0.13	L
2	BH1	2.28	Sandstone	F	A		44	51	1.00	1.03	1.00	1	0.36	M
3	BH1	3.79	Sandstone	F	D	40	51		1.00	1.01	0.19	1	0.07	VL
4	BH1	3.83	Sandstone	F	A		44	51	1.00	1.03	0.86	1	0.31	M
5	BH1	4.35	Sandstone	F	D	32	51		1.00	1.01	0.30	1	0.12	L
6	BH1	4.35	Sandstone	F	A		32	51	1.00	0.96	0.93	1	0.43	M
7	BH1	5.60	Siltstone	F	D	30	51		1.00	1.01	0.17	1	0.07	VL
8	BH1	5.60	Siltstone	F	A		30	51	1.00	0.95	0.13	1	0.06	VL
9	BH1	6.92	Siltstone	F	D	42	51		1.00	1.01	0.18	1	0.07	VL
10	BH1	6.92	Siltstone	F	A		42	51	1.00	1.02	0.36	4	0.13	L
11	BH1	7.70	Sandstone	F	D	32	51		1.00	1.01	0.34	1	0.13	L
12	BH1	7.70	Sandstone	F	A		32	51	1.00	0.96	1.68	1	0.78	M
13	BH1	8.29	Sandstone	F	D	42	51		1.00	1.01	0.04	3	0.02	EL
14	BH1	8.29	Sandstone	F	A		42	51	1.00	1.02	2.16	4	0.81	M
15	BH1	3.50	Sandstone	F	D	40	51		1.00	1.01	0.09	3	0.03	VL
16	BH1	3.50	Sandstone	F	A		40	51	1.00	1.01	0.11	1	0.04	VL
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Diametral (D)



Axial (A)



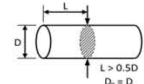
Irregular Lump (L)

$L > 0.5D$
 $0.6W < D < W$
 $D_c = \sqrt[3]{4DW/n}$

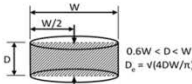
Is (50) = 1000 x fKP / De² (MPa)
P = Failure Load (kN)
De = Equivalent core diameter (mm)
K = Size Correction Factor
f = Gauge Factor

FAILURE DESCRIPTION:													MADE BY: JW	
1. Fracture through fabric of specimen not influenced by weak planes.													CHECKED BY: AC	
2. Fracture along bedding.													DATE: 22/05/2018	
3. Fracture influenced by pre-existing plane (J), microfracture (M), vein (V), chemical alteration (C)													JOB No: 261648	
4. Chip or Partial Fracture													VERIFIED BY:	
POINT LOAD TESTER SERIAL No: 6510-0617													DATE VERIFIED:	
DATE OF CALIBRATION: 17/10/2016														

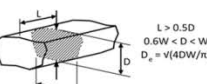
POINT LOAD STRENGTH INDEX TEST RESULTS													SHEET 1 OF 1		
PROJECT NAME			Terrigal Boardwalk												
LOCATION			TEST DATA										RESULTS		
TEST No.	LOCATION ID	Depth (m)	SAMPLE DESCRIPTION	MOISTURE CONDITION	TEST TYPE	L (mm)	D (mm)	W (mm)	GAUGE FACTOR, f	SIZE CORRECTION FACTOR, K	FAILURE LOAD, P (kN)	FAILURE DESCRIPTION	Is (50) MPa	STRENGTH CLASSIFICATION	
1	BH2	1.42	Sandstone	F	D	32	51		1.00	1.01	0.28	1	0.11	L	
2	BH2	1.42	Sandstone	F	A		32	51	1.00	0.96	0.56	4	0.26	L	
3	BH2	2.70	Sandstone	F	D	34	51		1.00	1.01	0.05	3	0.02	EL	
4	BH2	2.70	Sandstone	F	A		34	51	1.00	0.97	0.50	1	0.22	L	
5	BH2	3.22	Sandstone	F	D	36	51		1.00	1.01	0.17	1	0.07	VL	
6	BH2	3.22	Sandstone	F	A		36	51	1.00	0.99	0.48	1	0.20	L	
7	BH2	4.52	Sandstone	F	D	30	51		1.00	1.01	0.33	1	0.13	L	
8	BH2	4.52	Sandstone	F	A		30	51	1.00	0.95	0.69	4	0.33	M	
9	BH2	4.86	Sandstone	F	D	30	51		1.00	1.01	0.51	1	0.20	L	
10	BH2	4.86	Sandstone	F	A		30	51	1.00	0.95	1.30	1	0.63	M	
11	BH2	5.49	Sandstone	F	D	34	51		1.00	1.01	0.40	1	0.16	L	
12	BH2	5.49	Sandstone	F	A		34	51	1.00	0.97	0.79	1	0.35	M	
13	BH2	6.17	Sandstone	F	D	35	51		1.00	1.01	0.94	1	0.36	M	
14	BH2	6.17	Sandstone	F	A		35	51	1.00	0.98	1.48	1	0.64	M	
15	BH2	7.65	Sandstone	F	D	42	51		1.00	1.01	1.01	1	0.39	M	
16	BH2	7.65	Sandstone	F	A		42	51	0.99	1.02	2.77	1	1.03	H	
17	BH2	7.86	Sandstone	F	D	33	51		1.00	1.01	0.20	3	0.08	VL	
18	BH2	7.86	Sandstone	F	A		33	51	1.00	0.97	0.85	1	0.38	M	
19	BH2	8.45	Sandstone	F	D	34	51		1.00	1.01	0.95	1	0.37	M	
20	BH2	8.45	Sandstone	F	A		34	51	1.00	0.97	1.50	1	0.66	M	
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Diametral (D)



Axial (A)



Irregular Lump (L)

Is (50) = 1000 x fKP / De² (MPa)
P = Failure Load (kN)
De = Equivalent core diameter (mm)
K = Size Correction Factor
f = Gauge Factor

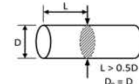
FAILURE DESCRIPTION:

- Fracture through fabric of specimen not influenced by weak planes.
- Fracture along bedding.
- Fracture influenced by pre-existing plane (J), microfracture (M), vein (V), chemical alteration (C)
- Chip or Partial Fracture

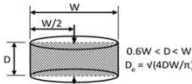
POINT LOAD TESTER SERIAL No: 6510-0617 DATE OF CALIBRATION: 17/10/2016

MADE BY: JW
CHECKED BY: AC
DATE: 23/05/2018
JOB No: 261648
VERIFIED BY:
DATE VERIFIED:

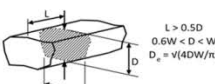
POINT LOAD STRENGTH INDEX TEST RESULTS												SHEET 1 OF 1		
PROJECT NAME			Terrigal Boardwalk BH3											
LOCATION			TEST DATA										RESULTS	
TEST No.	LOCATION ID	Depth (m)	SAMPLE DESCRIPTION	MOISTURE CONDITION	TEST TYPE	L (mm)	D (mm)	W (mm)	GAUGE FACTOR, f	SIZE CORRECTION FACTOR, K	FAILURE LOAD, P (kN)	FAILURE DESCRIPTION	Is (50) MPa	STRENGTH CLASSIFICATION
1	BH3	1.19	Siltstone	F	D	35	51		1.00	1.01	0.05	3	0.02	EL
2	BH3	1.19	Siltstone	F	A		35	51	1.00	0.98	0.22	4	0.09	VL
3	BH3	2.26	Siltstone	F	D	37	51		1.00	1.01	0.58	1	0.22	L
4	BH3	2.26	Siltstone	F	A		37	51	1.00	0.99	1.99	1	0.82	M
5	BH3	3.29	Sandstone	F	D	42	51		1.00	1.01	0.45	1	0.17	L
6	BH3	3.29	Sandstone	F	A		42	51	1.00	1.02	1.52	1	0.57	M
7	BH3	4.79	Sandstone	F	D	38	51		1.00	1.01	0.24	1	0.09	VL
8	BH3	4.79	Sandstone	F	A		38	51	1.00	1.00	1.27	1	0.51	M
9	BH3	3.47	Sandstone	F	D	42	51		1.00	1.01	0.31	1	0.12	L
10	BH3	3.47	Sandstone	F	A		42	51	1.00	1.02	0.68	4	0.25	L
11	BH3	3.78	Sandstone	F	D	41	51		1.00	1.01	0.41	1	0.16	L
12	BH3	3.78	Sandstone	F	A		41	51	1.00	1.01	1.58	1	0.60	M
13	BH3	5.04	Sandstone	F	D	32	51		1.00	1.01	0.25	1	0.10	VL
14	BH3	5.04	Sandstone	F	A		32	51	1.00	0.96	1.11	1	0.51	M
15	BH3	6.07	Sandstone	F	D	41	51		1.00	1.01	0.84	1	0.33	M
16	BH3	6.07	Sandstone	F	A		41	51	1.00	1.01	2.24	1	0.85	M
17	BH3	7.04	Sandstone	F	D	36	51		1.00	1.01	0.81	1	0.31	M
18	BH3	7.04	Sandstone	F	A		36	51	1.00	0.99	0.95	1	0.40	M
19	BH3	8.15	Siltstone	F	D	31	51		1.00	1.01	0.24	1	0.09	VL
20	BH3	8.15	Siltstone	F	A		31	51	1.00	0.95	0.24	4	0.11	L
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Diametral (D)



Axial (A)

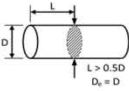


Irregular Lump (L)

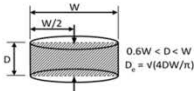
Is (50) = 1000 x fKP / De² (MPa)
P = Failure Load (kN)
De = Equivalent core diameter (mm)
K = Size Correction Factor
f = Gauge Factor

FAILURE DESCRIPTION:													MADE BY: JW	
1. Fracture through fabric of specimen not influenced by weak planes.													CHECKED BY: AC	
2. Fracture along bedding.													DATE: 22/05/2018	
3. Fracture influenced by pre-existing plane (J), microfracture (M), vein (V), chemical alteration (C)													JOB No: 261648	
4. Chip or Partial Fracture													VERIFIED BY:	
POINT LOAD TESTER SERIAL No: 6510-0617													DATE VERIFIED:	
DATE OF CALIBRATION: 17/10/2016														

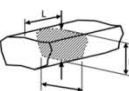
POINT LOAD STRENGTH INDEX TEST RESULTS													SHEET 1 OF 1		
PROJECT NAME			Terrigal Boardwalk												
LOCATION			TEST DATA										RESULTS		
TEST No.	LOCATION ID	Depth (m)	SAMPLE DESCRIPTION	MOISTURE CONDITION	TEST TYPE	L (mm)	D (mm)	W (mm)	GAUGE FACTOR, f	SIZE CORRECTION FACTOR, K	FAILURE LOAD, P (kN)	FAILURE DESCRIPTION	Is (50) MPa	STRENGTH CLASSIFICATION	
1	BH4	1.73	Sandstone	F	D	34	51		1.00	1.01	0.12	1	0.05	VL	
2	BH4	1.73	Sandstone	F	A		34	51	1.00	0.97	0.50	1	0.22	L	
3	BH4	2.25	Sandstone	F	D	37	51		1.00	1.01	0.28	1	0.11	L	
4	BH4	2.25	Sandstone	F	A		37	51	1.00	0.99	0.78	1	0.32	M	
5	BH4	2.46	Sandstone	F	D	43	51		1.00	1.01	0.42	1	0.16	L	
6	BH4	2.46	Sandstone	F	A		43	51	1.00	1.03	0.77	1	0.28	L	
7	BH4	3.08	Sandstone	F	D	39	51		1.00	1.01	0.12	3	0.05	VL	
8	BH4	3.08	Sandstone	F	A		39	51	1.00	1.00	0.73	4	0.29	L	
9	BH4	3.31	Sandstone	F	D	39	51		1.00	1.01	0.13	1	0.05	VL	
10	BH4	3.31	Sandstone	F	A		39	51	1.00	1.00	0.58	4	0.23	L	
11	BH4	4.81	Sandstone	F	D	39	51		1.00	1.01	1.92	1	0.74	M	
12	BH4	4.81	Sandstone	F	A		39	51	0.99	1.00	2.70	1	1.06	H	
13	BH4	5.62	Siltstone	F	D	38	51		1.00	1.01	0.20	3	0.08	VL	
14	BH4	5.62	Siltstone	F	A		38	51	1.00	1.00	0.34	4	0.14	L	
15	BH4	6.00	Siltstone	F	D	47	51		1.00	1.01	0.11	1	0.04	VL	
16	BH4	6.00	Siltstone	F	A		47	51	1.00	1.05	0.22	4	0.08	VL	
17	BH4	7.68	Sandstone	F	D	36	51		1.00	1.01	0.26	1	0.10	L	
18	BH4	7.68	Sandstone	F	A		36	51	1.00	0.99	2.04	1	0.86	M	
19	BH4	8.16	Sandstone	F	D	38	51		1.00	1.01	0.26	1	0.10	L	
20	BH4	8.16	Sandstone	F	A		38	51	0.99	1.00	2.78	1	1.11	H	
21	BH4	7.95	Sandstone	F	D	26	51		1.00	1.01	0.52	1	0.20	L	
22	BH4	7.95	Sandstone	F	A		26	51	1.00	0.92	0.96	1	0.52	M	
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Diametral (D)



Axial (A)



Irregular Lump (L)

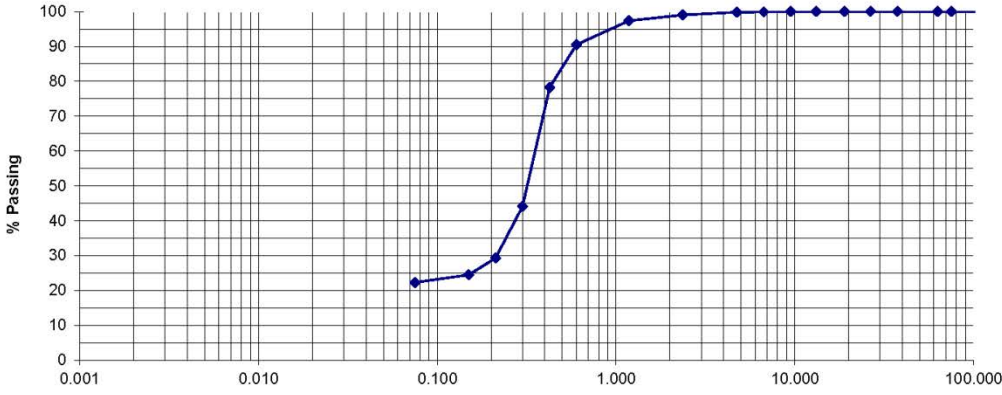



$L > 0.5D$
 $0.6W < D < W$
 $D_e = \sqrt{4DW/n}$

Is (50) = 1000 x fKP / De² (MPa)
P = Failure Load (kN)
De = Equivalent core diameter (mm)
K = Size Correction Factor
f = Gauge Factor

FAILURE DESCRIPTION:													MADE BY: JW	
1. Fracture through fabric of specimen not influenced by weak planes.													CHECKED BY: AC	
2. Fracture along bedding.													DATE: 24/05/2018	
3. Fracture influenced by pre-existing plane (J), microfracture (M), vein (V), chemical alteration (C)													JOB No: 261648	
4. Chip or Partial Fracture													VERIFIED BY:	
POINT LOAD TESTER SERIAL No: 6510-0617													DATE VERIFIED:	
DATE OF CALIBRATION: 17/10/2016														

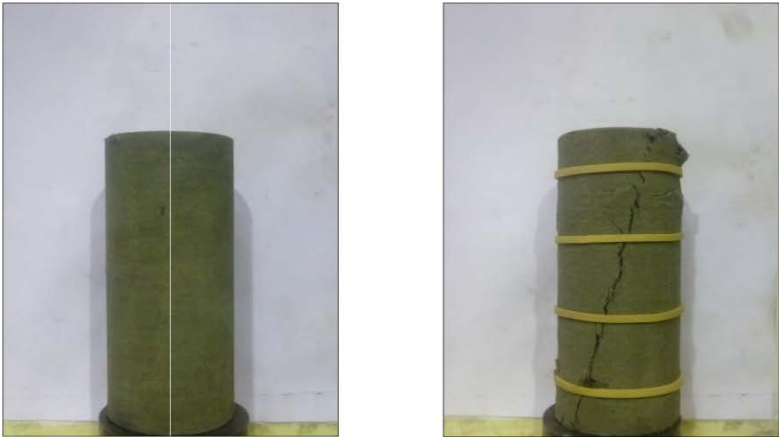



Appendix E

Laboratory Test Result
Certificates

PARTICLE SIZE DISTRIBUTION REPORT																																																																																																																			
Client:	Arup	Source:	BH1-01 0.5-0.65m																																																																																																																
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Clayey SAND trace of Gravel																																																																																																																
Project:	Terrigal Boardwalk (261648)	Report No.:	S33957-PSD																																																																																																																
Job No.:	S18220	Lab No.:	S33957																																																																																																																
Test Procedure: <input checked="" type="checkbox"/> AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving																																																																																																																			
Sampling: Sampled by Client				Date Sampled: 23/05/2018																																																																																																															
Preparation: Prepared in accordance with the test method																																																																																																																			
																																																																																																																			
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Clay</th> <th colspan="2">Silt</th> <th colspan="2">Sand</th> <th colspan="2">Gravel</th> <th colspan="2">Cobbles</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Sieve Aperture: (mm)</td> <td style="text-align: center;">% Passing</td> <td style="text-align: center;">Sieve Aperture: (mm)</td> <td style="text-align: center;">% Passing</td> <td style="text-align: center;">Sieve Aperture: (mm)</td> <td style="text-align: center;">% Passing</td> <td style="text-align: center;">Sieve Aperture: (mm)</td> <td style="text-align: center;">% Passing</td> <td style="text-align: center;">Sieve Aperture: (mm)</td> <td style="text-align: center;">% Passing</td> </tr> <tr> <td style="text-align: center;">200</td> <td style="text-align: center;">100</td> <td style="text-align: center;">4.75</td> <td style="text-align: center;">100</td> <td style="text-align: center;">2.36</td> <td style="text-align: center;">99</td> <td style="text-align: center;">1.18</td> <td style="text-align: center;">97</td> <td style="text-align: center;">0.600</td> <td style="text-align: center;">90</td> </tr> <tr> <td style="text-align: center;">75</td> <td style="text-align: center;">100</td> <td style="text-align: center;">0.425</td> <td style="text-align: center;">78</td> <td style="text-align: center;">0.300</td> <td style="text-align: center;">44</td> <td style="text-align: center;">0.212</td> <td style="text-align: center;">29</td> <td style="text-align: center;">0.150</td> <td style="text-align: center;">24</td> </tr> <tr> <td style="text-align: center;">63</td> <td style="text-align: center;">100</td> <td style="text-align: center;">0.075</td> <td style="text-align: center;">22</td> <td colspan="6"></td> </tr> <tr> <td style="text-align: center;">37.5</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> <tr> <td style="text-align: center;">26.5</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> <tr> <td style="text-align: center;">19</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> <tr> <td style="text-align: center;">13.2</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> <tr> <td style="text-align: center;">9.5</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> <tr> <td style="text-align: center;">6.7</td> <td style="text-align: center;">100</td> <td colspan="8"></td> </tr> </tbody> </table>						Clay		Silt		Sand		Gravel		Cobbles		Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	200	100	4.75	100	2.36	99	1.18	97	0.600	90	75	100	0.425	78	0.300	44	0.212	29	0.150	24	63	100	0.075	22							37.5	100									26.5	100									19	100									13.2	100									9.5	100									6.7	100								
Clay		Silt		Sand		Gravel		Cobbles																																																																																																											
Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing	Sieve Aperture: (mm)	% Passing																																																																																																										
200	100	4.75	100	2.36	99	1.18	97	0.600	90																																																																																																										
75	100	0.425	78	0.300	44	0.212	29	0.150	24																																																																																																										
63	100	0.075	22																																																																																																																
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PARTICLE SIZE DISTRIBUTION REPORT																																																																											
Client:	Arup	Source:	BH3-01 0.5-0.9m																																																																								
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	SAND trace of Clay and Gravel																																																																								
Project:	Terrigal Boardwalk (261648)	Report No.:	S33963-PSD																																																																								
Job No.:	S18220	Lab No.:	S33963																																																																								
Test Procedure: <input checked="" type="checkbox"/> AS1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving																																																																											
Sampling: Sampled by Client				Date Sampled: 23/05/2018																																																																							
Preparation: Prepared in accordance with the test method																																																																											
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Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH1-02 2.14-2.28m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Sandstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33958-UCS
Job No.:	S18220	Lab No.:	S33958
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
<div style="display: flex; justify-content: space-around;">   </div>			
Uniaxial Compressive Strength 10 MPa			
Date Tested:	5/06/2018	Moisture Content:	6.8 %
Specimen Height:	123.0 mm	Duration of Test:	634 seconds
Average Specimen Diameter:	52.0 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
Deviation from Standard:	Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.		
 <p>The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing. This document shall not be reproduced, except in full.</p>		<p>Authorised Signatory:</p>  <p>Jacob Lloyd</p>	
NATA Accredited Laboratory Number: 14874		Date: 7/06/2018	
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street Alexandria NSW 2015</p>	

Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH1-04 8.37-8.55m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Sandstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33960-UCS
Job No.:	S18220	Lab No.:	S33960
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 13 MPa			
Date Tested:	5/06/2018	Moisture Content:	4.3 %
Specimen Height:	110.4 mm	Duration of Test:	642 seconds
Average Specimen Diameter:	51.7 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Single shear plane		
Other Pertinent Observations:			
Deviation from Standard:	Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.		
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NATA Accredited Laboratory Number: 14874		Date: 7/06/2018	
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street</p> <p>Alexandria NSW 2015</p>	

Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH2-01 3.06-3.23m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Sandstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33961-UCS
Job No.:	S18220	Lab No.:	S33961
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 7.6 MPa			
Date Tested:	5/06/2018	Moisture Content:	7.5 %
Specimen Height:	133.6 mm	Duration of Test:	624 seconds
Average Specimen Diameter:	51.7 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Single shear plane		
Other Pertinent Observations:			
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;">  <p>The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing. This document shall not be reproduced, except in full.</p> </div> <div style="text-align: right;"> <p>Authorised Signatory:</p>  <p>Jacob Lloyd</p> </div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <p>NATA Accredited Laboratory Number: 14874</p> <p>Date: 7/06/2018</p> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="text-align: center;">  </div> <div style="text-align: right;"> <p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street</p> <p>Alexandria NSW 2015</p> </div> </div>			




Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH2-02 7.7-7.86m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Siltstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33962-UCS
Job No.:	S18220	Lab No.:	S33962
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 7.7 MPa			
Date Tested:	5/06/2018	Moisture Content:	5.6 %
Specimen Height:	126.5 mm	Duration of Test:	621 seconds
Average Specimen Diameter:	50.2 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
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Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH3-02 1.75-1.88m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Siltstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33964-UCS
Job No.:	S18220	Lab No.:	S33964
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 1.9 MPa			
Date Tested:	5/06/2018	Moisture Content:	11.3 %
Specimen Height:	103.5 mm	Duration of Test:	646 seconds
Average Specimen Diameter:	52.6 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
Deviation from Standard:	Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.		
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NATA Accredited Laboratory Number: 14874		Date: 7/06/2018	
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street</p> <p>Alexandria NSW 2015</p>	




Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH3-04 6.81-7m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Siltstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33966-UCS
Job No.:	S18220	Lab No.:	S33966
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 9.9 MPa			
Date Tested:	5/06/2018	Moisture Content:	6.6 %
Specimen Height:	131.6 mm	Duration of Test:	606 seconds
Average Specimen Diameter:	51.8 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;">  <p>The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing. This document shall not be reproduced, except in full.</p> <p>NATA Accredited Laboratory Number: 14874</p> </div> <div style="text-align: right;"> <p>Authorised Signatory:</p>  <p>Jacob Lloyd</p> <p>Date: 7/06/2018</p> </div> </div>			
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street Alexandria NSW 2015</p>	




Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH4-01 2.31-2.47m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Siltstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33967-UCS
Job No.:	S18220	Lab No.:	S33967
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
<div style="display: flex; justify-content: space-around;">   </div>			
Uniaxial Compressive Strength 9.9 MPa			
Date Tested:	5/06/2018	Moisture Content:	6.6 %
Specimen Height:	131.6 mm	Duration of Test:	606 seconds
Average Specimen Diameter:	51.8 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 45%;">  <p>The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing. This document shall not be reproduced, except in full.</p> <p>NATA Accredited Laboratory Number: 14874</p> </div> <div style="width: 45%; text-align: right;"> <p>Authorised Signatory:</p>  <p>Jacob Lloyd</p> <p>Date: 7/06/2018</p> </div> </div>			
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street Alexandria NSW 2015</p>	




Uniaxial Compressive Strength			
Client:	Arup	Sample Source:	BH4-03 8-8.17m
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Siltstone
Project:	Terrigal Boardwalk (261648)	Report No.:	S33969-UCS
Job No.:	S18220	Lab No.:	S33969
Test Procedure:	AS 4133.4.2.2 Determination of uniaxial compressive strength-Rock strength less than 50 MPa		
Testing Machine:	Matest 2000 kN Compression Machine	Sample Curing:	-
Sampling Method:	Sampled by Client	Date Sampled:	23/05/2018
Storage History:	Core Box	Storage Environment:	Sealed at as received moisture condition
			
Uniaxial Compressive Strength 9.1 MPa			
Date Tested:	5/06/2018	Moisture Content:	5.0 %
Specimen Height:	125.1 mm	Duration of Test:	640 seconds
Average Specimen Diameter:	51.9 mm	Rate of Displacement:	< 0.1 mm/min
Failure Type:	Mixed mode		
Other Pertinent Observations:			
Deviation from Standard:	Test specimen length to diameter ratio falls outside of standard limitations of 2.5-3.0.		
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NATA Accredited Laboratory Number: 14874		Date: 7/06/2018	
		<p>Macquarie Geotechnical</p> <p>U8 10 Bradford Street Alexandria NSW 2015</p>	

SOIL CHEMICAL PROPERTIES REPORT																									
Client:	Arup	Source:	BH1 - 03 6-6.1m																						
Address:	Level 10, 201 Kent Street, Sydney 2000 Australia	Sample Description:	Silty CLAY with sand																						
Project:	Terrigal Boardwalk (261648)	Report No:	B48632-SCP																						
Job No:	S18220	Lab No:	B48632 (S33959)																						
Test Procedure:																									
<input checked="" type="checkbox"/>	AS1289 4.2.1	Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method																							
<input checked="" type="checkbox"/>	AS1289 4.3.1	Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method																							
<input type="checkbox"/>	AS 1289 4.4.1	Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material																							
<input type="checkbox"/>	AS 1012.20	Chloride and sulphate																							
<input type="checkbox"/>	RMS T123	pH value of a soil (electrometric method)																							
<input type="checkbox"/>	RMS T185	Resistivity of sands and granular road construction materials																							
<input type="checkbox"/>	RMS T200	Chloride content of roadbase																							
<input checked="" type="checkbox"/>	RMS T1010	Quantitative determination of chlorides in soil																							
<input type="checkbox"/>	RMS T1011	Quantitative determination of sulphates in soil																							
<input type="checkbox"/>	BS1377(1990 pt.3)	Water soluble sulphate content																							
<input type="checkbox"/>	APHA 4500 H+B	pH																							
<input type="checkbox"/>	APHA 4500 SO4 2-B	Sulphate																							
<input type="checkbox"/>	APHA 4500 Cl-B	Chloride																							
<input type="checkbox"/>	APHA 2510 & 2520-B	Electrical Conductivity																							
<input type="checkbox"/>	TAI B117	Sulphides Present (This service Not Covered by NATA Accreditation)																							
Sampling:		Sampled by Client																							
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Date Sampled:		23/05/2018																							
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Job No:	S18220	Lab No:	B48633 (S33961)																						
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Terrigal Boardwalk

CONSULTATION REPORT

April 2019



Date: 5 April 2019

Version 2

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Executive Summary

Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven. The concept designs, environmental assessment and geotechnical report were placed on public exhibition from 12 November to 14 December 2018.

The purpose of consultation for the Terrigal Boardwalk was to:

- Encourage the community and stakeholders to provide feedback on the concept design and supporting assessments
- Communicate the features and need for the proposal
- Provide the community an opportunity to speak directly with project staff
- Hear from stakeholders and the community to identify issues

Consultation methods

Two methods were used to collect feedback from the community and stakeholders.

- | | |
|--|--|
| Method 1: Written submissions | All residents and stakeholders could make a written submission via email, the online submission form on yourvoiceourcoast.com , hand written submission forms provided at information sessions, or via post. |
| Method 2: Random face-to-face surveys | Interviewers from an independent market researcher (Micromex) approached 441 people randomly in public places. The purpose of these surveys was to understand sentiment of residents from both Terrigal and other areas on the Central Coast. This method aimed to eliminate self-selection bias (where an individual chooses to participate in the consultation and may lead to a biased sample). |

A copy of the survey questions can be found in [Appendix A](#).

Surveys were conducted at:

- Terrigal Beach Markets
- Terrigal Lions Club Car boot Sale
- Terrigal CBD
- Gosford CBD
- Greedy Guts Market (Terrigal)
- The Entrance Markets

Terrigal Boardwalk consultation report

April 2019

What we heard

Consultation method 1: Written submissions

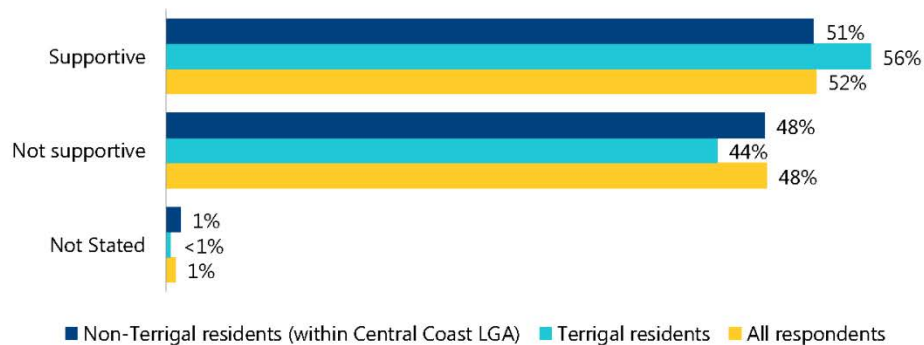
A total of **688** written submissions were received during the consultation period from 12 November to 14 December 2018.

Of the 688 individuals who made a submission:

- **52%** (355) expressed **general support** for the proposal
- **48%** (328) expressed a **lack of support** for the proposal
- **Less than 1%** (3) did not express clear sentiment towards the proposal

(Note: these percentages have been rounded)

Figure 1. **Level of support based on written submissions – Comparison between place of residence** (Note: percentages have been rounded)



Consultation method 2: Random face-to-face surveys

In addition to written submissions, **441** random face-to-face surveys were conducted over a week between Saturday 2 and Saturday 9 February 2019.

Before being asked questions about the boardwalk, participants were shown concept drawings, advised of the estimated cost, and where the funding for the boardwalk was being sourced.

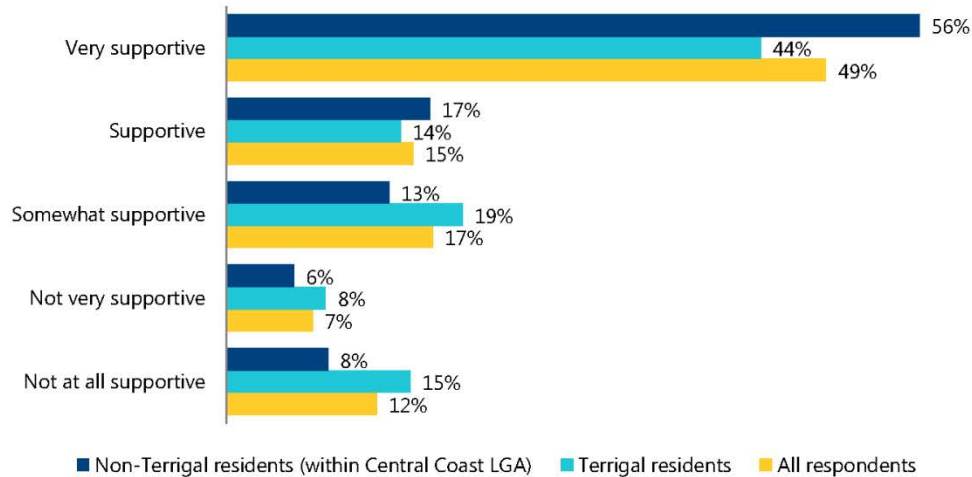
Of the 441 individuals who took part in the surveys:

- **49%** were **very supportive** of the proposal
- **15%** were **supportive** of the proposal
- **17%** were **somewhat supportive** of the proposal
- **7%** were **not very supportive** of the proposal
- **12%** were **not at all supportive** of the proposal

Terrigal Boardwalk consultation report

April 2019

Figure 2. **Level of support based on random face-to-face surveys – Comparison between place of residence**



Consultation outcomes

The overall majority of submissions and survey responses expressed support for the proposal.

Based on feedback provided through both methods, the **key reasons to support** the proposal were:

- Better access and recreation opportunities
- Tourism and economic benefits
- Favorable design
- Positive visual impact (eg complements the area)

Based on feedback provided through both methods, the **key reasons not to support** the proposal were:

- High cost of the project
- Negative visual impact
- Lack of need (eg there is already a path)
- Impact on current use of the rock platform / Haven Beach
- Ecological impact / litter and pollution

Council has provided response to the themes and issues raised during the consultation process within this report.

Next steps

The next steps for Terrigal Boardwalk are as follows.

Terrigal Boardwalk consultation report

April 2019

- A report to Council will be prepared recommending the boardwalk proceed and the allocation of \$2.98 million of Council funds to match State Government funding.
- The feedback received from the community will be incorporated into the design where feasible during detailed design phase.
- The final design will be shared with the State Government as the grant authority and published on www.yourvoiceourcoast.com
- The Review of Environmental Factors document will be continuously updated during the detailed design stage.
- The inclusion of artwork along the boardwalk will be considered subject to availability of funds once a cost estimate is prepared upon completion of detailed design.
- Works to upgrade the rock pool are expected to be completed before the 2019/20 summer season. This project is being funded by the NSW Government which has provided \$250,000 from the Public Reserves Management Fund Program to assist with works.

All other feedback we received as part of the consultation period which is not directly related to the boardwalk has been shared with the relevant departments within Council.

Terrigal Boardwalk consultation report

April 2019

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Introduction

Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven.

Council has been successful in receiving \$2.9 million of NSW Government funding through the Regional Growth Environment and Tourism Fund to build the boardwalk, with a 50:50 funding match to be provided by Council.

Council engaged Arup Pty Ltd to carry out technical investigations, environmental studies, and to develop a concept design and detailed design.

The proposal

The Terrigal Boardwalk concept plans exhibited for feedback consisted of:

- A 220 metre boardwalk connecting the existing pathway at the Terrigal rock pool to the west with The Haven precinct at the existing seawall to the east
- A viewing platform
- Extension of the sandstone wall from The Haven Beach to connect the built boardwalk.

The concept designs for the boardwalk can be viewed in Appendix B.

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Consultation Approach

Objectives of consultation

The purpose of consultation for the Terrigal Boardwalk was to:

- Encourage the community and stakeholders to provide feedback on the concept design and supporting assessments
- Communicate the features and need for the proposal
- Provide the community an opportunity to speak directly with project staff
- Hear from stakeholders and the community to identify issues

Our engagement framework

Consultation has been designed in accordance with Central Coast Council's Engagement Framework. This framework is available to view at <https://www.yourvoiceourcoast.com/Central-Coast-Council-Engagement-Framework>

How we consulted

Consultation tools

Method 1: Written submissions	All residents and stakeholders could make a written submission via email, the online submission form on yourvoiceourcoast.com , hand written submissions forms provided at information sessions, or via post.
Method 2: Random face-to-face surveys	<p>Interviewers from an independent market researcher (Micromex) approached 441 people randomly in public places. The purpose of these surveys was to understand sentiment of residents from both Terrigal and other areas on the Central Coast. This method aimed to eliminate self-selection bias (where an individual chooses to participate in the consultation and may lead to a biased sample).</p> <p>A copy of the survey questions can be found in Appendix A</p> <p>Surveys were conducted at:</p> <ul style="list-style-type: none"> • Terrigal Beach Markets • Terrigal Lions Club Car boot Sale • Terrigal CBD • Gosford CBD • Greedy Guts Market (Terrigal) • The Entrance Markets

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Promotion of activities

We carried out extensive promotion of the consultation period to ensure the community and affected stakeholders were aware of the opportunity to learn about the proposal and given enough notice to make a submission.

Media release	<ul style="list-style-type: none"> • 'Community can have their say on Terrigal Boardwalk design' issued on 13 November 2018 • A copy of the media release can be found in Appendix C
Print advertising	<ul style="list-style-type: none"> • Advertising featured in Central Coast Express Advocate on 27 September • A copy of the advertisement can be found in Appendix D
Radio advertising	<ul style="list-style-type: none"> • Southern Cross Austereo: 14 November until 7 December 2018 • StarFM: 12 November until 11 December 2018
Social media	<ul style="list-style-type: none"> • Facebook posts on 21 November and 12 December Total reach of 8,869 – 61 comments, 16 shares and 106 reactions • Twitter tweets on 13 November, 21 November and 12 December • Copies of the posts can be found in Appendix E
Drop-in information sessions	<p>Two drop-in information sessions were held on:</p> <ul style="list-style-type: none"> • Saturday 24 November 2018 at Terrigal Esplanade, 9am to 1pm • Wednesday 28 November 2018 at Terrigal Surf Life Saving Club, 4pm to 7pm • A total of 330 people attended these information sessions.
Your Voice – Our Coast website	<ul style="list-style-type: none"> • Project page launched on 12 November 2018 https://www.yourvoiceourcoast.com/terrigan-boardwalk • The page received 3600 visits during consultation period
Postcards	<ul style="list-style-type: none"> • 300 postcards were letterbox dropped to Terrigal residents • The distribution area can be found in Appendix F
Outdoor posters	<ul style="list-style-type: none"> • Outdoor posters were installed throughout Terrigal CBD, Terrigal Esplanade and The Haven • Copies of the posts can be found in Appendix G

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Media coverage achieved

Television	<ul style="list-style-type: none">• NBN Central Coast TV News – 6.00-7.00pm – 26 November 2018
Radio	<ul style="list-style-type: none">• STAR Radio News – 10.00am – 15 November 2018• STAR Radio News – 9.00am – 21 November 2018• STAR Radio News – 12.00pm – 21 November 2018

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What we heard

Based on feedback provided through both methods, the **key reasons to support** the proposal were:

- Better access and recreation opportunities
- Tourism and economic benefits
- Favorable design
- Positive visual impact (eg complements the area)

Based on feedback provided through both methods, the **key reasons not to support** the proposal were:

- High cost of the project
- Negative visual impact
- Lack of need (eg there is already a path)
- Impact on current use of the rock platform / Haven Beach
- Ecological impact / litter and pollution

While an overall majority of participants expressed general support for the proposal, a wide range of issues and concerns regarding the proposal, or elements of it, were raised.

The key themes raised were:

- Cost of project
- Tourism and economy (benefits, negative impacts)
- Impact on current use of the rock platform / Haven Beach
- Project need (includes for / against)
- Access and recreation
- Usage (once built)
- Design
- Ongoing maintenance / longevity
- Rock-fall
- Visual impact
- Ecological impact
- Litter and pollution
- Construction
- Fix / upgrade rock pool

Please refer to Table 1 (page 17) to see the type of comment or issue placed under each theme. Council's response to these can also be found in this table.

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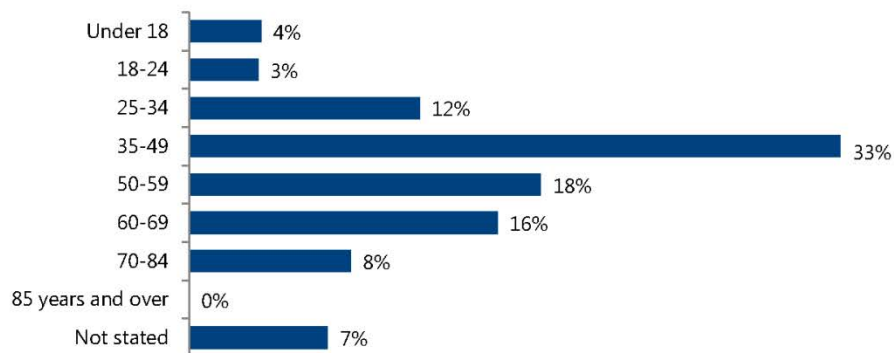
Method 1: Written submissions

A total of **688** written submissions were received during the consultation period.

If an individual made a more than one submission, we combined the content and have counted these as a single submission for reporting purposes.

Submissions were provided as emails, online submissions through yourvoiceourcoast.com and hand written submissions forms provided at information sessions on the 24 and 28 November 2018.

Figure 3. **Stakeholder ages (Method 1: Written submissions)**



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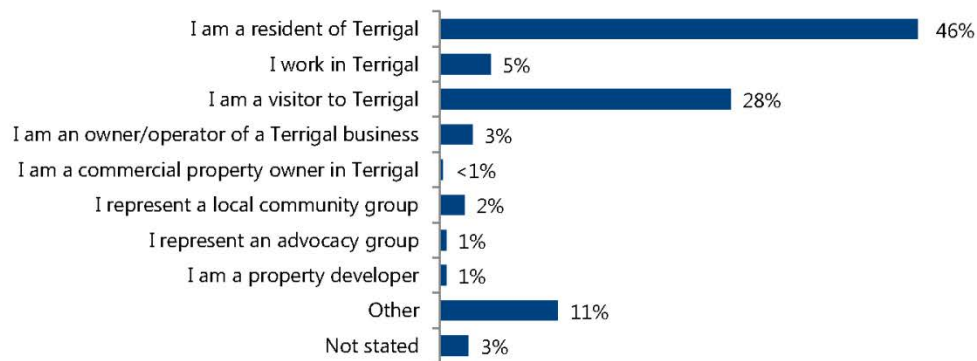
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Figure 4. **Residential suburb of stakeholder (Method 1: Written submissions)**

Suburb	Percentage	Suburb	Percentage
Terrigal	47%	Springfield	<1%
Wamberal	8%	Chittaway Bay	<1%
North Avoca	3%	Jilliby	<1%
Avoca Beach	2%	Long Jetty	<1%
Saratoga	2%	Point Clare	<1%
Green Point	2%	Tuggerah	<1%
Foresters Beach	2%	Blue Bay	<1%
Kincumber	2%	Blue Haven	<1%
Narara	2%	Canton Beach	<1%
Bateau Bay	2%	Daleys Point	<1%
Erina	1%	Davistown	<1%
Gosford	1%	Ettalong Beach	<1%
Umina Beach	1%	Gorokan	<1%
Wyoming	1%	Gwandalan	<1%
Tumbi Umbi	1%	Horsfield Bay	<1%
East Gosford	1%	Kanwal	<1%
Lisarow	1%	Pickett's Valley	<1%
Matcham	1%	Point Frederick	<1%
Bensville	1%	Pretty Beach	<1%
Killarney Vale	1%	Shelly Beach	<1%
Copacabana	1%	Summerland Point	<1%
Holgate	1%	The Entrance	<1%
Ourimbah	1%	Wadalba	<1%
Niagara Park	1%	Woongarra	<1%
Kariong	1%	Woy Woy	<1%
Macmasters Beach	1%	Wyee	<1%
Berkeley Vale	<1%	Wyong	<1%
Empire Bay	<1%	Yattalunga	<1%
Glenning Valley	<1%	Warnervale	<1%
Norah Head	<1%	Outside Central Coast	1%
North Gosford	<1%	Not stated	2.0%

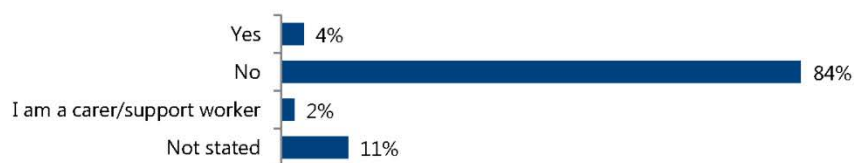
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Figure 5. **Interest in the proposal (Method 1: Written submissions)**

'Other' specified interests include (but are not limited to):

- Surf Life Saving Club member/s or lifeguard
- Grew up in Terrigal
- Family in Terrigal
- Ocean swimming group member / regular swimmer
- Regular exerciser at Terrigal
- Central Coast Councillor
- State Member
- Potential new resident
- Terrigal High School student/s
- Rate payers

Figure 6. **Percentage of stakeholders with mobility impairment (Method 1: Written submissions)**

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From the **688** submissions, a total of **1273** separate comments were made (one submission can contain several comments). These comments have been themed for reporting purposes.

Figure 7. **Themes raised by stakeholders (Method 1: Written submissions)**

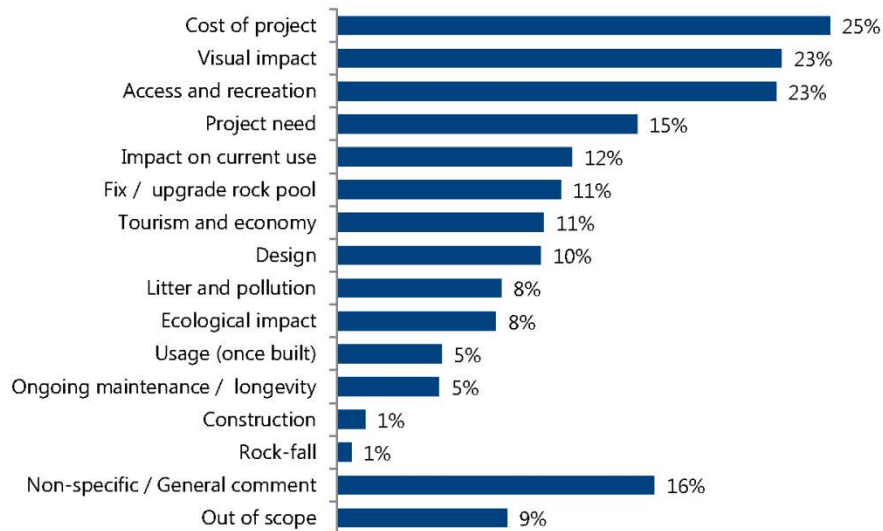
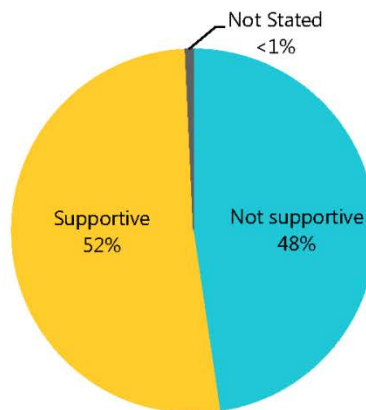


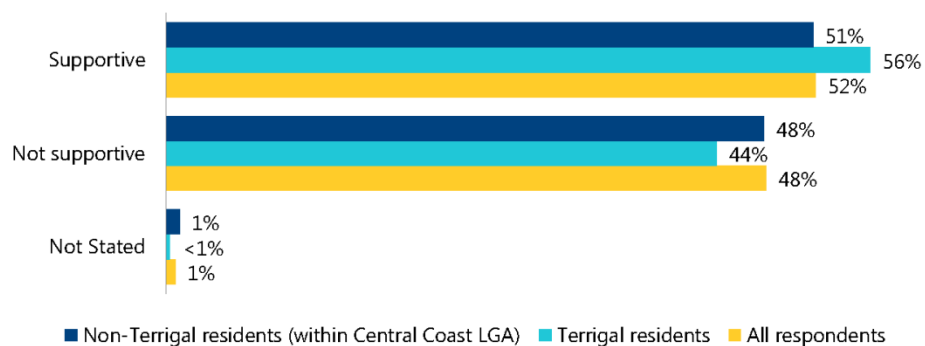
Figure 8. **Overall level of support (Method 1: Written submissions)** (Note: percentages have been rounded)



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Figure 9. **Level of support – Comparison between place of residence (Method 1: Written submissions)** (Note: Percentages have been rounded)



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Written submissions from Terrigal residents only

From the **320** submissions from residents who selected '**Terrigal**' as their current suburb, a total **590** separate comments were made (one submission can contain several comments). These comments have been themed for reporting purposes.

Figure 10. **Themes raised by Terrigal residents (Method 1: Written submissions)**

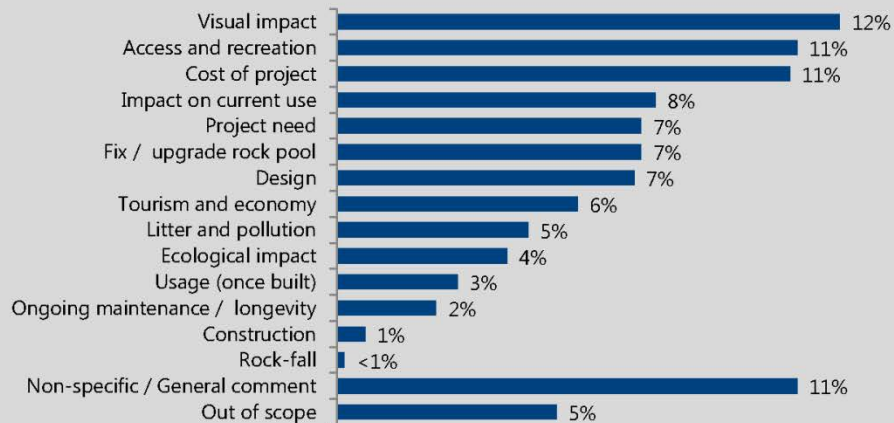
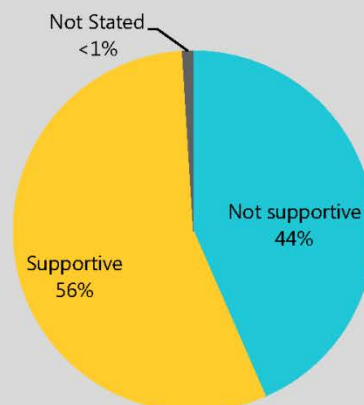


Figure 11. **Level of support – Terrigal residents only (Method 1: Written submissions)** (Note: percentages have been rounded)



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Method 2: Random face-to-face survey

In addition to written submissions, **441** Random face-to-face surveys were conducted over a week between Saturday 2 and Saturday 9 February.

This involved interviewers from an independent market researcher (Micromex) approaching 441 people randomly in public places. The purpose of these surveys was to understand sentiment of residents from both Terrigal and other areas on the Central Coast. This method aimed to eliminate self-selection bias (where an individual chooses to participate in the consultation and may lead to a biased sample).

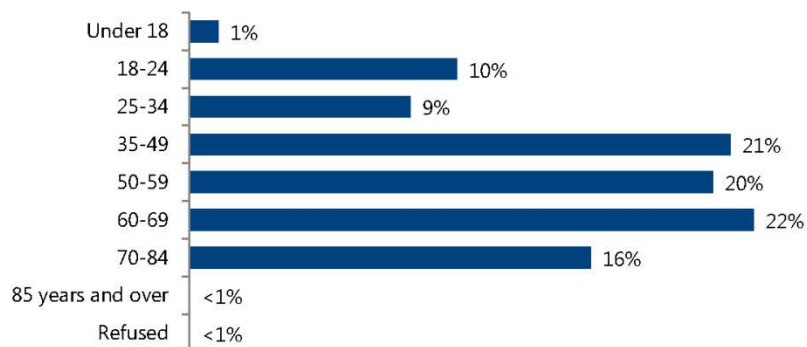
A copy of the survey questions can be found in Appendix A.

Surveys were conducted at:

- Terrigal Beach Markets
- Terrigal Lions Club Car boot Sale
- Terrigal CBD
- Gosford CBD
- Greedy Guts Market (Terrigal)
- The Entrance Markets

Before being asked questions about the boardwalk, participants were shown concept drawings, advised of the estimated cost, and where the funding for the boardwalk was being sourced.

Figure 12. **Stakeholder ages (Method 2: Random face-to-face surveys)**



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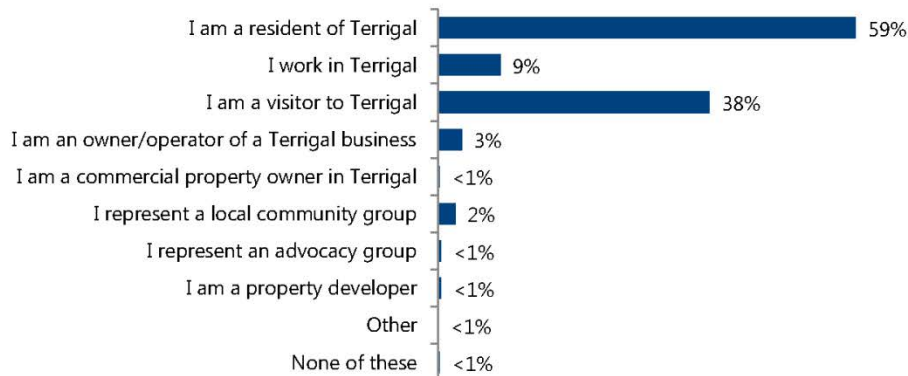
Figure 13. **Residential suburb of survey participants (Method 2: Random face-to-face surveys)**

Suburb	Percentage
Terrigal	59%
Wamberal	5%
Erina	2%
Gosford	2%
Green Point	2%
Kariong	2%
Narara	2%
Wyoming	2%
Avoca Beach	1%
Bateau Bay	1%
East Gosford	1%
Killarney Vale	1%
Kincumber	1%
Lisarow	1%
Long Jetty	1%
North Avoca	1%
North Gosford	1%
Ourimbah	1%
Springfield	1%
The Entrance	1%
West Gosford	1%
Bensville	<1%
Berkeley Vale	<1%
Blue Bay	<1%
Blue Haven	<1%
Booker Bay	<1%
Budgewoi	<1%
Chittaway Bay	<1%
Copacabana	<1%
Davistown	<1%
Erina Heights	<1%
Ettalong Beach	<1%

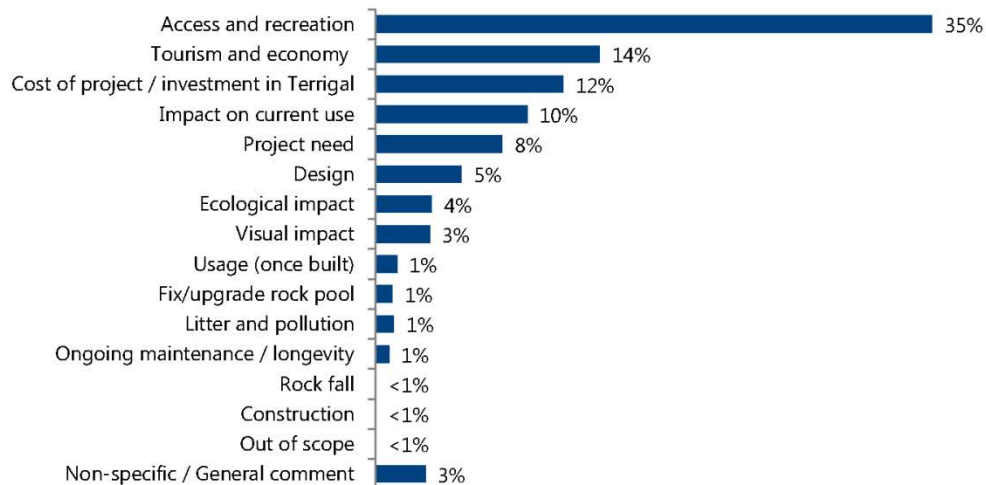
Suburb	Percentage
Forresters Beach	<1%
Fountaindale	<1%
Glenning Valley	<1%
Glenworth Valley	<1%
Gorokan	<1%
Halekulani	<1%
Holgate	<1%
Jilliby	<1%
Kanwal	<1%
Killcare Heights	<1%
Lake Munmorah	<1%
MacMasters Beach	<1%
Moonee	<1%
Mooney Mooney	<1%
Niagara Park	<1%
Noraville	<1%
Patonga	<1%
Peats Ridge	<1%
Point Clare	<1%
Point Frederick	<1%
Rocky Point	<1%
Shelly Beach	<1%
Somersby	<1%
Tascott	<1%
The Entrance North	<1%
Toowoona Bay	<1%
Tuggerah	<1%
Tumbi Umbi	<1%
Umina Beach	<1%
Woy Woy	<1%
Wyong	<1%
Wyongah	<1%

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Figure 14. **Interest in the proposal (Method 2: Random face-to-face survey)**Figure 15. **Percentage of survey participants with mobility impairment (Method 2: Random face-to-face survey)**

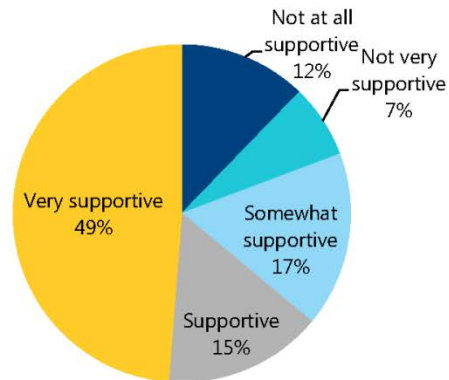
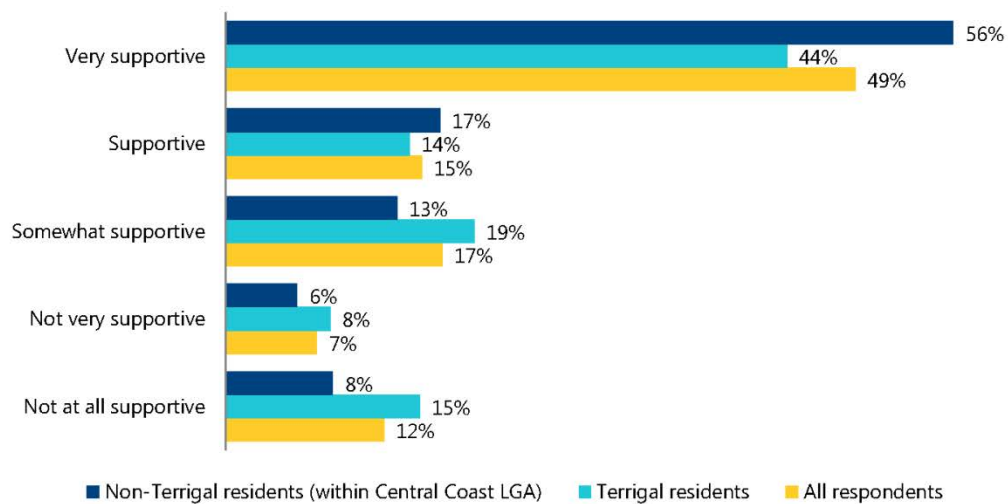
From the **441** completed surveys, a total of **1006** separate reasons were provided to justify the level of support expressed by the participant (one survey participant could provide several reasons). These reasons have been themed for reporting purposes.

Figure 16. **Themes raised by survey participants (Method 2: Random face-to-face survey)**

Please refer to Table 1 (page 17) to see the type of comment or issue placed under each theme. Council's response to these can also be found in this table.

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Figure 17. **Overall level of support (Method 2: Random face-to-face surveys)**Figure 18. **Level of support – Comparison between place of residence (Method 2: Random face-to-face surveys)**

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Random face-to-face survey results from Terrigal residents only

From the **260** survey participants who stated 'Terrigal' as their current suburb, a total of **606** separate reasons were provided to justify the level of support expressed by the participant (one survey participant could provide several reasons). These reasons have been themed for reporting purposes.

Figure 19. **Themes raised by Terrigal resident (Method 2: Random face-to-face surveys)**

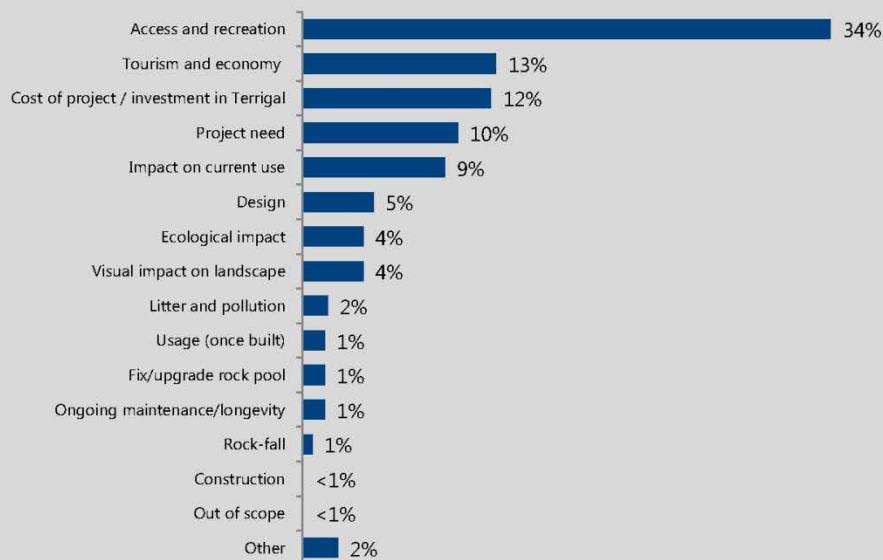
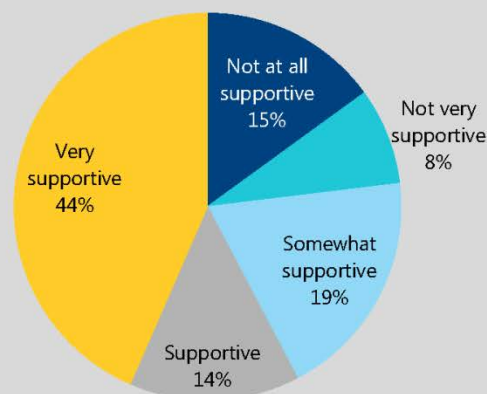


Figure 20. **Level of support – Terrigal residents only (Method 2: Random face-to-face surveys)**



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Council's response

Due to the large volume and variety of content contained within community feedback, not every comment was able to be included and responded to in this report however they have all been considered.

Table 1

Category	Summary of issue / Example of comment	Council's response
Cost of project	<ul style="list-style-type: none"> Concerns about the high cost of the boardwalk Suggestion the money should be spent elsewhere (many other suggestions provided) Why is this money being spent in Terrigal? Good to see something tangible for our rates money 	<p>The concept design for the boardwalk has been prepared in compliance with industry best practice, codes and standards required for coastal infrastructure which has added to the cost.</p> <p>Terrigal has been chosen for investment because the proposed boardwalk is intended to improve the amenity and accessibility for local residents as well as tourists visiting the region.</p> <p>The boardwalk aims to activate Terrigal as a key visitor destination, including a conference destination. This in turn will contribute to economic activity and an increase in turnover for local businesses in Terrigal and the wider Central Coast.</p> <p>The construction of the boardwalk is expected to further boost the local economy by creating a projected 90 local jobs, of which 67 are anticipated to be resident jobs.</p> <p>The <i>Terrigal Haven Plan of Management</i> prepared by former Gosford Council in December 2009 incorporated the management action "Provision of CBD access improvements" to investigate a number of options for access improvements to Terrigal CBD, including the provision of a boardwalk linking Terrigal Beach promenade to The Haven precinct. The proposal responds to this action within the Plan of Management.</p>


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Category	Summary of issue / Example of comment	Council's response
Tourism and economy (benefits, negative impacts)	<ul style="list-style-type: none"> Boardwalk will be good for business Will be good to attract more tourists Concerns about attracting more tourists Will encourage crowds / overwhelm the area 	<p>The boardwalk aims to activate Terrigal as a key visitor destination, including a conference destination. This in turn will contribute to the economic activity and an increase in turnover for local businesses in Terrigal and the wider Central Coast.</p> <p>The construction of the boardwalk is expected to further boost the local economy by creating a projected 90 local jobs, of which 67 are anticipated to be resident jobs.</p> <p>Increased visitation</p> <p>Council has recently completed road upgrades in the Terrigal CBD to better manage traffic flow and congestion.</p> <p>Council has also upgraded the Wilson Road multi storey carpark, creating 110 additional car parks.</p> <p>Further investigations are being carried out to assess the need for additional car parking in Terrigal as part of the Central Coast Regional Parking Strategy.</p>
Impact on current use	<ul style="list-style-type: none"> Concerns the boardwalk will negatively impact the current use of the rock platform Eg. children's play, fishing, general use, dog swimming area, western end of The Haven beach The boardwalk will complement the use of the area 	<p>The risk assessment carried out in line with Australian Geomechanics Society (AGS) Framework of Landslide Risk has identified a risk of rock fall and it is not safe to use the rock shelf.</p> <p>Once the boardwalk is built, access to rock platform will therefore not be encouraged.</p> <p>Currently there are signs at Terrigal advising risk of falling rocks accessing this areas.</p>

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Category	Summary of issue / Example of comment	Council's response
		 <p>The boardwalk will be built away from the platform so the community can still continue using this area providing more safety from rock fall.</p> <p>The loss of space at the western end of the beach due to construction of the boardwalk will be further investigated at detailed design stage to minimise the loss of beach space.</p>
Project need	<ul style="list-style-type: none"> • The project isn't need • The project is needed • A path already connects Terrigal Promenade to The Haven 	<p>Council is proposing to build the boardwalk to:</p> <ul style="list-style-type: none"> • Provide safe access for pedestrians by connecting the existing walkways at Terrigal Beach promenade and The Haven • Enhance the experience of the area for pedestrians by offering a natural and aesthetically pleasing coastal walk/run • Offer a safer, more inclusive and direct coastal walk option to the current pedestrian path located alongside the road. It will divert foot traffic away from the path up the hill onto a more level platform. • Maximise access and mobility to meet the needs of all community members, as well as tourists visiting the area. • Encourage a sense of an inclusive

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Category	Summary of issue / Example of comment	Council's response
		<p>community by allowing children, parents with prams and people with disabilities to use the area more.</p> <ul style="list-style-type: none"> • Offer health benefits and better recreation opportunities through increased participation and physical activity, as it is suitable for walkers, cyclists, runners, dog walkers (dogs on a leash) and families. • Provide all opportunities for pedestrians of all abilities to soak up the views from the viewing platform.
Access and recreation	<ul style="list-style-type: none"> • Suggestion the boardwalk will be great for walkers, runners and families • Will be good for people with mobility impairments • Will open up the area • The new connection will improve access to parking at The Haven 	<p>The boardwalk will offer health benefits and better recreation opportunities through increased participation and physical activity, as it is suitable for walkers, cyclists, runners, dog walkers (dogs on a leash) and families.</p> <p>Additionally the boardwalk will provide safe and easy access between Terrigal Beach promenade to The Haven.</p>
Usage (once built)	<ul style="list-style-type: none"> • What is allowed/not allowed on boardwalk? • Potential for anti-social behaviour • Concern about diving and jumping from boardwalk / general water safety • Dog should not be allowed on the boardwalk • Will the boardwalk be closed off at times? • Conflicting use and safety 	<p>Council anticipates the following allowances and restrictions would apply to boardwalk once built. These will be confirmed in detailed design stage.</p> <ul style="list-style-type: none"> • Walking, cycling, prams, mobility scooters and dogs on leash will be allowed on the boardwalk. • Skate boards, fishing and jumping from the structure will not be allowed. • The boardwalk may be closed during major weather events, or signage may be erected. • Appropriate signage will be fixed near the boardwalk to inform users of what is permitted/not permitted and to address safety concerns.
Design	<ul style="list-style-type: none"> • Comments on the boardwalk design (eg. I don't like the look of it / I think it looks great) • Comments/suggestion on materials, specific design elements 	<p>The principle objective of the design is to provide a high quality experience for Terrigal's coastal walk for pedestrians.</p> <p>The design of the boardwalk is compliant with relevant Australian Standards and was</p>

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Category	Summary of issue / Example of comment	Council's response
	<ul style="list-style-type: none"> Why is the boardwalk extended so far out? Can it be closer to the cliff? What were the other options? 	<p>prepared after careful consideration to manage the risk of rockfall from adjacent cliff while also managing coastal considerations including wave impact, sea-level rise and inundation.</p> <p>The design of the boardwalk addresses the interface between the existing pedestrian walkways on either end and the safety issues associated with a naturally changing cliff line and water levels.</p> <p>The material selection has been carried out to achieve aesthetic impact while providing a durable, cost effective solution that manages maintenance requirements. A wide range of material options were reviewed at concept design stage keeping in mind the design life, maintenance requirements and durability in a coastal environment.</p> <p>The material options were evaluated against cost, aesthetic/user experience, durability/maintenance, availability and environmental Impact criteria. The recommended materials will be further investigated prior to being finalised during detailed design stage. The boardwalk is extended far out to mitigate the risk of rock fall/debris from the adjacent cliff-face.</p> <p>The other two options were 'Nature walk' and 'Cable-stay'. All three options were evaluated against environmental impact, capital cost, design/constructability risk, statement design and user experience criteria. A decision was made to proceed with Option 2 ('Views and lookout platform').</p> <p>The Nature Walk option was not chosen as this design potentially needed more piles/supports.</p> <p>Cable stay was not selected as it required a more expensive structural solution and</p>

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Category	Summary of issue / Example of comment	Council's response
		was over the budget.
Ongoing maintenance / longevity	<ul style="list-style-type: none"> Concern the boardwalk will not withstand rough seas and storms Concern the boardwalk be hard to maintain 	<p>The deck of the boardwalk has been designed as high as practicable above wave crest height to avoid wave slam and potential damage. Wave loading has been considered on the piles of the boardwalk and on the structure itself. The potential for wave overtopping is considered at each location along the boardwalk. A bathymetric survey has been carried out to inform the wave crest assessment, as well as wave loading on the boardwalk. An assessment of scour at the toe of the seawall has been carried out for the extension of the seawall along the beach. The design is composed of simple and durable materials within the coastal context to ensure the longevity of the boardwalk and ease of maintenance.</p>
Rock-fall	<ul style="list-style-type: none"> Concerns about rock fall and the stability of the cliff face 	<p>The geometry, alignment and elevation of the boardwalk has been carefully considered to manage the risk of rockfall from adjacent cliff. An Australian Geomechanics Society (AGS) 2007 risk assessment was carried out to assess the landslide risk to persons using the boardwalk.</p> <p>The boardwalk is extended far out to mitigate the risk of rock fall/debris from the adjacent cliff-face. Slope remediation in the form of rock netting attached to the slope will be carried out where a minimum 6m offset isn't achieved. Remediation would also include 'dental' treatment of weathered seams with reinforced shotcrete and rock bolts.</p>
Visual impact	<ul style="list-style-type: none"> Concern about negative visual impact on the natural cliff face/ rock platform Suggestion the boardwalk will complement the natural cliff face / rock platform 	<p>The selection of appropriate materials and finishes during detailed design stage would help integrate the structure of the boardwalk into the landscape and likely reduce the visual impact.</p> <p>The visual contrast and reflectivity of</p>

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Category	Summary of issue / Example of comment	Council's response
		<p>boardwalk materials will be limited through appropriate colour choices. The boardwalk thickness where possible will be minimised to decrease visual profile. The size and number of supporting columns will also be minimised. Any infill to the base of columns will complement the colour and texture of existing rock.</p> <p>Council will also ensure retaining walls and sea walls visually integrate with the existing landscape through appropriate selection of materials.</p> <p>The boardwalk is extended far out to mitigate the risk of rock fall/debris from the adjacent cliff-face.</p>
Ecological impact	<ul style="list-style-type: none"> Concern over impacts to natural environment and ecology Suggestion of inadequate assessment of environmental impacts / gaps in Review of Environmental Factors 	<p>The comments received from community relating to the Review of Environmental Factors (REF) have been carefully reviewed in consultation with Council's Environmental Reporting Section.</p> <p>Council will look into minimising the potential loss of the eastern end of the beach due to re-alignment of the sea wall. Council is also investigating the merits of carrying out a sub-tidal aquatic survey, substantial fauna survey and developing a vegetation management plan.</p> <p>In addition to incorporating any relevant feedback from the community, the REF document will be continuously updated during the detailed design stage to minimise the impacts to the natural environment and ecology as new issues arise.</p> <p>Council is also required to seek license from the NSW Department of fisheries before commencement of construction, at which stage additional aquatic surveys may be required to be carried out in line with the requirements of the licence.</p>

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Category	Summary of issue / Example of comment	Council's response
Litter and pollution	<ul style="list-style-type: none"> Concerns about litter pollution Concerns about disposal of dog poo/ compliance Comments about current poor enforcement of irresponsible dog ownership 	<p>An adequate number of bins will be provided along the boardwalk , which will be regularly serviced.</p> <p>The boardwalk will be patrolled by Council rangers, with visits increased if dog owners fail to appropriately dispose of dog poo. Appropriate signage will be in place advising dog owners of the applicable penalties. CCTV will also be installed to assist with identifying offenders.</p>
Construction	<ul style="list-style-type: none"> Concerns construction period will impact local trade Concern about environmental impacts during construction (eg. barge over seagrass) 	<p>Council will liaise with the business community regarding traffic management controls to minimise the impact on local trade throughout construction. Designated construction haulage routes would be determined in advance of construction to minimise impacts on local roads.</p> <p>The Department of Primary Industries (DPI) Fisheries will be consulted during the detailed design stage and a license will be obtained prior to contractor using a barge over seagrass during construction.</p> <p>A peer review of the "basis of detailed design" document will be carried out by an independent coastal engineering consultant to ensure the constructability of the boardwalk.</p>
Fix / upgrade rock pool	<ul style="list-style-type: none"> Request to upgrade the rock pool Request that the rock pool be turned into a larger ocean pool 	<p>Works to upgrade the rock pool are expected to be completed before the 2019/20 summer season.</p> <p>The project is being funded by the NSW Government which has provided \$250,000 from the Public Reserves Management Fund Program to assist with works.</p> <p>At this stage there is no plan to convert the rock pool into a larger ocean pool.</p>
Out of scope	<ul style="list-style-type: none"> Suggestions to improve water quality of Terrigal Beach (water from lagoon / storm water 	<p>Water quality</p> <p>Council is presently taking a number of</p>

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Category	Summary of issue / Example of comment	Council's response
	<p>discharge)</p> <ul style="list-style-type: none"> • Comments about parking • Request to provide better public toilet facilities • Other non-related suggestions 	<p>steps to understand and manage water quality at Terrigal.</p> <p>Council samples water quality between the lifeguard flags at Terrigal Beach each week. The samples are laboratory tested for bacteria and published on the Council website. On most days the beach is considered good for swimming.</p> <p>Permanent signage has been erected at three entry locations to Terrigal Beach advising that swimming is not recommended following rain events. Temporary signage is also placed on the beach following a poor water quality reading.</p> <p>A catchment audit is in progress for Terrigal Beach to better understand the potential causes of those times that are not considered good for swimming. This includes measuring water quality in stormwater pipe beach outlets during both dry and wet periods. The audit is also investigating if there is a correlation between high bacteria and rainfall and/or lagoon openings. Work is also underway to understand the sources of bacteria, whether human, animals, birds, or seagrass kelp. The audit is being carried out in consultation with Council's Water and Sewer section in regard to incorrect household plumbing connections (whether sewage connected to stormwater or rainwater connected to sewerage) and in regard to possible Council sewerage system leaks or overflows.</p> <p>Two years ago Council rehabilitated two sewer mains under Terrigal Lagoon to reduce the risk of sewage leaks.</p> <p>Parking</p> <p>Council has recently upgraded the Wilson Road multi storey carpark, creating 110</p>

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Category	Summary of issue / Example of comment	Council's response
		<p>additional car parks in the CBD.</p> <p>Further investigations are being carried out to assess the need for additional car parking in Terrigal as part of the Central Coast Regional Parking Strategy.</p> <p>Public toilets</p> <p>Council has allocated funding in the 2019/20 financial year towards internal refurbishment and improved ventilation of Terrigal Surf Club public toilets.</p> <p>Longer term Council is looking at redeveloping the toilets in conjunction with works that the surf club is planning.</p> <p>Investigations will also be carried out to construct additional amenities during detailed design stage of the boardwalk.</p>

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Consultation outcomes and next steps

Thank you to everyone who provided submissions for the proposed boardwalk at Terrigal and attended the drop-in information sessions.

The next steps for Terrigal Boardwalk are as follows.

- A report to Council will be prepared recommending the boardwalk proceed and the allocation of \$2.98 million of Council funds to match State Government funding.
- The feedback received from the community will be incorporated into the design where feasible during detailed design phase.
- The final design will be shared with the State Government as the grant authority and published on www.yourvoiceourcoast.com
- The Review of Environmental Factors document will be continuously updated during the detailed design stage.
- The inclusion of artwork along the boardwalk will be considered subject to availability of funds once a cost estimate is prepared upon completion of detailed design.
- Works to upgrade the rock pool are expected to be completed before the 2019/20 summer season. This project is being funded by the NSW Government which has provided \$250,000 from the Public Reserves Management Fund Program to assist with works.

All other feedback we have received as part of the consultation period which is not directly related to the boardwalk ('out of scope') has been shared with the relevant departments within Council.

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Appendices

Appendix A

Face-to-face survey questions

<p>Central Coast Council Terrigal Boardwalk Validation questionnaire February 2019</p>

Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven.

Council has developed a concept design for the boardwalk and we'd like to ask a few questions about it, would you have a few minutes to assist us please?

Q1a. Which suburb do you live in?

.....

Q1b. Interviewer only question: Record residential location.

- ☐ Terrigal
- ☐ Other location within the Central Coast LGA
- ☐ Outside of the Central Coast LGA **(Terminate)**

Q2. What is your age?

- ☐ Under 18
- ☐ 18-24
- ☐ 25-34
- ☐ 35-49
- ☐ 50-59
- ☐ 60-69
- ☐ 70-84
- ☐ 85 years and over
- ☐ Refused

Q3. Do you consider yourself to have a mobility impairment? (SR)

- ☐ Yes
- ☐ No
- ☐ I am a carer/support worker
- ☐ Refused

Q4. Gender.

- ☐ Male
- ☐ Female

Q5. How would you best describe your interest in the boardwalk? (MR)

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- ☐ I am a resident of Terrigal (*pre-populate for those with the residential location of Terrigal*)
- ☐ I work in Terrigal
- ☐ I am a visitor to Terrigal (*Hide for those with the residential location of Terrigal*)
- ☐ I am an owner/operator of a Terrigal business
- ☐ I am a commercial property owner in Terrigal
- ☐ I represent a local community group
- ☐ I represent an advocacy group
- ☐ I am a property developer
- ☐ Other (please specify).....
- ☐ None of these

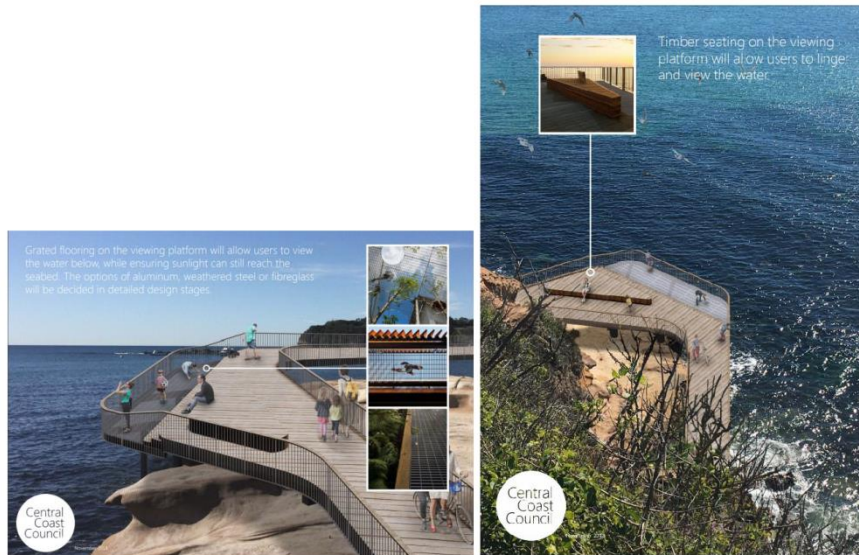
As I mentioned earlier, Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven.

Council has already secured \$2.9 million of funding from the NSW Government to build it, and will need to provide another \$2.9 million.

The boardwalk is expected to be completed by summer next year (2020).

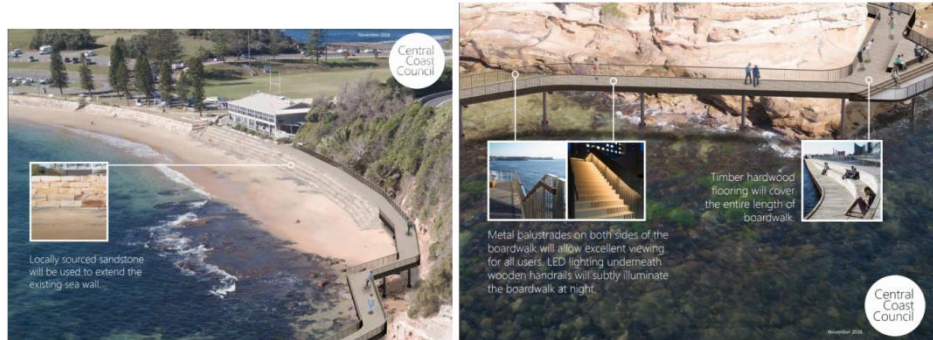
Council has developed a concept design for the boardwalk which looks as follows:

Images enlarged for Showcard



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Q6a. Looking at these images, and thinking about the information I've provided, how supportive are you of this proposal?

- ☐ Very supportive
- ☐ Supportive
- ☐ Somewhat supportive
- ☐ Not very supportive
- ☐ Not at all supportive
- ☐ **(Do not prompt)** Unsure

Q6b. What are the reasons for your support/ lack of support?

.....

Q7. For quality control purposes, my supervisor might be in contact to confirm I completed this survey with you. Could I please have your:

First name:
 Phone number:

That is the end of the survey, thank you for your time today
Interviewer to provide business card with www.yourvoiceourcoast.com

Q. Interviewer only: Record location.

- ☐ Terrigal Beach Markets
- ☐ Terrigal Lions Club Car Boot Sale
- ☐ Terrigal CBD
- ☐ Greedy Guts Markets
- ☐ The Entrance Market
- ☐ Gosford Farmers Market
- ☐ Gosford CBD
- ☐ Love Lanes Festival

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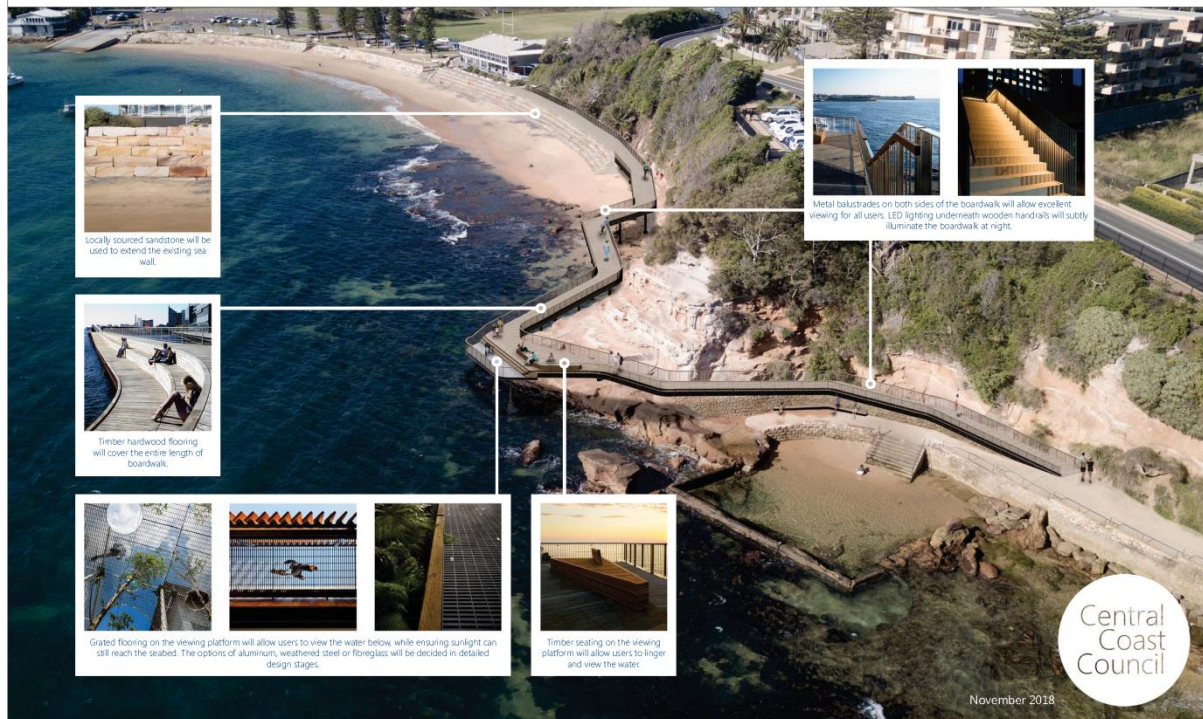
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Appendix B

Concept Design

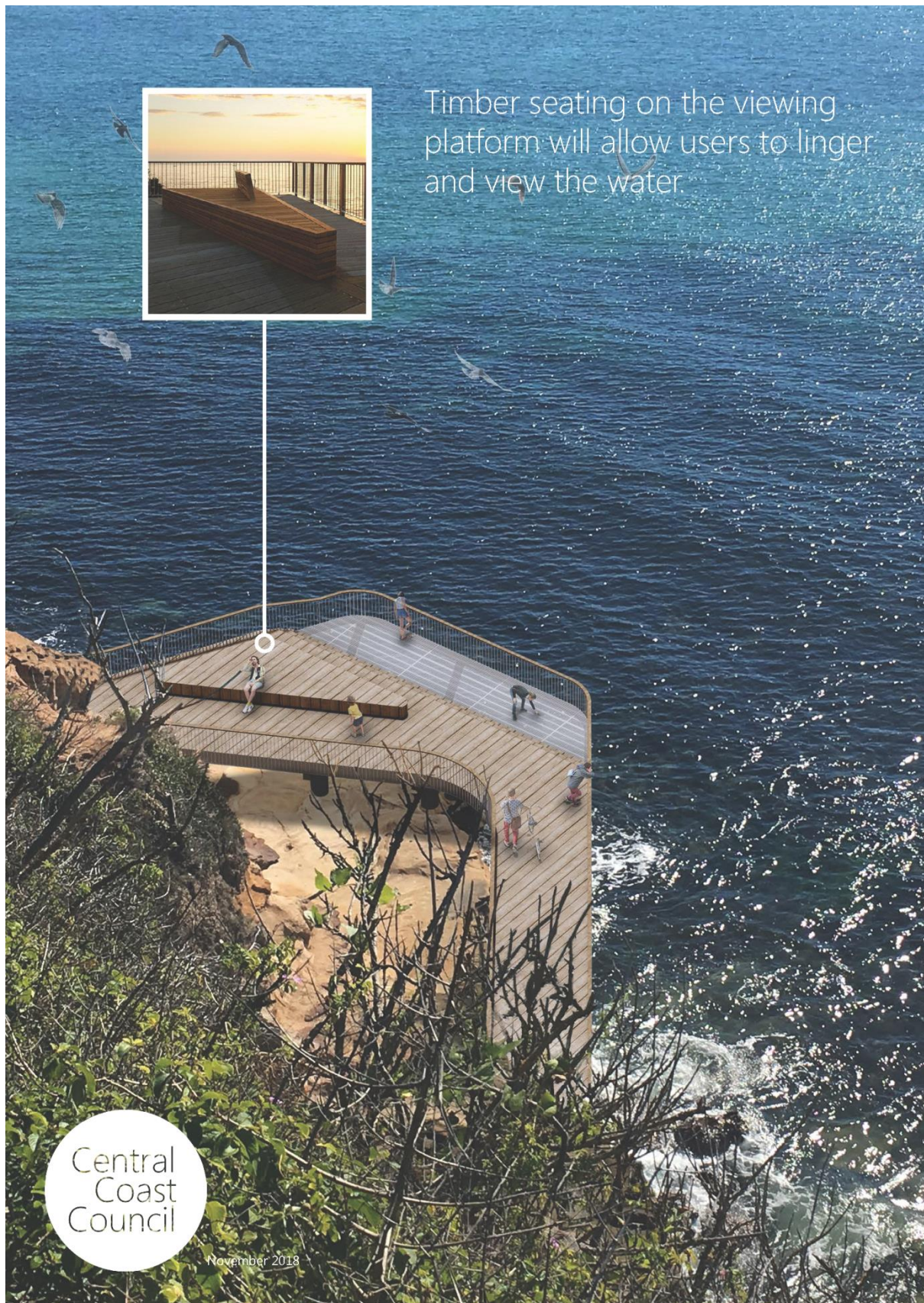
Boardwalk materials

Materials for the proposed boardwalk have been selected with sustainability in mind. The materials will complement the surrounding natural environment while ensuring the safety of users and keeping maintenance as easy as possible in a challenging coastal environment.



Grated flooring on the viewing platform will allow users to view the water below, while ensuring sunlight can still reach the seabed. The options of aluminum, weathered steel or fibreglass will be decided in detailed design stages.







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Appendix C

Media release

13 November 2018

Community can have their say on Terrigal Boardwalk design

Central Coast Council is looking to the community for their feedback on the proposed concept design of a boardwalk that will run from Terrigal Beach promenade to The Haven.

Council Chief Executive Officer, Gary Murphy said that the Terrigal boardwalk is a catalyst project for the Central Coast.

"Terrigal boardwalk will significantly improve pedestrian access between Terrigal Beach promenade and The Haven, enhancing the experience of the area for locals and visitors," Mr Murphy said.

"We value feedback from the community, and as such, we're calling on the local residents to have their say on our preliminary plans for this exciting project.

"This feedback will then be used to identify any issues that may need to be further investigated during the detailed design and construction stages."

Mayor Jane Smith said that the development of the boardwalk in Terrigal has the potential to grow tourism on the Coast, as it will attract more visitors, and in turn boost the local economy.

"The community has told us, through our Community Strategic Plan, that they want our town centres activated as key destinations and attractors for businesses, residents, visitors and tourists," Mayor Smith said.

"I understand there are different views on this project and I want to assure local residents, visitors and the broader community we are interested in all views and will take them on board as this project progresses."

Council has been successful in receiving a \$2.9million NSW Government Regional Growth Environment and Tourism Fund grant to go towards funding the proposed boardwalk. An additional \$2.9million will need to be provided by Council through the yearly capital works budget.

To find out more on Terrigal boardwalk and have your say on the concept design visit yourvoiceourcoast.com or Erina Library, or come along to one of Council's pop up stalls:

- Terrigal Beach Esplanade, Saturday 24 November, 9am to 1pm
- Terrigal Surf Life Saving Club, Wednesday 28 November, 4pm to 7pm

Council will be accepting feedback on this project until Friday 14 December 2018.

ENDS

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Appendix D

Advertising and publications

Central Coast Express Advocate – 27 September 2018

Terrigal Boardwalk - Have Your Say

Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven, which will significantly improve pedestrian access between these destinations and enhance the experience of the area for locals and visitors.

After a site investigation and an environmental assessment, Council has developed a concept design and is now seeking community feedback on the proposal.

A \$2.9million NSW Government Regional Growth Environment and Tourism Fund grant has been received for this project. An additional \$2.9 million will need to be provided by Council through the yearly capital works budget.

To find out more and have your say visit yourvoiceourcoast.com or Erina Library before Friday 14 December, or come along to one of our pop up stalls:

Terrigal Beach Esplanade	Terrigal Surf Life Saving Club
Saturday 24 November	Wednesday 28 November
9am - 1pm	4pm - 7pm

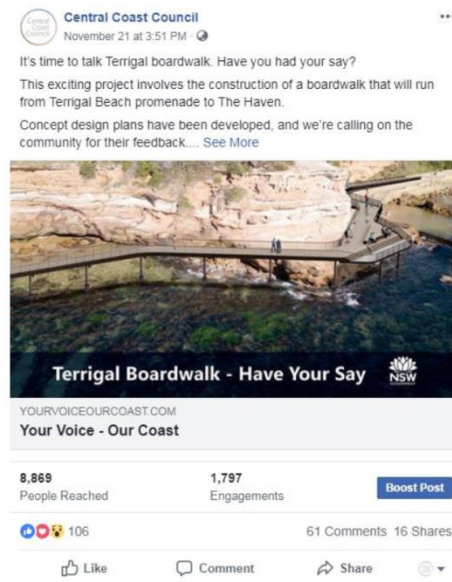
yourvoiceourcoast.com 

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Appendix E

Social media post examples



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Appendix F

Project postcard and letterbox distribution area



Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven, which will significantly improve pedestrian access between these destinations and enhance the experience of the area for locals and visitors.

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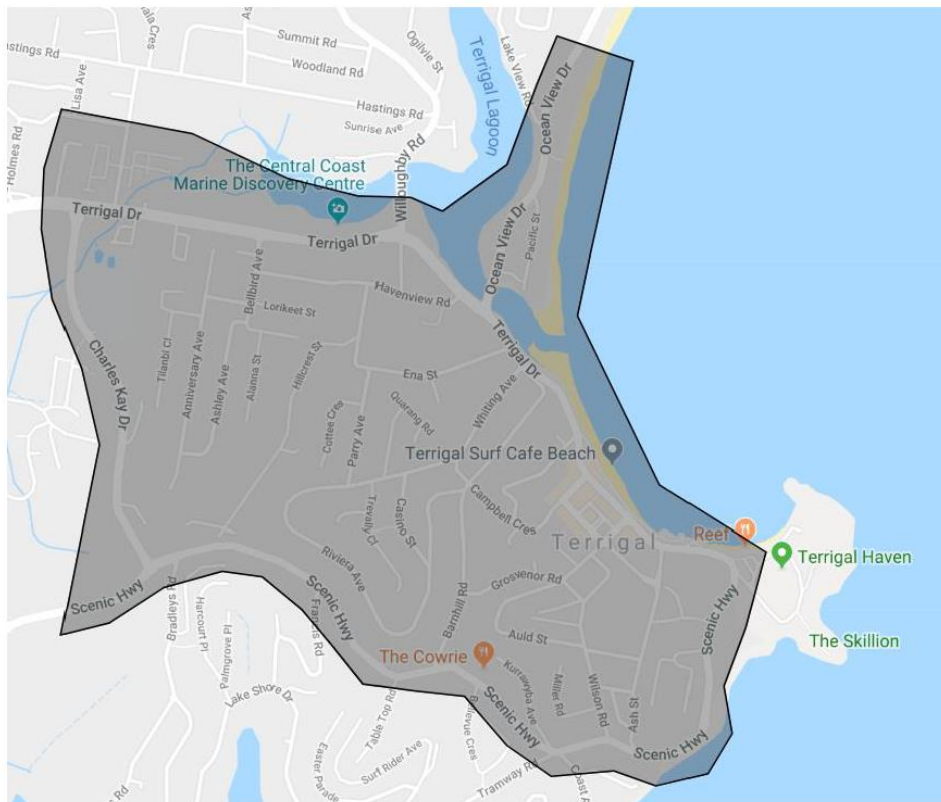
Terrigal Beach Esplanade
Saturday 24 November
9am - 1pm

Terrigal Surf Life Saving Club
Wednesday 28 November
4pm - 7pm

yourvoiceourcoast.com

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Appendix G

Outdoor poster



Central Coast Council

Terrigal Boardwalk - Have Your Say

Central Coast Council is proposing to build a boardwalk from Terrigal Beach promenade to The Haven, which will significantly improve pedestrian access between these destinations and enhance the experience of the area for locals and visitors.

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