ECLIPSE | CONSULTING ENGINEERS

Flood Study Report

Proposed Industrial Subdivision and General Industrial Building Development

2 & 10 Bowman Road
MOSS VALE 2577

For

SAAS Pty Ltd
c/o Jackson Environment and Planning
Suite 102, Level 1, 25-29 Berry St
North Sydney NSW 2060

Reference:	10530-004-fs
Issue Date:	31 July 2023
Issue:	3
Status:	Approval

ECLIPSE Consulting Engineers Pty Ltd
305/12 Century Circuit
Norwest Central
NORWEST NSW 2153

ABN 61 114 354 054
Phone (02) 9894 8500
info@eclipseconsulting.com.au
www.eclipseconsulting.com.au

1. Contents

1.1. Table of Contents

1.2. List of Figures

1.3. List of Tables

2. Introduction and Background

2.1. Purpose

The purpose of this Flood Study report is to investigate and document the impacts of floodwaters on the proposed development site, as well as the likely impacts of the proposed development on receiving waters, particularly in major flooding events.

This report achieves these outcomes through a qualitative review of available data on the existing site conditions, and a software analysis of runoff routing during selected rainfall events.

2.2. Site Description

The site is described as Lot 2 in DP1070888 and part of Lot 10 in DP130176. The development site is addressed as 2 & 10 Bowman Road, Moss Vale. The location of the site is shown in Figure 2.1, below.

Figure 2.1: Aerial photograph of the site location (SIXMaps)

The site currently consists of an agricultural lot with a single residential structure. The site is bounded by industrial developments to the east, Whites Creek to the South, agricultural land to the west, and a Council-operated waste transfer station to the north. The site slopes from north to south with an approximate grade of 4.5%.

2.3. Proposed Development

SAAS Aus Pty Ltd (SAAS) is seeking to create a subdivision that will include industrial land from the property at 2 Bowman Road, Moss Vale (Lot 2, DP1070888), and a small portion of the adjacent property at 10 Bowman Road (Lot 51, DP130176), and the remaining rural land from the properties. General industrial buildings are proposed to be constructed on three of the created lots with industrial land use zoning. The buildings will be used to house SAAS' scaffolding supply businesses.

Lot 2 covers an area of approximately 14.2 ha and is divided into three areas separated by a road and gas pipeline easement. The Lot consists of the following land use zones (Figure 2.2):

- E4 General Industrial
- RU2 Rural Landscape

The property at 2 Bowman Road also includes Lot 1, DP103123, a C3 Environmental Management zoned portion of land on the opposite side of Whites Creek (Figure 2.2). No development is proposed on this portion of land, and it will not be included in the subdivision.

The adjacent property at 10 Bowman Road (Lot 51, DP130176) is a 48 ha rural property adjacent to the western boundary of Lot 2 (Figure 2.2). An area of approximately 12,500 m^2 in the north-east portion of the Lot is zoned E4 and is proposed to be incorporated into the industrial subdivision and building development. The remainder of the property is zoned RU2.

Subdivision

The subdivision will result in the creation of four new lots and leave Lot 1, DP103123 in its current arrangement. The proposed subdivision will result in the following lots as shown in Figure 2.3:

- Created Lot 1: Approximately 2.88 ha of land zoned E4 General Industrial. Access to the lot will be directly from Bowman Road at the eastern end of the lot. The road frontage will be approximately 157 m, and the depth of the lot will vary from approximately 148 m on the southern boundary, to approximately 224 m on the northern boundary.
- Created Lot 2: Approximately 2.64 ha of land zoned E4 General Industrial. This lot will be formed by adjusting the boundaries of Lot 51 and Lot 2 to match the land use zone boundaries. This lot has a frontage to Bowman Road at the eastern end of the lot approximately 127 m wide. The lot will be approximately 352 m deep, tapering to a width of approximately 35 m at the western boundary. This lot is affected by the gas pipeline easement at the south-eastern end.
- Created Lot 3: Approximately 2.62 ha of land zoned E4 General Industrial. This is an irregularly shaped lot with a frontage to Bowman Road of approximately 388 m. This lot also has a frontage of approximately 132 m to an unformed paper road (Hutchinson Road) on the southern boundary. The northern portion of this lot is affected by the gas pipeline easement.
- Created Lot 4: Approximately 54.64 ha of RU2 Rural Landscape zoned land. This is the RU2 portion of Lot 2, DP1070888 separated from the remainder of the lot by the paper road along its northern boundary. The southern boundary of this lot is defined by Whites Creek and is within Wingecarribee Shire Council's Flood Planning Area. This part of the lot is to be merged with the remainder of the RU2 Rural Landscape lot of 51, DP130176.

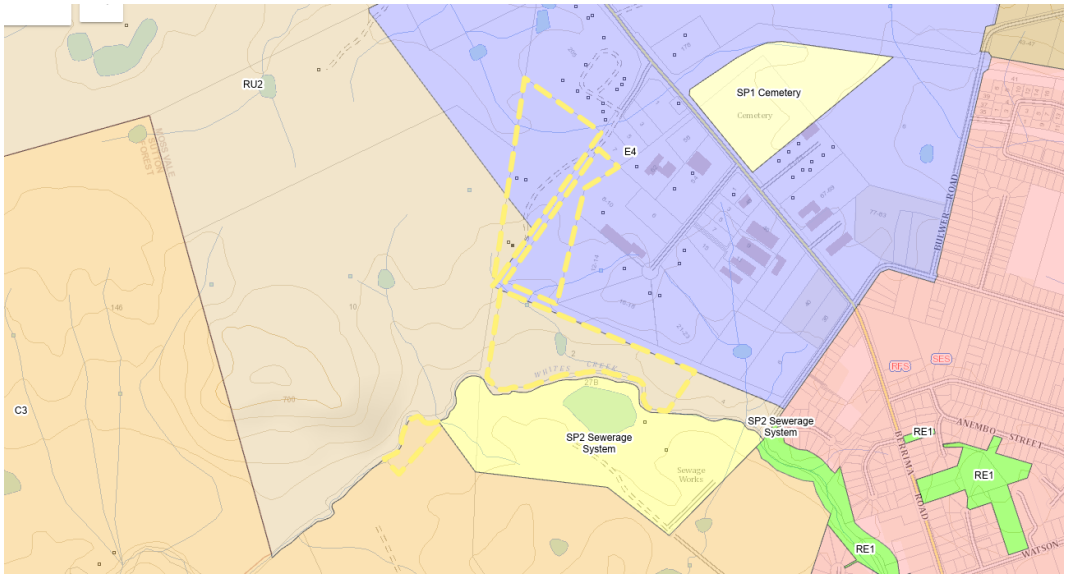


Figure 2.2: Existing property boundaries and land use zoning for 2 Bowman Road, Moss Vale NSW 2577. Existing Lot 2, DP1070888 (yellow dashed line), Lot 51, DP130176 (blue dashed line) and Lot 1, DP103123 (green dashed line) are shown. E4 General Industrial; RU2

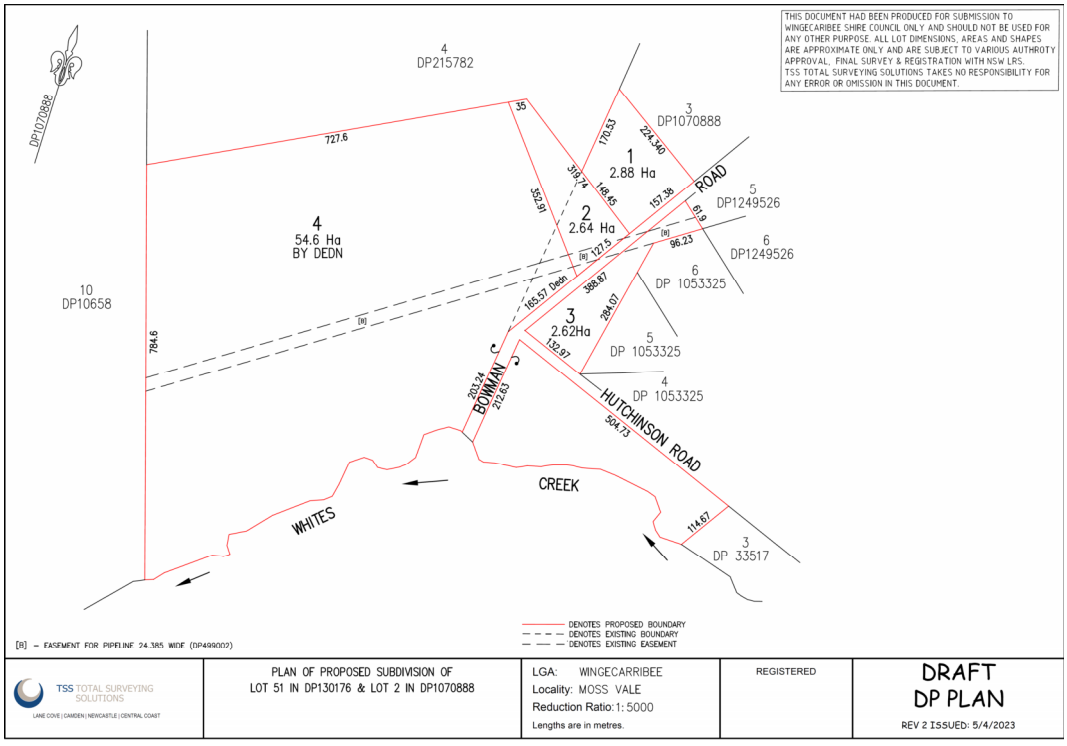


Figure 2.3: Proposed subdivision layout

Building Development

The development proposes the following elements (Figure 2.4):

- Building 1: An irregularly shaped building to be located in Created Lot 1 of the proposed subdivision. The north-east corner of the building will accommodate 956 m^2 office and staff amenities area split over the ground floor, first floor, and second floor, outdoor visitor parking along the eastern side of the building, and a basement carpark under the south-east corner of the building. The outdoor hardstand will provide truck parking along the southern lot boundary, an enclosed loading/unloading area along the entire southern side of the building, and a smaller, covered loading/unloading area on the northern side. A fire

sprinkler system will be installed within the building. A 200,000 L underground tank will be installed to capture rainwater for re-use on site.

- Building 2: An irregularly shaped building to be located on Created Lot 2 of the subdivision. The building will provide 1,392 m^2 of office space and amenities over a ground and first floor. There will be a covered outdoor loading area at the north-western end of the building. A fire sprinkler system will be installed within the building. A 200,000 L underground tank will be installed to capture rainwater for re-use on site.
- Building 3: This building will be constructed as a split-level building with the upper and lower levels divided and provided with separate amenities and access. It will be located in the southern portion of Created Lot 3, away from the gas pipeline easement. Building 3A will be further split into two sections (North and South) and will include offices and staff amenities over a ground and first floor within its north-west corner. Parking and access will be provided at the northern end for Building 3A. Building 3B (also split into North and South sections) will include offices and staff amenities within its south-west corner over a ground and first floor. Parking and access will be provided at the southern end for Building 3A. Fire sprinklers will be installed in all sections of the buildings. A 120,000 L underground tank will be installed to capture rainwater for re-use on site.
- Extension of Bowman Road and formation of the paper Hutchinson Rd to provide access to all created lots and buildings. Hutchinson Road will terminate in an industrial cul-de-sac near the south-eastern corner of Created Lot 3. An easement will be created within the northern portion of Created Lot 4 to accommodate this cul-de-sac.
- Internal haul roads to accommodate up to 26m B-Doubles (Buildings 1 and 2); heavy vehicles to use Building 3 will be limited to 19m semi-trailers.
- Outdoor hardstand areas surrounding each building.
- Individual stormwater capture and treatment systems to be provided to each buildings will include a HumeCeptor Gross Pollutant Trap to remove suspended solids and hydrocarbons, and a HumeFilter Universal Pollutant Trap to capture suspended solids, nitrogen, phosphorous and gross pollutants in stormwater runoff. The treatment systems will discharge to below ground on-site detention basin/s with discharge control to manage stormwater flow volumes.
- Stormwater from the proposed development will discharge to the northern portion of Created Lot 4 via an outlet headwall with scour protection. An easement will be created within the lot to facilitate construction and maintenance.
- Solar collection arrays on all building roofs.
- Landscaping along site boundaries and within parking areas.
- 1.8m high open black palisade fencing for security.

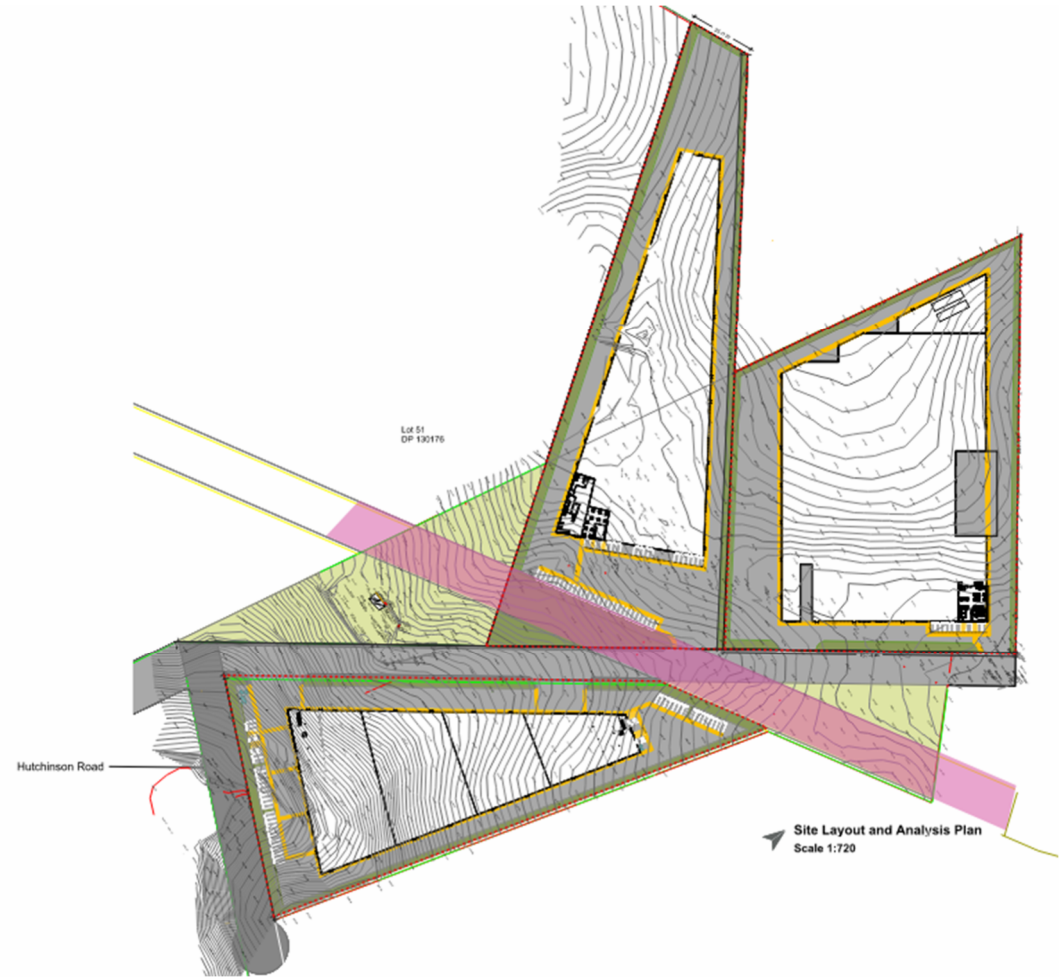


Figure 2.4: Proposed development site plan (Jackson Environment and Planning)

2.4. Proposed catchment areas.

The catchment areas for the proposed development are shown in Figures 2.5 to 2.9 below.

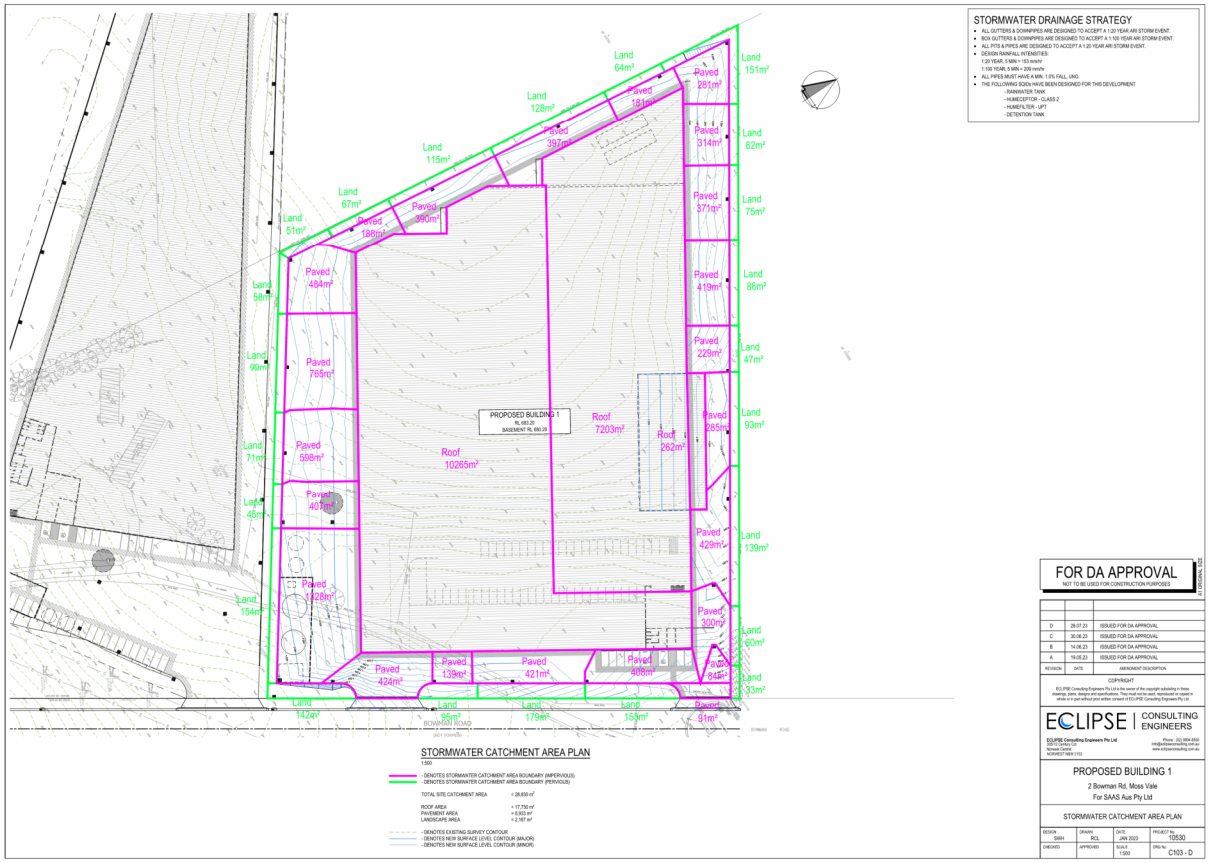


Figure 2.5: Catchment areas for Building 1

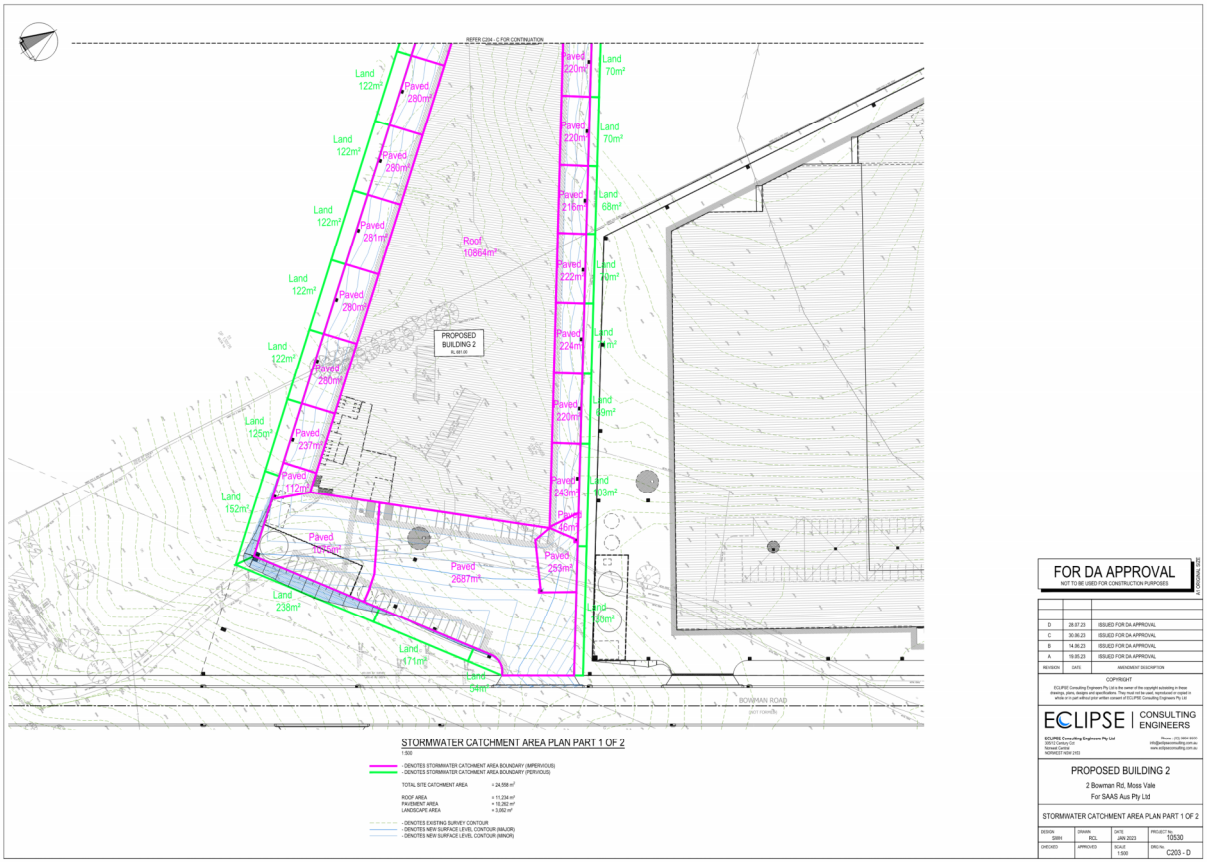


Figure 2.6: Catchment areas for Building 2 - Part 1

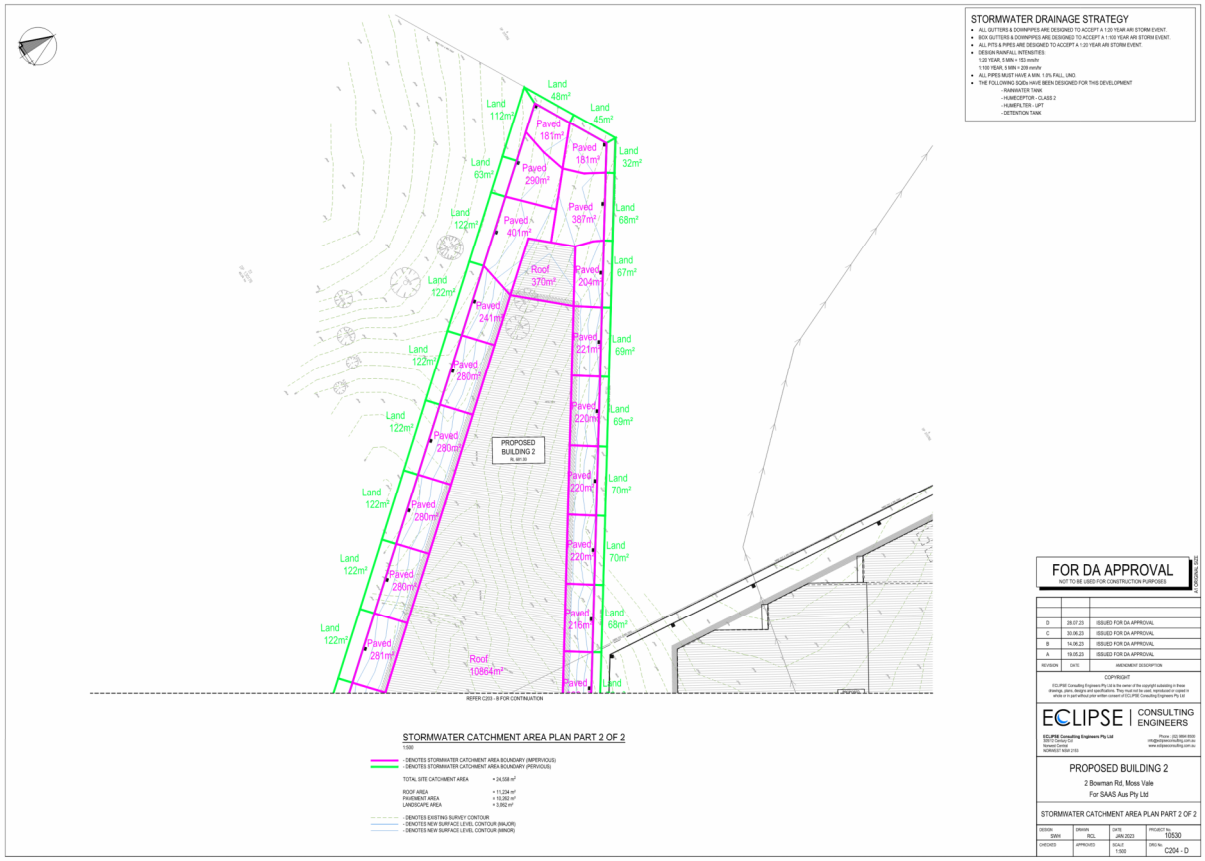


Figure 2.7: Catchment areas for Building 2 - Part 2

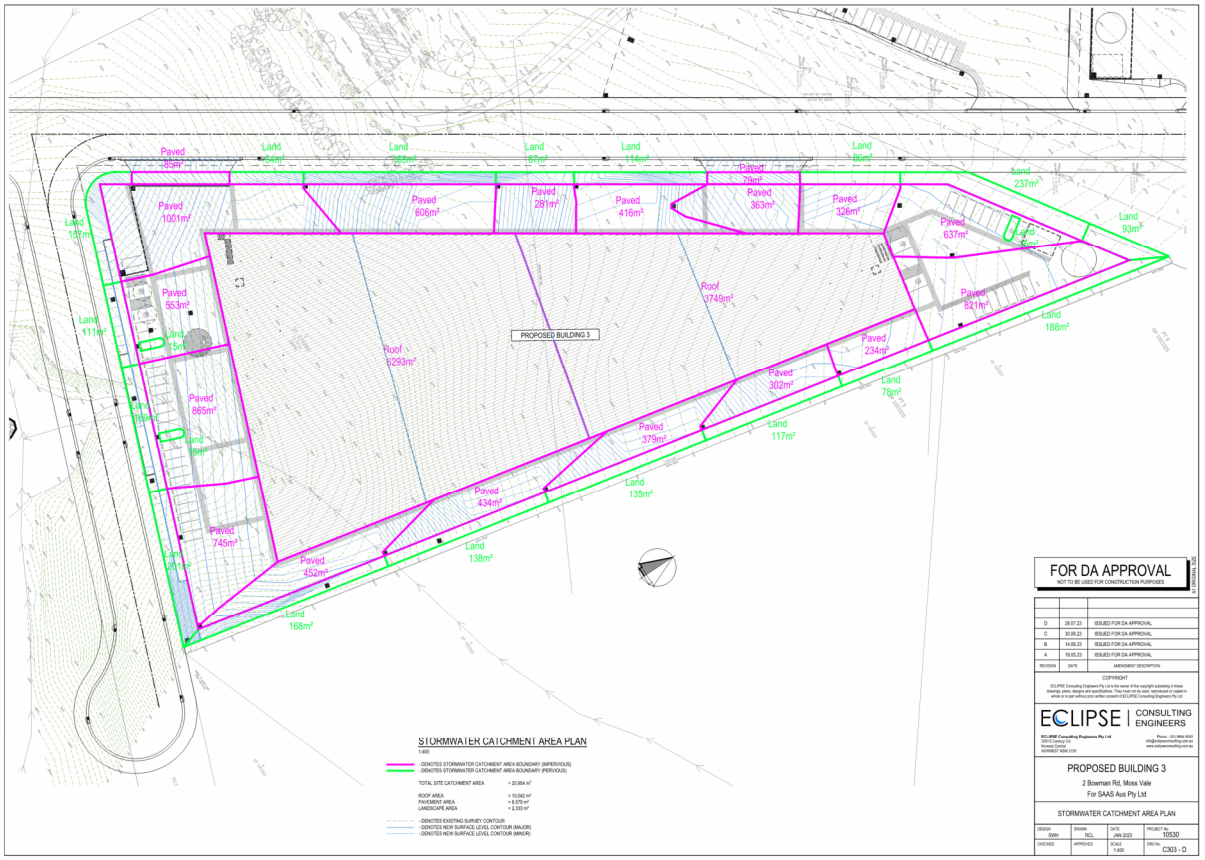


Figure 2.8: Catchment areas for Building 3

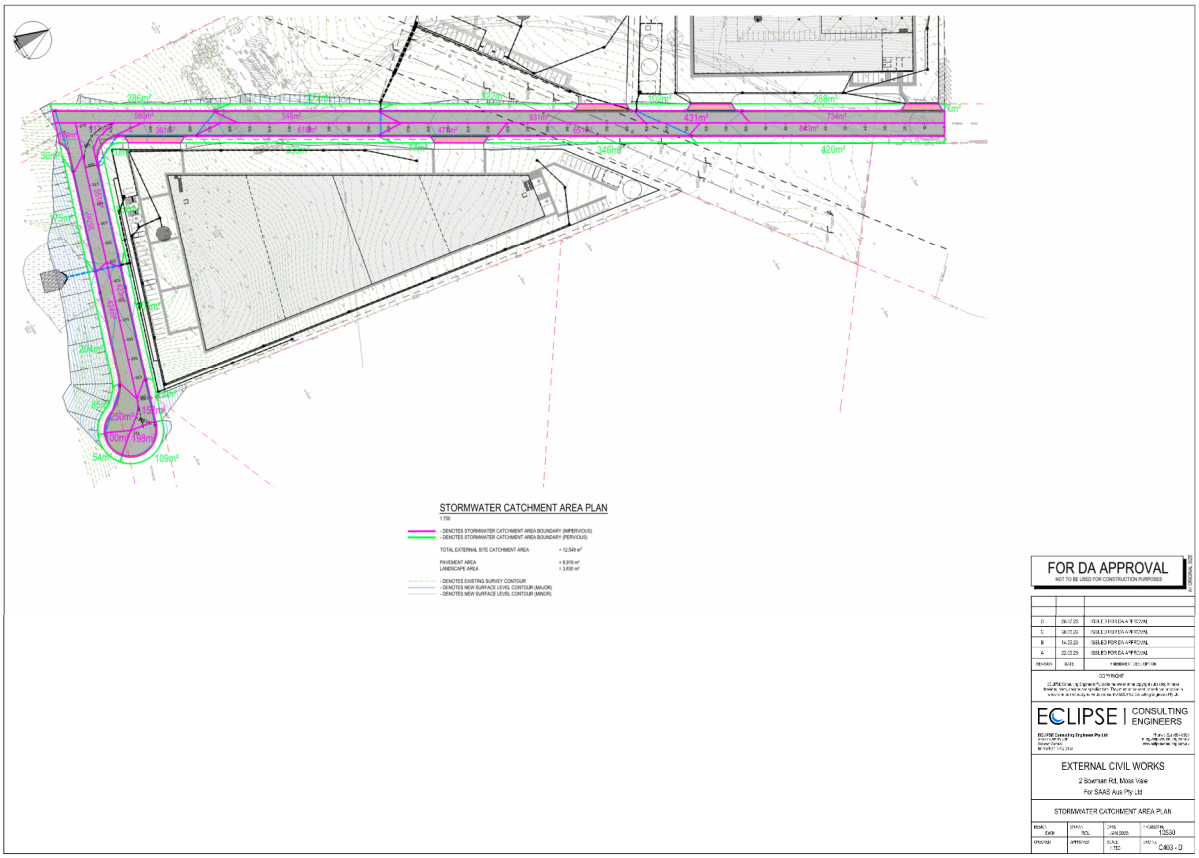


Figure 2.9: Catchment area plan for external works

3. Pre-Development Flood Behaviour

The development site is subject to overland flows from multiple water sources. This section reports on a qualitative and quantitative analysis of floodwater movement impacting the site from these sources.

3.1. Hydroline Spatial Analysis

The Water Management (General) Regulation 2018 hydroline spatial data online map provided by the NSW Government has identified that the proposed development site is impacted by two hydroline overland flow routes contributing to existing downstream natural watercourses.

Northern Hydroline

At the northern boundary of the site, a hydroline begins at 75 Berrima Road, Moss Vale. The watercourse tributary flows in a southerly direction across Berrima Road before turning westerly across the northern end of the proposed development site before continuing northwest towards an existing natural waterbody north of Abattoir Road. This hydroline has been identified in Figure 3.1 below.

Figure 3.1: Northern hydroline impacting the development site (NSW Spatial Services)

The natural waterbody at Abattoir Road is the first waterbody downstream of this hydroline which is permanently wet. A review of the satellite imagery and aerial photography in recent years of the area surrounding the hydroline suggests that the hydroline is rarely wet, and the small dam northwest of the proposed development site is intermittently dry. This would suggest that the hydroline is not indicative of a natural watercourse and is more likely to be an overland flow route for the movement of stormwater in major

rainfall events. There is little evidence to suggest that this flow route has been utilised in a flood event within accessible historic records.

The hydroline terminates at Stony Creek, which forms a tributary of the Wingecarribee River to the north of the development.

Southern Hydroline

A hydroline begins within the southern boundary of the site and at the southern end of Old Dairy Road. The proposed development would contribute stormwater at its outlet to this location, and a portion of the proposed Building 3 intercepts the contributed stormwater from Old Dairy Road. This hydroline has been identified in Figure 3.2 below.

Figure 3.2: Southern hydroline impacting the development site (NSW Spatial Services)

The hydroline proceeds in a southerly direction through two minor water bodies, both within the subject site. Both bodies are intermittently wet, collecting stormwater from the subject site and the industrial developments on Old Dairy Road. Analysis of satellite imagery and aerial photography of these bodies suggest that significant overflows from these bodies causing streamflow behaviour are rare, and that stormwater entering these bodies is likely to infiltrate into groundwater prior to the next rainfall event. In the event of overflow, stormwater flows in a southerly direction towards Whites Creek, which proceeds in a westerly direction away from the development site.

3.2. Catchment Analysis

Catchments North of Berrima Road

The proposed development site is downstream of a large catchment area to the north of Berrima Road. Prior to the development of the area, the site would be subject to sheet flows from a catchment with an approximate area of 110,000 m^2. The development of Berrima Road and the industrial sites associated with Bowman Road

and Old Dairy Road intercept overland flows from this catchment, directing stormwater flows elsewhere. The approximate area of this catchment, determined using publicly available contour mapping, is shown in Figure 3.3 below.

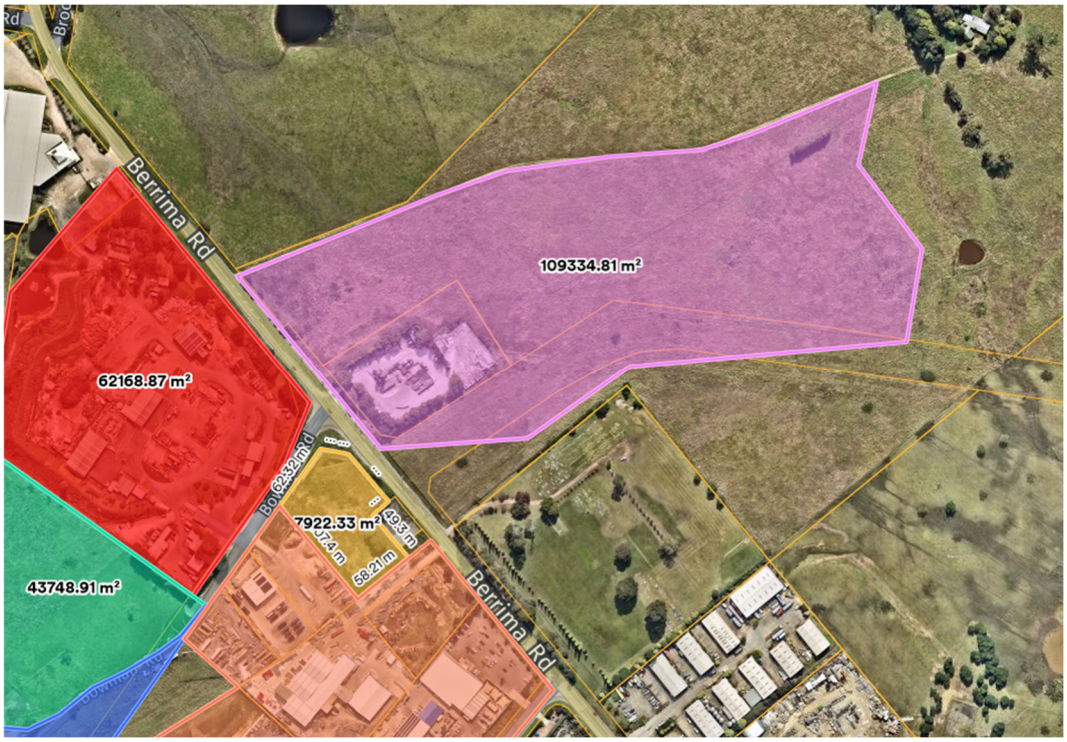


Figure 3.3: Upstream catchment producing overland flows at the development site (pink) (Nearmap)

This catchment includes an existing industrial development at 178 Berrima Road, with an approximate area of 9,000 m^2. For this study, this catchment has been excluded from producing overland flows as industrial developments are likely to include stormwater drainage connecting to an existing underground system managed by Wingecarribee Shire Council.

Wingecarribee Shire Council were requested to provide information regarding the existing drainage near the intersection of Berrima Road and Bowman Road. This was not provided. As such, for the purposes of modelling this catchment, it has been assumed that overland flows are collected on the surface of Berrima Road and directed to a stormwater outlet at 1 Bowman Road (discussed later in this section).

This catchment contributes to overland flows as part of the northern hydroline's catchment as outlined in Section 3.1. There are no catchments on the northern side of Berrima Road which contribute overland flows to the southern hydroline's catchment in either the pre-development or post-development scenario.

Resource Recovery Centre

The Resource Recovery Centre at 177 Berrima Road is an existing industrial development owned and operated by Wingecarribee Shire Council. The location of this site and the approximate catchment area is shown in Figure 3.4 below.

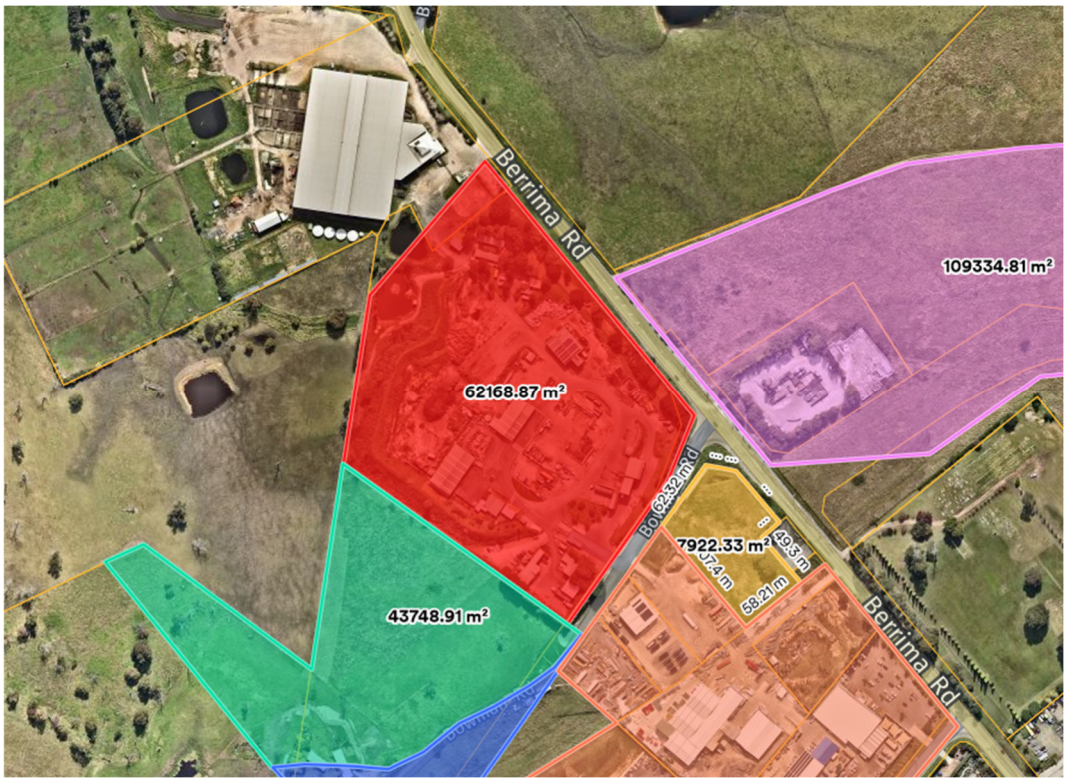


Figure 3.4: Resource Recovery Centre catchment (red) (Nearmap)

Wingecarribee Shire Council were requested to provide information regarding the existing drainage and stormwater disposal point of this development. This was not provided. For this study, it is assumed that stormwater is managed on site and overflows in extreme events are not disposed of to the subject site. A review of satellite imagery and aerial photographs suggests that stormwater flows from the Resource Recovery Centre are disposed of to the west, joining the northern hydroline and Stony Creek downstream of the proposed development site. As such, this catchment has not been included in the analysis model.

1 Bowman Road

As part of this study, Wingecarribee Shire Council were requested to provide available information about the nature of existing drainage at the intersection of Berrima Road and Bowman Road. This was not provided. As such, a series of assumptions have been made about the design intent of existing drainage. A critical aspect of the existing drainage network managed by Wingecarribee Shire Council is that the Council-owned lot at 1 Bowman Road appears to allow for collection and infiltration of stormwater from upstream developments.

At the intersection of Bowman Road and Berrima Road, existing street drainage from Bowman Road and Berrima Road meets at a headwall, passing under the intersection in a north-easterly direction. It is assumed that once stormwater enters this system, is continues to flow in a north-westerly direction along Berrima Road and is disposed of downstream of the subject site. As can be seen in Figures 3.5 and 3.6 below, when this system is subject to excess stormwater, it spills into the site at 1 Bowman Road which forms a basin with an approximate depth of 2 m at peak volume and an area of 7,900 m^2.

Figure 3.5: View of headwall inlet at Berrima Road and Bowman Road, including wet infiltration system at 1 Bowman Road (Google Maps)

Figure 3.6: 2 Bowman Road catchment and infiltration basin (yellow) (Nearmap)

Based on available contour mapping, this basin has a base level of 683 mAHD, and spills into the downstream system at the subject site once water reaches a level of 685 mAHD or greater. In the absence of geotechnical data, this basin is assumed to have an infiltration rate not exceeding 20 mm/hour, which is generally acceptable for sand/clay soils with unknown properties.

Old Dairy Road

All existing lots at Old Dairy Road are industrial in nature. Wingecarribee Shire Council were requested to provide information on the nature of existing drainage assets in Old Dairy Road. No information was provided. Based on satellite imagery and aerial photography, it has been assumed that industrial sites on the western side

of Old Dairy Road contribute stormwater to the southern hydroline impacting the subject site. This approximate catchment is shown in Figure 3.7 below.

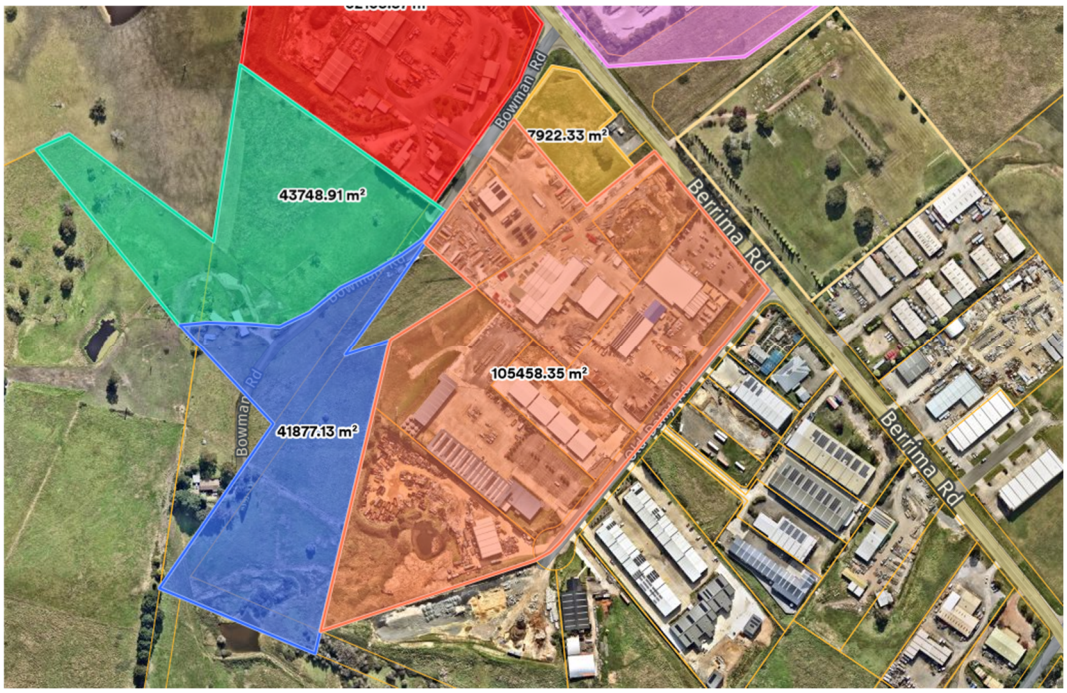


Figure 3.7: Old Dairy Road catchment (orange) (Nearmap)

In the absence of additional information, the industrial developments in this catchment are assumed to meet Wingecarribee Shire Council requirements in disposing stormwater at rates not greater than pre-development rates up to and including the 1% AEP storm. For this study, greenfield runoff rates have been assumed for the developments in this area.

2 Bowman Road Northern Hydroline Catchment

The survey of the subject site conducted by Total Surveying Solutions in August 2022 has assisted with the accurate identification of the catchment areas contributing to both the northern and southern hydroline catchments at the subject site. The survey documentation has been included in Appendix A.

The area of the subject site contributing to the northern hydroline catchment is shown in Figure 3.8 below.

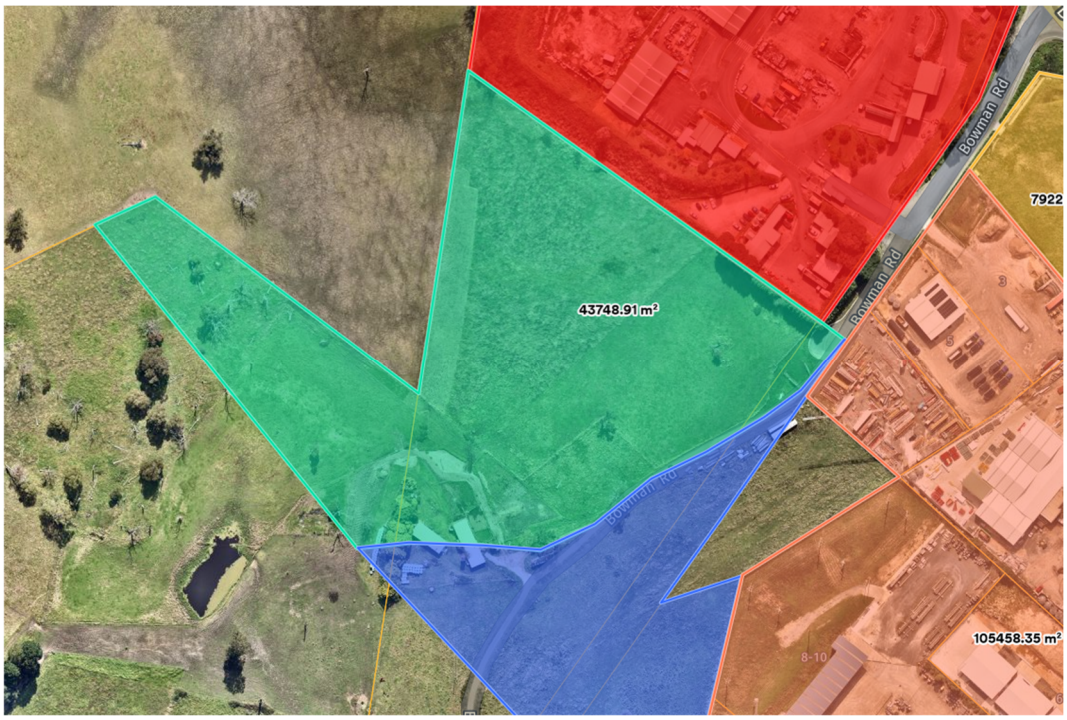


Figure 3.8: 2 Bowman Road northern hydroline catchment (green) (Nearmap)

For the purposes of this study, this catchment is assumed to produce runoff at pre-development rates in accordance with Wingecarribee Shire Council requirements for new developments.

2 Bowman Road Southern Hydroline Catchment

The area of the subject site contributing to the southern hydroline catchment is shown in Figure 3.9 below.

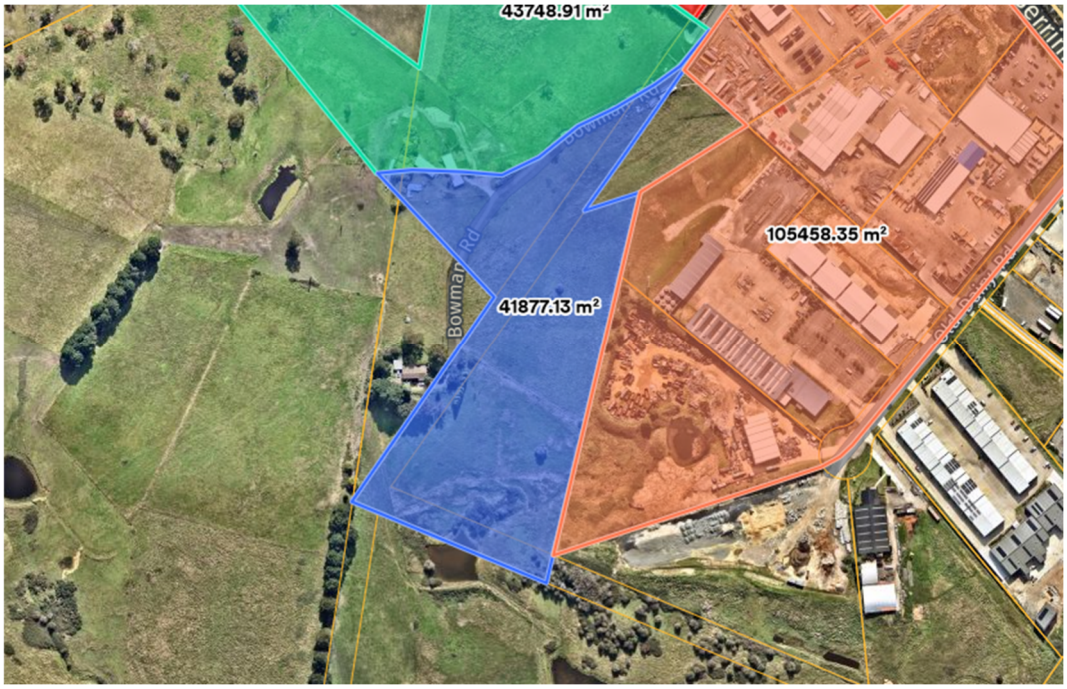


Figure 3.9: 2 Bowman Road southern hydroline catchment (blue) (Nearmap)

For the purposes of this study, this catchment is assumed to produce runoff at pre-development rates in accordance with Wingecarribee Shire Council requirements for new developments.

Catchment Summary

An overview of the catchment areas included in this study is included in Figure 3.10 below.

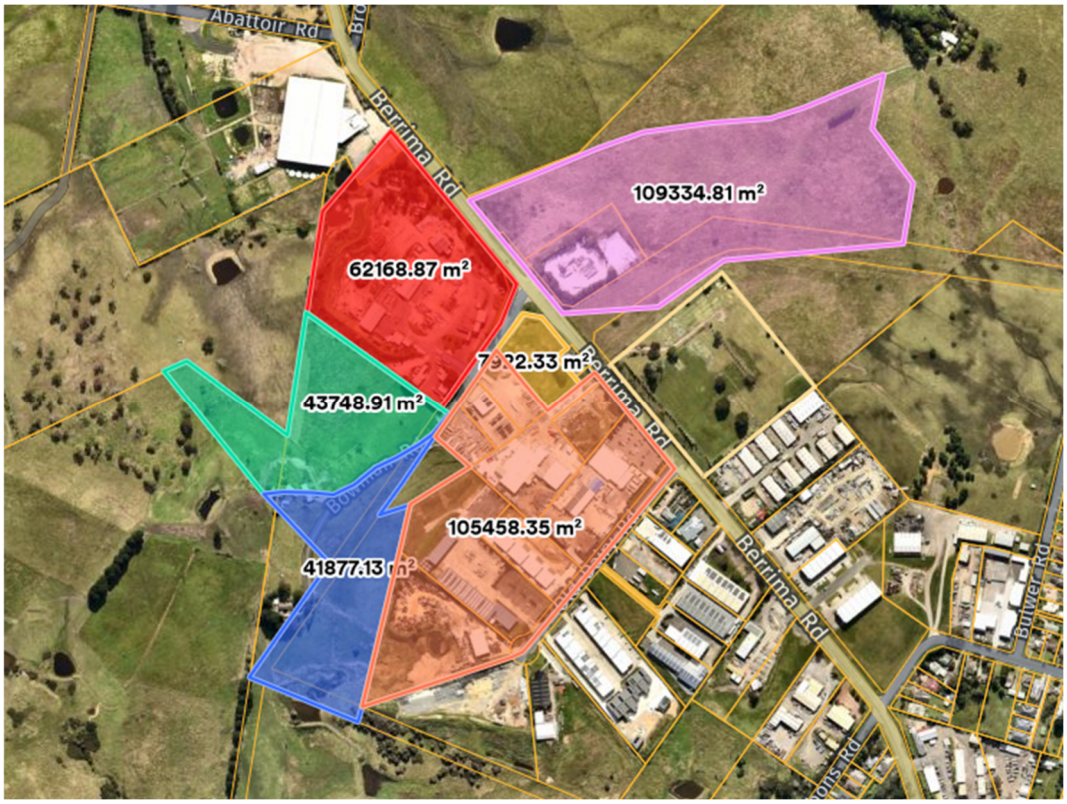


Figure 3.10: Study area catchment overview (Nearmap)

4. Post-Development Flood Behaviour

4.1. Hydroline Routes

The proposed development site intends to drain collected stormwater to the south of the proposed development. Refer to civil engineering plans for this project and the associated Stormwater Management Plan Report (ECLIPSE Consulting Engineers ref. 10530-003-smp).

As a result of this, there are likely to be changes to the flow regime of both Whites Creek and Stony Creek. A visual summary of the pre-development and post-development flow paths of the existing hydrolines impacting the development are shown in Figures 4.1 to 4.4 below.

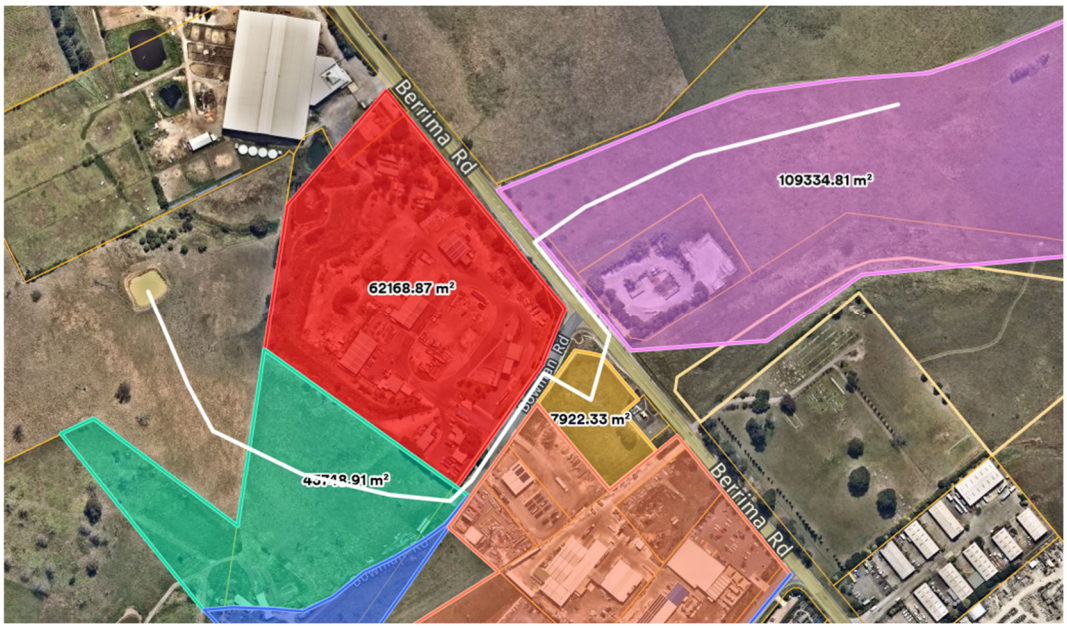


Figure 4.1: Pre-development flow path for northern hydroline (Nearmap)

Figure 4.2: Post-development flow path for northern hydroline (Nearmap)

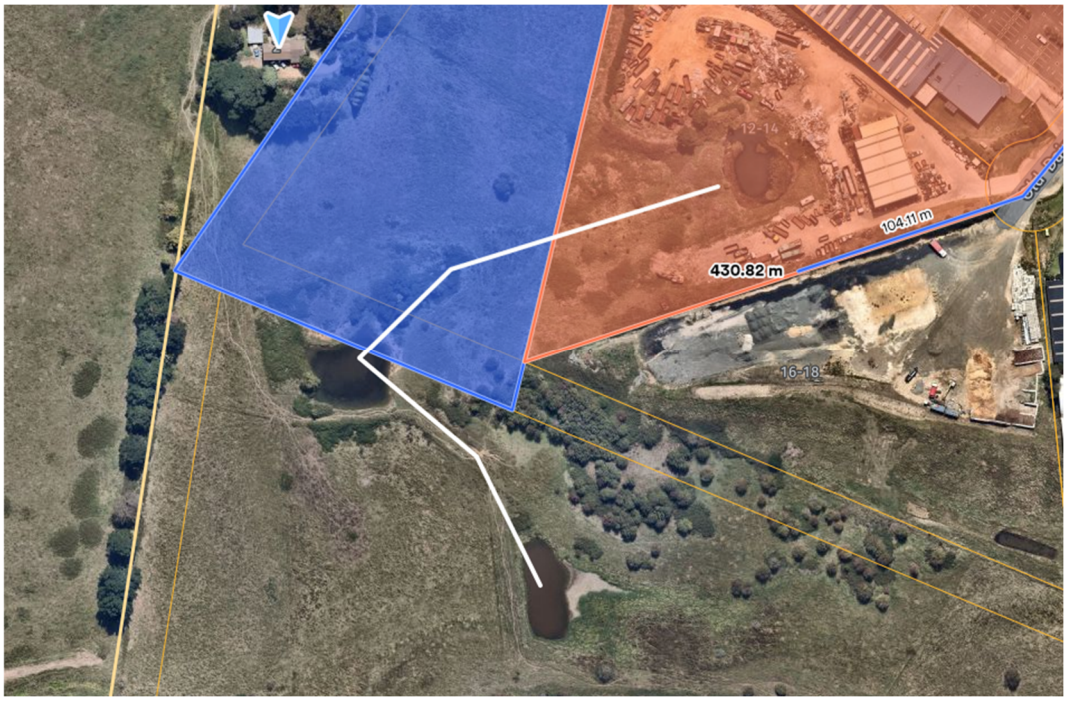


Figure 4.3: Pre-development flow path for southern hydroline (Nearmap)

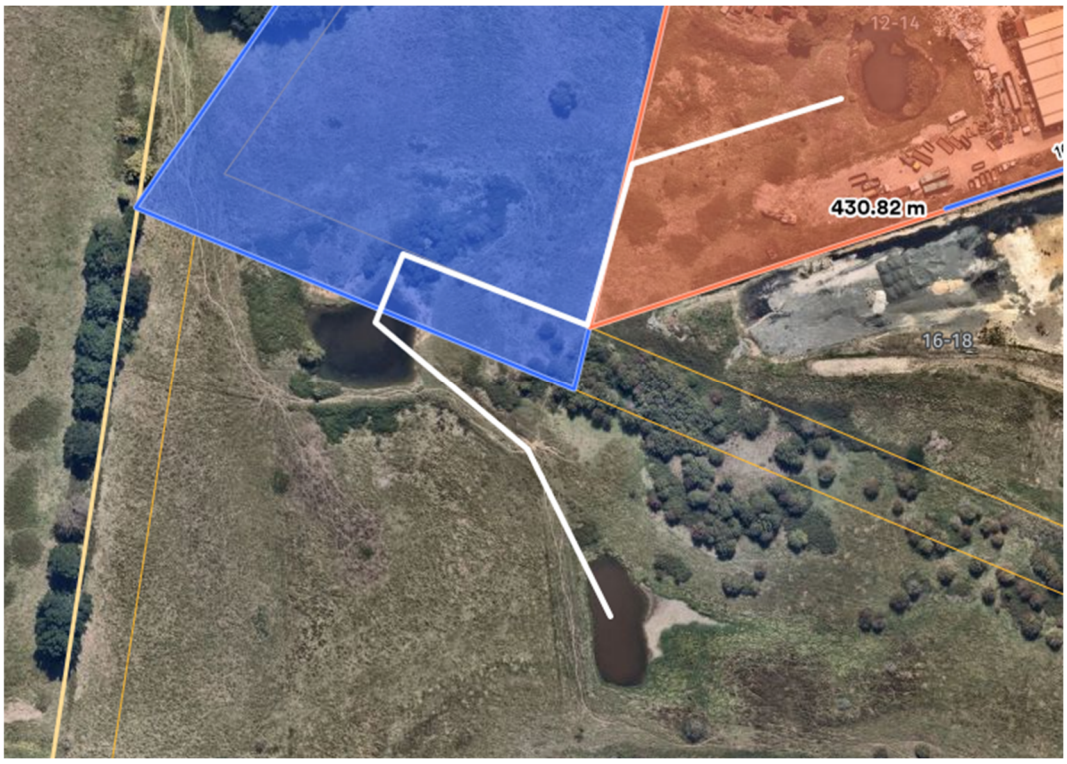


Figure 4.4: Post-development flow path for southern hydroline (Nearmap)

This study has used runoff-routing models to quantify the expected changes to the output in specific storm events. A summary of the changes between pre- and post-development flows are provided in Table 4.1 below.

Catchment Colour	Approximate Area (m^2)	Pre-Development Destination	Post-Development Destination
Pink	100,000	Northern hydroline	*Southern hydroline*
Red	62,000	N/A	N/A
Yellow	8,000	Northern hydroline	*Southern hydroline*
Orange	105,000	Southern hydroline	Southern hydroline
Green	44,000	Northern hydroline	*Southern hydroline*
Blue	42,000	Southern hydroline	Southern hydroline

Table 4.1: Pre- and post-development flood behaviour

The analysis conducted in this study intends to report on the likely changes in flood behaviour because of the changes to the flow regimes associated with the proposed development.

4.2. Wingecarribee Local Environment Plan Requirements

In accordance with the Wingecarribee Local Environment Plan 2010, the northern and southern hydrolines investigated in this study full under Category 3 – Bank Stability & Water Quality. Refer to Appendix D for mapping.

In accordance with Clause 7.5 of the Wingecarribee Local Environment Plan, the proposed development is required to be designed in such a way that potential adverse impacts are avoided, managed, and mitigated appropriately within 10 m from the top of bank.

As outlined in Section 3 of this report, neither the northern or southern hydrolines are readily observable as natural watercourses, and as such the proposed development over these corridors is required to manage potential adverse impacts. Because of the negligible definition of the existing banks of the watercourses, the stability of the existing bed of the waterway is not meaningfully impacted by the proposed development. This

flood study investigates and quantifies the impact of the development on the natural flow regime in a variety of rainfall and flood events. Refer to the following section for details. The proposed development is subject to Neutral or Beneficial impact for stormwater quality, which is considered in detail in the accompanying Stormwater Management Plan (10530-003-smp). As such, the application is considered to meet the requirements of the Wingecarribee Local Environment Plan for developments impacting riparian land.

5. Hydraulic Modelling

5.1. Hydrological Data

A DRAINS model has been prepared as the primary means of quantitative analysis in this study. The rainfall depth data shown in Table 5.1 below was used in conjunction with the procedures outlined in Australian Rainfall and Runoff 2019 to determine pre- and post-development discharge rates.

Rainfall Depths (mm) [34.5375 (S), 150.3375 (E)] issued 24 March 2023						
	Annual Exceedance Probability (AEP)					
Duration	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
1 min	2.02	2.77	3.31	3.87	4.67	5.31
2 min	3.16	4.2	4.97	5.76	6.89	7.85
3 min	4.43	5.94	7.04	8.17	9.79	11.1
4 min	5.64	7.61	9.05	10.5	12.6	14.4
5 min	6.73	9.15	10.9	12.7	15.3	17.4
10 min	10.8	14.9	17.8	20.9	25.2	28.7
15 min	13.4	18.4	22.1	25.9	31.3	35.7
20 min	15.2	20.9	25.1	29.4	35.5	40.4
25 min	16.6	22.8	27.2	31.9	38.5	43.9
30 min	17.8	24.2	29	33.9	40.9	46.6
45 min	20.3	27.5	32.8	38.2	45.9	52.3
1 hour	22.3	30	35.6	41.4	49.7	56.4
1.5 hour	25.5	34	40.2	46.6	55.6	63.1
2 hour	28.2	37.5	44.3	51.2	60.9	68.9
3 hour	32.9	43.9	51.7	59.6	70.7	79.6
6 hour	45	60.7	71.7	82.8	97.7	109
12 hour	64.1	88.7	106	123	145	162
18 hour	78.9	111	134	157	186	207
24 hour	90.7	130	158	186	220	246
30 hour	100	145	177	210	250	279
36 hour	108	158	194	231	275	308
48 hour	120	177	219	263	314	353
72 hour	135	200	249	303	364	411
96 hour	143	211	264	322	390	442
120 hour	147	217	271	332	402	457
144 hour	150	219	274	335	407	463
168 hour	151	221	274	335	408	464

Table 5.1: Design rainfall depth for the development site (Bureau of Meteorology)

5.2. DRAINS Model Arrangement

The model arrangements shown in Figures 5.1 and 5.2 below have been used to produce estimates of the downstream flows from each catchment's outlet point in the pre- and post- development scenario.

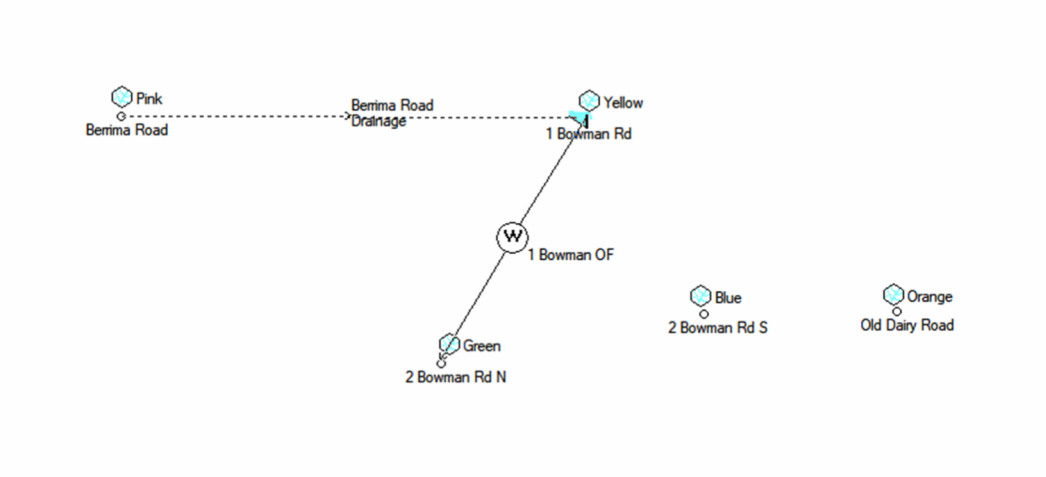


Figure 5.1: Pre-development DRAINS model arrangement

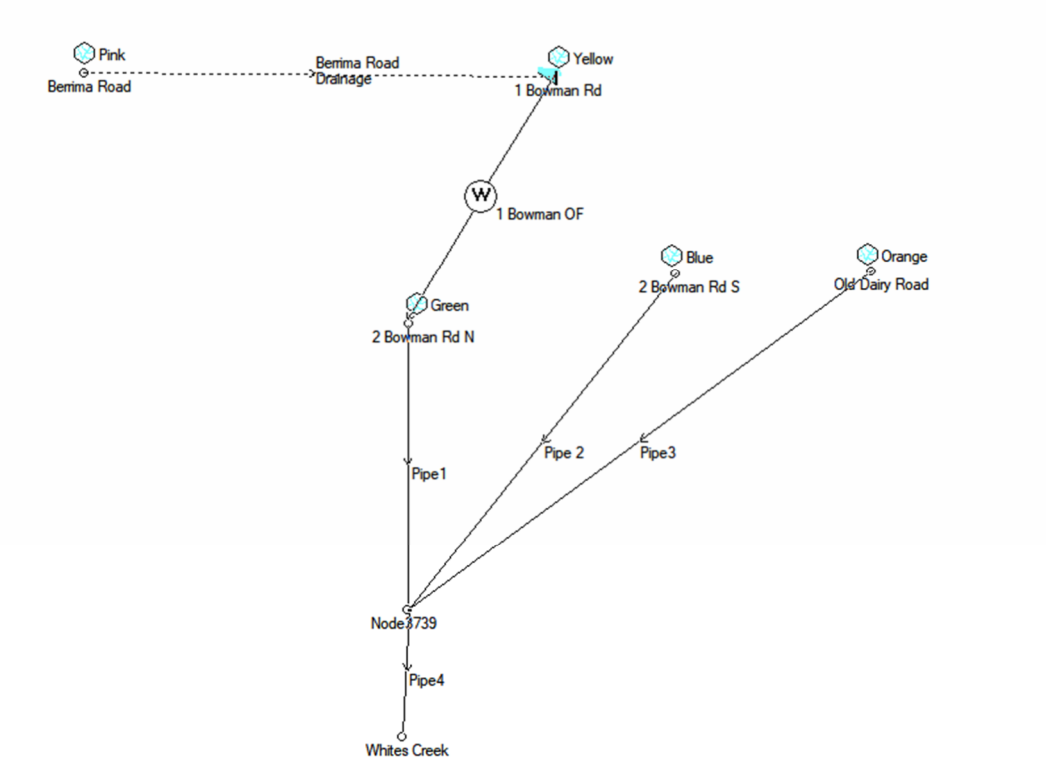


Figure 5.2: Post-development DRAINS model arrangement

5.3. Results and Discussion

The tables below include critical flows in both the minor storm event (5% AEP) and major storm event (1% AEP) for both pre- and post-development scenarios. This section also highlights the numerical difference in expected output flows for the northern and southern hydroline catchments which will likely be induced by the proposed construction at the subject site.

Catchment Colour	5% AEP – Mean Maximum Catchment Flow (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Pink	0.599	0.911	1.154	0.665	0.487	0.362	0.305
Yellow	0.339	0.282	0.186	0.082	0.045	0.029	0.026
Orange	3.083	3.193	2.144	1.033	0.593	0.380	0.340
Green	1.863	1.550	1.023	0.453	0.249	0.159	0.143
Blue	1.778	1.480	0.977	0.433	0.237	0.152	0.136

Table 5.2: Mean maximum catchment flows - 5% AEP (DRAINS)

Catchment Colour	1% AEP – Mean Maximum Catchment Flow (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Pink	0.930	1.421	1.665	0.878	0.634	0.514	0.444
Yellow	0.464	0.437	0.232	0.110	0.056	0.041	0.036
Orange	4.790	5.344	2.778	1.386	0.741	0.540	0.467
Green	2.552	2.404	1.275	0.604	0.310	0.226	0.196
Blue	2.436	2.294	1.217	0.576	0.296	0.216	0.187

Table 5.3: Mean maximum catchment flows - 1% AEP (DRAINS)

As can be seen from the tables above, critical flows for each catchment appear to occur in events of duration between 5 minutes and 1 hour. Storms of all durations show increases between the 5% AEP and 1% AEP events, with volumetric increases in the order of 50%.

The tables below show mean flows in the 5% AEP and 1% AEP storm events at critical drainage links and outlets.

Link Location	5% AEP – Mean Maximum Link Flow – Pre-Development (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Overflow – 1 Bowman Rd	0.000	0.000	0.000	0.000	0.528	0.397	0.115
Northern Hydroline Outlet	1.863	1.550	1.023	0.453	0.777	0.556	0.258
Southern Hydroline Outlet	4.861	4.673	3.121	1.466	0.830	0.532	0.476

Table 5.4: Mean maximum link flows - Pre-Development - 5% AEP

Link Location	1% AEP – Mean Maximum Link Flow – Pre-Development (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Overflow – 1 Bowman Rd	0.000	0.000	0.000	0.000	0.784	0.615	0.476
Northern Hydroline Outlet	2.552	2.404	1.275	0.604	1.094	1.155	0.672
Southern Hydroline Outlet	7.226	7.638	3.995	1.962	1.037	0.756	0.654

Table 5.5: Mean maximum link flows - Pre-Development - 1% AEP

These results suggest that the infiltration basin at 1 Bowman Road has adequate capacity for overflows from catchment north of Berrima Road for all storm events up to major events no longer than 6 hours. As such, in both the pre-development and post-development scenarios, overflows from upstream catchments which contribute to the northern hydroline are not expected except in major events producing significant volumes of stormwater over long periods.

The tables below summarise the expected flows at the outlet of the northern and southern hydrolines in both the 5% AEP and 1% AEP events, as well as the expected change in flows in these events compared to the pre-development scenario.

Link Location	5% AEP – Mean Maximum Link Flow – Post-Development (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Northern Hydroline Outlet	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Southern Hydroline Outlet	5.002	5.657	3.569	1.793	1.251	0.877	0.638

Table 5.6: Mean maximum link flows - Post-Development - 5% AEP

Link Location	1% AEP – Mean Maximum Link Flow – Post-Development (m^3/s)						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Northern Hydroline Outlet	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Southern Hydroline Outlet	7.451	7.975	4.692	2.424	1.712	1.291	1.045

Table 5.7: Mean maximum link flows - Post-Development - 1% AEP

Link Location	5% AEP – Change in Mean Maximum Flow						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Northern Hydroline Outlet	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Southern Hydroline Outlet	+2.9%	+21.1%	+14.3%	+22.3%	+50.7%	+64.8%	+34.0%

Table 5.8: Change in mean maximum link flows - 5% AEP

Link Location	1% AEP – Change in Mean Maximum Flow						
	5 min	10 min	1 hour	6 hour	24 hour	72 hour	168 hour
Northern Hydroline Outlet	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Southern Hydroline Outlet	+3.1%	+4.4%	+17.4%	+23.5%	+65.1%	+70.8%	+59.8%

Table 5.9: Change in mean maximum link flows - 1% AEP

These results indicate that the proposed development will result in no disposal of stormwater to the northern hydroline from the subject site and upstream catchments. Due to the redirection of stormwater, there is likely to be an increase in stormwater discharged to the southern hydroline. In shorter events where stormwater volumes are dominated by the Old Dairy Road catchment, increases are likely to be small, in the order of 5 to 15%. However, in longer events with more persistent flows, increases reaching over 50% can be expected, reaching a maximum of 70.8% increase in the 1% AEP 72 hour event.

As the proposed development will result in changes to flood routing impacting downstream water bodies, a high-level qualitative review of this data has been conducted as part of this study. The southern hydroline at the subject site discharges to Whites Creek immediately downstream of the subject site. The capacity of the existing drainage route to convey stormwater in major and minor rainfall events is not likely to be an issue, as excess flows have adequate space to be discharged as overland sheet flow if drainage routes overflow.

A review of the Whites Creek Floodplain Risk Management Study & Plan was undertaken by Catchment Simulation Solutions in February 2020. The existing flood study generally covers areas upstream of the development site, which includes much of the township of Moss Vale. The Whites Creek catchment included in the flood study has been included in Appendix B.

The station where modelled flood levels were recorded closest to the subject site was at Moss Vale Sewage Treatment Plant. In the 1% AEP flood event, the peak flood level at this location is modelled as 655.98 mAHD. In the PMF flood event, the peak flood level at this location is modelled as 657.97 mAHD. The surveyed levels at the lowest point of the site are no lower than 659.00 mAHD. This indicates that the existing site and the proposed development are unlikely to be inundated by flooding of Whites Creek in any rainfall events, meaning there are no tailwater effects to be considered for the discharge design for this development.

Mean values for the 1% AEP flood flows at Moss Vale Sewage Treatment Plant have been provided in the review of the flood study. The chart provided is included in Appendix C. The expected increase in flow due to the proposed development in selected rainfall durations are shown in Table 5.10 below.

	Outlet Stream Flow – 1% AEP			
	10 min	**1 hour**	**6 hour**	**24 hour**
Southern Hydroline Pre-Development (m^3/s)	7.638	3.995	1.962	1.037
Southern Hydroline Post-Development (m^3/s)	7.975	4.692	2.424	1.712
Southern Hydroline Increase (m^3/s)	0.337	0.697	0.462	0.675
Moss Vale Sewage Treatment Plant Flow (m^3/s)	23.201	48.121	53.198	45.515
Relative Increase to Downstream Flooding (%)	1.5	1.4	0.9	1.9

Table 5.10: Relative increase to downstream stream flow – 1% AEP

This table indicates that the proposed development will result in an up to 2% increase in stream flow in Whites Creek in major flooding events. This increase has been indicated conservatively with the assumption that critical storm events occur simultaneously upstream for Whites Creek and the catchments considered in this study.

The proposed development is estimated to have a small but non-negligible impact on the receiving waters immediately downstream of the subject site. With appropriate design consideration, the outlet structures at the discharge point could be designed to effectively manage increased flows and ensure excessive scour and downstream flooding are minimised.

Appendix A – Subject Site Survey

NOTE:

THE BOUNDARY INFORMATION SHOWN ON THIS PLAN REGARDING THE LOCATION OF THE PROPERTY BOUNDARIES HAS BEEN TAKEN FROM THE TITLE DEPOSITED PLAN. IT HAS BEEN PLOTTED AS REQUIRED UNDER DIVISION 1, SECTION 9(1) OF THE "SURVEYING AND SPATIAL INFORMATION REGULATION (2017" AND IS ACCURATE TO ABOUT ±1.0m. IT HAS NOT BEEN DETERMINED BY AN ACCURATE BOUNDARY SURVEY.

THERE ARE UNCERTAINTIES IN THE BOUNDARY INFORMATION PROVIDED ON THE DEPOSITED PLANS WHICH MAKE UP THE SITE. IT IS RECOMMENDED THAT A PLAN OF RECOGNITION IS REGISTERED OVER THE SITE PRIOR TO ANY DETAILED DESIGN ON OR NEAR THE PARCEL BOUNDARIES AND EASEMENTS. REGISTERING THIS PLAN WILL REMOVE ANY UNCERTAINTY AS TO THE WHEREABOUTS OF THE DEVELOPMENT SITE BOUNDARIES AND ENSURE THAT THE DEVELOPMENT PROGRESSES SMOOTHLY THROUGH THE EARLY STAGES OF CONSTRUCTION.

A DETAIL & LEVEL SURVEY IS NOT A "LAND SURVEY" AS DEFINED BY THE SURVEYING AND SPATIAL INFORMATION ACT, 2002. IF ANY CONSTRUCTION OR DESIGN WORK WHICH RELIES ON CRITICAL SETBACKS FROM THE STREET OR BOUNDARIES IS PLANNED, IT WOULD BE IMPERATIVE TO CARRY OUT FURTHER SURVEY WORK TO DETERMINE THE BOUNDARY DIMENSIONS.

PRIOR TO ANY CONSTRUCTION WORK, SURVEY MARKS SHOULD BE PLACED TO DEFINE THE PROPERTY BOUNDARIES.

SERVICES SHOWN ARE INDICATIVE ONLY. POSITIONS ARE BASED ON SURFACE INDICATOR(S) LOCATED DURING FIELD SURVEY. CONFIRMATION OF THE EXACT POSITION SHOULD BE MADE PRIOR TO ANY EXCAVATION WORK. OTHER SERVICES MAY EXIST WHICH ARE NOT SHOWN.

LEVELS ARE BASED ON AUSTRALIAN HEIGHT DATUM (AHD) USING SSM 19145 WITH RL 675.66 (AHD) (GNSS OBS).

RIDGE & GUTTER HEIGHTS HAVE BEEN OBTAINED BY INDIRECT METHOD AND ARE ACCURATE TO ± 0.05m.

CONTOURS SHOWN DEPICT THE TOPOGRAPHY, EXCEPT AT SPOT LEVELS SHOWN THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. THE SPOT LEVELS ARE TRUE FOR THEIR POSITION, AND ARE INTENDED TO BE USEFUL TO REPRESENT THE GENERAL TERRAIN. CARE SHOULD BE TAKEN IF EXTRAPOLATING.

THIS SITE IS MADE UP OF THE FOLLOWING PARCELS OF LAND:

- LOT 2 DP 1070888
- LOT 51 DP 130176

(A) EASEMENT FOR PIPELINE 24.385 WIDE, D147975 (DP1070888)

AREAS OF LOTS SHOWN ARE TITLE AREAS TAKEN FROM THE DEPOSITED PLANS WHICH MAKE UP THE SITE.

OVERALL SHEET

BOUNDARIES HAVE NOT BEEN LOCATED BY SURVEY. THE BOUNDARIES SHOWN ON THIS PLAN HAVE BEEN TAKEN FROM THE TITLE DEPOSITED PLAN AND ARE APPROXIMATE RELATIVE TO THE DETAIL SURVEY.

LEGEND

BENCH MARK	
TELSTRA PIT	TEL
ELECTRIC LIGHT POLE	LP
POWER POLE	PP
SIGN POST	SP
SP/WR INSPECTION PIT	SIP
SEWER VENT	SEWER
MANHOLE	MH
SEWER MANHOLE	SMH
STOP VALVE	SV
WATER HYDRANT	HYD
WATER METER	WM
GAS METER	GM
STATE SURVEY MARK	SSM

DIAL BEFORE YOU DIG www.1100.com.au

TSS TOTAL SURVEYING SOLUTIONS
LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

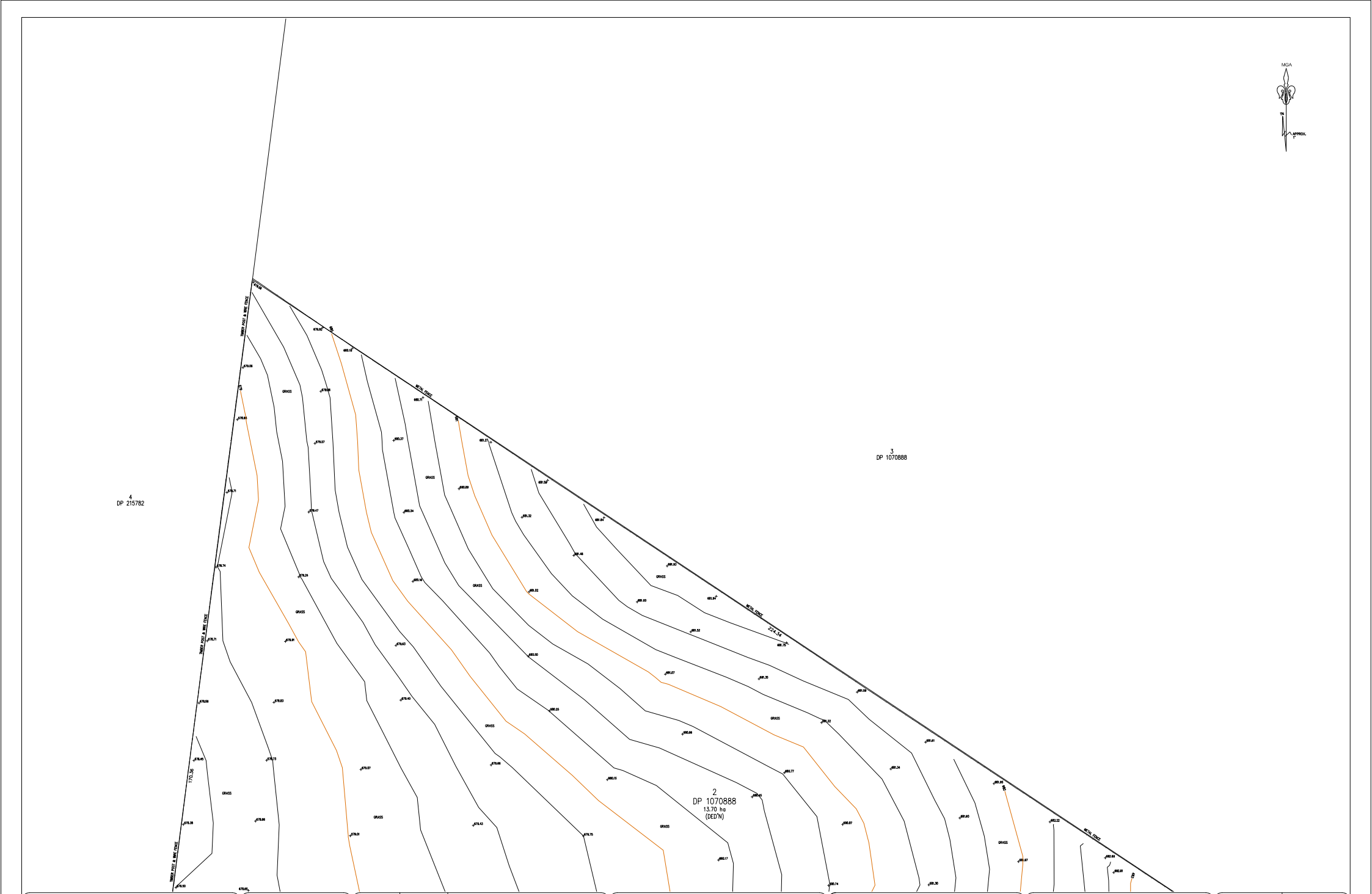
CL - CENTERLINE	RR - ROOF RIDGE
BK - BACK OF KERB	FL - FLOOR LEVEL
LIP - LIP LINE	PA - PARAPET LEVEL
GUT - GUTTER	TOW - TOP OF WALL
AWN - AWNING	TB - TOP OF BANK
TG - TOP OF GUTTER	0.4/10/16 - DIAMETER/SPREAD/HEIGHT

NOT TO SCALE

PLAN SHOWING PARTIAL DETAIL & LEVELS OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT: JACKSON ENVIRONMENT AND PLANNING PTY LTD	
PROJECT: MOSS VALE	
ADDRESS: 2 BOWMAN ROAD, MOSS VALE	

JOB No.: 220698	LGA: WINGECARRIBEE
PLAN No.: 220698-1A	DATUM: AHD
DATE: 16/08/2022	SCALE: NTS @A0
DRAWN: AP	CONT. INTERVAL: 0.25m
CHK: KF	SHEET 1 OF 7



TSS TOTAL SURVEYING SOLUTIONS

LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

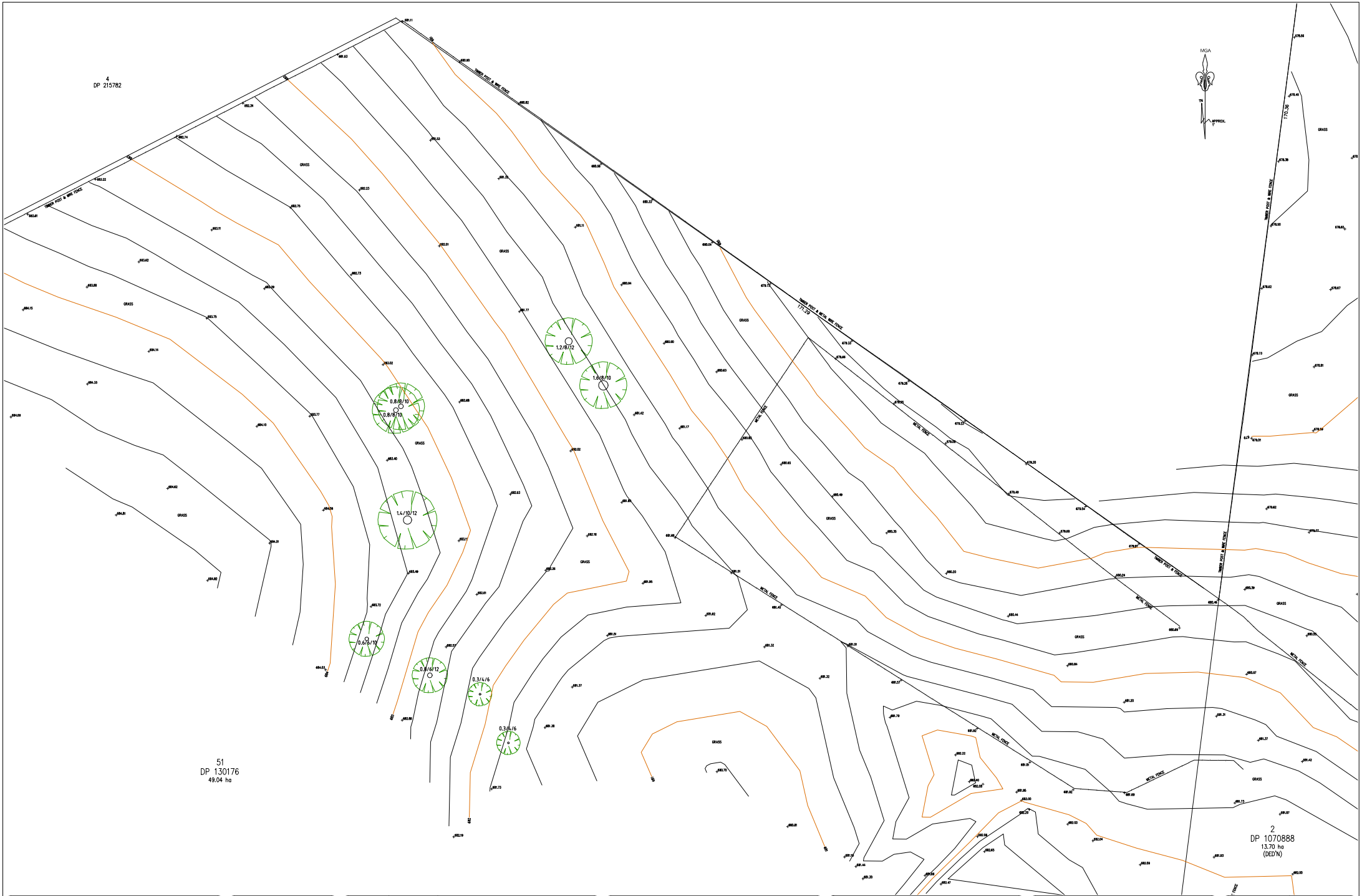
CL - CENTERLINE
BK - BACK OF KERB
LIP - LIP LINE
GUT - GUTTER
AWN - AWNING
TG - TOP OF GUTTER
RR - ROOF RIDGE
FL - FLOOR LEVEL
PA - PARAPET LEVEL
TOW - TOP OF WALL
TB - TOP OF BANK
0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (A0 SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT: JACKSON ENVIRONMENT AND PLANNING PTY LTD
PROJECT: MOSS VALE
ADDRESS: 2 BOWMAN ROAD, MOSS VALE

JOB No.: 220698	LGA: WINGECARRIBEE
PLAN No.: 220698-1A	DATUM: AHD
DATE: 16/08/2022	SCALE: 1:200@A0
DRAWN: AP	CONT. INTERVAL: 0.25m
CHK: KF	SHEET 2 OF 7



TSS TOTAL SURVEYING SOLUTIONS

LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

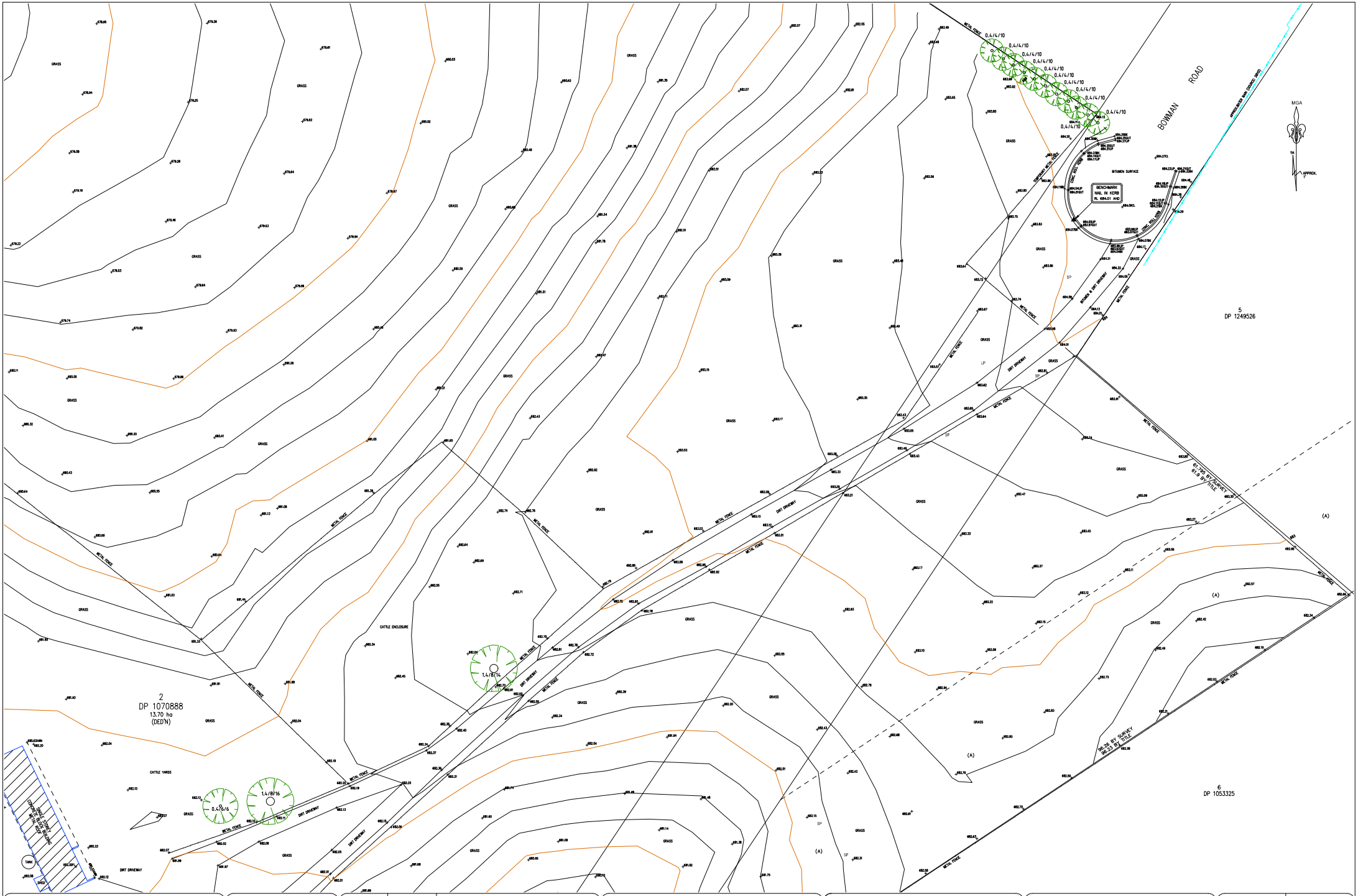
LEGEND:

CL - CENTERLINE
BK - BACK OF KERB
LIP - LIP LINE
GUT - GUTTER
AWN - AWNING
TG - TOP OF GUTTER
RR - ROOF RIDGE
FL - FLOOR LEVEL
PA - PARAPET LEVEL
TOW - TOP OF WALL
TB - TOP OF BANK
0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (A0 SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT:	JACKSON ENVIRONMENT AND PLANNING PTY LTD	JOB No.: 220698	LGA: WINGECARRIBEE
PROJECT:	MOSS VALE	PLAN No.: 220698-1A	DATUM: AHD
ADDRESS:	2 BOWMAN ROAD, MOSS VALE	DATE: 16/08/2022	SCALE: 1:200@A0
		DRAWN: AP	CONT. INTERVAL: 0.25m
		CHK: KF	SHEET 3 OF 7



TSS TOTAL SURVEYING SOLUTIONS

LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

NOTE:
INFORMATION CONTAINED IN THIS PLAN IS THE COPYRIGHT OF TOTAL SURVEYING SOLUTIONS. THE USE OR DUPLICATION WITHOUT THE WRITTEN CONSENT OF TOTAL SURVEYING SOLUTIONS CONSTITUTES AN INFRINGEMENT OF COPYRIGHT.

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

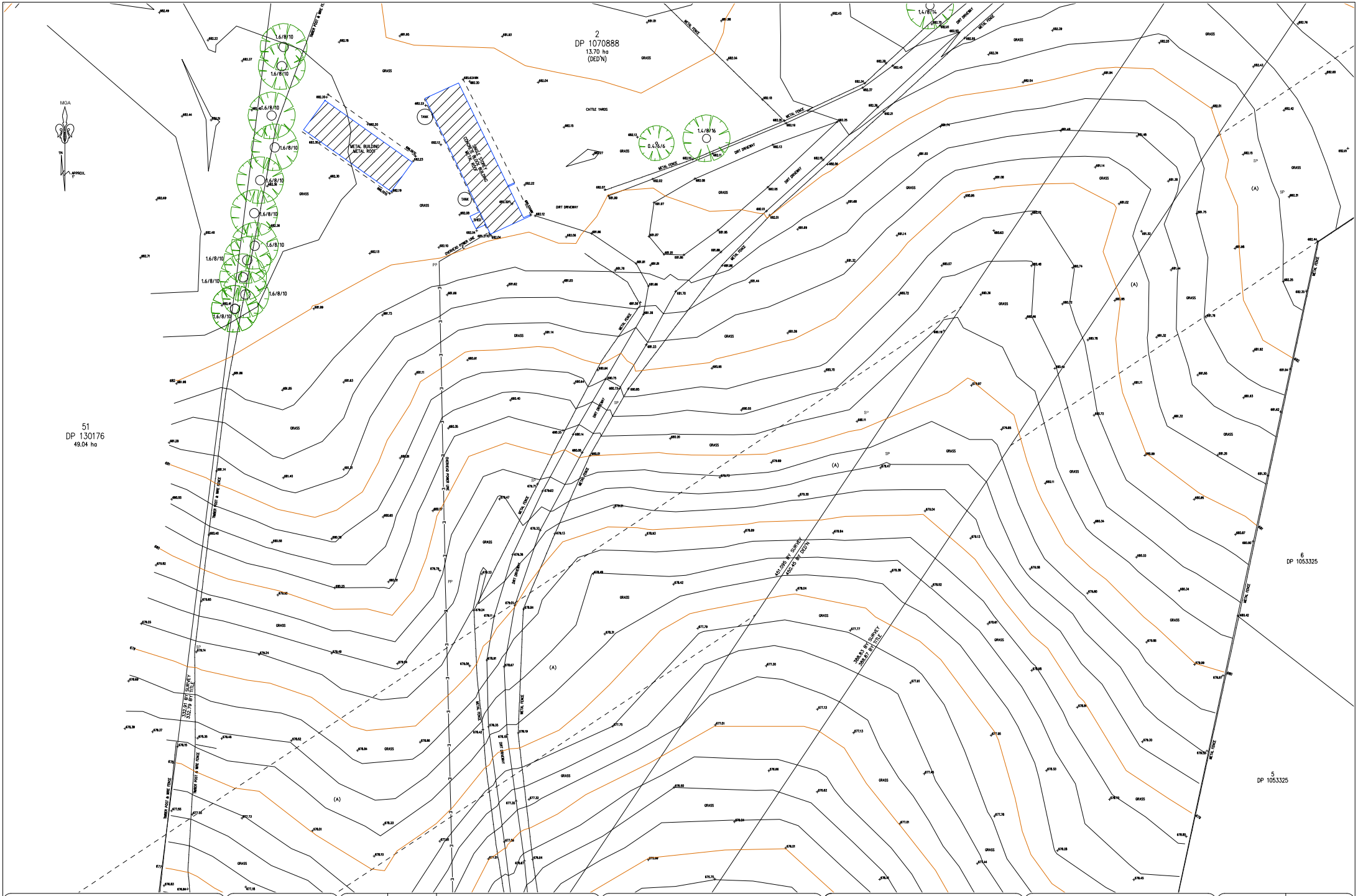
CL - CENTERLINE	RR - ROOF RIDGE
BK - BACK OF KERB	FL - FLOOR LEVEL
LIP - LIP LINE	PA - PARAPET LEVEL
GUT - GUTTER	TOW - TOP OF WALL
AWN - AWNING	TB - TOP OF BANK
TG - TOP OF GUTTER	0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (AO SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS
OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT: JACKSON ENVIRONMENT AND PLANNING PTY LTD
PROJECT: MOSS VALE
ADDRESS: 2 BOWMAN ROAD, MOSS VALE

JOB No.: 220698	LGA: WINGECARRIBEE
PLAN No.: 220698-1A	DATUM: AHD
DATE: 16/08/2022	SCALE: 1:200@A0
DRAWN: AP	CONT. INTERVAL: 0.25m
CHK: KF	SHEET 4 OF 7



TSS TOTAL SURVEYING SOLUTIONS

LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

NOTE:
INFORMATION CONTAINED IN THIS PLAN IS THE COPYRIGHT OF TOTAL SURVEYING SOLUTIONS. THE USE OR DUPLICATION WITHOUT THE WRITTEN CONSENT OF TOTAL SURVEYING SOLUTIONS CONSTITUTES AN INFRINGEMENT OF COPYRIGHT.

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

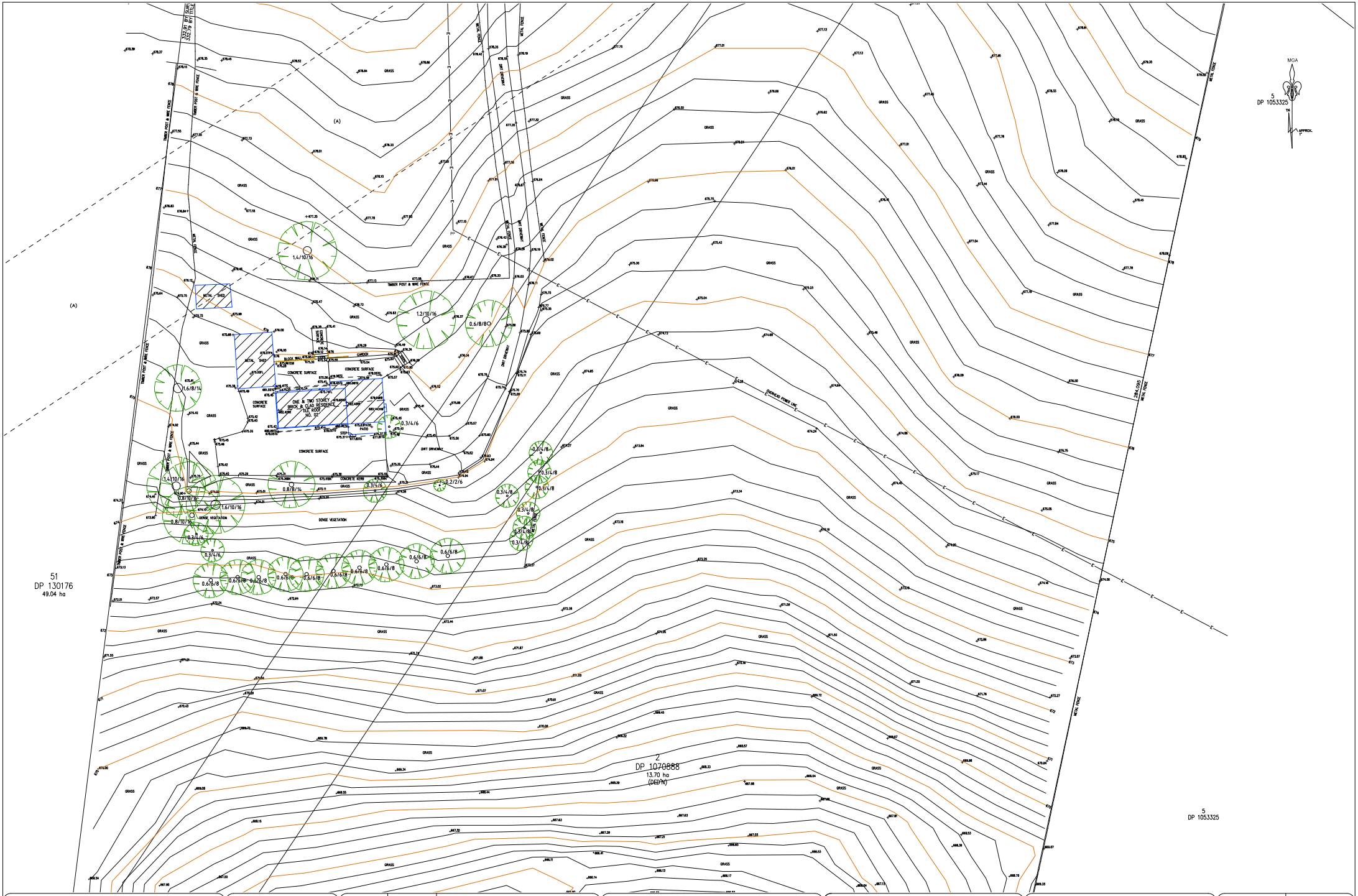
CL - CENTERLINE
BK - BACK OF KERB
LIP - LIP LINE
GUT - GUTTER
AWN - AWNING
TG - TOP OF GUTTER
RR - ROOF RIDGE
FL - FLOOR LEVEL
PA - PARAPET LEVEL
TOW - TOP OF WALL
TB - TOP OF BANK
0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (A0 SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS
OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT: JACKSON ENVIRONMENT AND PLANNING PTY LTD
PROJECT: MOSS VALE
ADDRESS: 2 BOWMAN ROAD, MOSS VALE

JOB No.: 220698	LGA: WINGECARRIBEE
PLAN No.: 220698-1A	DATUM: AHD
DATE: 16/08/2022	SCALE: 1:200@A0
DRAWN: AP	CONT. INTERVAL: 0.25m
CHK: KF	SHEET 5 OF 7



TSS TOTAL SURVEYING SOLUTIONS

LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

NOTE:
INFORMATION CONTAINED IN THIS PLAN IS THE COPYRIGHT OF TOTAL SURVEYING SOLUTIONS. THE USE OR DUPLICATION WITHOUT THE WRITTEN CONSENT OF TOTAL SURVEYING SOLUTIONS CONSTITUTES AN INFRINGEMENT OF COPYRIGHT.

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

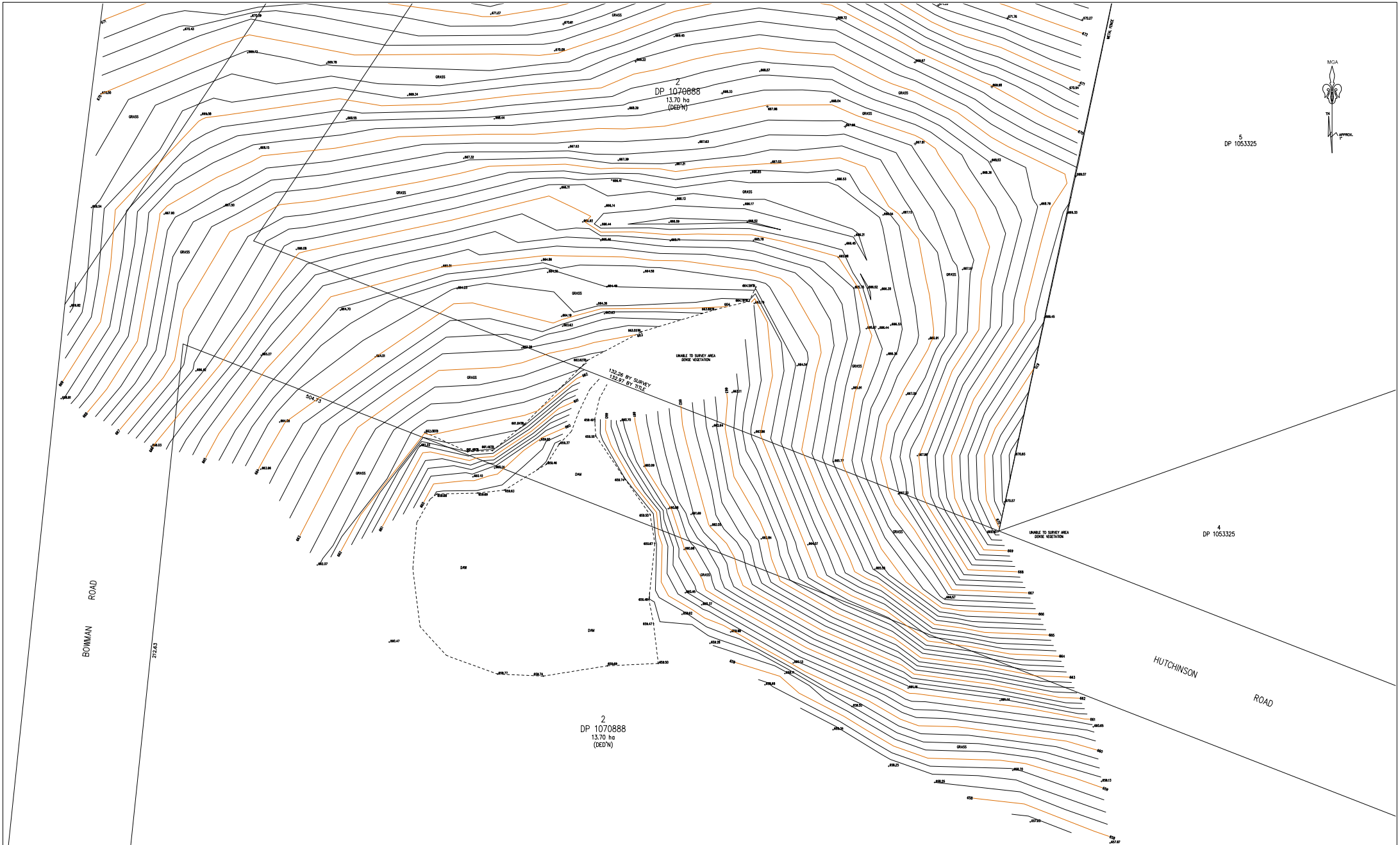
CL - CENTERLINE	RR - ROOF RIDGE
BK - BACK OF KERB	FL - FLOOR LEVEL
LIP - LIP LINE	PA - PARAPET LEVEL
GUT - GUTTER	TOW - TOP OF WALL
AWN - AWNING	TB - TOP OF BANK
TG - TOP OF GUTTER	0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (A0 SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS
OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT: JACKSON ENVIRONMENT AND PLANNING PTY LTD
PROJECT: MOSS VALE
ADDRESS: 2 BOWMAN ROAD, MOSS VALE

JOB No.: 220698	LGA: WINGECARRIBEE
PLAN No.: 220698-1A	DATUM: AHD
DATE: 16/08/2022	SCALE: 1:200@A0
DRAWN: AP	CONT. INTERVAL: 0.25m
CHK: KF	SHEET 6 OF 7



TSS TOTAL SURVEYING SOLUTIONS
LANE COVE | CAMDEN | MANLY VALE | CENTRAL COAST

REVISION No.	REVISION DATE:	COMMENT:
220698-1	16/08/2022	DETAIL & CONTOUR SURVEY
220698-1A	20/09/2022	EXTRA DETAIL

LEGEND:

CL - CENTERLINE	RR - ROOF RIDGE
BK - BACK OF KERB	FL - FLOOR LEVEL
LIP - LIP LINE	PA - PARAPET LEVEL
GUT - GUTTER	TOW - TOP OF WAL
AWN - AWNING	TB - TOP OF BANK
TG - TOP OF GUTTER	0.4/10/16 - DIAMETER/SPREAD/HEIGHT

BAR SCALE
0 2 4 6 8 10 20m
PLOTTED SCALE 1:200 (A0 SIZE SHEET)

PLAN SHOWING DETAIL & LEVELS
OVER LOT 2 IN DP1070888 & LOT 51 IN DP130176

CLIENT:	JACKSON ENVIRONMENT AND PLANNING PTY LTD	JOB No.: 220698	LGA: WINGECARRIBEE
PROJECT:	MOSS VALE	PLAN No.: 220698-1A	DATUM: AHD
ADDRESS:	2 BOWMAN ROAD, MOSS VALE	DATE: 16/08/2022	SCALE: 1:200@A0
		DRAWN: AP	CONT. INTERVAL: 0.25m
		CHK: KF	SHEET 7 OF 7

Appendix B – Whites Creek Catchment (Whites Creek Flood Study)

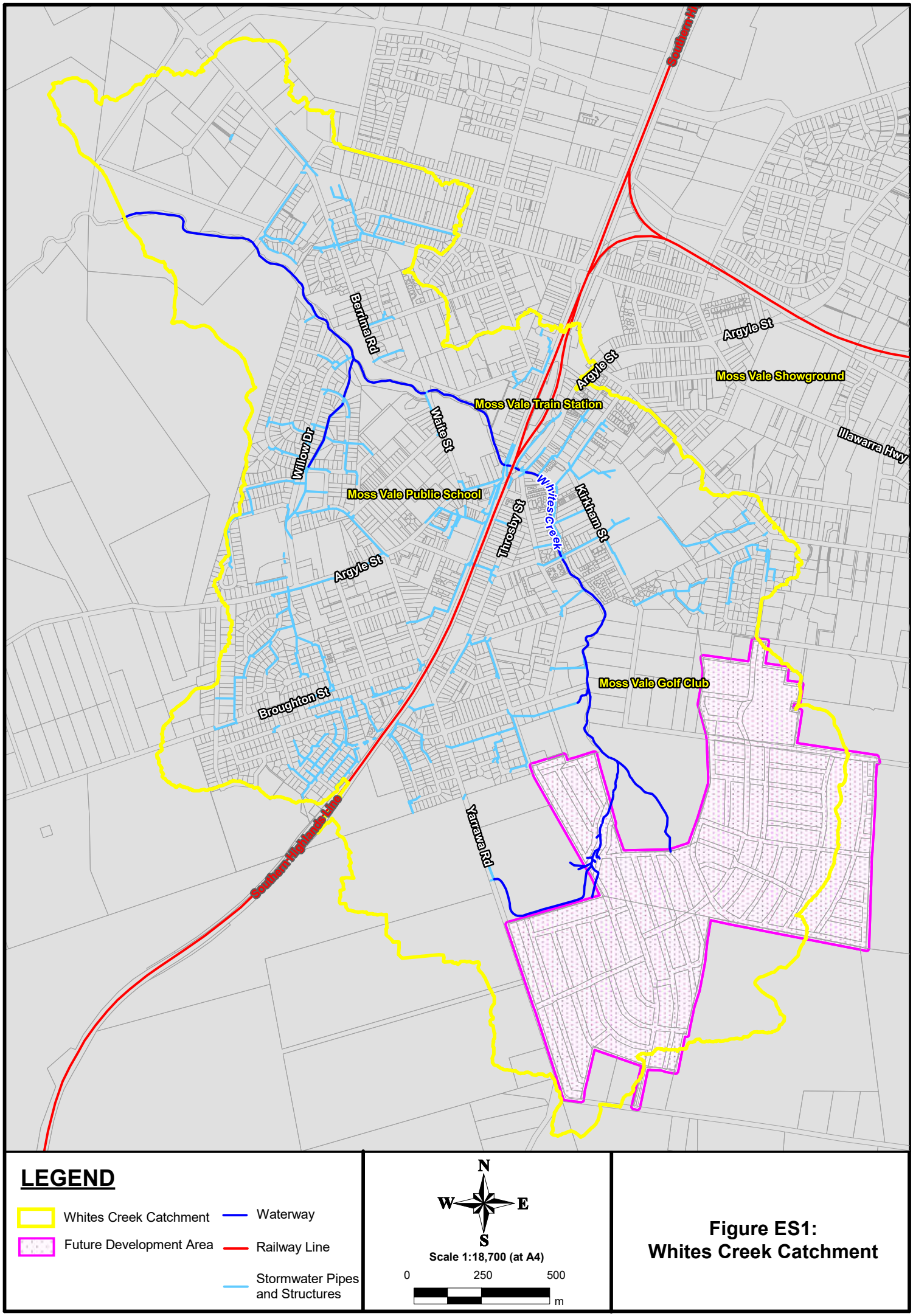
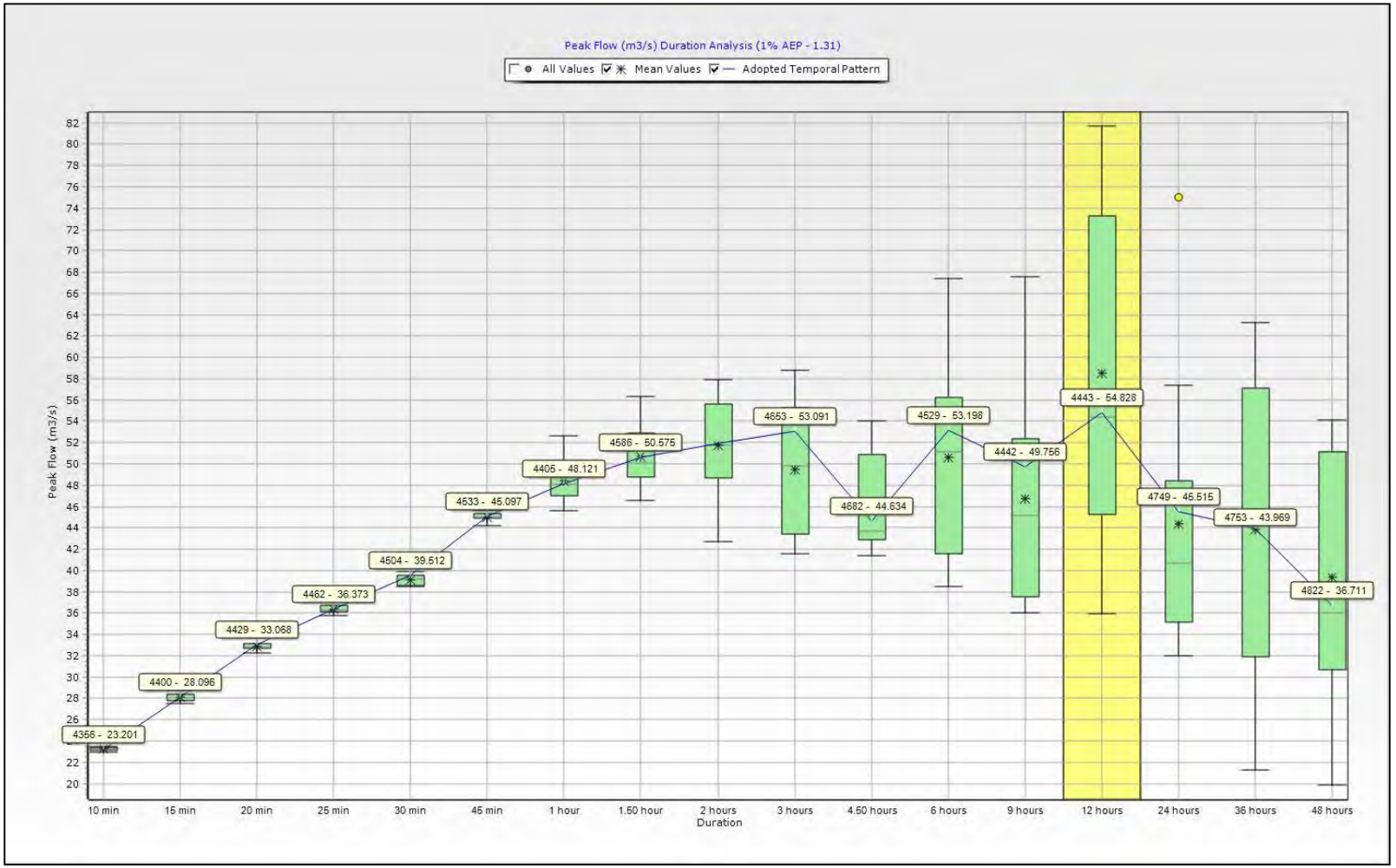


Figure ES1:
Whites Creek Catchment

Appendix C – Moss Vale Sewage Treatment Plan 1% AEP Stream Flows

ARR2016 Box Plots at Focus Locations for Whites Creek 1% AEP Design Event

Moss Vale Sewage Treatment Plant



Appendix D – Wingecarribee Local Environment Plan 2010 Natural Resources Sensitivity Map

Wingecarribee Local Environmental Plan 2010

Natural Resources Sensitivity Map - Sheet NRS_007

Riparian Land

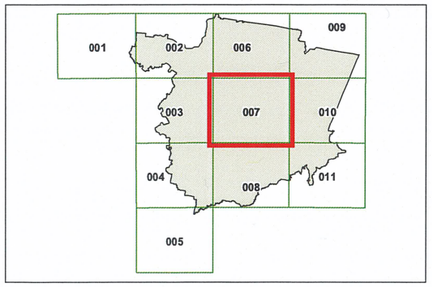
- Category 1 - Environmental Corridor
  (within 50 metres from the top of stream bank on each side)
- Category 2 - Aquatic & Terrestrial Habitat
  (within 30 metres from the top of stream bank on each side)
- Category 3 - Bank Stability & Water Quality
  (within 10 metres from the top of stream bank on each side)

Natural Waterbodies

Regional Wildlife Habitat Corridor

Cadastre

Cadastre 04/11/11 © Land and Property Information (LPI)



N
W E
S

0 750 1,500 2,250 3,000
Metres

Projection: MGA (GDA94) Zone 56

Scale 1:80,000 @ A3

Map identification number:

8350_COM_NRS_007_080_20120123