Consulting Engineers

STRUCTURAL - CIVIL - STORMWATER - REMEDIAL

... STRUCTURALLY SOUND

Flood Risk Management Report

44 Kooloora Avenue, Freshwater

Job no. 200273

Issue A

8 September 2020

Prepared for: Brewster Hjorth Architects

Prepared by: Christian Ferry

Flood Risk Management Report

Project no: 200273

Issue: A

Date: 08.09.2020

Client: Brewster Hjorth Architects

Engineer: Christian Ferry

Principal review: Rick Wray

Council: Northern Beaches Council (Warringah)

Northern Beaches Consulting Engineers Pty Ltd

ABN 076 121 616

Suite 207, 30 Fisher Road, Dee Why NSW 2099

SYDNEY Tel: (02) 9984 7000

Email: nb@nbconsulting.com.au

Web: www.nbconsulting.com.au

Document History

Issue	Engineer	Checked	Description	Date
A	C. Ferry	M.Wachjo	Flood Risk Management Report	08.09.2020

Contents

Figures

Summary

Northern Beaches Consulting Engineers were engaged by Brewster Hjorth Architects to prepare a Flood Risk Management report. The purpose of the report is to determine the effects of a proposed development on the existing flooding regime within the development site and neighbouring properties. The development site is located at 44 Kooloora Avenue in Freshwater. The subject site is located within an existing flood zone, however, the area within which the development site is located has not been identified as a flood affected area in any of Council's available land zoning mapping or flood information, and therefore has not been strictly assessed against the Northern Beaches Council (Warringah area) flood controls. The criteria used in this report was established in the Stormwater Pre-DA meeting (SPLM2020/0001) with Northern Beaches Council.

To effectively assess the anticipated flooding effects, a hydraulic model was constructed using DRAINS software to determine the peak flood depth within the subject site up to the 1% Annual Exceedance Probability (AEP) storm event. The hydraulic modelling results were used to determine any potential adverse flooding effects associated with the development up to the 1% AEP storm event.

Concluding the results from the DRAINS analysis, further calculations were prepared to determine the extent of flood storage losses as a result of the proposed works. To compensate for the flood storage losses, a flood detention tank has been proposed below the ground floor level of the new dwelling. The volume of the flood detention tank has been calculated to offset any flood storage losses within the development site. Therefore, the development is not expected to cause adverse flooding effects to neighbouring properties should the recommendations in this report be adopted. The results from the analysis are detailed in the report below.

1. Introduction

Northern Beaches Consulting Engineers were engaged by Brewster Hjorth Architects to undertake a hydrologic and hydraulic investigation into the effects of a proposed residential development at 44 Kooloora Avenue in Freshwater. The assessment involved analysing localised flooding behaviour within the Freshwater catchment up to the 1% AEP storm event.

Christian Ferry and Michael Wachjo of Northern Beaches Consulting Engineers (NBCE) conducted a site inspection at the above address on 13 November 2019. The site inspection was carried out to both observe and measure the existing drainage infrastructure within the development site and critical elements of Council's stormwater drainage infrastructure within the Freshwater catchment. The premises have been assessed in accordance with the requirements of the Stormwater Pre-DA meeting minutes (SPLM2020/0001) dated 02/07/2020, the Council supplied flood information and the *NSW Government Floodplain Management Manual 2005*.

1.1 Aim

The purpose of this report is to determine the peak flood depth within the subject site up to the 1% AEP storm event within an acceptable design criterion and assess the potential flooding impacts within the development site and neighbouring properties as a result of the proposed works. An analysis was undertaken to assess the extent of flooding envisaged to occur through the subject site and examine strategies to mitigate any impacts from flood waters during heavy rainfall events. Note, the analysis utilised the results of 1% AEP storm event modelling using IFD (Intensity Frequency Duration) design rainfall data based on AR&R 2019 (Australian Rainfall & Runoff) methodology.

The calculations and recommendations presented in this report have been prepared in general accordance with the following policies:

- *Australian Rainfall and Runoff: A Guide to Flood Estimation 2019*
- *NSW Government Floodplain Management Manual 2005*

1.2 Site Characteristics

The 573m^2 site is located on Kooloora Avenue in Freshwater within the Northern Beaches Council (Warringah) LGA and is bounded by residential properties along the north-eastern, north-western and south-eastern boundaries of the site.

Topographical information indicates that the subject site is located within a flood storage area at the bottom of the Freshwater catchment. The base of the Freshwater catchment forms a localised basin, bounded by the vegetated sand dunes west of the Freshwater Beach foreshore which becomes a temporary flood storage zone in heavy rainfall events. The primary cause of flooding is due to the inadequate hydraulic capacity of the existing Council stormwater drainage infrastructure which discharges to Freshwater beach. The impact of the inadequate discharge capacity is exacerbated when peak storm events occur in conjunction with high tides.

The existing stormwater drainage network consists of a series of pits and pipes which conveys public stormwater from the upstream catchment through to the catchment discharge point at the northern end of the Freshwater Beach foreshore. There are currently 2 x 1650mm & a 450mm diameter Council owned reinforced concrete pipeline (RCP) which extends through the subject property frontage towards Freshwater Beach (refer Appendix B for details). These pipes discharge into 2 x 1800mm diameter pipes which outlet onto the Freshwater Beach foreshore. These outlet pipelines convey collected runoff from the upstream catchment which extends west of 44 Kooloora Avenue up to the crest on McDonald street approximately 1350m away.

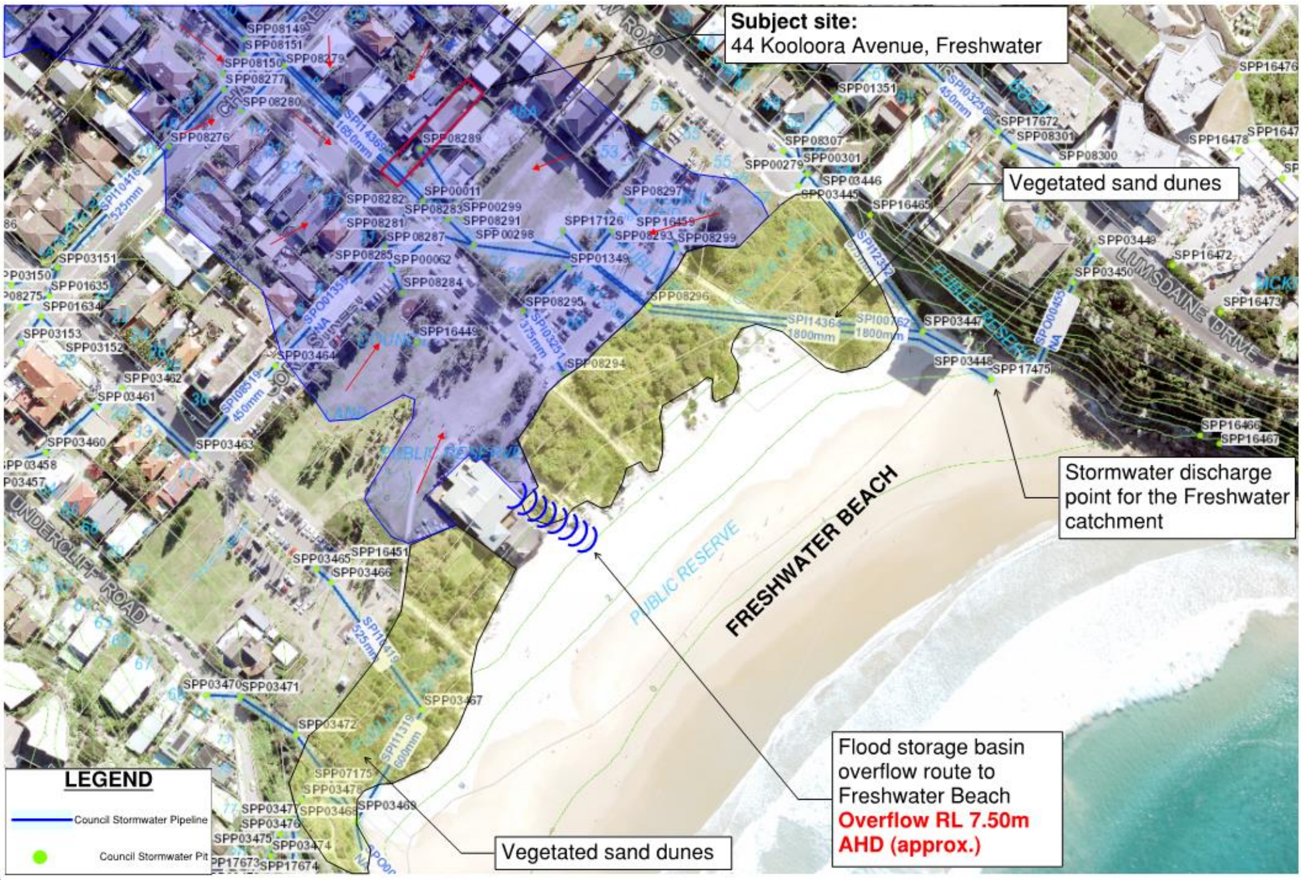


Figure 1 - Subject Site Location and Surroundings. Source: SIX Maps (NSW)

2. Flooding

2.1 Methodology

The flooding extent was modelled using the computer program DRAINS. A combination of LiDAR (Light Detection and Ranging) survey data, survey levels prepared by TTS Total Surveying Solutions and SIX Maps (NSW) government website information were used to estimate the total catchment area. The peak stormwater runoff rates within each of the contributing sub-catchments upstream of the subject site and the resulting flood depth within the flood storage area was modelled in the computer program DRAINS for the 1% AEP storm event.

2.2 Hydraulic Modelling Parameters

Multiple assumptions and parameters were considered in the construction of the hydraulic model. The modelling assumptions and parameters used are based on available survey data and on-site investigations.

2.2.1 Sub-Catchment Assumptions

Five sub-catchments were used in the analysis to effectively determine the flood behaviour within the wider catchment. The following assumptions are based on available survey information and recommended guidelines.

- An impervious ratio of 75% was used for 4 of the upper sub-catchment nodes (refer to Figure 2).
- An impervious ratio of 67% was used for the lower sub-catchment node at the bottom of the freshwater catchment (refer to Figure 2). This catchment also includes large grass park areas at the eastern end of Kooloora avenue.
- A roughness retardance coefficient of 0.012 and 0.33 was used for the impervious and pervious areas, respectively.

2.2.2 Pit and Pipe Blockage Factors

The following assumptions are based on available survey information and accepted guidelines. The below parameters are based upon an approved criterion set by Northern Beaches Council in the Stormwater Pre-Lodgement Meeting Notes (SPLM2020/0001 dated 20/07/2020).

- No blockage factors have been applied to the pipe in the hydraulic model. The velocities through the 2 x 1800mm diameter outlets at Freshwater beach are expected to fall between 3-4m/s during peak storm events. These high velocity rates will facilitate self-cleaning of the pipelines (refer to Appendix F for details).
- A blockage factor of 80% was applied to all sag pits within the hydraulic model.
- A constant outlet water level of 1.475m AHD was used to represent the king tide tailwater condition for the 2 x 1800mm diameter outlets at Freshwater Beach. The king tide level has been conservatively taken as the highest tidal level ever recorded in the Sydney area (refer to Figure 2 below). Source: Manly Hydraulics Laboratory (NSW Government website)

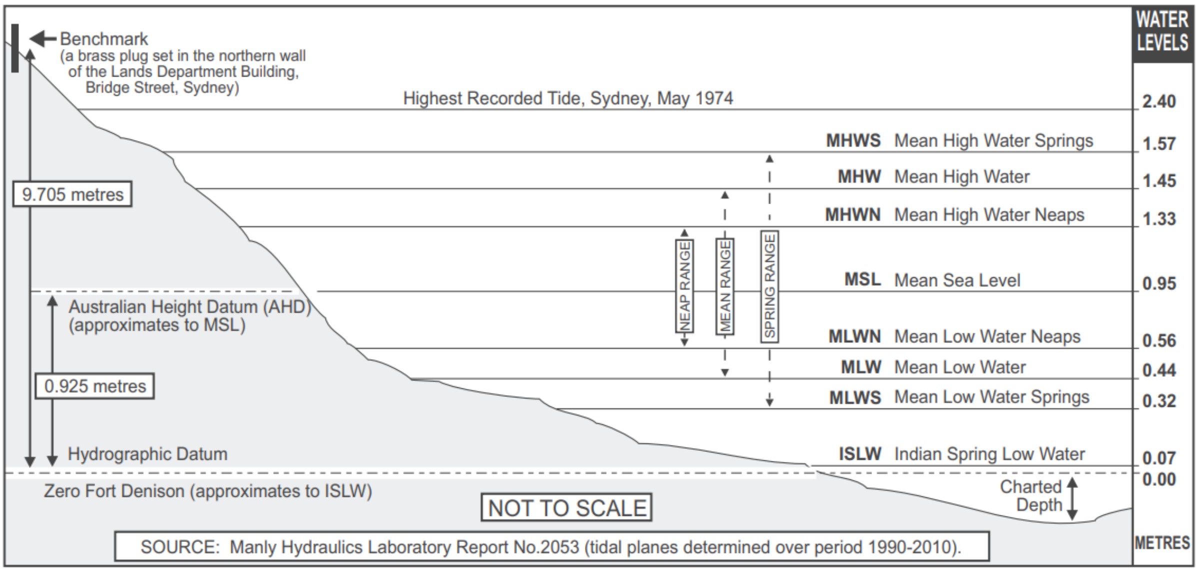


Figure 2 - NSW Tidal Charts (2020). Source: Manly Hydraulics Laboratory (NSW Government website)

2.2.3 Flood Storage Basin Parameters

To effectively represent the flood storage areas within the wider Freshwater catchment, storage basin nodes were used in a hydraulic model to accurately represent each of the critical temporary detention basins within the catchment, as these have a considerable impact on the hydraulic behaviour of stormwater runoff within the wider catchment. The following assumptions are based on available survey information and on-site observations (refer to Figure 3 and the DRAINS hydraulic model).

- Jacka Park Storage Basin 1
- Jacka Park Storage Basin 2
- Freshwater Storage Basin

Figure 3 - Storage Basin Locations within the Freshwater Catchment. Source: QGIS

2.2 Catchment Analysis

The subject site is located within the Freshwater catchment which conveys stormwater runoff to Freshwater Beach via Council's stormwater drainage infrastructure. The total contributing catchment affecting the subject site was measured in the computer program QGIS 2.18.8 using LiDAR data and is approximately 89.215 Ha.

The contributing catchment consists predominately of low-medium residential development. The catchment extends approximately 1500m upstream and reaches an elevation of approximately 68m AHD. QGIS 2.18.8 was also used to measure the average catchment slope. The manning's roughness 'n' values used for the analysis have been approximated based on observed site conditions (refer Table 1 below). Modelled results from a DRAINS analysis have been used to estimate the peak flow flood depth for the 1% AEP storm event.

Table 1 - Roughness Parameters used for HEC-RAS analysis

Surface Type	Manning's Roughness (n)
Road / Paving	0.015
Grass	0.05

Five sub-catchments were considered in the analysis to appropriately represent the wider Freshwater catchment. The wider catchment was reduced to five critical sub-catchments for the purpose of providing a more accurate representation of the wider catchment flow behaviour. Each of the sub-catchments are listed below (refer to Figure 4).

- Jacka Park Sub-Catchment (Sub-Catchment A)
- Soldiers Avenue Sub-Catchment (Sub-Catchment B)
- Alfred Street Sub-Catchment (Sub-Catchment C)
- Ocean View Road Sub-Catchment (Sub-Catchment D)
- Freshwater Sub-Catchment (Sub-Catchment E)

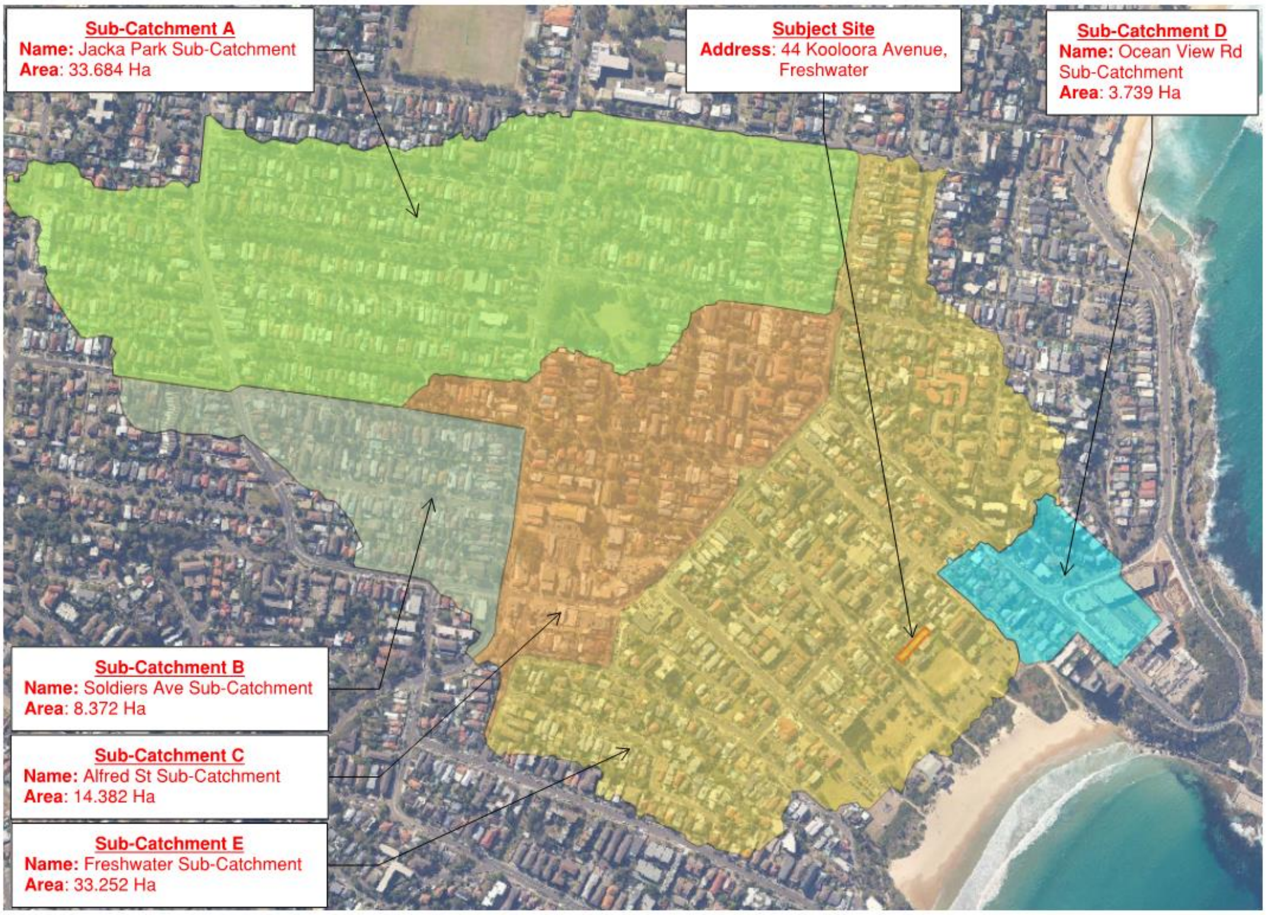


Figure 4 – Critical Sub-Catchments within the Freshwater Catchment. Source: QGIS

3. Analysis & Results

3.1 Peak Flow Results

A DRAINS computation analysis was completed to determine the anticipated runoff through the subject site. The 1% AEP storm event was computed, and the peak runoff rates are shown in Table 2 below:

Table 2 - Catchment Flow Rates for the 1% AEP Storm Event

AEP	Sub-Catchment	Area (Ha)	Piped Flow (m^3/s)	Overflow (m^3/s)
1%	A	33.684	6.82	2.52
	B	8.372	0.131	4.02
	C	14.382	6.65	9.32
	D	3.739	2.12	0
	E	33.252	20.2	0

For further detail refer Appendix B.

3.2 Flooding Extent

The 1% AEP peak flood depth has been estimated using the computer program DRAINS. The 1% AEP storm event was computed, and the peak flood depths within the Freshwater Storage Basin within the Freshwater sub-catchment are shown in Table 3 below:

Table 3 - Flood Depths for the 1%, 2%, 5% & 0.2EY Storm Events

AEP / EY	Flood Depth (m AHD)
1% AEP	5.05
2% AEP	4.86
5%	4.63
0.2EY	4.20

3.3 Flood Storage Loss

The footprint of the new dwelling proposes to extend beyond the footprint of the existing dwelling with significant alterations to the current landscape. The majority of the proposed filling appears to be located beyond the flood affected area (within existing areas above RL 5.05m AHD). However, modification of the current landscape levels is proposed in the frontage of the site to accommodate access to the ground floor level and proposed basement. Therefore, flood storage calculations were carried out to determine the extent of flood storage losses within the site. The critical locations accounting for the flood storage losses due to filling are listed below (refer to Figure 5 below).

- The proposed on-grade driveway access to the basement (including side batters)
- The dwelling frontage (set between 6m-12m beyond the existing dwelling towards Kooloora Avenue)
- The proposed side path and staircase access along the south-eastern boundary
- The proposed planter between the new driveway and entry access to the dwelling

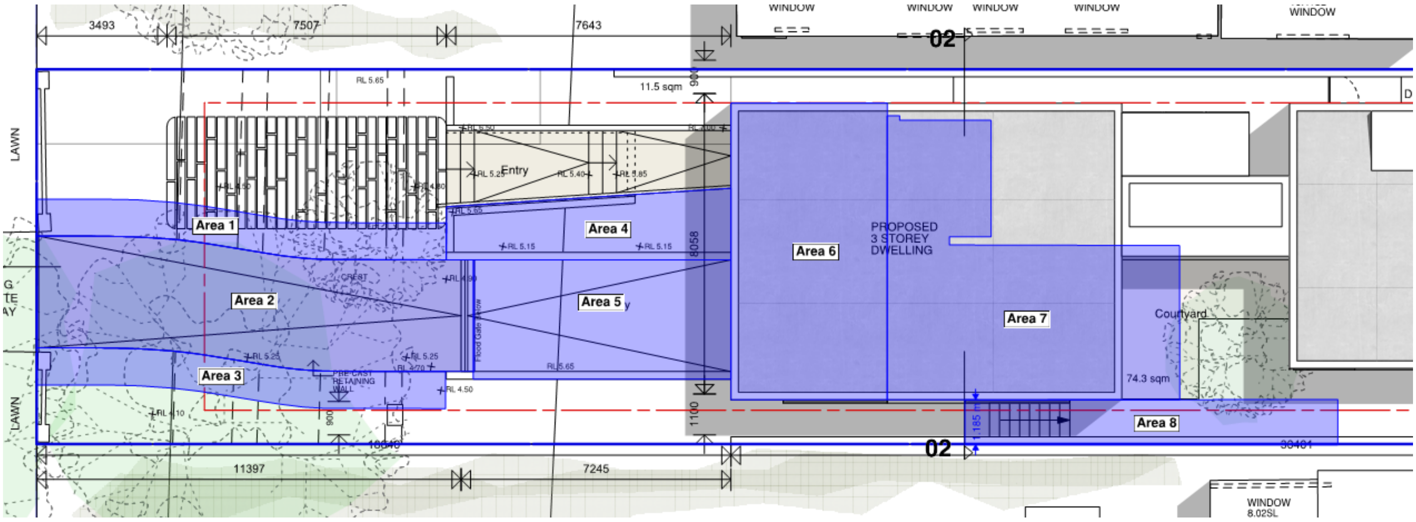


Figure 5 - Flood Storage Loss Areas for the Proposed Development Case

The total calculated flood storage loss for the proposed development is approx. **87.6m^3**. To offset the flood storage losses, a flood detention tank has been proposed below the rear pavilion of the dwelling (refer to section 4.2 for details).

4. Recommendations

4.1 Flood Protection of Basement

The proposed development details the construction of a new basement level which is below the 1% AEP flood depth. Therefore, in order to safeguard the basement against flooding up to the 1% AEP event, the following solutions have been proposed (refer to Figure 6 below):

- Raise the crest of the proposed driveway to RL 4.85m AHD to protect against all events up to the 5% AEP storm. Note: The driveway crest level was not raised further as doing so would have resulted in non-compliant access grades into the proposed basement.

- Provision of a non-powered buoyant mechanical flood gate at the driveway crest to protect against flood events in excess of the 5% AEP event up to the Flood Planning Level (FPL). The FPL has been determined as RL 5.55m AHD, which includes 500mm of freeboard above the 1% AEP flood depth.

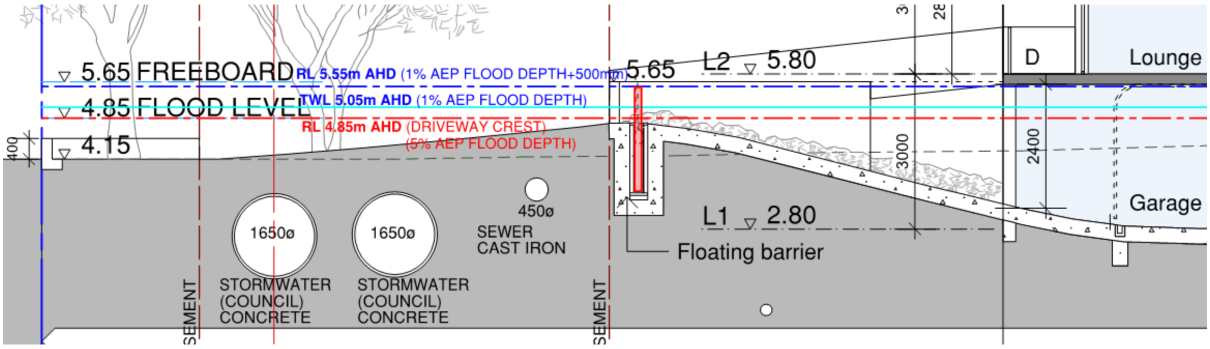


Figure 6 - Section of Proposed Basement

4.2 Flood Detention Tank

In heavy rainfall events, the subject site is envisaged to experience mainstream flooding which is predicted to rise to RL 5.05m AHD in the 1% AEP storm event. Therefore, to effectively offset total flood storage losses within the subject site, a Flood Detention Tank (FDT) has been proposed below the rear pavilion of the new dwelling (refer to the Stormwater Management Plan prepared by NBCE dated 08/09/2020 for details). The proposed volume of the flood detention tank is **91m^3**. The flood storage loss calculations for the subject site with the installation of the flood detention tank are detailed below.

Additional Flood Storage Loss volume for post-development case (without FDT): **87.6m^3**

Flood Detention Tank (FDT) volume: **91m^3**

Additional Flood Storage volume for post-development case (inclusive of FDT): **3.4m^3**

Total Excess Flood Storage Provided Post-Development: **3.4m^3**

4.3 Recommendations for structural design

The proposed flood wall must be designed and by a suitably qualified structural engineer to withstand with following loading cases;

- Lateral flood flow loads
- Debris impact loads
- Any additional loading cases as required by Council

4.3 Types of Construction Materials

Any new structure is to be constructed of concrete, timber, steel and/or brickwork to above the flood levels. Any proposed fencing, alternative to pool type fencing, is to be designed by a structural / civil engineer to withstand hydrostatic forces up to the 1% AEP storm event.

5. Conclusion

In accordance with accepted engineering practice, NBCE has undertaken a flood study of the stormwater drainage system at 44 Kooloora Avenue in Freshwater and can confirm the accuracy of the calculated results based on the DRAINS modelling. The proposed development will be safeguarded from flooding and will not adversely affect other structures or properties as a result of the proposed development. Please contact the author if further clarification is required.

NORTHERN BEACHES CONSULTING ENGINEERS P/L
Rick Wray

BE(Civil) MIEAust CPEng NER RPEQ

\\NBADS\Company\Synergy\Projects\200273 44 KOOLOORA AVENUE, FRESHWATER\ENG Design\Flood\Report\200273 - 44 Kooloora Ave - Flood Report 2020-08-11.docx

APPENDIX A

DRAINS Results

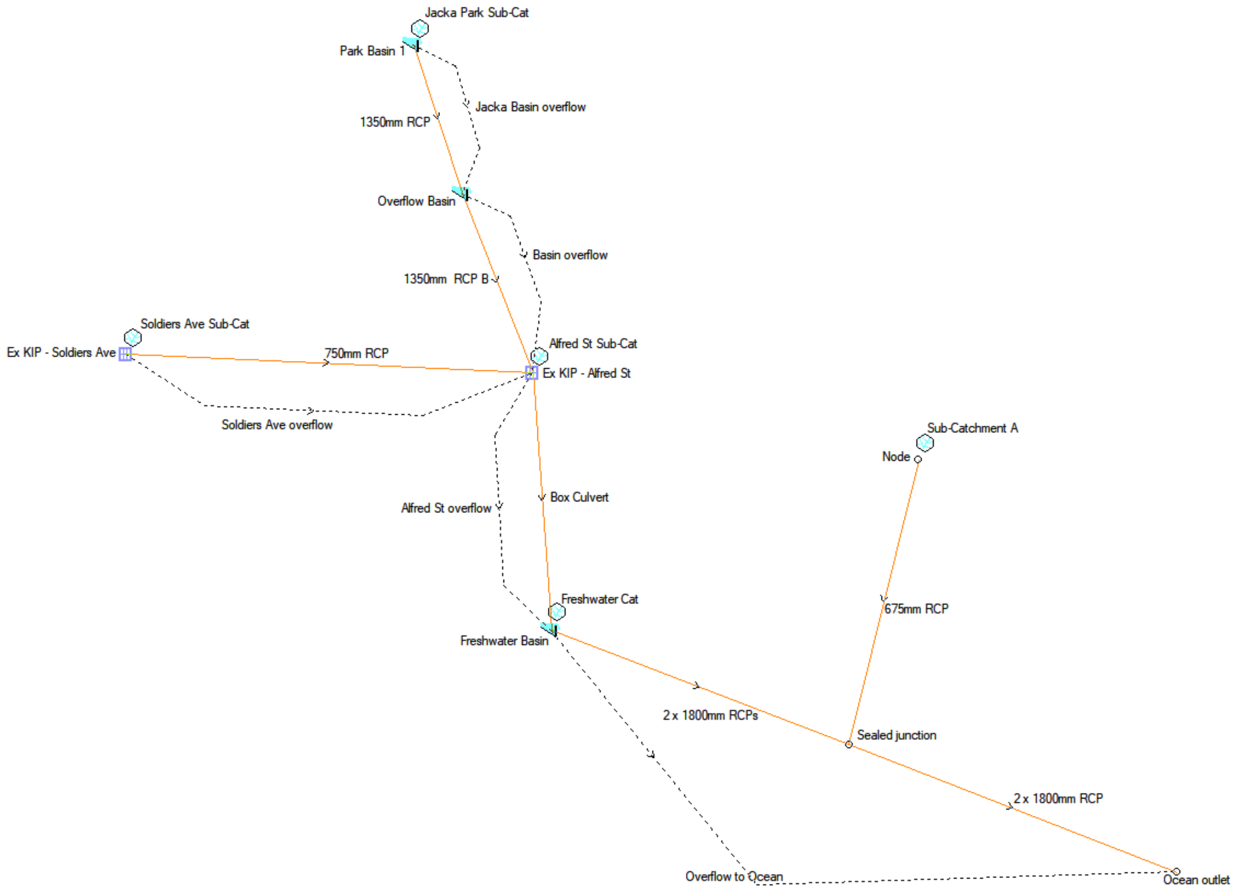


Figure 7 – DRAINS model: Catchment configuration

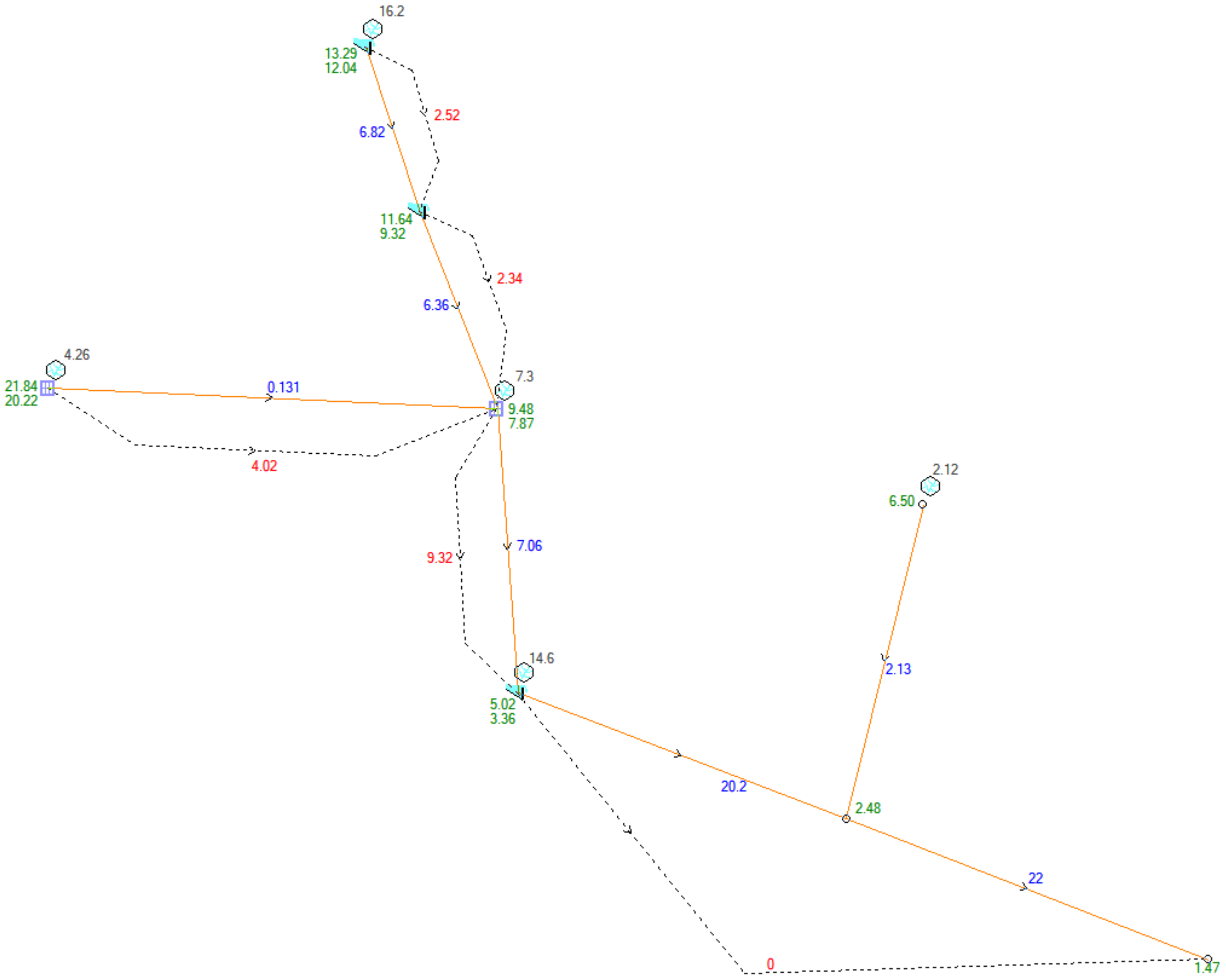
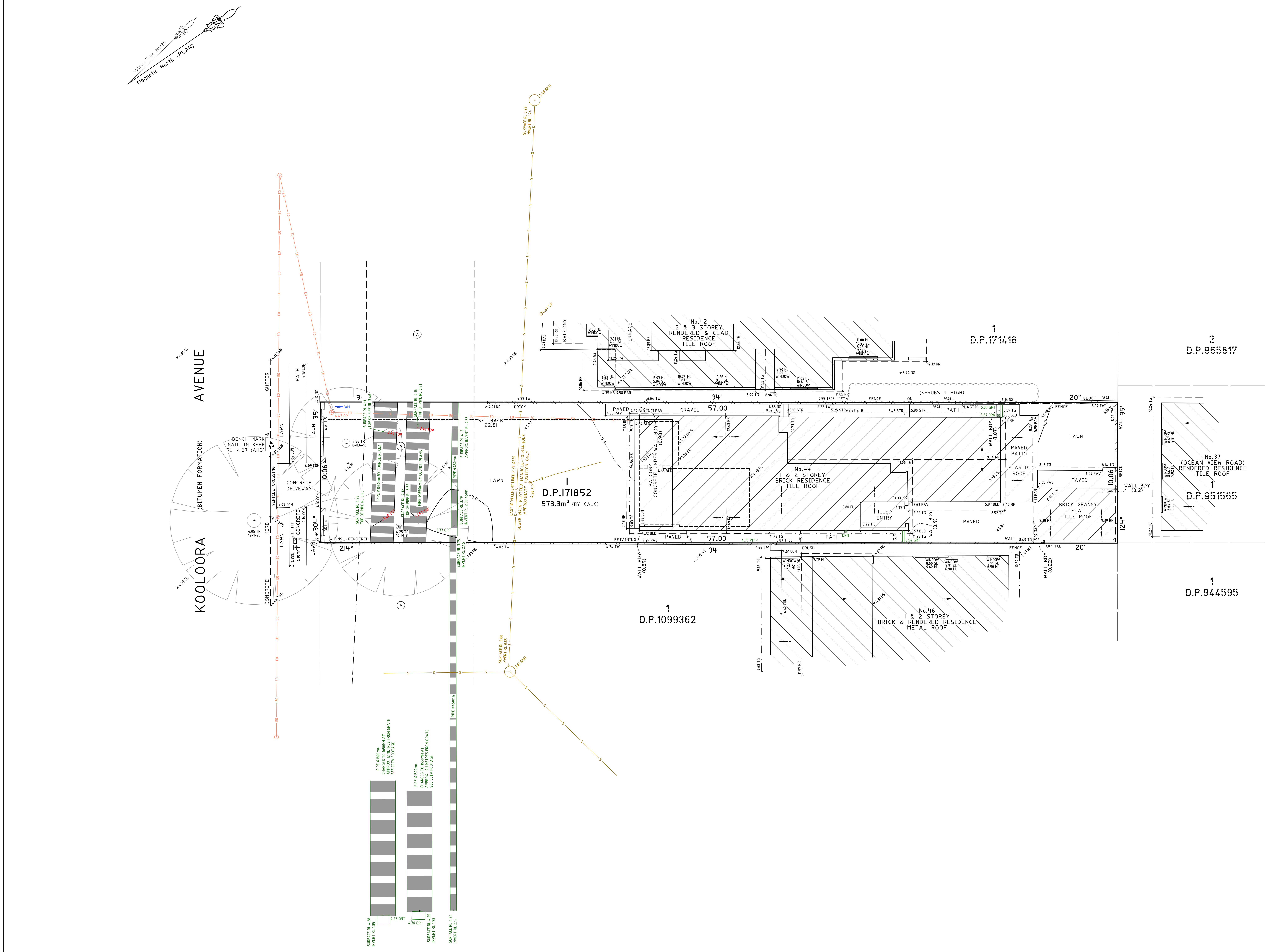


Figure 8 – DRAINS model: Catchment Flows for 1% AEP Storm Event. Source: DRAINS

APPENDIX B

Site Survey Plan & Architectural Plan

A0



Ⓐ PROPOSED EASEMENT TO DRAIN WATER 6m TO 7.7m WIDE & VARIABLE WIDTH BY DP636528.

TITLE INDICATES THAT LOT 1 IN D.P.171852 IS SUBJECT TO:
- RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S).

0 1 2 3 4 5 6 7 8 9 10

SCALE 1:100

NOTES

- **A BOUNDARY SURVEY HAS BEEN UNDERTAKEN.**
- **WALL TO BOUNDARY DIMENSIONS SHOWN HEREON MUST NOT BE USED FOR CONSTRUCTION.**
- **IF CONSTRUCTION ON OR NEAR BOUNDARIES IS REQUIRED IT IS RECOMMENDED THAT THE BOUNDARIES OF THE LAND BE MARKED OR THE BUILDING SET OUT.**
- TREE SIZES ARE ESTIMATES ONLY.
- THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF ADRIAN & NICOLE STEWART.
- RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.
- EXCEPT WHERE SHOWN BY DIMENSION LOCATION OF DETAIL WITH RESPECT TO BOUNDARIES IS INDICATIVE ONLY.
- ONLY VISIBLE SERVICES HAVE BEEN LOCATED. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED. DIAL BEFORE YOU DIG SERVICES (ph 1100) SHOULD BE USED AND A FULL UTILITY INVESTIGATION, INCLUDING A UTILITY LOCATION SURVEY, SHOULD BE UNDERTAKEN BEFORE CARRYING OUT ANY CONSTRUCTION ACTIVITY IN OR NEAR THE SURVEYED AREA.
- SEWER MAIN PLOTTED FROM SYDNEY WATER SEWER DIAGRAM. LOCATION SHOULD BE MARKED ON SITE IF CRITICAL.
- CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.
- THIS PLAN IS ONLY TO BE USED FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS.
- CONTOURS SHOWN DEPICT THE TOPOGRAPHY. THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.
- CONTOUR INTERVAL - 0.5 metre. - SPOT LEVELS SHOULD BE ADOPTED.
- POSITION OF RIDGE LINES ARE DIAGRAMMATIC ONLY (NOT TO SCALE).
- THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100.
- DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.

MURRAY LEARMONT
REGISTERED SURVEYOR BOSSI NUMBER 1462

LEGEND:

BAL = BALCONY
BLD = EXTERNAL BUILDING
CL = CENTRELINE
CON = CONCRETE
DS = DOOR SILL LEVEL
FL = FLOOR LEVEL
GAFL = GARAGE FLOOR LEVEL
GAR = GARAGE
GRT = GRATE
HL = HEAD LEVEL
NS = NATURAL SURFACE
PAR = PARAPET
PAV = PAVING
PIT = TOP OF PIT
RF = TOP OF ROOF
RR = ROOF RIDGE
SIP = SEWER INSPECTION PIT
SL = SILL LEVEL
SMH = SEWER MAN HOLE
STR = STAIRS
SWSL= STORMWATER SURFACE LEVEL
SSL = SEWER UNDERGROUND
TFCE = TOP OF FENCE
TG = TOP OF GUTTER
TIL = TILE
TKB = TOP OF KERB
TPIT = TELSTRA PIT
TR = TREE
TW = TOP OF WALL
WM = WATER METER
—EO— = ELECTRICITY OVERHEAD
—S— = SEWER UNDERGROUND
TREE SPREAD-DIAMETER-HEIGHT

HORIZONTAL DATUM:
CO-ORDINATE SYSTEM: ASSUMED
MARKS ADOPTED: N/A

VERTICAL DATUM:
DATUM: AUSTRALIAN HEIGHT DATUM (AHD)
B.M. ADOPTED: SSM 772
R.L. 4.254 (ORDER L2)
SOURCE: S.C.I.M.S. (07/02/19)

3	STORMWATER UPDATED	30/01/20
2	STORMWATER & SEWER INVESTIGATION	17/01/20
1	FIRST ISSUE	15/02/19

CLIENT:
ADRIAN & NICOLE STEWART
c/- BREWSTER HJORTH ARCHITECTS
L1 4-14 FOSTER STREET
SURRY HILLS NSW 2000

SURVEY PLAN
SHOWING DETAIL & LEVELS
OVER LOT 1 IN D.P.171852
No. 44 KOOLOORA AVENUE
FRESHWATER NSW 2096

CMS SURVEYORS
C.M.S. Surveyors Pty Limited
ACN: 096 240 201
PO Box 463 Dee Why
NSW 2099
2/99A South Creek Road,
Dee Why NSW 2099
Telephone: (02) 9971 4802
Facsimile: (02) 9971 4822
E-mail: info@cmssurveyors.com.au

LGA: NORTHERN BEACHES		SHEET 1 OF 2	
SURVEYED H.H./M.E.	DRAWN R.N.	CHECKED H.H./M.E.	APPROVED A.F.
SURVEY INSTRUCTION 18354A	SCALE 1:100 @ A0	DATE OF SURVEY 08/02/19 & 10/01/20	
DRAWING NAME 18354Adetail			ISSUE 3
CAD FILE 18354Adetail 3.dwg			

Roof & Site Plan

N

1:100 @ A1 + 1:200 @ A3

0 1 2 5

LEGEND

- EXISTING TREE ON SURVEY TO BE RETAINED
- SITE BOUNDARY
- SITE SETBACKS

NOTE

LANDSCAPE OPEN SPACE

SITE AREA : 573.3 sqm

LANDSCAPE OPEN SPACE PERCENTAGE : 42.8 %

LANDSCAPE OPEN SPACE TOTAL : 245.4 sqm

Stewart House

44 Kooloora Ave. Freshwater

Site Plan and Roof Plan

DA03

28/8/20 DA Submission

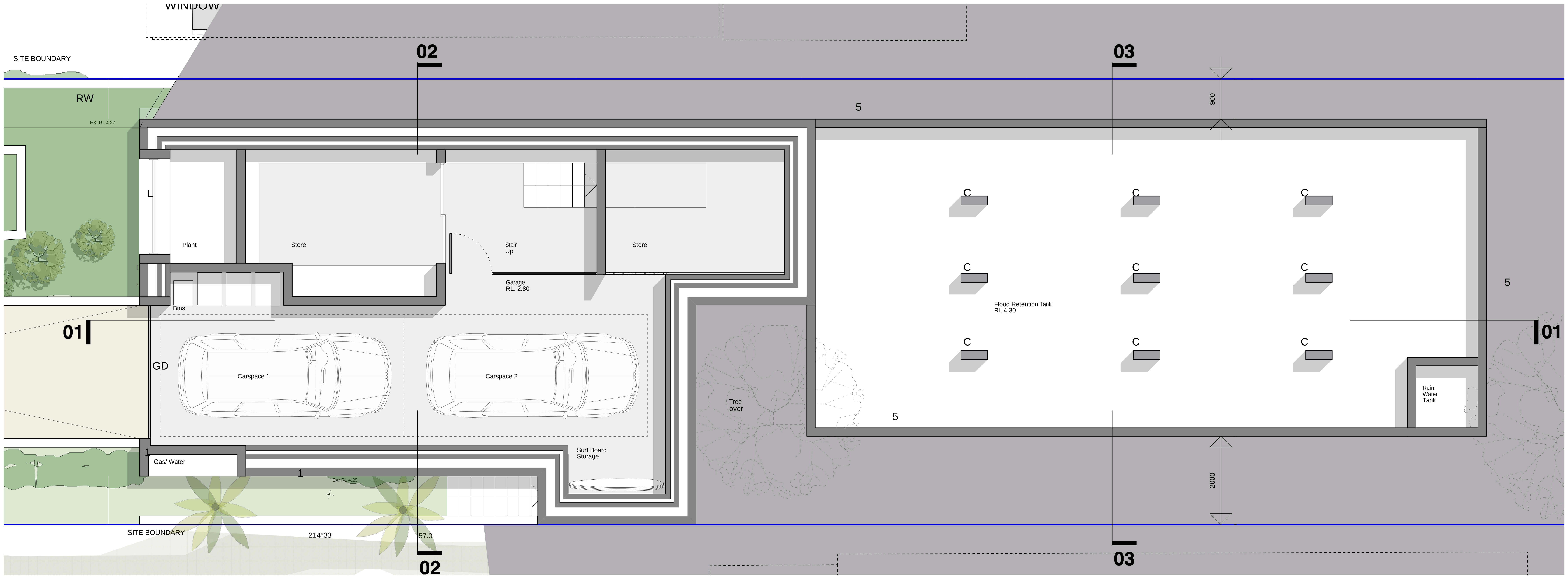
brewster hjorth architects

first floor
4-14 foster st, surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

21910 DA02-05 Plans & Site plans v2019.vwx

Level 1 Plan



Basement Plan

1:50 @ A1 + 1:100 @ A3

0 1 2.5

LEGEND

	EXISTING TREE ON SURVEY TO BE RETAINED
	SITE BOUNDARY
	SITE SETBACKS
C	COLUMN
GD	GARAGE DOOR
G	GUTTER
L	LOUVRE
P	PAVED
RW	RETAINING WALL
1	CONCRETE
2	CAVITY BRICKWORK
3	SINGLE GLAZED LOW-E GLASS U 4.7 SHGC 0.63
4	DOUBLE GLAZED LOW-E GLAZED U 3.74 SHGC 0.62
5	BLOCKWORK 'ECO-BLOCK'
6	PILE CAVITY BLOCKWORK WALL

Stewart House

44 Kooloora Ave. Freshwater

Basement & Level 1 Plan

DA04

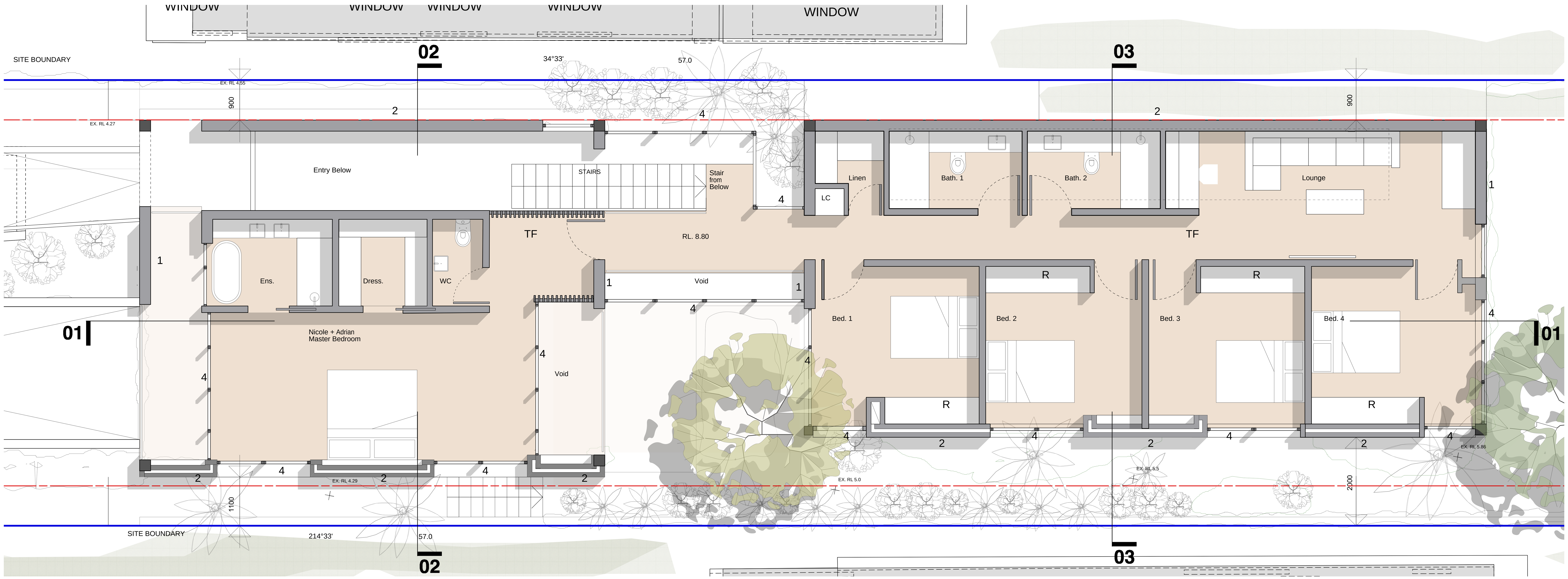
1/9/20 DA Submission

brewster hjorth architects

first floor
4-14 foster st, surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

21910 DA02-05 Plans & Site plans v2019.vwx



Level 2 Plan

1:50 @ A1 + 1:100 @ A3

0 1 2.5

LEGEND

	EXISTING TREE ON SURVEY TO BE RETAINED
	SITE BOUNDARY
C	COLUMN
GD	GARAGE DOOR
G	GUTTER
L	LOUVRE
P	PAVED
RW	RETAINING WALL
TF	TIMBER FLOOR
R	ROBE
1	CONCRETE
2	CAVITY BRICKWORK
3	SINGLE GLAZED LOW-E GLASS U 4.7 SHGC 0.63
4	DOUBLE GLAZED LOW-E GLAZED U 3.74SHGC 0.62

DA05

Stewart House

44 Kooloora Ave. Freshwater

Level 2 Plan

1/9/20 DA Submission

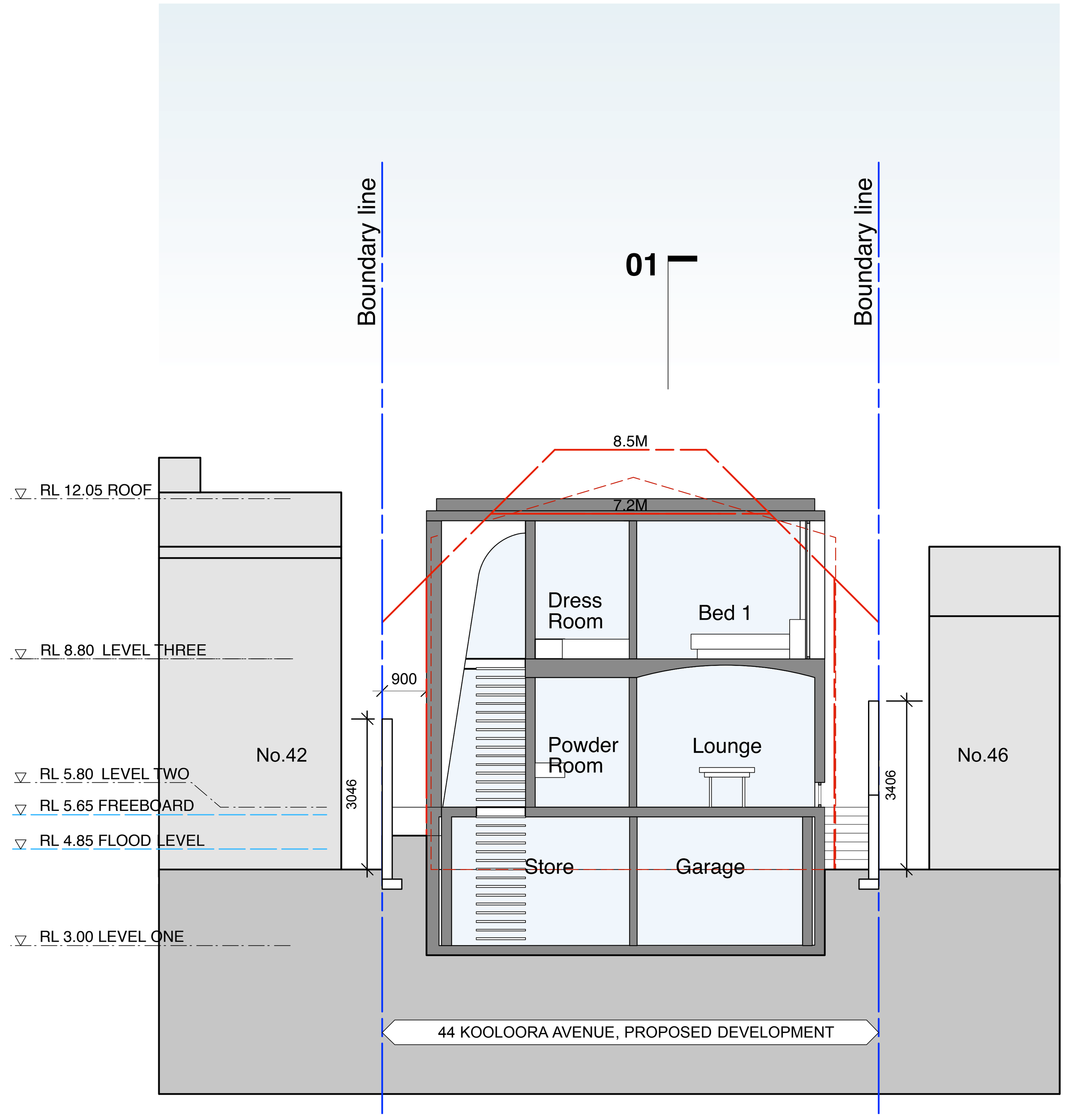
brewster hjorth architects

first floor
4-14 foster st, surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

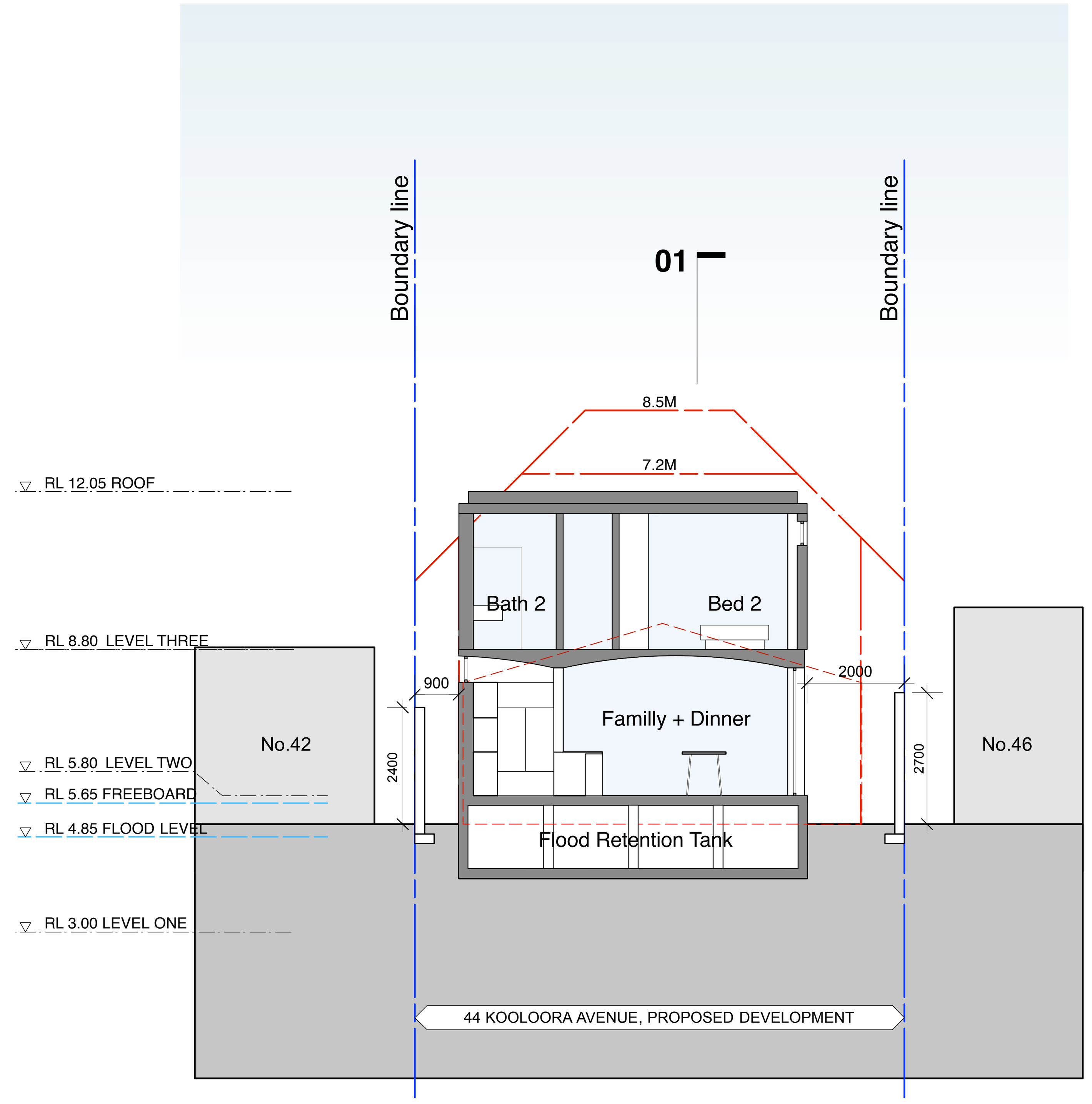
21910 DA02-05 Plans & Site plans v2019.vwx

Section 2



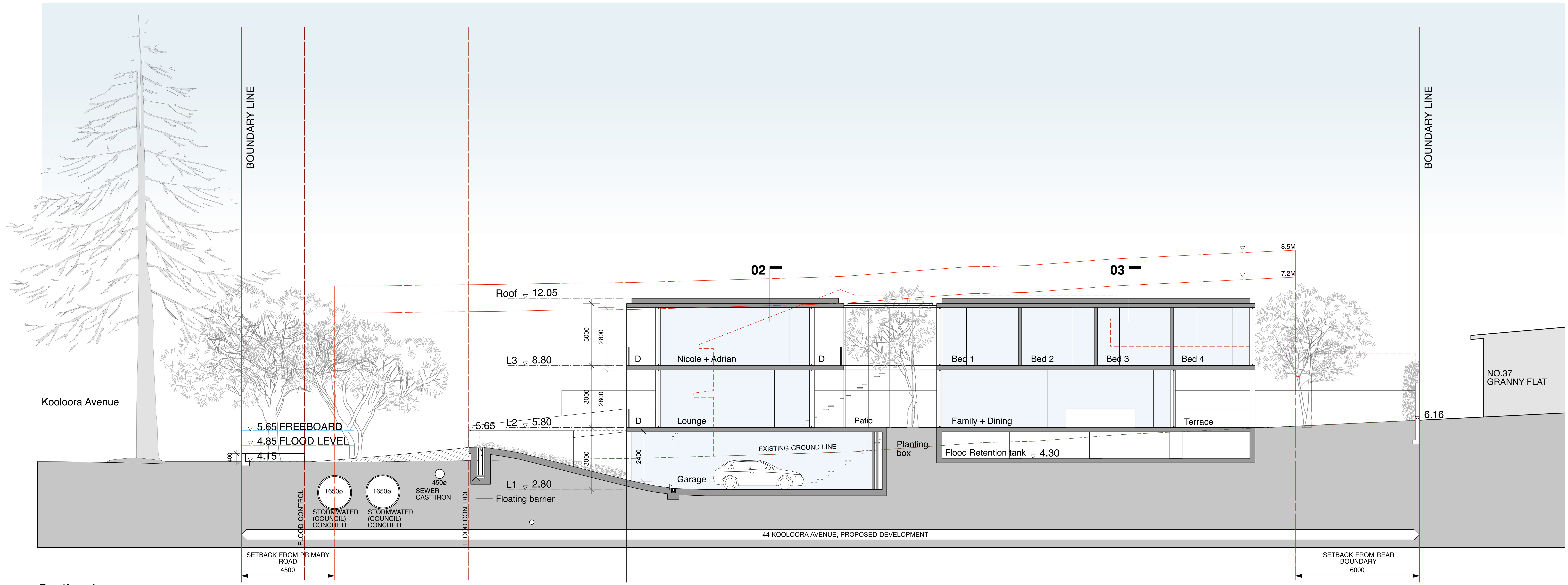
Section 2

Section 3



Section 3

Section 1



Section 1

1:100 @ A1 + 1:200 @ A3

0 1 2 5

DA08 Stewart House

44 Kooloora Ave. Freshwater

Sections

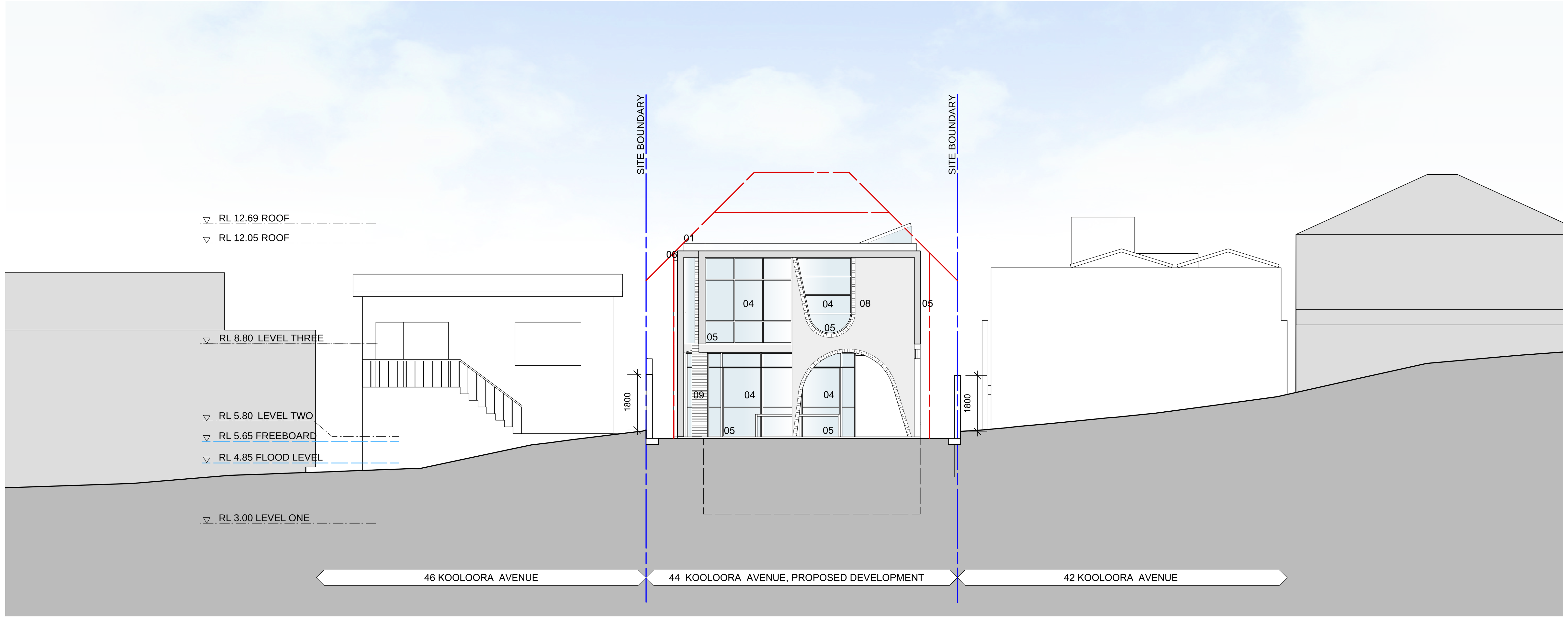
4/9/20 DA Submission

brewster hjorth architects

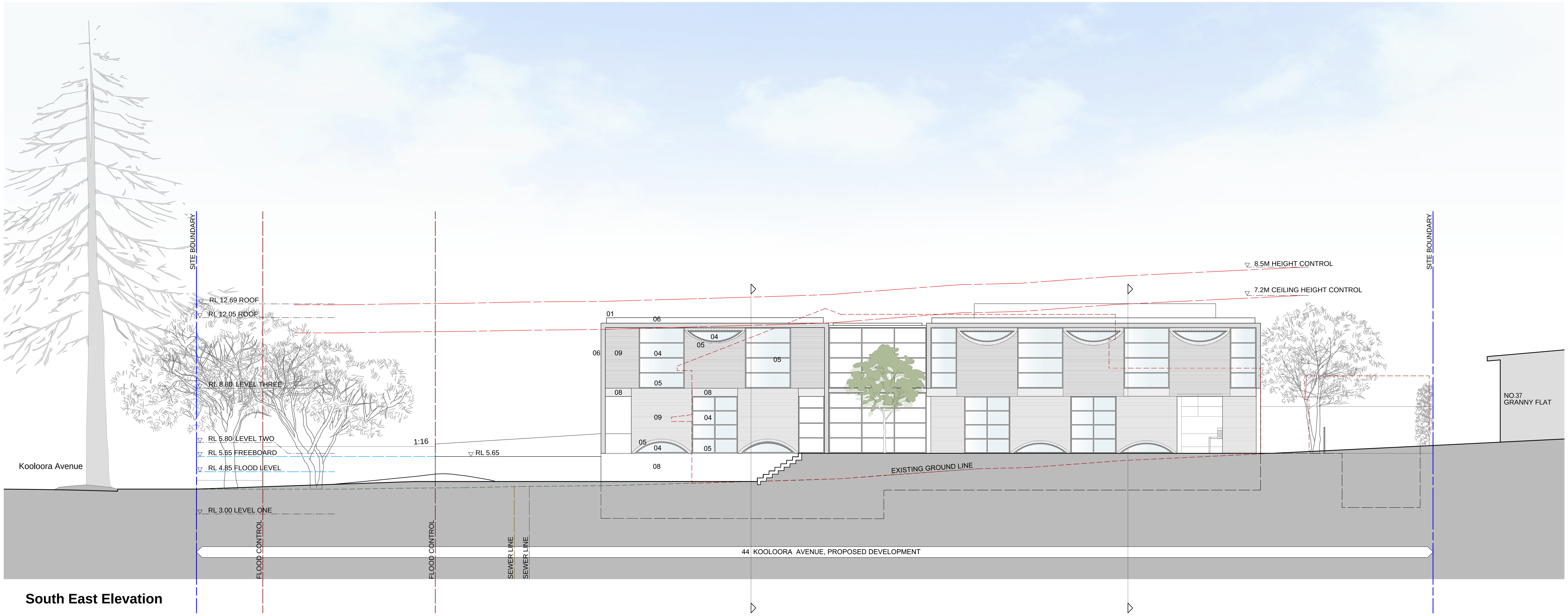
first floor
4-14 foster st, surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

21910 DA06-08 Elevation & Section v2019.vwx



North East Elevation



South East Elevation

1:100 @ A1 + 1:200 @ A3

0 1 2 5

- 01 ROOF AND GUTTERS
- 02 UPPER WALLS
- 03 SOFFIT
- 04 GLAZED WINDOWS AND DOORS
- 05 ALUMINIUM WINDOWS AND DOORS
- 06 STRUCTURAL STEEL
- 07 TIMBER
- 08 CONCRETE
- 09 BRICKWORK
- 10 EXTERNAL PAVING

DA06

Stewart House

44 Kooloora Ave. Freshwater

North East and South East Elevation

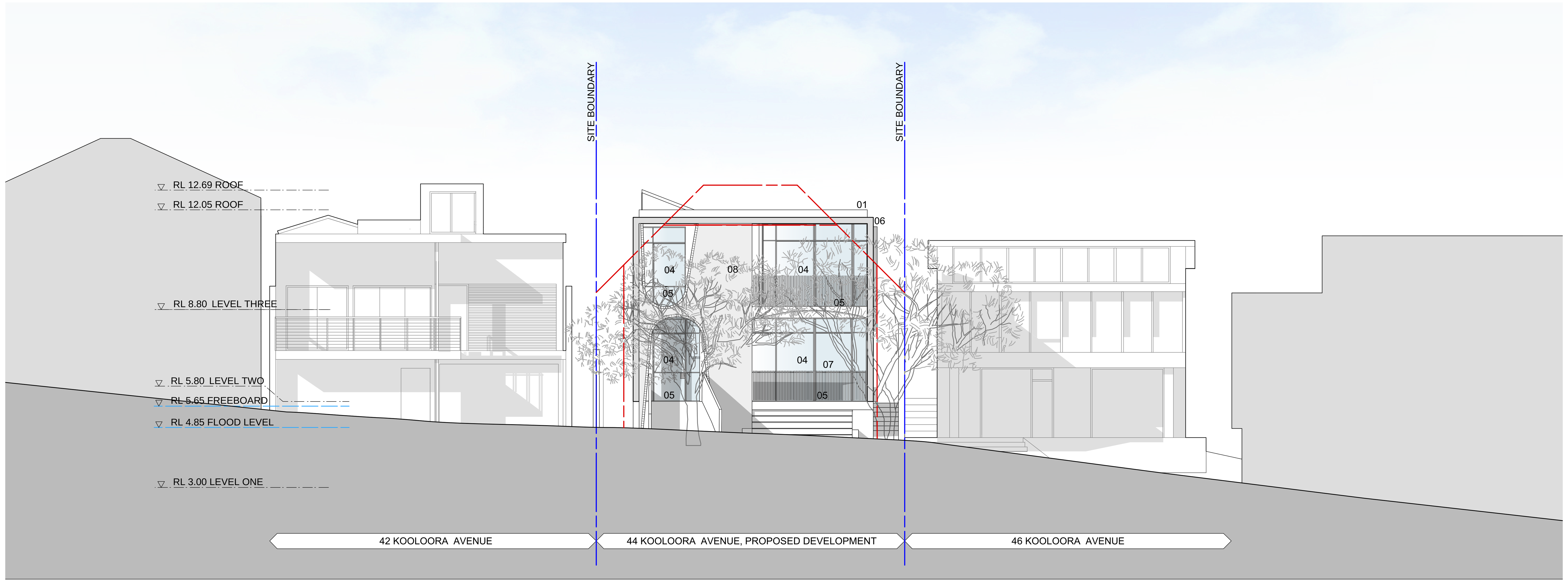
20/8/20 DA Submission

brewster hjorth architects

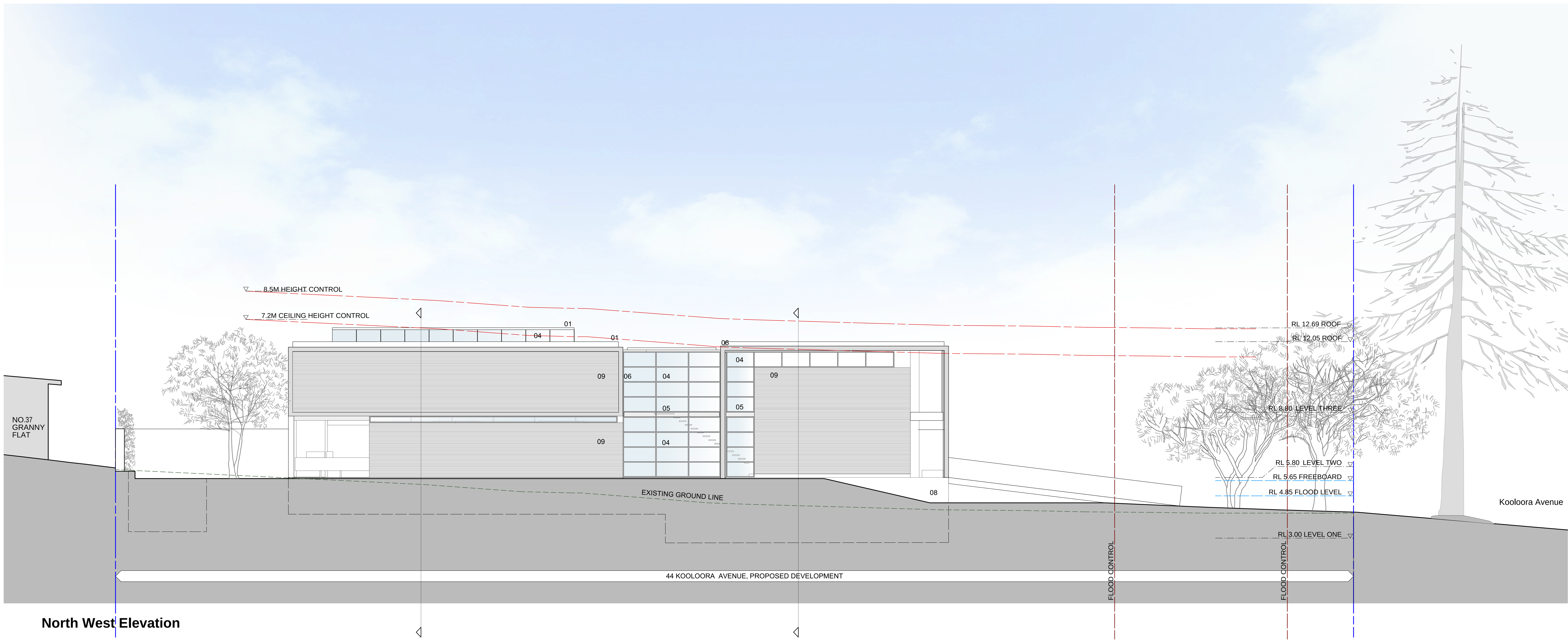
first floor
4-14 foster st., surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

21910 DA06-08 Elevation & Section.vwx



South West Elevation (Kooloora Avenue)



North West Elevation

1:100 @ A1 + 1:200 @ A3

0 1 2 5

01 ROOF AND GUTTERS
02 UPPER WALLS
03 SOFFIT
04 GLAZED WINDOWS AND DOORS
05 ALUMINIUM WINDOWS AND DOORS
06 STRUCTURAL STEEL
07 TIMBER
08 CONCRETE
09 BRICKWORK

DA07 Stewart House

44 Kooloora Ave. Freshwater

South West and North West Elevation

20/8/20 DA Submission

brewster hjorth architects

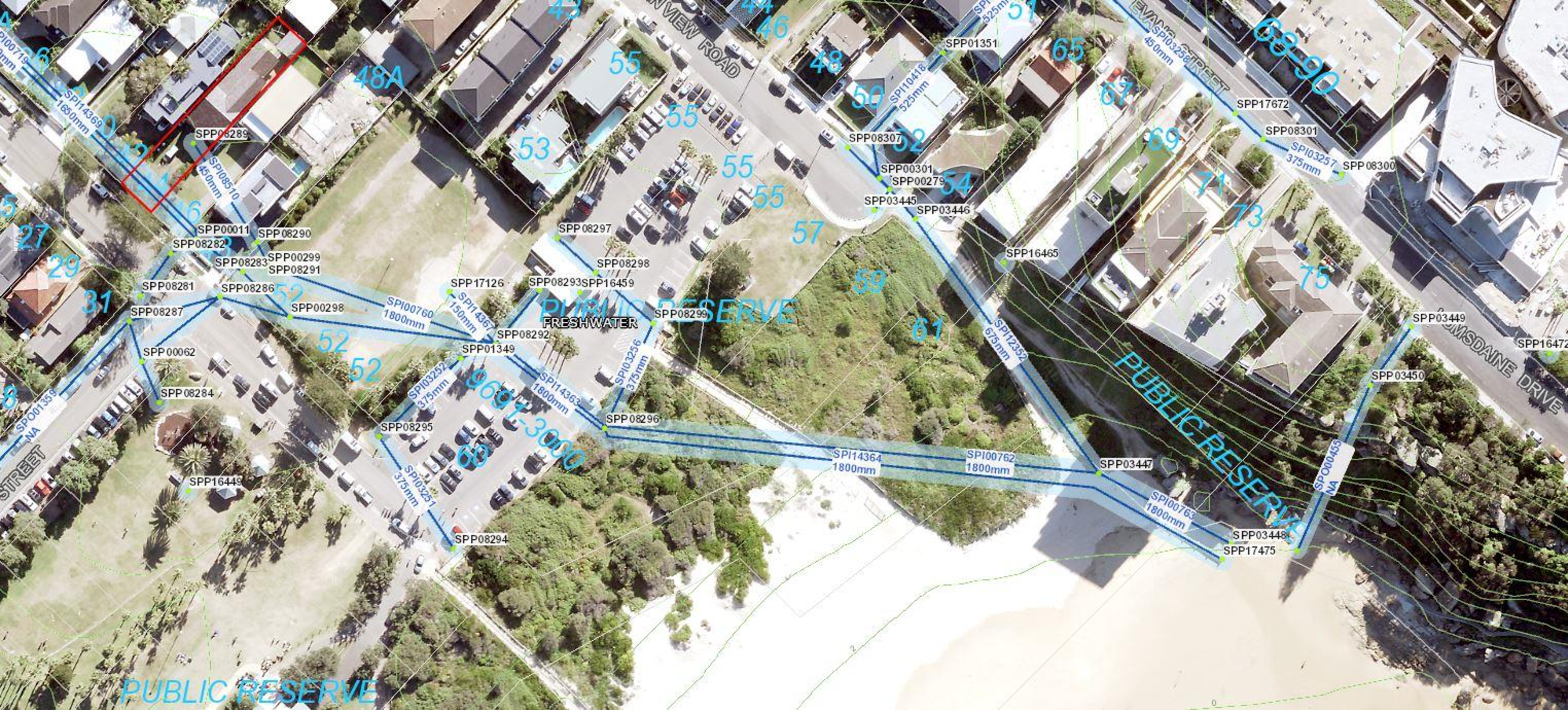
first floor
4-14 foster st, surry hills nsw 2010
t: 02 8231 7100
www.brewsterhjorth.com.au

nominated architects
ian brewster reg 5561
larry melocco reg 5481
andrew hjorth reg 5413

21910 DA06-08 Elevation & Section.vwx

APPENDIX C

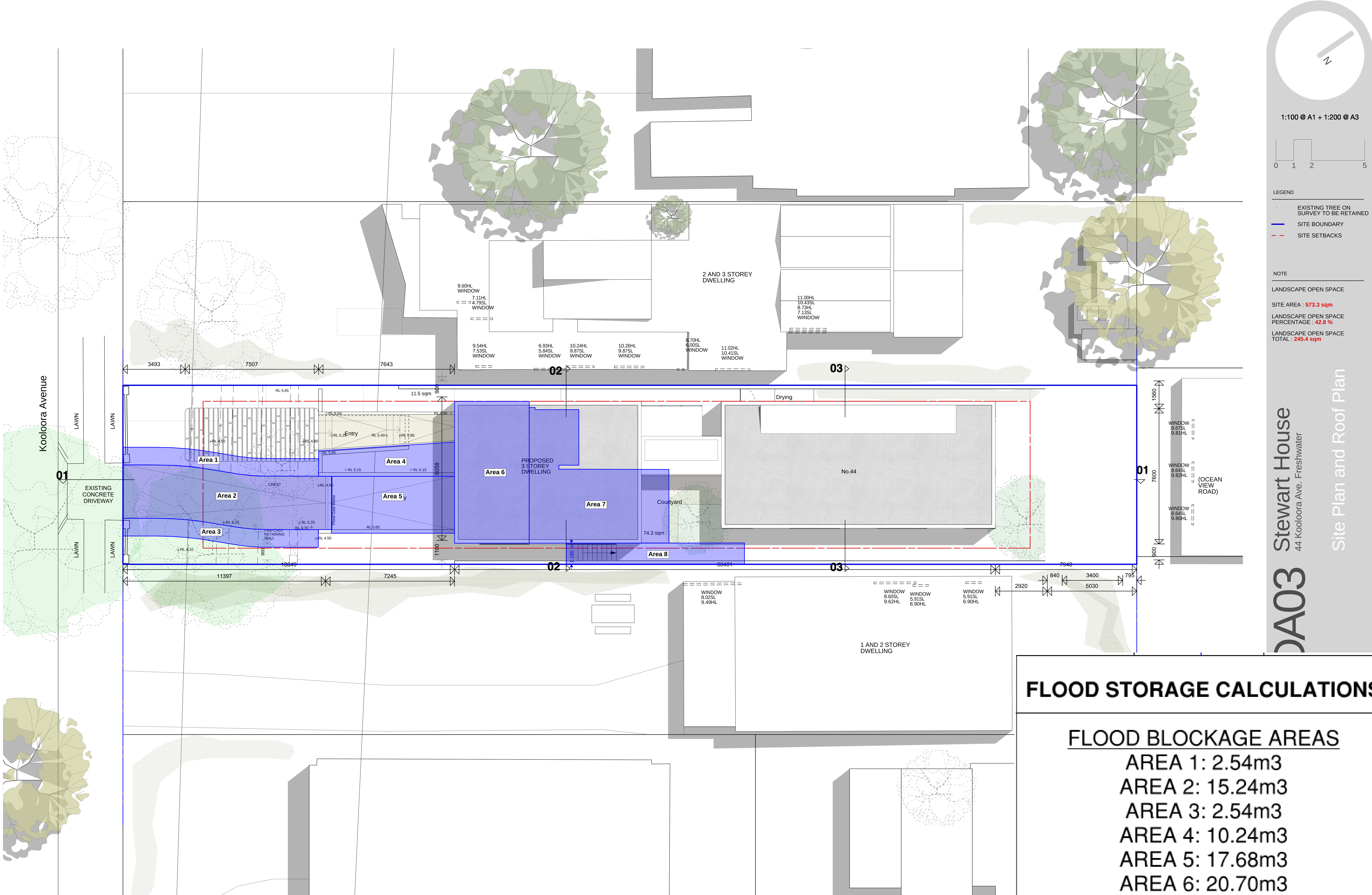
Council Flood Mapping Information



VIEW ROAD
EVANS STREET
LUMSDAINE DRIVE
STREET
PUBLIC RESERVE
PUBLIC RESERVE
PUBLIC RESERVE
FRESHWATER
9691-3000
68-90
48A
46
48
50
52
54
55
53
57
59
61
60
65
67
69
71
73
75
27
29
31
SPP01351
SPP17672
SPP08301
SPP08300
SPP08307
SPP00301
SPP00279
SPP03445
SPP03446
SPP16465
SPP03449
SPP16472
SPP03450
SPP08289
SPP00011
SPP08290
SPP08282
SPP08283
SPP00299
SPP08291
SPP08281
SPP08286
SPP00298
SPP08287
SPP00062
SPP08284
SPP17126
SPP08293
SPP16459
SPP08297
SPP08298
SPP08299
SPP08292
SPP01349
SPP08296
SPP08295
SPP16449
SPP08294
SPP03447
SPP03448
SPP17475
SPI14369 1650mm
SPI08510 450mm
SPI00760 1800mm
SPI14367 150mm
SPI03252 375mm
SPI14363 1800mm
SPI03256 375mm
SPI03251 375mm
SPI14364 1800mm
SPI00762 1800mm
SPI00763 1800mm
SPI12352 675mm
SPI10418 525mm
SPI03258 450mm
SPI03257 375mm
SPO00455 NA
SPO01359 NA

APPENDIX E

Flood Storage Calculations



Roof & Site Plan

FLOOD STORAGE CALCULATIONS

FLOOD BLOCKAGE AREAS

AREA 1: 2.54m3
AREA 2: 15.24m3
AREA 3: 2.54m3
AREA 4: 10.24m3
AREA 5: 17.68m3
AREA 6: 20.70m3
AREA 7: 15.40m3
AREA 8: 3.30m3

TOTAL FLOOD BLOCKAGE: 87.6m3

APPENDIX F

Pipeline Velocity Self-Cleaning Information

Pg 1: Brisbane City Council, “Stormwater Outlets in Parks and Waterways [Guidelines]”, Version 2, 2003, Chapter 3, pg 5

Pg 2: Concrete Pipe Association of Australasia , “Hydraulics of Precast Concrete Conduits”, Reprinted 2012, Pg 42

PERFORMANCE CRITERIA	ACCEPTABLE SOLUTIONS

- Consequences of adverse flooding impacts are investigated for full grate blockage.

A4.6 Detention Storage

Where the public space is also used for stormwater detention storage, the design intents and safety aspects satisfy the requirements of Council's Subdivision and Development Guidelines.

A4.7 Pipe Velocity

The velocity of stormwater flows in pipes or box sections is adequate to maintain self-cleaning, and the velocity prevents scouring and erosion of the conduit especially the invert.

- The desirable minimum design velocities are limited to 1.2 m/s for partial flow and 1.0 m/s for full flow conditions.
- The desirable maximum design velocities are limited to 4.7 m/s for partial flow and 4.0 m/s for full flow conditions (energy dissipation may be required).

A4.8 Outlet Velocity

The average outlet velocity (V_o) for the nominated design discharge (Q_o) is determined. Typically Q_o also corresponds to the design storm event for the pipe. However, for reasons of cost or practicality, it may be necessary to design scour protection for a lower discharge event. The permissible maximum flow velocities (m/s) for the different types of exposed soil immediately downstream of the outlet are given below. These figures assume slope gradient <10%, peak velocities maintained for period less than 6 hours, and good (ie 80%) ground cover. Soil erodibility factor, $K \leq 0.019$ corresponds to low erodibility. $0.020 \leq K \leq 0.045$ and $K>0.045$ correspond to moderate and high erodibilities respectively.

Permissible maximum flow velocity (m/s)

	Soil erodibility (K) - Low	Moderate	High
Bare soil	0.7	0.5	0.3
Tussock grasses	1.3	0.9	0.5
Other improved perennials	1.6	1.3	0.9
Couch, carpet & other sward-forming grass	2.0	1.8	1.4
Kikuyu grass	2.5	2.2	1.9

Visual intrusion of this stormwater outlet is minimised

4. STORMWATER DRAINAGE

4.1 INTRODUCTION

4.1.1 HEAD LOSSES

The design flow is established as outlined in Section 2, and it is customary in the hydraulic design to assume the pipes flowing full.

The design must take into consideration:

(i) resistance to flow in conduits

(ii) losses at inlets and junction pits, bends and other deviations from straight lines of uniform cross section and flow.

Investigations have shown that the latter source of losses can be of greater significance than the energy losses on uniform straight runs, particularly on short lengths of pipeline [4.1, 4.2].

4.1.2 MINIMUM AND MAXIMUM VELOCITIES

Much of the debris entering stormwater drains is heavier than water, and to ensure some measure of self cleansing a minimum velocity of about 0.5 to 1 m/s at full and half full flow or a boundary shear of 1.5 N/m^2 is recommended [4.1, 4.3]. (Refer also to Section 1.4 and 3.4.4.)

Maximum velocities are discussed in Section 3.4.3. Generally velocities should be kept below 8 m/s if possible.

4.1.3 TOPOGRAPHY

Topographic conditions are significant for the design. In very flat country of minimal fall, layout and details minimising head losses are important in order to avoid excessively deep drains.

In hilly country with steep grades design must consider the possibility of erosion.

4.2 RESISTANCE TO FLOW IN CONDUITS

4.2.1 STRAIGHT DRAINS

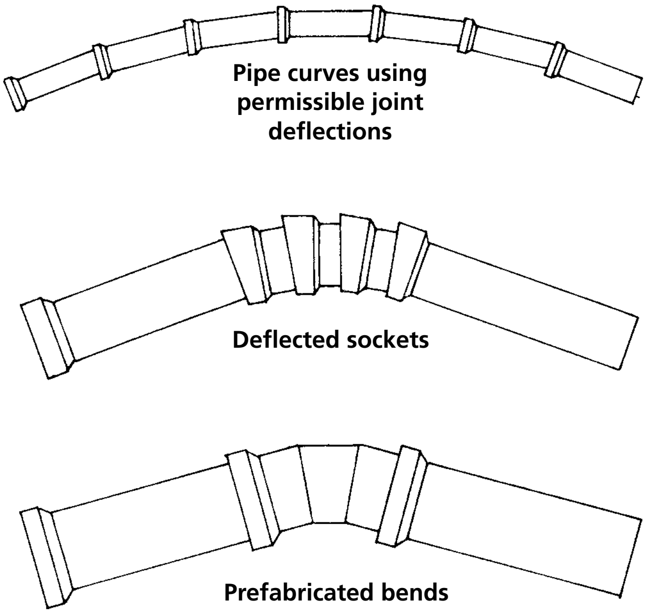
For straight, precast concrete pipes or box culverts flowing full with clean water a k value of 0.15 would be appropriate when using the Colebrook-White equation. Having regard to the effect of the debris a value of 0.6 seems reasonable (Figure 1.10) but it must be realised that no tests under these conditions are known to exist.

Figures 1.8 – 1.11 can be used for box culverts (full or part-full flowing) by substituting 4R for diameter D, where R is the hydraulic radius for the cross section.

4.2.2 CURVED DRAINS

4.2.2.1 PIPES

It is common for drainage pipelines to be laid straight, but there are circumstances when curves or bends are desirable. Concrete pipes can be laid satisfactorily with deflections at the joints to construct curved pipelines with curve radii of 100–300 pipe diameters. Joint deflections range from 0.6 to 3.0° dependent on diameter. (See Figure 4.1.)



PIPE CURVES AND BENDS
Figure 4.1

Splayed pipes and bends can be produced to provide curve radii down to about 5 pipe diameters.

Energy losses in curves formed by joint deflections are only slightly higher than those in straight lines and can be treated as such or an extra allowance of

$$0.1 \frac{v^2}{2g}$$

can be added for curve deflections over 20°.

Lobster-back bends show losses with k_b –values ranging up to 1.3 for 90° single splay bends. This and other examples are shown in Table 1.2.

4.2.2.2 BOX CULVERTS

Most box culverts are made with simple butt joints without any claims to watertightness. The joint itself, consequently, offers little scope for joint deflection.