



REPORT

# Updated Narara Creek Flood Study

*GOSFORD CITY COUNCIL*

Submitted to:

**Gosford City Council**

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Submitted by:

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## Record of Issue

VERSION	CLIENT CONTACT	COMPANY	METHOD OF DELIVERY	DATE
REV G	Robert Baker	Central Coast Council	Email	6/07/2018

It is the responsibility of the reader to verify the currency of the version number of this report. All subsequent releases will be made directly to the client.

## Record of Review

VERSION	AUTHORS	AUTHORS	REVIEWER	APPROVED BY	DATE
Rev G	Nigel Moon	Muhammad Parker	Scott Creighton	Scott Creighton	6/07/2018
<b>Title</b>	Senior Water Resources Engineer	Water Resources Engineer	<b>Principal Water Resources Engineer</b>	Principal Water Resources Engineer	
<b>Signatures</b>					

## Limitations

Your attention is drawn to the document - "Limitations", which is included in APPENDIX I of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the services provided for this project. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

## Executive Summary

Existing Council flood studies (Existing Studies) of each of the major sub-catchments of Narara Creek are now more than 15 years old and needed to be reviewed and updated. Council has undertaken a comprehensive review and update to the flood studies and this report presents the results. This Updated Narara Creek Flood Study report (The Updated Flood Study) presents a revision to the previously published 2012 flood study providing updates to the catchment geometry and hydrology.

The Updated Flood Study consisted of construction of a new model of the whole of the Narara Creek catchment and was calibrated to historical events that occurred in February 1990, February 1992 and in June 2007.

Following calibration, the Updated Flood Study model was used to derive flood extents, depths, velocities, flow distribution, provisional flood hazard and hydraulic categories for various design flood events (from 50% AEP (2 y event) through the 1% AEP (100 y event) up to Probable Maximum Flood (PMF)). Note that AEP means Annual Exceedance Probability.

The results of Updated Flood Study have been presented in map and in long-section based on the maximum of a range of storm durations. The sensitivity of model results to changes in model inputs is also presented, including the potential impact of climate change.

An innovation in this Updated Flood Study compared to Existing Studies has been the construction of a model that encompasses the whole of the Narara Creek catchment, rather than discretisation of the catchment into individual tributaries. Accordingly, the whole model is time-varying, rather than some components being steady state. This provided the opportunity for interaction of the timing of flood peaks from various sub-catchments to be considered. e.g. in the vicinity of the model railway where there is confluence of Wyoming, Wingello and Bradys Gully with Narara Creek.

The Updated Flood Study modelling indicates that flood mitigation measures implemented in the recent past, such as the works at the confluence of Wyoming Creek, Wingello Creek and Bradys Gully with Narara Creek, have been effective in transmitting peak flood flow from these tributaries prior to arrival of peak flood flow from Narara Creek itself. This has led to an overall reduction in modelled flood height at that location.

Figure ES1 presents the 1% AEP modelled flood depth and flood height together with Council's existing 1% AEP flood extent. The 1% AEP event is currently Council's Flood Planning Level. Figure ES2 presents the results for the PMF. Figure ES3 presents the 1% AEP event provisional flood hazard together with Council's existing 1% AEP event flood extent. Figure ES4 presents the provisional flood hazard for the PMF.

### FLOOD STUDY SENSITIVITY TO CLIMATE CHANGE AND RAINFALL INTENSITY

Sensitivity analysis indicates model results (1% AEP, 9 h event only) are quite sensitive to climate change scenarios incorporating increased rainfall intensity. A 30% increase in rainfall intensity leads to a 40 to 50 cm increase in flood height at Showground Road, as an example. Modelling indicates that sea level rise, on its own, does not result in significant additional flooding in Narara Creek upstream of the Golf Course. The combination of sea level rise and increased rainfall intensity, however, leads to a 60 cm increase in flood height at Showground Road and a 30 to 50 cm increase upstream of Manns Road Bridge.

The sensitivity of flood levels in the Narara Creek catchment to increased rainfall intensity is due to its "fan-type" catchment layout. i.e. there are several tributaries with stream lengths that are similar, which leads to flood peaks arriving at their confluence with Narara Creek at a similar time. It is for this reason that the modelled flood height of the PMF is significantly above the 1% AEP event, since the PMF "thundercell", as applied to this catchment, is centred on Manns Road Bridge.

## COMPARISON OF THE UPDATED FLOOD STUDY RESULTS TO EXISTING STUDIES

From Figure ES1, results from the Update Flood Study model for Narara Creek, for the 1% AEP event, are consistent with Council's Existing Studies flood extent for this event. A detailed comparative analysis has been completed and is presented below. The results for the PMF event, presented in Figure ES2, are new results.

Updated Flood Study model results supersede Existing Studies results due to:

- updated geometry
- integrated model approach rather than separate models
- transient flow modelling rather than some components being in steady state
- Incorporation of new flood management options such as Brookes Avenue detention basin, channel modification/naturalisation programs (Bradys Gully, Wyoming Creek, and Wingello Creek) and upgrades to culverts at various locations that have been implemented since the previous studies were undertaken.

The results from Existing Studies have been extracted and are presented in long-section together with the new model results for 1% AEP, 5% AEP and 20% AEP design flood events. Detailed comments are provided with respect to each tributary separately. It is noted that flood levels for the full set of design flood events (50% AEP through to PMF) are presented in the main body of the report.

### Lower Narara Creek

Figure ES5 presents the Updated Flood Study design flood level in long-section together with results from the Existing Studies.

From Figure ES5, the Updated Flood Study flood level at the outlet of Narara Creek is higher than Existing Studies modelling due to improved definition of hydraulic gradient. In the Existing Studies, the fixed level at the railway crossing reduced the outlet hydraulic gradient unrealistically.

Existing Studies modelling adopted a fixed level in Fagans Bay at the railway crossing. These levels were 1.95 mAHD (1% AEP), 1.7 mAHD (5% AEP) and 1.5 mAHD (20% AEP). In the Updated Flood Study, the downstream boundary condition was set at 0.72 mAHD in Brisbane Water opposite Point Frederick. The downstream boundary level used in this study was derived from the Brisbane Water Foreshore Flood Study and is the 1% PoE (Probability of Exceedance).

Upstream of Manns Road bridge to Deane St, improved definition of the floodway leads to a lower flood level in the Updated Flood Study model compared to the Existing Studies, together with flood mitigation works at the confluence of Narara Creek and Bradys Gully, Wingello Creek and Wyoming Creek. By way of example, in the Existing Studies flood model there is only one (1) model node at Manns Road and one model node at Carrington St.

### Upper Narara Creek

Figure ES5 also presents the Updated Flood Study model results for Upper Narara Creek.

From Figure ES5, there is generally reasonable agreement between the Updated Flood Study model results compared to the results from the Existing Studies.

The flood modelling undertaken in the Existing Studies, conducted by Kinhill in 1993 and updated by Patterson Britton in 1995, assumed a 75% blockage of Narara Valley Drive. Channel improvement works have been undertaken along Koninderie Parade since that study; however, the Updated Flood Study modelled flood levels are still higher than the previous modelled levels.

Review of the calibration of the Existing Studies flood model (Kinhill, 1993) to the February 1992 event suggests one of the calibration marks may be suspect. The 9.82 mAHD data point is a creek-bank debris mark and is inconsistent with another mark just upstream at 10.68 mAHD, derived from a debris-mark on a building.

Calibration of the Updated Flood Study model to the June 2007 event is very well matched; therefore the difference is attributed to the update of the calibration of the model in that location.

It is noted that no blockage was assumed for the Narara Valley Drive culvert in the Updated Flood Study model since blockage prevention devices are installed at this location. The impact of potential blockage; however, has been assessed in this study within sensitivity analysis.

### **Bradys Gully**

Figure ES6 presents Updated Flood Study design flood level in long-section together with results from the Existing Studies .

From Figure ES6, the upgrade of culverts and channel improvement works at Henry Parry Drive have led to a lower design flood level at that location compared to Existing Studies results.

There is a discrepancy between Existing Studies modelled flood levels and Updated Flood Study flood levels between Bradys Gullys Road and Henry Parry Drive. Whilst there have been channel improvement works downstream of Bradys Gully Road, the explanation of the difference is likely to be due to the software code utilised at that time.

The Existing Studies flood modelling was undertaken using HEC-2 by Kinhill in 1991. HEC-2 is a solution to the 1D steady, gradually varied flow equation. As such, HEC-2 is not capable of modelling mixed flow regimes. This is important where there is a transition from super-critical to sub-critical flow and vice-versa. A sub-critical flow regime results in deep slow-moving flow whereas a super-critical flow regime results in shallow fast-moving flow.

Review of the calibration of the 7 February 1990 event in the Updated Flood Study model indicates good agreement with historical observation. Accordingly, the difference between the Existing Studies flood levels and the Updated Flood Study flood levels is attributed to the update of the capability of the software.

Upstream of Bradys Gully Road, the Updated Flood Study flood levels are higher than Existing Studies modelled flood levels due to improved definition of the floodway. In the Existing Studies model, there were only four (4) model nodes upstream of Bradys Gully Road. Accordingly, the Existing Studies results are likely not particularly accurate. As a point of reference, the Updated Flood Study model has 13 model nodes as well as the floodplain being defined in 2D at that location.

### **Wingello Creek**

Figure ES7 presents the Updated Flood Study flood level in long-section together with results from the Existing Studies.

From Figure ES7, there is generally good agreement between Updated Flood Study design flood levels and the results from the Existing Studies. Upgrade of the culverts and channel at the Pacific Highway has led to a lower design flood level at that location compared to Existing Studies results.

Upstream of Pecan Close detention basin, improved model definition has led to a lower design flood level at that location compared to Existing Studies model results. In the Existing Studies model, undertaken in HEC-2, the detention basin was represented in 1D whereas the detention basin is included in the Updated Flood Study model dynamically and in 2D. Comparison of the Existing Studies model results upstream of the

Rainforest Road culvert to the Updated Flood Study model results suggests insufficient channel definition in the previous model in that location.

Review of the calibration of the new model to the 7 February 1990 event indicates very good agreement with historical observation.

### **Wyoming Creek**

Figure ES8 presents the Updated Flood Study design flood level in long-section together with results from the Existing Studies.

From Figure ES8, there is generally good agreement between new flood levels and the results from the Existing Studies upstream of the Day St culvert.

The difference in flood level at the Day St culvert is due to the blockage assumption at the culvert itself, as well as the sub-critical flow regime assumption downstream of this culvert. It is noted that a blockage prevention device has since been installed at the Day St culvert.

Downstream of the Day St culvert, the difference in flood level is attributed to the sub-critical flow regime assumption adopted in the previous HEC-2 modelling. A sub-critical flow regime results in deep slow-moving flow whereas a super-critical flow regime results in shallow fast-moving flow. The transition between these flow regimes is dependent on the slope of the channel and the slope of the water surface profile.

Kinhill (1991) explain that during calibration of the HEC-2 model to the 7 February 1990 event it was necessary to make this assumption in order to emulate the impact of the observed blockage by debris during that event.

The Updated Flood Study model considers a mixed flow regime as well as blockage via a reduction in conveyance, thereby allowing transition from sub-critical to super-critical at that location. Review of the calibration of the Updated Flood Study model to the 7 February 1990 event indicates very good agreement with historical observation.

### **West Narara Creek**

Figure ES9 presents the Updated Flood Study design flood level in long-section together with results from the Existing Studies.

From Figure ES9, there is generally good agreement between new flood levels and the results from the Existing Studies.

There is a minor difference immediately upstream of Hanlan St South culvert; however, this is attributed to the upgrade of the Hanlan St South culvert and causeway.

### **Fountain Creek**

Figure ES10 presents the Updated Flood Study design flood level, in long-section, together with the results from the Existing Studies.

From Figure ES10, there are two areas of difference between the Updated Flood Study model results and the results from the Existing Studies as presented in Kinhill 1997. Upstream of the Reeves St Causeway, the Updated Flood Study model results are lower than the Existing Studies results. Review of the calibration of the Updated Flood Study model to the February 1992 event and the June 2007 event indicates reasonable agreement.

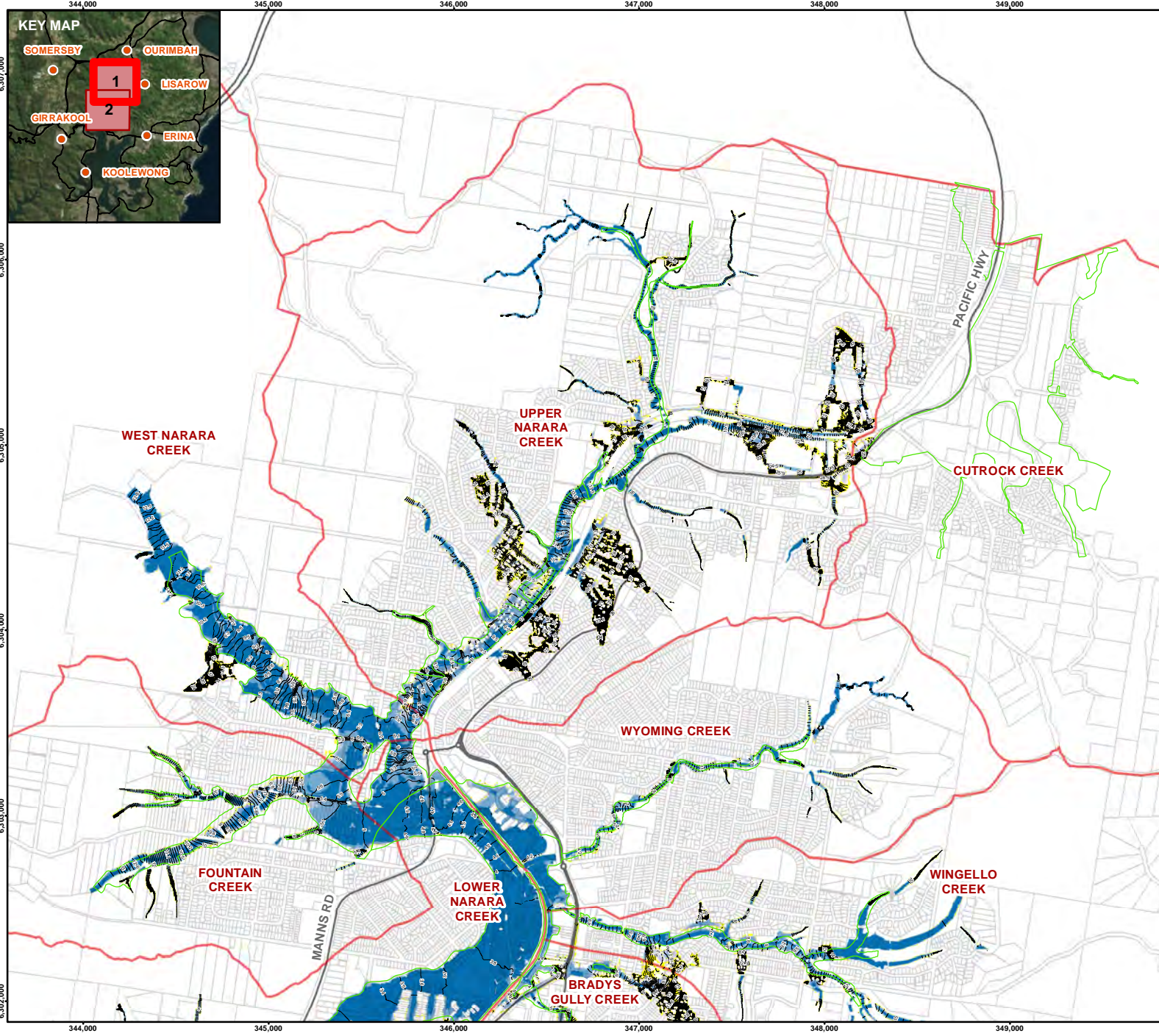
The Existing Studies modelling of Fountain Creek was undertaken using HEC-2. As identified in the discussion of the comparison of results for Bradys Gully, Wyoming and Wingello Creek, model results using

HEC-2 can be affected because of the assumption of either super-critical or sub-critical flow. Generally the maximum level from either flow regime is considered and reported, however, the Updated Flood Study model allows transition between either flow regime within the one simulation.

This is likely to be the explanation of the difference in model results at this location due to the complex interaction between the causeway (over-topping, weir flow) and the private timber bridge immediately downstream (backwater effect). Model results in the Existing Studies HEC-2 model relative to the new model in this location may also be somewhat inaccurate due to the limited number of model nodes upstream and downstream of the causeway.

Between the Reeves St causeway and the Carrington St culvert, a residential driveway access (small pipe culvert) was identified by Kinhill (1997) as significantly impacting design flood levels. This culvert has subsequently been removed. Review of previous model results suggests a sub-critical flow regime was assumed upstream of that access point. This may have affected the model results at that location. Review of the calibration of the Updated Flood Study model to the February 1992 event at that location indicates reasonable agreement.

From Figure ES1, there is also a difference in flood extent between Council's current 1% AEP extent and the results from the Existing Studies, downstream of the Reeves St causeway. Based on the drawing in Kinhill (1997), Council's 1% AEP extent appears to have been overestimated compared to model results presented by Kinhill. Council's current 1% AEP extent appears to have been drawn to the end of cross-section, CS9.7, as an example, which terminates at an elevation of 10 mAHD; whereas the model result presented in Kinhill is actually 8.5 mAHD. This discrepancy explains the observable difference between the updated flood extents compared to Council's current extent in this area.



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary
- Council's Current 1% AEP Flood Extent

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- 0.1 m Contours

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 1% AEP EVENT**

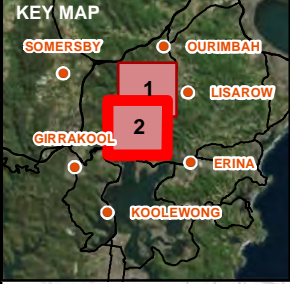
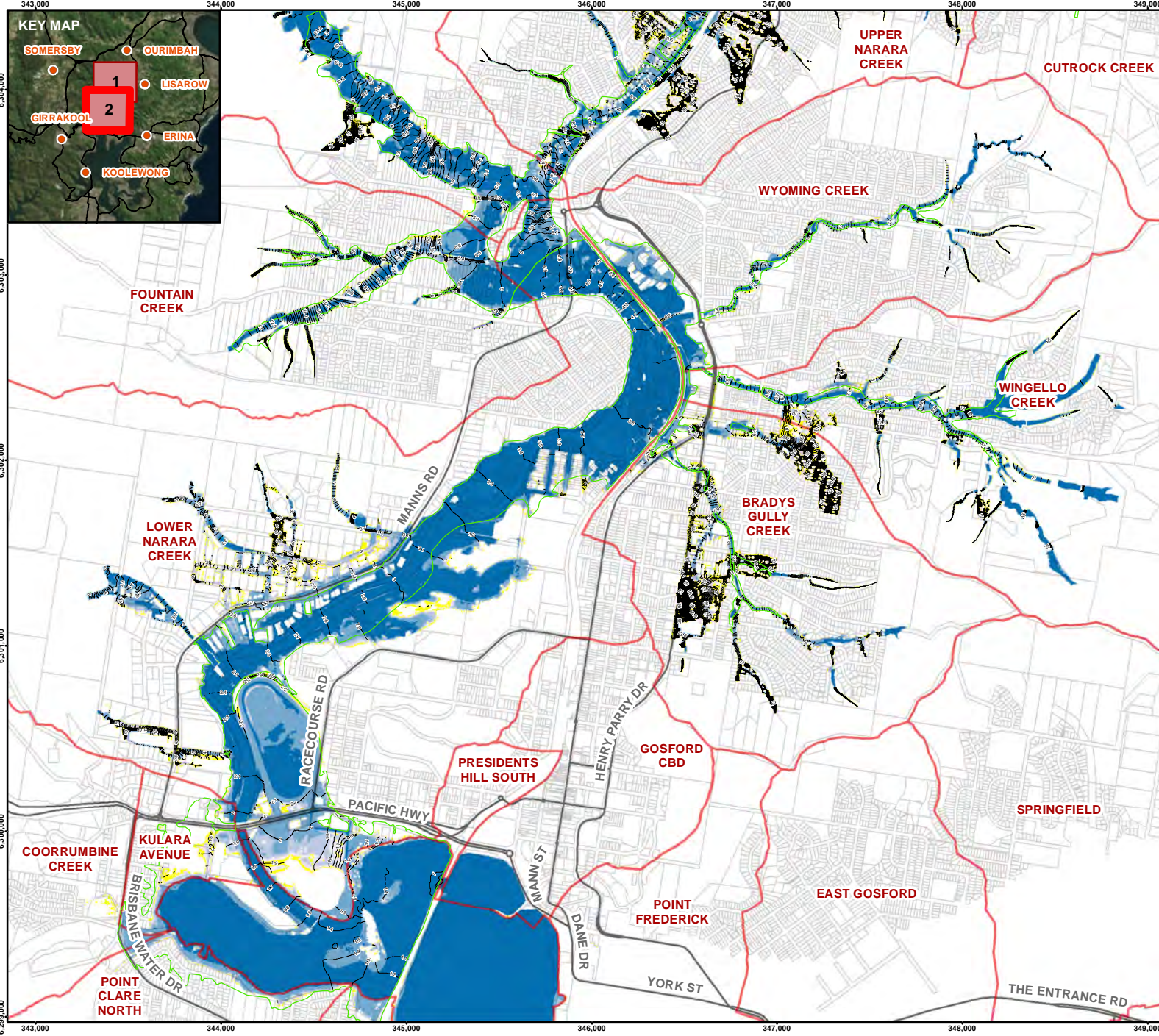
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DD/MM/YYYY	27/06/2018
DESIGNED	JZ
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
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**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary
- Council's Current 1% AEP Flood Extent

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

N  
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Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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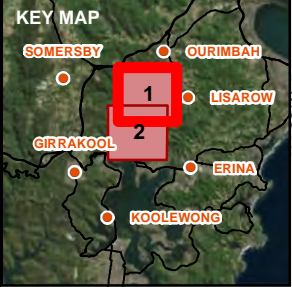
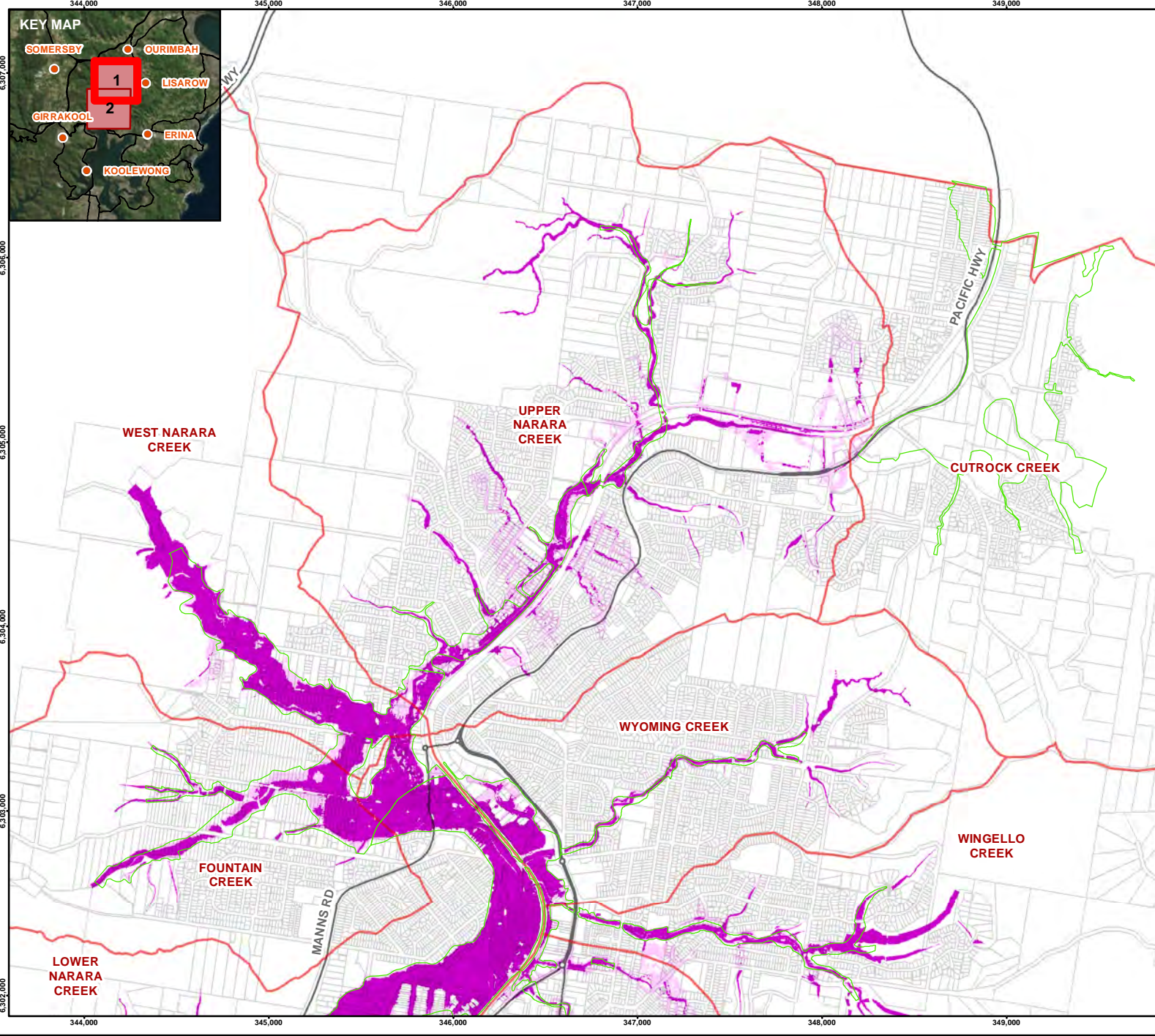
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PREPARED	HB
REVIEWED	NM
APPROVED	NM

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**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Council's Current 1% AEP Flood Extent

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

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Coordinate System: GDA 1994 MGA Zone 56  
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TITLE  
**PROVISIONAL FLOOD HAZARD 1% AEP EVENT**

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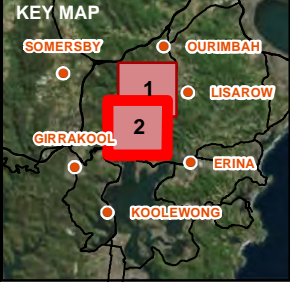
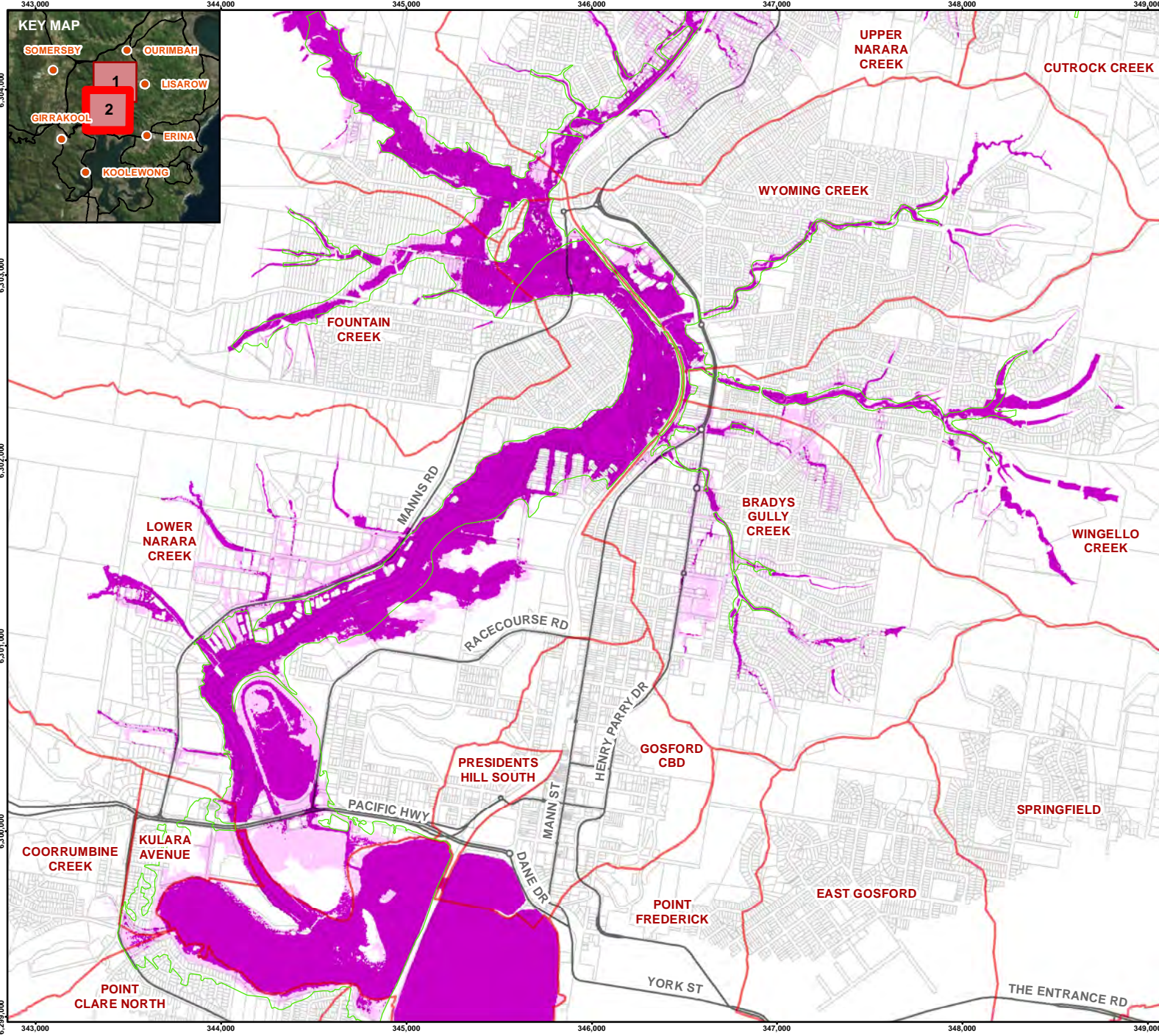
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APPROVED NM

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**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Council's Current 1% AEP Flood Extent

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

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1:30,000 @A4 METRES

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Projection: Transverse Mercator  
Datum: GDA 1994

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**PROVISIONAL FLOOD HAZARD 1% AEP EVENT**

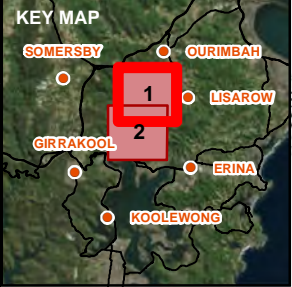
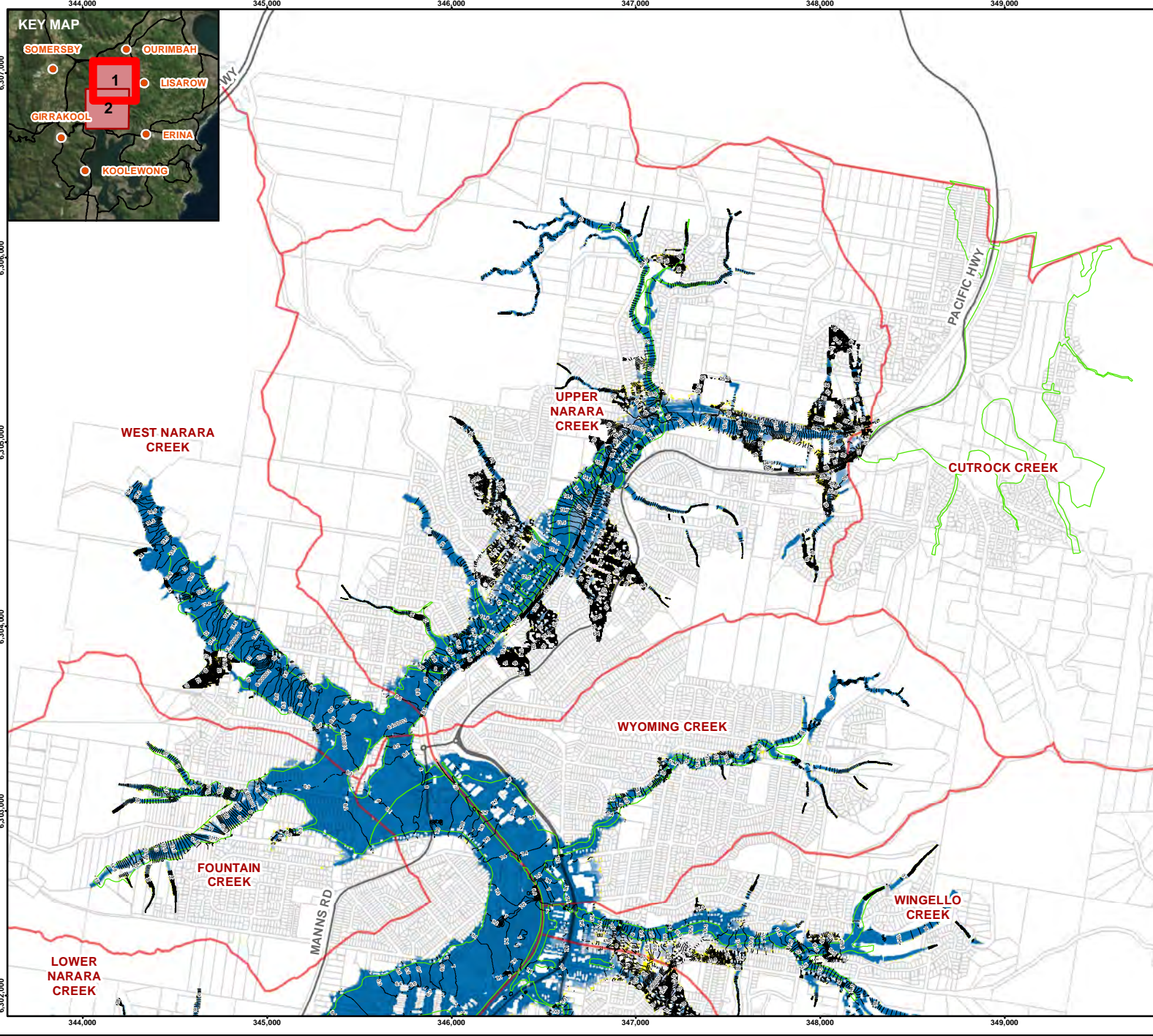
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**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary
- Council's Current 1% AEP Flood Extent

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- 0.1 m Contours

Coordinate System: GDA 1994 MGA Zone 56  
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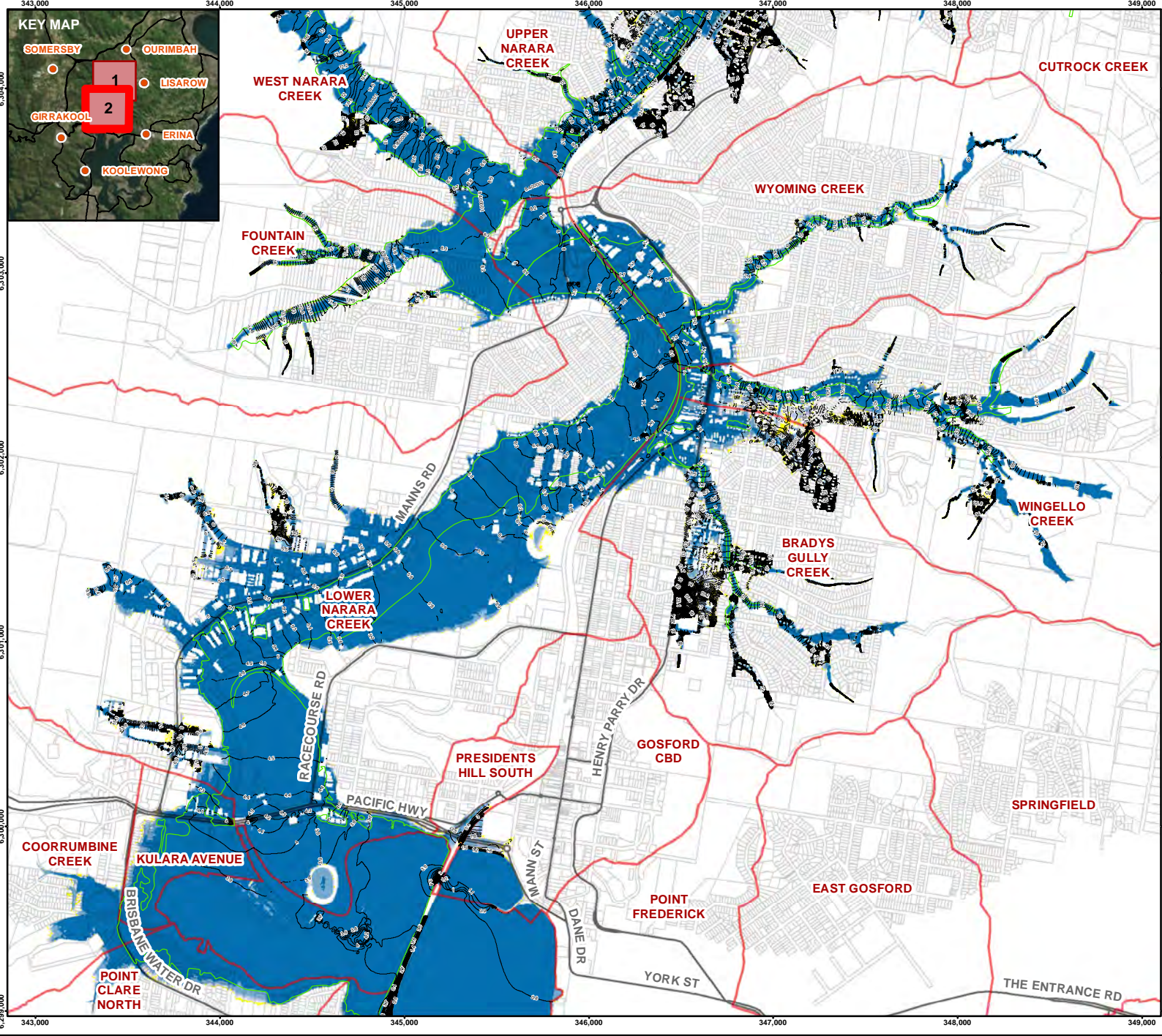
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT PMF EVENT**

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APPROVED	NM

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097626068	006	G	ES3-A

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**Legend**

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- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Council's Current 1% AEP Flood Extent

**Flood Depth (cm)**

Yellow	< 10 cm
Light Blue	10 to 20 cm
Medium Blue	20 to 40 cm
Dark Blue	40 cm to 1 m
Very Dark Blue	> 1 m

N

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Coordinate System: GDA 1994 MGA Zone 56  
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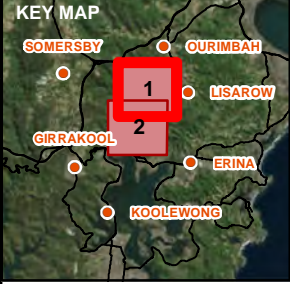
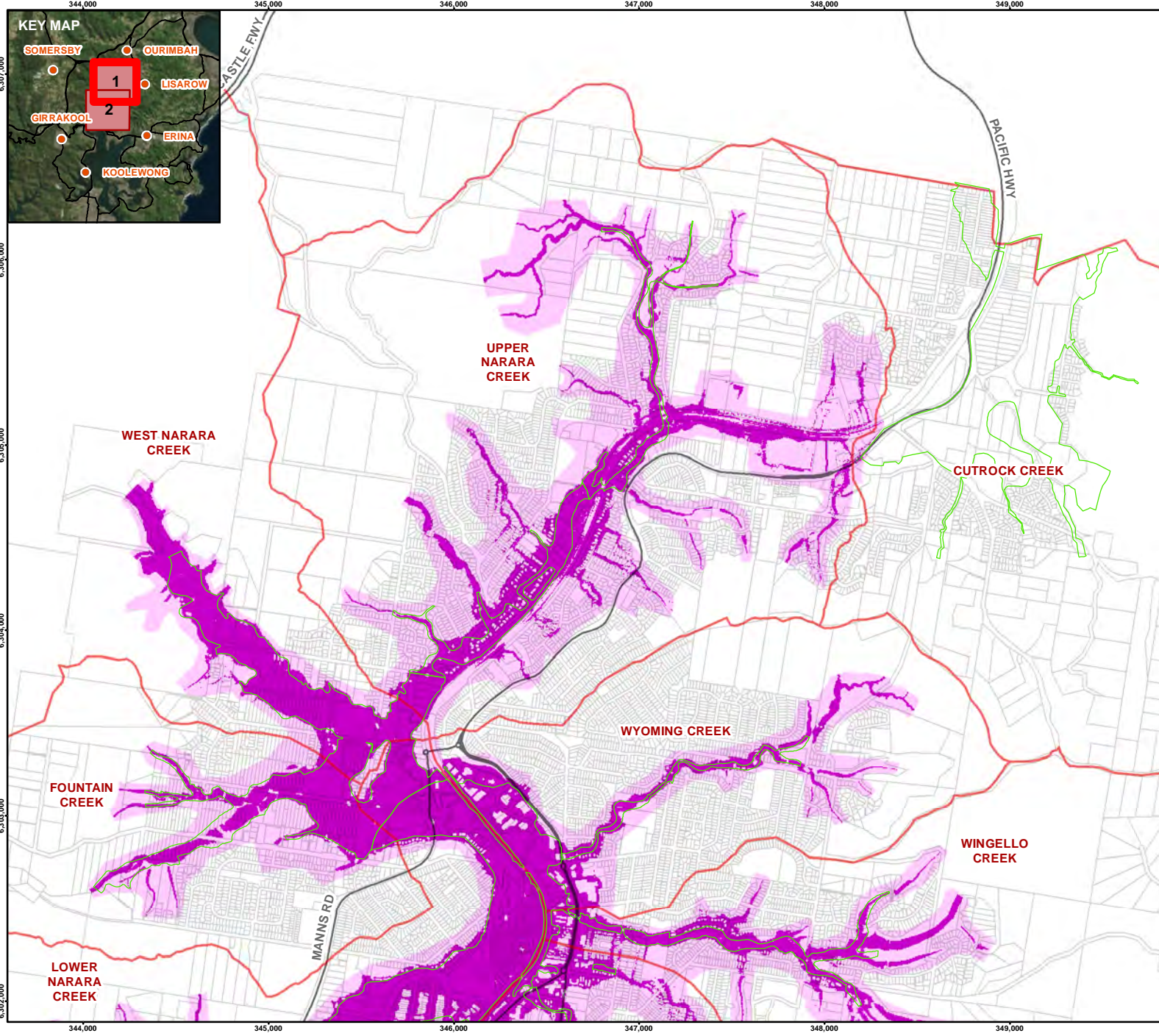
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**PEAK FLOOD DEPTH AND FLOOD HEIGHT PMF EVENT**

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**Provisional Flood Hazard**

- Low Hazard
- High Hazard

N  
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TITLE  
**PROVISIONAL FLOOD HAZARD PMF EVENT**

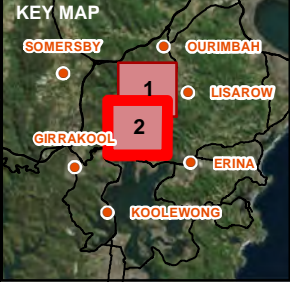
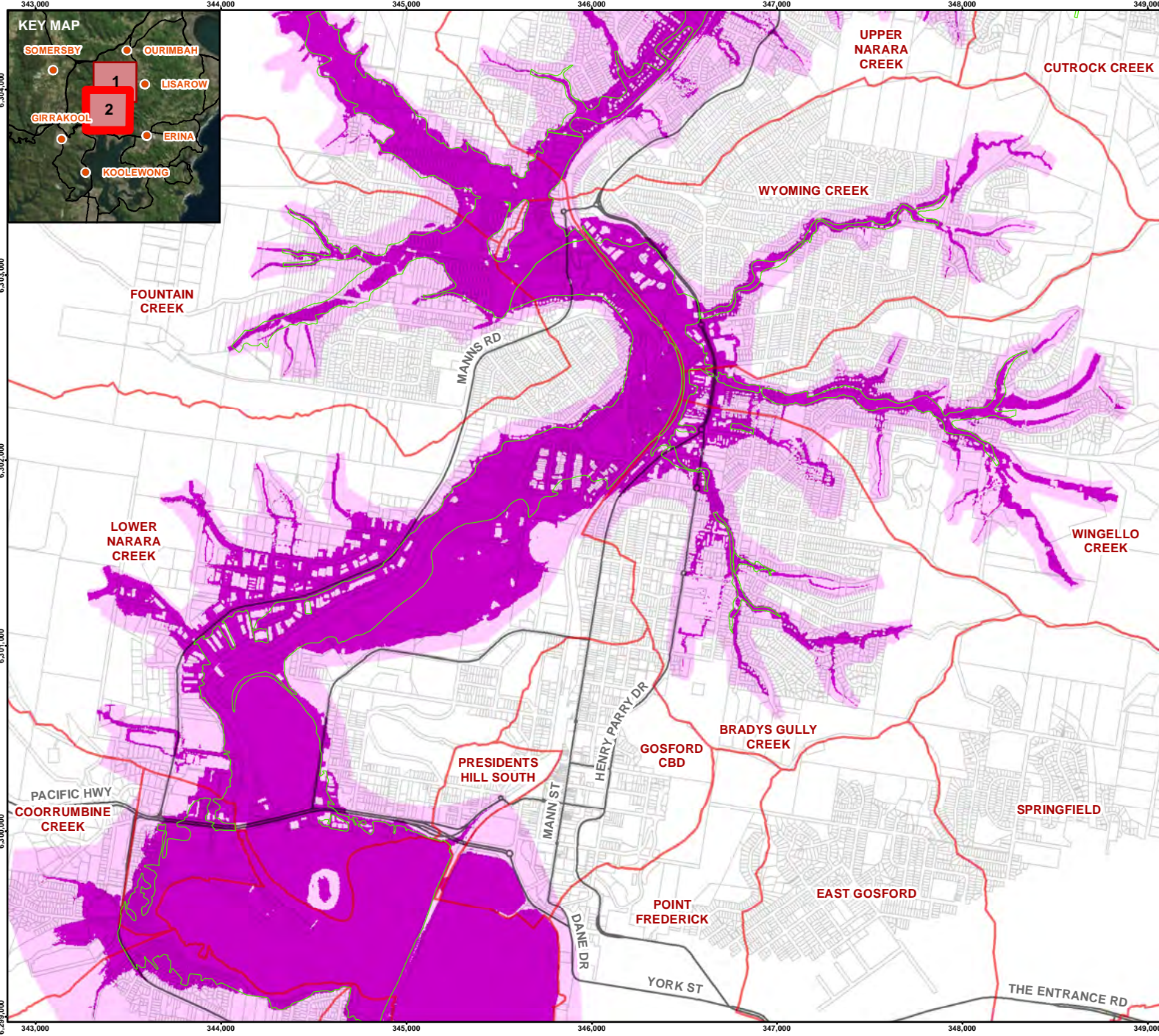
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APPROVED	NM

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- ▭ Cadastral Boundary
- ▭ Council's Current 1% AEP Flood Extent

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

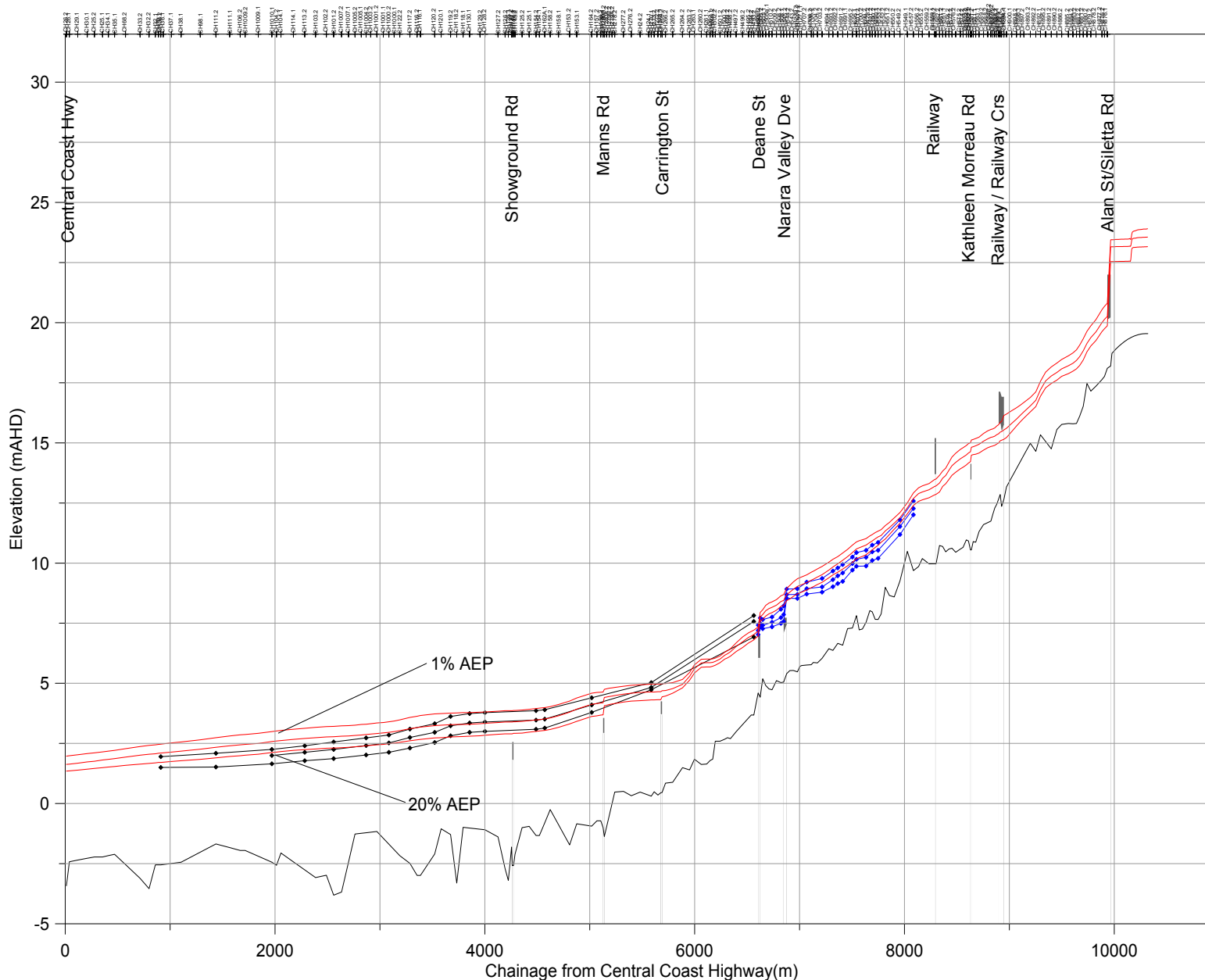
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**PROVISIONAL FLOOD HAZARD PMF EVENT**

CONSULTANT

DD-MM-YYYY	27/06/2018
DESIGNED	JZ
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	ES4-B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



### Legend

Modelled Flood Height (mAHd):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Kinhill 1993) (mAHd):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Patt. Brit. 1995) (mAHd):

- 1% AEP
- 5% AEP
- 20% AEP

Model Geometry:

- Bridge Deck/Culvert
- Creek-Bed

**NOTE(S)**  
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PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**

CONSULTANT



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PREPARED PÓ

REVIEWED NM

APPROVED NM

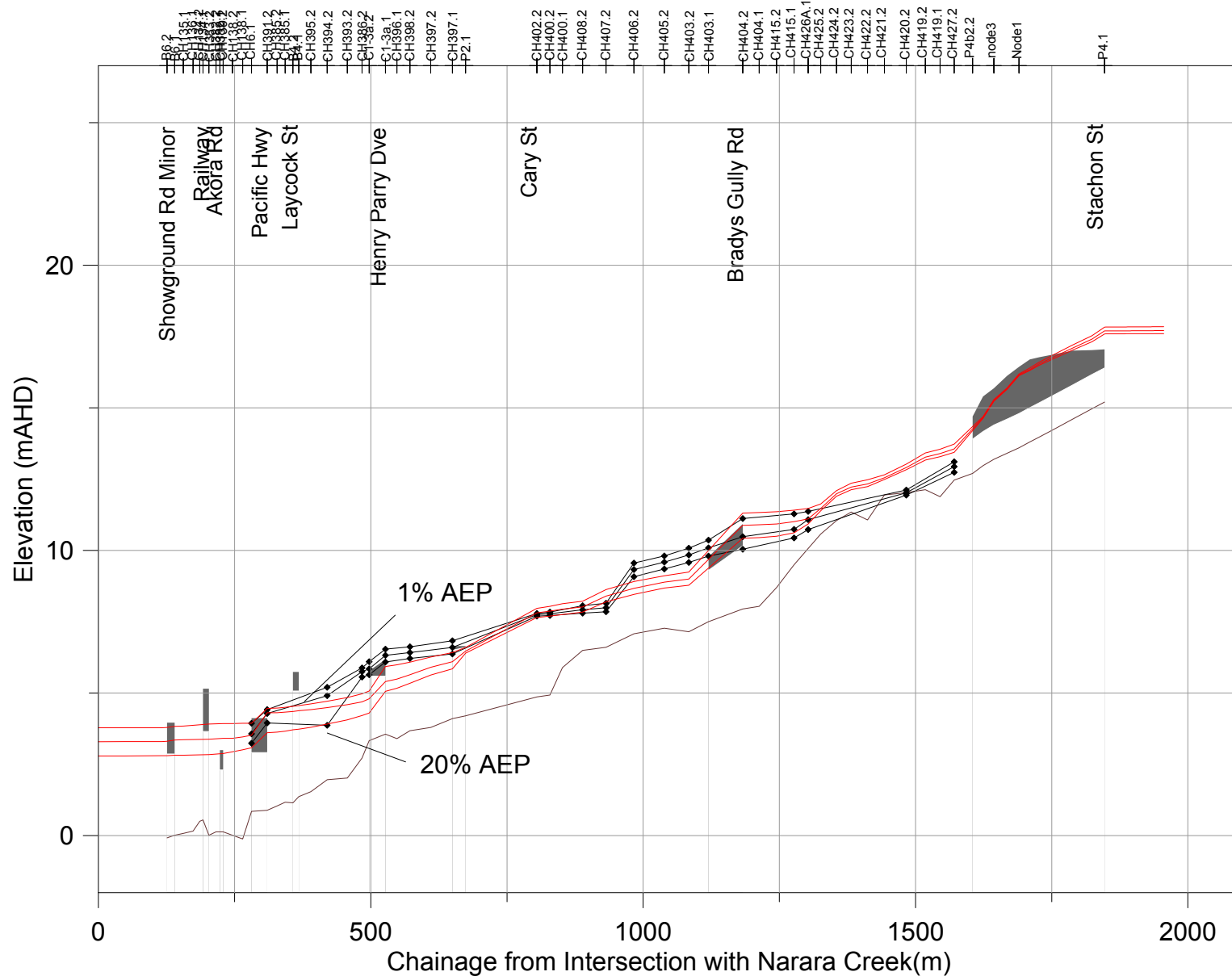
PROJECT NO.  
097626068

CONTROL  
006

REV.  
G

FIGURE  
ES5





**Legend**

**Modelled Flood Height (mAHD):**

- 1% AEP
- 5% AEP
- 20% AEP

**Previous Modelled Flood Height (from Kinhill 1991) (mAHD):**

- 1% AEP
- 5% AEP
- 20% AEP

**Model Geometry:**

- Bridge Deck/Culvert
- Creek-Bed

**Model Nodes**

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CENTRAL COAST COUNCIL

**PROJECT**  
NARARA CREEK FLOOD STUDY

**TITLE**  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**

**CONSULTANT**

**YYYY-MM-DD** 2018/06/27

**DESIGNED** MP

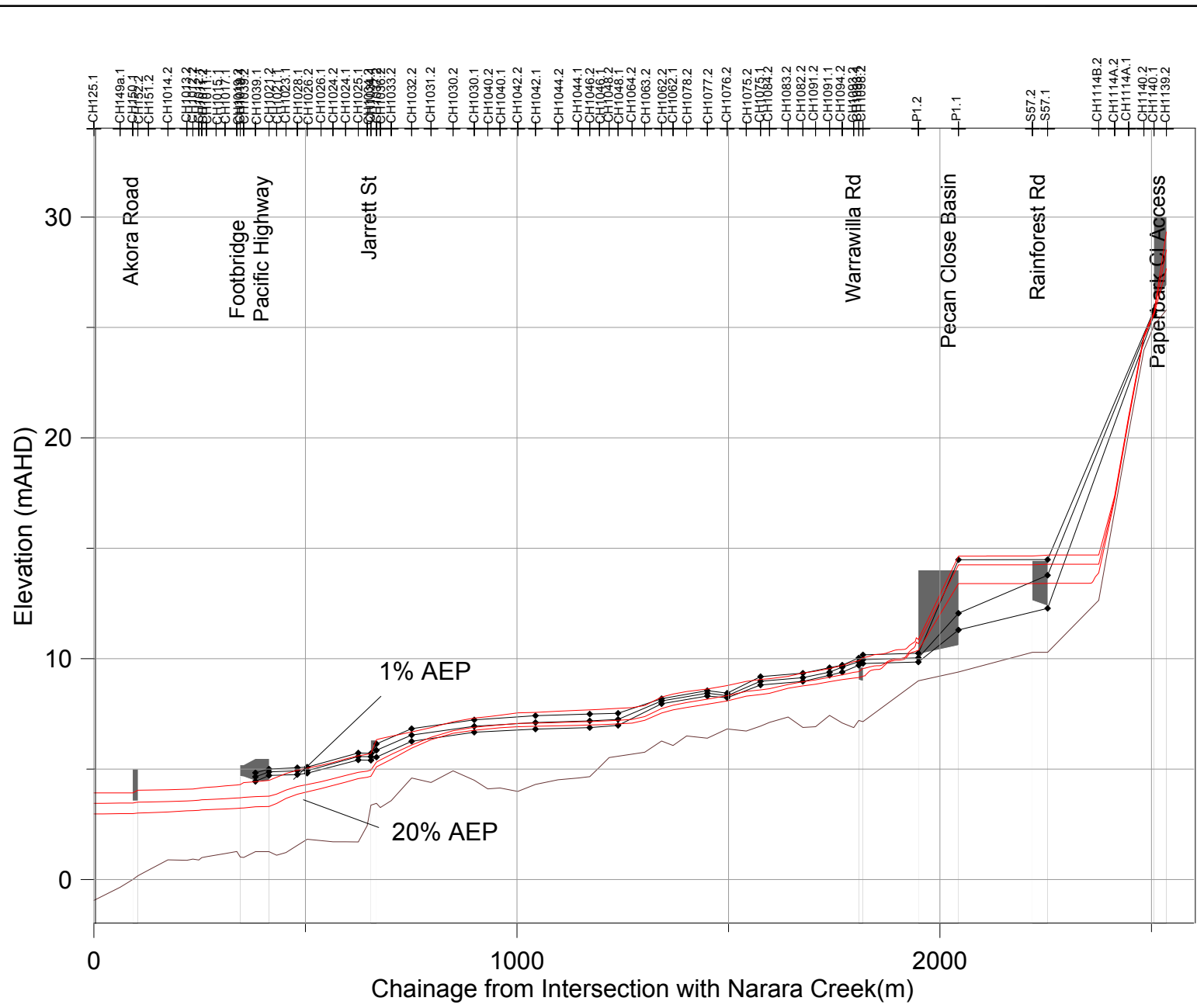
**PREPARED** HB

**REVIEWED** NM

**APPROVED** NM

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**PROJECT NO.** 097626068    **CONTROL** 006    **REV.** G    **FIGURE** ES6



### Legend

Modelled Flood Height (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Kinhill 1991) (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

◆ Model Nodes

Model Geometry:

- Bridge Deck/Culvert
- Creek-Bed

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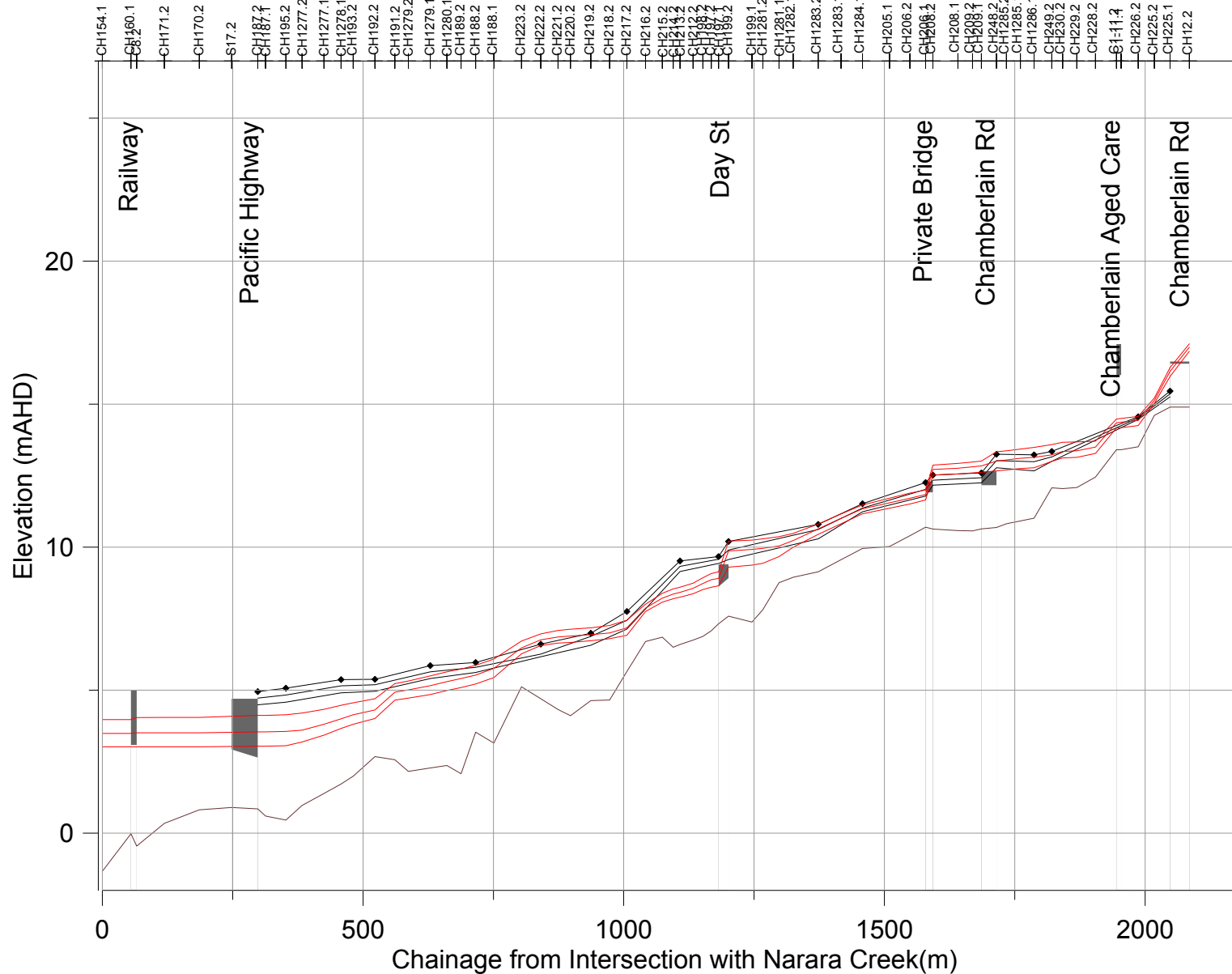
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PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**



YYYY-MM-DD	2018/06/27
DESIGNED	MP
PREPARED	HB
REVIEWED	NM
APPROVED	NM



### Legend

Modelled Flood Height (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Kinhill 1991) (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

Model Nodes

Model Geometry:

- Bridge Deck/Culvert
- Creek-Bed

**NOTE(S)**  
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PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**

CONSULTANT



YYYY-MM-DD 2018/06/27

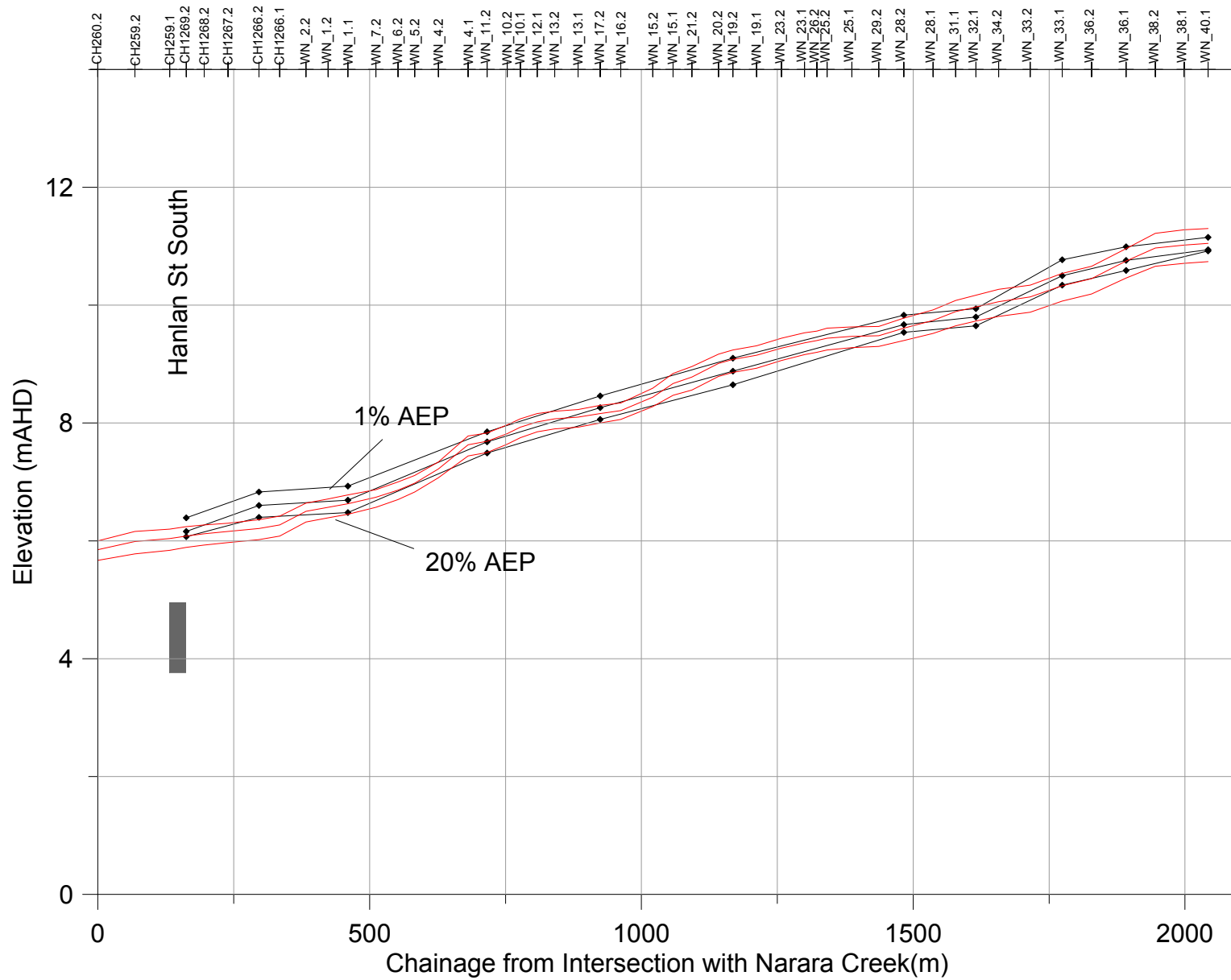
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PREPARED HB

REVIEWED NM

APPROVED NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE ES8
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### Legend

Modelled Flood Height (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Kinhill 1991) (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP
- Model Nodes

Model Geometry:

- Bridge Deck/Culvert
- Creek-Bed

**NOTE(S)**  
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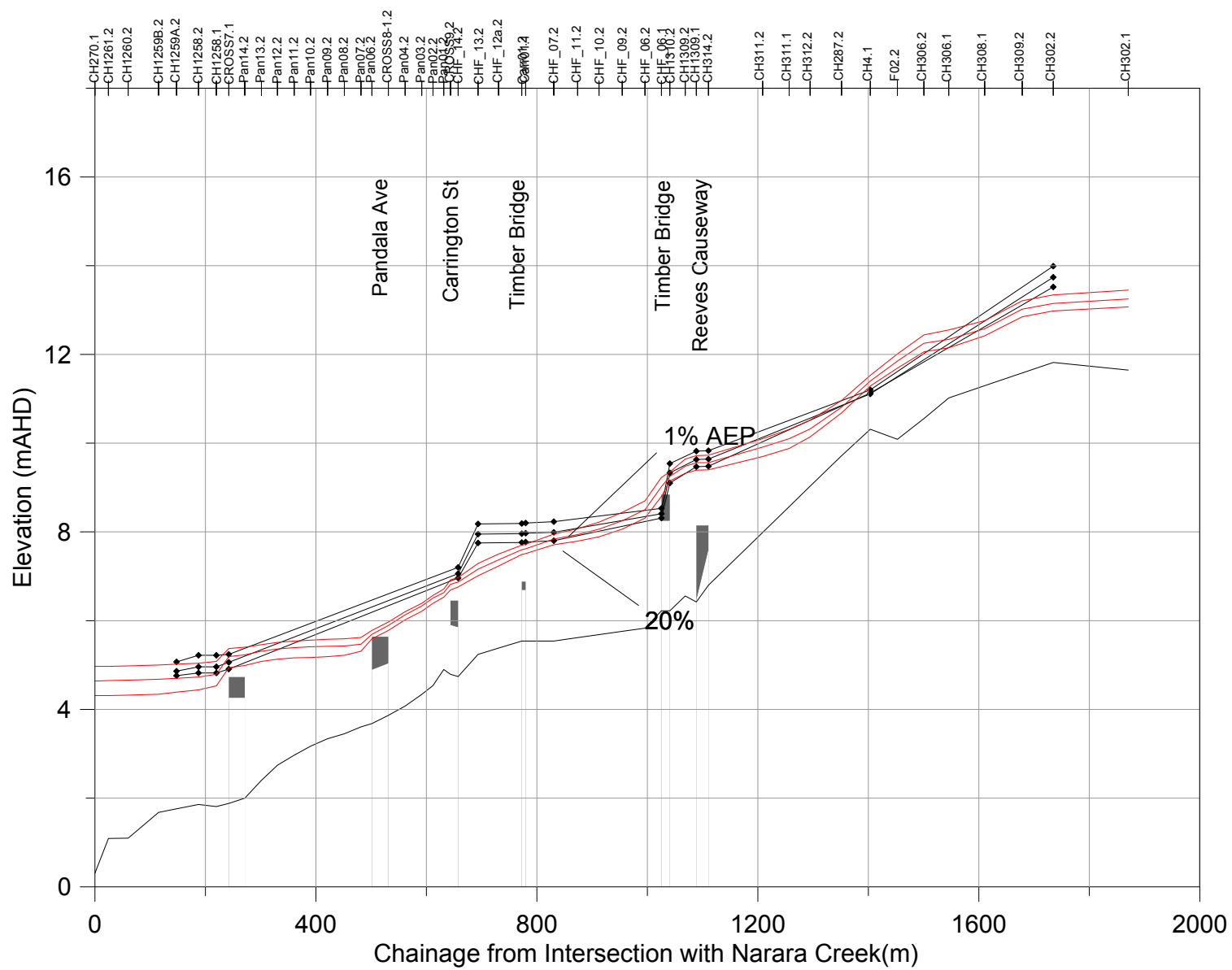
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PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**



YYYY-MM-DD	2018/06/27
DESIGNED	MP
PREPARED	HB
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APPROVED	NM



### Legend

Modelled Flood Height (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP

Previous Modelled Flood Height (from Kinhill 1991) (mAHD):

- 1% AEP
- 5% AEP
- 20% AEP
- Model Nodes

Model Geometry:

- Bridge Deck/Culvert
- Creek-Bed

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PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**



YYYY-MM-DD	2018/06/27
DESIGNED	MP
PREPARED	HB
REVIEWED	NM
APPROVED	NM

# Table of Contents

<b>1.0 INTRODUCTION</b>	<b>6</b>
1.1 Document Revision	7
1.2 Previous Work	7
1.3 Objectives of this Updated Narara Creek Flood Study	7
<b>2.0 REVIEW OF PREVIOUS STUDIES</b>	<b>8</b>
2.1 Flood Studies	8
2.2 Floodplain Risk Management Studies	9
2.3 Floodplain Risk Management Plans	10
<b>3.0 DATA COLLECTION</b>	<b>12</b>
3.1 Topographic Data	12
3.1.1 Digital Elevation Models	13
3.1.2 Verification of ALS survey	13
3.2 Hydrographic Data	14
3.3 Existing Drainage Infrastructure	14
3.3.1 Acquisition of additional survey data	15
3.4 Community Survey	15
3.5 Historical Information	15
3.5.1 Historical Rainfall Data	15
3.5.2 Historical Water Level Data	20
3.5.3 Gauged Discharge Data	23
<b>4.0 HYDROLOGIC MODELLING</b>	<b>24</b>
4.1 Hydrologic Modelling System	24
4.2 Model Setup	24
4.2.1 Catchment Analysis	24
4.2.2 Rainfall Losses	27
4.3 Design Rainfall Data	27
4.4 Model Calibration	28
4.5 Design Discharge Modelling	28
4.5.1 Model Verification	28

<b>5.0</b>	<b>HYDRAULIC MODELLING</b> .....	<b>30</b>
5.1	Model Geometry.....	31
5.1.1	Model Extent and Grid Size .....	31
5.1.2	Model Approach .....	31
5.1.3	1D Geometry.....	31
5.1.4	2D Geometry.....	34
5.2	Model Boundaries .....	35
5.2.1	Downstream Water Level Boundary .....	35
5.2.2	Inflow Hydrographs .....	36
5.2.3	Initial Conditions.....	36
5.3	Model Output Processing.....	36
5.4	Model Calibration .....	36
5.4.1	Model Geometry.....	37
5.4.2	Pluvio Data Distribution.....	38
5.4.3	Calibration Approach .....	38
5.4.4	Calibration Data .....	38
5.4.5	Calibrated Parameters .....	39
5.4.6	Calibration Results .....	40
5.4.7	Calibration Discussion .....	54
<b>6.0</b>	<b>DESIGN FLOOD MODELLING</b> .....	<b>55</b>
6.1	General Model Results.....	55
6.2	Lower and Upper Narara Creek.....	56
6.3	Bradys Gully .....	59
6.4	Wingello Creek.....	63
6.5	Wyoming Creek.....	65
6.6	West Narara Creek .....	66
6.7	Fountain Creek.....	67
<b>7.0</b>	<b>SENSITIVITY ANALYSIS</b> .....	<b>69</b>
7.1	General Sensitivity .....	69
7.1.1	Peak Discharge.....	69
7.1.2	Hydraulic Roughness.....	69

7.1.3	Tailwater Level .....	70
7.2	Blockage Analysis .....	70
7.2.1	100% Blockage .....	70
7.2.2	Partial Blockage .....	71
7.3	Potential Impact of Climate Change .....	72
7.3.1	Increased Rainfall Intensity .....	72
7.3.2	Sea Level Rise .....	73
7.3.3	Increased Rainfall Intensity and Sea Level Rise .....	73
<b>8.0</b>	<b>REFERENCES .....</b>	<b>75</b>

## TABLES

Table 1:	Summary of Council's Pit and Pipe Database .....	14
Table 2:	Relevant Rainfall Pluviograph Stations .....	16
Table 3:	Relevant Daily Rainfall Stations .....	17
Table 5:	Historical Peak Flood Heights .....	22
Table 6:	RAFTS Catchment Characteristics .....	24
Table 7:	RAFTS Catchments Surface Roughness and Imperviousness .....	26
Table 8:	RAFTS Rainfall Losses .....	27
Table 9:	Intensity, Frequency and Duration (IFD) Coefficients - Gosford NSW .....	27
Table 10:	RAFTS Uncalibrated Design Peak Discharge (m <sup>3</sup> /s) .....	28
Table 11:	Comparison of Probabilistic Rational Method to RAFTS Uncalibrated Peak (m <sup>3</sup> /s) .....	29
Table 12:	TUFLOW 1D Open Channel Elements .....	31
Table 13:	TUFLOW 1D Culvert Elements .....	32
Table 14:	TUFLOW 1D Bridge Elements .....	32
Table 15:	TUFLOW 1D Pit and Pipe Form Loss Coefficients .....	33
Table 16:	TUFLOW 1D Pit Types .....	33
Table 17:	TUFLOW 1D Pit and Pipe Network .....	34
Table 18:	TUFLOW 2D Downstream Water Level Boundary .....	35
Table 20:	Calibrated TUFLOW 1D Channel Roughnesses .....	39
Table 21:	Observed Vs Modelled – June 2007 Event .....	42
Table 22:	Observed Vs Modelled - 2 February 1990 event .....	45
Table 23:	Observed Vs Modelled - 7 February 1990 event .....	47
Table 24:	TUFLOW Observed Vs Modelled - February 1992 event .....	51
Table 25:	Bridge and Culvert Hydraulics - 1% AEP (Lower Narara Creek) .....	57



Table 26: Bridge and Culvert Hydraulics - 1% AEP (Upper Narara Creek) .....	58
Table 27: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully - Lower Reach).....	59
Table 28: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully – Upper Reach).....	62
Table 29: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Lower Reach) .....	63
Table 30: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Upper Reaches) .....	64
Table 31: Bridge and Culvert Hydraulics – 1% AEP (Wyoming Creek) .....	65
Table 32: Bridge and Culvert Hydraulics – 1% AEP (West Narara Creek).....	66
Table 33: Bridge and Culvert Hydraulics – 1% AEP (Fountain Creek) .....	68

## FIGURES

Figure A: Cumulative Rainfall Distribution of Historical Events .....	20
Figure B: Water Level Gauging - June 2007 (Narara Creek - Manns Road) .....	21
Figure C: Time-Series Observation against Modelled - 24 Hour Tidal Cycle.....	41
Figure D: Time-Series Observation against Modelled - June 2007 .....	42
Figure E: Time-Series Observation against Modelled - 2 February 1990 event .....	44
Figure F: Time-Series Observation against Modelled - February 1992 event .....	50

## APPENDICES

### APPENDIX A

Bibliography

### APPENDIX B

Community Survey

### APPENDIX C

Rainfall Data

### APPENDIX D

Water Level Data

### APPENDIX E

Model Inputs

### APPENDIX F

Topographic and Hydrographic Survey

### APPENDIX G

Tabulated Model Output

### APPENDIX H

Design Flood Modelling - Critical Durations

### APPENDIX I

Limitations

## FOREWARD

Floodplain risk management in NSW is the responsibility of Local Government under the guidance of the NSW State Government's Flood Policy. Under this policy, the Floodplain Development Manual (2005) assists councils in formulating management plans through the Floodplain Risk Management Process. The sequential stages of the Floodplain Risk Management Process are as follows:

- Formation of Floodplain Risk Management Committee
- Data Collection
- Flood Study – Defines flood behaviour within the catchment
- Floodplain Risk Management Study – Provides analysis of potential flood mitigation measures
- Floodplain Risk Management Plan – Defines a plan of action to address identified flood risks
- Plan Implementation
- Review

This report contains detailed information with respect to the Flood Study stage of the Floodplain Risk Management process undertaken for the Narara Creek Catchment in Gosford Local Government Area. The results from this study would be used to undertake the floodplain risk management study and prepare a flood risk management plan to manage the flood risk in Narara Creek Catchment.

This document is the revised report published by Golder in 2012 (Golder reference: 097626068-006-RevF). Modifications were made to the setup of the hydrological RAFTS model and the hydraulic TUFLOW model since the previous revision incorrectly excluded some catchments. Note the changes to the hydrological model are only in the setup of the catchments, the hydrological analysis methods outlined in the updated Australian Rainfall and Runoff guideline (2016) have not been adopted into this revised report as the purpose of this revision is to only include the missing catchments.

## 1.0 INTRODUCTION

Central Coast Council (Formerly known as Gosford City Council) commissioned Golder Associates to undertake the Review and update to the existing Narara Creek Flood Studies and Floodplain Risk Management Study and Plan. This Updated Narara Creek Flood Study (The Updated Flood Study) consists of a whole-of-catchment approach and this was a primary objective when undertaking this update. Accordingly, a detailed flood study using a 2D hydraulic model of the whole Narara Creek catchment was created to establish the flood behaviour in the catchment.

The Updated Flood Study report provides details of data collection, a discussion of historical flood behaviour in the catchment, details of the hydrologic model and methodology adopted, and presents details of the hydraulic model including calibration. Detailed analysis including flood maps are presented in the final sections of the report.

Narara Creek is a tributary of Brisbane Water and is located to the north of the estuary, within the Gosford Local Government Area.

Residents of the Narara Creek catchment have experienced several major flooding events in the past, which have caused extensive damage to property and disruption to the community. Gosford Council through the Council Floodplain Risk Management Committee has resolved to address the flooding issues in the Narara Creek Catchment and initiated this study to review the existing studies/plans, to effectively manage the flood risk in the catchment.

The Narara Creek Catchment has a total area of 46.7 km<sup>2</sup> and drains generally southward. Narara Creek discharges into Brisbane Water through a bridge of the Main Northern Railway. The railway line, in effect, has created an embayment. There are also several local catchments that contribute runoff to Fagans Bay. To the east of the railway line, this area is referred to as the Broadwater before becoming Brisbane Water. Figure 1 presents the layout of the Narara Creek catchment and surrounds.

The topography of the Narara Creek Catchment is generally steep in the upper reaches and heavily forested. Residential, commercial and industrial development occurs in the low lying areas of the valley. The local catchments contributing directly to Fagans Bay are of similar nature.

The Narara Creek system comprises seven major sub-catchments. These sub-catchments include:

- West Narara Creek (14.3 km<sup>2</sup>)
- Upper Narara Creek (8.3 km<sup>2</sup>)
- Fountain Creek (5.1 km<sup>2</sup>)
- Wyoming Creek (3.1 km<sup>2</sup>)
- Wingello Creek (4.9 km<sup>2</sup>)
- Bradys Gully (2.6 km<sup>2</sup>)
- Lower Narara (8.4 km<sup>2</sup>).

The catchments contributing to Fagans Bay, which are outside of Narara Creek Catchment are:

- Coorumbine Creek (4.0 km<sup>2</sup>)
- Brisbane Water West (2.0 km<sup>2</sup>)
- President Hill (0.3 km<sup>2</sup>)
- Gosford CBD (1.3 km<sup>2</sup>)
- Point Frederick (0.9 km<sup>2</sup>, Partial)

## 1.1 Document Revision

This document is the revised report published by Golder in 2012 (Golder reference: 097626068-006-RevF). Modifications were made to the setup of the hydrological RAFTS model and the hydraulic TUFLOW model since the previous revision incorrectly excluded some catchments. Note the changes to the hydrological model are only in the setup of the catchments, the hydrological analysis methods outlined in the updated Australian Rainfall and Runoff guideline (2016) have not been adopted into this revised report as the purpose of this revision is to only include the missing catchments.

## 1.2 Previous Work

Flood studies have been previously conducted for each of the major subcatchments of Narara Creek. However, these studies are now more than 15 years old and need to be reviewed and updated. Previous flood studies split Narara Creek into Upper and Lower sections and tributaries Wyoming Creek, Wingello Creek and Bradys Gully, Narara Creek West of Hanlan St, Fountain Creek and Reeves Creek were treated as separate study areas. Accordingly, there were some inconsistencies identified when the results from separate studies were integrated.

## 1.3 Objectives of this Updated Narara Creek Flood Study

The objective of this study is to develop a calibrated combined 1D-2D hydraulic model of the whole catchment to define flood behaviour and produce information on flood flows, velocities, levels and extents for a full range of flood events under existing catchment and floodplain conditions, assumed to be representative of fully developed catchment and floodplain conditions.

The design flood events for the study, in accordance with the tender brief, include 0.2% Annual Exceedance Probability (AEP), 0.5% AEP, 1% AEP, 2% AEP, 5% AEP, 10% AEP, 20% AEP, 50% AEP, together with the Probable Maximum Flood (PMF). For the purposes of consistent terminology, it is noted that 20% AEP and 50% AEP were assumed to refer to 5 y ARI and 2 y ARI respectively in this study.

## 2.0 REVIEW OF PREVIOUS STUDIES

There have been several flood studies undertaken and floodplain risk management plans prepared for the Narara Creek Catchment previously, covering each of the main tributaries, as well as Narara Creek itself.

Studies included hydrologic and hydraulic modelling of Narara Creek (Upper and Lower and Narara Creek Tributaries west of Hanlan St), Wyoming Creek, Wingello Creek and Bradys Gully. A brief summary of each of the studies is provided below. A detailed bibliography is provided in Appendix A.

Figure 2 presents the location and extents of the previous studies.

### 2.1 Flood Studies

*Narara Creek Drainage Study, Willing and Partners, 1979* – This report presents a hydrologic analysis of Wyoming, Wingello and Narara Creeks using RAFTL and RSWM. The report also considered augmentation options including retardation basins and channel formalisation.

*Proposed Industrial Subdivision along Narara Creek, Willing and Partners, 1982* – This report presents predicted impacts of filling on flood levels of industrial land north of Glennie St West.

*Lower Narara Creek Flood Study. PWD, 1988* – This report detailed a hydrologic analysis of the Narara Creek catchment using a RORB model. Hydraulic analysis was undertaken using a CELLS model. The limit of the hydraulic model was Deane St in the north, Hanlan St to the west, the Northern Railway to the east and Fagans Bay to the south. The hydraulic model was calibrated against several flood events; namely the 1949, 1974, 1977, 1978, 1981 and 1985 events.

*Flood Study for Wyoming, Wingello and Bradys Gully Creeks, Kinhill 1991* – This report details hydrologic modelling of Wyoming, Wingello and Bradys Gully Creeks using RORB. Hydraulic modelling was undertaken using a steady state HEC-2 model.

*Upper Narara Creek Flood Study. Kinhill, 1993* - This report detailed a hydraulic analysis using MIKE-11 of Narara Creek above Deane St up to Niagara Park Public School. A hydrologic analysis of the catchment contributing to this model domain was developed using RAFTS. Downstream boundary condition for the MIKE-11, at Deane St, was synthesised via a rating curve using results from a CELLS model developed for the Lower Narara Creek Flood Study.

*Upper Narara Creek Extensions. Lawson and Treloar 1995* – This letter report details extension of the Niagara Park Branch RAFTS and MIKE-11 model to include the confluence of Upper Narara Creek and Fountain Creek. The previous HEC-2 models for Upper Narara and Fountain Creeks were converted and incorporated into MIKE-11, so as to present a complete model of the Upper Narara Creek system downstream to the limit of the existing CELLS model. A comparison is presented between combined MIKE-11 model and reported levels from the Floodplain Risk Management Study by Kinhill.

*Flood Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan St. Kinhill, 1997* – This report was an update of a flood study for Narara Creek and Lower Creek tributaries West of Hanlan St initially reported in 1991. Following severe flooding in February 1992 in the Lower Narara Creek study area additional calibration information was obtained that prompted review of the previous calibration. A RORB model of the Narara Creek catchment was used as the hydrologic model for catchment and a steady-state HEC-2 model used for hydraulic analysis.

*Narara Creek Flood Level Resolution. Lawson and Treloar, 1998* – This letter report details revision of the combined MIKE-11 model of Upper Narara Creek to resolve the differences between adopted flood levels and the MIKE-11 results in that area. The MIKE-11 model was prepared by Lawson and Treloar for Patterson Britton and Partners for use in the Floodplain Management Study and Plan for Upper Narara Creek.

*Narara Creek – Revised Flood Estimates. Lawson and Treloar, 1999* – This letter presents updated flood levels from the MIKE-11 model of Upper Narara Creek which was revised to include new survey of the Upper Narara Creek floodplain. It is noted that the update improved the match between the model and Floodplain Management Study levels.

*Brisbane Water Foreshore Flood Study. Cardno Lawson Treloar, 2009* – This report detailed a hydrodynamic analysis of Brisbane Water using the Delft3D model. Narara Creek is one of several creeks draining to Brisbane Water. A RAFTS hydrologic model was established for each of the catchment, including Narara Creek, to provide runoff input to the hydrodynamic model. Probabilities of Exceedance with respect to water levels were prepared as an output from this study. These water levels will be used to set downstream boundary conditions for the Narara Creek flood study and other studies.

## 2.2 Floodplain Risk Management Studies

*Flood Mitigation Investigations in the Narara Valley. Willing and Partners, 1979* – This report detailed hydrologic modelling of Narara Creek, Wyoming Creek and Wingello Creek using RAFTL and RSWM. There was no hydraulic modelling undertaken in that investigation. Potential detention storage systems were assessed with respect to each of the Narara Creek, Wyoming Creek and Wingello Creek.

*Lower Narara Creek Flood Study – Effect of Floodplain Filling. PWD, 1983* – This study examined the impact of floodplain filling on predicted flood levels in the CELLS model.

*Review of Lower Narara Creek Floodplain Management Study. Kinhill, 1993* – This study updated an earlier update of a flood study conducted by PWD, 1988. This review was undertaken following severe flooding in February 1992 in the Lower Narara Creek study area which provided additional calibration data. The review also updated previously analysed management options. Management options included voluntary purchase, flood proofing of industrial properties and some houses, levee construction and channel improvement works. The hydrologic model, RORB, was retained for the flood study component of the analysis and the hydraulic model, CELLS, was also retained, however, it was noted that the model version had been upgraded. The extent of the hydraulic model was the same as the PWD, 1988 study.

*Wingello Creek Flooding Investigation. Kinhill, 1993* – This report presents results of investigation of realignment options for Wingello Creek downstream of the Pacific Highway. The report presents details of a HEC-2 hydraulic model established to analyse this area. The area of study was below the Wingello Creek HEC-2 model and was not of sufficient resolution in the Lower Narara Creek CELLS model at the time.

*Brooks Avenue Flooding Investigation. Kinhill, 1993* – This report presents an analysis of proposed realignment of Wyoming Creek and construction of a levee along Wyoming Creek to protect Brooks Avenue.

*Floodplain Management Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan St. Kinhill, 1997* – This study assessed management options for Narara Creek and Fountain and Reeves Creek. Options included potential voluntary purchases, upgrade of hydraulic infrastructure and/or bridges, enlargement of conveyances, and installation of detention basins.

*Flood Access Investigation for a Proposed High School, Narara. Kinhill, 1991* – This report identified potential access routes from the proposed high school site. This preliminary investigation examined potential for upgrade to culvert capacities, establishment of flood-free access routes and likely probability of occurrence of flooding during school hours.

*Upper Narara Creek Floodplain Management Study. Patterson Britton and Partners, 1995* – This report presents potential structural and non-structural flood management options within the Upper Narara Creek area. As part of preparation of this study, a MIKE-11 model of the combined Upper and Lower Narara Creek system was prepared. Management options included bridge works (Deane St and Narara Valley Drive),

channel modification, raising floor levels and bank stabilisation. Non-structural options included planning controls, acquisition of flood affected properties and evacuation planning.

*Bradys Gully Blanche St Drainage Investigation. Webb McKeown and Associates, 1995* – A drainage analysis was undertaken in ILSAX, with hydraulic analysis in HEC-2 of the overland flow path downstream of the earthen dam above Blanche St. Cost-benefit analysis was undertaken of the culvert upgrade between Blanche St and Jarrett St as well as a new pipe upstream of Blanche St. A new drainage system option for North Crescent was also developed.

## 2.3 Floodplain Risk Management Plans

*Lower Narara Creek Floodplain Management Plan. Kinhill, 1991.* The plan presented detailed review of options for thirteen general locations. These included Narara Creek floodway; West Gosford Industrial Area; Dwyer St Old Sewage Treatment Plant; Glennie St West Industrial Area; Rowena Road Protection Area; Showground Road Protection Area; Manns Road – Deane St Floodway; Brooks Avenue Flood Storage Area; and Wyoming and Wingello Creek Flood Storage Area. Management options included development control, stream modification, construction of berms/levees, potential voluntary purchase.

*Floodplain Management Plan for Narara Creek and Lower Narara Creek Tributaries West of Hanlan St. Kinhill, 1997* – The plan provides detailed discussion and estimated costings of each of the selected management options identified from the management study. These included raising Hanlan St and upgrade culvert capacity; construct a wet detention basin upstream of Hanlan St; creek realignment works; installation of a sediment trap; voluntary purchase; realignment and channel stabilisation works; wet detention basin for Fountain and Reeves Creek; removal of existing culvert on Carrington St; establishment of a causeway or bridge along Reeves St; upgrade of culvert capacity on Reeves St; and implementation of a development control plan for the catchment.

*Floodplain Management Plan for Wingello Creek. Kinhill, 1993* – The plan provides details of recommended options for Wingello Creek including costs. Options included replacement of low level bridge and adjustment of weir level; channel realignment; bank protection works; review of existing detention basin in Pecan Close; and a regular waterway maintenance program. Simulated flood contours, assuming all works are implemented, are also provided.

*Floodplain Management Plan for Wyoming Creek. Kinhill, 1993* – The plan provides detailed description and estimated costs for various management options. Simulated flood contours, assuming all works are implemented, are also provided. Management options include increase in culvert capacity and channelization of creek; construction of energy dissipation structure; upgrade of bridge accesses to properties; bank protection works; inlet works and upgrade of culvert capacity; and implement a regular waterway maintenance program.

*Floodplain Management Plan for Bradys Gully. Kinhill, 1993* – The plan presents recommended management options for Bradys Gully including provisional costs. Simulated flood contours, assuming all works are implemented, are also provided. Management options include creek channelization; upgrade of culvert capacities; bank protection works; finalise channelization; upgrade pipe diameters; and implement a regular waterway maintenance program.

*Upper Narara Creek Floodplain Management Plan. Patterson Britton and Partners, 1995* – The plan presents recommended management options for the Upper Narara Creek area. Recommendations did not include acquisition of properties or floor level raising as these were considered uneconomic. Cost-benefit analysis was undertaken of the remaining options.

*Update to Floodplain Management Study and Plan for Narara Creek and Lower Narara Creek West Tributaries West of Hanlan St. KBR, 2002* – This letter updates two tables in the Floodplain Management Study based on review of details of a culvert under Hanlan St in the HEC-2 model.



## 3.0 DATA COLLECTION

There were several sources of information utilised in this study. The data obtained was utilised in the preparation and calibration of hydrologic and hydraulic models and to present the study results. The data acquired for the study includes:

- Cadastre
- Land use (Council zoning)
- Aerial photography
- Topographic data
- Hydrographic data
- Survey of existing hydraulic infrastructure
- Collation of historical information

In addition to the above, a community survey of residents of the Narara Creek catchment was undertaken to supplement historic flood information and to communicate and elicit the communities expectations in regard to floodplain management in the catchment. The community survey is presented in APPENDIX B.

### 3.1 Topographic Data

A database of topographic information was made available for use in this flood study. These data were provided by Council under a Data Sharing Agreement. Data was provided in electronic format configured to the ESRI/ArcMap Geographic Information System in the MGA94Z56 coordinate system. Data included:

- Digital elevation models
- Processed and unprocessed aerial laser scanning data
- Elevation contours
- Waterways and creek lines
- High-resolution aerial photogrammetry
- Catchment and subcatchment boundaries
- Vegetation mapping
- Cadastral boundaries and suburb boundaries
- Road centrelines
- Current zoning
- MIKE-11 cross-section locations

### 3.1.1 Digital Elevation Models

There were two Digital Elevation Models (DEMs) made available; one derived from a survey conducted in 2005 and another derived from a survey conducted in 2007. It is noted that the 2007 survey did not cover the entire catchment; the northwest corner of the study area was not available. Accordingly, the 2005 survey was used as supplementary information for areas not covered by the 2007 survey.

The resolution of the 2007 DEM was 0.5 m (0.5 m sized pixels) whilst the resolution of the 2005 DEM was 1 m (1.0 m sized pixels). Elevation contour data was provided at 0.5 m intervals derived from the 2007 DEM where available. The 2005 and 2007 DEM were adopted as the baseline elevation information upon which the hydraulic model was constructed.

Aerial Laser Survey (ALS), upon which DEMs are based, has reduced accuracy in vegetated areas compared to ground survey. On hard surfaces, such as roads and footpaths, accuracy is generally very good. Council indicated their preference to use DEM derived information wherever possible to reduce otherwise prohibitive survey cost and accepted that there may be discrepancies in cross-section definition compared to formal surveyed sections; however, overall, the error should not significantly impact on the accuracy of reported flood levels where the flood level is well out of creek bank.

Where the natural creek system has been formalised into a regular shape channel, such as along Wyoming Creek and Wingello Creek, it was judged to be important to have accurate definition because of the proximity of surrounding properties. Cross-sections for these locations were, therefore, obtained through ground survey. Figure 3 presents the location of these cross-sections. In total, 235 cross-sections were surveyed and 797 were derived from the DEM. In addition, 42 hydraulic structures were surveyed.

Data from the survey program undertaken during this study is presented in APPENDIX F.

### 3.1.2 Verification of ALS survey

There was limited topographic survey available to allow specific verification of ALS derived elevations; therefore the DEM was compared to:

- Extracted MIKE-11 cross-sections at several locations along Narara Creek (provided by Council)
- Ground survey associated with proposed upgrade to Pacific Highway between Narara and Ourimbah (provided via Council)

#### **Comparison against MIKE-11 Cross-Sections**

Figure 3 presents the location of MIKE-11 cross-sections along Narara Creek that were used for comparison. APPENDIX F presents a comparison of sections where the DEM data was inspected at 0.5 m increments along the cross-section.

A reasonable agreement between the DEM and some cross-sections presented in the current version of the MIKE-11 model of Narara Creek in the Upper Narara Creek Area and Lower Narara Creek between Deane St and Carrington St was observed. There are, however, discrepancies in the elevation of the floodplain adjacent Lower Narara Creek.

#### **Comparison against Ground Survey**

Ground survey information at specific hydraulic structures was provided by Council from investigation works associated with proposed upgrade of Pacific Highway between Narara and Ourimbah. These surveys included ground survey immediately upstream and downstream of particular hydraulic structures.

In vegetated areas, adjacent to these structures, the discrepancy between DEM derived elevation and ground survey was of the order of 10 to 30 cm, whereas on hard surfaces such as the road surface, the discrepancy between DEM and ground survey was 0 to 10 cm.

Elsewhere in the catchment, where the natural creek system is heavily vegetated, comparison was undertaken between construction plans provided by Council of their Rivercare Works program in the vicinity of Carrington St and DEM derived cross-section. Discrepancy between DEM and ground survey ranges from 10 cm at channel bank up to 90 cm at the bed of the channel.

## 3.2 Hydrographic Data

Hydrographic data within the Broadwater, within Fagan Bay and along Narara Creek up to its tidal limits was required for the development of hydraulic model. The hydrographic data within the Broadwater and within Fagans Bay was available from the recently completed Brisbane Water Foreshore Flood Study (Cardno Lawson and Treloar, 2009).

Cross-section data along Narara Creek up to tidal limit (Carrington St crossing) was available from previous modelling work. However, this data could not be checked against the ALS data, since ALS data cannot be obtained below the water surface. In addition, the existing cross-section data was deemed too old for use in this study.

Hydrographic survey was therefore commissioned for Lower Narara Creek from the entrance of Narara Creek up to the tidal limit (to Manns Road). Figure 3 presents the location of these cross-sections. Data from that cross-sectional survey is presented in APPENDIX F

## 3.3 Existing Drainage Infrastructure

The current stormwater asset database held by Council was made available for use in this flood study. Data was provided in electronic format configured to the ESRI/ArcMap system.

Council's pit and pipe network database included:

- Approximate location of pit and pipe elements
- Approximately location of headwalls and drainage easements
- Dimensions of pipe elements including length, however, no invert levels were available

Table 1 presents a summary of this database including the number of elements and range of values.

**Table 1: Summary of Council's Pit and Pipe Database**

Element Type	# of Elements <sup>1</sup>	Minimum Size	Maximum Size
Pits	3076	N/A	N/A
Pipes	3243	100 mm Ø	2 x 1200 mm Ø
Culverts	34	300 mm x 150 mm	3000 x 1500 mm

<sup>1</sup>The majority of elements in Council's database were partial segments of pipe or culvert branches.

Of these data, 113 pipe branches were identified as being of interest for this flood study and 66 channel/culvert crossings.

The pipe branches were selected where the main waterway of a particular tributary has been piped and the trunk drainage network would need to be included in the hydraulic model. Only pipes with 600 mm diameter and above were selected for modelling purposes.

It is noted that the pit and pipe network was expanded, including pipes with diameter less than 600 mm, where required to improve modelled flood behaviour.

### 3.3.1 Acquisition of additional survey data

Out of 113 pipe branches identified as being of interest for this flood study, seven branches were selected for detailed survey (inverts and dimensions). The remaining pipes were incorporated in the model using the dimensions in the database and using the DEM to derive pit elevations and pipe inverts assuming a minimum ground cover of 600 mm. Data from that survey is presented in APPENDIX F.

It is noted that whilst the 600 mm cover assumption is appropriate for hydraulic modelling at the level of detail of this study, it is not a substitute for formal survey and should not be used for any other purpose.

Of the 66 channel / culvert crossings identified as being of interest for this flood study, 16 were identified for detailed survey (inverts, including upstream and downstream cross-section as well as dimensions including bridge deck and railing heights) and 26 less detailed survey (dimensions only), with the remainder incorporated in the model based on the information within the pit and pipe database. Details of that survey are presented in APPENDIX F.

It is noted that detailed survey of 38 additional channel / culvert crossings were provided by Council from the work associated with upgrade to the Pacific Highway between Ourimbah and Narara. Details of that survey is also presented in APPENDIX F.

## 3.4 Community Survey

A community questionnaire was distributed during November 2009 to residents within the provisional 1% AEP Flood Extent provided by Council. Considering the provisional nature of the flood extents, a 15 m buffer was added on either side of the flood extent. 1578 questionnaires were sent to the community and 342 responses were received between 26 November 2009 and 4 February 2010. Residents identified the February 1990, February 1992 and the June 2007 flood events as the **historically** significant storms that have occurred in the Narara Creek catchment. The community survey report is presented in APPENDIX B.

## 3.5 Historical Information

### 3.5.1 Historical Rainfall Data

Historical rainfall data was acquired at stations within and in the vicinity of the Narara Creek catchment. Data was obtained from Manly Hydraulics Laboratory (MHL) and Bureau of Meteorology (BOM).

Data types acquired included:

- Pluviograph data (processed into six minute intervals)
- Daily rainfall data (24 hour total rainfall to 9 am)

Figure 4 presents the location of rainfall pluviograph stations utilised in this study, with relevant data from these rainfall stations presented in APPENDIX C. Table 2 presents a summary of the pluviograph stations used in this study.

**Table 2: Relevant Rainfall Pluviograph Stations**

Abbreviation	Station Name	Commenced	Closed	Operator <sup>1</sup>
KKI	Kincumber	1987	Current	MHL
KME	Mount Elliot <sup>2</sup>	1987	Current	MHL
KNA	Narara <sup>2</sup>	1989	Current	MHL
KSR	Strickland	1988	Current	MHL
KWO	Woy Woy	2005	Current	MHL
KWY	Wyoming <sup>2</sup>	1988	Current	MHL
LBA	Bateau Bay	1987	Current	MHL
LBE	Berkeley Vale	1988	Current	MHL
LCH	Chittaway	1989	Current	MHL
LKU	Kulnara	1989	Current	MHL
LLI	Lisarow	1989	Current	MHL
LMA	Mardi Dam	1988	Current	MHL
LST	Sterland <sup>2</sup>	1997	Current	MHL
LSU	Yarramalong	1990	Current	MHL
LWA	Warnervale	1991	Current	MHL
061351	Peats Ridge	1981	Current	BOM

MHL is Manly Hydraulics Laboratory (NSW Department of Commerce); BOM is Bureau of Meteorology; <sup>2</sup> Station lies within Narara Creek catchment

Daily rainfall data from relevant BOM stations were also collated. Table 3 presents a summary of the daily rainfall stations and Figure 4 presents the location of those stations. Rainfall data from these stations is presented in APPENDIX C.

**Table 3: Relevant Daily Rainfall Stations**

Abbreviation	Station Name	Commenced	Closed	Operator <sup>1</sup>
61319	GOSFORD NORTH (GLENNIE ST)	1971	Current	BOM
61087	GOSFORD (NARARA RESEARCH STATION) AWS	1916	Current	BOM
61023	GOSFORD (GERTRUDE PLACE)	1877	Current	BOM
61093	OURIMBAH (DOG TRAP ROAD)	1953	Current	BOM
61381	WYONG (MOUNT ELLIOT)	1994	Current	BOM
61351	PEATS RIDGE (WARATAH ROAD)	1981	Current	BOM

BOM is Bureau of Meteorology.

From this data, and responses gathered from the community survey, three historically significant rainfall events were extracted. The rainfall events selected to consider included:

- 1 February 1990 to 5 February 1990 (there was also a short-duration event on 7 February 1990)
- 8 February 1992 to 11 February 1992
- 6 June 2007 to 11 June 2007

Figure A presents the cumulative rainfall distribution for each of the historically significant events. Relevant data is presented in APPENDIX C.

### **2 February 1990 and 7 February 1990**

Pluviograph data was available from the following gauges: Narara, Lisarow, Mt Elliot, Strickland and Peats Ridge. Wyoming gauge was not available due to equipment failure. Peats Ridge is located outside of the Narara Creek catchment, to the northwest. Review indicated close agreement between Narara, Lisarow and Mt Elliot. These gauges cover the majority of the catchment. Strickland gauge, in the north of the catchment, is significantly lower. Figure 5 presents the adopted pluviograph distribution used in the RAFTS model. The pluviograph distribution was based on a weighted-area approach. It is noted that the same pluviograph distribution was adopted in both the 2 February 1990 and 7 February 1990 events. Comparison of recorded data with design Intensity-Frequency-Duration (IFD) data indicates the 2 February 1990 event had an AEP of between 10% and 5% (assuming a critical storm duration for Narara Creek of between 6 hr and 9 hrs). For the 7 February 1990 event, the AEP was estimated to be 5% AEP (assuming a critical duration for Bradys Gully, Wingello and Wyoming of between 1 and 2 hrs).

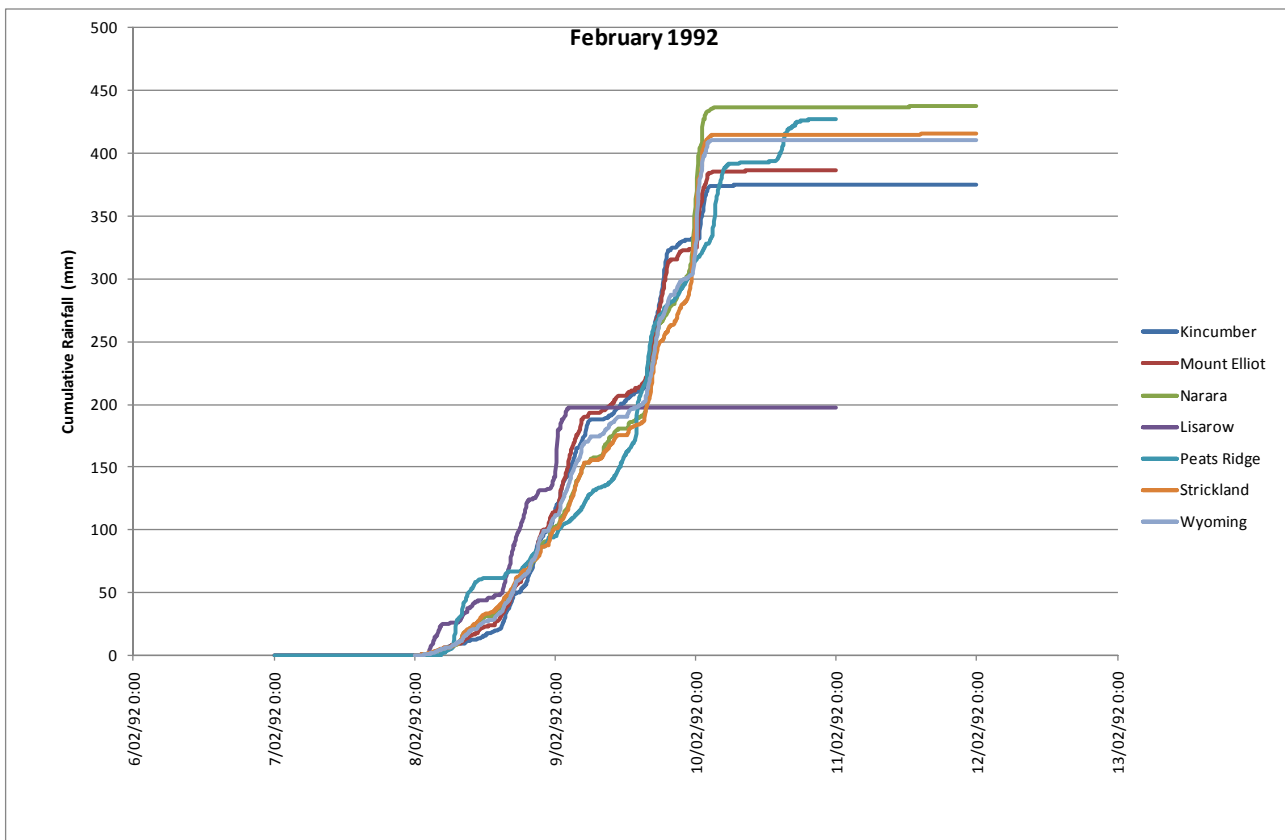
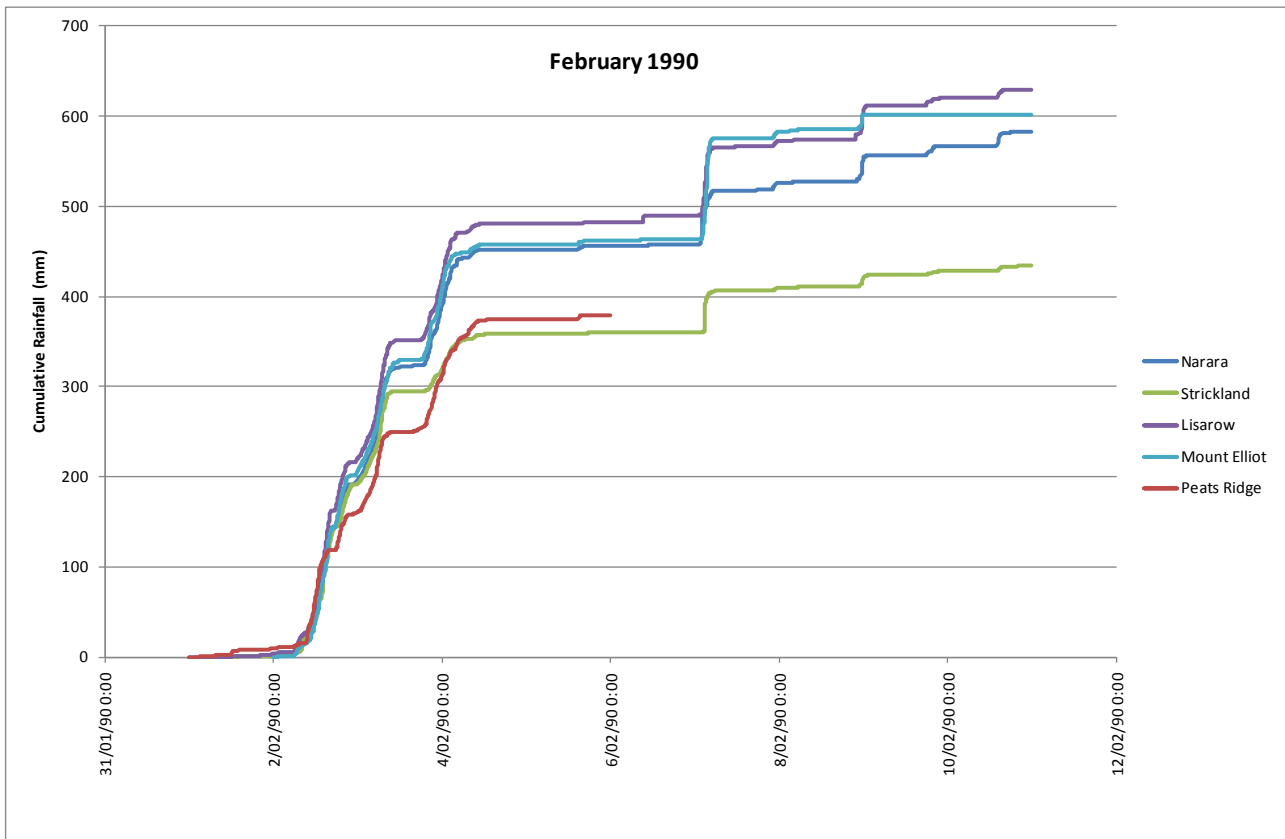
### **February 1992**

Data was available from the following pluviograph stations: Narara, Lisarow, Mt Elliot, Strickland, Wyoming and Peats Ridge. Review indicated that Mt Elliot, Lisarow and Peats Ridge gauges had an incorrect date. This was resolved by back-dating those datasets by 24 hours. In general, cumulative rainfall totals from pluviographs were in close agreement. Lisarow dataset was discarded as being suspect due to the cumulative rainfall total being half of the other stations. Figure 6 presents the adopted distribution used in the RAFTS model. Comparison of recorded data with design Intensity-Frequency-Duration (IFD) data suggests the February 1992 event was between 2% (assuming a critical duration for Bradys Gully, Wingello and Wyoming of between 1 and 2 hrs) and 1% AEP (assuming a critical duration for Narara Creek of 6 to 9 hrs).

### **June 2007**

Data was available for each pluviograph gauge: Narara, Lisarow, Mt Elliot, Strickland, Wyoming and Peats Ridge. Cumulative rainfall distribution indicates a greater spatial distribution in this event than the February 1990 and February 1992 events. Figure 7 presents the adopted pluviograph distribution used in the RAFTS model.

Comparison of rainfall intensity against design Intensity-Frequency-Duration (IFD) data indicates the June 2007 event had an AEP of about 20% (assuming a critical duration for Narara Creek of 6 to 9 hrs).





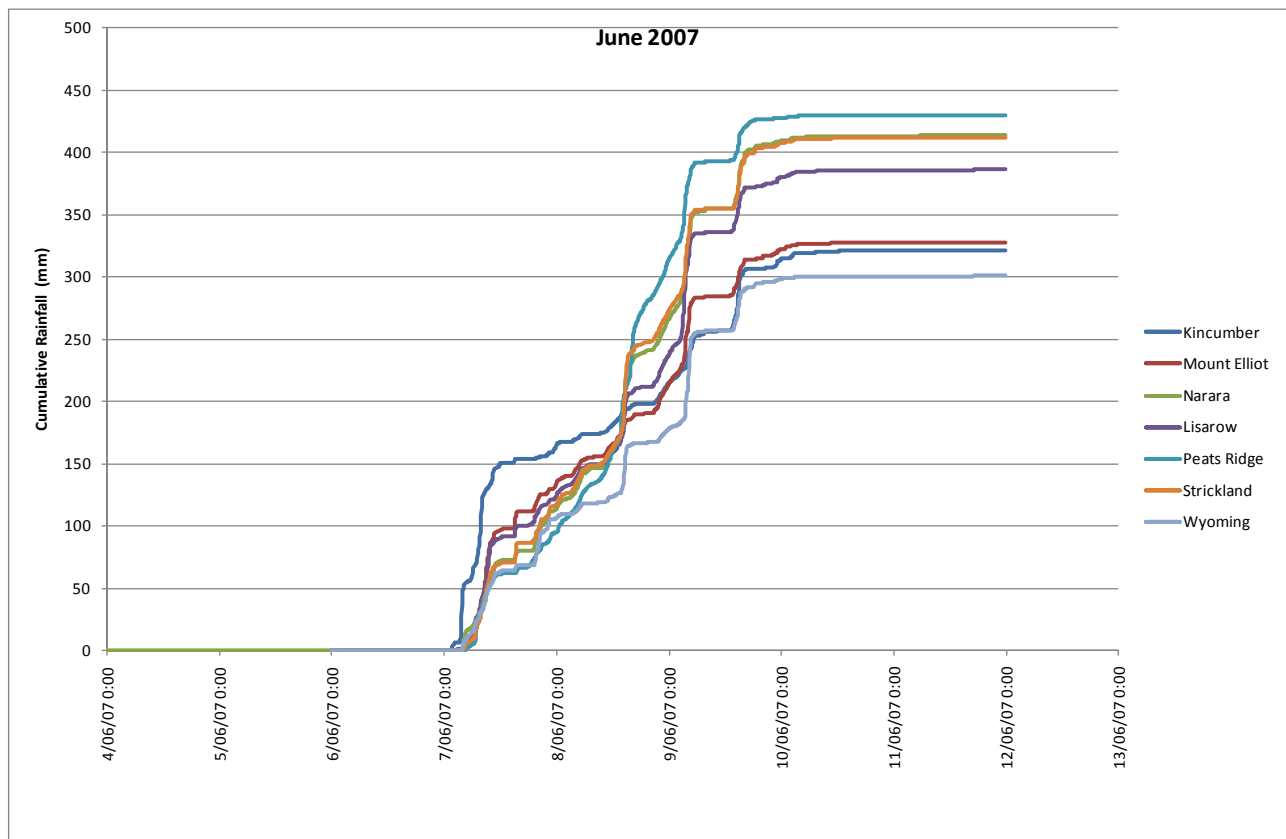


Figure A: Cumulative Rainfall Distribution of Historical Events

### 3.5.2 Historical Water Level Data

#### Time-Series Water Level Data

Historical time-series water level data was acquired within the Narara Creek Catchment and in Fagans Bay and Brisbane Water. Data was obtained from MHL, and included:

- Water level gauging within Narara Creek Catchment and from Brisbane Water.
- Maximum height recorders within Narara Creek Catchment

Figure 4 presents the location of water level gauging stations utilised in this study, with relevant data from these gauging stations presented in APPENDIX D. It is noted that the maximum height recorder (MHR) monitoring program was discontinued in 2000. Table 4 presents details of the time-series water level gauging stations used in this study. These stations collect data on a 15 minute interval basis.

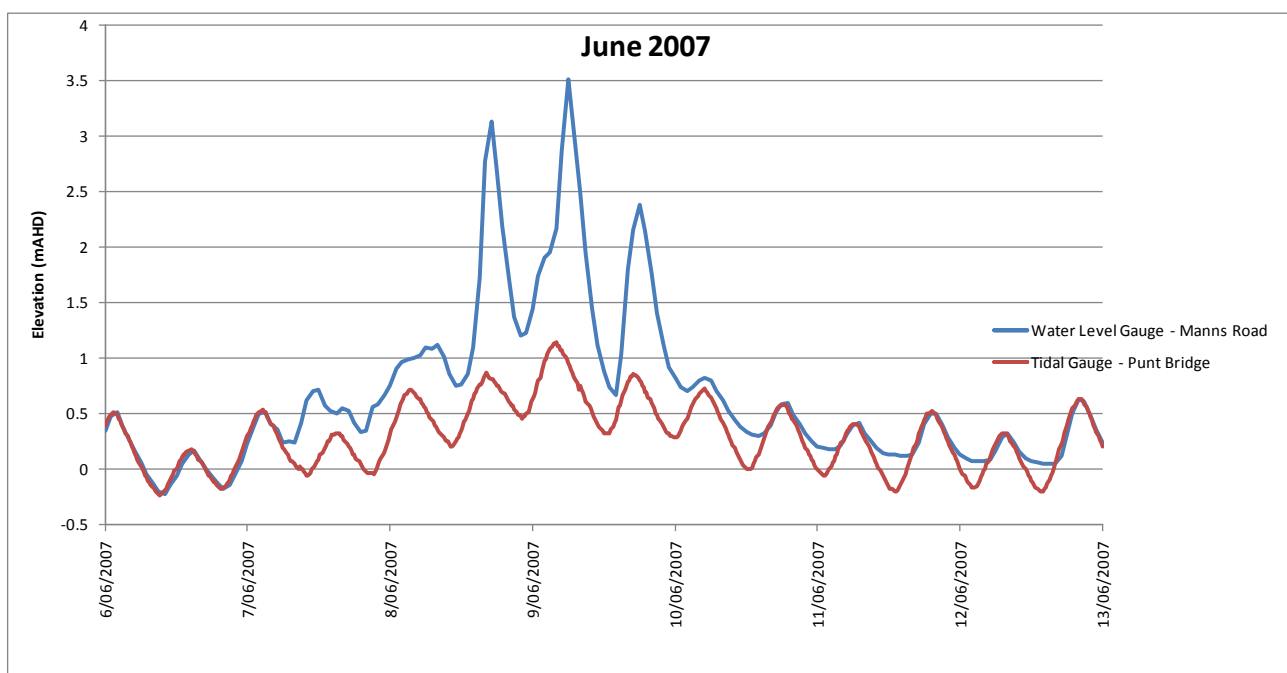
It is noted that water level gauging data from the Erina Creek and Brisbane Water stations was used for the downstream boundary condition of the hydraulic model during historic flood events.

**Table 4: Relevant Water Level Gauging Stations**

Abbreviation	Station Name	Commenced	Closed	Operator <sup>1</sup>
NMA	Narara Creek – Manns Road	Mar 1996	Current	MHL
NCN	Narara Creek – Narara A/C	Jun 1989	Mar 1995	MHL
Site 20	Narara Creek – Entrance	Feb 2004	Apr 2004	DIPNR
N/A	Narara Creek – West Gosford	May 2010	Current	MHL
N/A	Narara Creel – Hanlan St	May 2010	Current	MHL
HPB	Erina Creek – Punt Bridge	Mar 1994	Current	MHL
BWW	Brisbane Water – Wharf St	Aug 1985	May 1995	MHL
BWK	Brisbane Water – Koolewong	Aug 1985	Current	MHL

<sup>1</sup> MHL is Manly Hydraulics Laboratory (NSW Department of Commerce); DIPNR is Department of Infrastructure, Planning and Natural Resources.

Figure B presents water level gauging data from the Narara Creek station (Manns Road), by way of example, for the June 2007 historical event. Processed data from other stations is presented in APPENDIX D in tabular form.



**Figure B: Water Level Gauging - June 2007 (Narara Creek - Manns Road)**

### Peak Water Level Data

Estimated peak water levels of historical events were acquired in the Narara Creek catchment. That data included:

- Surveyed and estimated peak flood heights presented in previous studies
- Surveyed peak flood heights from June 2007

Historic surveyed flood levels were obtained from Council for the June 2007 event and historical level survey obtained during this study on the basis of the community survey.

It is noted that electronic records of surveyed peak flood levels from earlier flood events (February 1990 and February 1992) were not available from Council; therefore these levels were derived by digitising relevant long-section plots and maps from reports of previous studies. The compiled data is presented in APPENDIX D.

From the responses to the community questionnaire, 14 locations were identified as being suitable for detailed level survey and respondents were contacted. Of these, 10 locations were actually surveyed. The remaining four (4) respondents withdrew from participating in the data collation exercise. Each of surveyed locations referred to the June 2007 event. Details of the results of that survey is presented in APPENDIX F. Available historical peak flood heights from previous studies, recently obtained surveyed peak heights from the June 2007 event collected by Council and surveyed peak heights identified during the community survey are summarised in Table 5. These historical levels are presented together with model results in Section 5.4.

**Table 5: Historical Peak Flood Heights**

Event	Relevant Report	Data Source	Number of Data Points
<i>Upper Narara Creek</i>			
Jun 2007	N/A	Council Collected Levels	5
	N/A	Current Survey Program	2
Feb 1992	Upper Narara Creek Flood Study. Kinhill, 1993.	Resident Survey and Council Collected Levels	18
<i>Lower Narara Creek</i>			
Jun 2007	N/A	Council Collected Levels	4
	N/A	Current Survey Program	2
Feb 1992	Review of Lower Narara Creek Floodplain Management Study. Kinhill, 1993	Resident Survey and Council Collected Levels	38
Feb 1990	Review of Lower Narara Creek Floodplain Management Study. Kinhill, 1993	Resident Survey and Council Collected Levels	18
<i>Narara Creek and Lower Narara Creek Tributaries West of Hanlan St</i>			
Jun 2007	N/A	Current Survey Program	4
Feb 1992	Flood Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan St	Council Collected Levels	6
Feb 1990	Flood Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan St	Council Collected Level	1
<i>Brady's Gully</i>			

Feb 1990	Flood Study for Wyoming, Wingello and Bradys Gully Creeks. Kinhill, 1991.	Resident Survey and Council Collected Levels	10
<b>Wingello Creek</b>			
Feb 1990	Flood Study for Wyoming, Wingello and Bradys Gully Creeks. Kinhill, 1991.	Resident Survey and Council Collected Levels	13
<b>Wyoming Creek</b>			
Feb 1990	Flood Study for Wyoming, Wingello and Bradys Gully Creeks. Kinhill, 1991.	Resident Survey and Council Collected Levels	11

### 3.5.3 Gauged Discharge Data

The water level gauging station on Narara Creek at Manns Road was installed in March 1996 and is operated by MHL as part of the Brisbane Water monitoring network. MHL have indicated that there is no rating curve available for this water level station, therefore gauged discharge data for Narara Creek is not available. Similarly, the water level gauging station on West Narara Creek at the former Agricultural College also does not have a rating curve. Accordingly, the combined hydrologic/hydraulic model for Narara Creek was calibrated to water level data.

## 4.0 HYDROLOGIC MODELLING

Hydrologic modelling of the Narara Creek catchment was undertaken to derive the discharge hydrographs at various locations in the catchment. A review of the previous hydrologic modelling was conducted and it was decided, due to the increased level of detail required for hydraulic modelling, to develop a completely new model. The RAFTS hydrologic model was adopted for this study.

Factors affecting the discharge volume and the peak discharge include:

- Size and slope of the catchment and adjoining channels
- Catchment land use – particularly the level of development (percentage imperviousness)
- Condition of the catchment (dry or saturated) at commencement of the rainfall
- Intensity and temporal pattern of the rainfall
- The ability of the catchment and other features to store runoff

The Narara Creek catchment has several major tributaries and flow routing is therefore important. Routing of runoff from individual subcatchments within each major tributary allows a more accurate representation of the rainfall-runoff response time at subcatchment outlet, as well as travel time from various parts of the catchment with respect to confluence of flood peaks.

### 4.1 Hydrologic Modelling System

RAFTS is a distributed hydrologic model. The Narara Creek catchment and catchments contributing to Fagans Bay were subdivided based on local catchment characteristics as listed above. The model consists of a node-link sequence with nodes representing the subcatchments and links representing the channels/overland flowpaths. For this study, the hydrologic lag approach was used to define travel time between each model node.

### 4.2 Model Setup

#### 4.2.1 Catchment Analysis

The Narara Creek Catchment comprises seven subcatchments which generally exhibit steep forested areas in the upper reaches, and relatively flat developed areas at the bottom of the valleys. The West Narara Creek subcatchment is the least developed of all the subcatchments. The catchments contributing directly to Fagans Bay also have steep forest areas in upper reaches and relatively flat developed areas around the foreshore.

Each of the catchments were broken into smaller subcatchments based on the natural topographic relief and slope and land use. Figure 8 presents the hydrologic subcatchments adopted for the RAFTS model.

Each smaller subcatchment was entered into RAFTS with its own set of catchment parameters. Typical values of catchment roughness and fraction impervious for various land uses are presented in Table 6. Detailed model input for each subcatchment is provided in the electronic data compendium. In total, the hydrologic model consists of 497 subcatchments.

**Table 6: RAFTS Catchment Characteristics**

Catchment	Parameter	Value		
		Minimum	Maximum	Average
Bradys Gully (35 nodes)	Area (ha)	1.8	17.5	9.7
	Slope (%)	1	45	23
	Impervious Fraction (%)	5	80	43

	Catchment Roughness (n)	0.015	0.060	0.038
Wyoming Creek (54 nodes)	Area (ha)	0.9	16.1	8.5
	Slope (%)	0	42	21
	Impervious Fraction (%)	5	80	42.5
	Catchment Roughness (n)	0.015	0.060	0.038
Wingello Creek (62 nodes)	Area (ha)	0.4	87.8	44.1
	Slope (%)	0	44	22
	Impervious Fraction (%)	5	50	27.5
	Catchment Roughness (n)	0.025	0.060	0.043
Upper Narara Creek (121 nodes)	Area (ha)	1.0	68.4	34.7
	Slope (%)	0	49	24
	Impervious Fraction (%)	5	80	42
	Catchment Roughness (n)	0.015	0.060	0.038
Lower Narara (125 nodes)	Area (ha)	0.2	60.3	30.3
	Slope (%)	0	56	28
	Impervious Fraction (%)	5	80	43
	Catchment Roughness (n)	0.015	0.060	0.038
Fountain Creek (39 nodes)	Area (ha)	0.9	151.5	76.2
	Slope (%)	0	39	20
	Impervious Fraction (%)	5	50	28
	Catchment Roughness (n)	0.025	0.060	0.043
West Narara Creek (36 nodes)	Area (ha)	1.7	220.4	111.0
	Slope (%)	0	42	21
	Impervious Fraction (%)	5	50	28
	Catchment Roughness (n)	0.025	0.060	0.043
Coorumbine Creek (11 nodes)	Area (ha)	9.8	139.4	74.6
	Slope (%)	0	39	20
	Impervious Fraction (%)	5	80	53
	Catchment Roughness (n)	0.015	0.060	0.038
Brisbane Water West (6 nodes)	Area (ha)	13.5	53.2	33.4
	Slope (%)	2	32	17
	Impervious Fraction (%)	5	65	35
	Catchment Roughness (n)	0.025	0.060	0.043
Presidential Hill (1 nodes)	Area (ha)	33.0		33.0
	Slope (%)	25		25
	Impervious Fraction (%)	40		40
	Catchment Roughness (n)	0.025		0.025
Gosford CBD (4 nodes)	Area (ha)	19.7	41.4	30.6
	Slope (%)	2	28	15
	Impervious Fraction (%)	20	80	50
	Catchment Roughness (n)	0.015	0.060	0.038
Point Frederick (Partial) (2 nodes)	Area (ha)	37.8	52.9	45.4
	Slope (%)	7	17	12
	Impervious Fraction (%)	5	80	42.5
	Catchment Roughness (n)	0.015	0.060	0.038

Table 7 presents the sub-catchment surface roughness and imperviousness of the whole catchment, discretised with respect to land use.

**Table 7: RAFTS Catchments Surface Roughness and Imperviousness**

Land Use Type	Roughness (Average Value)	Impervious (%) (Average Value)
Commercial / Industrial / Water Body and Foreshore	0.015	80
Residential	0.026	50
Open Area / Forest Fringe	0.042	15
Forest	0.057	5

A split approach can be used in RAFTS (first and second subcatchments) to reduce the number of subcatchments within a particular model. This overcomes the need to prepare separate subcatchments for different land-uses (residential; commercial/industrial; Open Area/Forest Fringe; Forest) and/or different slopes. i.e. two land-use types or two slope regimes can be represented in one subcatchment.

In the case of this model, a “first subcatchment only” approach was used due the very high level of discretisation adopted. Subcatchments were discretised based on slope and individual land-use type. This was also necessary to provide an appropriate level of detail for inputs into the hydraulic model, TUFLOW. Accordingly, the runoff response of differing land-uses or slopes was encapsulated directly.

## 4.2.2 Rainfall Losses

RAFTS allows distribution of rainfall losses within each sub-catchments. An Initial Loss (IL, mm) at the commencement of rainfall events is applied to primarily account for interception by vegetation. A Continuing Loss (CL, mm/hr) is also applied to each sub-catchment to account for soil infiltration. Different values for continuing loss are typically applied to different land use types (urban and rural).

Design IL (mm) and CL (mm/hr) were allocated based on recommendations in Australian Rainfall and Runoff (1987). Table 8 presents the adopted IL and CL used for both calibration and the design simulations for four dominant land use types. As noted in Section 4.2, the impervious fraction was calculated for each subcatchment dependent on the distribution of land use. Areas that are natural forested were assumed to have a high IL as a result of interception losses from the canopy of trees and also a high CL due to natural ground conditions and extensive leaf litter layer. Highly urbanised areas such as Commercial/Industrial were assumed to have low IL and CL and a high percentage imperviousness.

**Table 8: RAFTS Rainfall Losses**

Land Use Type	IL (mm) <sup>1</sup>	CL (mm/hr) <sup>2</sup>
Commercial / Industrial / Water Body and Foreshore	5	1
Residential	10	1 - 2
Open Area / Forest Fringe	15	1.5 - 2
Forest	20	2.5

<sup>1</sup> Initial Loss; <sup>2</sup> Continuing Loss

Figure 9 presents the distribution of loss model determined following hydraulic model calibration within the Narara Creek catchment and within those catchments that contribute directly to Fagans Bay.

## 4.3 Design Rainfall Data

Intensity Frequency Duration (IFD) data for the catchment was established based on data and methodology presented in Volume 2 of Australian Rainfall & Runoff (Institute of Engineers Australia, 1987). Table 9 provides the coefficients used in the IFD determination which are identical to that used in Kinhill 1991. The calculated IFD table for the catchment is presented in APPENDIX C.

**Table 9: Intensity, Frequency and Duration (IFD) Coefficients - Gosford NSW**

Duration	2 Year	50 Year
1 hr Rainfall Intensity (mm/hr)	37.4	72.5
12 hr Rainfall Intensity (mm/hr)	8.50	17.9
72 hr Rainfall Intensity (mm/hr)	2.77	6.04
G (skewness) = 0.0; F2 = 4.30; F50 = 15.90		

Design storm events were modelled in RAFTS for the following durations: 30 min, 45 min, 60 min, 90 min, 2 hr, 3 hr, 6 hr, 9 hr, 12 hr and 18 hr durations.

The Probable Maximum Precipitation (PMP) event was implemented within RAFTS using the Generalised Short Duration Method (GSDM). Relevant parameter values as well as PMP depths and PMP ellipses are



presented in APPENDIX C. The PMP was modelled using the following durations: 30 min, 45 min, 60 min, 90 min, 2 hr, 3 hr and 6 hr. It is noted that 6 hr is the limit of applicable durations for the GSDM.

## 4.4 Model Calibration

The RAFTS model could not be calibrated separately due to lack of gauged data. Indirect calibration of the model was achieved through calibration of the hydraulic model. Model results were, however, verified using other hydrologic methods as discussed in Section 4.5.1 below.

## 4.5 Design Discharge Modelling

The RAFTS model was executed for 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP and 0.2% AEP design storm events as well as the PMP event.

The peak discharge at the outlet of various subcatchments is reported in Table 10. It is noted that these are uncalibrated results and whilst appropriate to use for the purposes of comparison to other hydrologic methods, such as Rational Method detailed below, refer to detailed model output presented in Section 6.1 for calibrated flow distribution.

**Table 10: RAFTS Uncalibrated Design Peak Discharge (m<sup>3</sup>/s)**

Node ID <sup>1</sup>	Subcatchment	Design Event (AEP)							
		50% <sup>3</sup>	20% <sup>3</sup>	10%	5%	2%	1%	0.5%	0.2%
		Peak Discharge (m <sup>3</sup> /s)							
At Subcatchment Outlets									
355	West Narara Creek	85	118	136	166	198	226	256	295
143	Upper Narara Creek	51	71	82	98	118	133	150	172
315+	Fountain Creek	21	32	38	46	53	60	68	77
314+		3	8	9	10	11	12	14	16
318		4	12	13	15	17	19	21	23
379	Wyoming Creek	24	34	39	46	54	62	69	78
397	Wingello Creek	33	45	54	66	78	90	103	120
422	Brady's Gully	24	33	37	43	51	58	65	75
112 <sup>2</sup>	Lower Narara Creek	189	272	320	385	454	516	581	670

<sup>1</sup> See Figure 8 for Node location; <sup>2</sup> Narara Creek catchment outlet; <sup>3</sup> It was assumed for the purpose of consistent terminology that 50% and 20% AEP are equivalent to 2 and 5 y ARI respectively.

### 4.5.1 Model Verification

#### *Rational Method*

Verification of the model results was undertaken via comparison of predicted peak discharge from RAFTS with the Probabilistic Rational Method, in accordance with the methodology presented in Australian Rainfall and Runoff (IEAust, 1987) for Eastern NSW. Table 11 presents the respective peak discharges from RAFTS and Rational Method.

**Table 11: Comparison of Probabilistic Rational Method to RAFTS Uncalibrated Peak (m<sup>3</sup>/s)**

Node ID <sup>1</sup>	Subcatchment	Design Event (AEP)			
		50%		1%	
		Peak Discharge (m <sup>3</sup> /s)			
		Rational Method	RAFTS	Rational Method	RAFTS
At Subcatchment Outlets					
355	West Narara Creek	47	85	203	226
143	Upper Narara Creek	33	51	142	133
315+314+318	Fountain Creek	23	28	98	102
379	Wyoming Creek	16	24	69	62
397	Wingello Creek	22	33	94	90
422	Brady's Gully	14	24	58	58
112 <sup>2</sup>	Narara Creek catchment	112	189	481	516

<sup>1</sup> See Figure 8 for Node location; <sup>2</sup> Narara Creek catchment outlet; <sup>3</sup> It was assumed for the purpose of consistent terminology that 50% and 20% AEP are equivalent to 2 and 5 y ARI respectively.

From Table 11 the Rational Method peak discharge for the 50% AEP event and 1% AEP event is less than the RAFTS model peak discharges in West Narara Creek and Narara Creek. In general, results are, however, consistent within the limit of variability of hydrologic analysis.

## 5.0 HYDRAULIC MODELLING

Hydraulic modelling was undertaken to determine flood flows, velocities and flood levels within the Narara Creek Catchment and to present preliminary flood levels within Fagans Bay. The TUFLOW hydraulic model was selected for this purpose because it can combine one-dimensional (1D) open channel network, two-dimensional (2D) flow on the floodplain in a single model together with culverts and pit and pipe drainage networks. A review of previous hydraulic models was undertaken and relevant data extracted. Previous hydraulic models were 1D only.

Elements of the new TUFLOW hydraulic model for Narara Creek include:

- Model geometry (1D and 2D)
- Surface roughness
- Boundary conditions (hydrographic inflow and fixed water level such as tides)
- Points or continuous lines of exchange between 1D and 2D model components

All model components, both 1D and 2D geometry, including model control files and model results, are presented in the electronic data compendium attached to this report.

Model layout, selected 1D model geometry and selected model output (flow, velocity and flood height) is presented in APPENDIX E.

## 5.1 Model Geometry

### 5.1.1 Model Extent and Grid Size

The extent of the TUFLOW model is presented in Figure 10. The DEM of Narara Creek Catchment is also presented in Figure 10. It is noted that DEM2007 did not extend into the north west of the catchment. In that area, DEM2005 was used during construction of the hydrologic model.

The hydraulic model extends from the Broadwater adjacent Point Frederick in the south, west to Coorumbine Creek as well as the former Agricultural College, north to above Siletta Road and east to encompass Bradys Gully, Wingello and Wyoming Creeks and the boundary between Narara Creek catchment and Cutrock Creek Catchments.

The selected grid size of the model was 5 m, with the grid oriented North-South in the MGA94Z56 coordinate system. The grid comprises 1,999,500 grid cells (6.45 km X 7.75 km), of which 590,988 cells are active in the model. The active cells are those cells which fall within the model extent indicated in Figure 10.

### 5.1.2 Model Approach

In general, the model approach adopted for the study consisted of open channels and creeks represented in 1D, with floodplain in 2D. Trunk pit and pipe drainage network was modelled in 1D and connected to the 2D component at appropriate locations. The 1D extent within the 2D grid is presented in Figure 10. Within that 1D extent, the 2D grid was deactivated and hydraulic calculation was undertaken in 1D only. 1D and 2D water levels are balanced at the edge of the 1D model extent such that creeks and open channels can break out of bank and flow onto the floodplain and vice-versa.

### 5.1.3 1D Geometry

1D elements in TUFLOW comprise: open channels, culverts, weirs, pipes, pits and cross-sections. Details of the survey data used for the 1D geometry are presented in Section 3.1, 3.2 and 3.3.

#### Open Channels

Creek systems within the Narara Creek catchment were modelled in 1D wherever appropriate. 1D open channel elements in TUFLOW consist of channel length and cross-sections.

Cross-sections were determined based on:

- Formal surveyed sections (below tidal limit and the lower parts of Wyoming and Wingello Creeks)
- Constructed sections based on survey of existing hydraulic structures (available from NSW RTA or obtained as part of this study)
- Sections derived from sampling of DEM2007

Figure 11 presents the location of open channels and other hydraulic structures such as culverts and trunk and pipe drainage. Figure 3 presents the location of model cross-sections.

Table 12 presents a summary of the 1D open channel elements in TUFLOW. Mannings roughness of open channel were allocated based on aerial photography and land-use maps and adjusted during model calibration. Adopted values of channel roughness, following calibration are presented in Section 5.4.5

**Table 12: TUFLOW 1D Open Channel Elements**

# Channels	Length	Total Length	# Cross-Sections
997	6 – 182 m, 41 m ave	40.7 km	243 Surveyed, 796 Derived from DEM (Total Cross-Sections = 999)

## Culverts and Weirs

Hydraulic structures such as culverts and weirs were also modelled in TUFLOW in 1D. Culverts require dimension information, whether circular or rectangular, as well as upstream and downstream inverts and relevant hydraulic losses and roughnesses. Invert levels were obtained from survey information obtained as part of this study or from survey provided by Council from the NSW RTA. If no other information was available, inverts were estimated from the DEM.

Weir dimensions were also applied to each culvert such that culvert could be submerged and flow modelled across road or railway. Geometry of weirs (width and cross-section) were set based on survey information or DEM.

Where there was a fence or handrail that could present an impediment to weir flow, a blockage factor was applied. Blockage factors ranged between 25% for tubular metal handrails to 90% for vertical rectangular metal bar fences. Layout of the hydraulic model is presented in APPENDIX E including attribute data. Blockage factors applied at every structure are presented in the attribute data.

Hydraulic losses and adopted roughness applied to culvert elements are summarised in Table 13.

**Table 13: TUFLOW 1D Culvert Elements**

Culverts <sup>1</sup>	Length	Dimensions	Manning's n*	Hydraulic Losses
28	7.5 – 50.5 m, 11 m ave	Circular: 1 x 300 mm to 3 x 3050 mm  Rectangular: 1 x 2400X1200 mm to 6 x 2400X1200 mm	0.017	Circular culvert inlet controlled contraction coefficient = 1.0 Rectangular and irregular culvert height contraction coefficient = 0.6 Rectangular and irregular culvert width contraction coefficient = 0.9 Culvert inlet loss coefficient = 0.5 Culvert outlet loss coefficient = 1.0

\* Assumed to be aged structures. Parameter value not adjusted during model calibration; <sup>1</sup> TUFLOW 1D model type = "CW" or "RW".

## Bridges

Bridges within the Narara Creek Catchment were also modelled in 1D. 1D bridges in TUFLOW consist of definition of open area as well as form loss with respect to elevation. Form losses were set based on presence and width of bridge piers and dimensions of bridge elements. Weir elements were allocated to each bridge to account for depth of superstructure, pedestrian railing, if relevant and weir geometry (width, cross-section). Table 14 presents a summary of bridge elements used in TUFLOW.

**Table 14: TUFLOW 1D Bridge Elements**

# Bridges <sup>1</sup>	Adopted Hydraulic Losses (K)
26	Within Open Area (from base up to within 10% of soffit): 0.2 to 1.0 (dependent on bridge structure) Superstructure (from within 10% of soffit to top of deck): 1.56 Handrail/Fencing: 1.4 Above Handrail/Fencing: 1.0

<sup>1</sup> TUFLOW 1D model type = "B" or "BW".

## Pits and Pipes

Trunk drainage network (diameter greater than 600 mm) was included in TUFLOW where the main watercourse had been piped. This network was also implemented (including pipes less than 600 mm) where required to improve model representation of the area.

The pipe network in TUFLOW requires dimensions, whether circular or rectangular, roughness and form loss coefficient. In general, pipe length is derived from length of model object in GIS. Pipe inverts are obtained from pit inverts and interpolated elsewhere, if required. If a pipe discharges to a 2D grid cell or to an open channel, the downstream invert is required.

Form loss coefficients were applied where a pipe lay downstream of a pit or pipe junction. Table 15 presents form loss coefficients adopted for this study.

**Table 15: TUFLOW 1D Pit and Pipe Form Loss Coefficients**

Type of Pit	Pit Loss Coefficient, $K^1$
Pit at the top of a line	5.0
Pit with a straight through flow, no sidelines, 50% grate inflow	1.4
Pit with a right angle direction change, no sidelines	1.7
Pit with a straight through flow, one or more sidelines	2.2
Pit with a right angle direction change from two opposed inflow pipes	2.0

<sup>1</sup>Adapted from DRAINS User Manual (Watercom, 2009)

Pit elements in TUFLOW require pit type and invert. Pit surface level was obtained from the 2D grid such that the 1D and 2D model components were dynamically connected. The pit types were predefined and in this case consist of depth-discharge hydraulic characteristic curves determined for standard pit inlet configurations. The type of pits used in this TUFLOW model are summarised in Table 16.

**Table 16: TUFLOW 1D Pit Types**

Element Type	Mode	Slopes	Dimensions	Name <sup>1</sup>
Kerb Inlet with Grate	on-grade	2%, 4%, 6%, 8%, 10%, 12%, 14% and 16%	Kerb inlet (2.4 m) with Grate (0.95 m x 0.45 m)	e.g. 10%Horn2400
Kerb Inlet with Grate	sag	N/A	Kerb inlet (2.4 m) with Grate (0.95 m x 0.45 m)	e.g. 2%Horn2400-S
Grate Only	on-grade	2%, 4%, 6%, 8%, 10%, 12%, 14% and 16%	Grate (0.95 m x 0.45 m)	e.g. 6%RM7
Grate Only	sag	N/A	Grate (0.95 m x 0.45 m)	e.g. 2%RM7-S

<sup>1</sup> depth-discharge curves based on Department of Main Roads (1979), *Model Analysis to Determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings*, Sydney, as cited in DRAINS User Manual (Watercom, 2009)

In general, there were no pit invert level data available. Inverts were therefore interpreted based on an assumed level of cover above particular pipe

It is noted that different lintel lengths in a standard kerb inlet with grate pit were not included in the model database since the level of detail for this study is not equivalent to a local drainage analysis. The depth-discharge relationship was scaled, however, using a multiplication factor on the pit element where there were 'double' or 'triple' pits. Layout of the hydraulic model is presented in APPENDIX E together with all attribute data including where 'double' or 'triple' pits were utilised.

Table 17 presents the summary of the pit and pipe network.

**Table 17: TUFLOW 1D Pit and Pipe Network**

# Pits	# Pipe Elements <sup>a</sup>	Pipe/Culvert Dimensions	Manning's n <sup>*</sup>	Form Loss Coefficient
563	1728	Circular: 300 mm to 3000 mm  Rectangular: 1200 X 800 mm to 3000 X 3700 mm	0.017	0 - 5.0

\* Assumed to be aged structures. Parameter value not adjusted during model calibration; <sup>a</sup> TUFLOW 1D model type = "C" or "R".

The depth-discharge relationships used in TUFLOW are presented in APPENDIX E. It is noted that a blockage factor of 20% for 'on-grade' and 50% for 'sag' pits was applied during design event modelling; however, no blocking factor was applied with respect to modelling of calibration events. Further discussion of pit blockage factors is presented in Section 5.2.2.

### 5.1.4 2D Geometry

2D elements in TUFLOW consist of: elevation grid, surface roughness, layered flow constrictions and building footprints. A description of these elements is presented below:

#### **Elevation Grid**

The elevation dataset is constructed using a series of ground survey layers, with subsequent layer overwriting and updating elevation information one on top of another.

For the Narara Creek model, the base elevation dataset was DEM2007, where the elevation was uploaded directly and then subsequently modified at specific locations as required.

In general, there were few changes to the elevation dataset. Changes that were undertaken included:

- Smoothing channel definition within 2D floodplain at inlets and outlets of particular culverts

#### **Surface Roughness**

Surface roughness throughout the 2D grid was defined in terms of Manning's n. 2D surface roughness was used as a calibration parameter. Calibrated values for 2D surface roughness are presented in Section 5.4.5.

#### **Layered Flow Constriction**

A layered flow constriction is an approach to modelling bridges in 2D. Layered flow constrictions are similar to the 1D approach to modelling bridges in that they incorporate blockage above the soffit and free-overfall when water level exceeds the top of the bridge deck. Form loss coefficient with respect to depth is defined within the layered flow constriction object. Bridges were modelled in 2D at Narara Creek overflow channel at Manns

Road adjacent the Nursery and the railway bridge at Brookes Avenue. This 2D approach was adopted at Manns Road to overcome model stability constraints due to poor channel definition. At the railway bridge at Brookes Avenue, the 2D approach was used due to unique circumstance of downstream side of bridge being deliberately filled and this bridge potentially only being active when Narara Creek is in significant flood.

### **Building Footprints**

There are several approaches to modelling the impact of buildings within the floodplain. The approach adopted in this study, with agreement from Council, was a block-out of building footprint plus a high surface roughness applied to the relevant cadastral lot. The block-out of building footprint consisted digitising the building extent and raising the elevation beneath the footprint by 5 m above the floodplain. In total, about 1400 buildings were digitised within the catchment area.

## **5.2 Model Boundaries**

Appropriate boundaries were adopted for the modelling of historic and design flood events. A discussion on the model boundaries is presented below. Figure 12 presents the location of boundary conditions used in the hydraulic model.

### **5.2.1 Downstream Water Level Boundary**

The downstream water level boundary condition was established in the Broadwater adjacent to Point Frederick at the lower end of the 2D grid. Data from the Wharf St and Punt Bridge water level time-series gauges were used for calibration events whereas the relevant level from the Brisbane Water Foreshore Study (Cardno, 2008) was used in design flood modelling. Table 18 presents the adopted values used in this study. From Table 6.3 in the Cardno report (Cardno, 2008), the 1% Probability of Exceedance (PoE) value at Point Frederick is 0.72 mAHD. This was based on analysis of Brisbane Water estuary and is the water level that will be exceeded only 1% of the time.

**Table 18: TUFLOW 2D Downstream Water Level Boundary**

<b>Model Name</b>	<b>Event Description</b>	<b>Dataset / Adopted Value</b>	<b>Comment</b>
<b>Calibration Events</b>			
CAL07	June 2007	7/6/2007 0:00 to 10/6/2007 0:00 (84 hours)	Punt Bridge
CALTIDE	24 hr Tidal Cycle	1/6/2007 0:00 to 2/6/2007 :00 (24 hours)	Punt Bridge
CAL7FEB90	7 February 1990	7/2/1990 0:00 to 7/2/1990 18:00 (18 hours)	Wharf St
CAL90	2 February 1990	2/2/1990 0:00 to 5/2/1990 0:00 (72 hours)	Wharf St
CAL92	February 1992	8/2/1992 0:00 to 11/2/1992 0:00 (72 hours)	Wharf St
<b>Design Events</b>			
2 y	50% AEP Design Event	0.72	1% PoE
5 y	20% AEP Design Event	0.72	1% PoE



10 y	10% AEP Design Event	0.72	1% PoE
20 y	5% AEP Design Event	0.72	1% PoE
50 y	2% AEP Design Event	0.72	1% PoE
100 y	1% AEP Design Event	0.72	1% PoE
200 y	0.5% AEP Design Event	0.72	1% PoE
500 y	0.2% AEP Design Event	0.72	1% PoE
PMF	Probable Maximum Flood	0.72	1% PoE

### 5.2.2 Inflow Hydrographs

Output from the RAFTS model described in Section 4.1 was used as input to the hydraulic model as inflow hydrographs. Generally, inflow hydrographs were applied to 1D open channels, distributed over several nodes as appropriate. In some cases, inflow hydrographs were applied directly to the 2D grid.

For 1D pits and pipes, inflow hydrographs were applied to the bottom of pit channels rather than at ground surface. This was because only trunk drainage was included in the model and accordingly, it was necessary to represent stormwater flow already 'entrained' in the pipe network. To account for multiple potential water connection points, pipe lengths were also subdivided between pits, where appropriate, such that inflows were smoothly distributed rather than all being applied at the base of only a few pits.

It is therefore noted that on-grade and sag depth-discharge relationships were only relevant for surcharging pits and where surcharged stormwater flow re-entered the stormwater network further down-gradient.

Figure 10 presents the location of model boundary conditions.

### 5.2.3 Initial Conditions

Initial conditions are the starting position when the model commences. In this case the initial condition was set based on first value of the downstream time-series water level boundary. That initial condition was applied to both the 1D and 2D model components and represented by downstream water level boundary as presented in Table 18.

## 5.3 Model Output Processing

Model output is presented on a 5 m regular grid aligned to the 2D model extent. Within the 1D open channel extents, results were also uploaded to the regular grid. The 1D results were extracted from internal output from TUFLOW which is based on linear interpolation between 1D channel nodes.

## 5.4 Model Calibration

Model calibration consists of comparing recorded historical observations against model output and adjusting model parameters, within an acceptable range, to achieve appropriate agreement. In this case, the primary model parameters were 2D surface and 1D channel roughness, infiltration losses in the hydrologic model and energy losses at hydraulic structures. IL and CL parameter values are presented in Section 4.2.2 and were dependent on land-use. Those values for IL and CL were adopted in calibration and design flood models.

Five events were utilised during model calibration. These included:

- 24 hr tidal-cycle
- June 2007
- 2 February 1990
- 7 February 1990
- February 1992

#### 5.4.1 Model Geometry

The tidal time-series and June 2007 model setup is based on conditions current at that time. The 2 February 1990, 7 February 1990 and February 1992 model setup required further modification to account for flood mitigation measures that have been implemented following those events. Those changes included:

- Upper Narara Creek
  - Silleta Road basin
  - Channel improvement works – Koninderie Parade
  - Levee bank constructed – upstream of Haggerty Close
- West Narara Creek
  - Hanlan St causeway upgraded
- Reeves Creek
  - Culvert on Reeves St near Manns Road upgraded
- Lower Narara Creek
  - Railway bridge blocked – Brookes Avenue
  - Levee bank and detention basin – Brookes Avenue
  - Channel widening, Showground Rd causeway and overflow channel
  - Homes removed from Showground Round
  - Creek realigned and new bridge on Showground Road
  - Homes removed and land lowered – Rowena Road
  - Floodway excavated – north of Glennie St West
  - Part of old sewage treatment pond removed
- Wyoming Creek
  - Chamberlain Road culvert
  - Channel lining and rock chute construction below Alan Davidson Park
  - Blockage by debris downstream of Day St culvert (2 February and 7 February 1990 events only)
  - Blocked Day St culvert by 25%
  - Outlet realigned, new culverts under Pacific Highway
- Wingello Creek
  - Channel and culvert upgrade to 1% downstream of Pacific Highway

- Outlet realignment at Willow Motel
- Pecan Close retarding basin upgraded
- Weir and footbridge within former Reptile Park including channel works
- Channel works Warrawilla Road
- Bradys Gully
  - Channel and Henry Parry Drive culverts upgraded to 1%
  - Blocked Laycock St by 25%
  - Channel and Kirkness Ave culvert upgraded to 1%
  - Jarrett St pipe drainage

The location plan provided by Council of mitigation works that have occurred since the February 1992 event is presented in APPENDIX E.

#### 5.4.2 Pluvio Data Distribution

Available pluviograph data was reviewed with respect to each rainfall event. As discussed in Section 3.5.1, pluvio data that was suspect was excluded. An equal-area weighting approach was adopted with respect to the remaining data (thiessen polygons).

Figure 5, 6 and 7 present the adopted pluviograph distribution with respect to the June 2007, 2 February 1990, 7 February 1990 and February 1992 events respectively. It is noted that the pluviograph distribution used for the 2 February 1990 event was also used for 7 February 1990 event.

#### 5.4.3 Calibration Approach

Historical pluviograph data was then distributed within the hydrologic model as described in Section 3.5.1 and the hydraulic models were executed. Various sets of values for 2D surface and 1D channel roughness and structure loss coefficients were trialed until an acceptable agreement between modelled and observed data was achieved.

Review of historical aerial photography (from approximately 1991) indicates that land use changes within the catchment have not been substantial, except for flood mitigation measures discussed in Section 5.4.1. Accordingly, the same 2D surface roughness distribution was adopted for both earlier flood events (2 and 7 February 1990 and February 1992) and the recent flood event (June 2007).

For 1D open channels, a consistent set of channel roughness were adopted for the 2 February 1990, 7 February 1990 and February 1992 events since they all occurred relatively close to one another with respect to time. For the 2007 and tidal calibration events, a separate set of 1D channel roughness were calculated since there were a number of flood mitigation measures introduced within the catchment following the 1990 and 1992 events.

#### 5.4.4 Calibration Data

Calibration data was obtained from several sources. As discussed in Section 3.5.2, time-series water level data was available from former Agricultural College with respect to earlier flood events (2 and 7 February 1990, February 1992) and current Manns Road gauge with respect to recent flood event (June 2007).

Peak water level data for earlier flood events (2 and 7 February 1990, February 1992) were digitised from graphical plots in previous reports or extracted from tables. A copy of the reported data is presented in APPENDIX D.

Surveyed locations of historical observation were not available and instead were presented in previous report according to chainage. Chainages from various models were digitised based on figures in previous reports, therefore were not exact. Whenever landmark information was available, this was used to 'site' the observation as closely as possible.

The extent of culvert blockages during historical events is uncertain. Blockages were applied to Laycock St and Day St culverts (25%) for earlier flood events, however, these were approximate. A blockage factor was applied to those culverts, in particular, because they now currently have a blockage prevention system in place.

Peak water level data for the recent June 2007 event were obtained from survey conducted by Council at that time or survey obtained as part of this study. Comment is provided with respect to the source and quality of each observation, where applicable. The location of observation points are presented in relevant maps of model results.

### 5.4.5 Calibrated Parameters

The distribution of calibrated 2D surface roughness is presented in Figure 13A and summarised in **Table 19**

**Table 19: Calibrated TUFLOW 2D Surface Roughness Values**

Landuse	Manning's n
Vegetated Waterway	0.080
Heavily Vegetated Waterway	0.100
Park/Sports Field/Bare Ground	0.035
Pasture/Urban Floodplain	0.050
Road/Carpark	0.020
Building/Stabiliser	0.100
Fagans Bay	0.035

Different sets of 1D channel roughnesses were used for earlier flood events (2 and 7 February 1990, February 1992) and recent flood event (June 2007) to account for flood mitigation measures introduced within the catchment following the earlier flood events.

Table 20 presents a summary of the calibrated TUFLOW 1D channel roughnesses. Figure 13B and 13C presents the distribution of these calibrated roughness in plan view.

**Table 20: Calibrated TUFLOW 1D Channel Roughnesses**

Creek System and Reach	1D Manning's n	
	June 2007	2 February 1990, 7 February 1990 and February 1992
<b>Narara Creek</b>		
Fagans Bay to Dell Rd	0.035	0.035
Dell Rd to Showground Rd	0.04	0.04
Showground Rd to Manns Rd	0.05	0.05
Manns Rd to Narara Valley Drive	0.06	0.06

Creek System and Reach	1D Manning's n	
	June 2007	2 February 1990, 7 February 1990 and February 1992
Narara Valley Drive to end of Koninderie Parade	0.05 – 0.06	0.05-0.06
End of Koninderie Parade to Railway Crescent	0.08	0.08
Railway Crescent to Alan St	0.08	0.08
<b>Bradys Gully Creek</b>		
Showground Rd to Pacific Hwy	0.06	0.06
Pacific Hwy to Cary St	0.05	0.06
Glennie St to above Brady Gullys Rd	0.04	0.04
Above Bradys Gully Rd to Stachon St	0.06	0.06
<b>Wingello Creek</b>		
Railway Bridge to Akora Rd	0.06	0.08
Akora Rd to Pacific Hwy	0.04	0.08
Pacific Hwy to Veronica Crescent	0.08	0.08
Veronica Crescent to Fuschia St	0.04	0.04
Fuschia St to Turpentine St	0.06-0.08	0.06-0.08
Fuschia St to Warawilla Rd and above	0.08	0.08
<b>Wyoming Creek</b>		
Railway Bridge to Pacific Hwy	0.04	N/A
Pacific Hwy to Alan Davidson Park	0.04	0.08
Alan Davidson Park to Day St concrete channel	0.05	0.05
Day St concrete channel to Day St culvert	0.03	0.07 (2 and 7 Feb 1990) <sup>1</sup> 0.03 (Feb 1992)
Day St to Chamberlain Rd	0.04-0.05	0.04-0.05
Chamberlain Rd to Chamberlain Rd and above	0.04	0.04
<b>Upper Narara Creek</b>		
Parallel to Railway Crescent and above	0.08	0.08
<b>Fountain Creek</b>		
Above Carrington St bridge	0.08	0.08
West Narara		
Above Hanlan St culvert	0.08	0.08

<sup>1</sup> Due to blockage in 2 and 7 February 1990 events.

### 5.4.6 Calibration Results

TUFLOW results were extracted from each simulation and are presented in long-section, in plan and in tabular format against historical observations including time-series observation where available (the location of time-series observation for June 2007 and 24 hr tidal cycle is different for 2 February 1990, 7 February 1990 and February 1992).

The TUFLOW control files associated with the calibration results presented below are:

- GA\_CALTIDE\_08 = 24 hr tidal cycle
- GA\_CAL07\_58.tcf = June 2007 event
- GA\_CAL90\_40.tcf = 2 February 1990 event
- GA\_CAL7FEB90\_23.tcf = 7 February 1990 event
- GA\_CAL92\_30.tcf = February 1992 event

## Tidal Calibration

The current Narara Creek cross-section data was used for this model calibration.

Figure C presents a time-series comparison between observation and modelled water level at Manns Road gauging station. This TUFLOW simulation did not include rainfall input. The downstream tidal boundary condition is also presented in this figure to illustrate the tidal lag.

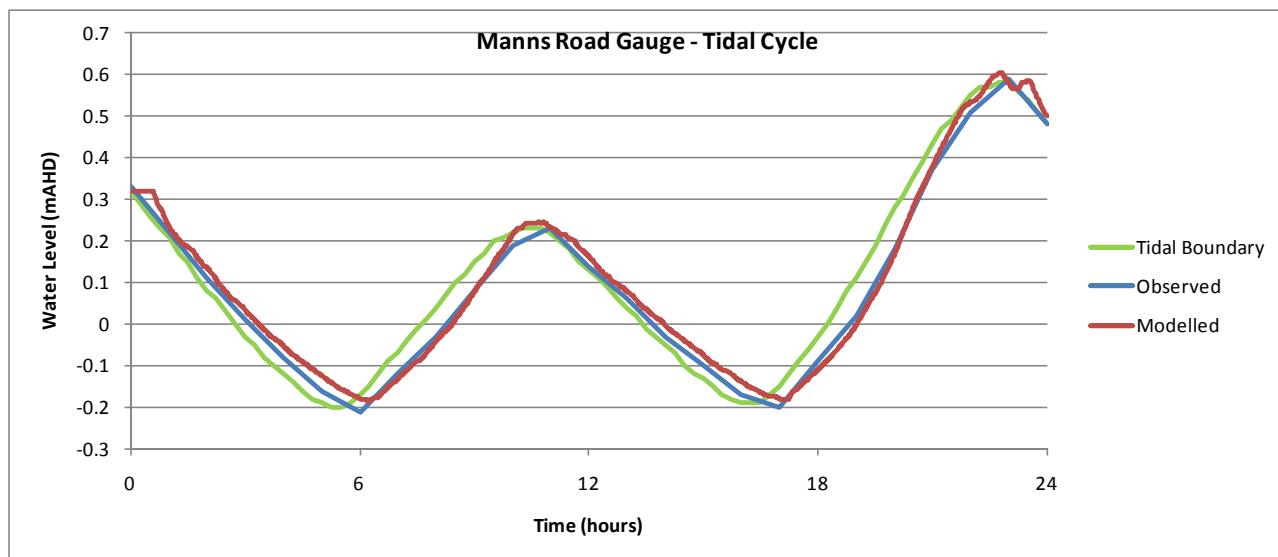


Figure C: Time-Series Observation against Modelled - 24 Hour Tidal Cycle

Model simulation indicates close agreement with observation, both with respect to water level and timing of tidal peaks. Model results imply that the hydraulic characteristics of Narara Creek, below Manns Road, are reasonable.

## June 2007

Figure 14 presents the location of long-sections used to illustrate model calibration and present design flood profile. Figure 15 to 18 present relevant long-section plots of maximum flood height for the June 2007 event with respect to available historical observation. Soffits of bridges and ground cover on culverts are also presented. It is noted that the maximum height is recorded throughout the simulation and the presented water surface profile represents the maximum level from any timestep.

Figure 19 presents modelled maximum flood depth from the June 2007 event in plan view, together with contours of modelled flood height. Location of surveyed historical observation is also presented in Figure 19, together with their recorded values.

Anecdotal historical observation data is also presented in Figure 19. These data were determined from analysis of community survey results. Responses were categorised into the following:

- property not affected
- backyard or front yard affected
- above floor flooding.

Figure D presents time-series comparison where observation from the current Manns Road water level gauging station was compared to model simulation.

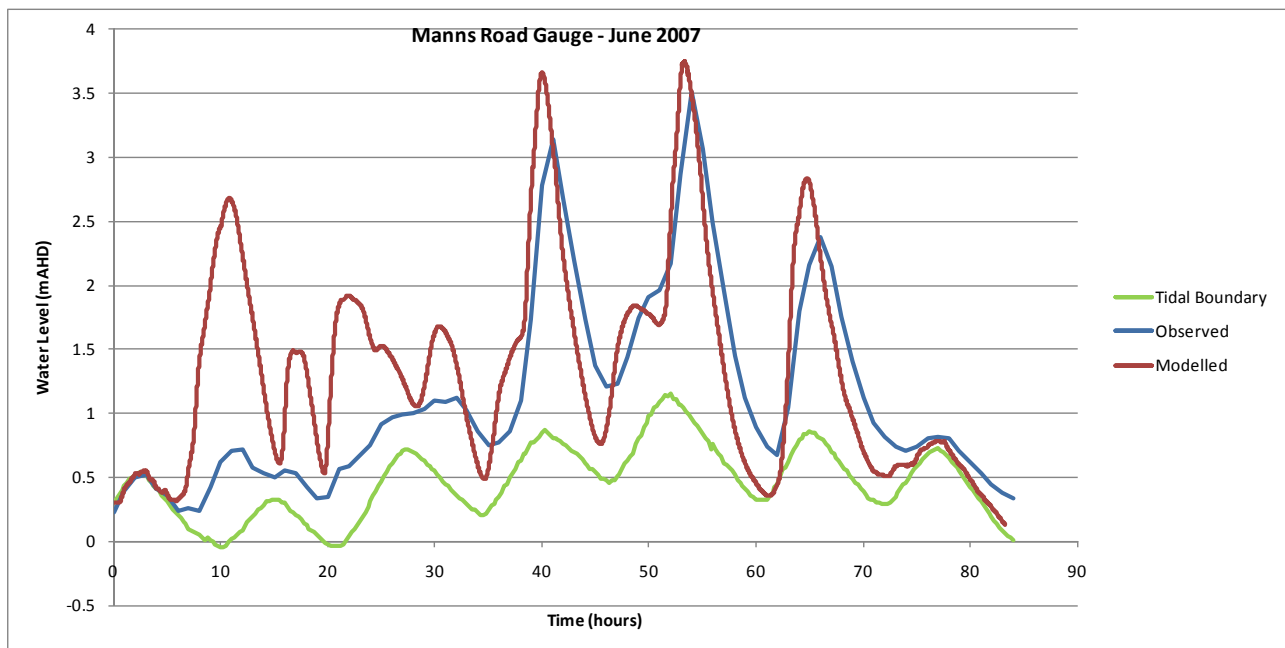


Figure D: Time-Series Observation against Modelled - June 2007

Table 21 presents tabulation of modelled maximum flood height against historical observation for June 2007 event. Comment is provided where there is significant departure between observed and modelled.

Table 21: Observed Vs Modelled – June 2007 Event.

Chainage (m)	Observed Flood Level (mAHD)	Peak Modelled Flood Level (mAHD)	Difference (m)	Source
<b>Narara Creek (Figure 14)</b>				
2868	2.32	2.51	0.2	Resident Interview
3905	2.92	2.88	0.0	Gosford Council
5127	3.51	3.76	0.3	Resident Interview
5792	4.69	4.61	-0.1	Resident Interview
6625	7.61	7.67	0.1	Gosford Council
6823	8.37	8.29	-0.1	Gosford Council
6893	8.51	8.57	0.1	Gosford Council
7002	9.02	8.91	-0.1	Resident Interview
7196	9.25	9.25	0.0	Resident Interview
8913	15.68	15.15	-0.5	Gosford Council
<b>West Narara (Figure 15)</b>				
163	6.28	6.01	-0.3	Gosford Council

Chainage (m)	Observed Flood Level (mAHD)	Peak Modelled Flood Level (mAHD)	Difference (m)	Source
627	7.40	7.26	-0.1	Resident Interview
778	7.88	7.89	0.0	Resident Interview
<b>Bradys Gully (Figure 16)</b>				
159	2.88	2.94	0.1	Gosford Council
203	2.49	2.98	0.5 <sup>BG1</sup>	Gosford Council
229	3.00	3.42	0.4	Gosford Council
<b>Fountains Creek (Figure 17)</b>				
1076	9.00	8.39	-0.6	Resident Interview
1146	9.38	9.06	-0.3	Resident Interview

<sup>BG1</sup> Railway Bridge

Model simulation indicates close agreement with historical observation. Time-series observation, Figure D, indicates representation of rainfall-runoff and routing within the hydrologic and hydraulic model is appropriate, with timing of various flood peaks being acceptably matched.

Within Bradys Gully Creek, the observation point (CH203, 2.49 mAHD {BG1}) is not well matched; however, all three observations are located within close proximity to one another, therefore this point is considered suspect.

Adopted value for continuing loss, CL, appear to be appropriate with respect to flood peaks, however, review of pre-flood peak results in Figure D suggest time-dependency of CL as catchments become progressively wet over the period of the storm. A higher value of IL and CL appears to be required early in the simulation although is appropriate at the time of flood peak. Another possibility is that the IL-CL model is not suitable for the dry catchment, but once the catchment is wet, the CL provides appropriate representation of the losses. IL and CL parameters are presented in Section 4.2.2.

Due to the “embedded storm” concept for design rainfall, the impact of this limitation (time-varying antecedent moisture condition or different loss models) is not considered significant because design simulations are undertaken assuming ‘wet’ catchment conditions.

Similarly, detailed examination of the time-series in Figure D indicates recession limbs following individual flood peaks are not well matched since attenuation due to groundwater-surface water interaction is not accounted for in either the hydrologic or hydraulic model. This limitation, however, does not impact upon the objective of predicting flood peak and its timing peak.

Comparison of historic flood levels in various creeks shows good agreement (Table 21). Majority of modelled flood levels are within 0.1 m of historic levels.



## 2 February 1990

Figure 20 and 21 present relevant long-section plots of maximum modelled flood height with respect to the 2 February 1990 event. Long-sections are presented from Lower and Upper Narara Creek and West Narara Creek. Figure 22 presents plan view of modelled maximum flood height and flood depth together with available surveyed historical locations including anecdotal historical observations from community survey.

Figure E presents time-series comparison between observed and modelled flood height at former Agricultural College station at the base of the upper reaches of West Narara Creek.

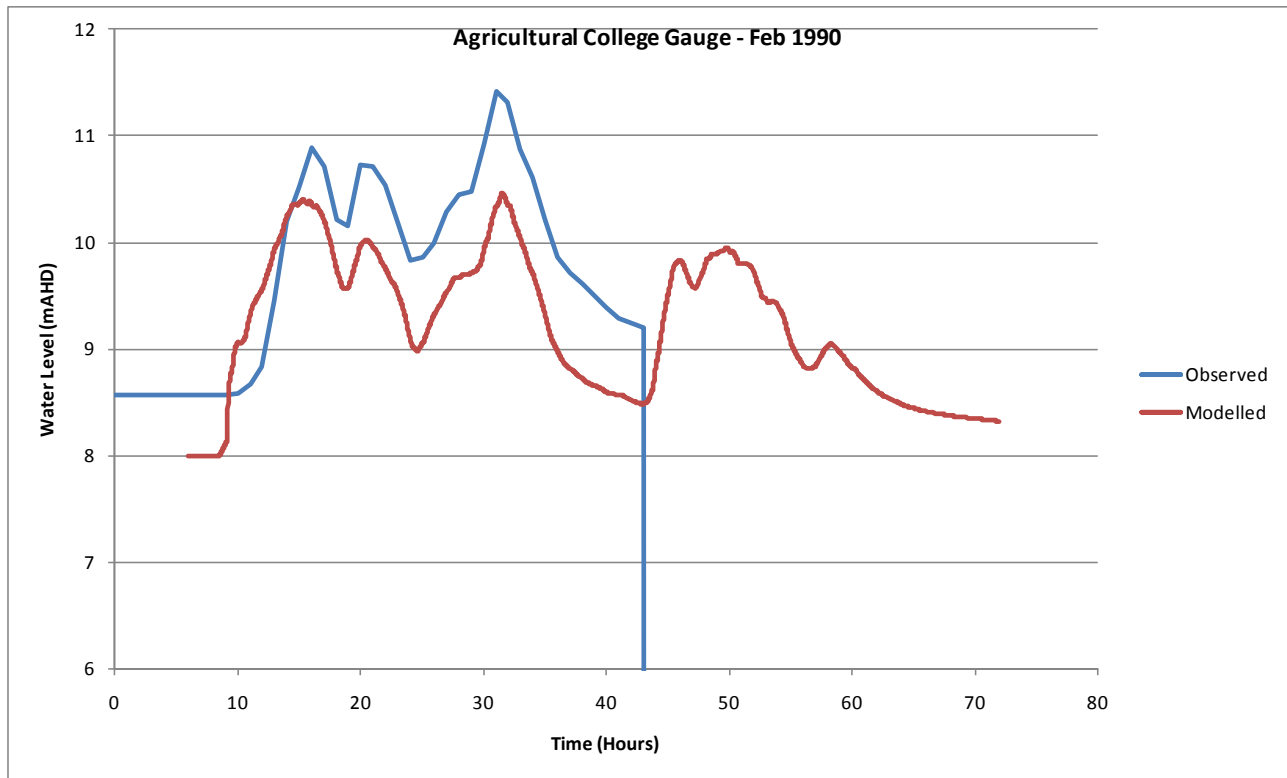


Figure E: Time-Series Observation against Modelled - 2 February 1990 event

Table 22 presents tabulation of modelled flood height against observations for the 2 February 1990 event. Comment is provided where there is significant discrepancy between model results and observation.

Table 22: Observed Vs Modelled - 2 February 1990 event

Chainage (m)	Observed Flood Level (mAHD)	Peak Modelled Flood Level (mAHD)	Difference (m)	Source
<b>Narara Creek (Figure 20)</b>				
1771	1.73	1.95	0.2	PWD MHR
3522	2.65	2.66	0.0	Resident Interview
3580	2.71	2.66	0.0	Resident Interview
3622	2.54	2.68	0.1	Resident Interview
3646	2.53	2.68	0.2	Resident Interview
3674	2.67	2.70	0.0	PWD MHR
3700	2.60	2.70	0.1	Resident Interview
3873	2.93	2.73	-0.2	PWD MHR
3873	2.93	2.73	-0.2	Resident Interview
3895	2.64	2.73	0.1	Resident Interview
3923	2.76	2.73	0.0	Resident Interview
3923	2.89	2.73	-0.2	Resident Interview
4020	2.86	2.78	-0.1	Resident Interview
4101	2.77	2.78	0.0	Resident Interview
4126	2.90	2.83	-0.1	Resident Interview
4521	3.14	2.96	-0.2	Resident Interview
4601	3.19	2.97	-0.2	Resident Interview
4683	3.22	3.00	-0.2	Resident Interview
4866	3.29	3.20	-0.1	Resident Interview
5106	3.31	3.63	0.3 <sup>NC1</sup>	PWD MHR
5127	4.18	3.65	-0.5 <sup>NC1</sup>	Resident Interview
5641	4.34	4.16	-0.2	Resident Interview
5722	5.08	4.38	-0.7 <sup>NC2</sup>	Resident Interview
<b>West Narara (Figure 21)</b>				
106	5.73	5.62	-0.1 <sup>WN1</sup>	Resident Interview

1168	9.50	8.69	-0.8	Resident Interview
1892	11.40	10.24	-1.2 <sup>WN2</sup>	MHL Gauge

<sup>NC1</sup> downstream of Manns Rd bridge; <sup>NC2</sup> upstream of Carrington St bridge; <sup>WN1</sup> Hanlan St causeway; <sup>WN2</sup> gauge at former Agricultural College

Time-series results presented in Figure E suggests under-prediction of flood level at former Agricultural College by approximately 100 cm with respect to this event, although timing of storm event appears reasonable. Given that the water level gauge failed part-way through this storm event, the degree of reliance to place on this data point is not clear.

Long-section profiles indicate good agreement between model simulation and observation; however, observations for this event are clustered within Lower Narara Creek and there is only one point at the former Agricultural College (CH1892, 11.40 mAHD {WN2}) and a point between the Agricultural College and Hanlan St upon which to assess the calibration. Long-section profile from June 2007 event, where reasonable calibration was achieved (Table 21), implies hydraulic representation of West Narara Creek is reasonable.

Two other discrepancies with respect to the 2 February 1990 event include upstream of Carrington St bridge (CH5722, 5.08 mAHD {NC2}) and immediately downstream of Manns Road bridge (CH5106, 3.31 mAHD and CH5127, 4.18 mAHD {NC1}).

Detailed survey information pertaining to the data point upstream of Carrington St (CH5722, 5.08 mAHD {NC2}) was not available; therefore the quality of this data point could not be ascertained. Review of this data point against model results suggests that the flood level refers to the February 1992 event rather than the 2 February 1990 event.

The data points downstream of Manns Road (CH5106, 3.31 mAHD and CH5127, 4.18 mAHD {NC2}) are simultaneously under-predicted and over-predicted. One observation was obtained from resident interview whereas the other was derived from a Public Works Department Maximum Height Recorder gauge.

### 7 February 1990

Figure 23 to 25 present long-section plots of model results against historical observation with respect to Bradys Gully, Wingello and Wyoming Creeks. This event was identified in Kinhill (1991) as the dominant event with respect to these catchments rather than the event a few days earlier.

Figure 26 presents plan view of modelled flood depth and contours of flood height with respect to this event. It is noted that Lower Narara Creek was not 'out of bank' during this event whereas it was during the 2 February 1990 event.

Time-series data was not available from the gauging station at the former Agricultural College due to equipment failure.

Table 23 presents tabulation of modelled flood height against observation for 7 February 1990 event.

Table 23: Observed Vs Modelled - 7 February 1990 event

Chainage (m)	Observed Flood Level (mAHD)	Peak Modelled Flood Level (mAHD)	Difference (m)	Source
<b>Bradys Gully (Figure 23)</b>				
281	3.28	3.36	0.1	Resident Interview
378	4.67	4.54	-0.1	Resident Interview
497	5.76	5.31	-0.5 <sup>BG1</sup>	Resident Interview
497	6.07	5.31	-0.8 <sup>BG1</sup>	Gosford Council
527	6.26	6.19	-0.1	Gosford Council
566	6.37	6.26	-0.1	Gosford Council
581	6.12	6.37	0.3	Gosford Council
593	6.31	6.37	0.1	Resident Interview
650	6.42	6.78	0.4	Gosford Council
674	6.43	7.10	0.7 <sup>BG2</sup>	Resident Interview
674	6.77	7.10	0.3 <sup>BG2</sup>	Gosford Council
805	7.87	7.91	0.0	Gosford Council
829	7.86	8.07	0.2	Gosford Council
889	8.01	8.26	0.3	Gosford Council
1120	9.92	9.40	-0.5	Gosford Council
1183	10.07	11.23	1.2 <sup>BG3</sup>	Gosford Council
<b>Wingello Creek (Figure 24)</b>				
354	4.24	3.48	-0.8 <sup>WG1</sup>	Resident Interview
454	4.83	4.42	-0.4	Resident Interview
504	5.31	4.66	-0.6	Resident Interview
655	5.51	5.81	0.3	Gosford Council
668	5.87	5.92	0.0	Resident Interview
668	5.89	5.92	0.0	PWD MHR
677	6.05	5.85	-0.2	Gosford Council
797	7.04	6.51	-0.5 <sup>WG2</sup>	Resident Interview

849	6.77	6.80	0.0 <sup>WG2</sup>	Gosford Council
960	7.34	7.07	-0.3	Gosford Council
1044	7.35	7.16	-0.2	Gosford Council
1097	7.61	7.19	-0.4	Resident Interview
1172	7.27	7.24	0.0	Gosford Council
1272	7.86	7.34	-0.5	Gosford Council
1369	7.80	7.95	0.2	Gosford Council
1428	8.41	8.04	-0.4	Resident Interview
1497	8.25	8.32	0.1	Gosford Council
1621	9.16	8.62	-0.5	Gosford Council
1691	9.30	8.92	-0.4	Gosford Council
1796	9.89	9.31	-0.6	Resident Interview
1808	9.72	9.34	-0.4	Gosford Council
1818	10.33	9.43	-0.9 <sup>WG3</sup>	Gosford Council
<b>Wyoming Creek (Figure 25)</b>				
248	3.75	3.31	-0.4	PWD MHR
352	4.45	3.78	-0.7 <sup>WY1</sup>	Resident Interview
458	5.16	4.29	-0.9 <sup>WY1</sup>	Gosford Council
523	5.22	4.84	-0.4	Gosford Council
574	5.45	5.25	-0.2	Gosford Council
704	5.77	5.52	-0.2	Gosford Council
776	6.12	5.76	-0.4	Gosford Council
937	6.65	6.45	-0.2	Gosford Council
1006	7.18	6.57	-0.6 <sup>WY2</sup>	Gosford Council
1042	11.14	8.22	-2.9 <sup>WY2</sup>	Resident Interview
1074	8.56	8.40	-0.2	Resident Interview
1095	8.90	8.53	-0.4	Gosford Council
1133	8.85	8.72	-0.1	Resident Interview

1143	9.11	8.72	-0.4	Gosford Council
1182	8.55	9.17	0.6	PWD MHR
1182	9.58	9.17	-0.4	Gosford Council
1201	9.63	9.52	-0.1	Gosford Council
1201	9.77	9.52	-0.3	Resident Interview
1481	11.60	11.13	-0.5	Resident Interview
1715	13.15	13.08	-0.1	Resident Interview

<sup>BG1</sup>downstream of Henry Parry Drive and Laycock St; <sup>BG2</sup>Cary St culvert; <sup>BG3</sup>upstream of Bradys Gully Rd; <sup>WG1</sup>Pacific Highway culverts; <sup>WG2</sup> Halcyon Street; <sup>WG3</sup> upstream of Warrawilla Road; <sup>WY1</sup> between Pacific Highway culverts and Alan Davidson Park; <sup>WY2</sup> Day St.

Long-section plots indicate good agreement between simulation and observation with respect to this event. The calibration is discussed individually with respect to each tributary.

### **Bradys Gully**

There is good general agreement within Bradys Gully between model simulation and historical observation.

Downstream of Henry Parry Drive, the predicted flood level is less than the reported observation at Laycock St (CH497, 5.76 mAHD {BG1}) and level collected by Council (CH497, 6.07 mAHD {BG1}). Detailed historical cross-section information was not available upstream and downstream of this culvert, except for what existed in the previous HEC2 model, therefore cross-section definition was approximated and is likely to be responsible for the discrepancy.

Reported observation by the resident (CH674, 6.43 mAHD {BG2}) is different to the level obtained by Gosford Council (CH674, 6.77 mAHD) at the same location. Council level matched to within 30 cm.

The historical observation upstream of Bradys Gully Road (CH1183, 10.07 mAHD {BG3}) is not well matched; however, downstream observation implies flow over the road, therefore debris mark at invert of the culvert on the upstream side may not be representative of the maximum water level.

### **Wingello Creek**

There is good general agreement between model simulation and observation along Wingello Creek. There were a couple of locations where there was a discrepancy. These are discussed below.

There is minor under-prediction upstream of Pacific Highway culverts (CH354, 4.24 mAHD; CH454, 4.83 mAHD, CH504, 5.31 mAHD {WY1}), within the former Reptile Park. Detailed historical survey information of this location is not available, except what exists in previous HEC2 model of this creek system. There was therefore limited opportunity to improve model fit further.

Reported observation by resident at Halcyon St (CH797, 7.04 mAHD {WG2}) is inconsistent with level upstream that was surveyed by Council (CH849, 6.77 mAHD {WG2}).

There is an observation upstream of Warrawilla Road culvert (CH818, 10.33 mAHD {WG3}) which is not well matched. There are channel works noted upstream of this culvert, however, the culvert dimensions themselves have not changed. Historical cross-section information was not available except for the single cross-section that existed in the previous HEC2 model. There was therefore limited opportunity to improve model fit.

## Wyoming Creek

There is good general agreement within Wyoming Creek between model simulation and historical observation in plotted long-section. There were a couple of discrepancies, which are discussed below.

The model under-predicts observed levels immediately upstream of Pacific Highway culverts (CH352, 4.45 mAHD; CH458, 5.16 mAHD {WY1}). Detailed historical cross-section survey information was not available, therefore previous channel configuration was approximated based on available HEC2 cross-sections. Whilst previous culvert size at Pacific Highway was implemented, a local blockage could also explain the discrepancy.

Reported blockage along Day St concrete-lined channel (CH1006, 7.18 mAHD {WY2}) was approximated by increased roughness and reduced conveyance, however, exact details of 'effective' geometry was not known. Observation level (CH1042, 11.14 mAHD {WY2}) was discounted as unrealistic compared to all other observations in the vicinity. This observation was also discounted in the Kinhill (1991) study.

## February 1992

Figure 27 to 29 present long-section plots of model results against observation with respect to Narara Creek, Reeves Creek and West Narara Creek. Figure 30 presents model results (depth and contours of flood height) in plan-view together with observation including anecdotal observation obtained from Community Survey.

Figure F presents time-series plot comparing observed from former Agricultural College and modelled results.

Table 24 presents tabulation of model results against observation.

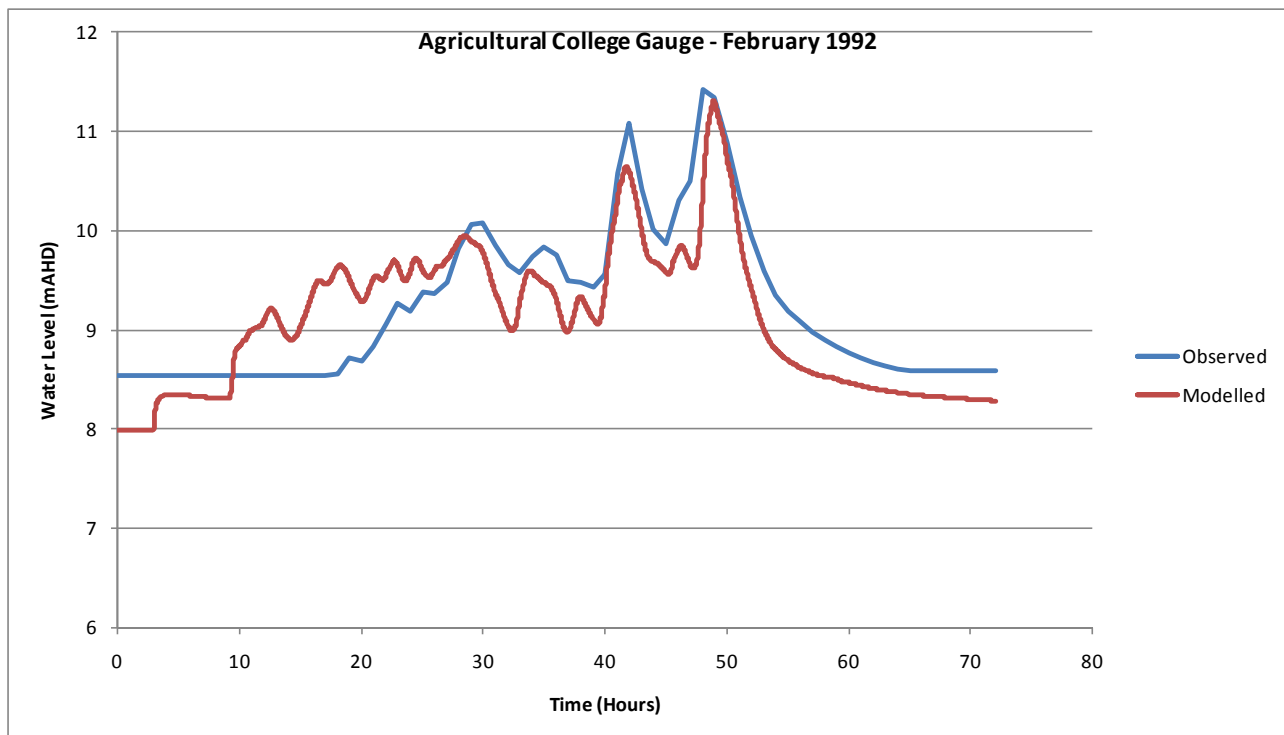


Figure F: Time-Series Observation against Modelled - February 1992 event

**Table 24: TUFLOW Observed Vs Modelled - February 1992 event**

Chainage (m)	Observed Flood Level (mAHD)	Peak Modelled Flood Level (mAHD)	Difference (m)	Source
<i>Narara Creek (Figure 27)</i>				
799	2.03	2.22	0.2	PWD MHR
859	2.11	2.25	0.1	Gosford Council
911	2.89	2.27	-0.6	Gosford Council
951	2.14	2.28	0.1	Gosford Council
2014	2.42	2.81	0.4	PWD MHR
2137	2.50	2.83	0.3	Gosford Council
2220	2.48	2.88	0.4	Gosford Council
2283	2.42	2.92	0.5	Gosford Council
2932	3.04	3.12	0.1	Gosford Council
3286	3.30	3.36	0.1	Gosford Council
3501	3.54	3.45	-0.1	Gosford Council
3522	3.75	3.54	-0.2	Gosford Council
3584	3.79	3.55	-0.2	Gosford Council
3674	3.73	3.57	-0.2	Gosford Council
3712	3.82	3.57	-0.3	PWD MHR
4076	3.93	3.65	-0.3	Gosford Council
4138	3.96	3.71	-0.3	Gosford Council
4225	4.00	3.74	-0.3	Gosford Council
4273	4.02	3.77	-0.3	Gosford Council
4367	4.08	3.79	-0.3	Gosford Council
4551	4.11	3.88	-0.2	Gosford Council
4593	4.39	3.88	-0.5	PWD MHR
4729	4.22	4.02	-0.2	Gosford Council
4749	4.40	4.02	-0.4	Gosford Council
4787	4.22	4.02	-0.2	Gosford Council



4808	4.45	4.20	-0.3	Gosford Council
4843	4.34	4.20	-0.1	Gosford Council
4862	4.41	4.20	-0.2	Gosford Council
4928	4.52	4.37	-0.1	PWD MHR
5069	4.26	4.66	0.4	Gosford Council
5069	4.47	4.66	0.2	Gosford Council
5127	4.53	4.68	0.1	Gosford Council
5140	4.78	4.76	0.0	Gosford Council
5155	4.42	4.76	0.3	Gosford Council
5187	4.84	4.80	0.0	Gosford Council
5212	4.42	4.81	0.4	Gosford Council
5357	5.13	4.87	-0.3	Gosford Council
5397	4.98	4.90	-0.1	Gosford Council
5428	5.04	4.90	-0.1	Gosford Council
5496	5.10	4.92	-0.2	Gosford Council
5641	5.26	4.94	-0.3	PWD MHR
5752	5.24	4.98	-0.3	Gosford Council
6457	6.95	6.89	-0.1	Gosford Council
6908	9.09	9.10	0.0	Gosford Council
6959	9.40	9.32	-0.1	Gosford Council
6972	9.41	9.32	-0.1	Gosford Council
6992	9.33	9.48	0.2	Gosford Council
7131	9.48	9.80	0.3	Gosford Council
7203	9.57	9.90	0.3	Gosford Council
7215	9.57	9.98	0.4	Gosford Council
7496	9.82	10.53	0.7 <sup>NC1</sup>	Gosford Council
7600	10.68	10.90	0.2	Gosford Council
7873	11.77	11.57	-0.2	Gosford Council

7879	11.70	11.57	-0.1	Gosford Council
7958	12.39	11.97	-0.4	Gosford Council
8656	15.42	14.93	-0.5	Gosford Council
9024	16.20	16.01	-0.2	Gosford Council
<b>West Narara (Figure 28)</b>				
68	6.43	6.16	-0.3	Gosford Council
132	6.40	6.20	-0.2	PWD MHR
163	6.56	6.27	-0.3	Gosford Council
905	8.70	8.25	-0.4	Gosford Council
1058	9.00	8.86	-0.1	Gosford Council
1168	9.80	9.26	-0.5	Gosford Council
2043	11.65	11.34	-0.3	Gosford Council
<b>Fountains Creek (Figure 29)</b>				
148	5.28	4.97	-0.3	PWD MHR
220	5.21	5.01	-0.2	Gosford Council
694	6.65	7.07	0.4	PWD MHR
968	8.78	7.68	-1.1 <sup>FC1</sup>	Gosford Council
1054	9.14	7.98	-1.2 <sup>FC1</sup>	Gosford Council

<sup>NC1</sup> upstream end of Koninderie Parade; <sup>FC1</sup> downstream of Reeves St causeway.

There is generally good agreement between model simulation and historical observation with respect to the February 1992 event. Modelled levels are mostly within  $\pm 30$  cm.

Time-series record at former Agricultural College indicates acceptable match with respect to predicted peak water level and timing of peaks. Review of pre-flood peak results again indicates the time-varying antecedent moisture condition issue which was discussed with respect to the June 2007 event.

Model simulation over-predicts observed flood peak at the upstream end of Koninderie Parade (CH7496, 9.82 mAHD {NC1}), although levels upstream and downstream of this location are well matched.

Recorded observation downstream of Reeves St causeway are under-predicted (CH968, 8.78 mAHD; CH1054, 9.14 mAHD {FC1}). This area is very heavily vegetated and there was limited historical cross-section information. Cross-sections in previous HEC2 model of Fountain Creek were up to 200 m apart and original survey information could not be located by Council. Model calibration at the Reeves St causeway, above the reported observation point, however, was adequate in the June 2007 event.

### 5.4.7 Calibration Discussion

Presented results indicate good agreement between modelled and observed maximum flood height with respect to each of the calibration events.

Flood profiles of historical events are acceptably matched given that detailed historical survey information was limited in most areas. Structure dimensions were generally available and were extracted from previous models and reports; however, original survey was not available to verify this data.

Time-series data indicates representation of rainfall-runoff and routing within the hydrologic and hydraulic model is appropriate, with timing of various flood peaks being acceptably matched.

Adopted value for continuing loss, CL, appears to be appropriate with respect to flood peaks, however, review of pre-flood peak results of June 2007, 2 February 1990 and February 1992 suggest time-dependency of CL as catchments become progressively wet. This limitation, however, is not significant because design simulations are undertaken assuming 'wet' conditions.

The calibrated values of 2D surface roughness and 1D channel roughness are presented in **Table 19** and **Table 20** (June 2007 values). Parameter values defined during calibration are all within acceptable ranges and are therefore suitable for design flood simulation.

## 6.0 DESIGN FLOOD MODELLING

Following calibration, design flood modelling was undertaken using the combined hydrologic/hydraulic model in RAFTS/TUFLOW. As presented in Section 4.5, a range of storm durations were implemented such that different critical durations throughout the catchment could be considered. Results of hydraulic modelling were then enveloped such that the maximum flood level was obtained. Calculated critical durations throughout the catchment are presented in APPENDIX H.

It is noted that recent changes such as Carrington St / Pandala Road and Blanche St and North Crescent works have been incorporated into the design flood model. IL and CL parameters are presented in Section 4.2.2. Calibrated hydraulic parameters are presented in Section 5.4.5.

The TUFLOW control files associated with design simulation results presented below are:

- GA\_SIM3\_05h.tcf
- GA\_SIM3\_05j.tcf
- GA\_RFOG1\_04.tcf

Rainfall on grid (RFOG) results were also prepared for selected design flood events (1% AEP and PMF). RFOG methodology consists of applying rainfall hyetograph directly to the 2D grid. The RFOG model is coarser (10 m grid) than the detailed 1D/2D model (5 m grid) and also does not contain any hydraulic structures. Accordingly, output from the RFOG model is not precise and was included in this study to provide indicative extent of the floodplain in the upper reaches of the Narara Creek catchment.

### 6.1 General Model Results

Figures 31 to 36 present long-section plots of peak flood height for Lower and Upper Narara Creek and each major tributary: Bradys Gully, Wingello, Wyoming, West Narara and Fountain Creek respectively.

Figures 37 to 64 present modelled peak flood depth, contours of flood height, peak flood velocity and flow distribution, in plan view, for each of the design AEP events. Provisional flood hazard is presented for 20%, 5%, 1% AEP and PMF and hydraulic categories are presented for 5% and 1% AEP events. RFOG results are presented, including provisional flood hazard, for the 1% AEP event and PMF respectively.

Provisional flood hazard is defined as per Figure L-2 of Floodplain Development Management (DECC, 2005), however, with intermediate hazard assigned to high hazard category. Provisional flood hazard is presented for 20%, 5%, 1% AEP and PMF.

It is noted that provisional flood hazards are not 'true' hazards because they do not consider external factors such as warning times, evacuation potential, evacuation difficulties or evacuation routes. Provisional hazard maps will be updated in the Floodplain Risk Management Study and Plan.

Hydraulic categories were developed based on the following criteria, as agreed with Council. Hydraulic categories were calculated for 5% and 1% AEP.

- Floodway: (Velocity X Depth  $\geq$  0.25 m<sup>2</sup>/s AND Velocity > 0.25 m/s) OR (Velocity > 1 m/s)
- Flood Storage: Not Floodway AND Depth > 0.5 m
- Flood Fringe: Not Floodway AND Not Flood Storage

Figure 65 presents the location of tabulated results. Tabulated results include modelled peak flood height, velocity and flood flows (1D and 2D) are presented in APPENDIX G. Figures 66 to 69 illustrate typical dwellings in relation to various flood events at different locations with the Narara Creek catchment. The location of the typical dwellings is presented in Figure 65.

## 6.2 Lower and Upper Narara Creek

### *Lower Narara Creek*

Modelling indicates most of Lower Narara Creek remains within its banks at the Racecourse up to the 10% AEP design event. In the 5% AEP design event and above, there is significant out-of-bank flow through the Racecourse.

Local watercourses within the Golf Course are backfilled by Narara Creek in each design event.

Commercial premises along Manns Road at West Gosford become flood affected by out-of-bank flow in the 20% AEP design event and above.

Peak flood height in Lower Narara Creek occurs associated with the 9 h design flood event in all AEPs. The maximum flood height in the PMF is associated with the 3 h design flood event.

Flood levels above 10% AEP in this area are primarily impacted by the constriction caused by the Main Northern Railway across Fagans Bay.

At Showground Road, Narara Creek is out-of-bank in the 50% AEP design event and above, with the Railway and Maliwa/Rowena Road acting as channel confines.

Showground Road Bridge is overtopped in the 20% AEP and above. Modelling indicates that a significant proportion of flow is out-of-bank in the vicinity of this bridge, with less 'in bank' compared to above and below. This suggests the creek may be silted up at this location.

Commercial premises on Showground Road adjacent Narara Creek within the Glennie Street West industrial area are impacted in the 50% AEP design event and above.

Backyards of properties at Showground Road near the Manns Road Bridge are flood affected in the 50% AEP and above, as is the Model Railway.

Peak flood height at this location on Narara Creek is associated with the 9 hr design flood event for all AEPs, except the PMF. The critical duration of the PMF at this location is 2 h. The time of peak in the 9 h 1% AEP is 6 to 6.5 h.

In contrast, peak flow from Bradys Gully, above Akora Road, is associated with the 2 h design flood event for all AEP except the PMF. The time of peak in the 2 h 1% AEP, as an example, is 50 min.

For Wingello Creek, peak flow at the confluence with Narara Creek occurs associated with the 9 h design event at time 6.25 h. The flood peak is 9 h due to the Pecan Close detention basin.

For Wyoming Creek, above the Pacific Highway, peak flow occurs associated with 2 h design event for AEP > 10%. The time of peak flood height at the outlet of Wyoming Creek is 45 min.

In summary, peak flows from Bradys Gully and Wingello Creek at the confluence with Narara Creek occur prior to peak flow of Narara Creek itself thereby allowing these tributaries to discharge. For Wyoming Creek, the critical duration is 9 h due to the Pecan Close detention basin; however, there is still significant discharge in the 2 h design flood event from this catchment.

In the vicinity of Carrington Street and Deane St, the Carrington Street Bridge is overtopped in the 20% AEP event and above. The Deane St Bridge is overtopped in the 50% AEP event and above. Similarly, modelling indicates the bridge at Manns Road is also overtopped in the 20% AEP and above.

Commercial premises on Manns Road, on the north side of Narara Creek, are flood affected above 10% AEP and floodplain is active in the 50% AEP and above. Similarly, the out-of-bank flood path west of Hanlan Street

is active in the 50% AEP and above. In this area, peak flood height in Narara Creek is associated with the 9 h design flood event in up to 1% AEP, except 2% AEP where it is 6 h. In the 0.5% and 0.2% AEP, the critical duration design flood event is 6 h.

Peak inflow from West Narara Creek is associated with the 2 h design flood event in the 1% AEP and above and is 6 h in lower AEPs. Fountain Creek peak inflow and flood height is associated with the 2 h design flood event for all AEPs except the PMF.

Tabulated results for the 1% AEP design event at major hydraulic structures along Lower Narara Creek are presented in Table 25.

**Table 25: Bridge and Culvert Hydraulics - 1% AEP (Lower Narara Creek)**

Description	Central Coast Highway	Manns Road (West Gosford)	Showground Road	Manns Road	Carrington Street	Deane Street
Dimension	Bridge, Soffit 2.35 mAHD	Bridge, Soffit 2.17 mAHD	Bridge, Soffit 1.8 mAHD	Bridge, Soffit 2.92 mAHD	Bridge, Soffit 3.70 mAHD	Bridge, Soffit 6.04 mAHD
Upstream Invert (mAHD)	-3.40	-0.23	-2.58	-1.00	0.45	4.60
Downstream Invert (mAHD)	-3.40	-0.23	-2.58	-1.00	0.45	4.60
Headwater Level (mAHD)	1.97	2.5	3.87	4.75	<b>4.99</b>	7.94
Tailwater Level (mAHD)	1.93	2.48	3.86	4.63	4.97	7.34
Weir Level (mAHD)	4.07	2.80	2.75	3.65	4.25	6.99
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	380.7	11.3	0.4	67.7	4.5	38.8
Q Weir (m <sup>3</sup> /s)	0	0	8.0	34.5	13.6	17.3
Q Total (m <sup>3</sup> /s) <sup>1</sup>	380.7	11.3	8.4	102.2	18.1	56.1
V Culvert (m/s) <sup>1</sup>	1.7	0.5	0.01	1.2	0.2	2.7
Length of Culvert	32	8.5	11.74	12.3	12.2	19
Culvert Regime at Peak	Bridge	Bridge	Bridge	Bridge	Bridge	Bridge
US_Node	CH26.2	CH67.2	CH146.2	CH280B.2	CH269.2	CH506.2
DS_Node	CH27.1	CH64.1	CH147.1	CH156.1	CH272.1	CH493.1

Description	Central Coast Highway	Manns Road (West Gosford)	Showground Road	Manns Road	Carrington Street	Deane Street
Critical duration (h)	9	9	9	9	9	2
Time of Peak Height (h)	7.14	6.92	6.42	6.17	6.13	1.31

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

### Upper Narara Creek

Narara Valley Drive is overtopped in the 50% AEP design event and above and Upper Narara Creek is out-of-bank at the lower end of Koninderie Parade.

Significant out-of-bank flow occurs along Koninderie Parade in the 10% AEP design event and above and the overland flood path behind Koninderie Parade is active in the 20% AEP and above.

The critical duration at this location occurs associated with the 9 h design flood event for AEP up to 10% event and is 2 h in the 5% AEP event and above. The critical duration of the PMF at Koninderie Parade is 60 min.

Flood level at the Railway Bridge, upstream of Koninderie Parade, is below the soffit up to the 0.5% AEP and the railway itself is just overtopped in the PMF.

Backyards of properties at Kathleen Morreau Road are flood affected in the 50% AEP and above, however, house floor levels appear to be adequate up to the 1% AEP. Kathleen Morreau Road Bridge is overtopped in the 50% AEP and above.

At the intersection of Perratt Close and Railway Crescent, modelling indicates the primary culvert is overtopped in the 0.2% AEP event and above. There is ponded stormwater, however, at this location in the 20% AEP event and above.

Above Railway Crescent to Alan Street, Upper Narara Creek is confined in-bank due to steep channel sides.

At Alan Street, at the intersection with Siletta Road, the structure is overtopped in the 10% AEP event and above. Table 26 presents model results and details of main structures that occur along Upper Narara Creek

**Table 26: Bridge and Culvert Hydraulics - 1% AEP (Upper Narara Creek)**

Description	Narara Valley Drive	Railway Bridge	Kathleen Morreau Road	Railway Bridge	Railway Crescent	Alan Street
Dimension	RCBC, 4*2700 X1800	Bridge, Soffit 13.68 mAHD	Bridge, Soffit 13.46 mAHD	Bridge, Soffit 15.79 mAHD; RCP 750 dia; RCP 2*900 dia	RCP, 3*3050 dia	RCP, 1*2000 dia
Upstream Invert (mAHD)	5.40	9.97	10.55	14.00, 12.91, 12.80	12.67	18.20

Downstream Invert (mAHD)	5.05	9.97	10.55	14.00, 12.71, 12.77	12.36	18.10
Headwater Level (mAHD)	8.95	13.50	15.12	15.86	16.14	23.44
Tailwater Level (mAHD)	8.69	13.47	15.01	15.77	15.89	20.80
Weir Level (mAHD)	7.53	15.20	14.13	17.19	17.02	22.90
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	53.5	99.83	23.9	48.94, 0.6, 1.86	51.46	18.26
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	53.5	0	16.0	0	0	22.1
Q Total (m <sup>3</sup> /s)	107	99.83	39.9	51.4	51.46	43.4
V Culvert (m/s) <sup>1</sup>	2.7	1.21	1.2	2.2, 1.4, 1.5	2.3	5.81
Length of Culvert	28.7	12.9	8.7	15	22.7	31.5
Culvert Regime at Peak	Outlet Control	Bridge	Bridge	Outlet Control	Outlet Control	Outlet Control
US_Node	CH545.2	CH563.2	CH582.2	CH22.2	CH894.2	S51.1
DS_Node	CH508.1	CH559.1	CH572.1	CH585.1	CH22.1	CH876.1
Critical duration (h)	2	2	2	2	2	2
Time of Peak Height (h)	1.26	1.02	0.95	1.13	1.15	1

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

## 6.3 Bradys Gully

### Lower Reach

Modelling indicates that Bradys Gully is in-bank up to the 2% AEP event below Henry Parry Drive to the Pacific Highway. Bradys Gully at the Pacific Highway is not overtopped until the 5% AEP event.

For design events greater than the 5% AEP, the constriction due to the Railway Bridge, as well as tailwater effects of Narara Creek, lead to ponding immediately east of the railway line.

There is surface overland flow at the roundabout of Pacific Highway, Henry Parry Drive and Pemell Street in the 50% AEP event, however, is generally less than 10 to 20 cm until the 10% AEP event. There is ponding in Pemell St in all AEP events > 50%. This is due to the low hydraulic gradient between this location and the outlet at the Railway.

Table 27 presents tabulated results of main hydraulic structures in the lower reach of Bradys Gully.

**Table 27: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully - Lower Reach)**



Description	Showground Road	Railway Bridge	Akora Road	Pacific Highway	Driveway Access Bridge	Henry Parry Drive	Halcyon Street
Dimension	Bridge, Soffit 2.86 mAHD	Bridge, Soffit 3.65 mAHD	Bridge, Soffit 2.30 mAHD	RCBC, 2*2100X2050	Bridge, Soffit 5.07 mAHD	RCBC, 2*2450X1500; RCBC 2*2450X1500	RCP, 2*1200 dia
Upstream Invert (mAHD)	-0.08	0.55	0.13	0.86	1.15	3.55, 3.73	5.90
Downstream Invert (mAHD)	-0.08	0.55	0.13	0.85	1.15	3.31, 3.33	5.80
Headwater Level (mAHD)	3.83	3.91	3.93	4.46	4.56	5.93	7.19
Tailwater Level (mAHD)	3.79	3.85	3.91	3.71	4.53	5.07	7.01
Weir Level (mAHD)	3.96	5.15	3.00	4.13	5.74	6.00	7.55
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	14.17	21.8	2.3	32.04	46.62	23.8, 22.3	3.99
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	0	0	6.3	3.7	0	0	0
Q Total (m <sup>3</sup> /s)	14.7	21.8	8.6	35.74	46.62	46.1	3.99
V Culvert (m/s) <sup>1</sup>	0.74	0.9	0.7	3.7	0.9	5.4, 5.05	1.9
Length of Culvert	13.6	10.5	5.8	28.9	11.4	30	19.2
Culvert Regime at Peak	Bridge	Bridge	Bridge	Outlet Control	Bridge	Inlet Control	Outlet Control
US_Node	B6.1	CH383.2	CH139.2	CH391.2	B4.1	C1-3a.1	S1.1
DS_Node	B6.2	CH137.1	CH383.1	CH6.1	B4.2	C1-3a.2	CH991.1
Critical duration (h)	9	9	9	2	2	2	90 min
Time of Peak Height (h)	6.44	6.3	6.34	0.87	0.86	0.83	0.54

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height; <sup>2</sup> Bridge swamped by floodplain cross-flow at maximum flood height.

## **Upper Reach**

The capacity of the Catholic School culvert is less than the 50% AEP event, however, the overland flow path between Glennie Street and Cary Street appears sufficient up to the 1% AEP. Floor levels will need to be confirmed.

Bradys Gully between Glennie Street and Bradys Gully Road is contained in-bank for all AEPs events up to PMF.

Above Glennie Street to Dwyer Street, the natural creek has been piped. The capacity of that system appears to be less than the 50% AEP event, with surface overland flow occurring through the multi-unit housing complex down to Glennie Street.

There is overland flow through North Gosford Hospital; however, it is quite shallow up to the 10% AEP event.

There is a minor tributary of Bradys Gully that runs parallel to Bradys Gully Road which is now piped from below an earthen dam through to Blanche St and Jarrett St. This trunk line has recently been upgraded. Due to the shallow hydraulic gradient at the downstream end, that trunk line is subject to outlet control. Modelling suggests the capacity of the new drainage line is ~20% AEP event.

A tributary of Bradys Gully through Kirkness Avenue has capacity up to the 2% AEP event. Surface overland flow along Kirkness Avenue (where the natural watercourse has been piped) is generally less than 10 to 20 cm.

Upstream of Bradys Gully Road, Bradys Gully is confined in-bank up to Stachon Street to about the 1% AEP event. The level of service of the pipe running parallel to Stachon Street is less than the 50% AEP event and residents report regular issues with standing water due to overland flow.

Table 28 presents tabulated results for main structures in the upper reaches of Bradys Gully.

**Table 28: Bridge and Culvert Hydraulics - 1% AEP (Bradys Gully – Upper Reach)**

Description	Catholic School Culvert	Bradys Gully Road	Stachon Street	Kirkness Avenue	Above Blanch St to Jarrett St	Jarrett St below Halycon	Halycon Street
Dimension	RCP, 3*1500 dia; RCBC, 2*1.5*2.4	RCP, 2*1800 dia	RCP, 1*1200 dia	RCBC, 1*3300X1200	RCP, 2*1200 dia; RCBC, 1*2.7*1.2; RCBC, 1*3.6*0.9	RCP, 2*1200 dia	RCP, 2*1200 dia
Upstream Invert (mAHD)	4.86	8.36	15.20	12.35	13.48	5.05	5.90
Downstream Invert (mAHD)	4.00 <sup>2</sup>	7.50	12.70	12.02	9.02	4.7	5.80
Headwater Level (mAHD)	7.97	10.84	17.83	14.21	16.17	6.35	7.19
Tailwater Level (mAHD)	6.42	9.01	13.99	13.34	9.25	5.92	7.01
Weir Level (mAHD)	6.58 <sup>4</sup>	11.00 <sup>5</sup>	17.00	13.99	N/A <sup>6</sup>	6.30	7.55
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	15.916	17.97	2.61	11.18	4.75	4.83	3.99
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	0	0	5.3123	2.08	4.75	16.18	0
Q Total (m <sup>3</sup> /s)	15.9	17.97	7.922	13.25	9.5	21.01	3.99
V Culvert (m/s) <sup>1</sup>	2.5	3.5	2.3	4.7	1.96	2.13	1.9
Length of Culvert	155 <sup>3</sup>	63	250	19.1	224	13.8	19.2
Culvert Regime at Peak	Outlet Control	Outlet Control	Outlet Control	Inlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	CH402.2	CH404.2	P4.1	c1-1.1	Blanch120a.1	CH993.2	S1.1
DS_Node	CH397.1	Blanch117.2	CH427.1	c1-1.2	Blanch117.2	S2.2	CH991.1
Critical duration (h)	2	12	2	2	90 min	90 min	90 min
Time of Peak Height (h)	0.79	7.05	0.76	0.72	0.52	0.53	0.54

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height; <sup>2</sup> at outlet of Cary St culvert; <sup>3</sup> combined; <sup>4</sup> in playground above 3\*1500 pipeline; <sup>5</sup> road crest; <sup>6</sup> overflow flow path from above Blanche St as well as from Blanche St to Jarrett St.

## 6.4 Wingello Creek

### Lower Reach

Wingello Creek between the confluence with Narara Creek and Jarrett Street remains in-bank for all AEP events, except for the PMF

Wingello Creek at Pacific Highway has a level of service of greater than the 1% AEP event.

Table 29 presents tabulated model results for the 1% AEP event with respect to the main hydraulic structures in the lower reach of Wingello Creek.

Below Warawilla Road as well as below Jarrett Street, the currently available floodplain appears sufficient to confine up to the 0.2% AEP event. An exception is Roselands Avenue, where there is localised ponding. This is due to the hydraulic gradient being such that the trunk drainage line at outlet from that sub-catchment is under outlet control. Outlet control reduces the effective conveyance capacity of the pipe network.

The culvert at Jarrett Street has a level of service of up to 0.2% AEP event. It is noted that the hydraulic regime at this structure is inlet control rather than outlet control.

The culvert at Warawilla Road has a level of serviceability of 20% AEP.

**Table 29: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Lower Reach)**

Description	Railway Bridge	Pedestrian Bridge	Willow Motel Driveway	Pacific Highway	Jarrett Street	Warawilla Road
Dimension	Bridge, Soffit 3.56 mAHD	Bridge, Soffit 4.85 mAHD	RCBC 1*3000*3650; RCBC 2*3000*2800	RCBC 1*3000*3600; 2*3000*3200	RCP 2*1740 dia; RCP 3*2100 dia	RCBC 6*1400*1830
Upstream Invert (mAHD)	0.00	0.88	1.04, 1.85	1.26, 1.26	3.45, 3.61	7.15
Downstream Invert (mAHD)	0.00	0.88	1.02, 1.84	1.26, 1.26	3.37, 3.38	7.20
Headwater Level (mAHD)	4.04	4.15	4.39	4.49	6.33	10.05
Tailwater Level (mAHD)	3.92	4.13	4.3	4.43	5.72	9.9
Weir Level (mAHD)	4.99	4.97	5.18	5.46	6.25	9.61
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	24.8	56.9	23.1, 33.25	37.5, 18.8	18.13, 37.58	27.35
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	0.0	0.0	0.0	0.0	0.342	4.96
Q Total (m <sup>3</sup> /s)	24.8	56.9	56.35	56.34	55.71	32.31

Description	Railway Bridge	Pedestrian Bridge	Willow Motel Driveway	Pacific Highway	Jarrett Street	Warrawilla Road
V Culvert (m/s) <sup>1</sup>	1.22	1.43	2.62, 2.61	1.136, 1.124	3.81, 3.62	1.78
Length of Culvert	11.6	6.8	7.3	32.1	12.9	10.0
Culvert Regime at Peak	Bridge	Bridge	Outlet Control	Outlet Control	Inlet Control	Outlet Control
US_Node	CH152.2	CH1011.2	CH1039.2	CH1021.2	CH1037.2	CH1098.2
DS_Node	CH150.1	CH1012.1	CH1019.1	CH1039.1	CH1034.1	CH1093.1
Critical duration (h)	9	9	9	9	9	9
Time of Peak Height (h)	6.42	6.18	6.01	5.99	5.85	5.63

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

### Upper Reaches

Modelling indicates the Pecan Close detention basin is overtopped in the 0.2% AEP event and above. As illustrated in Figure 33, this structure is critical in reducing the flood height below Warrawilla Road. The culvert at Maidens Brush Road has a level of service of 5% AEP.

Table 30 presents tabulated model results at main hydraulic structures in the upper reaches of Wingello Creek.

**Table 30: Bridge and Culvert Hydraulics – 1% AEP (Wingello Creek – Upper Reaches)**

Description	Pecan Close	Rainforest Road	Driveway Paperbark Close	Maidens Brush Road
Dimension	RCP 2*1200 dia	RCBC 1*1550X2100	RCP 1*1100 dia	RCP 3*1500 dia
Upstream Invert (mAHD)	9.40	10.29	25.80	10.35
Downstream Invert (mAHD)	9.00	10.29	25.10	10.13
Headwater Level (mAHD)	14.64	14.69	29.33	12.56
Tailwater Level (mAHD)	10.87	14.65	25.7	12.08
Weir Level (mAHD)	14.10	14.40	30.00	12.25
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	9.5	2.5	4.8	17.5

Q Weir (m <sup>3</sup> /s) <sup>1</sup>	0.0	0.0	0.0	2.9
Q Total (m <sup>3</sup> /s)	9.5	2.5	4.8	5.7
V Culvert (m/s) <sup>1</sup>	4.2	0.8	5.0	3.3
Length of Culvert	95.0	35.8	28.8	15.6
Culvert Regime at Peak	Outlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	P1.1	S57.1	CH1139.2	CH1165.2
DS_Node	P1.2	S57.2	CH1140.1	CH1157.1
Critical duration (h)	9	9	2	9
Time of Peak Height (h)	5.68	5.55	0.85	5.39

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

## 6.5 Wyoming Creek

Wyoming Creek between Pacific Highway and Alan Davison Park is confined in-bank up to the 2% AEP event. The culvert at Pacific Highway has a level of service of greater than the 0.2% AEP. There are some residential properties adjacent to Wyoming Creek that may be flood affected in the 1% AEP event and above.

The levee of the detention basin at Brookes Avenue is not exceeded until the 1% AEP design event. Floor levels within the basin will need to be confirmed to determine whether commercial premises are flood affected in that event.

Wyoming Creek is out-of-bank within Alan Davison Park in the 20% AEP event, however, is confined within the floodplain for all AEP events.

The Day Street channel has a level of service of about 2% AEP. 50% AEP levels are above the concrete-lined portion of this channel; however, the available easement appears sufficient up to the 2% AEP.

The Day Street culvert is overtopped in the 5% AEP event and above.

Above the Day Street culvert, Wyoming Creek is out-of-bank in the 50% AEP event and above, however, is confined within the available floodplain for essentially all AEP events except the PMF. Upstream of Chamberlain Road, Wyoming Creek is confined within the available floodplain up to the 0.2% AEP event. The Chamberlain Road culvert is overtopped in the 10% AEP design event and above. At Pangari Close, there is surface overland flow in events > 50% AEP; however, this results in localised ponding and may not lead to flood affectation of surrounding properties. Floor levels will need to be confirmed.

The access bridge to the Aged Care Facility on Chamberlain Road is above the PMF.

The culvert on Chamberlain Road at the intersection with Maya Street is overtopped in the 50% AEP event and above. Table 31 presents tabulated results at the main hydraulic structures within Wyoming Creek.

**Table 31: Bridge and Culvert Hydraulics – 1% AEP (Wyoming Creek)**

Description	Railway Bridge	Pacific Highway	Day Street	Chamberlain Road	Chamberlain Road/Maya Street	Pangari Close
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Dimension	Bridge, Soffit 3.07 mAHD	RCBC 3*3000X 2000	RCBC 2*3000X 1300	RCBC 2*3050X1500	RCP 1*1500 dia	RCP 1*1200 dia
Upstream Invert (mAHD)	-0.02	0.96	7.60	10.67	14.90	13.50
Downstream Invert (mAHD)	-0.02	0.90	7.32	10.64	14.90	13.20
Headwater Level (mAHD)	4.04	4.12	10.2	13.34	17.11	17.55
Tailwater Level (mAHD)	3.971	4.05	9.14	13.01	16.28	14.51
Weir Level (mAHD)	5.00	4.75	9.41	12.66	16.49	16.00
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	37.5	19.19	27.99	22.08	4.42	3.9
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	0	0	9.26	1.5	14.9	0
Q Total (m <sup>3</sup> /s)	37.5	19.19	37.25	23.58	5.73	3.9
V Culvert (m/s) <sup>1</sup>	0.97	1.06	5.98	2.4	2.5	3.45
Length of Culvert	10.8	50.5	19.4	29.2	37.4	115
Culvert Regime at Peak	Bridge	Outlet Control	Inlet Control	Outlet Control	Outlet Control	Outlet Control
US_Node	C8.2	CH187.2	CH199.2	CH248.2	CH12.2	P433.1
DS_Node	CH160.1	CH170.1	CH197.1	CH209.1	CH225.1	CH245.2
Critical duration (h)	9	9	2	2	90	2
Time of Peak Height (h)	6.41	6.18	0.76	0.75	0.54	0.82

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

## 6.6 West Narara Creek

Modelling indicates West Narara Creek is out-of-bank in the 50% AEP event and above. There is currently limited development within the floodplain of West Narara Creek. There are, however, a couple of residential buildings at the upper end of Deane Street, yet, ground levels imply these are above the 0.2% AEP flood level.

Table 32 presents tabulated model results for the Hanlan Street culvert, which is the only hydraulic structure in this creek.

The Hanlan Street culvert is overtopped in less than the 50% AEP event.

**Table 32: Bridge and Culvert Hydraulics – 1% AEP (West Narara Creek)**

Description	Hanlan St
Dimension	RCBC, 1*3150X2350; RCBC 2*2750X1950
Upstream Invert (mAHD)	1.79
Downstream Invert (mAHD)	1.79
Headwater Level (mAHD)	6.24
Tailwater Level (mAHD)	6.2
Weir Level (mAHD)	4.95
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	10.66,7.58
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	23.53
Q Total (m <sup>3</sup> /s)	41.77
V Culvert (m/s) <sup>1</sup>	0.99, 1.02
Length of Culvert	30.3
Culvert Regime at Peak	Outlet Control
US_Node	CH1269.2
DS_Node	CH259.1
Critical duration (h)	9
Time of Peak Height (h)	5.9

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

## 6.7 Fountain Creek

The Carrington Street culvert is overtopped in less than the 50% AEP design event with the Narara High School overland flow path active in the 50% AEP event and above.

Fountain Creek above Carrington Street culvert is confined in-bank in less than the 50% AEP design event, however, the available floodplain appears sufficient up to the 0.2% AEP event.

The causeway at Reeves Street is overtopped in less than the 50% AEP event and is reported by residents to be regularly impassable to vehicular traffic.

There do not appear to be residential buildings along Fountain Creek that are flood affected.

Table 33 presents tabulated model results for main hydraulic structures along Fountain Creek.



**Table 33: Bridge and Culvert Hydraulics – 1% AEP (Fountain Creek)**

Description	Carrington Street	Carrington Street	Driveway Access Bridge	Reeves Road Causeway	Reeves Road near Pildara Street
Dimension	Bridge, Soffit 4.25 mAHD	RCBC 2*2970*1100	Bridge, Soffit 6.68 mAHD	RCP, 2*900 dia	RCBC 1*2730X930
Upstream Invert (mAHD)	1.81	4.81	5.54	7.56	9.75
Downstream Invert (mAHD)	1.81	4.79	5.54	6.42	9.30
Headwater Level (mAHD)	5.37	6.89	7.66	9.67	10.87
Tailwater Level (mAHD)	5.08	6.84	7.64	9.66	9.80
Weir Level (mAHD)	4.73	6.45	6.88	8.15	10.86
Q Culvert (m <sup>3</sup> /s) <sup>1</sup>	32.2	9.6	3.05	0.31	5.0
Q Weir (m <sup>3</sup> /s) <sup>1</sup>	16.9	26.654	22.8	37.5	0.0
Q Total (m <sup>3</sup> /s)	49.1	36.3	25.85	37.81	5.0
V Culvert (m/s) <sup>1</sup>	1.9	1.5	0.4	0.25	2.7
Length of Culvert	22.6	13.8	6.5	22.0	16.0
Culvert Regime at Peak	Bridge	Outlet Control	Bridge	Outlet Control	Inlet Control
US_Node	CROSS7.1	CHF_14.2	Carr01.1	CH314.2	CH379.2
DS_Node	CH1258.1	CROSS9.2	Carr01.2	CH1309.1	CH381.1
Critical duration (h)	9	2	2	2	2
Time of Peak Height (h)	6.03	0.82	1.66	1.84	0.8

<sup>1</sup> Q and V at peak flood height of critical duration design storm event. Note that peak V and Peak Q (documented in APPENDIX E) may not occur concurrently with peak flood height.

The western tributary of Fountain Creek, accessed from Carrington Street and Reeves Road/Cross Street, is out-of-bank above the 50% AEP; however, model results indicate there are no residential properties flood affected in any modelled AEP design flood event.

Upstream of the end of Cross Street, the natural floodplain has been in-filled and there is a myriad of driveway access bridges in that area. Although the level of service of these access points is quite low, less than 50% AEP, they do not appear to result in flood affectation of surrounding residential properties in any modelled AEP event.

## 7.0 SENSITIVITY ANALYSIS

Sensitivity analysis consists of adjustment of model inputs to quantitatively assess their impact on model predictions. Three general classes of sensitivity analysis were considered in this study:

- General sensitivity
- Blockage analysis
- Potential impact of climate change

Sensitivity analysis was conducted on the 1% AEP, 9 h design flood event.

The impact of various sensitivity analysis runs were assessed with respect to change in modelled flood height and change in provisional flood hazard. Provisional flood hazard was defined as outlined in Section 6.1.

It is noted that when sensitivity analysis results in model cells that were previously dry and become wet then the impact to flood height will be recorded as  $> 1$  m. Similarly, where sensitivity analysis results in model cells becoming dry that were previously wet then these are recorded as a change in flood height of  $< -1$  m.

### 7.1 General Sensitivity

#### 7.1.1 Peak Discharge

The model of the Narara Creek catchment consists of hydrologic input into a hydraulic model. In this case, inflow hydrographs from RAFTS were modified by increasing or decreasing by 30% prior to application to the TUFLOW model.

The TUFLOW control files associated with these scenarios were:

- GA\_SEN3\_IncrPeak30pc\_05h\_100y\_9hr.tcf
- GA\_SEN3\_DecrPeak30pc\_05h\_100y\_9hr.tcf

Figures 69 and 70 present the impact to flood depth and provisional flood hazard from a 30% increase in discharge. Figure 71 and 72 presents the equivalent results from a 30% decrease in discharge.

From Figure 69, a 30% increase in discharge leads to an increase in flood depth of ~35 cm adjacent Gosford Racecourse, ~50 cm increase at Showground Road and a 20 to 40 cm increase above Manns Road Bridge. The impact on provisional flood hazard, presented in Figure 70, is a general increase within the flood fringe from Low to High due to increased flood extent.

From Figure 71, a 30% decrease in discharge leads to a decrease of ~40 cm adjacent Gosford Racecourse, ~60 cm decrease at Showground Road and a 20 to 40 cm decrease above Manns Road Bridge. The impact to provisional flood hazard, presented in Figure 72, is consistent with the decreased flood extent with decrease in hazard from High to Low at flood fringe.

#### 7.1.2 Hydraulic Roughness

The hydraulic roughness is represented in the hydraulic model via the Manning's  $n$  parameter. For this case, the Manning's  $n$  in both 1D and 2D were adjusted by  $\pm 20\%$ . No change was made to the hydrologic model.

The TUFLOW control files associated with these scenarios were:

- GA\_SEN4\_IncrRough20pc\_05h\_100y\_9hr.tcf
- GA\_SEN4\_DecrRough20pc\_05h\_100y\_9hr.tcf

Figures 73 and 74 present the impact of increasing Manning's n on modelled flood depth and provisional flood hazard respectively. Figure 75 and 76 present the impact of decreasing Manning's n.

From Figure 73, an increase in Manning's n leads to an increase in modelled flood height of 5 to 10 cm adjacent Gosford Racecourse, a ~20 cm increase at Showground Road and above Manns Road Bridge. The impact of provisional flood hazard, as presented in Figure 74, is essentially minimal, reflecting the minor change in flood event.

From Figure 75, there is a ~5 cm decrease adjacent Gosford Racecourse, a ~15 cm decrease at Showground Road and a ~ 5 cm decrease above Manns Road Bridge. There is limited change to provisional flood hazard, as indicated in Figure 76.

### 7.1.3 Tailwater Level

The tailwater level for the hydraulic model is set adjacent to Point Frederick in the Broadwater. There were two scenarios considered in this case; an increase from the 1% PoE design level (refer to Section 5.2.1 for further details) by 20% and a decrease in tailwater level of 20%.

The TUFLOW control files associated with these scenarios were:

- GA\_SEN2\_IncrTW20pc\_05h\_100y\_9hr.tcf
- GA\_SEN2\_DecrTW20pc\_05h\_100y\_9hr.tcf

Figure 77 and 78 present modelled change in flood height and provisional flood hazard due to an increase in tailwater level. Figure 79 and 80 present modelled change in flood height and provisional flood hazard due to a decrease in tailwater level.

From Figure 77, an increase in tailwater level leads to an increase in flood height of ~ 5 cm adjacent to Gosford Racecourse, however, there is no further increase upstream. Within Fagans Bay and in the Broadwater there is an increase of 5 to 15 cm. There is no change in provisional flood hazard associated with this sensitivity case (Figure 78).

From Figure 79, there is a decrease of ~ 2 cm at Gosford Racecourse itself; however, this is due to the change in initial condition. The limit of the change in Narara Creek is only to the outlet into Fagans Bay. There is a 5 to 15 cm decline in the Broadwater. There is no change in provisional flood hazard associated with this sensitivity case (Figure 80).

## 7.2 Blockage Analysis

### 7.2.1 100% Blockage

The impact on modelled flood height and provisional flood hazard resulting from 100% blockage of hydraulic structures was considered at 10 locations. Testing locations were selected in consultation with Council. The hydraulic model was modified such that the primary hydraulic structure was either removed or completely blocked. Weirs over the top of respective structures were not adjusted. It is noted that all blockages were implemented in a single model run.

The TUFLOW control file associated with this scenario was:

- GA\_SEN1\_Blockage100pc\_05h\_100y\_9hr.tcf

Figures 81 and 82 present the impact of 100% blockage on modelled flood height and provisional flood hazard.

From Figure 81, the impact of blockage of the railway culvert behind Karina Drive is significant, leading to an increase in flood depth of up to 1 m due to this structure being the only outlet of this trapped local depression. The modelled impact of blockage of Narara Valley Drive leads to an increase of 10 to 20 cm, however, there is blockage protection already installed at this location. The impact of blockage at Deane St is 5 to 10 cm due to this structure being quite small. Similarly the impact of blockage of Carrington Street Bridge (east) is minor to zero. Blockage of Carrington St Bridge (east), west of Hanlan St, leads to a 5 to 15 cm increase in flood height. There are no residential properties in immediate vicinity, therefore the impact is not significant.

Within Wyoming Creek, the blockage of Chamberlain Road culvert has a +20 cm impact. There are a couple of residential properties on the upstream side of this culvert whom might become flood affected in that scenario. At the outlet of Wyoming Creek to Narara Creek, blockage of Pacific Highway culverts leads to an increase in flood depth of approximately 1 m. There are several properties adjacent Wyoming Creek upstream of Pacific Highway that may be flood affected in the 1% AEP event. Analysis implies that flood affectation of these properties is sensitive to blockage of that culvert. Blockage of Brookes Avenue detention basin leads to a 5 cm impact due to back flow out of the raised railway underpass.

Within Bradys Gully, blockage of the Catholic School pipeline leads to a 10 to 20 cm increase in flood height of surface overland flow and a 5 to 10 cm increase in flood height within the main channel both upstream and downstream of the school. Diverted surface overland flow travels down Henry Parry Drive before re-entering Bradys Gully, potentially impacting properties. Blockage analysis does not indicate that the school buildings themselves become flood affected.

Within Wingello Creek, blockage of Warrawilla Road culverts leads to a ~40 cm increase in flood height; however, the extent is localised and does not lead to additional flood affectation of surrounding properties. Blockage at Warrawilla Road leads to a decrease in flood height downstream of Warrawilla Road.

From Figure 82, where blockage leads to a significant increase in flood height (e.g. Karina Drive, Pacific Highway culverts at Wyoming Creek outlet and at Warrawilla Road in Wingello Creek), there is a commensurate increase in provisional flood hazard from Low to High.

### 7.2.2 Partial Blockage

For this scenario, the hydraulic model was modified such that:

- all pipes with a diameter greater than 1050 mm were blocked by 25%
- all pipes with a diameter less than 1050 mm were 50% blocked
- all culverts had a hydraulic conveyance greater than an equivalent diameter of 1050 mm and were 25% blocked
- Bridges were blocked by 25%. The only exception was the timber bridge downstream of the Reeves St causeway, which had already been blocked by 50% during model calibration.
- depth-discharge relationships of pits in the hydraulic model, as presented in Section 5.1.3, were adjusted such that there was no blockage of pits.

The TUFLOW control file associated with this scenario was:

- GA\_SEN5\_BlockagePartial\_05h\_100y\_9hr.tcf

Figures 83 and 84 present the modelled impact of partial blockage of pipe infrastructure throughout the model.

### Upper Narara Creek

From Figure 83, the increase in modelled flood height upstream of Railway Crescent is more than 20 cm. The increase upstream of culvert at Pemburton Boulevard does not lead to flood affectation of surrounding

properties. At the Pacific Highway near Newling St, there is an increase of more than 20 cm, however, this does not lead to flood affectation of surrounding properties.

Blockage of railway culverts leads to localised impacts, however, only Karina Drive is significant in terms of potential flood affectation. Blockage at Yuranga Avenue leads to 5 to 20 cm increase locally and 1 to 5 cm increase in Koninderie Parade. The impact of partial blockage of Narara Valley Drive is an increase of 5 to 20 cm in flood height and is localised.

### **Wyoming Creek**

There is a localised increase upstream of Chamberlain Road and Day St Culverts of 5 to 20 cm, however, there is no increased flood affectation of surrounding properties. Partial blockage of the Pacific Highway culvert at the outlet of Wyoming Creek leads to 5 to 20 cm increase in flood height immediately upstream. The impact of partial blockage in the Brookes Avenue detention basin is an increase of 1 to 5 cm.

### **Wingello Creek**

Partial blockage leads to an increase in flood height upstream of the Pecan Close detention basin of more than 20 cm, however, this does not lead to flood affectation of surrounding properties. There is an increase in flood height upstream of Warrawilla Road of 5 to 20 cm including Henry Kendall retirement village, however, there is no increase in flood affectation of surrounding properties. There is localised increase upstream of Jarrett St culverts as well as Pacific Highway culverts of more than 20 cm; however, this does not lead to additional flood affectation of surrounding properties.

### **Bradys Gully**

There is an increase in flood height along Stachon St of 5 to 20 cm. There is an increase of 5 to 20 cm along the overland flow path downstream of North Gosford Hospital. It is noted that the natural watercourse has been piped in this location. Partial blockage of the Catholic School pipeline and the culvert at Henry Parry Drive leads to increased overland flow. Constriction of the outlet at Bradys Gully through the railway leads to an increase of 5 to 20 cm in flood height upstream of the railway line.

### **Lower Narara Creek**

There is no increase in flood height in Lower Narara Creek due to there not being any hydraulic infrastructure downstream of Showground Road. Constriction of the bridge at the Central Coast Highway does not have a significant impact on flood height. At West Gosford, there is a localised increase of 1 to 5 cm due to the pipe network being constricted.

### **Fountain Creek**

Minor constriction of Carrington St (east) and Manns Road Bridge leads to a 1 to 5 cm increase in flood height.

In general, the impact of partial blockage of hydraulic infrastructure is not particularly significant. This is consistent with findings from design flood modelling wherein most hydraulic structures were operating under an outlet-control hydraulic regime.

With respect to provisional flood hazard, there is no significant change associated with partial blockage of hydraulic structures. There are isolated changes to individual cells and localised patches; however, there are not considered significant.

## **7.3 Potential Impact of Climate Change**

### **7.3.1 Increased Rainfall Intensity**

Design rainfall intensities used as inputs in the hydrologic model were increased by 10%, 20% and 30% as agreed with Council. The RAFTS model was then executed and used as updated input to TUFLOW.

The TUFLOW control files associated with these scenarios were:

- GA\_CLIM1\_IncrIntensity10pc\_05h\_100y\_9hr.tcf
- GA\_CLIM1\_IncrIntensity20pc\_05h\_100y\_9hr.tcf
- GA\_CLIM1\_IncrIntensity30pc\_05h\_100y\_9hr.tcf

Figures 85 and 86 present the impact of an increase of 10%. Figures 87 and 88 present the impact of an increase of 20% and Figures 89 and 90 presents the impact of an increase of 30%.

Modelling indicates the impact on flood height associated with a 10% increase in rainfall intensity is 10 to 20 cm, except for Brookes Avenue detention basin where there is an increase of 30 cm. For a 20% increase in rainfall intensity, there is an increase in flood height of 30 to 40 cm along Narara Creek at Showground Road and that increase is 40 to 50 cm associated with the 30% increase in rainfall intensity scenario.

There is an increase in provisional flood hazard in each of these sensitivity runs proportional to the increase in flood extent.

Analysis indicates a general high sensitivity to an increase in rainfall intensity in the Narara Creek catchment, due to its hydrologic characteristic being a 'fan-type' catchment.

Detail model outputs are presented in the electronic compendium attached to this study.

### 7.3.2 Sea Level Rise

Tailwater level in the hydraulic model was increased by 40 cm and 90 cm compared to the 1% PoE level, as agreed with Council. Figures 91 and 92 present the impact of a 40 cm increase in tailwater level. Figures 93 and 94 present the impact of a 90 cm increase in tailwater level.

The TUFLOW control files associated with these scenarios were:

- GA\_CLIM2\_IncrTW40cm\_05h\_100y\_9hr.tcf
- GA\_CLIM2\_IncrTW90cm\_05h\_100y\_9hr.tcf

From Figure 91, there is an increase in flood height of 5 cm in Narara Creek up to the Gosford Golf Course and less than 5 cm up to Manns Road Bridge.

From Figure 93, the impact of the 90 cm increase in tailwater level extends up to Manns Road Bridge. There is a 5 cm increase at Showground Road and a 1 to 5 cm increase at Manns Road Bridge. The increase in flood height in the Brookes Avenue detention basin is due to the change in initial condition and this not being able to be dissipated until after the flood peak has passed.

There is an increase in provisional flood hazard within the flood fringe where flood hazard increases from Low to High due to the increase in flood extent.

### 7.3.3 Increased Rainfall Intensity and Sea Level Rise

Figures 95 and 96 present the impact of a combination of increased rainfall intensity of 30% and sea level rise of 90 cm.

The TUFLOW control file associated with this scenario was:

- GA\_CLIM3\_IncrIntensity30pc\_IncreaseTW90cm\_05h\_100y\_9hr.tcf

From Figure 95, the increase in flood height is 60 cm at Showground Road and is 30 to 50 cm above Manns Road Bridge. In general, the increase in provisional flood hazard is consistent with increased flood extent.

The impact of maximum increase in rainfall intensity, combined with maximum sea level rise, leads to a wholesale increase in flood height in the Narara Creek catchment. Of potential importance is that the magnitude of the predicted increase is in excess of Council's standard adopted freeboard of 50 cm, therefore the FPL of 1% AEP may not be achieved in that circumstance.

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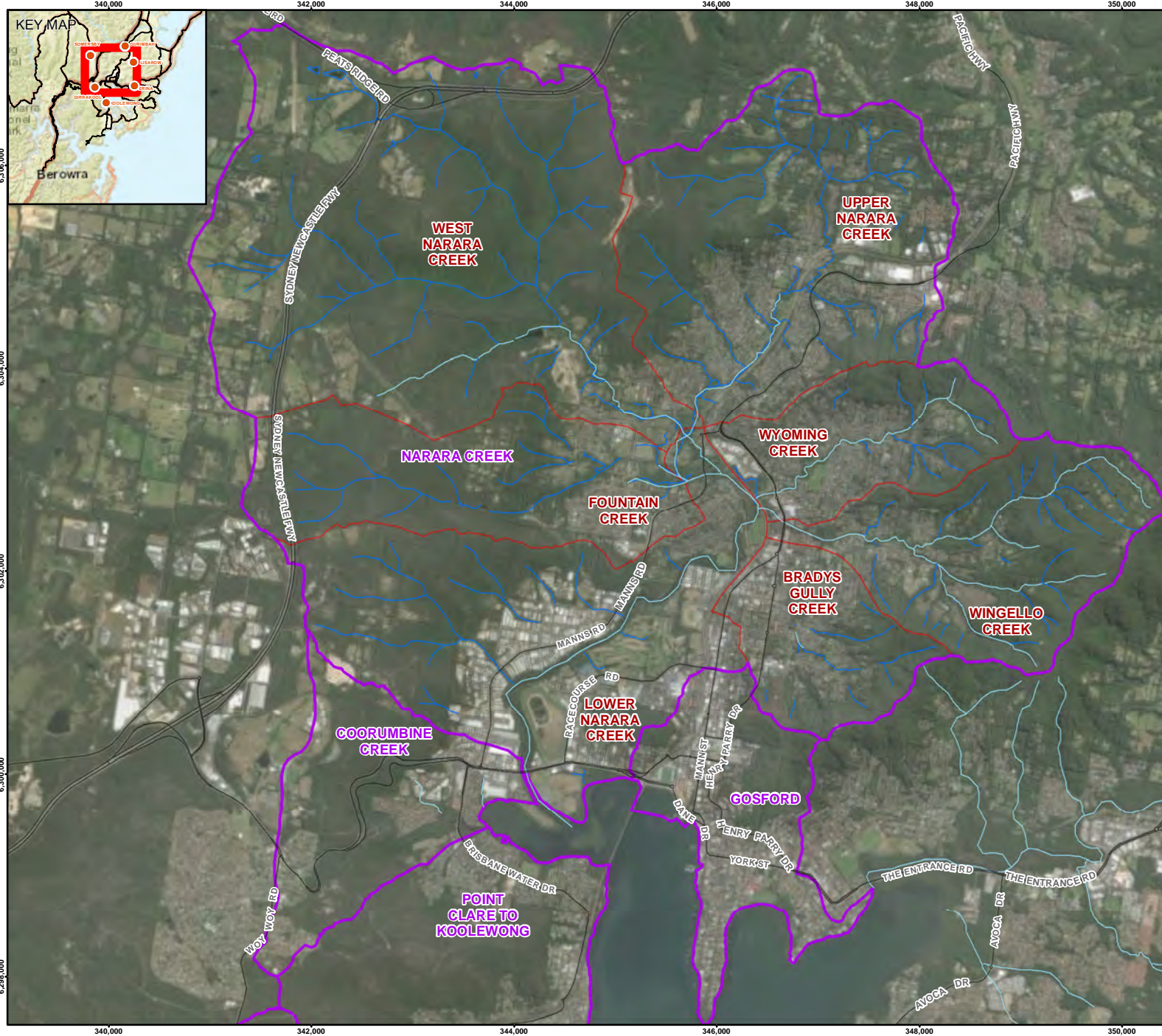
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**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Drainage Sub-Catchment
- Catchment Boundary
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Creek Lines, Narara Creek and Tributaries, Drainage Sub-Catchment, Catchment Boundary, Cadastre:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**NARARA CREEK CATCHMENT**

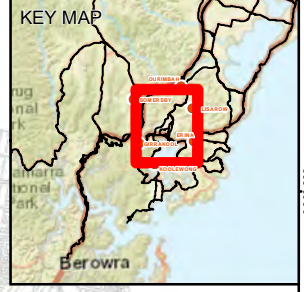
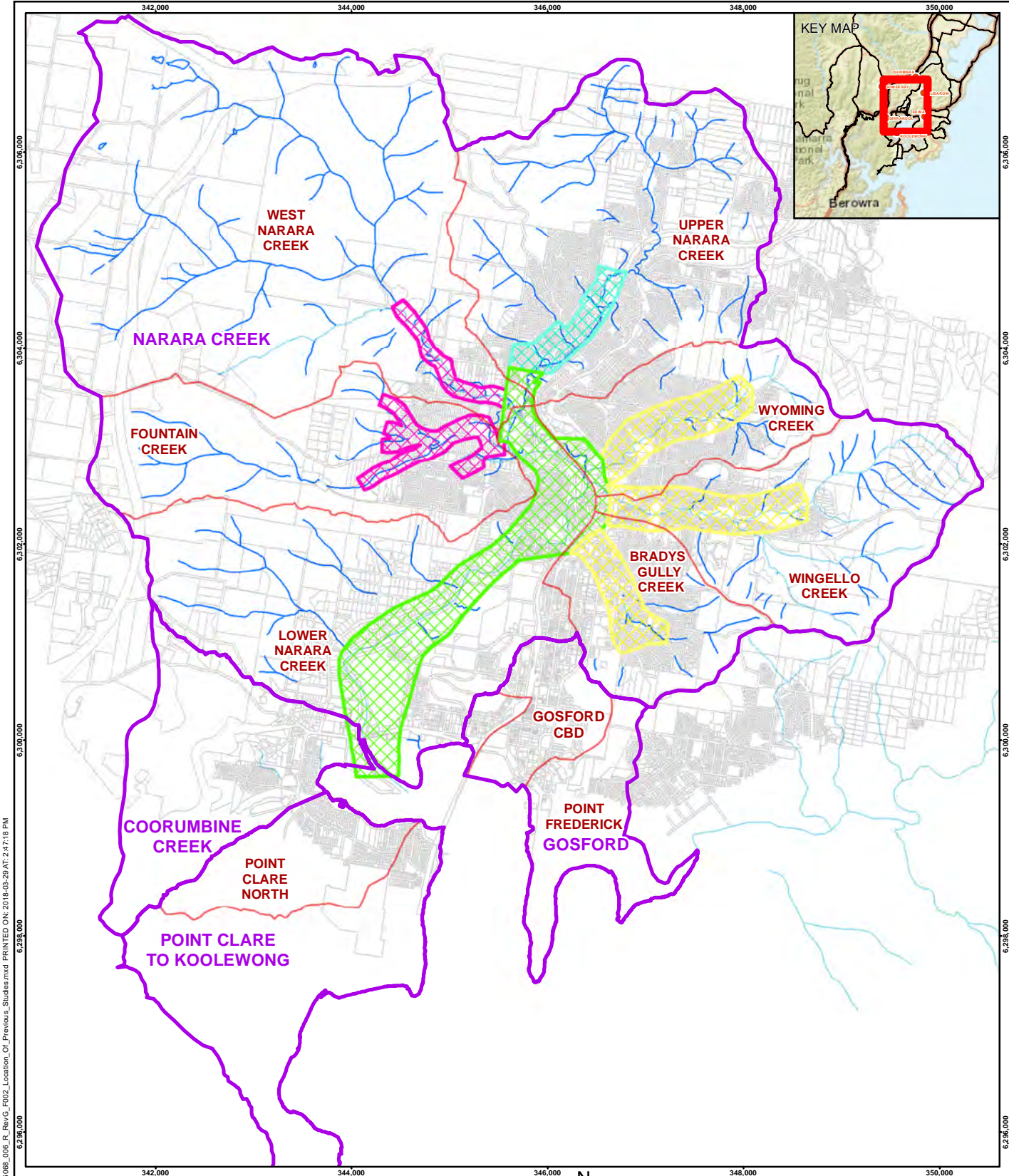
CONSULTANT



DD/MM/YYYY	29/03/2018
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PREPARED	BG
REVIEWED	NM
APPROVED	NM

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Legend	
	Creek Lines
	Narara Creek and Tributaries
	Catchment Boundary
	Drainage Sub-Catchment
	Cadastral Boundary
<b>Previous Studies</b>	
	Kinhill 1991. Flood Study for Wyoming, Wingello and Bradys Gully Creeks.
	Kinhill 1991. Lower Narara Creek Floodplain Management Study.
	Kinhill 1993. Upper Narara Creek Flood Study.
	Kinhill 1997. Flood Study for Narara Creek and Lower Narara Creek West of Hanlan St.



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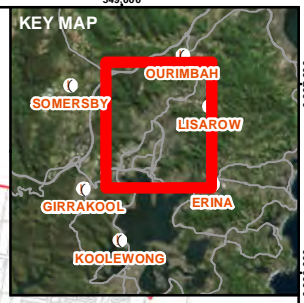
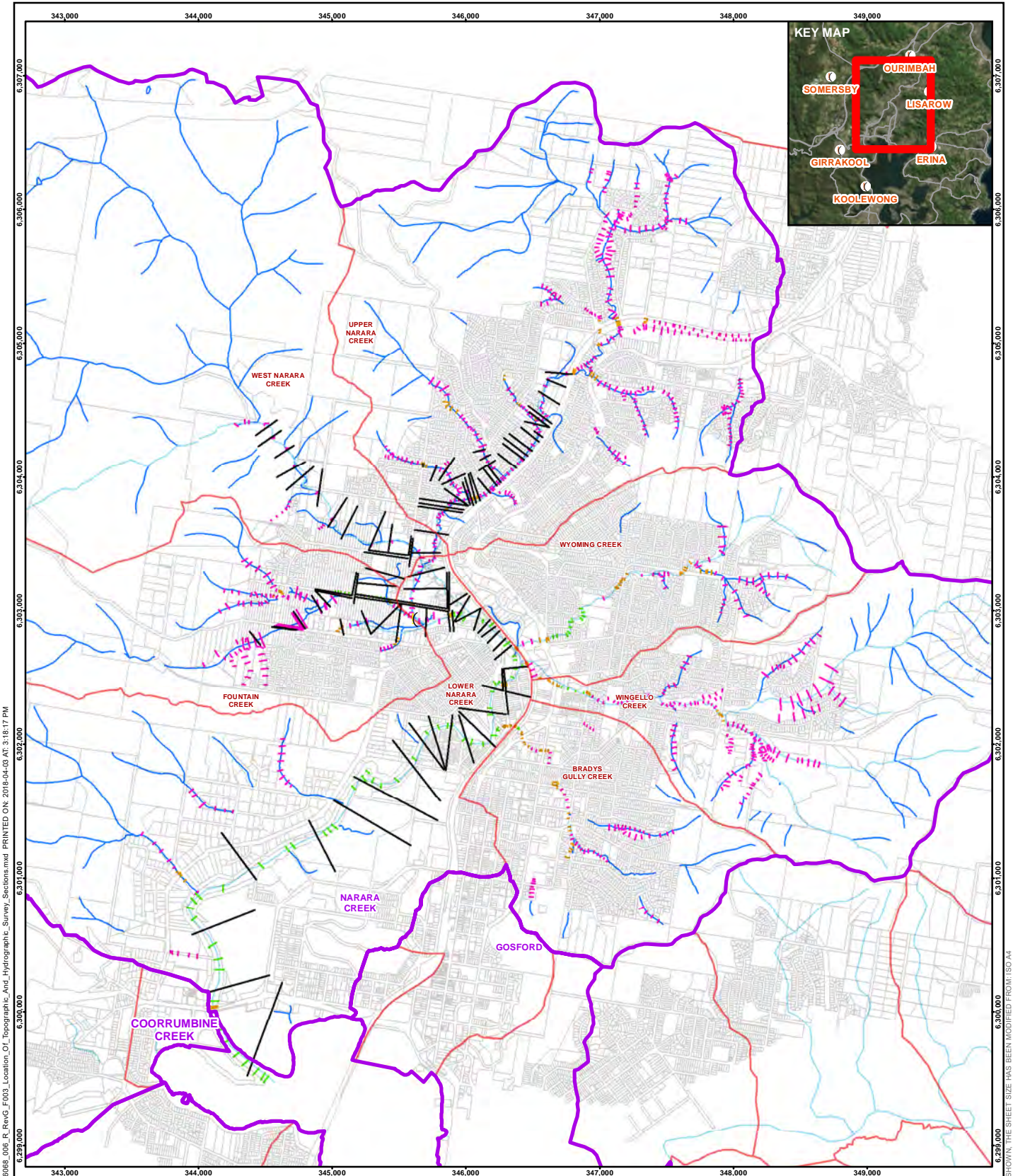
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**Narara Creek and Tributaries, Cadastral, Catchment Boundary, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

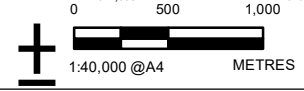
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	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

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TITLE	LOCATION OF PREVIOUS STUDIES		
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	2

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- ( ) Tidal Limit
  - Main Roads
  - Creek Lines
  - Narara Creek and Tributaries
  - Mike11 Cross Section
  - Surveyed Cross Section
  - Surveyed Structures
  - DEM Derived Cross Section
  - Catchment Boundary
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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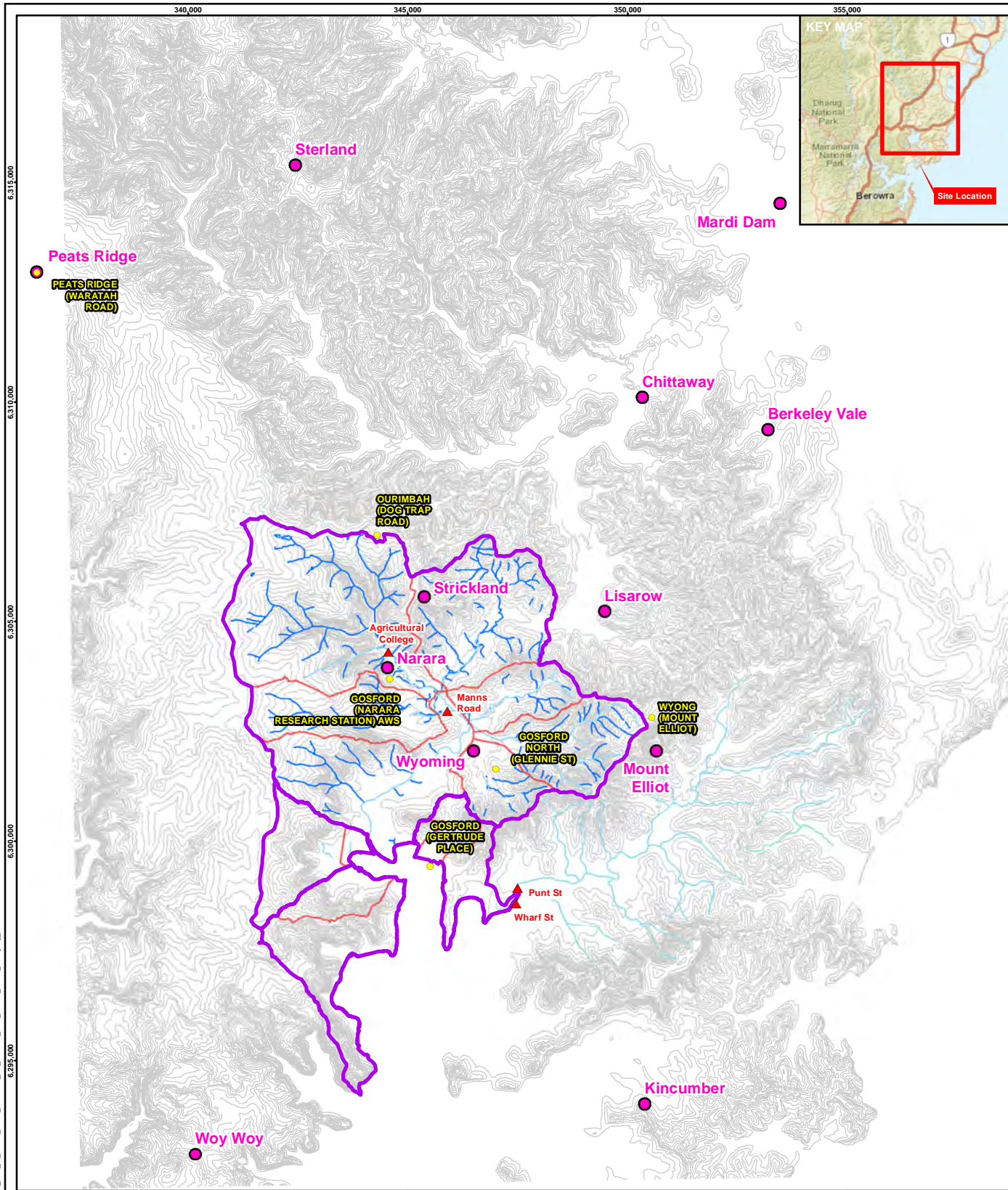
**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Catchment Boundary, Sub-Catchment Boundary:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

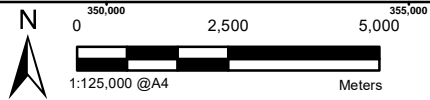
CONSULTANT	DD/MM/YYYY	
	3/04/2018	
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

PROJECT	TITLE	PROJECT NO.	CONTROL	REV.	FIGURE
NARARA CREEK FLOOD STUDY	<b>LOCATION OF CROSS SECTIONS</b>	097626068	006	G	<b>3</b>

PATH: R:\01 Client\Gosford City Council\097626068\_006\_R\_Rev0\_F003\_Location\_O\Topographic\_And\_Hydrographic\_Survey\_Sections.mxd PRINTED ON: 2018-04-09 AT: 3:18:17 PM  
 25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A4



- Legend**
- Daily Rainfall
  - Pluviographs
  - ▲ Water Level Recording
  - Creek Lines
  - Narara Creek and Tributaries
  - Contours
  - ▭ Catchment Boundary
  - ▭ Drainage Sub-Catchment



**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
 All data provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

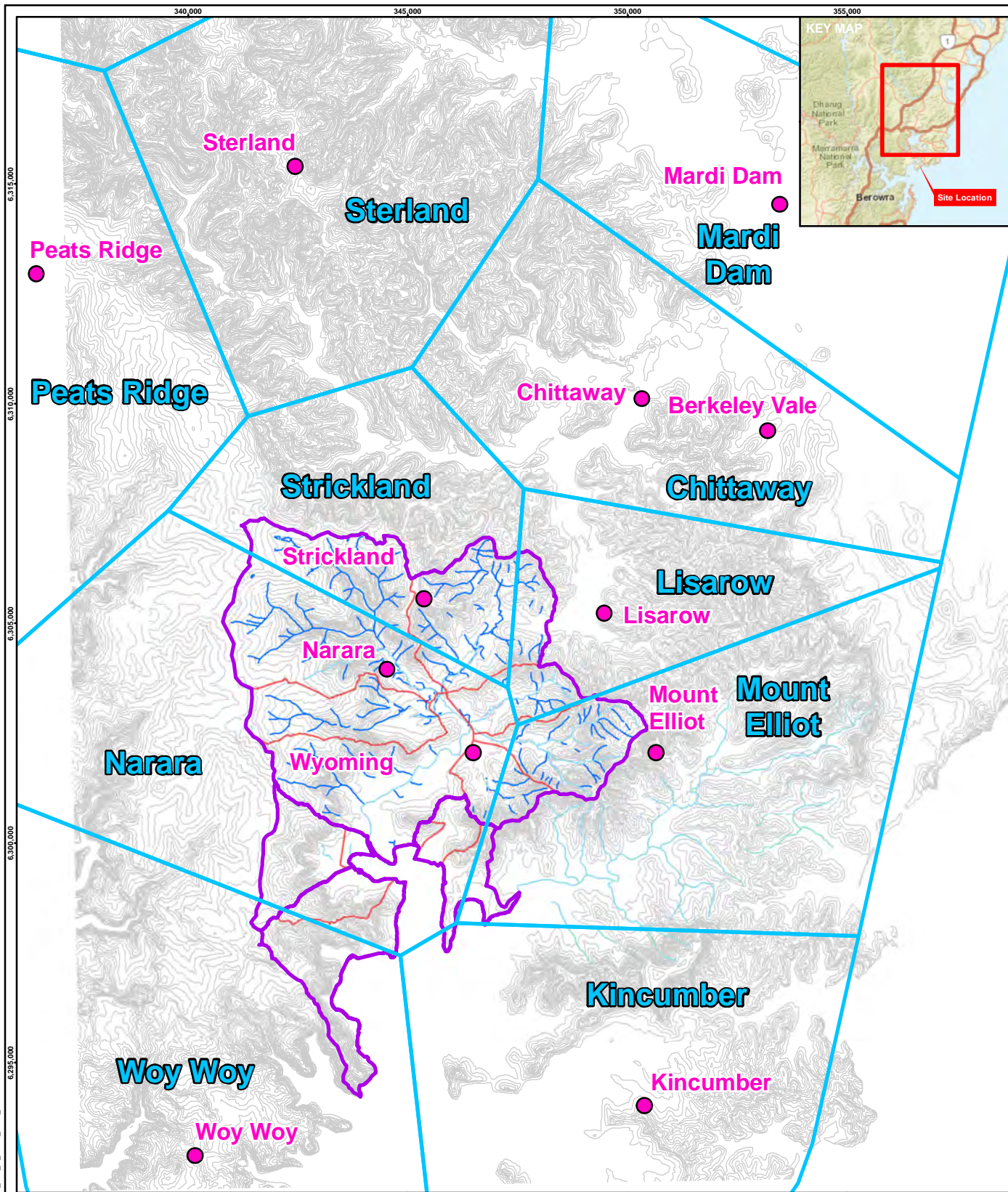
PROJECT  
**NARARA CREEK FLOOD STUDY**

CONSULTANT	DD/MM/YYYY	29/03/2018
DESIGNED	HB	
PREPARED	BG	
REVIEWED	NM	
APPROVED	NM	



TITLE  
**LOCATION OF RAINFALL AND WATER LEVEL GAUGING STATIONS**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	4



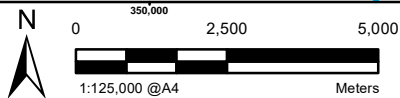
- Legend**
- Pluviographs
  - Creek Lines
  - Narara Creek and Tributaries
  - Contours
  - Catchment Boundary
  - Drainage Sub-Catchment
  - Thiessen Feb1990

CLIENT  
CENTRAL COAST COUNCIL

CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM



Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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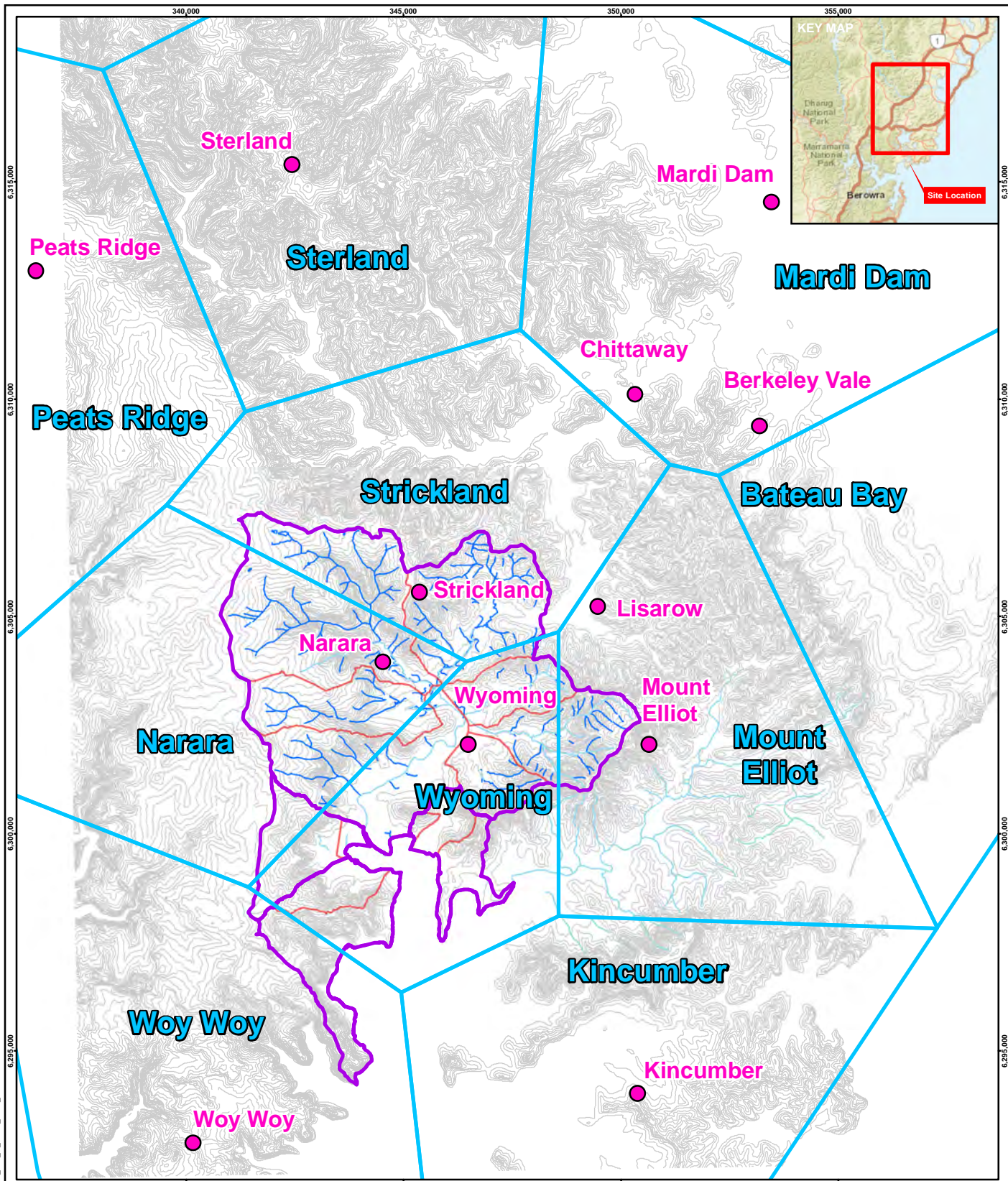
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NARARA CREEK FLOOD STUDY

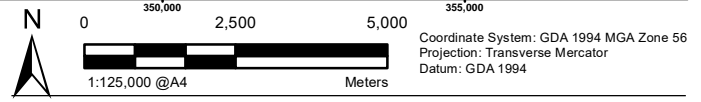
**TITLE**

**PLUVIOGRAPH DISTRIBUTION 2 AND 7 FEBRUARY 1990  
EVENT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	5



- Legend**
- Pluviographs
  - Creek Lines
  - Narara Creek and Tributaries
  - Contours
  - Catchment Boundary
  - Drainage Sub-Catchment
  - Thiessen Feb 1992



**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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 All data provided by Central Coast Council February 2018

**PROJECT**  
 NARARA CREEK FLOOD STUDY

**TITLE**  
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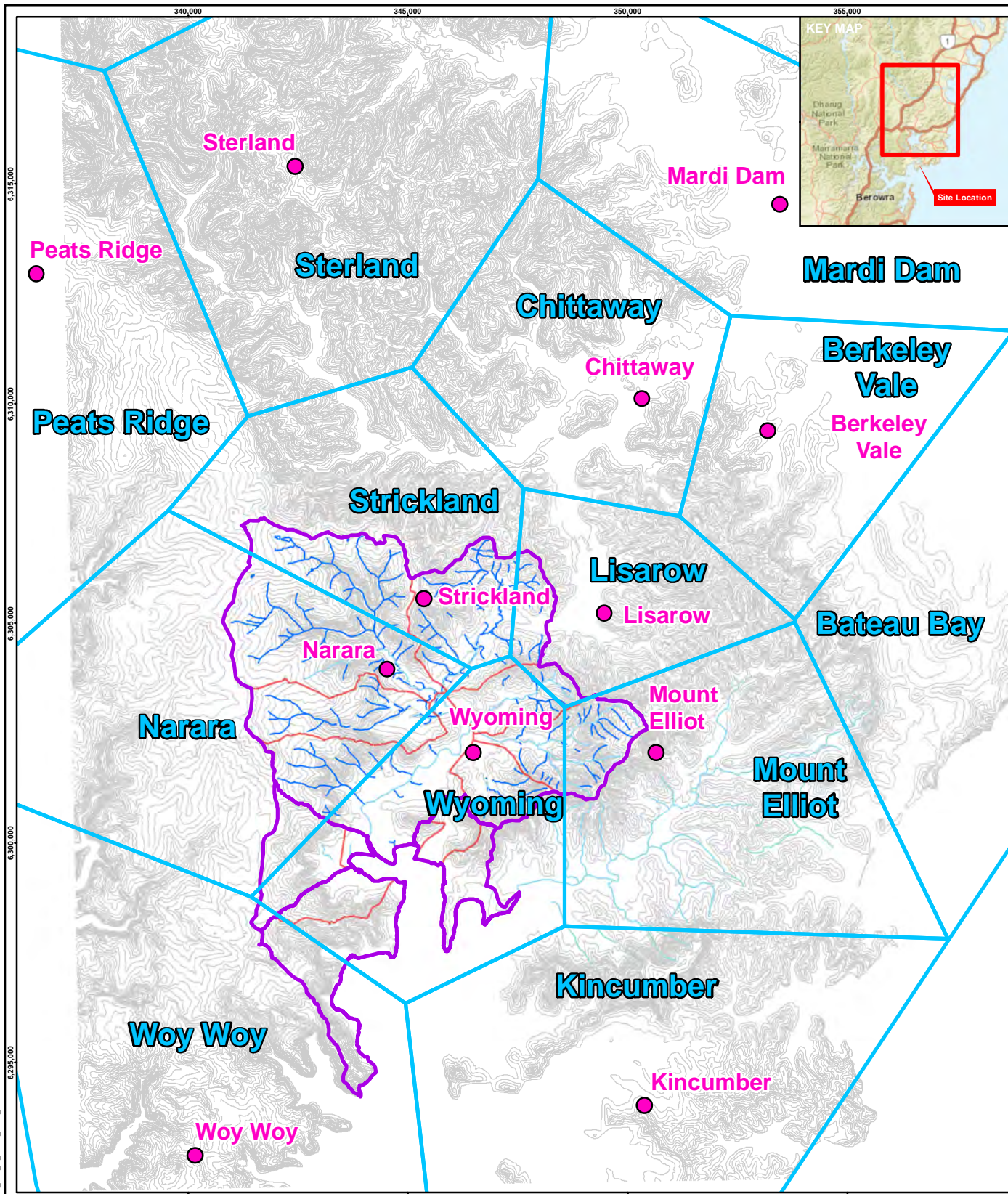
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 CENTRAL COAST COUNCIL

<b>CONSULTANT</b>		
	DD/MM/YYYY	3/04/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

<b>PROJECT NO.</b>	<b>CONTROL</b>	<b>REV.</b>	<b>FIGURE</b>
097626068	006	G	6

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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



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- Legend**
- Pluviographs
  - Creek Lines
  - Narara Creek and Tributaries
  - Contours
  - Drainage Sub-Catchment
  - Catchment Boundary
  - Thiessen Jun 2007



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
 All data provided by Central Coast Council February 2018

**PROJECT**  
 NARARA CREEK FLOOD STUDY

**TITLE**  
 PLUVIOGRAPH DISTRIBUTION JUNE 2007 EVENT

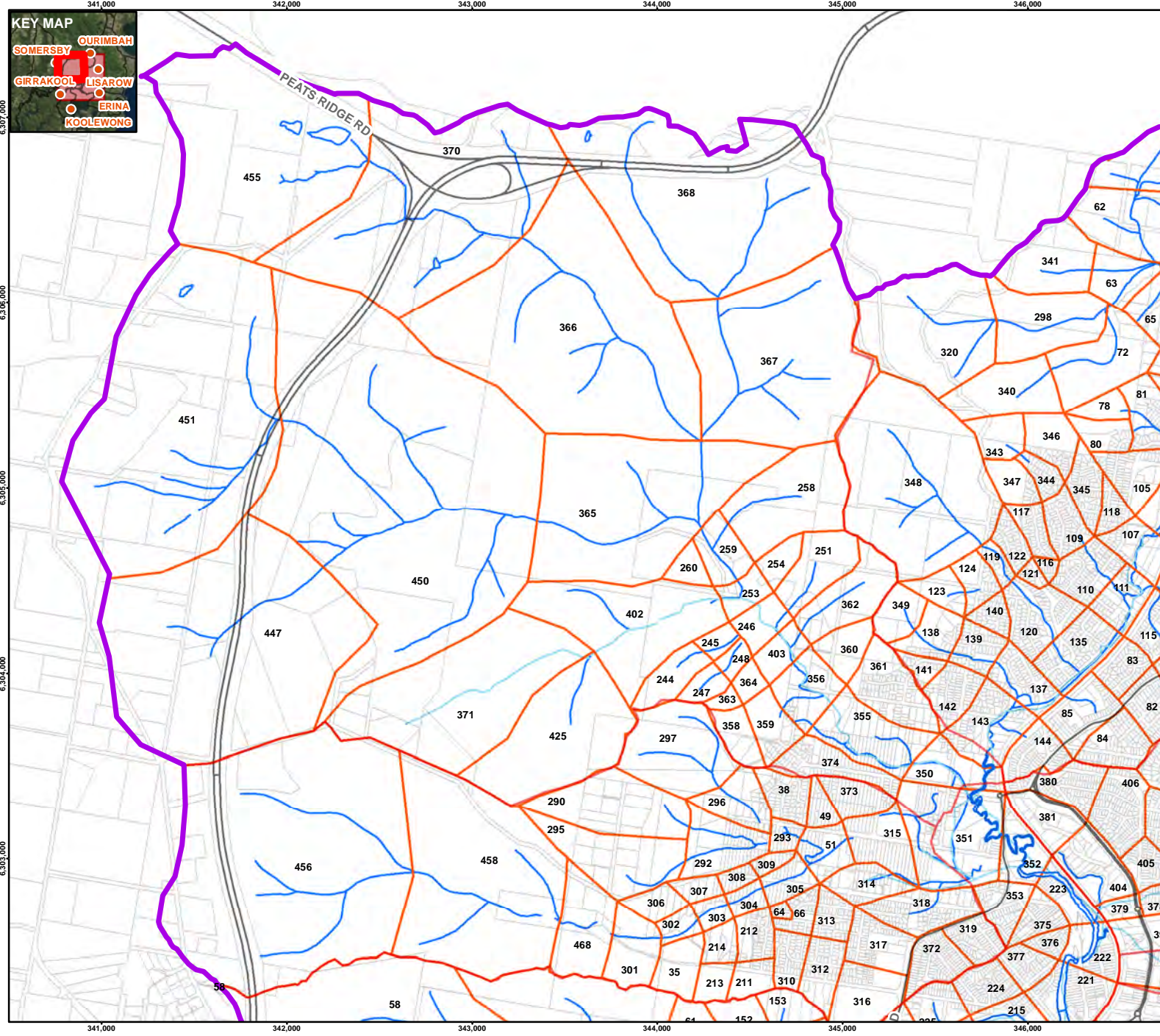
**CLIENT**  
 CENTRAL COAST COUNCIL

<b>CONSULTANT</b>	DD/MM/YYYY	3/04/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM



PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	7

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Catchment Boundary
- Drainage Sub-Catchment
- Cadastral Boundary
- Waterway
- RAFTS Subcatchments

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Catchment Boundary, Sub-Catchment Boundary, Waterways, Creeklines: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDROLOGIC SUBCATCHMENTS**

CONSULTANT

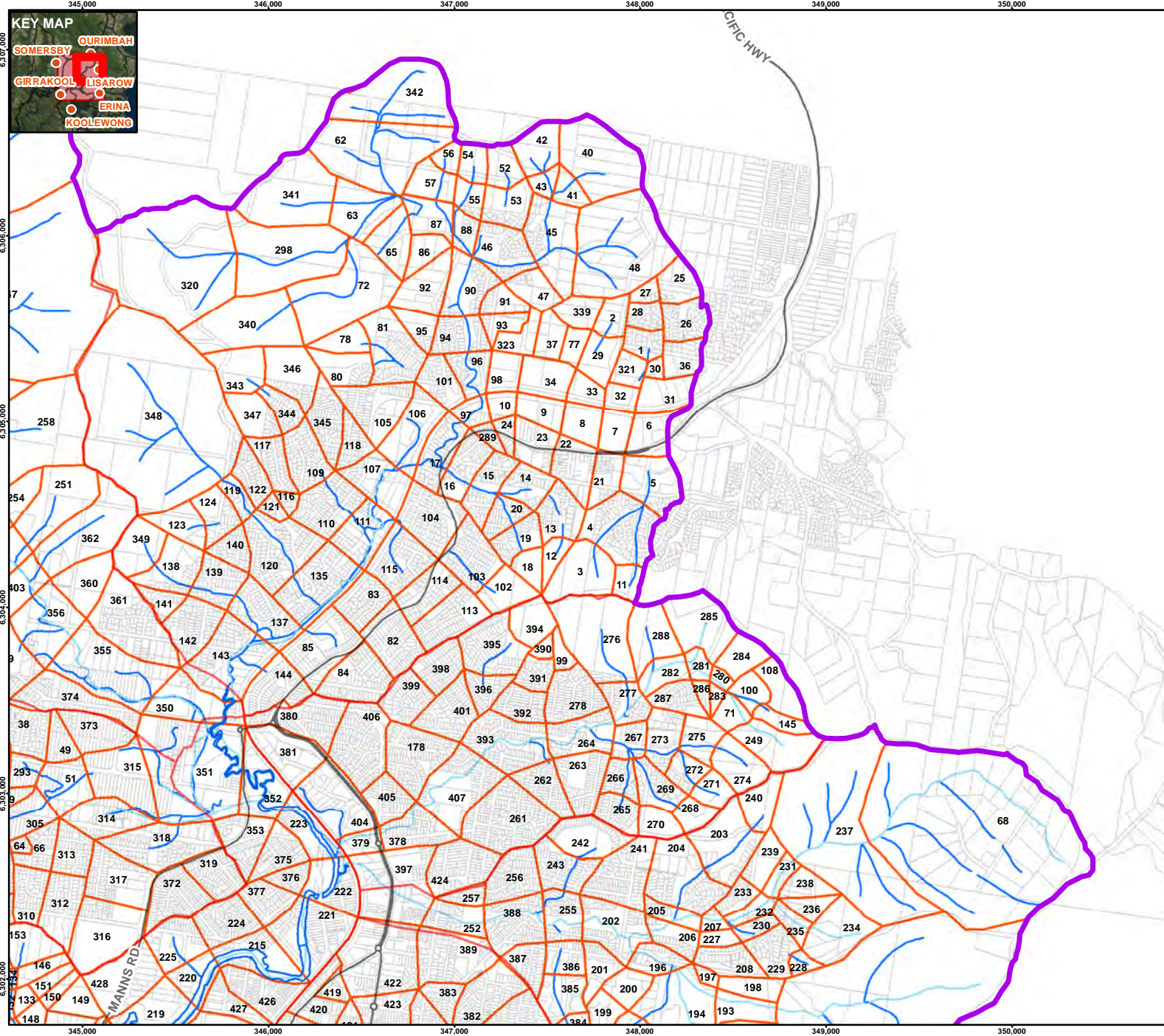


DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
<b>097626068</b>	<b>006</b>	<b>G</b>	<b>8B</b>

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4





**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Catchment Boundary
- Drainage Sub-Catchment
- Cadastral Boundary
- Waterway
- RAFTS Subcatchments



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Catchment Boundary, Sub-Catchment Boundary, Waterways, Creeklines:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

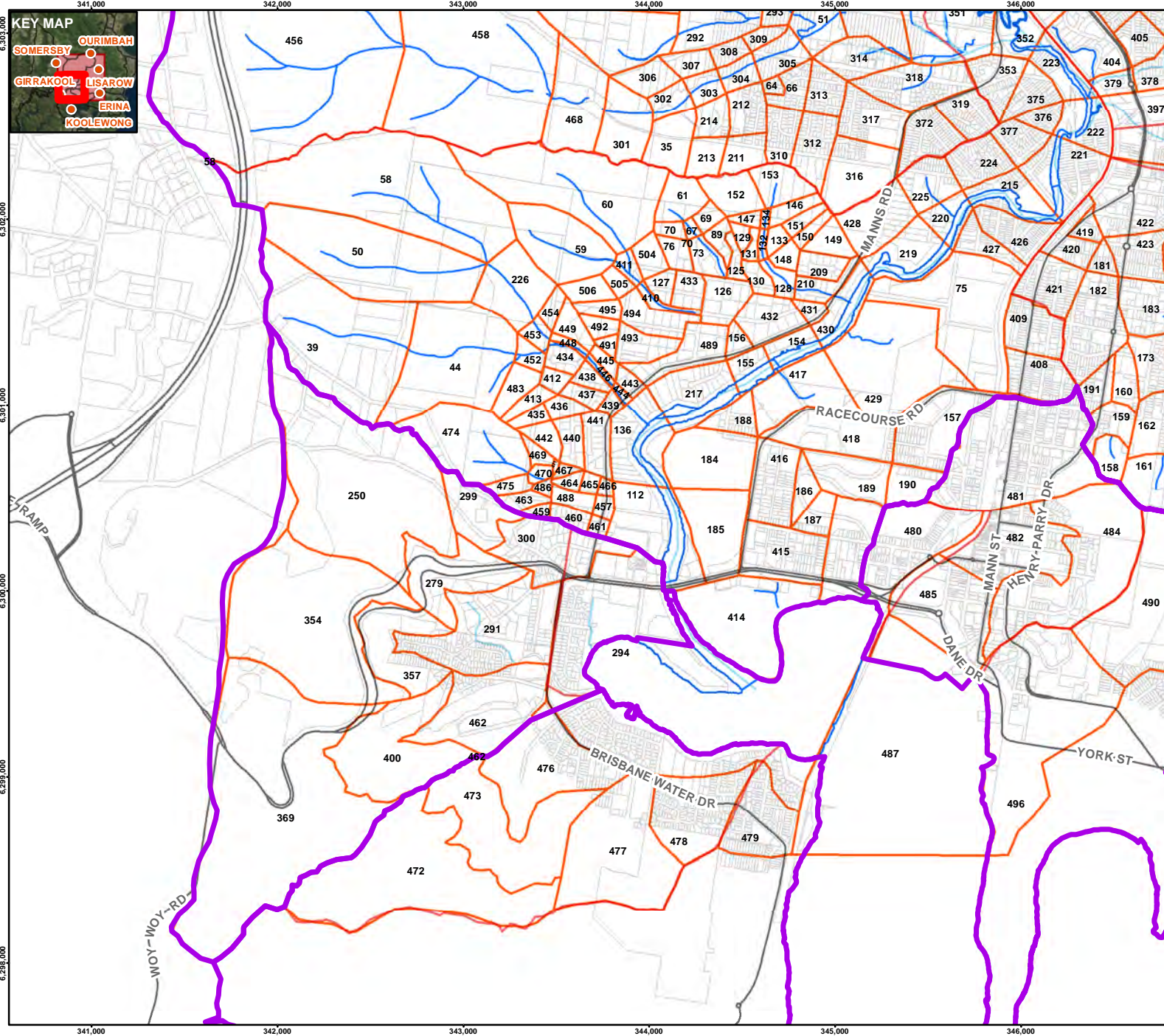
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**HYDROLOGIC SUBCATCHMENTS**

CONSULTANT

DD/MM/YYYY	29/03/2018
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REVIEWED	NM
APPROVED	NM

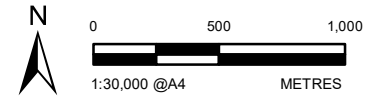
PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **8C**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Catchment Boundary
- Drainage Sub-Catchment
- Cadastral Boundary
- Waterway
- RAFTS Subcatchments



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Catchment Boundary, Sub-Catchment Boundary, Waterways, Creeklines:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

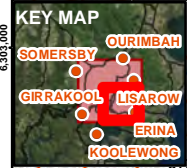
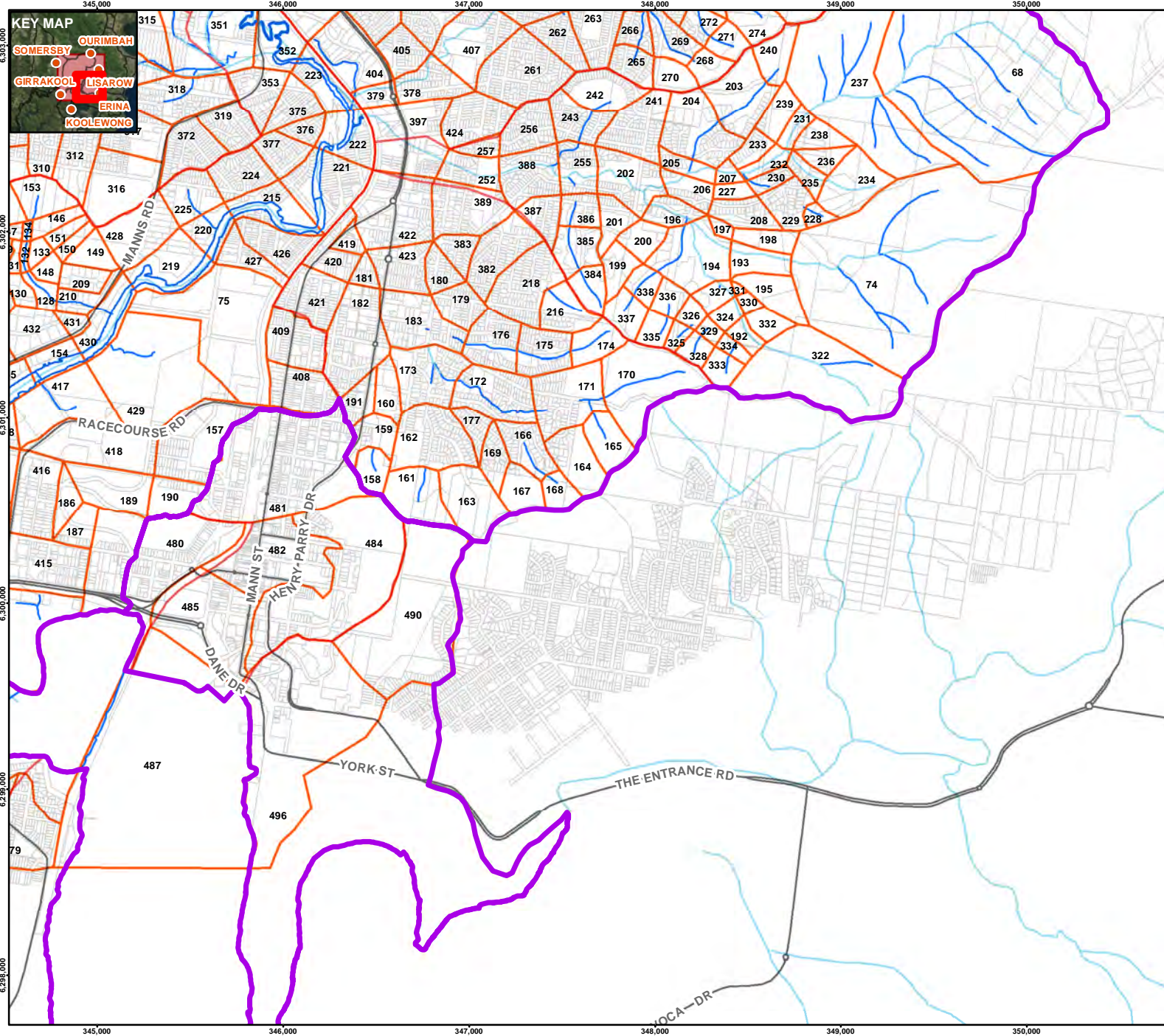
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**HYDROLOGIC SUBCATCHMENTS**



DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **8D**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Catchment Boundary
- Drainage Sub-Catchment
- Cadastral Boundary
- Waterway
- RAFTS Subcatchments



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

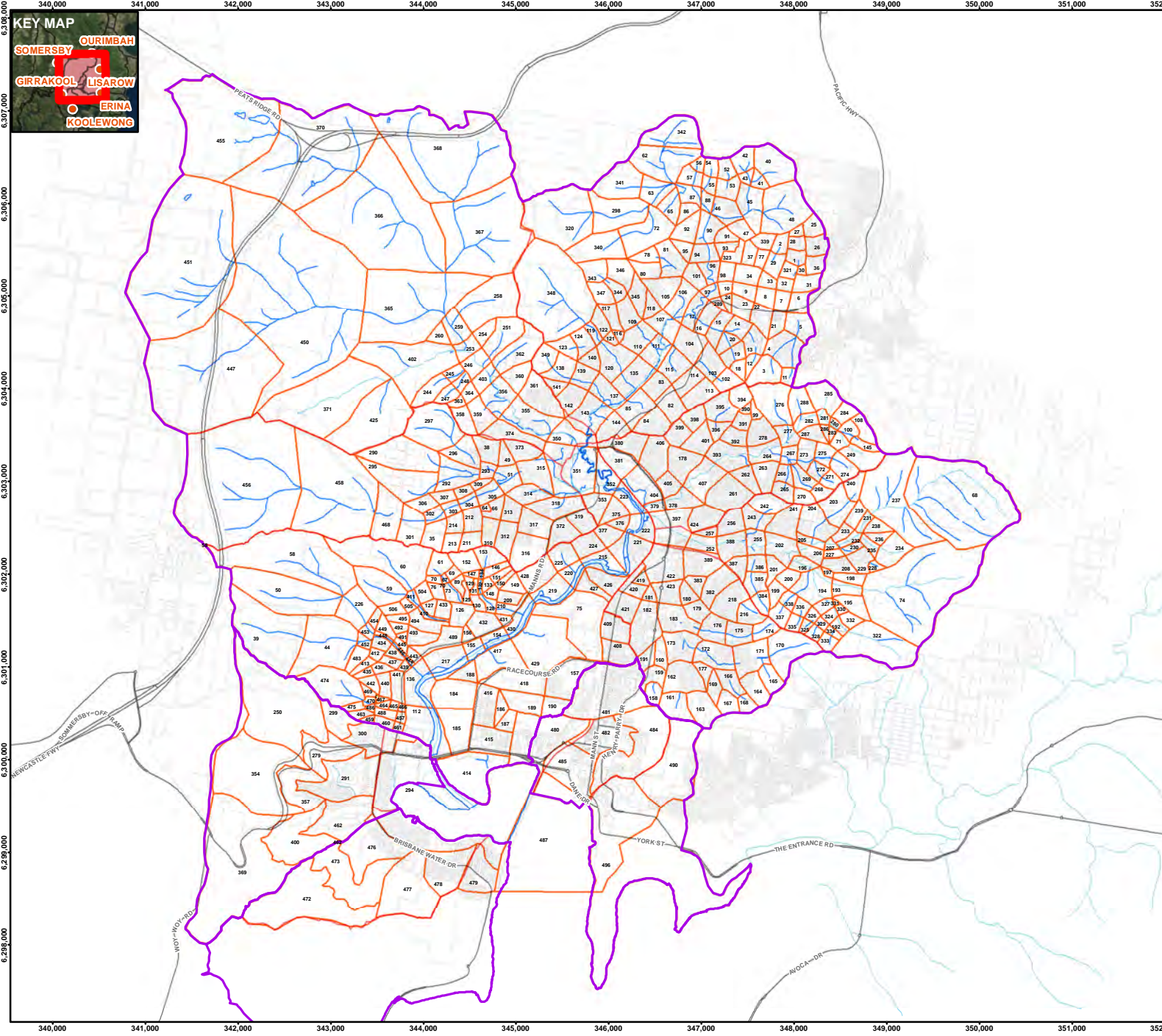
TITLE  
**HYDROLOGIC SUBCATCHMENTS**

CONSULTANT

DD/MM/YYYY	29/03/2018
DESIGNED	SL
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REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **8E**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- Catchment Boundary
- Drainage Sub-Catchment
- Cadastral Boundary
- Waterway
- RAFTS Subcatchments

**Scale:** 0 500 1,000 METRES  
1:60,000 @A4

**Coordinate System:** GDA 1994 MGA Zone 56  
**Projection:** Transverse Mercator  
**Datum:** GDA 1994

**NOTE(S)**  
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**Cadastral, Catchment Boundary, Sub-Catchment Boundary, Waterways, Creeklines:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

**PROJECT**  
**NARARA CREEK FLOOD STUDY**

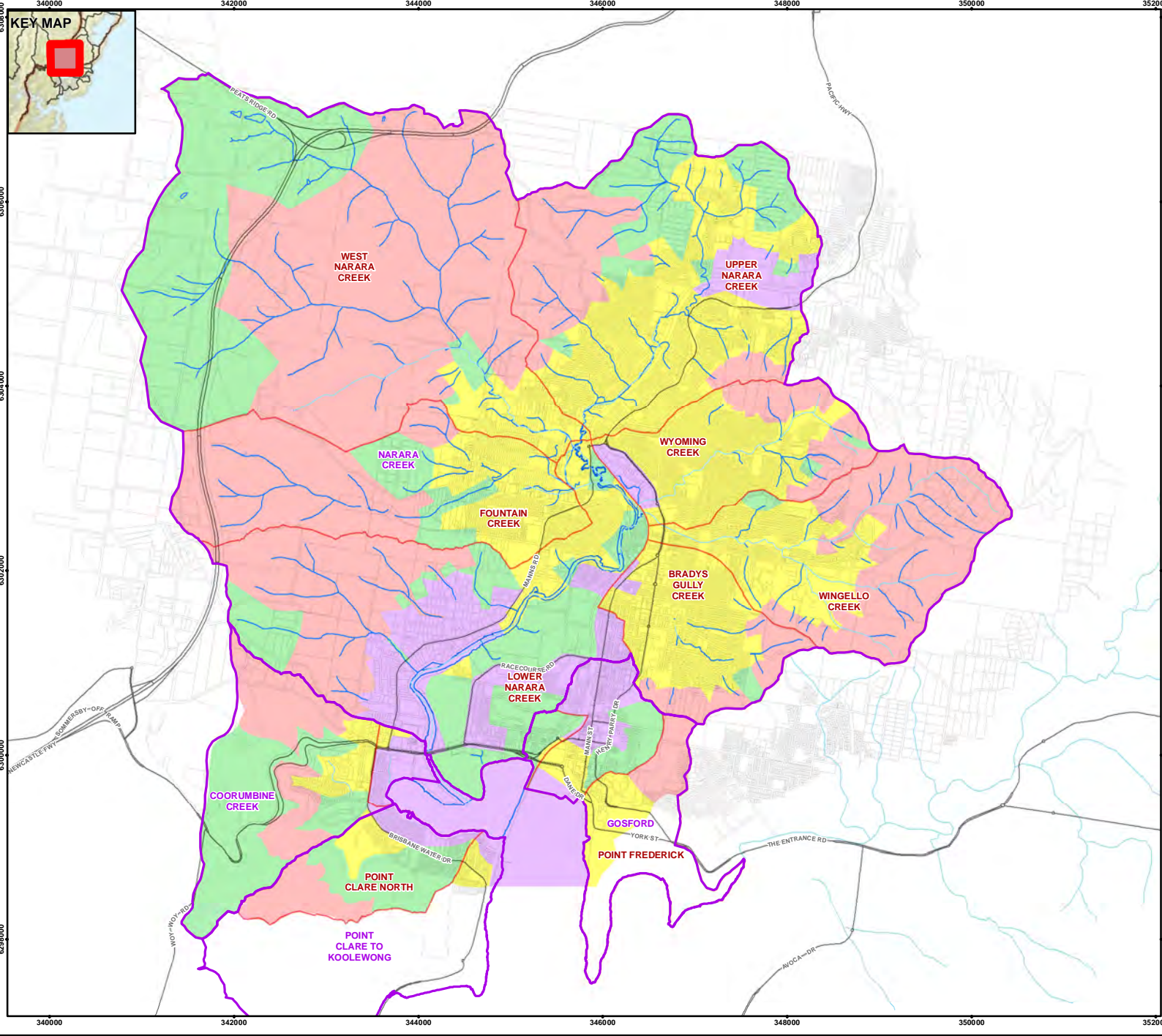
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**CONSULTANT**  


DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

<b>PROJECT NO.</b>	<b>CONTROL</b>	<b>REV.</b>	<b>FIGURE</b>
097626068	006	G	8A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- ▭ Catchment Boundary
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Waterway
- LANDUSE**
- ▭ Residential
- ▭ Open Area/ Forest Fringe
- ▭ Forest
- ▭ Commercial/ Industrial/ Water Body & Foreshore

N

0 1,000 2,000

1:60,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**Cadastre, Creek lines, Narara Creeks, Waterway, Land Use:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

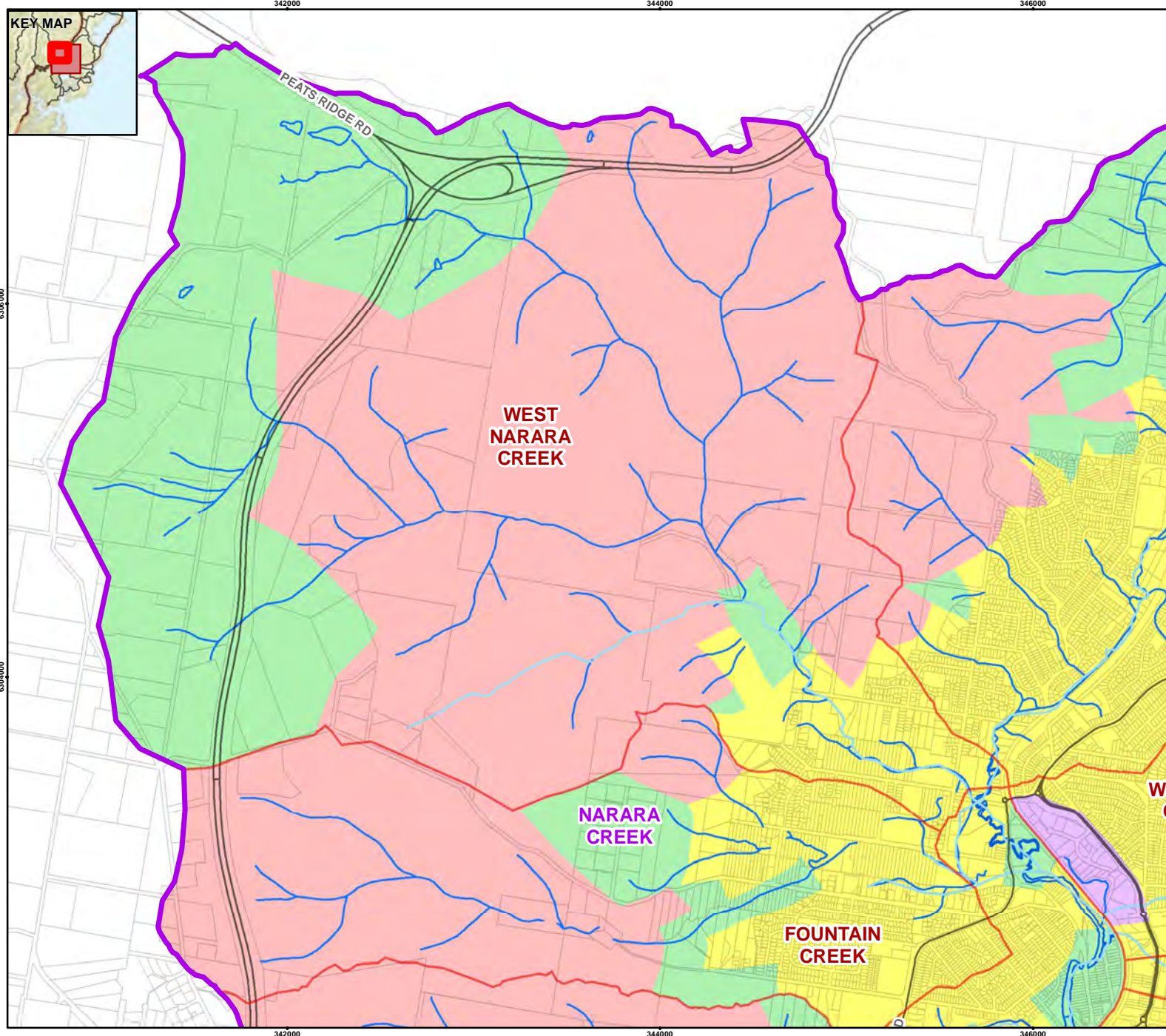
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CONSULTANT

DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	9A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- ▭ Catchment Boundary
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Waterway
- LANDUSE**
- ▭ Residential
- ▭ Open Area/ Forest Fringe
- ▭ Forest
- ▭ Commercial/ Industrial/ Water Body & Foreshore

N

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

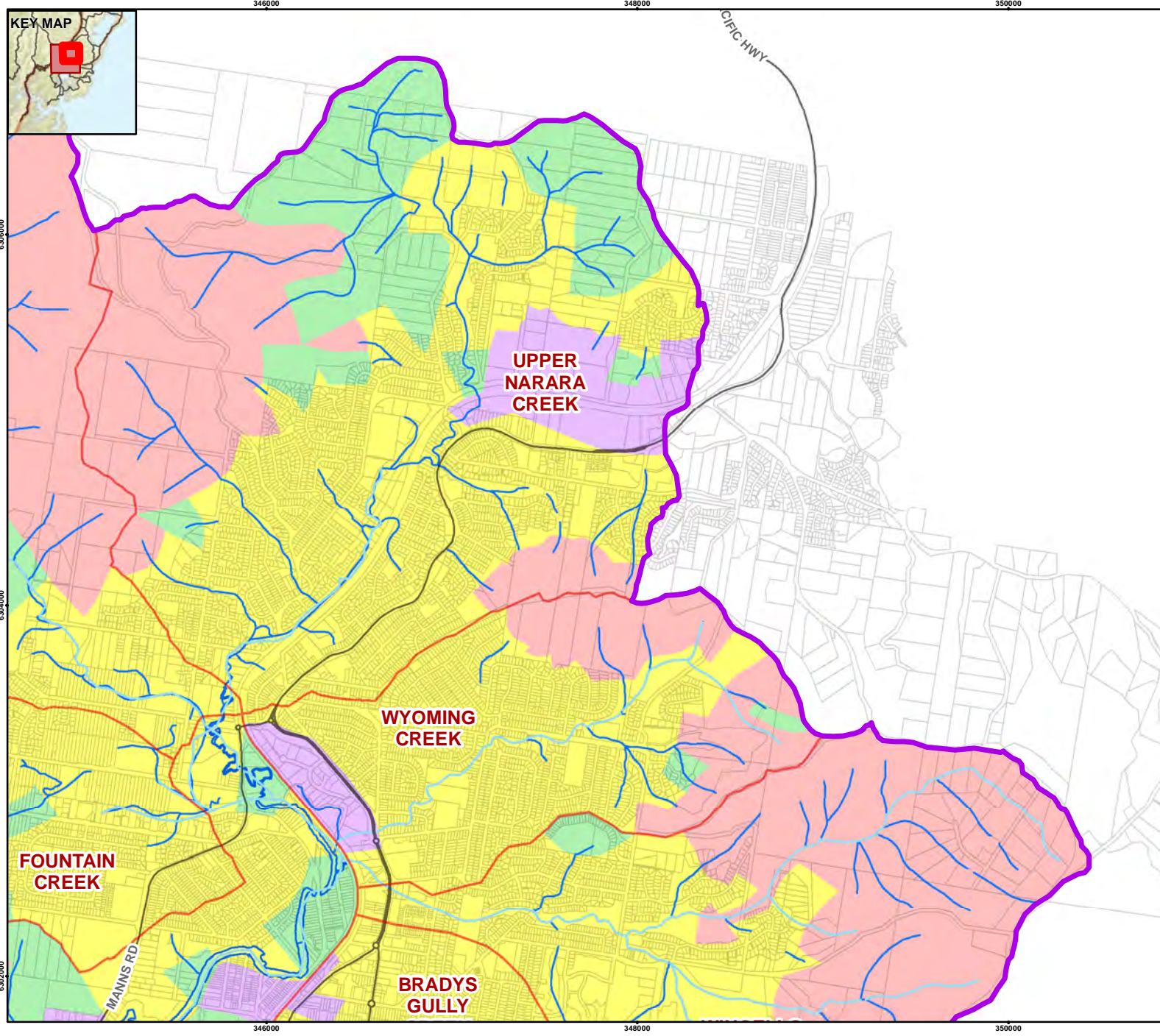
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**HYDROLOGIC MODEL LAND USE DISTRIBUTION**

CONSULTANT

DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	9B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- ▭ Catchment Boundary
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Waterway
- LANDUSE**
- ▭ Residential
- ▭ Open Area/ Forest Fringe
- ▭ Forest
- ▭ Commercial/ Industrial/ Water Body & Foreshore

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**Cadastral, Creek lines, Narara Creeks, Waterway, Land Use:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

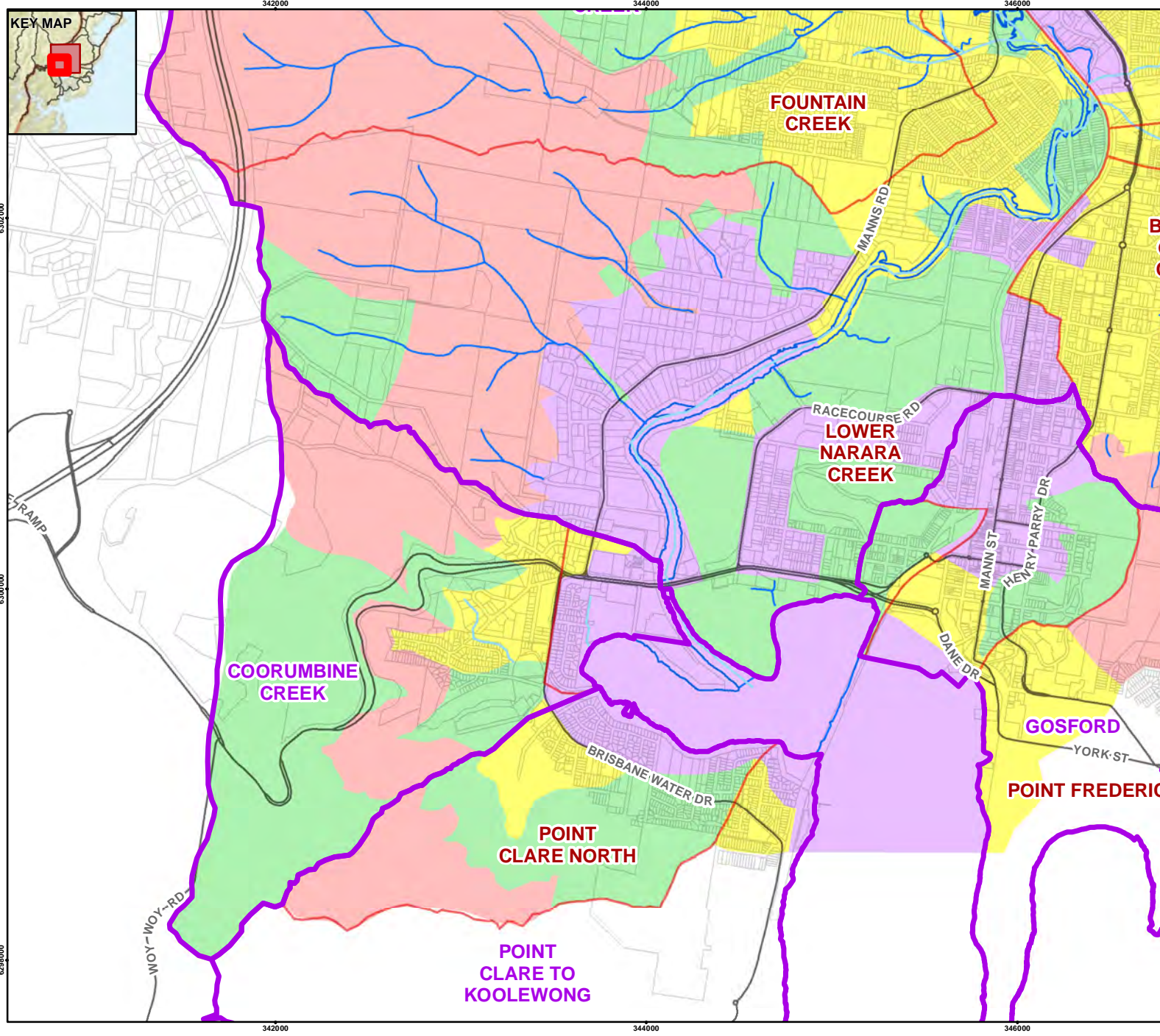
TITLE  
**HYDROLOGIC MODEL LAND USE DISTRIBUTION**

CONSULTANT  


DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	9C

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- ▭ Catchment Boundary
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Waterway
- LANDUSE**
- ▭ Residential
- ▭ Open Area/ Forest Fringe
- ▭ Forest
- ▭ Commercial/ Industrial Water Body & Foreshore

N

0 500 1,000

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Creek lines, Narara Creeks, Waterway, Land Use: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDROLOGIC MODEL LAND USE DISTRIBUTION**

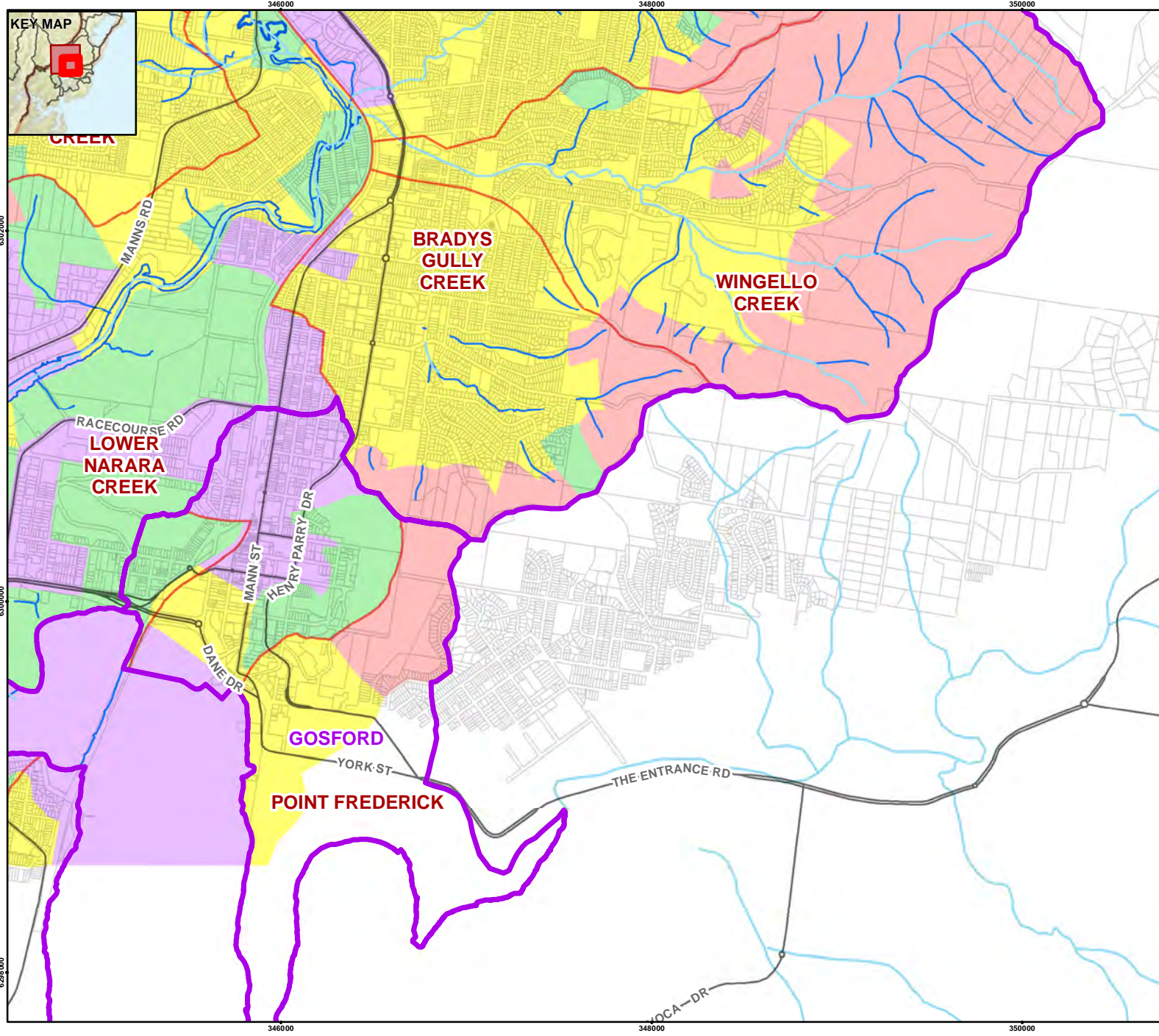
CONSULTANT  


DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	9D

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4





**Legend**

- Localities
- Main Roads
- Creek Lines
- Narara Creek and Tributaries
- ▭ Catchment Boundary
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Waterway
- LANDUSE**
- ▭ Residential
- ▭ Open Area/ Forest Fringe
- ▭ Forest
- ▭ Commercial/ Industrial/ Water Body & Foreshore

N

0 500 1,000

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Creek lines, Narara Creeks, Waterway, Land Use: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDROLOGIC MODEL LAND USE DISTRIBUTION**

CONSULTANT



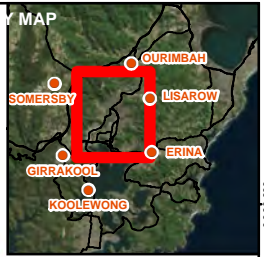
DD/MM/YYYY 29/03/2018

DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 9E

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4 25mm

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6,304,000

6,304,000

6,304,000

6,304,000

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6,302,000

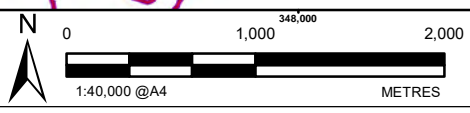
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6,300,000

344,000 346,000

- Legend**
- Catchment Boundary
  - Drainage Sub-Catchment
  - 2D Model Extent
  - 1D Extent within 2D Model

- DEM Legend**
- Elevation (mAHD):**
- 2.7 mAHD
  - 11.6 mAHD
  - 32.6 mAHD
  - 80.4 mAHD
  - 203.7 mAHD



**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Drainage Catchment, Sub-Catchment, DEM:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

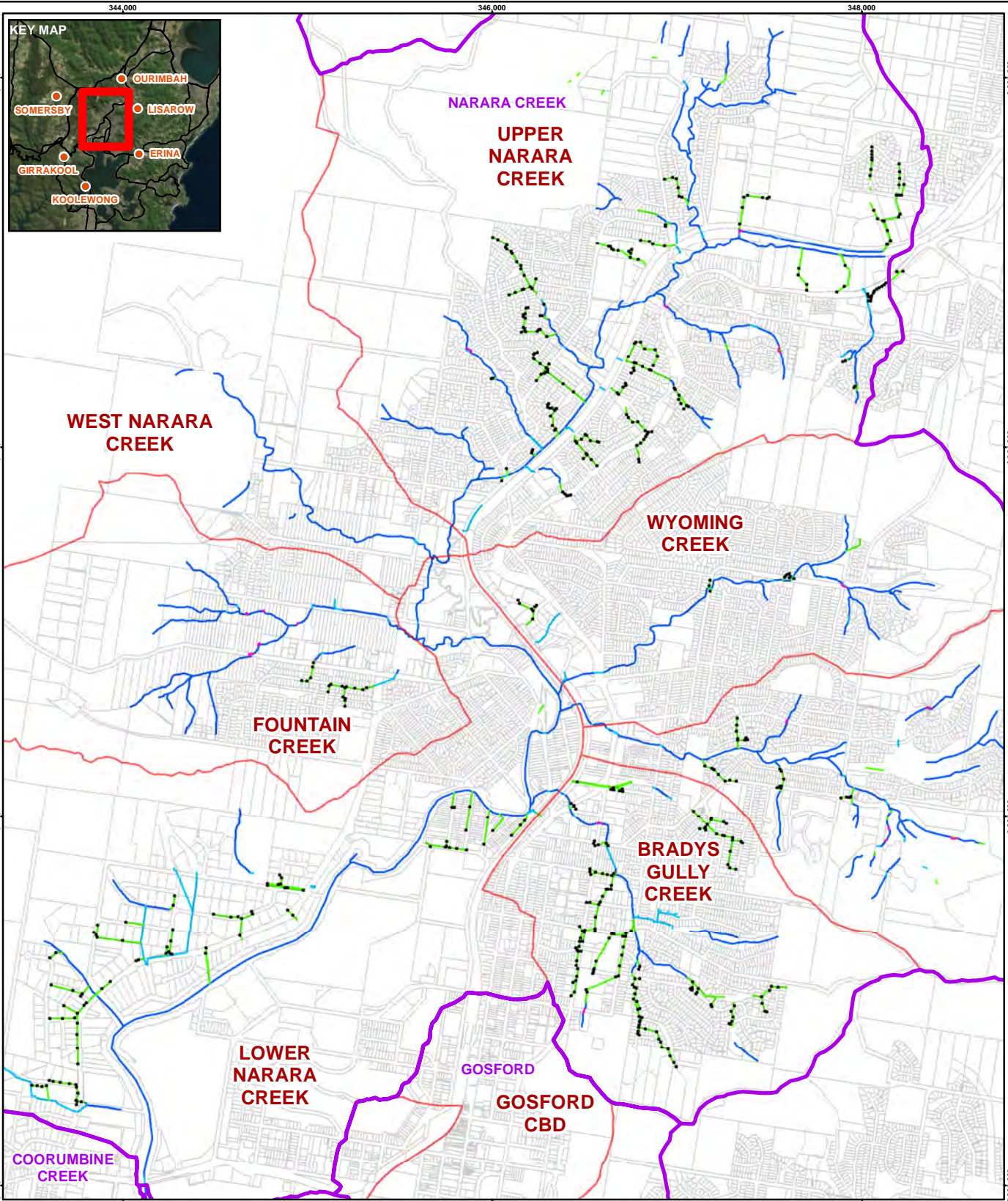
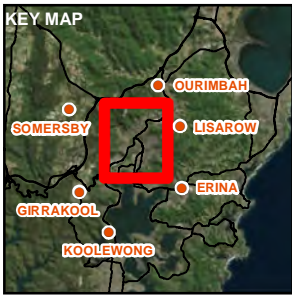
CONSULTANT	DD/MM/YYYY	29/03/2018
	DESIGNED	HB
	PREPARED	HB
	REVIEWED	NM
	APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

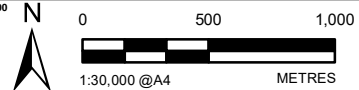
TITLE  
**2D HYDRAULIC MODEL EXTENT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	10

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 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- Unsurveyed Pit
  - Unsurveyed Pipe
  - Weir
  - Surveyed Structures
  - Open Channel
  - Catchment Boundary
  - Drainage Sub-Catchment



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Unsurveyed Pit, Unsurveyed Pipe, Weir, Surveyed Structures, Open Channel, Catchment Boundary, Drainage Sub-Catchment: Provided by Central Coast Council February 2018

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CONSULTANT	DD/MM/YYYY	29/03/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM



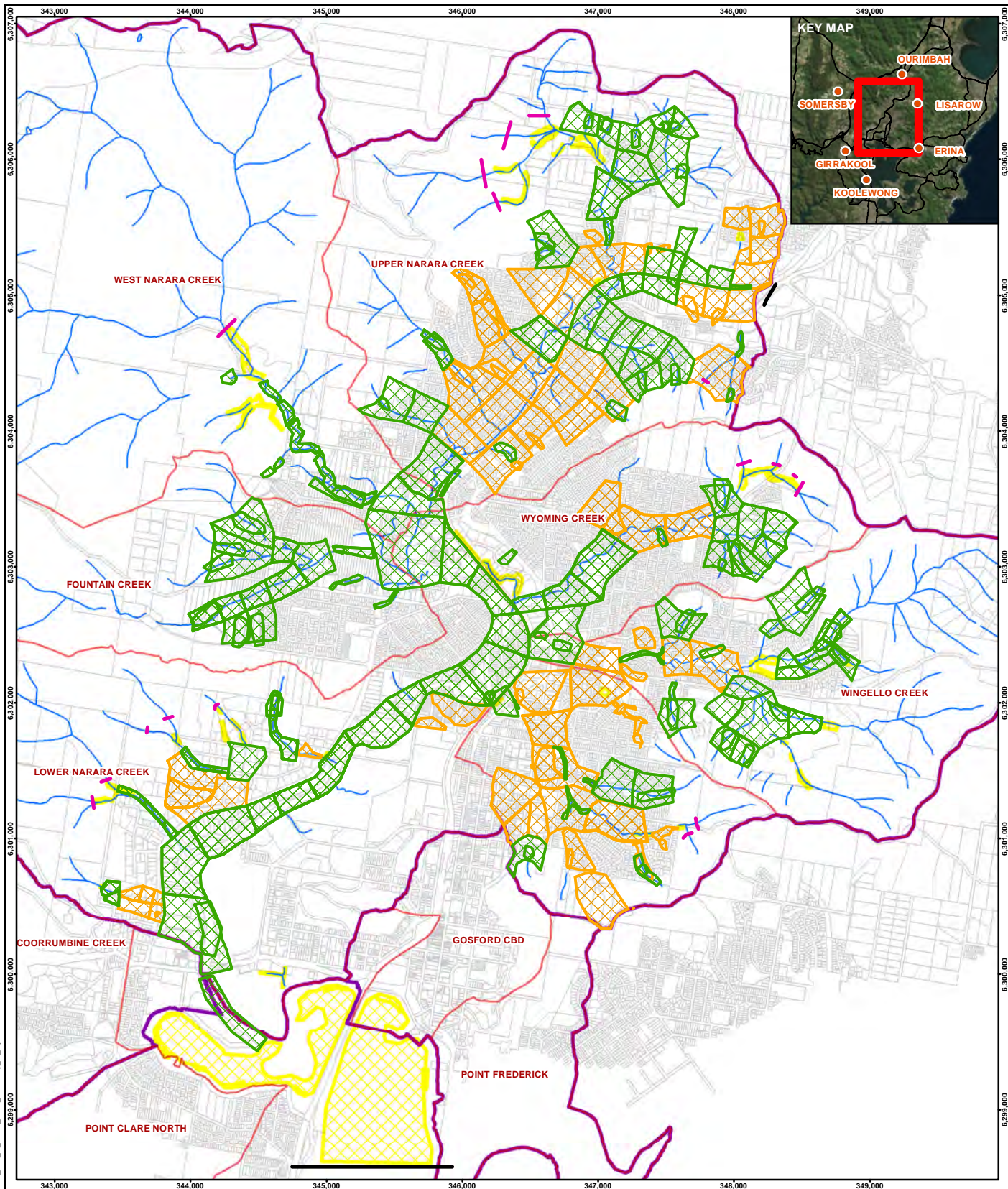
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**STRUCTURES IN HYDRAULIC MODEL**

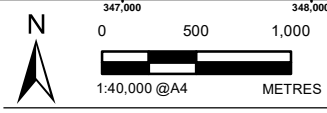
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	11

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344,000 346,000 348,000  
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 25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- 2D Inflow Hydrograph at Grid Edge
  - 2D Downstream Water Level
  - Narara Creek and Tributaries
  - Catchment Boundary
  - Drainage Sub-Catchment
  - Cadastral Boundary
  - 2D Inflow Hydrograph
  - 2D Pit Inflow Hydrograph
  - 1D Inflow Hydrograph



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Creek Lines, Sub-Catchment, Catchment: Provided by Central Coast Council February 2018

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CONSULTANT	DD/MM/YYYY	29/03/2018
	DESIGNED	HB
	PREPARED	HB
	REVIEWED	NM
	APPROVED	NM

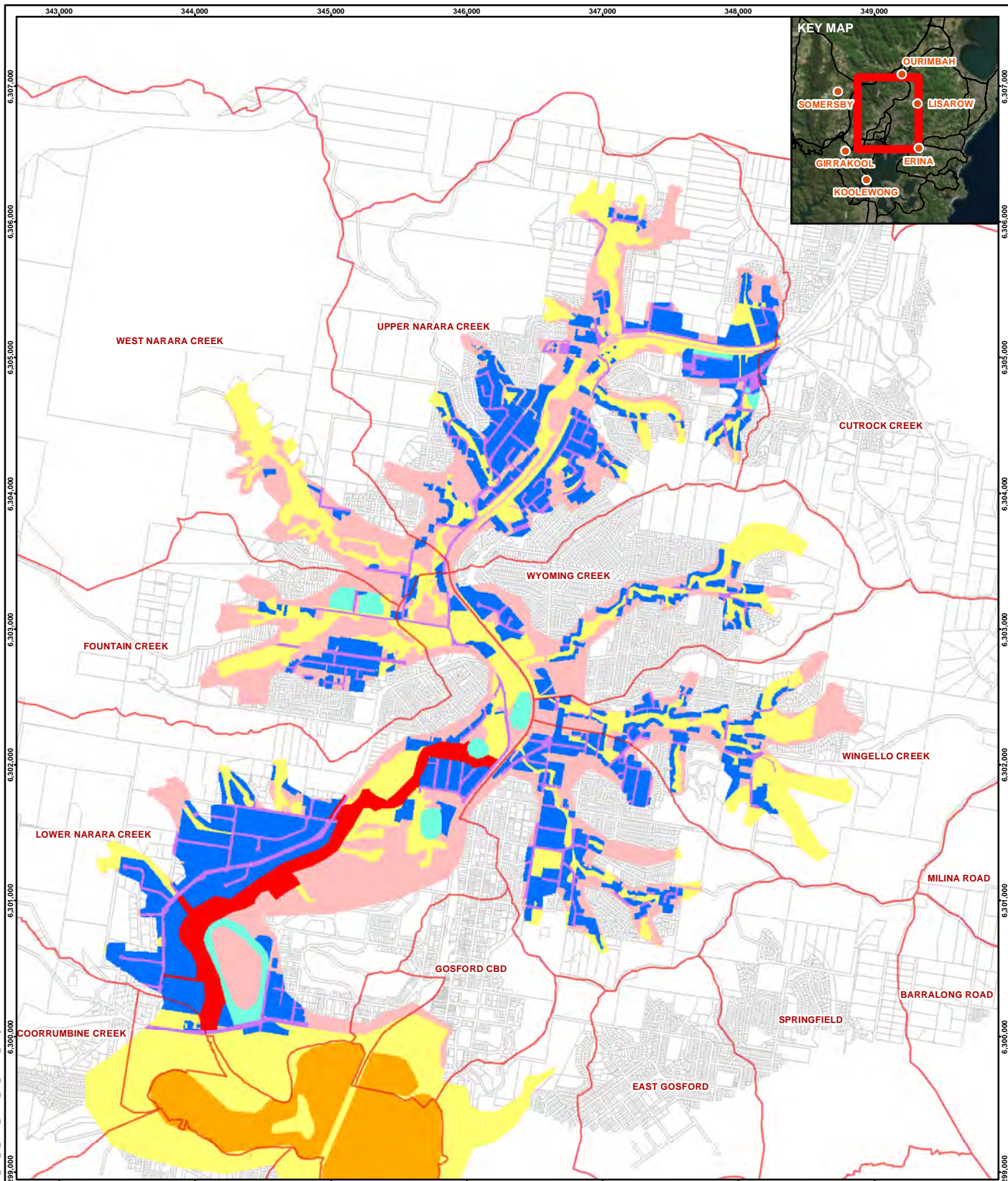


PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**BOUNDARY CONDITIONS IN HYDRAULIC MODEL**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	12

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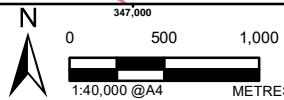
Legend	
	Drainage Sub-Catchment
	Cadastral Boundary
	Bush/Vegetated Waterway (0.08)
	Park/Sports Field/Bare Ground (0.035)
	Building/Stabiliser (0.1)
	Pasture/Urban Floodplain (0.05)
	Mangrove (0.1)
	Road/Carpark (0.02)
	Fagans Bay (0.035)

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CONSULTANT



DD/MM/YYYY	29/03/2018
DESIGNED	HB
PREPARED	HB
REVIEWED	NM
APPROVED	NM



Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

PROJECT

**NARARA CREEK FLOOD STUDY**

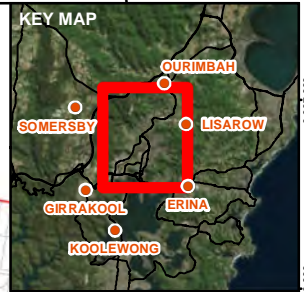
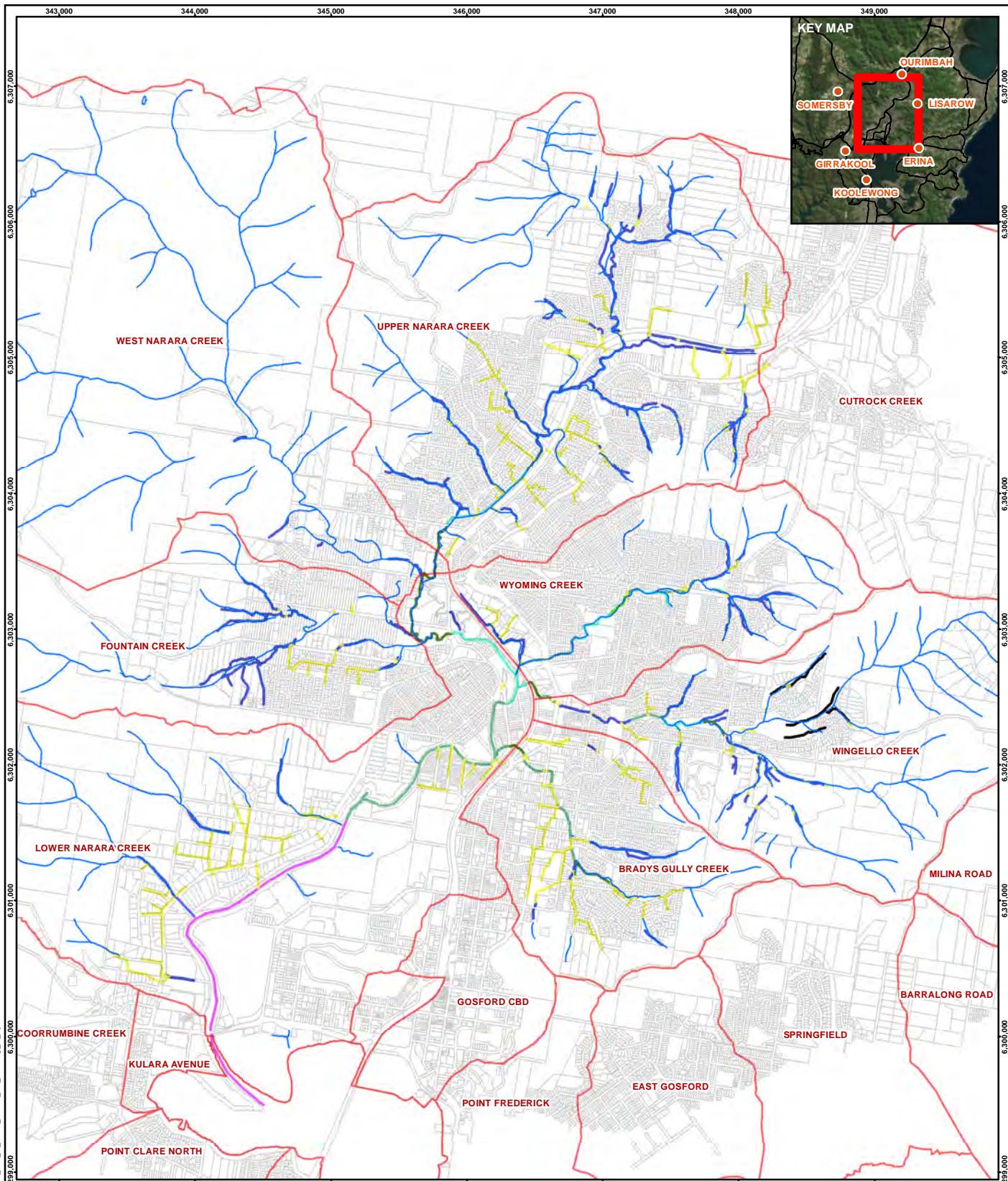
TITLE

**CALIBRATED 2D MANNING'S N**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	13A

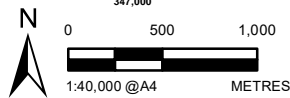
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

1D Manning's n	0.06
0.017	0.08
0.03	0.09
0.035	Drainage Sub-Catchment
0.04	Cadastral Boundary
0.045	
0.05	



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

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CONSULTANT



DD/MM/YYYY	29/03/2018
DESIGNED	HB
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

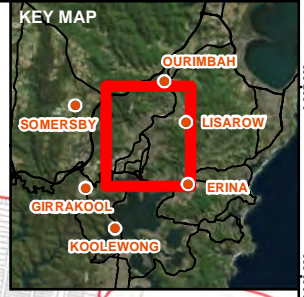
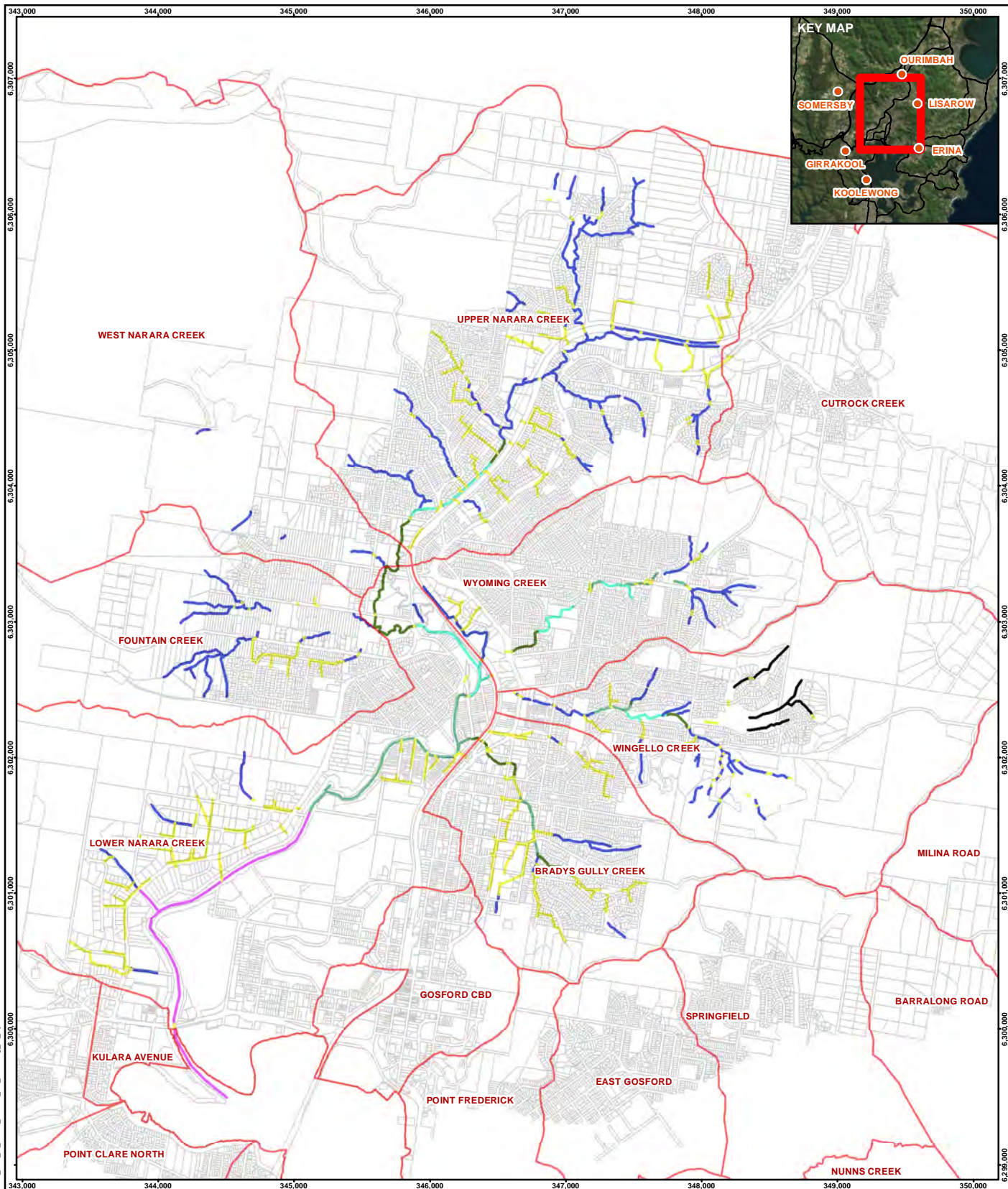
TITLE

**CALIBRATED 1D MANNING'S N JUNE 2007**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	13B

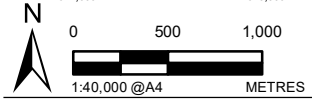
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

1D Manning's n	0.08
0.017	0.09
0.035	Drainage Sub-Catchment
0.04	Cadastral Boundary
0.045	
0.05	
0.06	



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 1D Manning's n, Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

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CONSULTANT



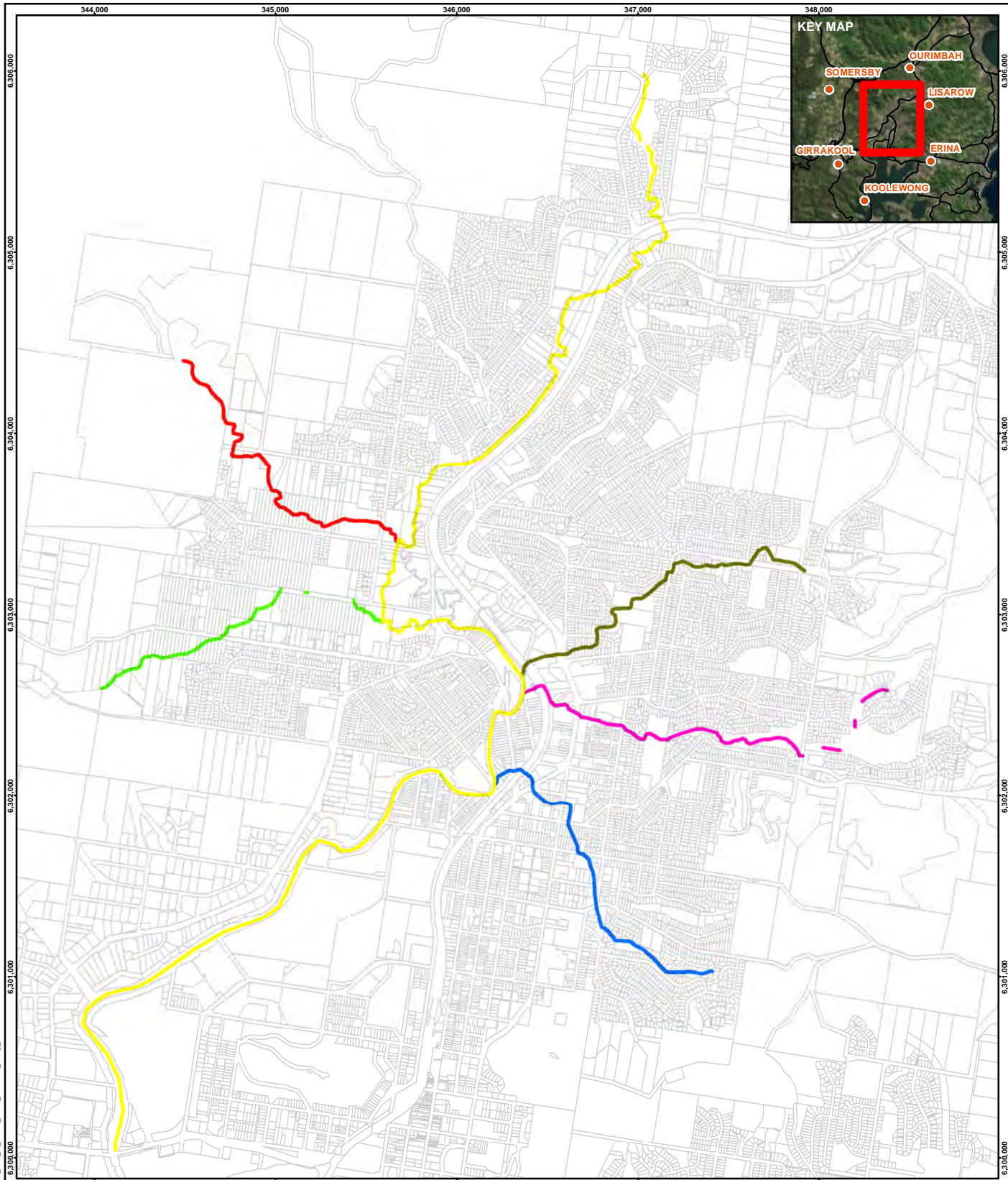
DD/MM/YYYY	29/03/2018
DESIGNED	HB
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CALIBRATED 1D MANNING'S N  
 2 & 7 FEBRUARY 1990, FEBRUARY 1992**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	13C

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 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- Localities
  - Lower and Upper Narara Creek
  - Bradys Gully
  - Wingello Creek
  - Wyoming Creek
  - West Narara Creek
  - Fountain Creek
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Localities:** Provided by MapInfo StreetPro.  
**Cadastre, Creek and Gully:** Provided by Central Coast Council February 2018

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CONSULTANT	DD/MM/YYYY	29/03/2018
	DESIGNED	HB
	PREPARED	HB
	REVIEWED	NM
	APPROVED	NM

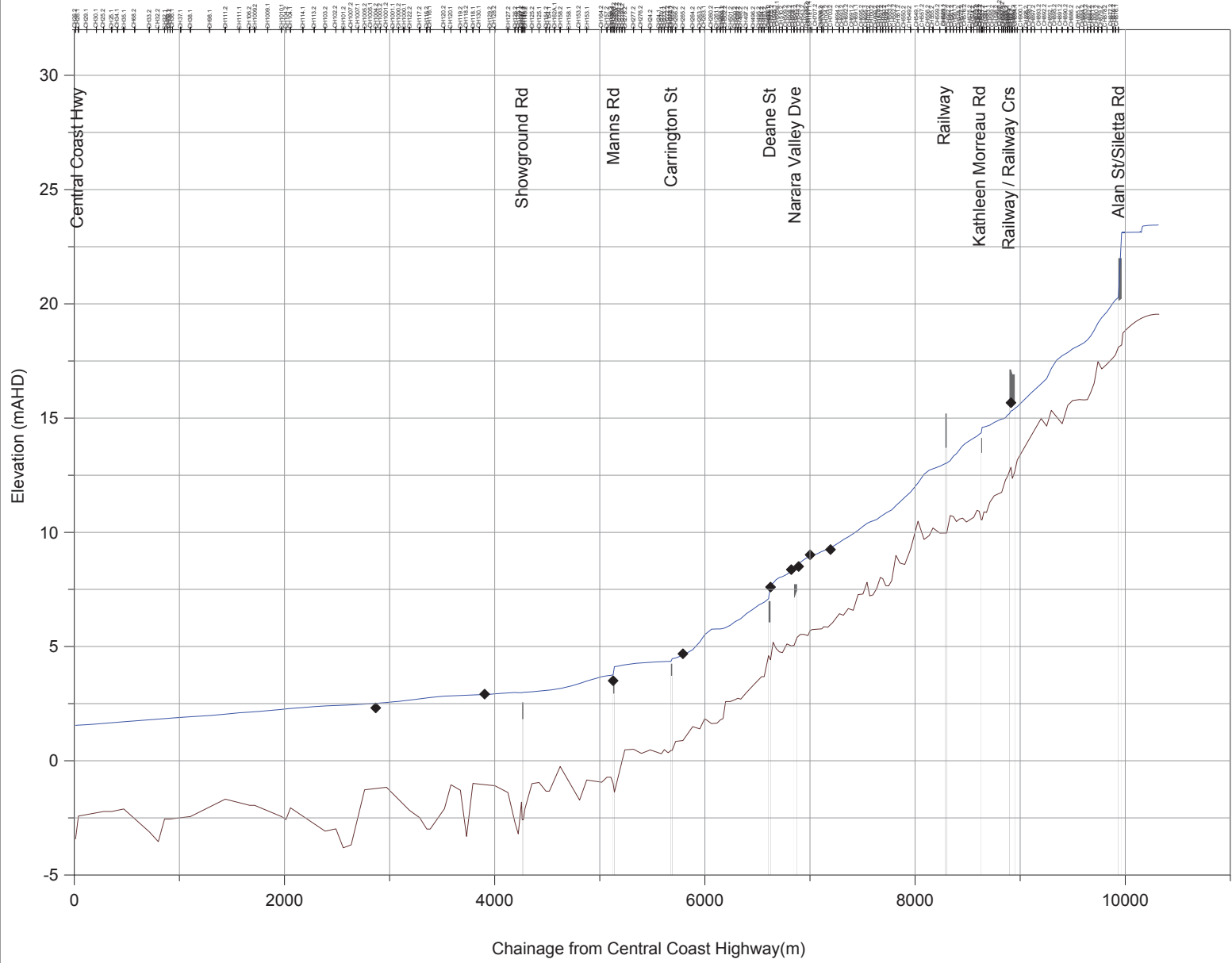
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**LOCATION OF RAINFALL AND WATER LEVEL GAUGING STATIONS**





PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	14

PATH: R:\01 Client\Gosford City Council\097626068\_006\_F\_RevG\_F014\_Location\_Long\_Sections.mxd PRINTED ON: 2018-03-29 AT: 5:20:26 PM  
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**Legend**

-  Modelled Flood Height (mAHD)
-  Observed
-  Bridge Deck /Culvert
-  Creek-Bed

**NOTE(S)**  
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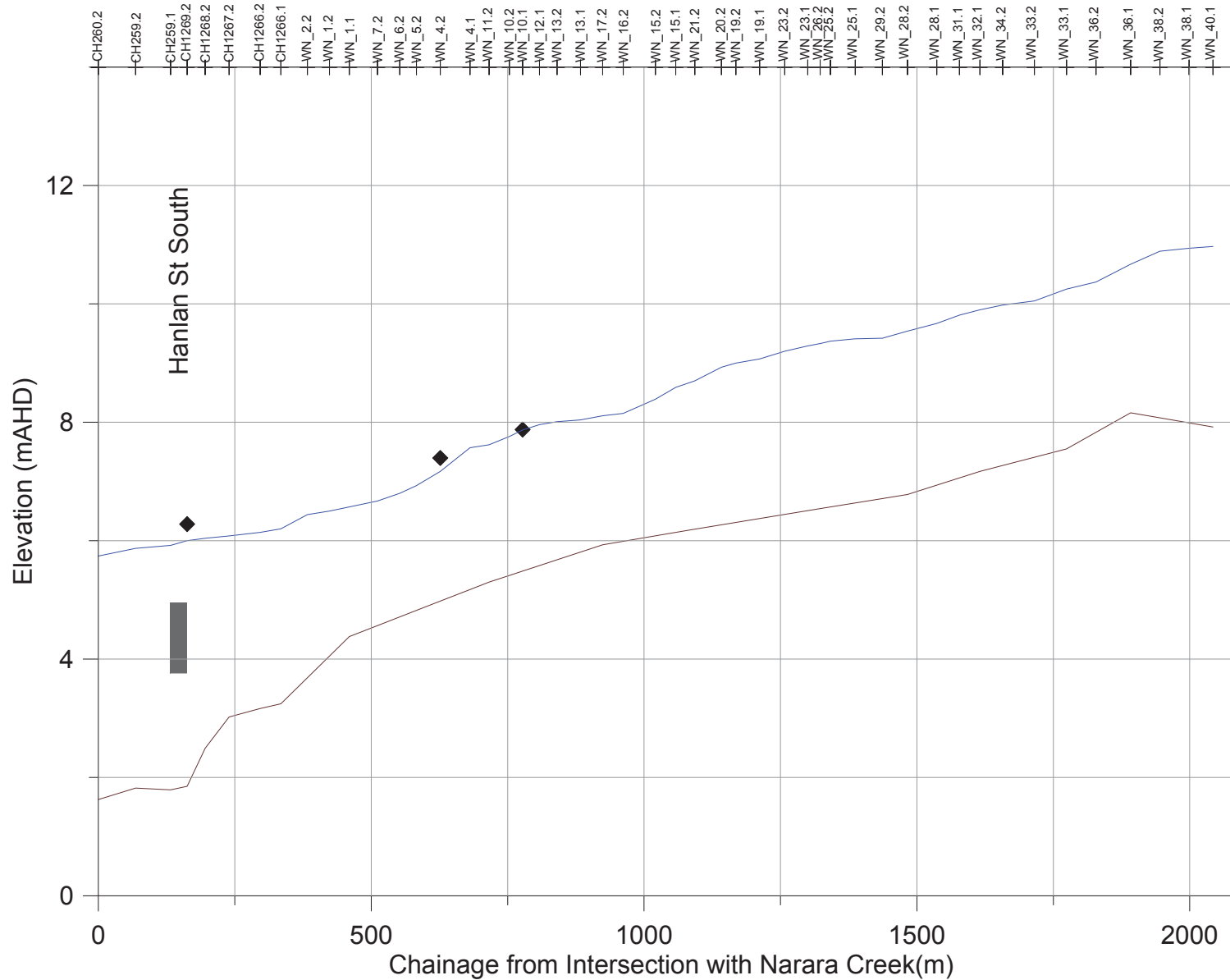
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY





TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
LOWER NARARA AND UPPER NARARA  
CREEK**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



### Legend

-  Modelled Flood Height (mAHD)
-  Observed
-  Bridge Deck /Culvert
-  Creek-Bed

**NOTE(S)**  
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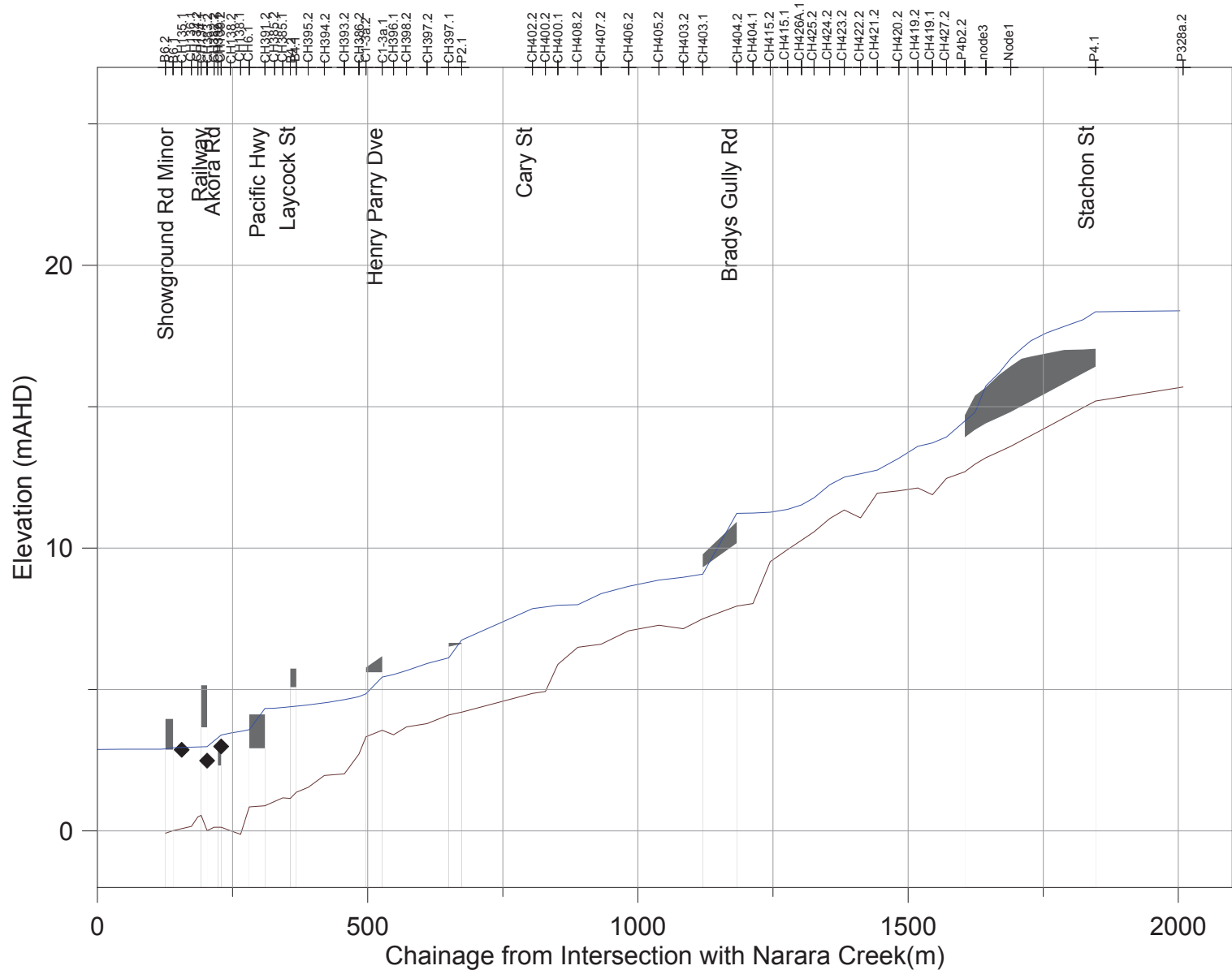
PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
WEST NARARA CREEK**





CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	16



### Legend

-  Modelled Flood Height (mAHD)
-  Observed
-  Bridge Deck /Culvert
-  Creek-Bed

**NOTE(S)**  
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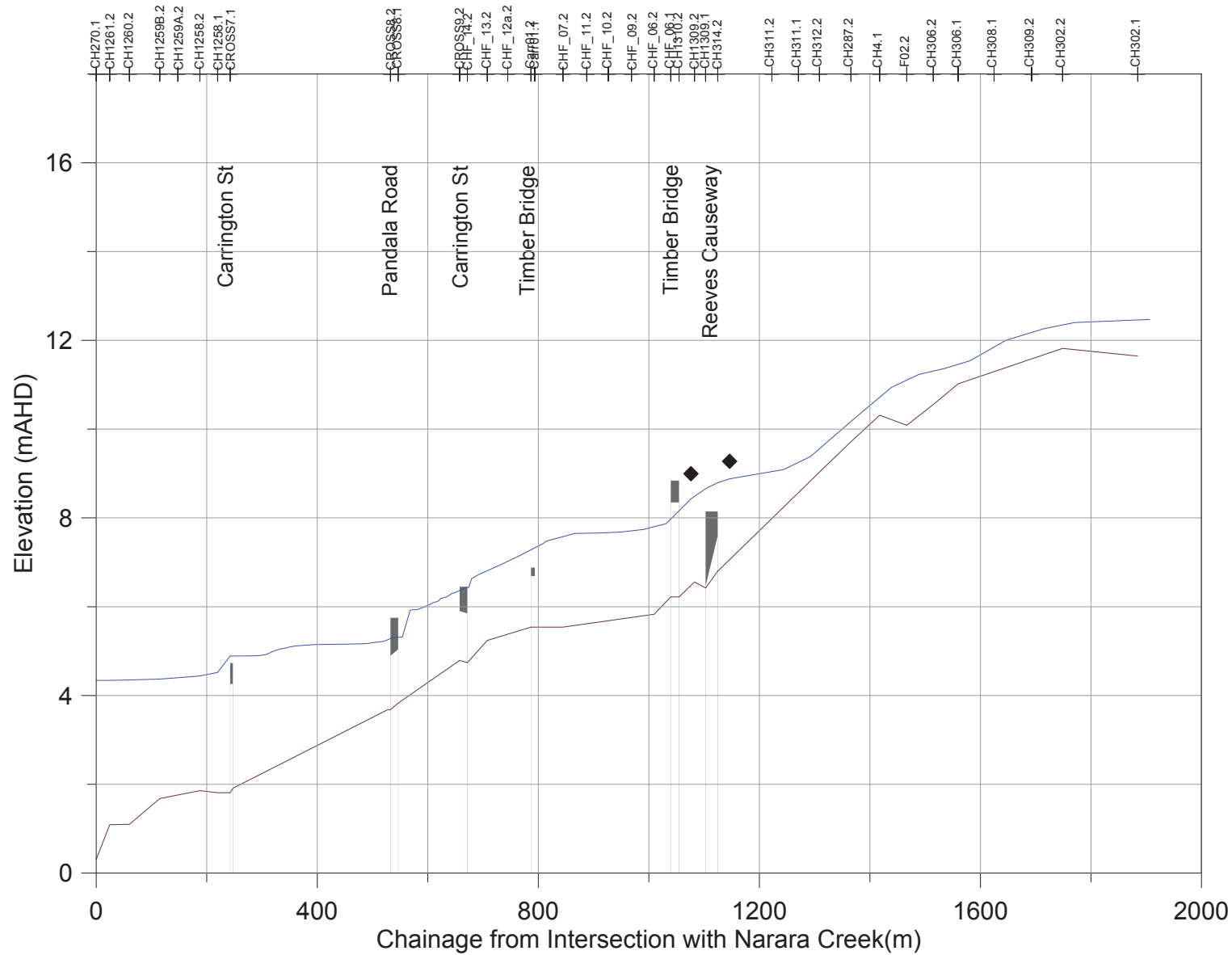
PROJECT  
NARARA CREEK FLOOD STUDY





TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
BRADY GULLY**

CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



- Legend**
-  Modelled Flood Height (mAHD)
  -  Observed
  -  Bridge Deck /Culvert
  -  Creek-Bed

**NOTE(S)**  
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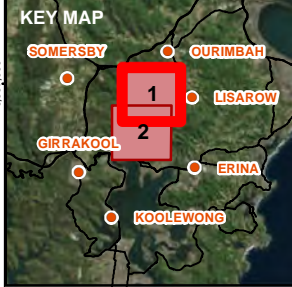
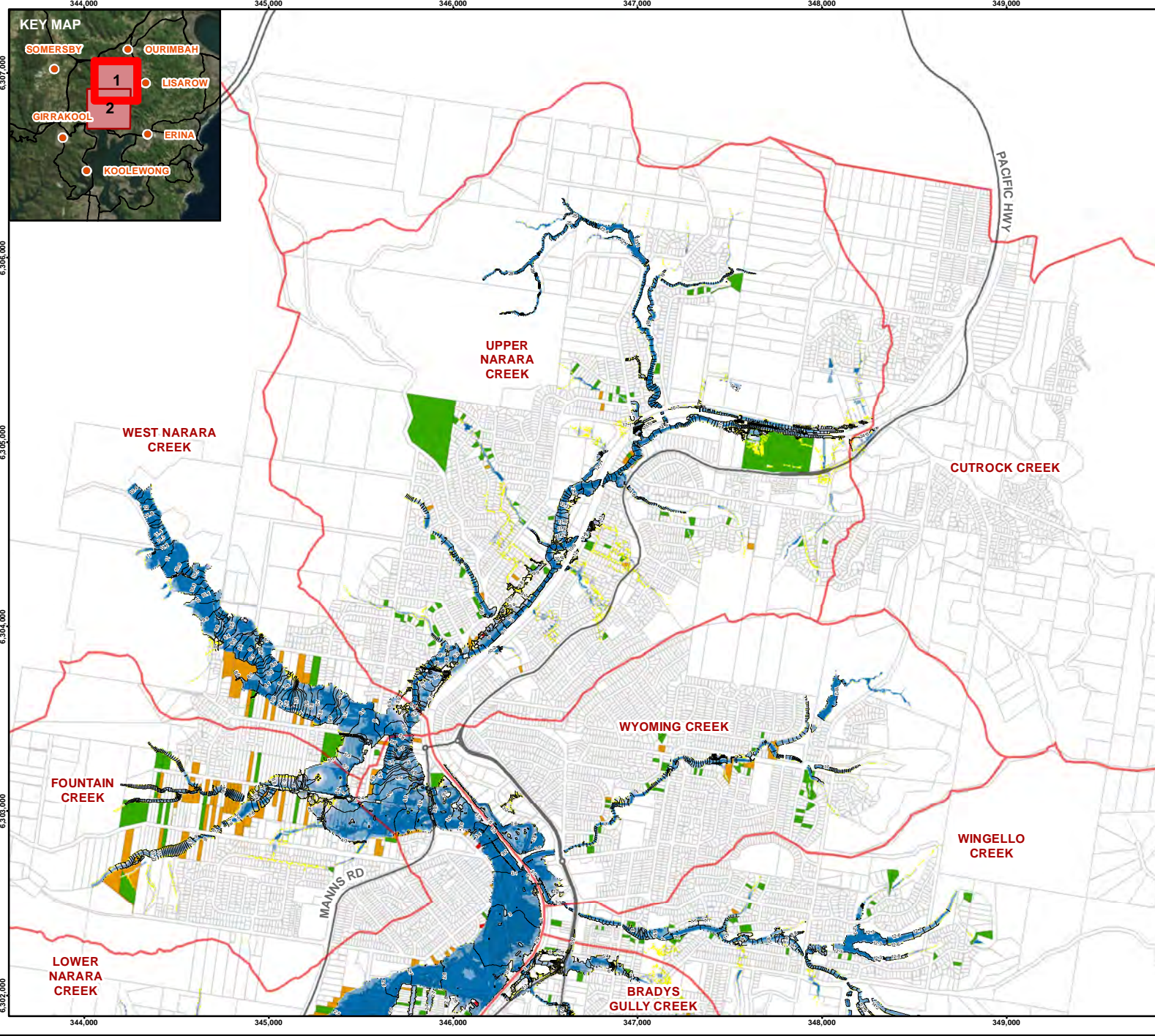
CLIENT  
 CENTRAL COAST COUNCIL

PROJECT  
 NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS (JUNE 2007)  
 FOUNTAIN CREEK**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Red: > 1 m

**Flood Status From Comm Survey**

- Green: property not affected
- Orange: backyard or frontyard affected
- Red: above floor flooding

Scale: 0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

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PROJECT  
**NARARA CREEK FLOOD STUDY**

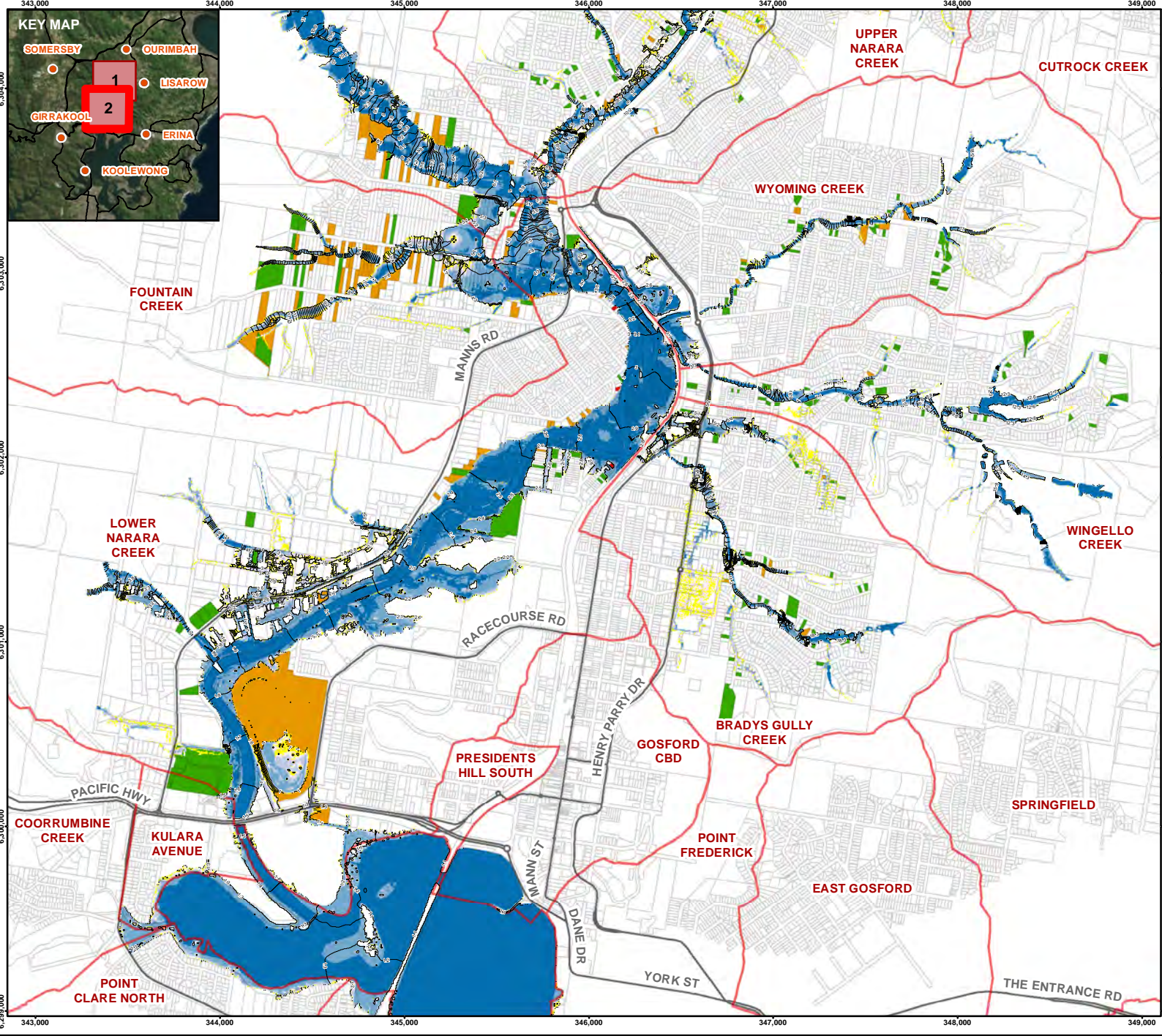
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT JUNE 2007**

CONSULTANT

DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	19A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

**Flood Status From Comm Survey**

- property not affected
- backyard or frontyard affected
- above floor flooding

Scale: 0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

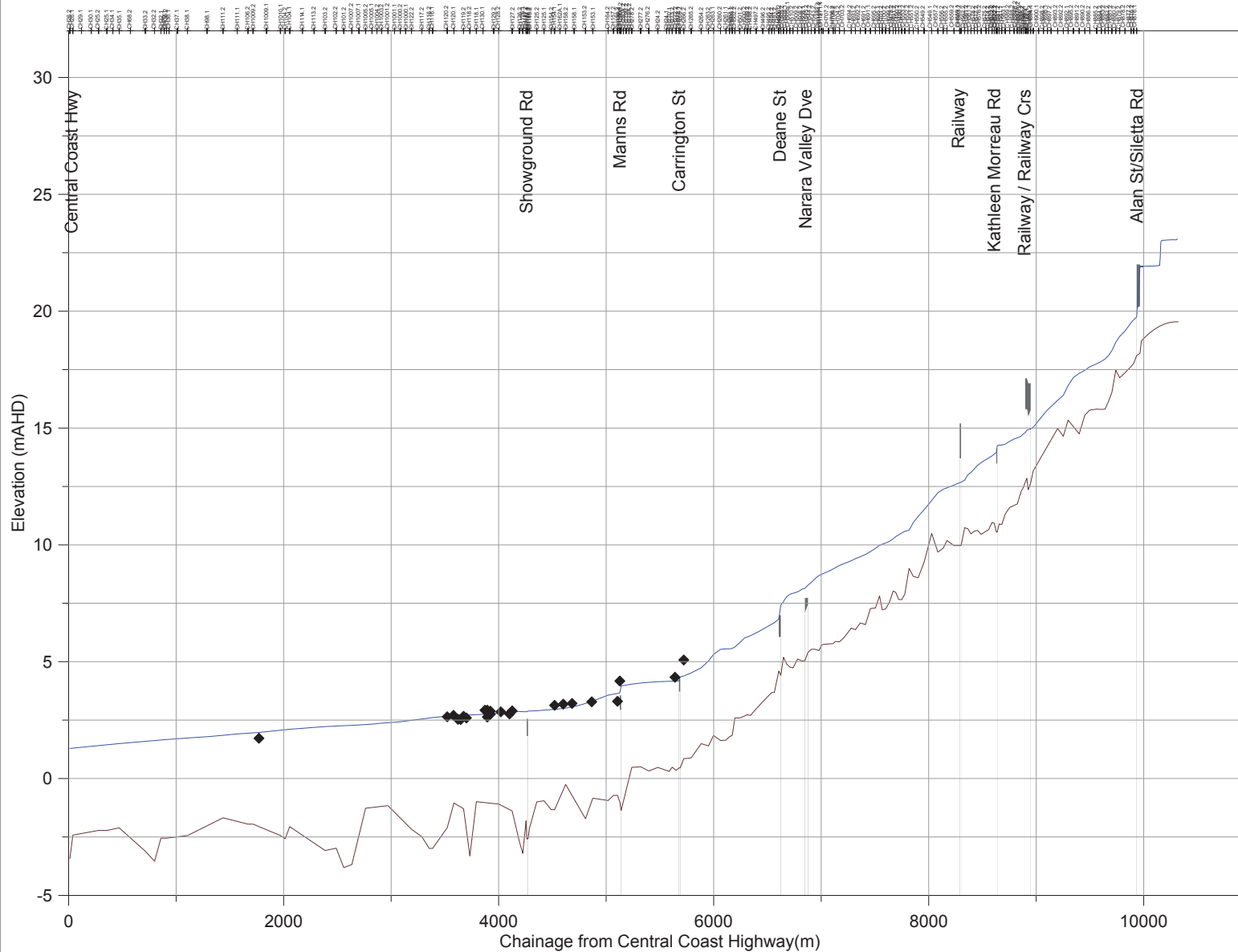
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT JUNE 2007**





CONSULTANT

DD/MM/YYYY	29/03/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 19B

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- Legend**
-  Modelled Flood Height (mAHD)
  -  Observed
  -  Bridge Deck /Culvert
  -  Creek-Bed

**NOTE(S)**  
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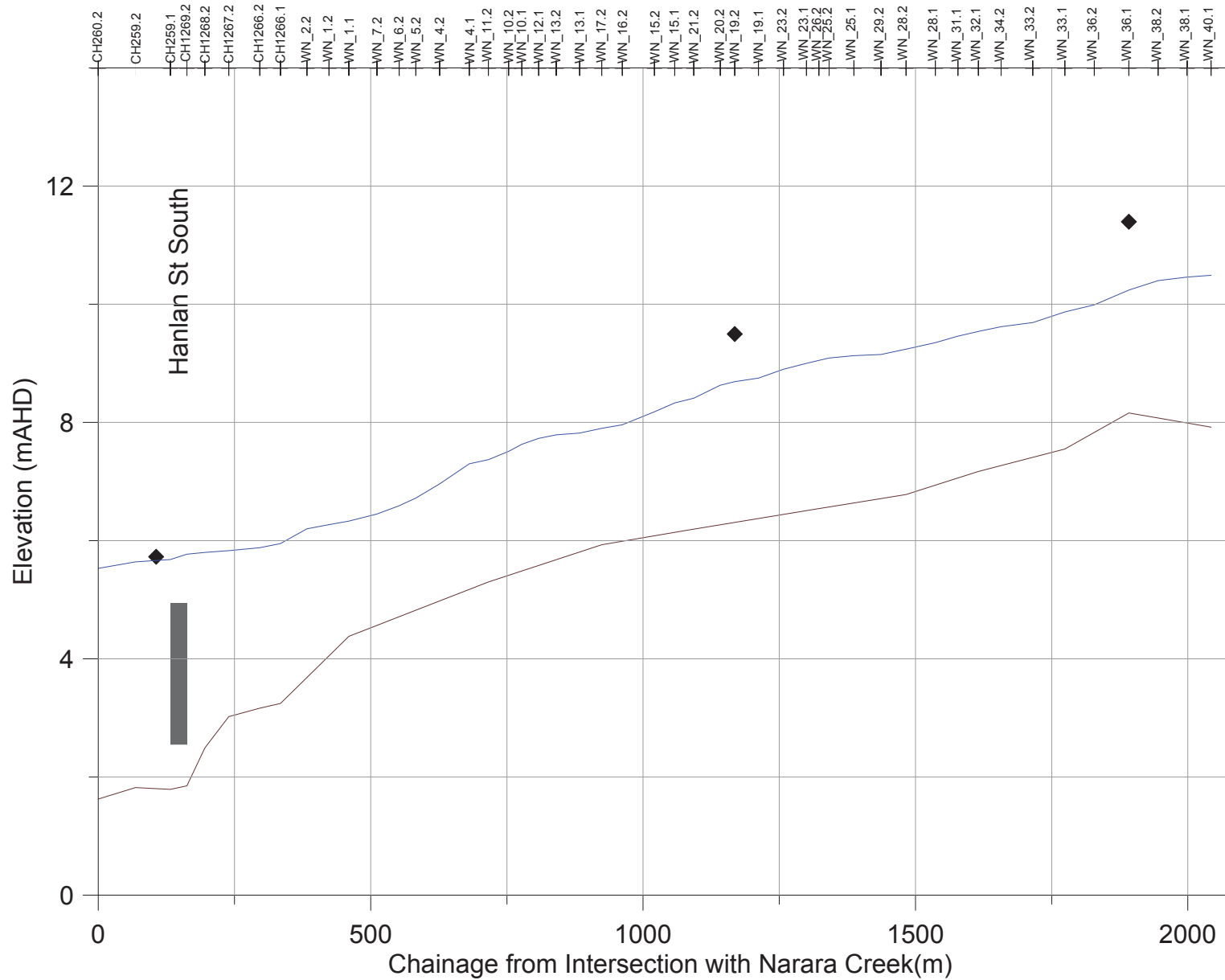
CLIENT  
 CENTRAL COAST COUNCIL





PROJECT  
 NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
 (2 FEBRUARY 1990) LOWER NARARA  
 AND UPPER NARARA CREEK**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



- Legend**
-  Modelled Flood Height (mAHD)
  -  Observed
  -  Bridge Deck /Culvert
  -  Creek-Bed

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CLIENT  
 CENTRAL COAST COUNCIL

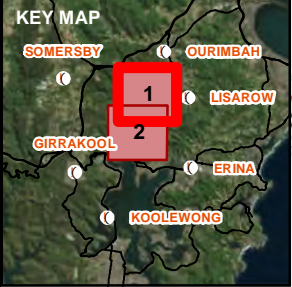
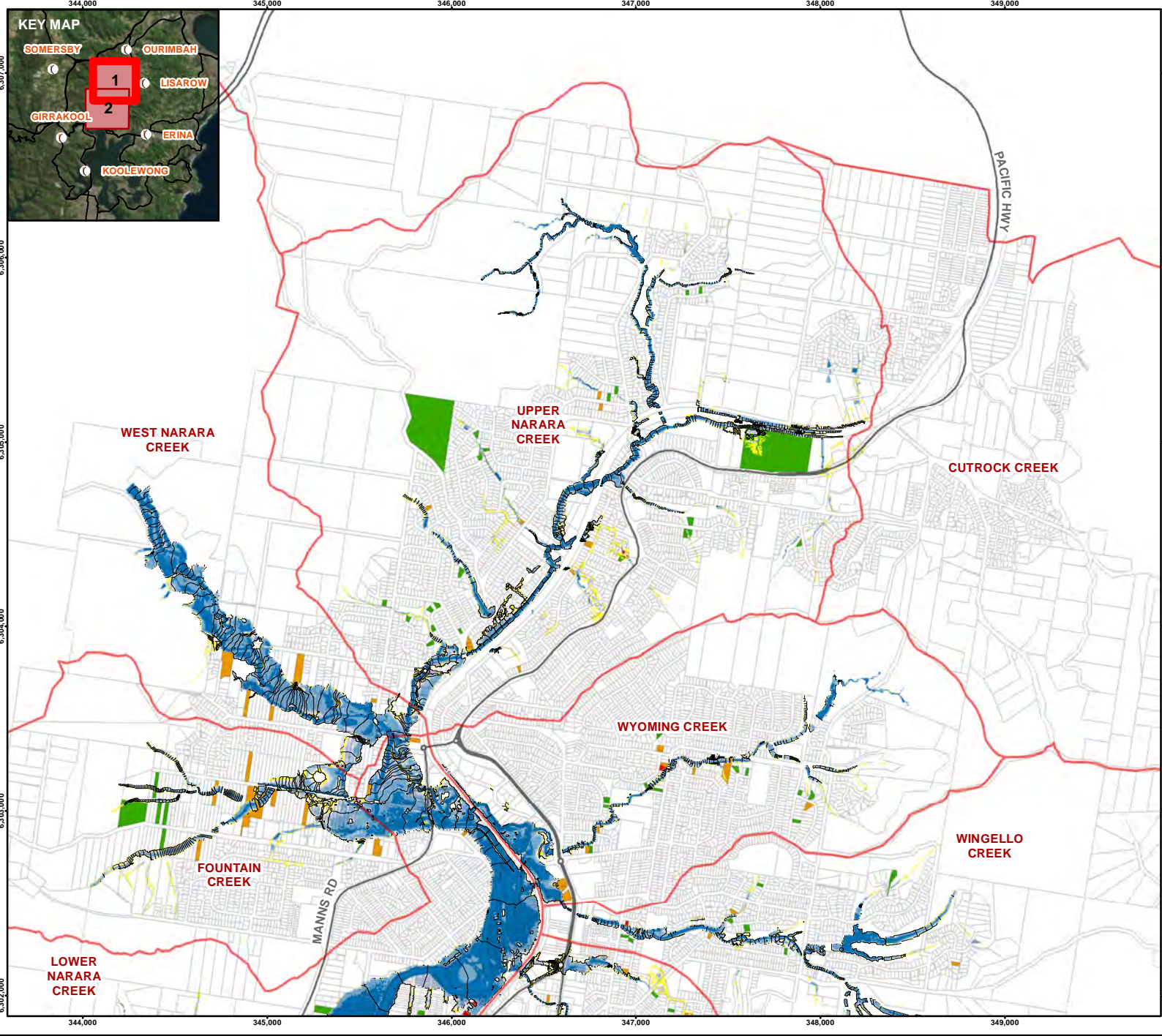
PROJECT  
 NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
 (2 FEBRUARY 1990) WEST NARARA  
 CREEK**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM





**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Red: > 1 m

**Flood Status From Comm Survey**

- Green: property not affected
- Orange: backyard or frontyard affected
- Red: above floor flooding

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT  
 2 FEBRUARY 1990**

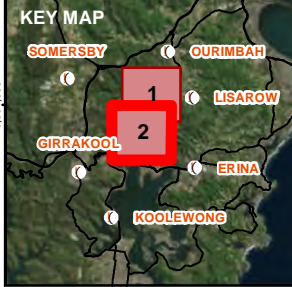
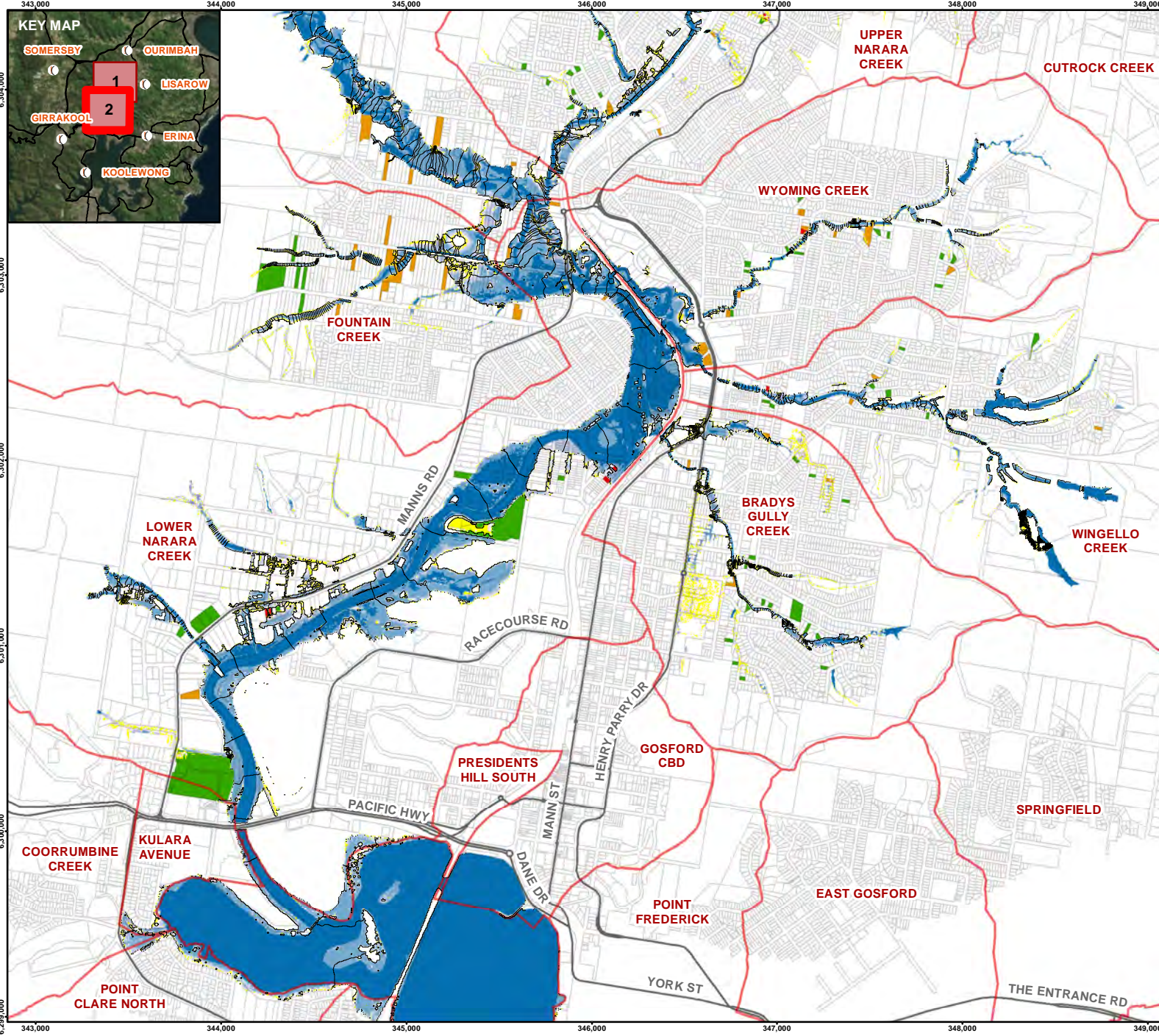
CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	22A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

**Flood Height (mAHD)**

**Flood Status From Comm Survey**

- Green: property not affected
- Orange: backyard or frontyard affected
- Red: above floor flooding

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

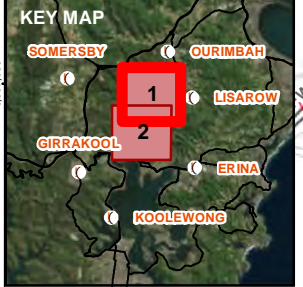
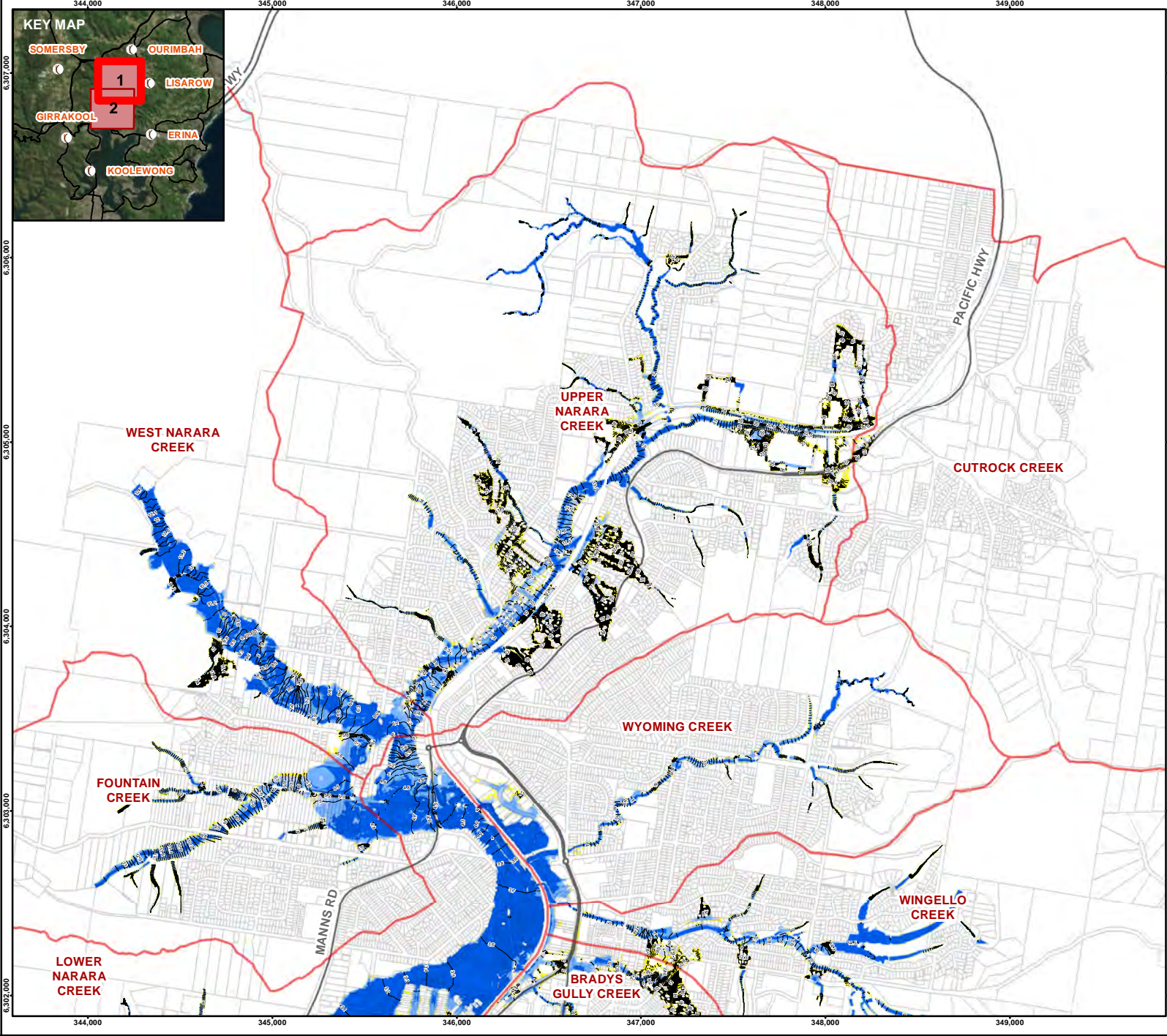
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT  
 2 FEBRUARY 1990**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	22B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

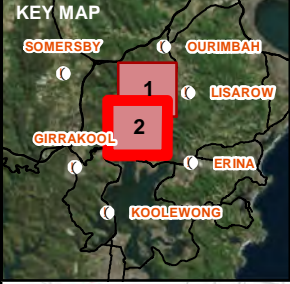
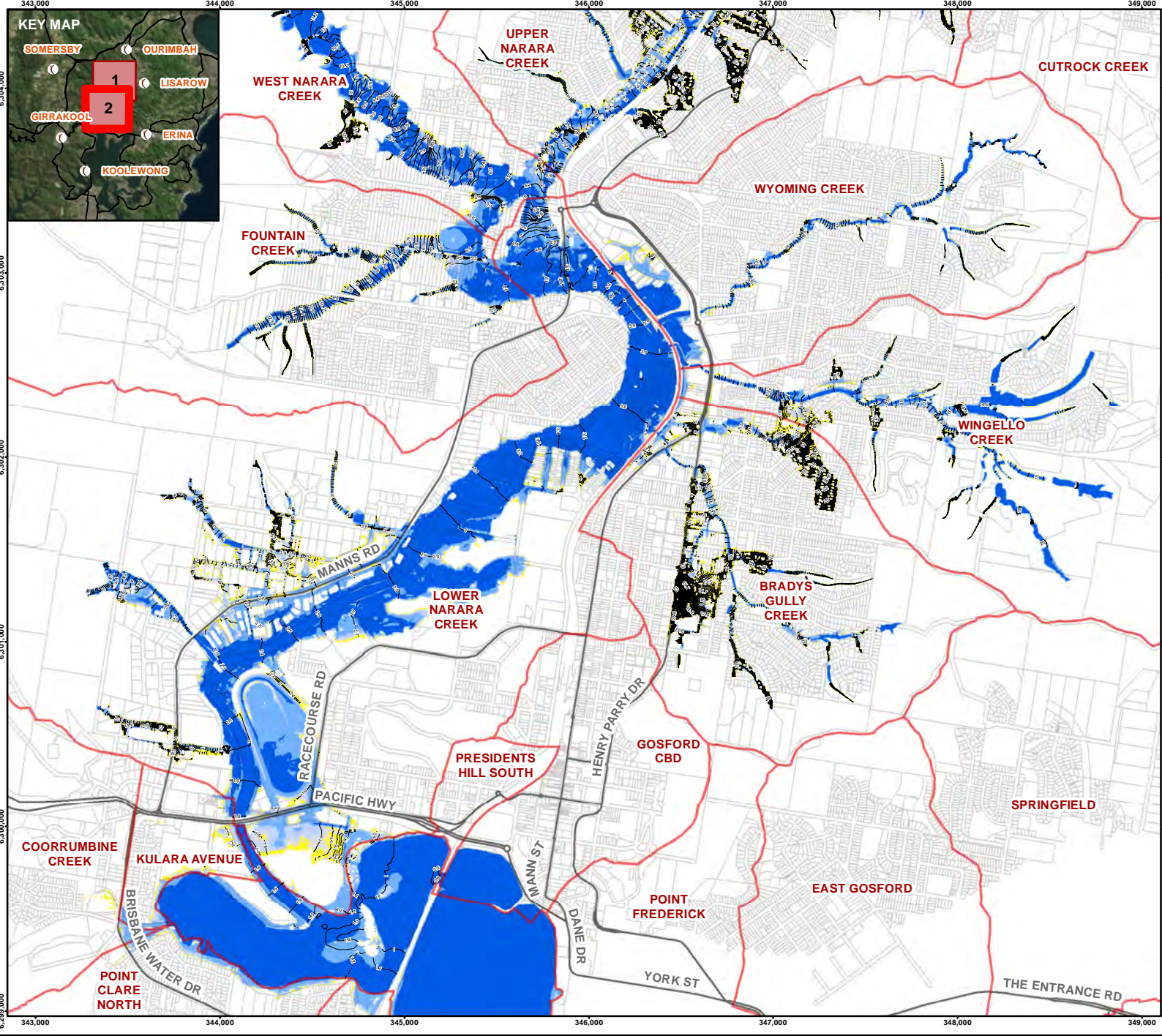
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 2% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	48A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

Scale: 1:30,000 @A4 METRES

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

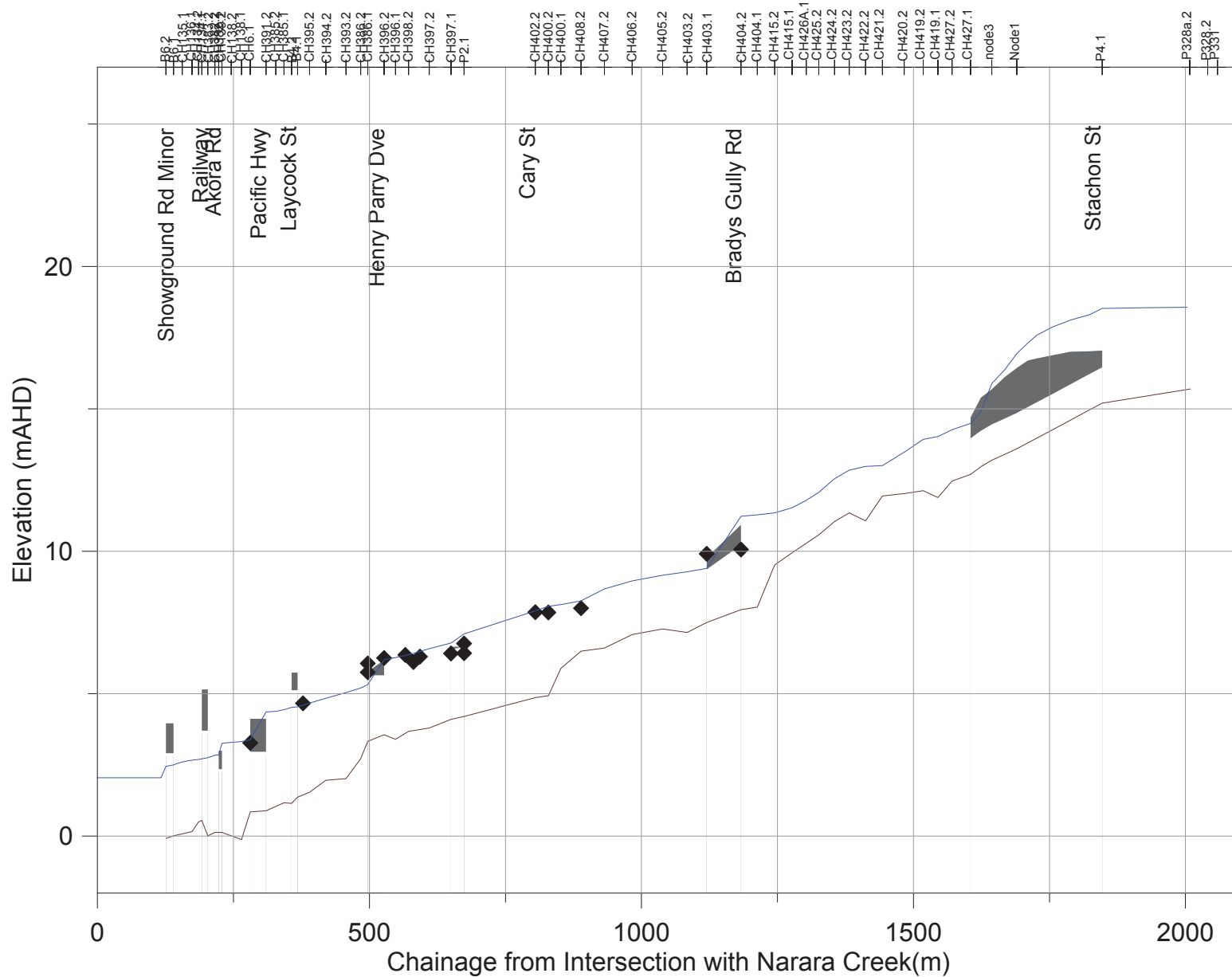
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 2% AEP EVENT**





CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	48B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



- ### Legend
-  Modelled Flood Height (mAHD)
  -  Observed
  -  Bridge Deck /Culvert
  -  Creek-Bed

**NOTE(S)**  
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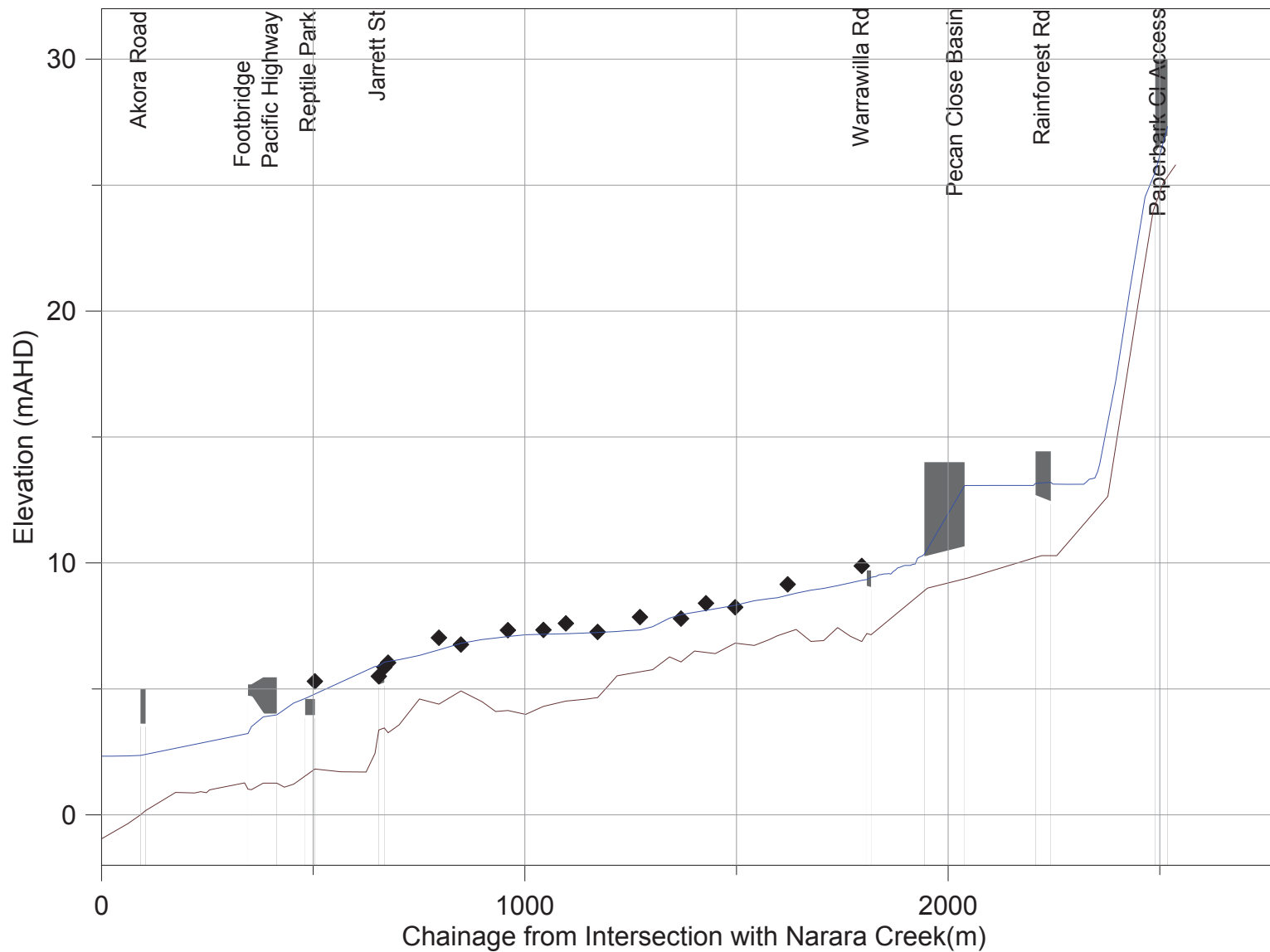
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY





TITLE  
**PEAK FLOOD LEVELS (7 FEBRUARY 1990) BRADYS GULLY**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



**Legend**

-  Modelled Flood Height (mAHD)
-  Observed
-  Bridge Deck /Culvert
-  Creek-Bed

**NOTE(S)**  
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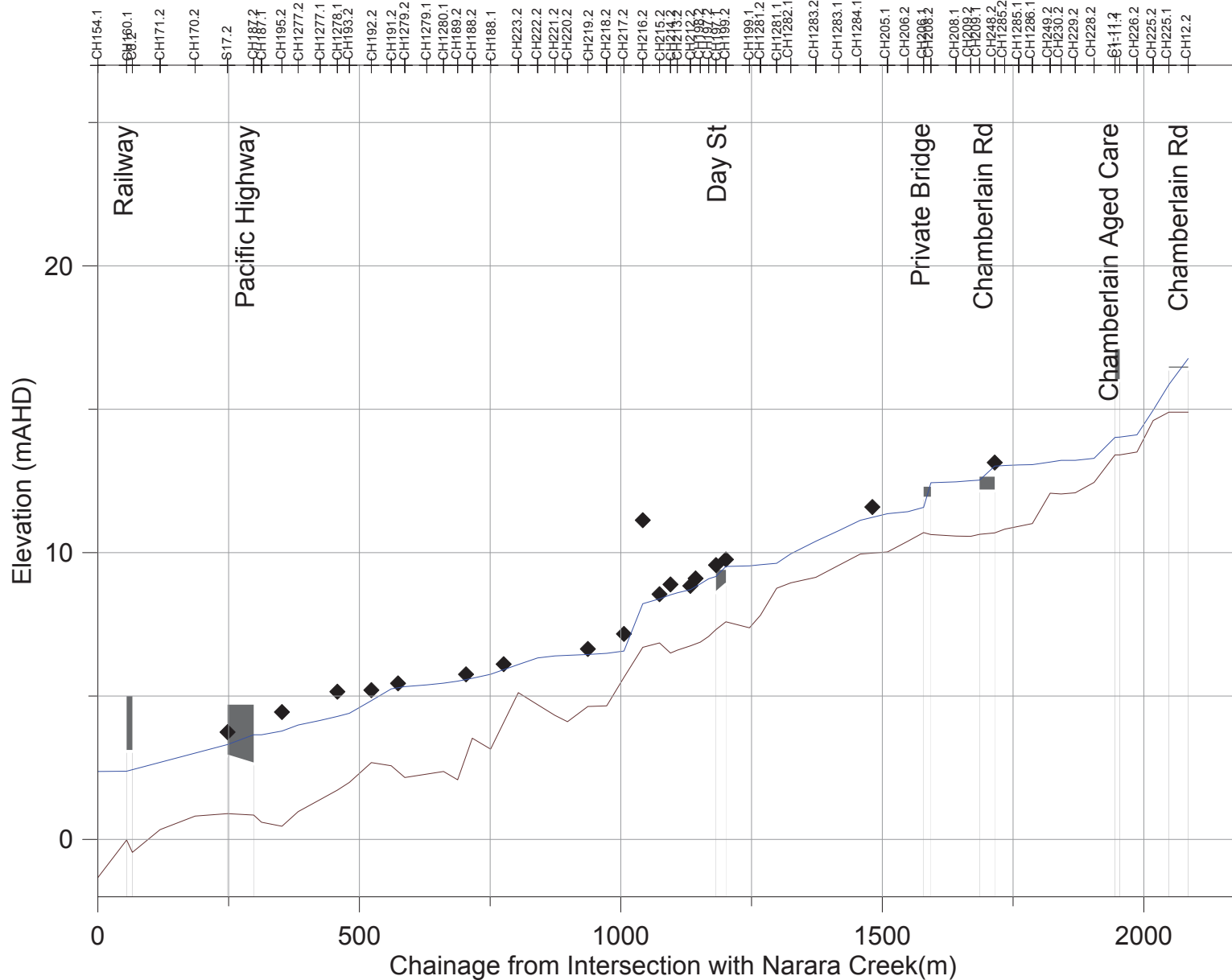
CLIENT  
CENTRAL COAST COUNCIL





PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
(7 FEBRUARY 1990) WINGELLO**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



- ### Legend
-  Modelled Flood Height (mAHD)
  -  Observed
  -  Bridge Deck /Culvert
  -  Creek-Bed

**NOTE(S)**  
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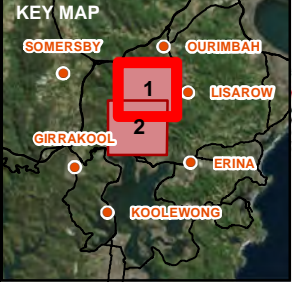
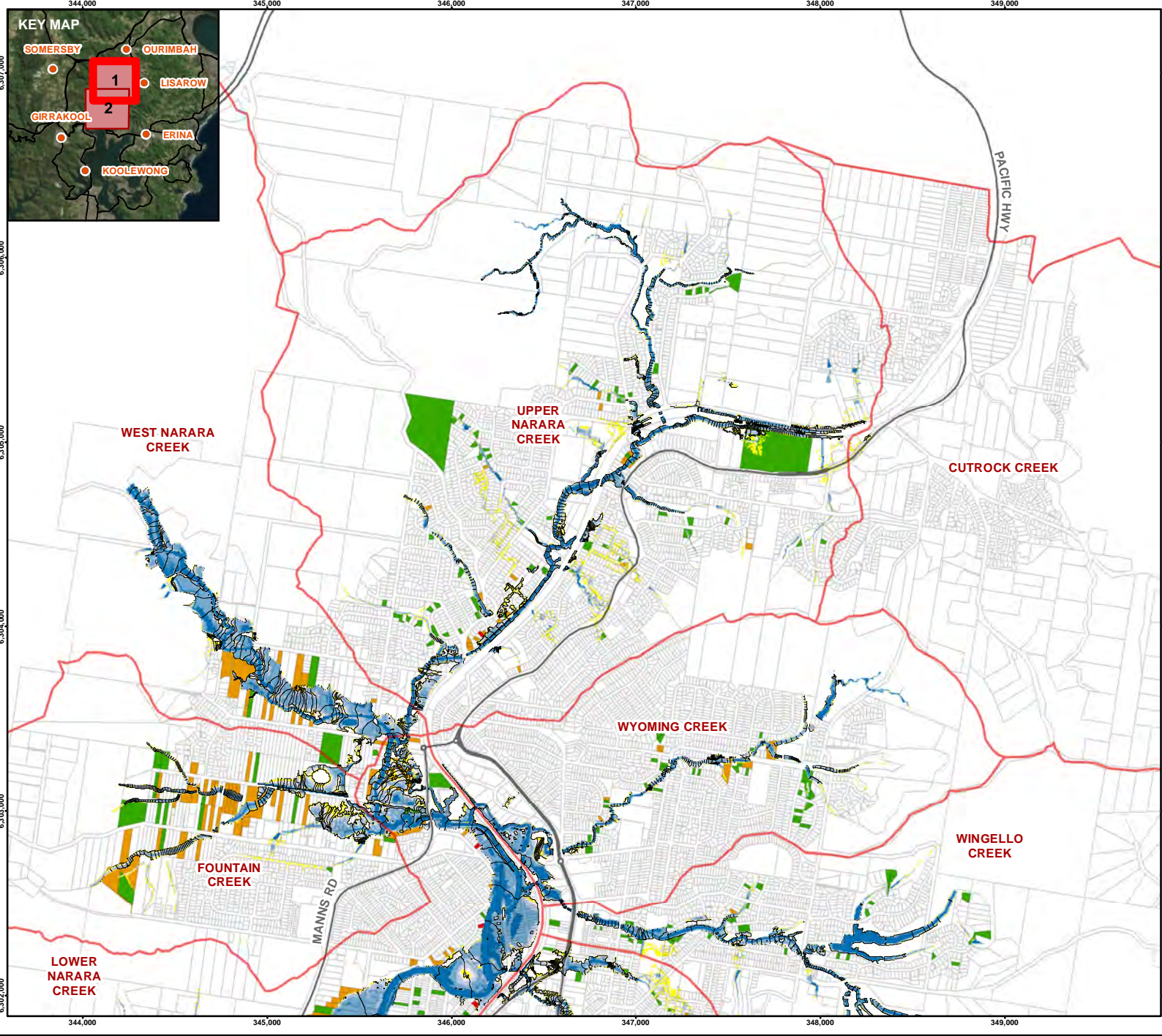
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
(7 FEBRUARY 1990) WYOMING**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Blue: > 1 m

**Flood Height (mAHD)**

- Green: property not affected
- Orange: backyard or frontyard affected
- Red: above floor flooding

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 7 FEBRUARY 1990**

CONSULTANT

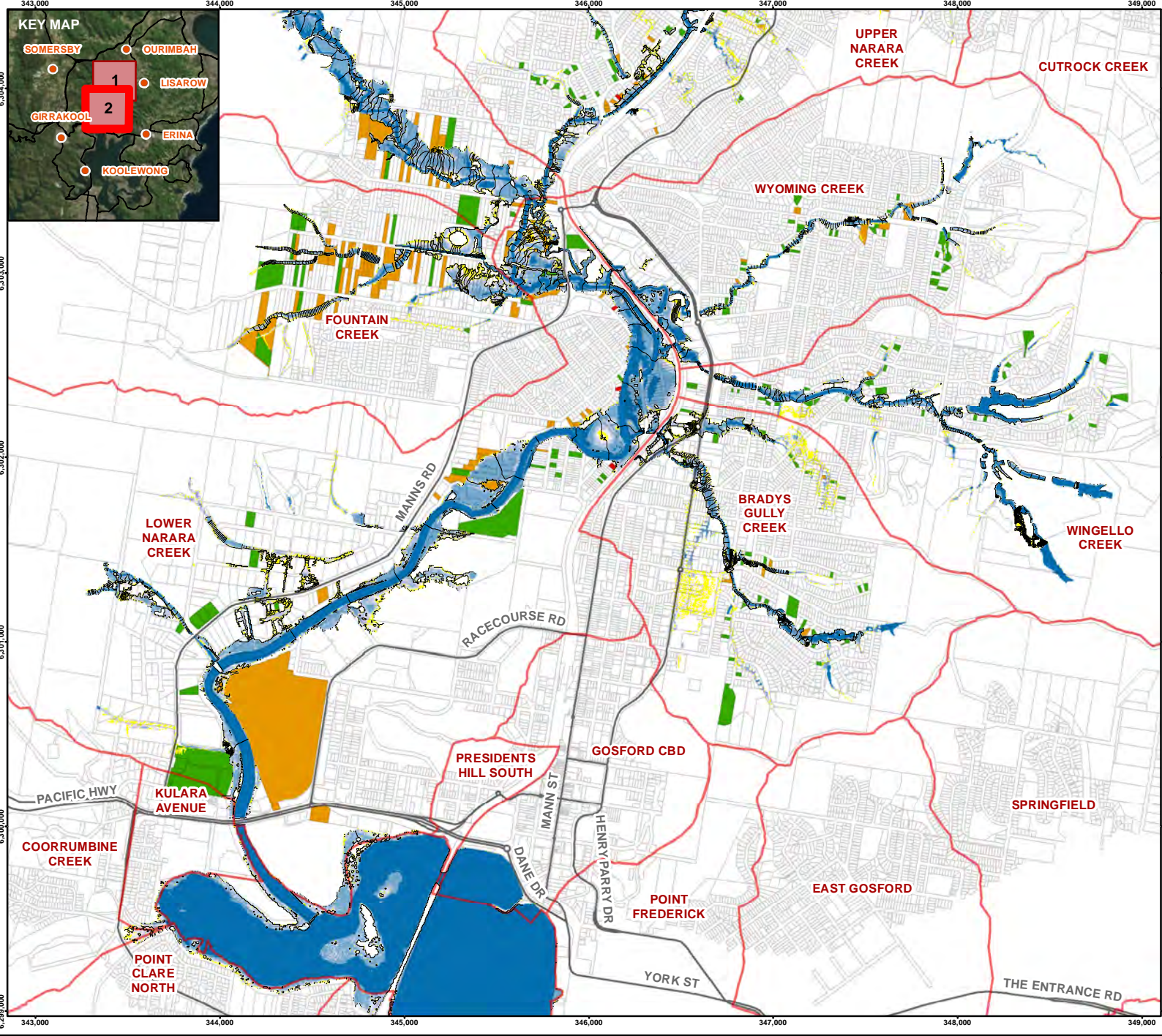


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	26A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4





**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Status From Comm Survey**

- property not affected
- backyard or frontyard affected
- above floor flooding

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

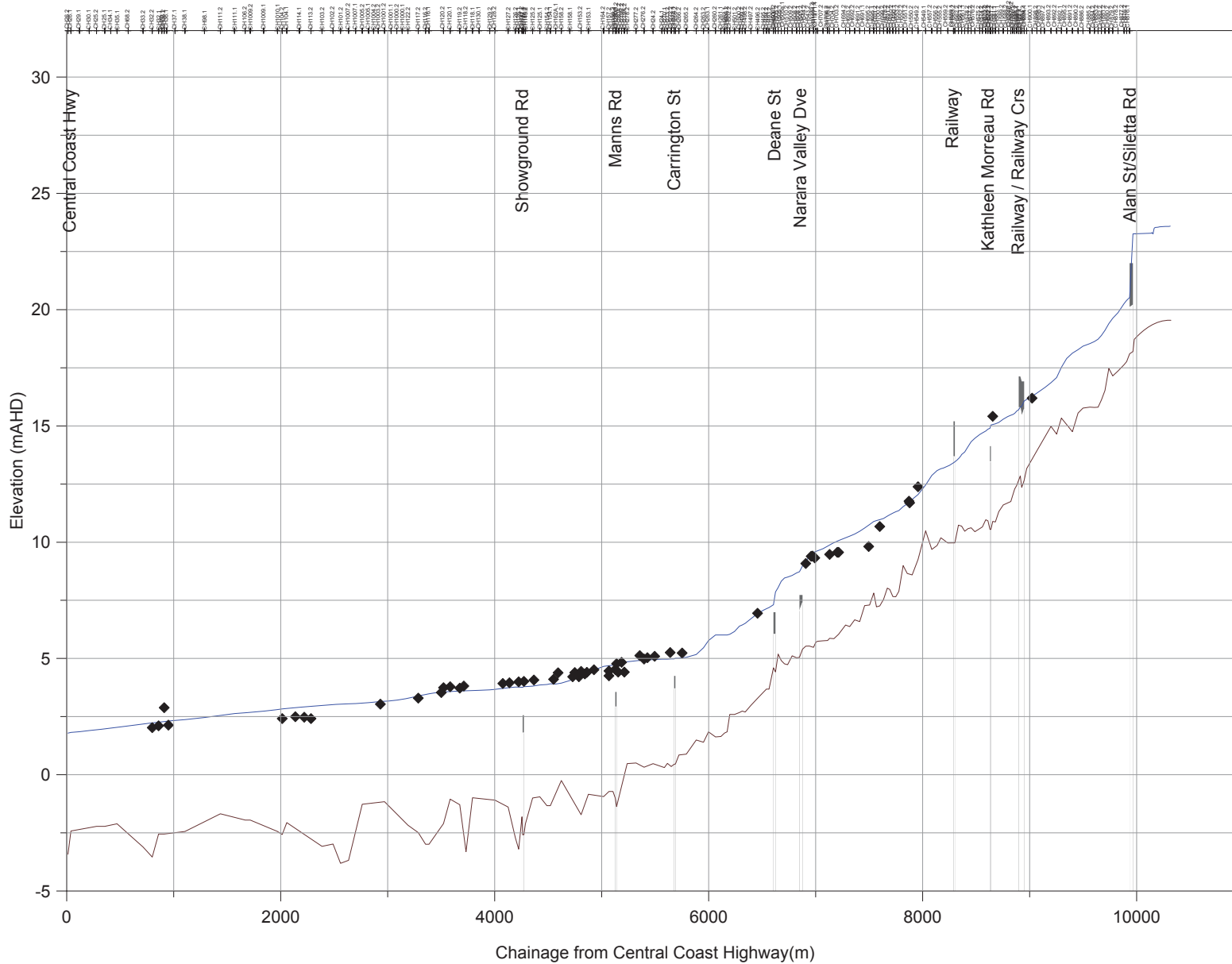
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 7 FEBRUARY 1990**

CONSULTANT





DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	26B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

-  Modelled Flood Height (mAHD)
-  Observed
-  Bridge Deck /Culvert
-  Creek-Bed

**NOTE(S)**  
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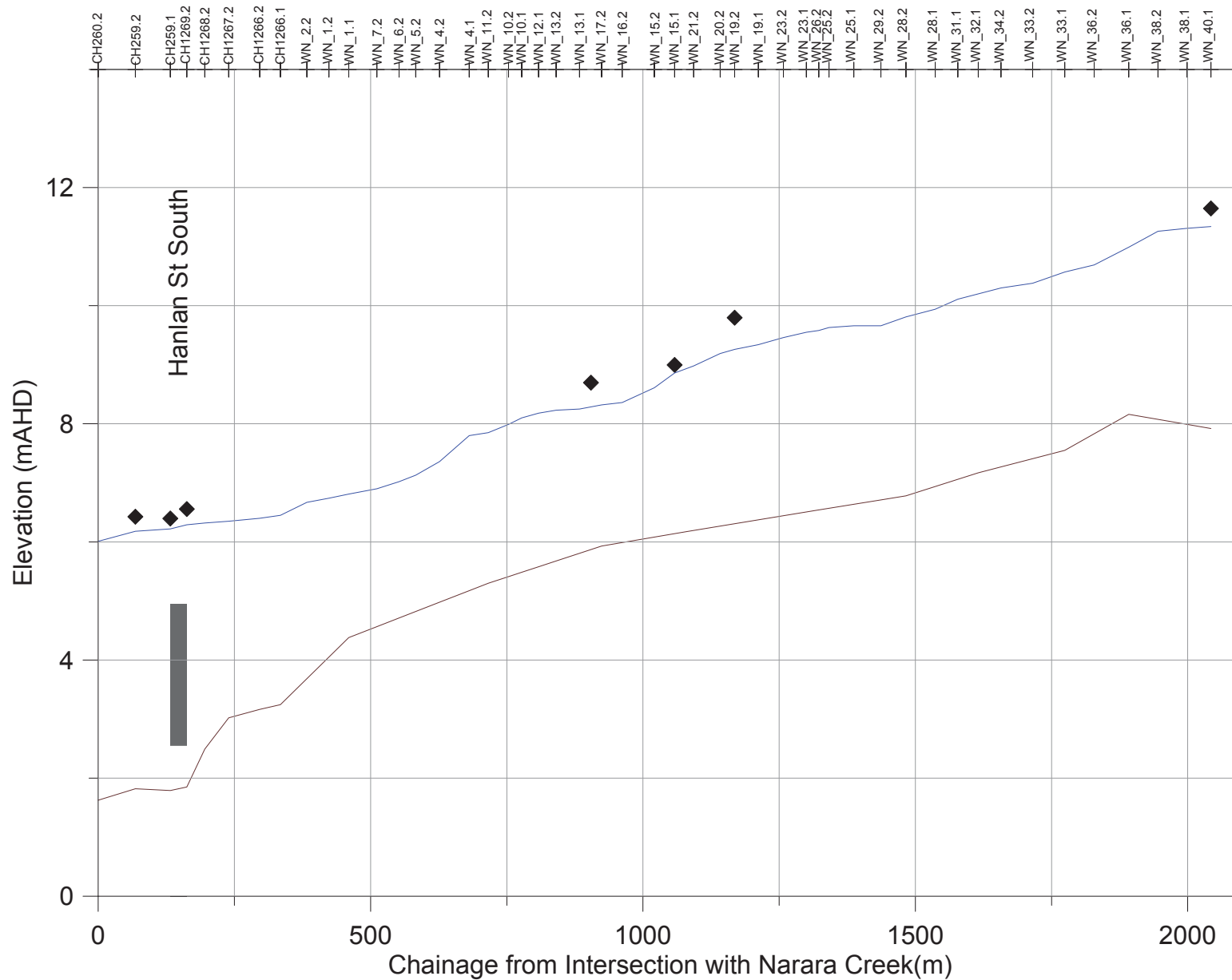
CLIENT  
 CENTRAL COAST COUNCIL

PROJECT  
 NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
 (FEBRUARY 1992) LOWER NARARA  
 AND UPPER NARARA CREEK**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM



- Legend**
- Modelled Flood Height (mAHD)
  - Observed
  - Bridge Deck /Culvert
  - Creek-Bed

**NOTE(S)**  
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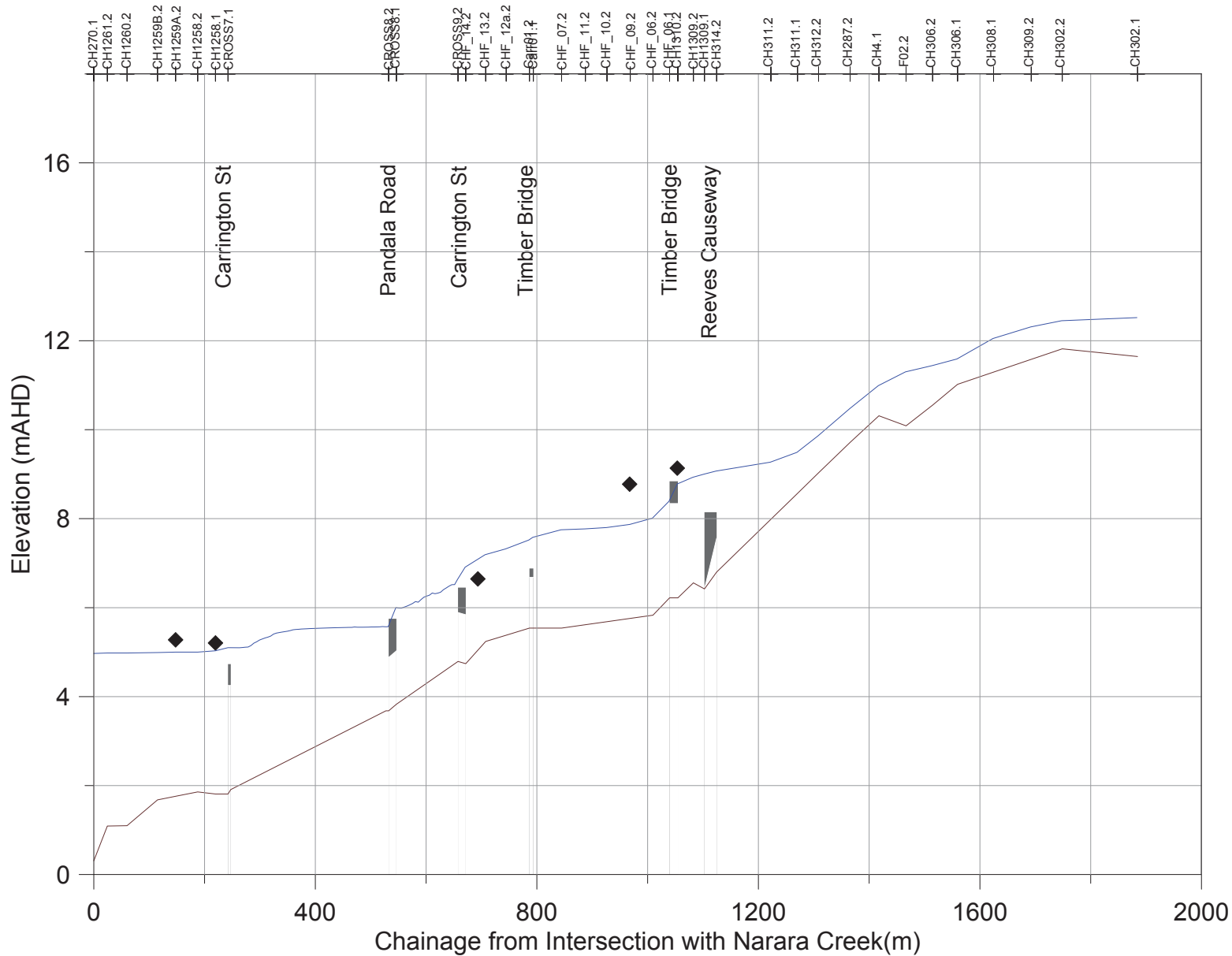
CLIENT  
CENTRAL COAST COUNCIL

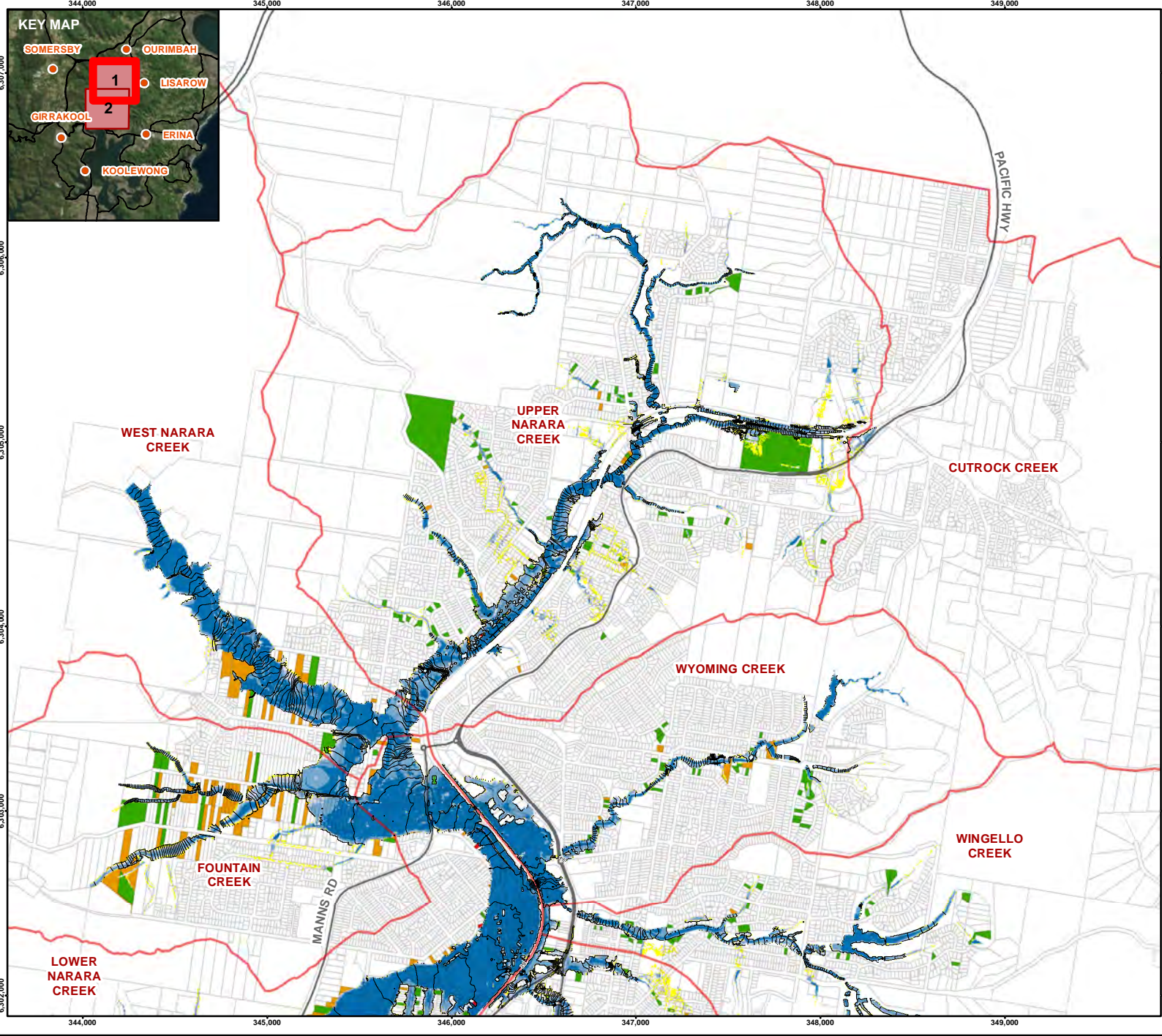
PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**PEAK FLOOD LEVELS  
(FEBRUARY 1992)  
WEST NARARA CREEK**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM





**Legend**

- Localities
- Weighted Raster Feature
- Main Roads
- 0.1 m Contours
- Drainage Sub-catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Status From Comm Survey**

- property not affected
- backyard or frontyard affected
- above floor flooding

Scale: 0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Catchment Boundary, Sub-catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

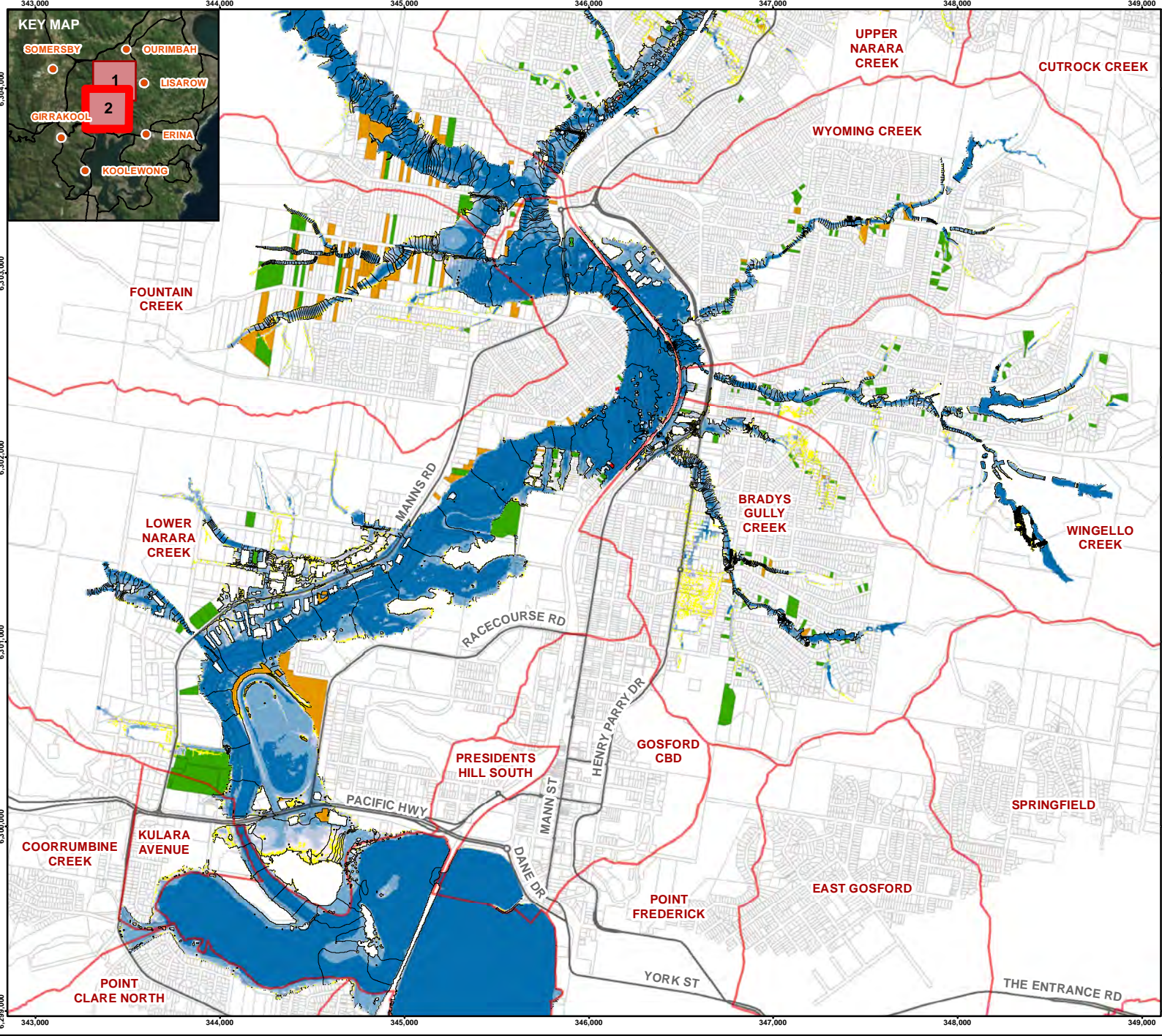
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT FEBRUARY 1992**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	30A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Weighted Raster Feature
- Main Roads
- 0.1 m Contours
- Drainage Sub-catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- 0.1 m Contours

**Flood Status From Comm Survey**

- property not affected
- backyard or frontyard affected
- above floor flooding

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Catchment Boundary, Sub-catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

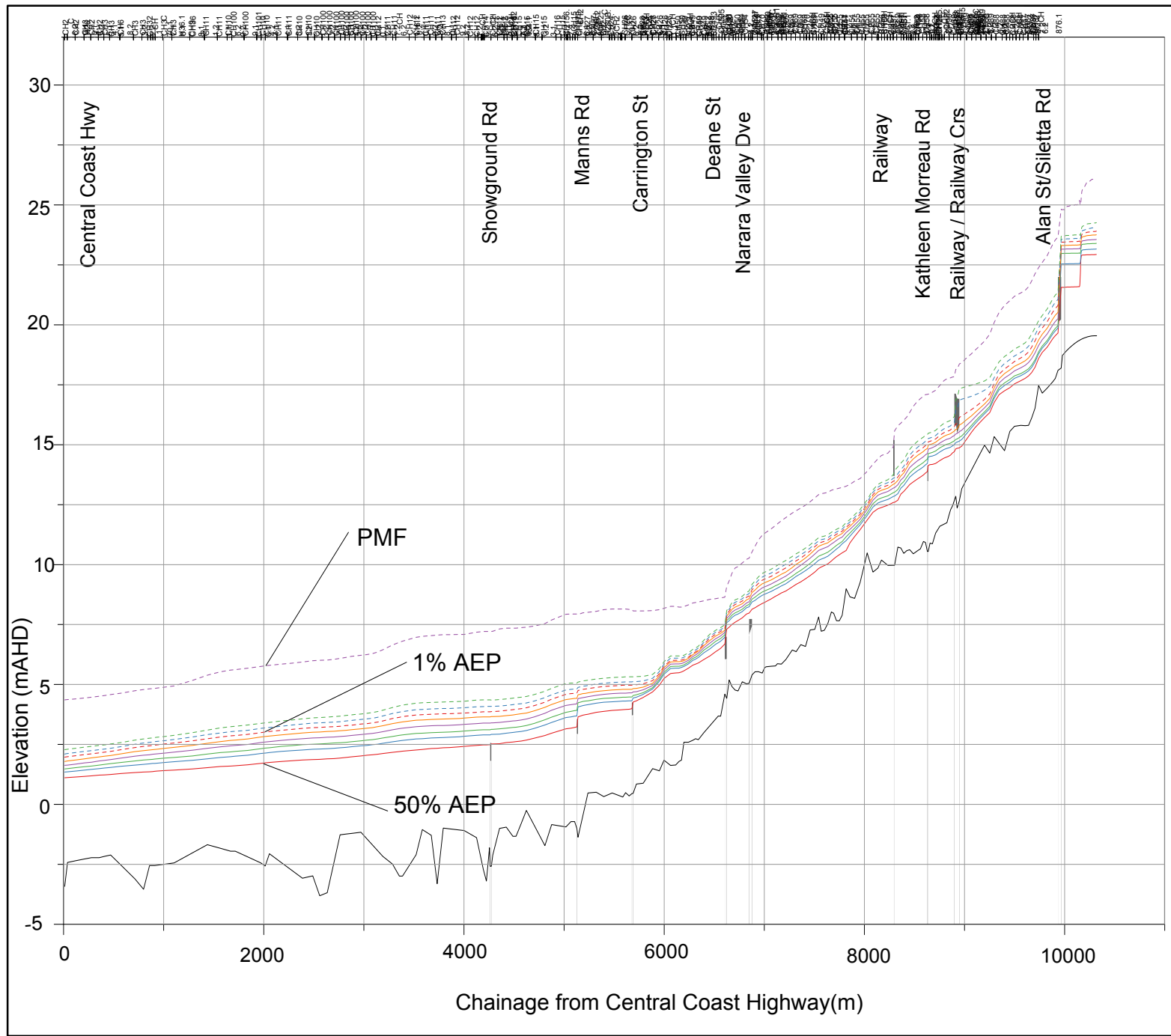
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT FEBRUARY 1992**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 30B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



### LEGEND

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

**NOTE(S)**  
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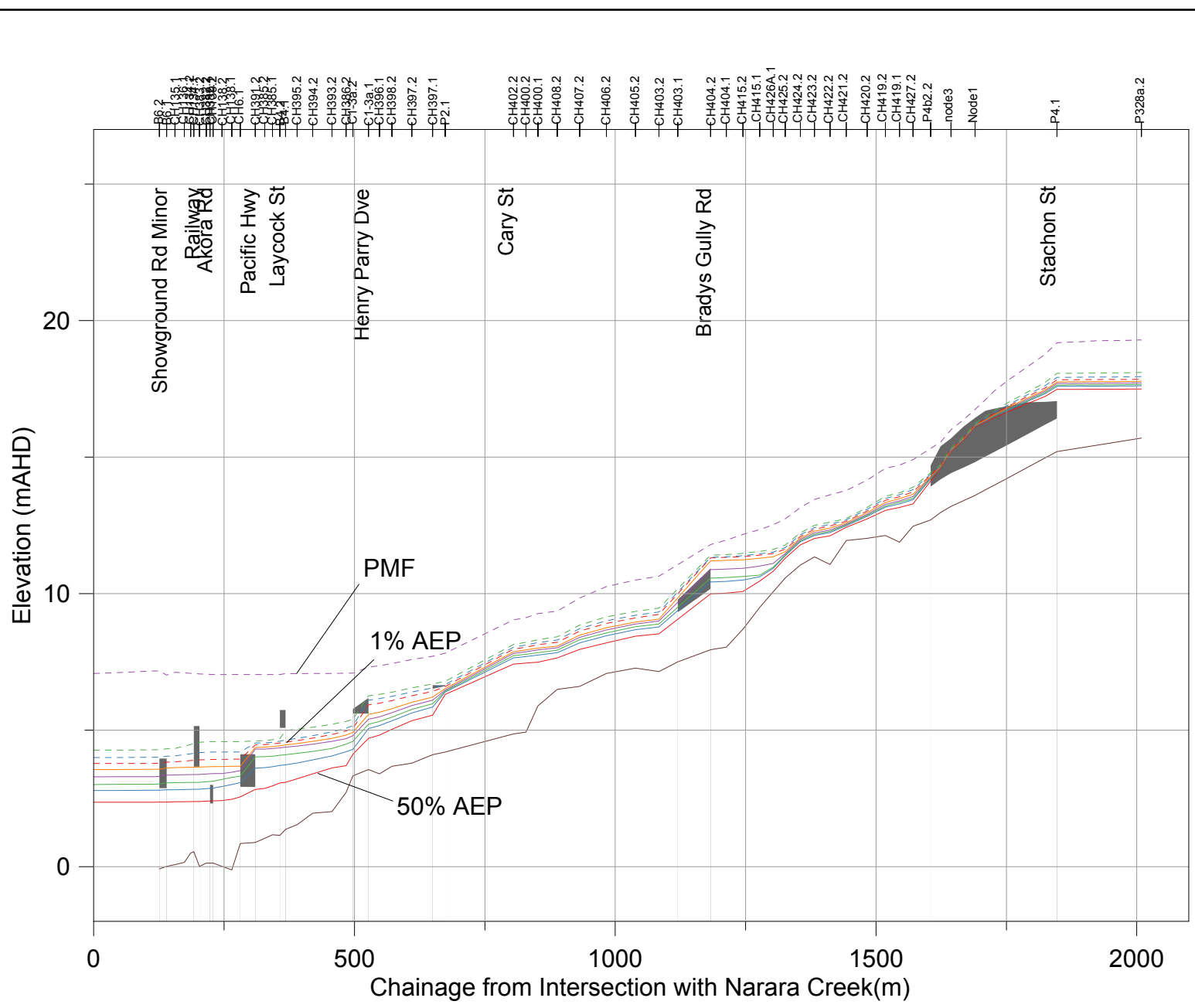
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS -  
LOWER NARARA  
AND UPPER NARARA CREEK**



DD/MM/YYYY	03/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM



### LEGEND

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

**NOTE(S)**  
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CLIENT  
CENTRAL COAST COUNCIL

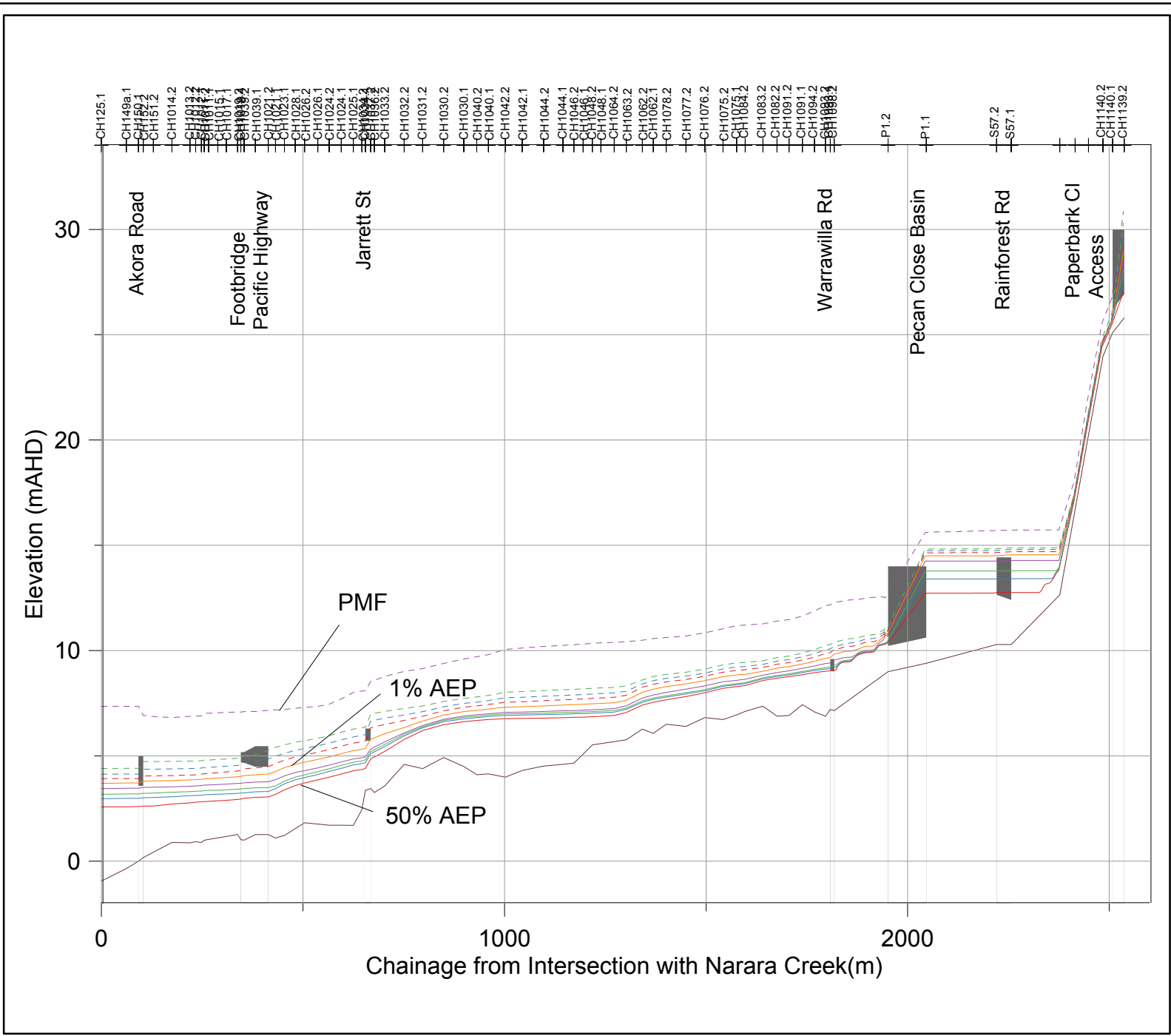
PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS -  
BRADY'S GULLY**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM





**LEGEND**

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

**NOTE(S)**  
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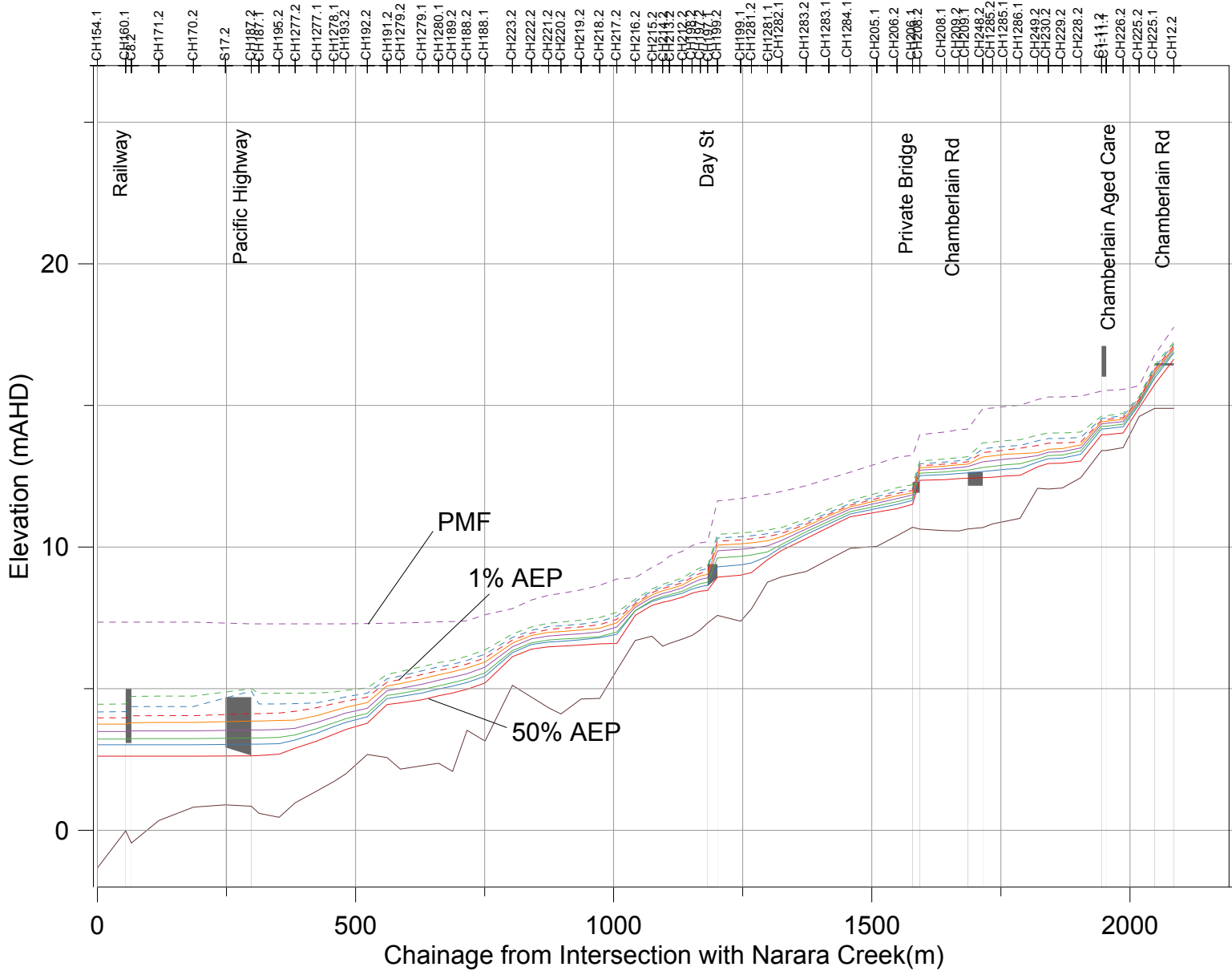
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS - WINGELLO**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM



### LEGEND

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

**NOTE(S)**  
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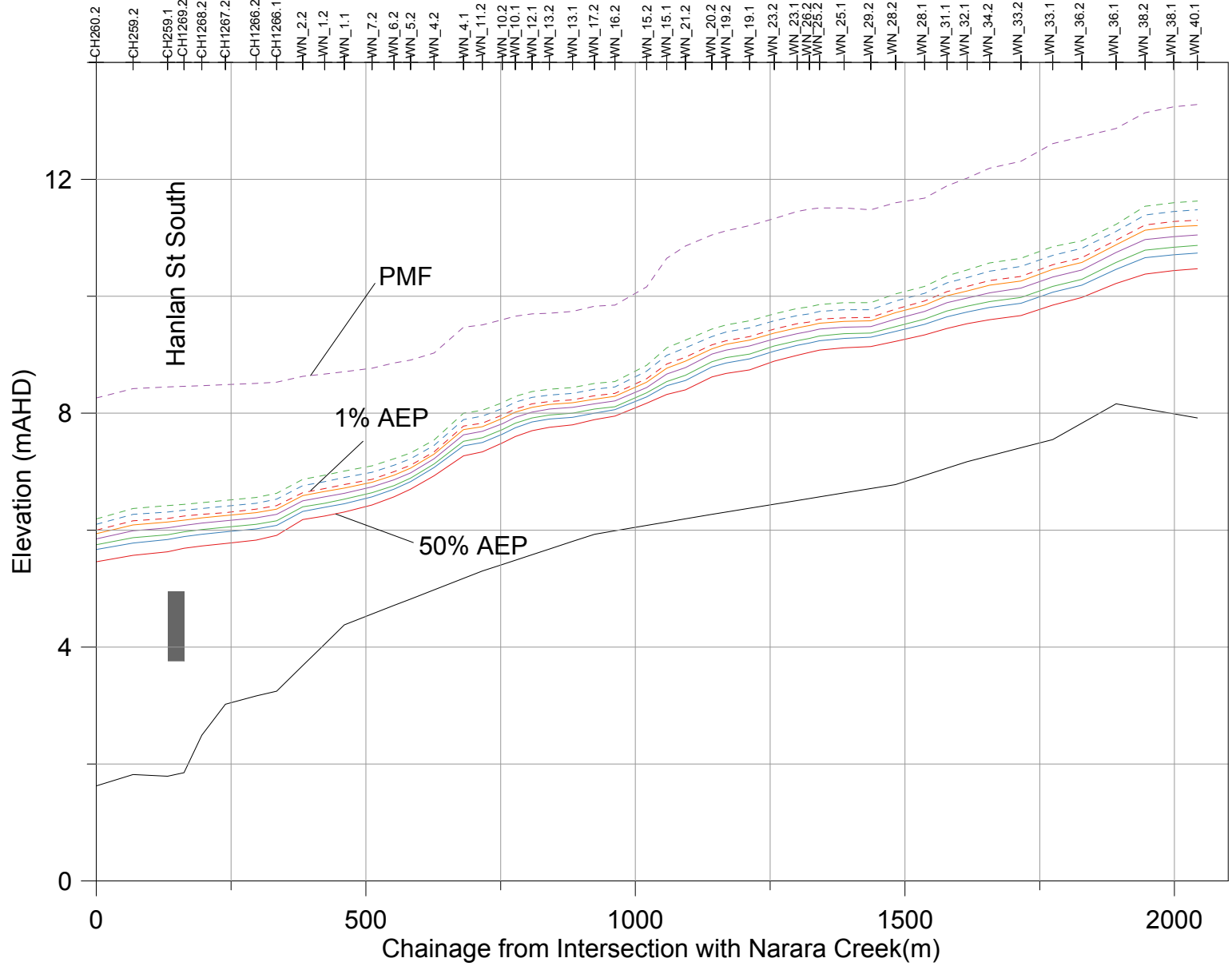
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS - WYOMING**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM



**LEGEND**

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

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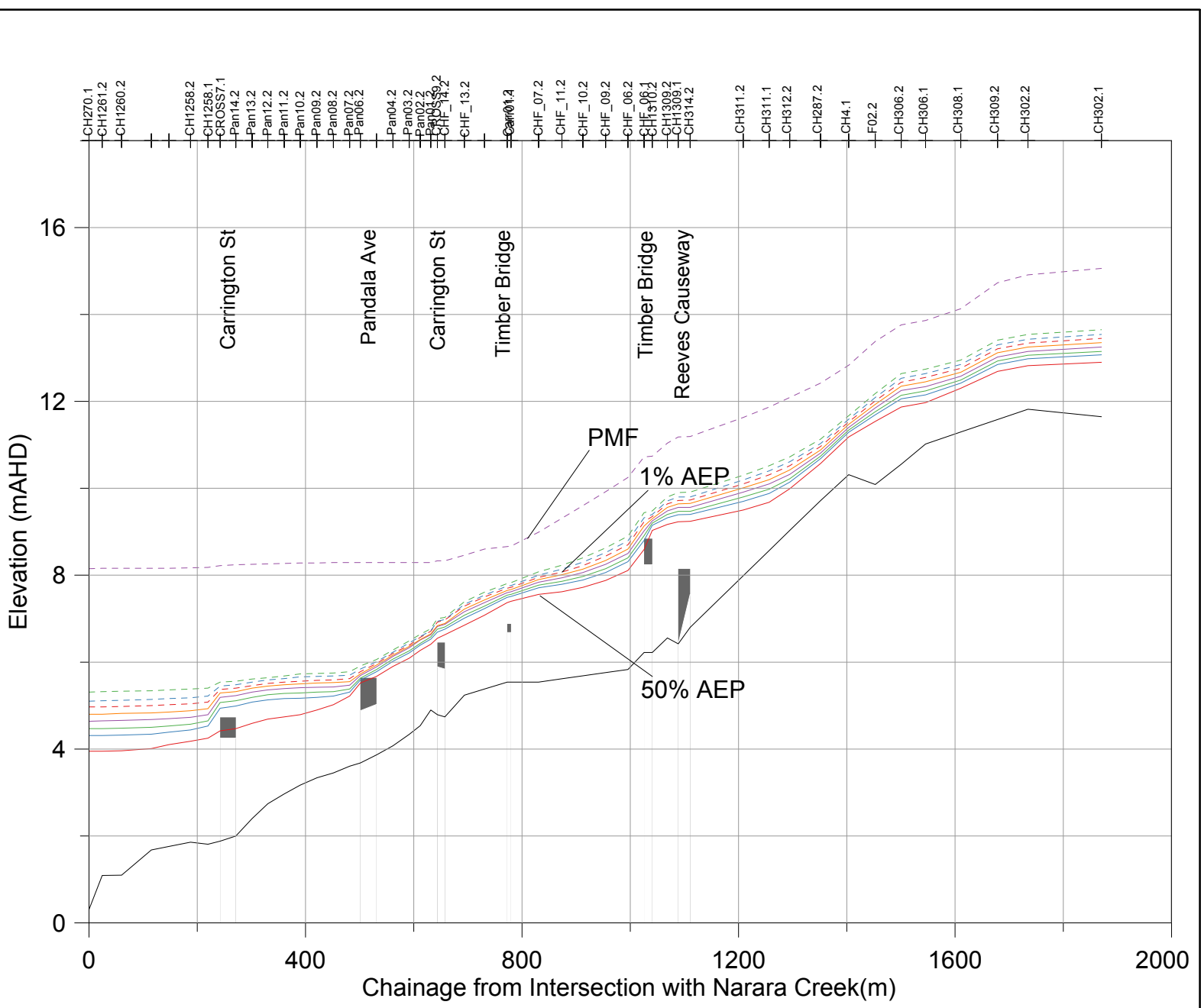
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS - WEST NARARA CREEK**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM



### LEGEND

Modelled Flood Height (mAHD):

- PMF
- 0.2% AEP
- 0.5% AEP
- 1% AEP
- 2% AEP
- 5% AEP
- 10% AEP
- 20% AEP
- 50% AEP
- Creek-Bed
- Bridge Deck/Culvert

**NOTE(S)**  
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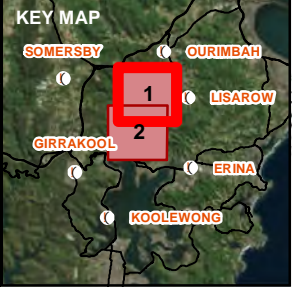
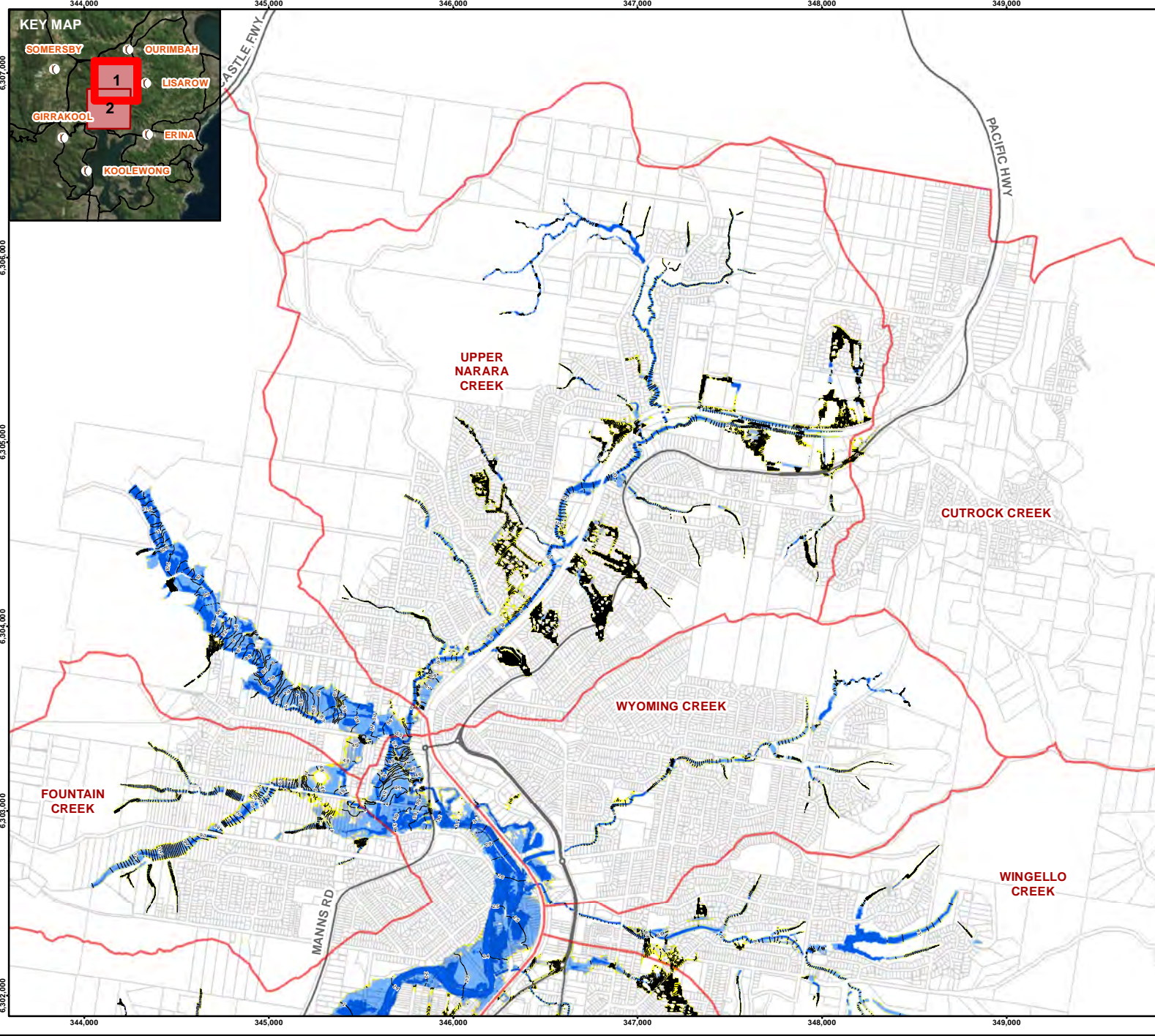
CLIENT  
CENTRAL COAST COUNCIL

PROJECT  
NARARA CREEK FLOOD STUDY

TITLE  
**DESIGN FLOOD LEVELS -  
FOUNTAIN CREEK**



DD/MM/YYYY	3/042018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Dark Blue: > 1 m

0 500 1,000  
 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 50% AEP EVENT**

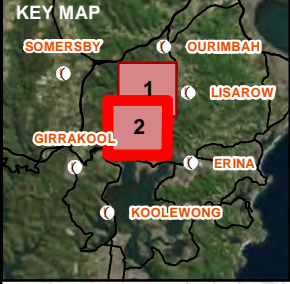
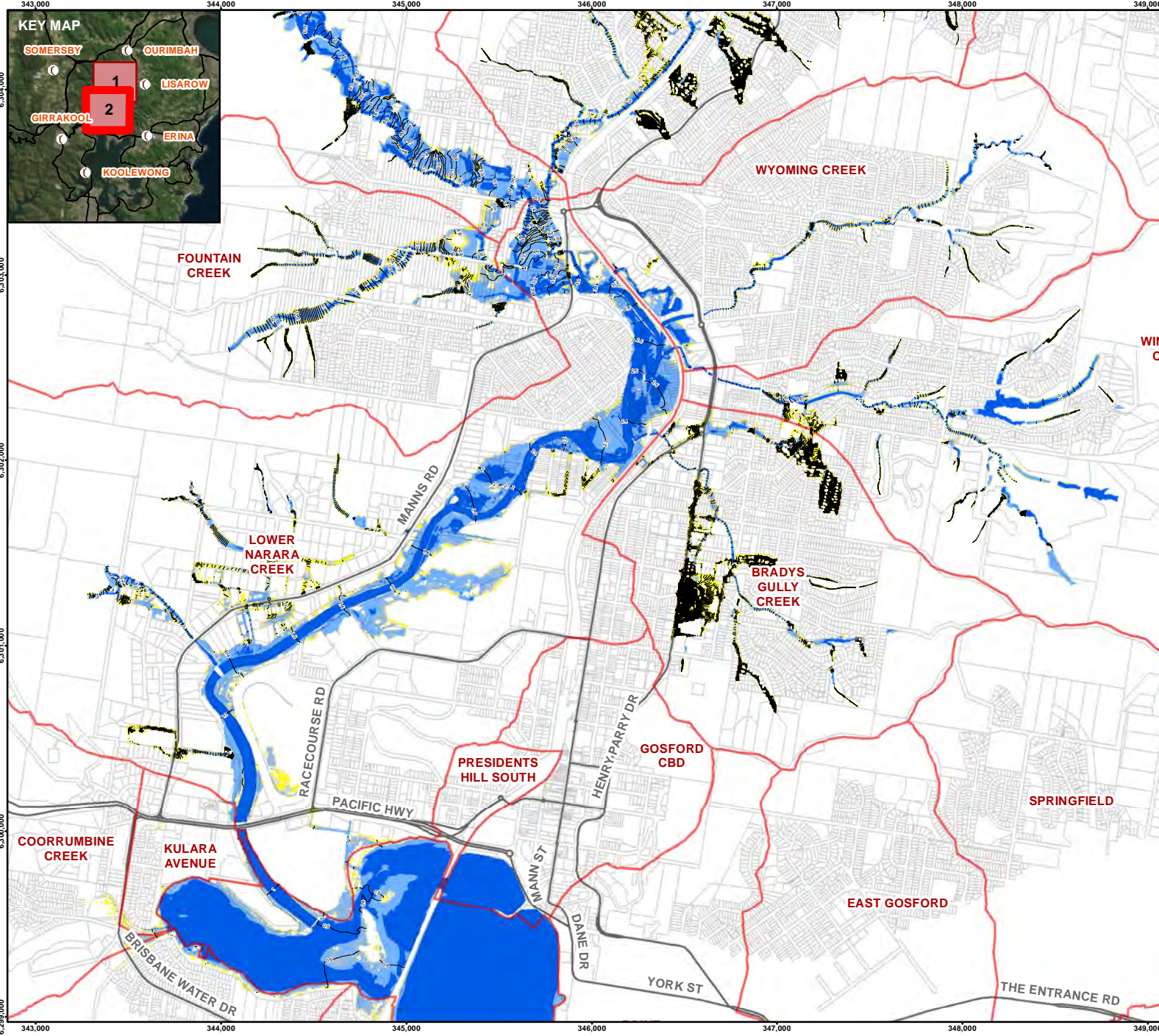
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	37A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-
- ▭ Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

0 500 1,000  
 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

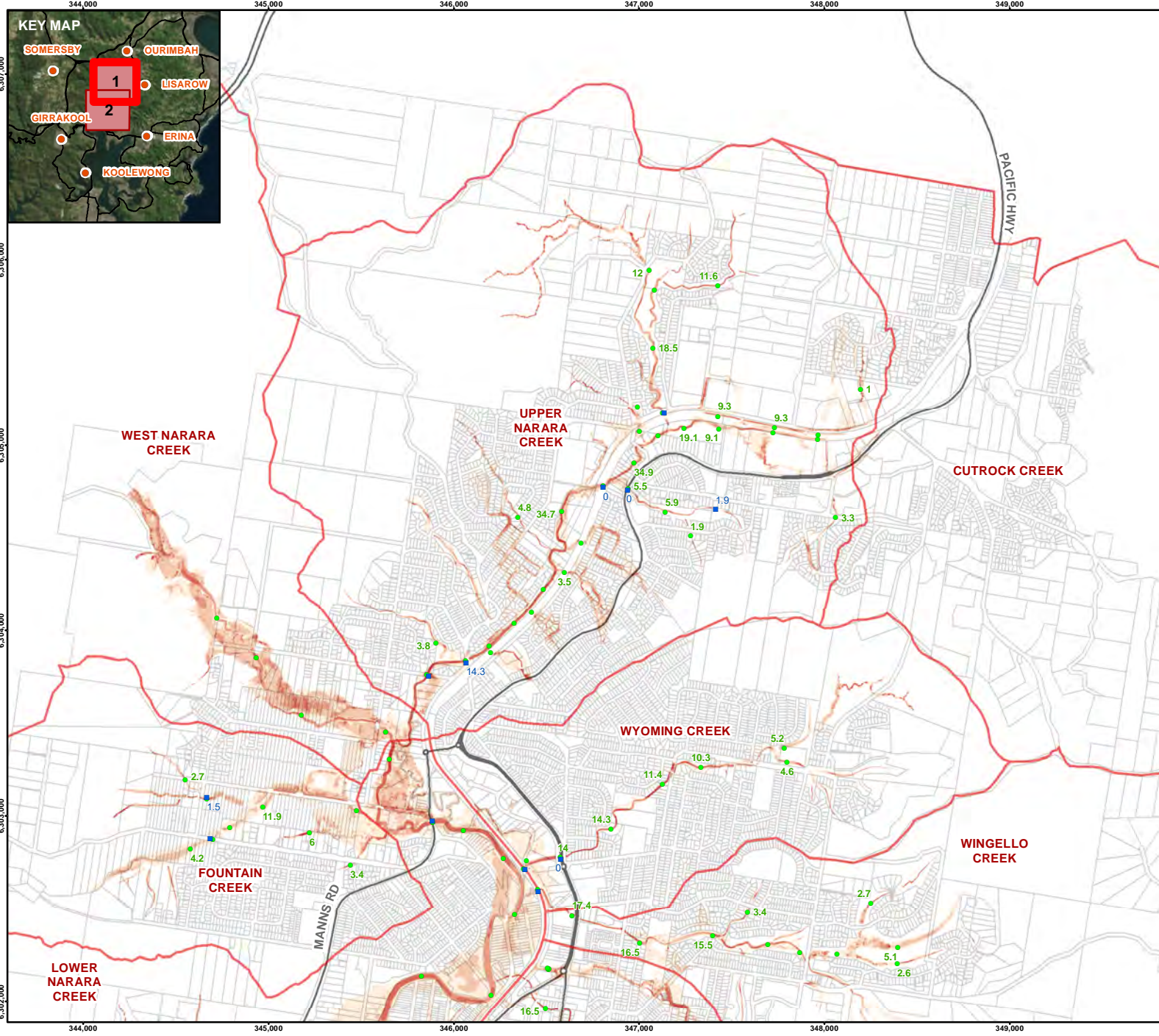
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 50% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	37B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- 1D Weir Flow (m3/s)
- 1D Pipe or Open Channel Flow (m3/s)
- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N 0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Drainage Sub-Catchment :** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

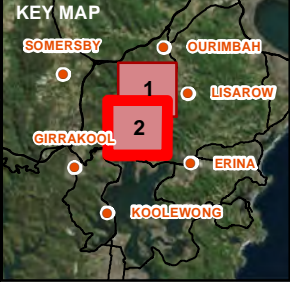
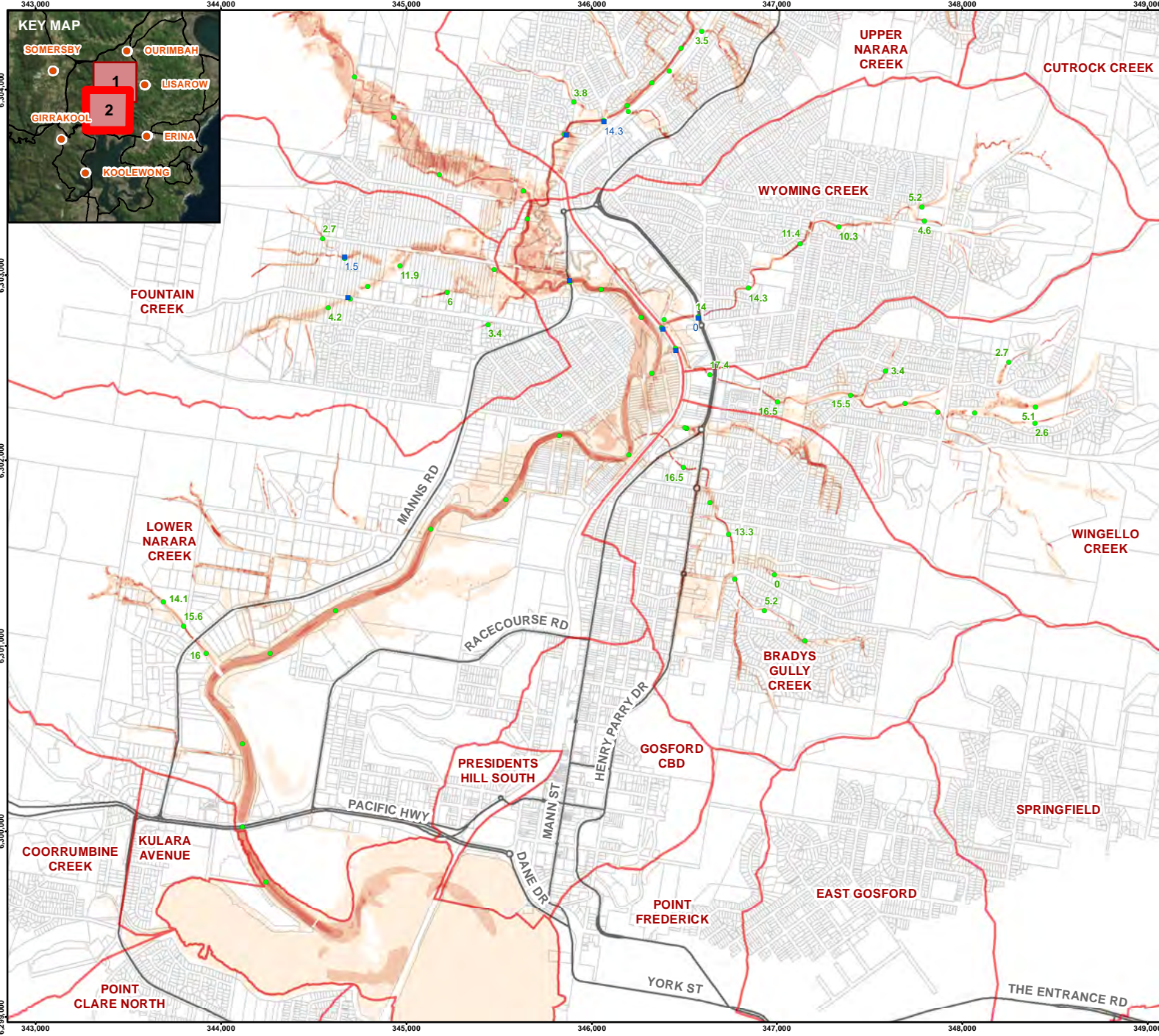
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 50% AEP EVENT**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	DP
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	38A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG A4

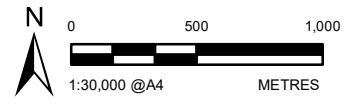


**Legend**

- 1D Weir Flow (m3/s)
- 1D Pipe or Open Channel Flow (m3/s)
- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment :** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 50% AEP EVENT**

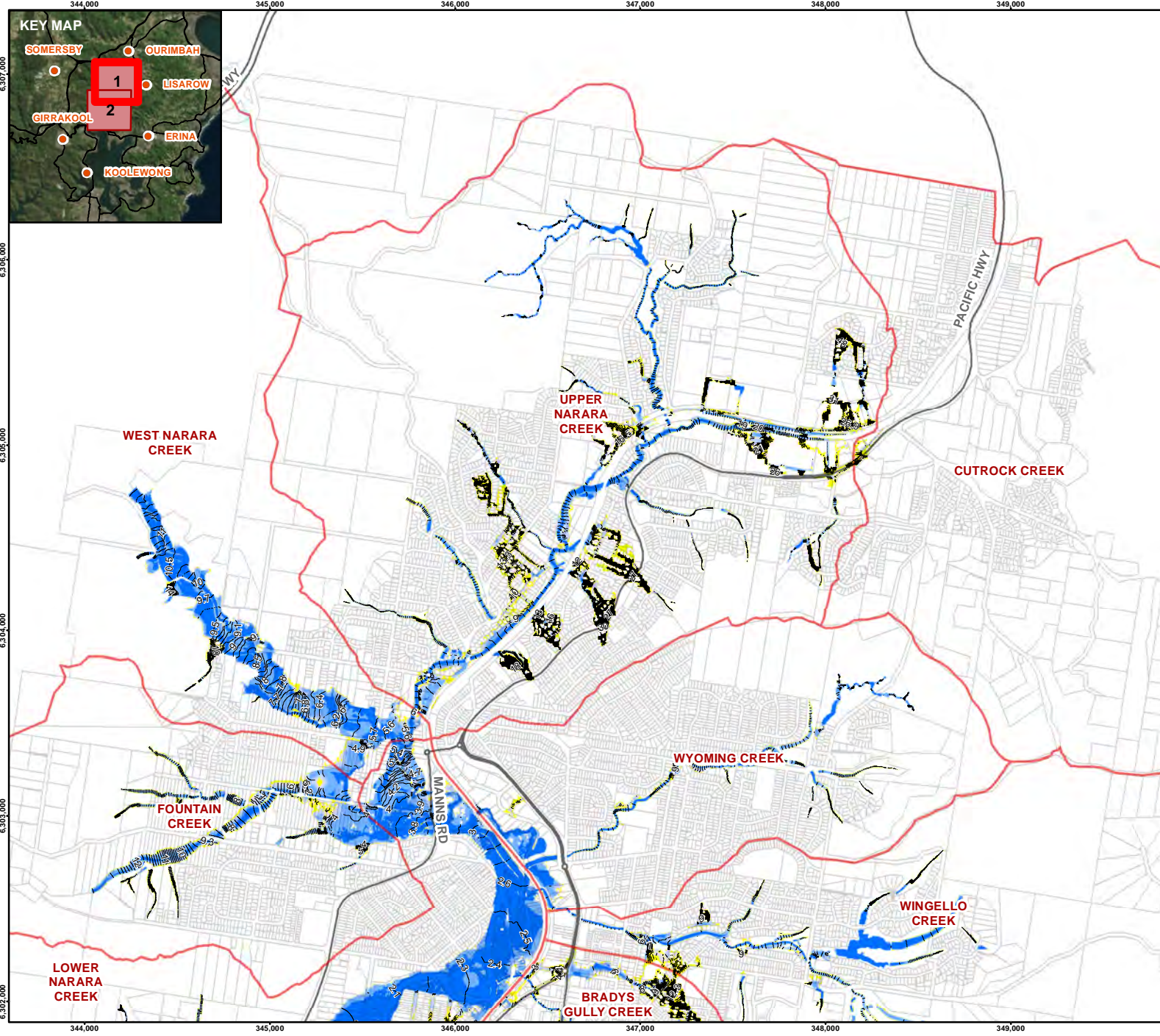
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	DP
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **38B**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm





**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm) D\_100Y**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- Drainage Sub-Catchment
- Cadastral Boundary

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

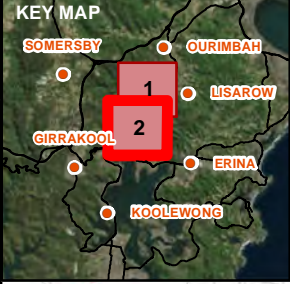
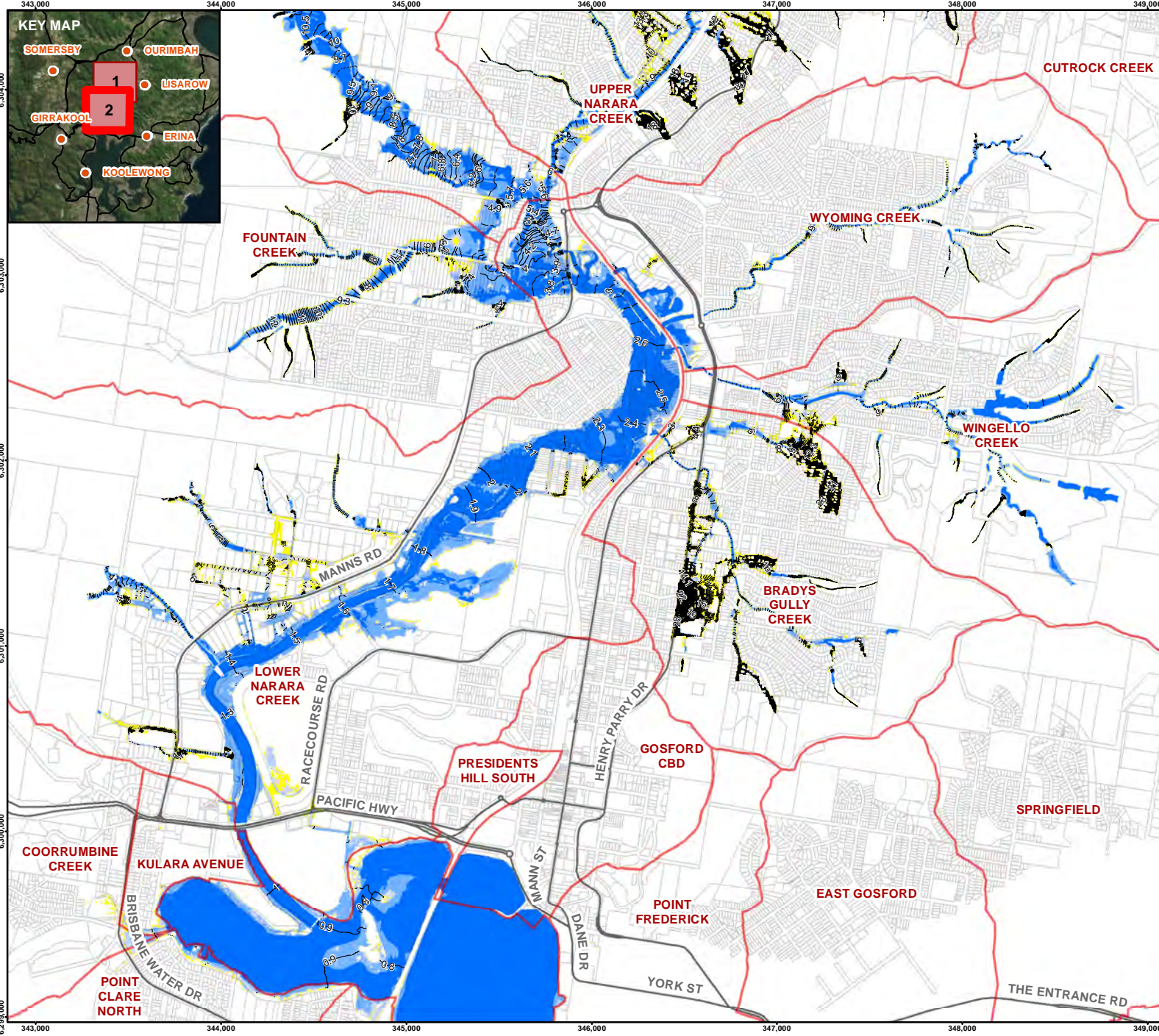
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 20% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	39A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm) D\_100Y**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

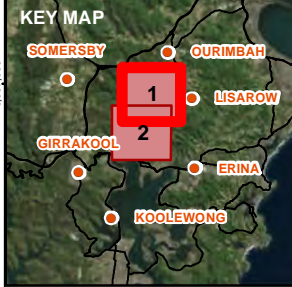
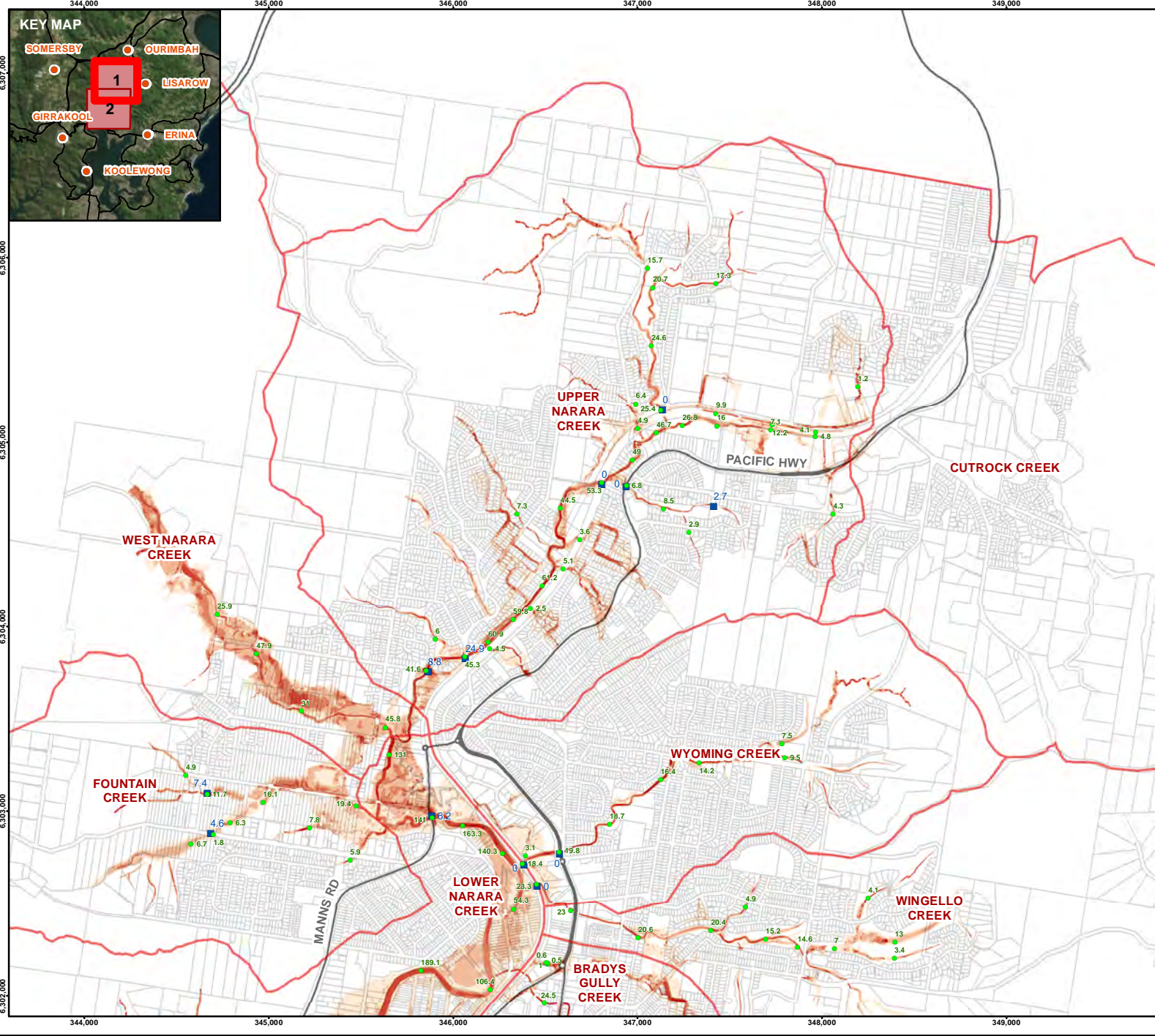
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 20% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	39B

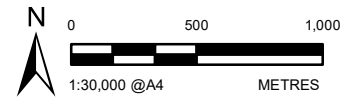
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
- 1D Weir Flow (m<sup>3</sup>/s)
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

Flood Velocity (m/s)	
	< 0.4
	0.4 to 0.8
	0.8 to 1.2
	1.2 to 2
	> 2



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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 Cadastre, Drainage Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

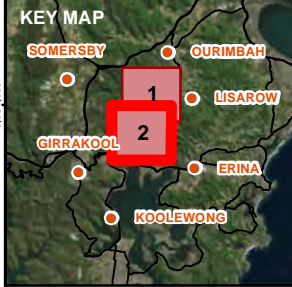
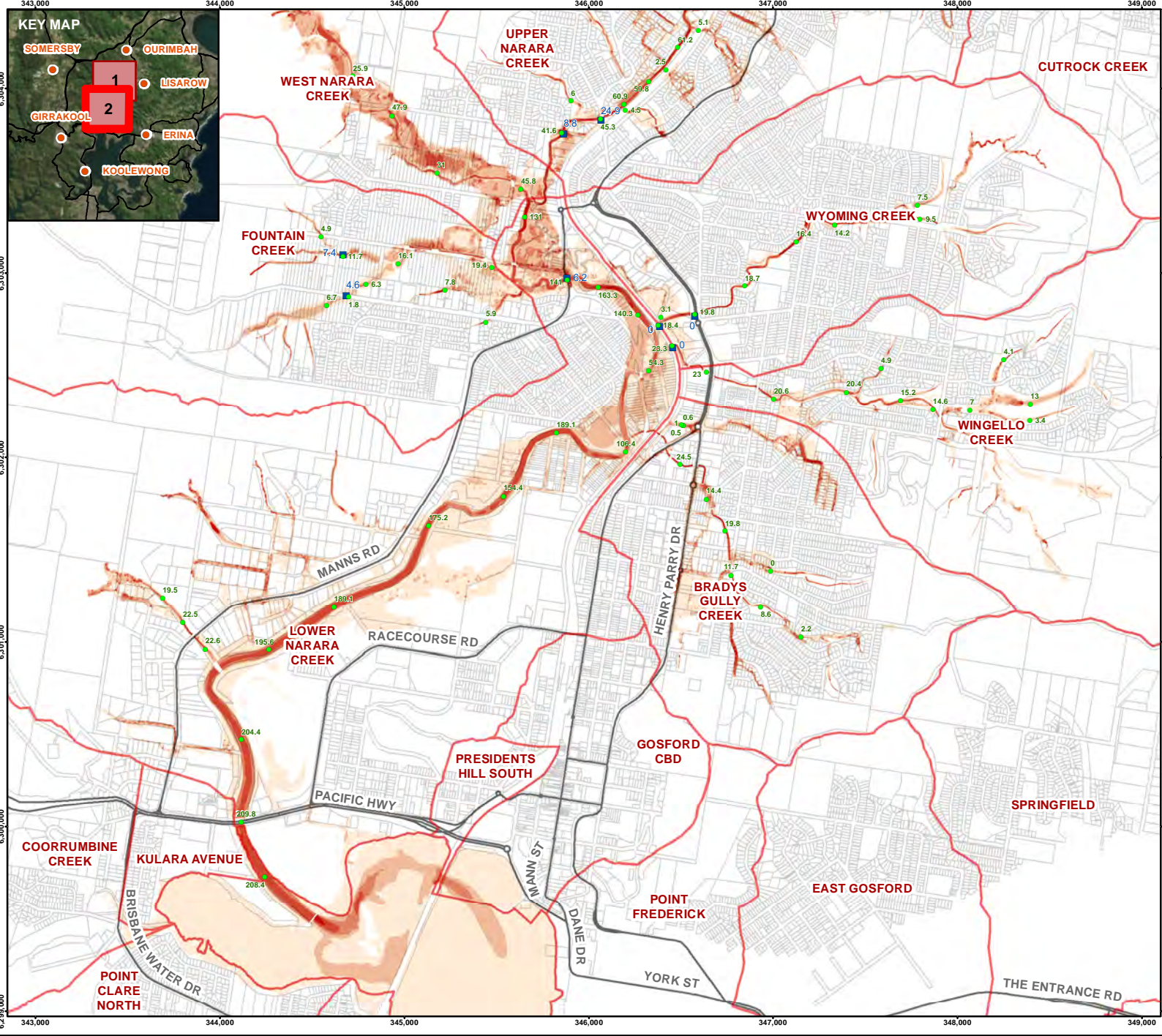
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 20% AEP EVENT**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	40A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44

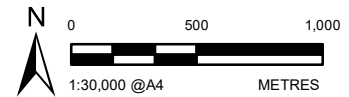


**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
- 1D Weir Flow (m<sup>3</sup>/s)
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4 \text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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 Cadastre, Drainage Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 20% AEP EVENT**

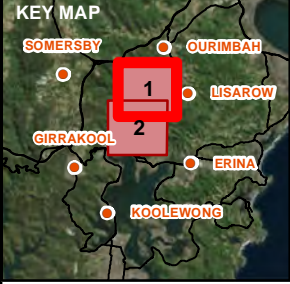
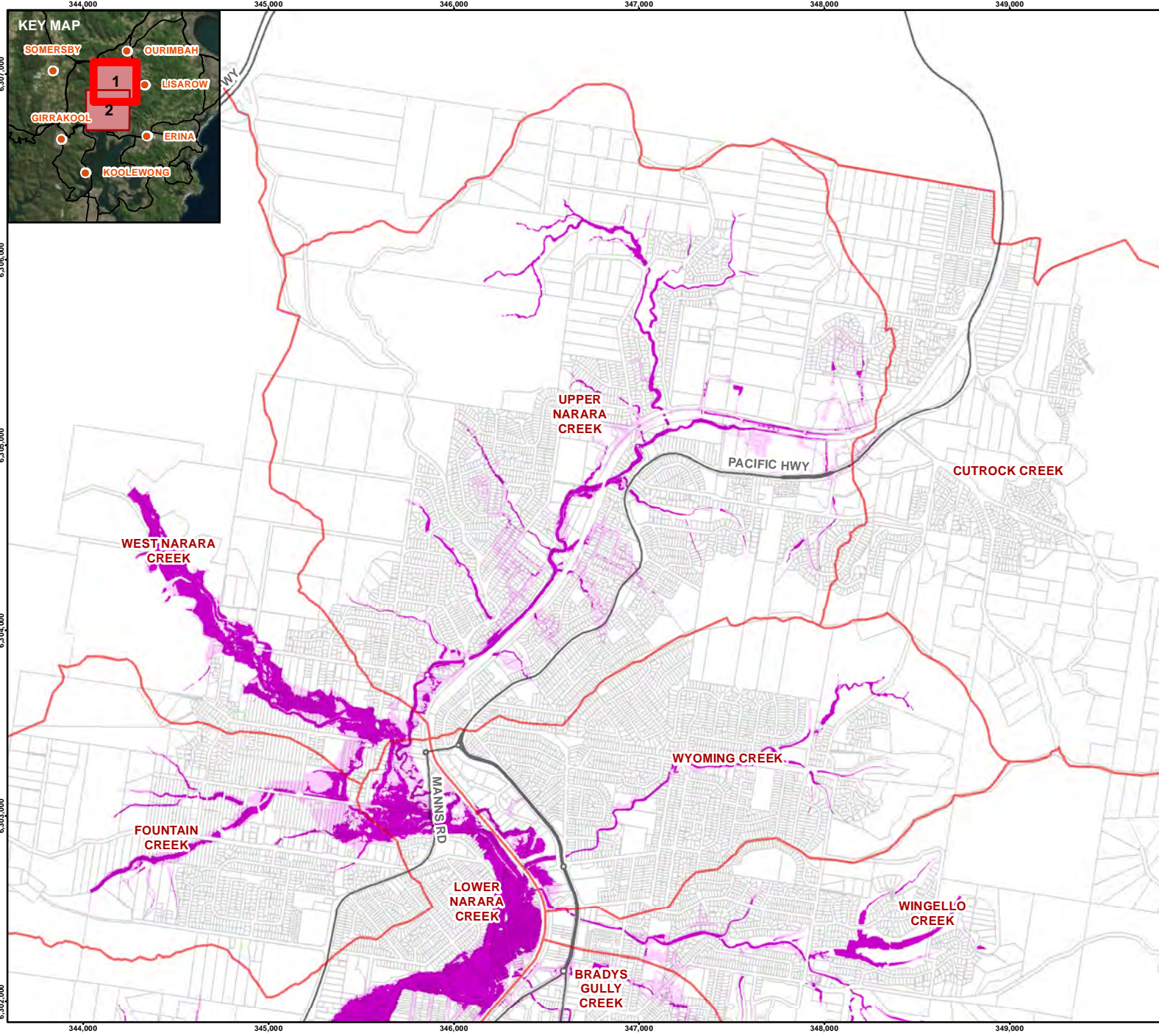
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	40B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

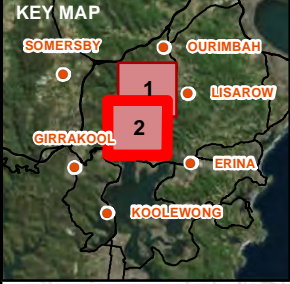
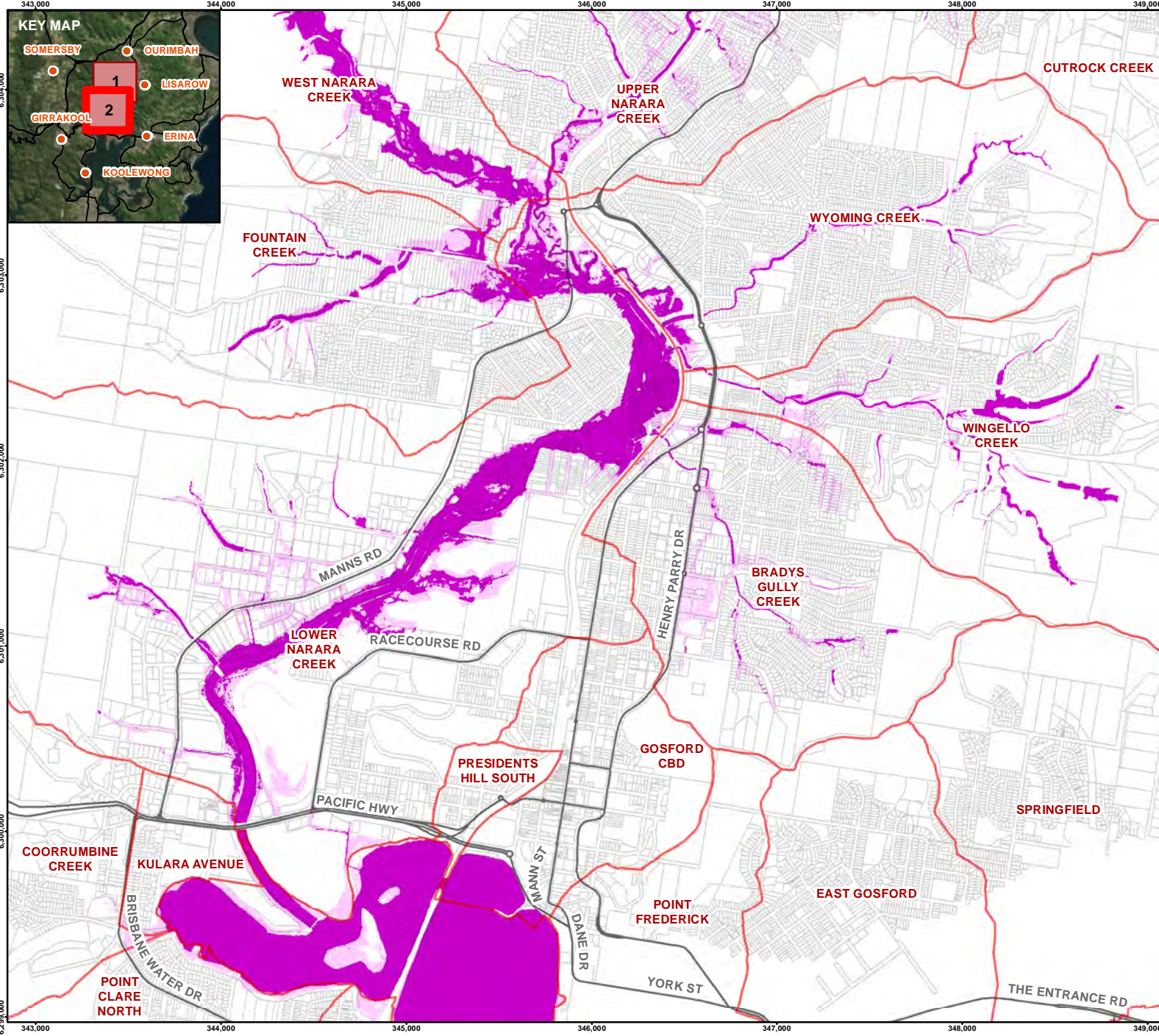
TITLE  
**PROVISIONAL FLOOD HAZARD  
 20% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	41A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Provisional Flood Hazard**

- Low Hazard
- High Hazard

**Scale**

0 500 1,000 METRES

1:30,000 @A4

**Coordinate System:** GDA 1994 MGA Zone 56  
**Projection:** Transverse Mercator  
**Datum:** GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

---

PROJECT  
**NARARA CREEK FLOOD STUDY**

---

TITLE  
**PROVISIONAL FLOOD HAZARD  
20% AEP EVENT**

---

CONSULTANT  
**Golder Associates**

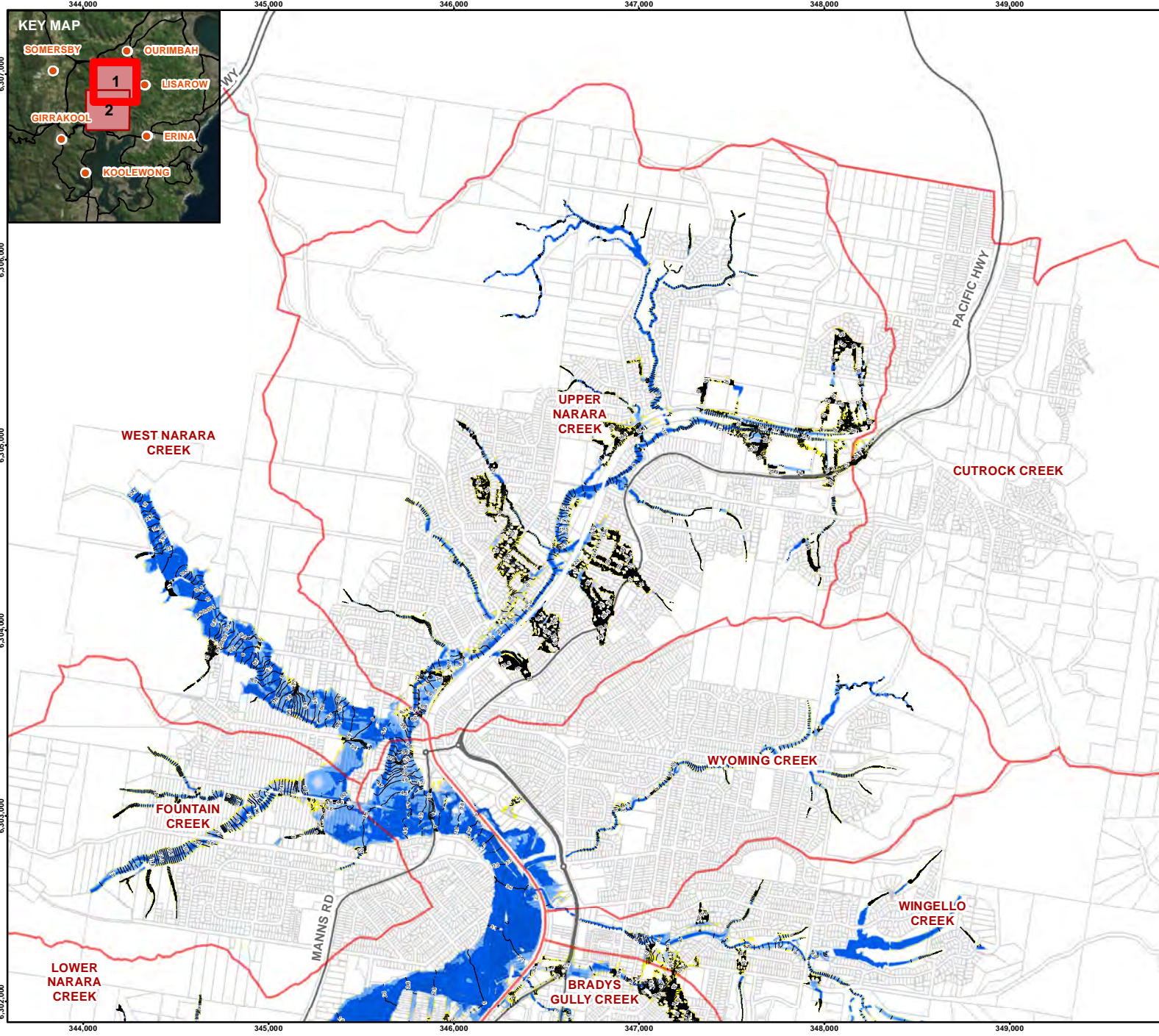
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

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PROJECT NO.	CONTROL	REV.	FIGURE
<b>097626068</b>	<b>006</b>	<b>G</b>	<b>41B</b>

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

25mm



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

Yellow	< 10 cm
Light Blue	10 to 20 cm
Medium Blue	20 to 40 cm
Dark Blue	40 cm to 1 m
Dark Blue	> 1 m

**Flood Height (mAHD)**

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT  
 10% AEP EVENT**

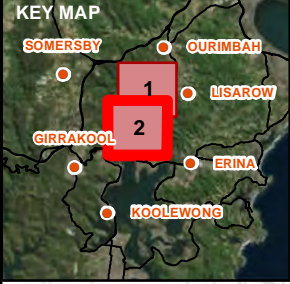
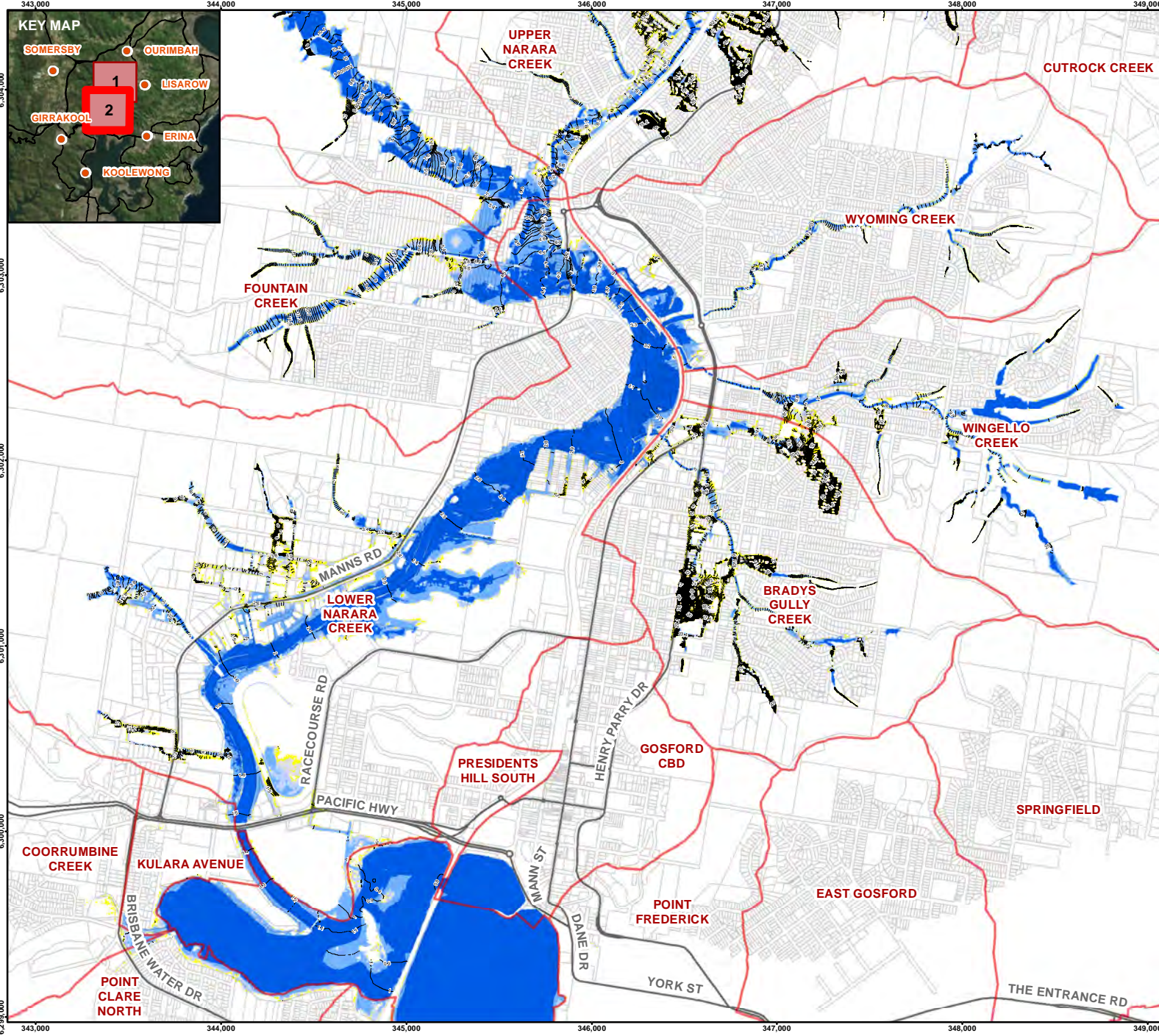
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. <b>097626068</b>	CONTROL <b>006</b>	REV. <b>G</b>	FIGURE <b>42A</b>
---------------------------------	-----------------------	------------------	----------------------

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

---

PROJECT  
**NARARA CREEK FLOOD STUDY**

---

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 10% AEP EVENT**

---

CONSULTANT

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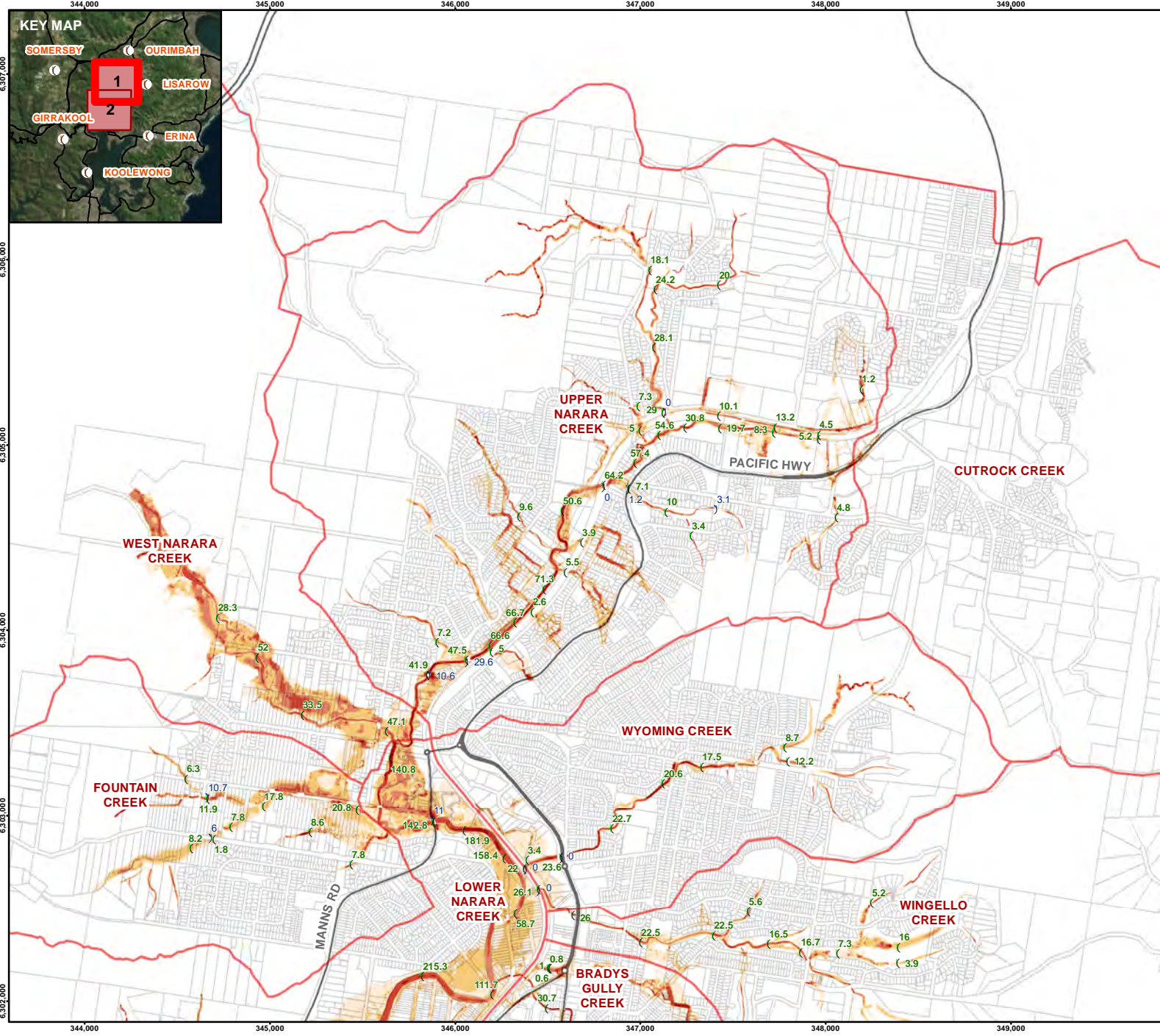
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

---

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	42B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4





**Legend**

- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4 \text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

0 500 1,000  
  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

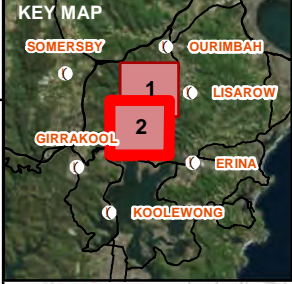
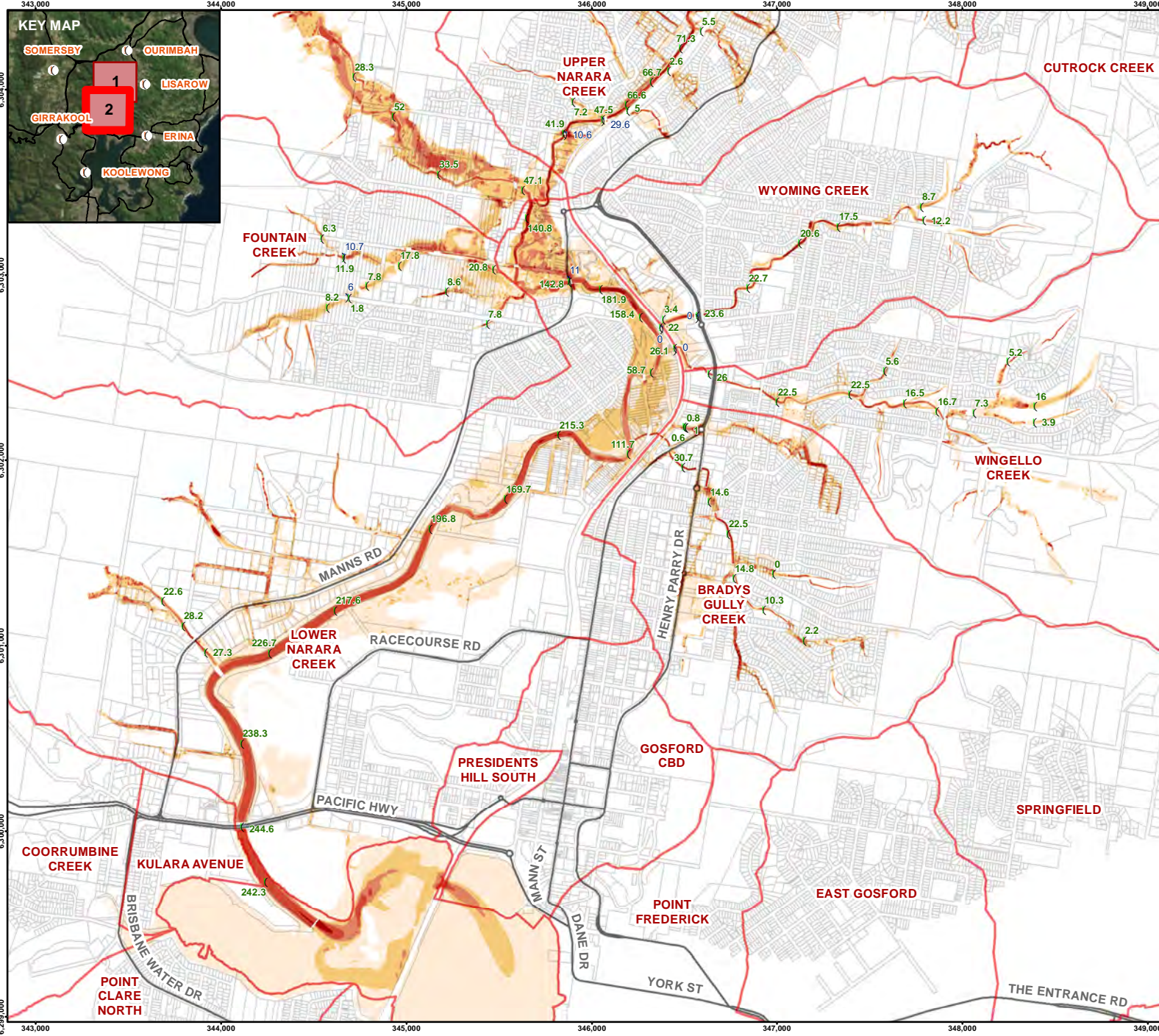
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 10% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	43A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

0 500 1,000  
  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

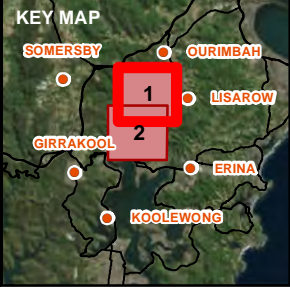
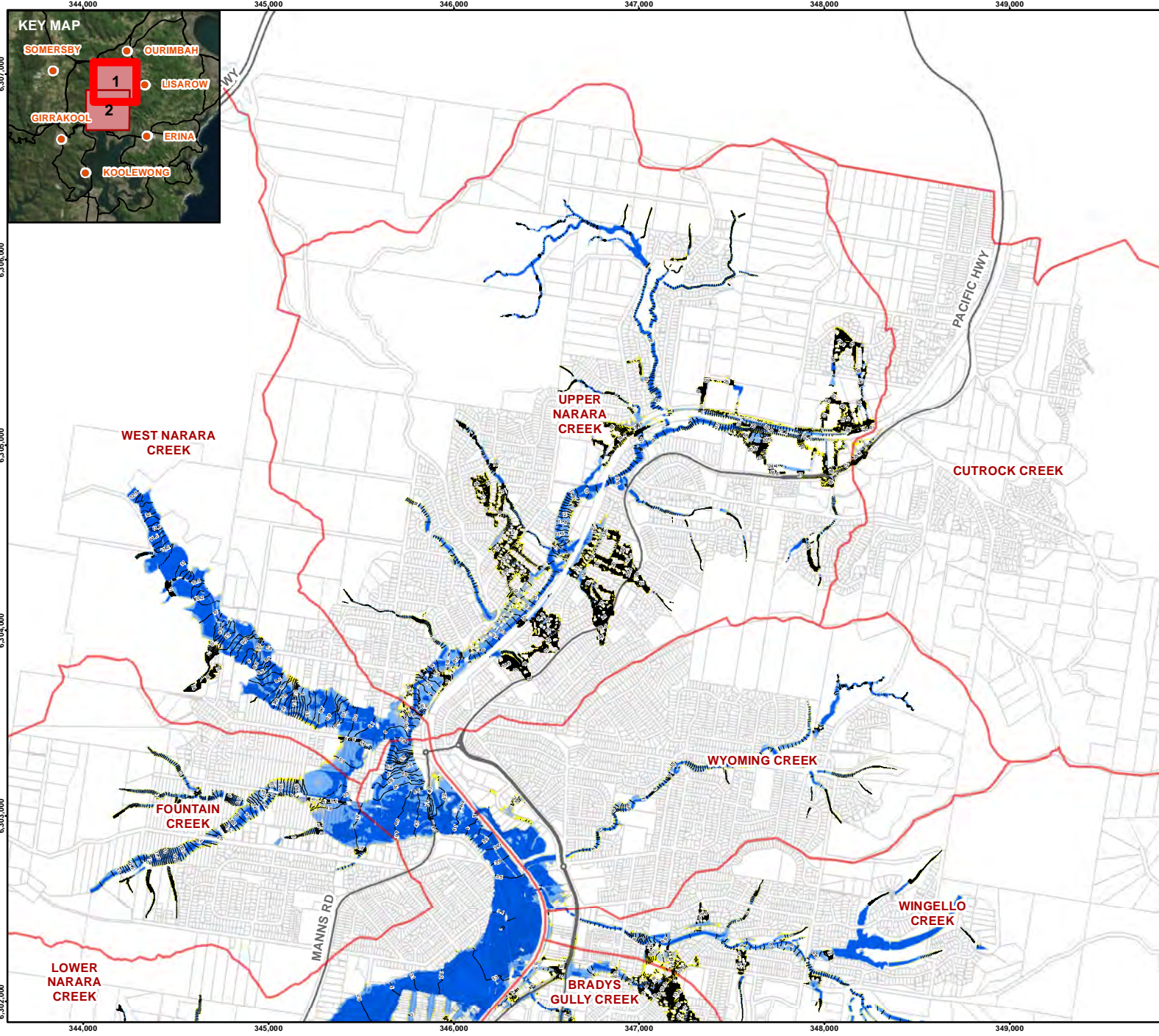
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 10% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	43B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT  
 5% AEP EVENT**

CONSULTANT

DD/MM/YYYY    3/04/2018

DESIGNED        SL

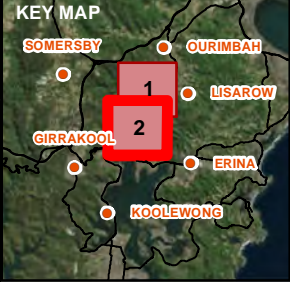
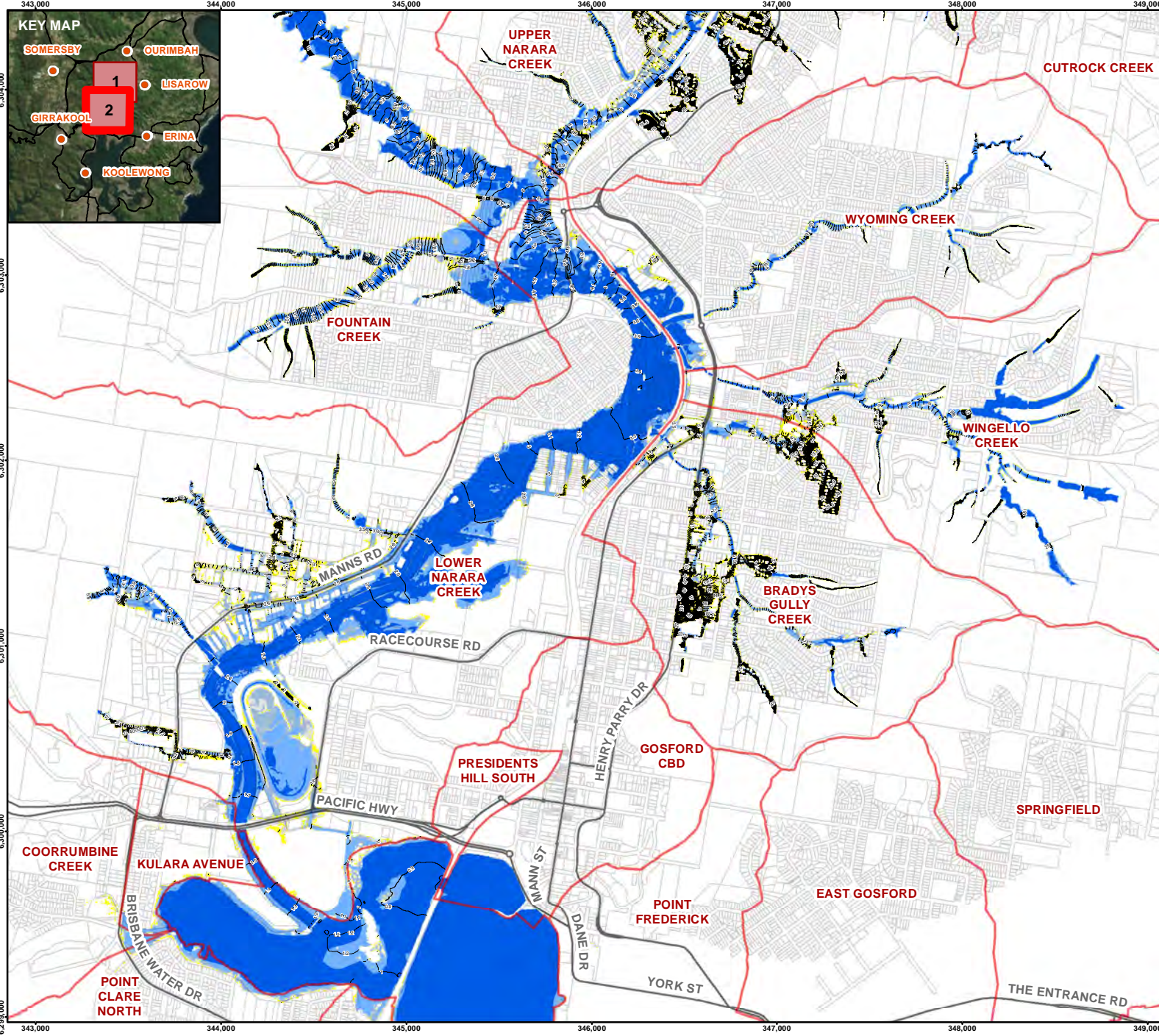
PREPARED        HB

REVIEWED        NM

APPROVED        NM

PROJECT NO.    097626068    CONTROL    006    REV.    G    FIGURE    44A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

N  
0 500 1,000  
METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 5% AEP EVENT**

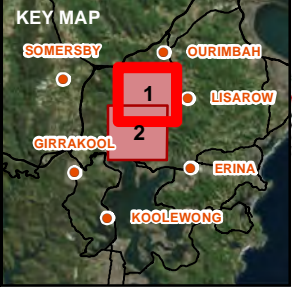
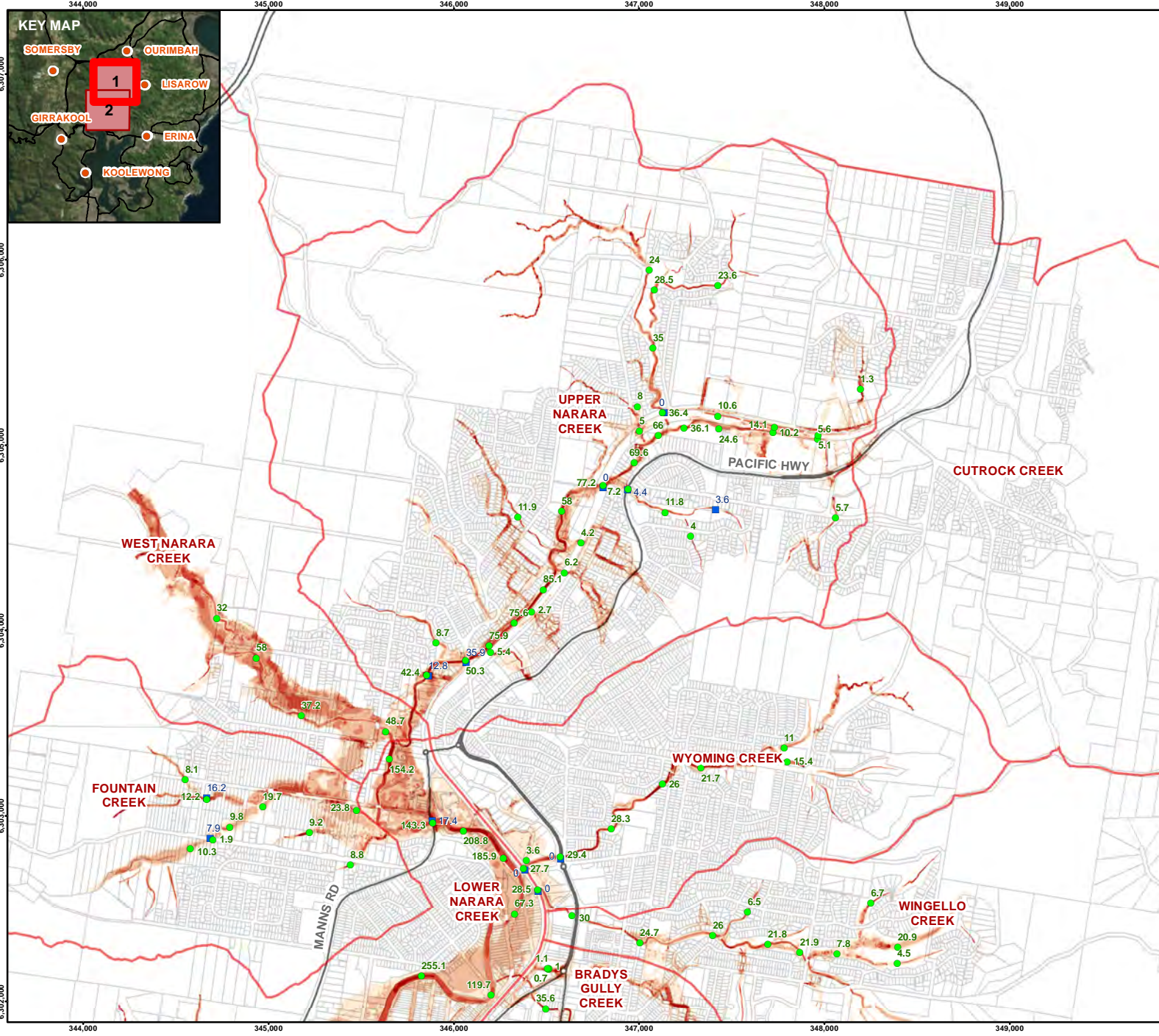
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	44B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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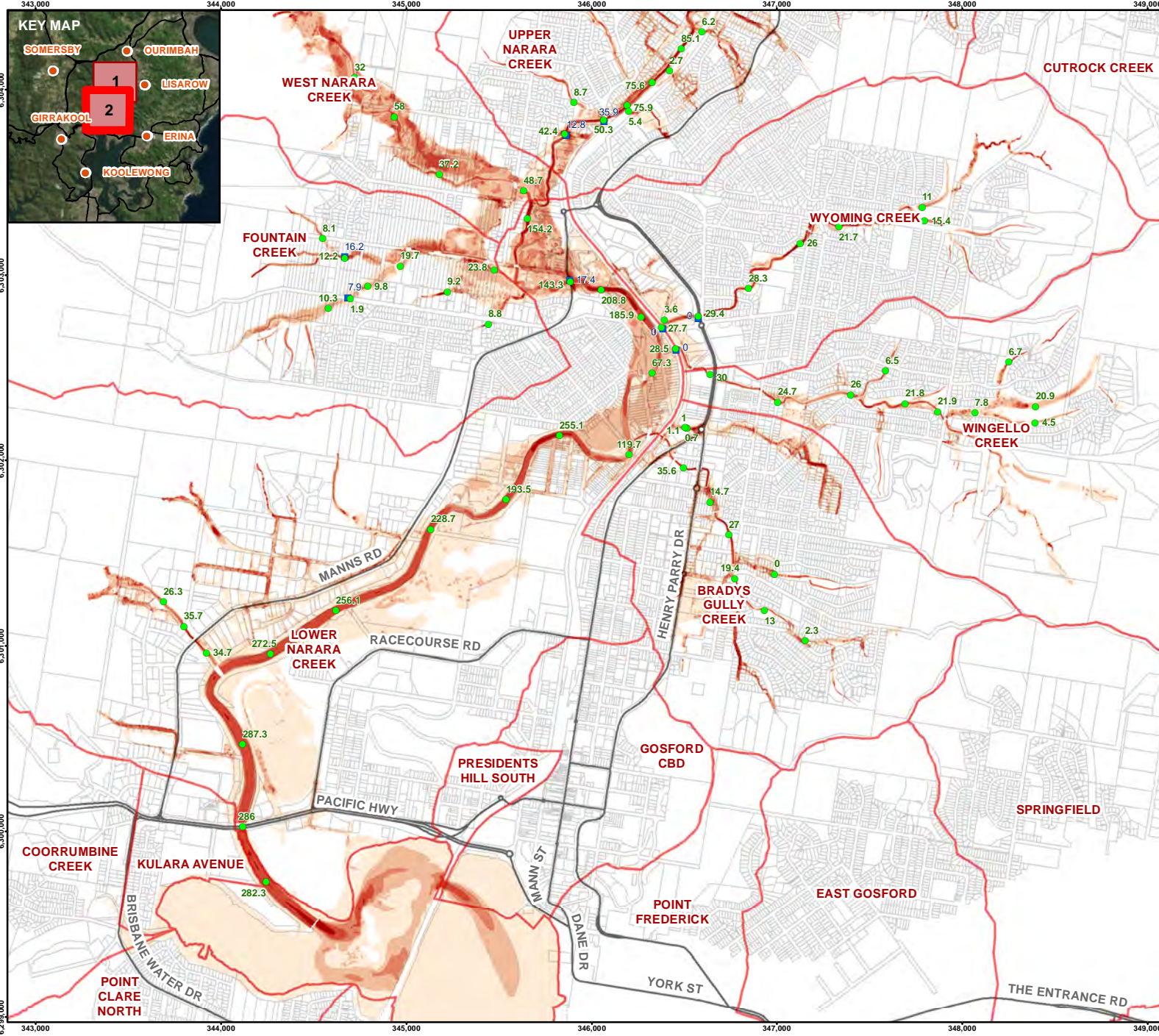
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**REFERENCE(S)**

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT	CENTRAL COAST COUNCIL
PROJECT	NARARA CREEK FLOOD STUDY
TITLE	PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 5% AEP EVENT
CONSULTANT	
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM
PROJECT NO.	097626068
CONTROL	006
REV.	G
FIGURE	45A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG A4



**Legend**

- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

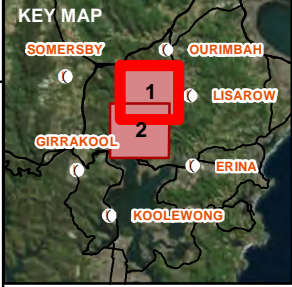
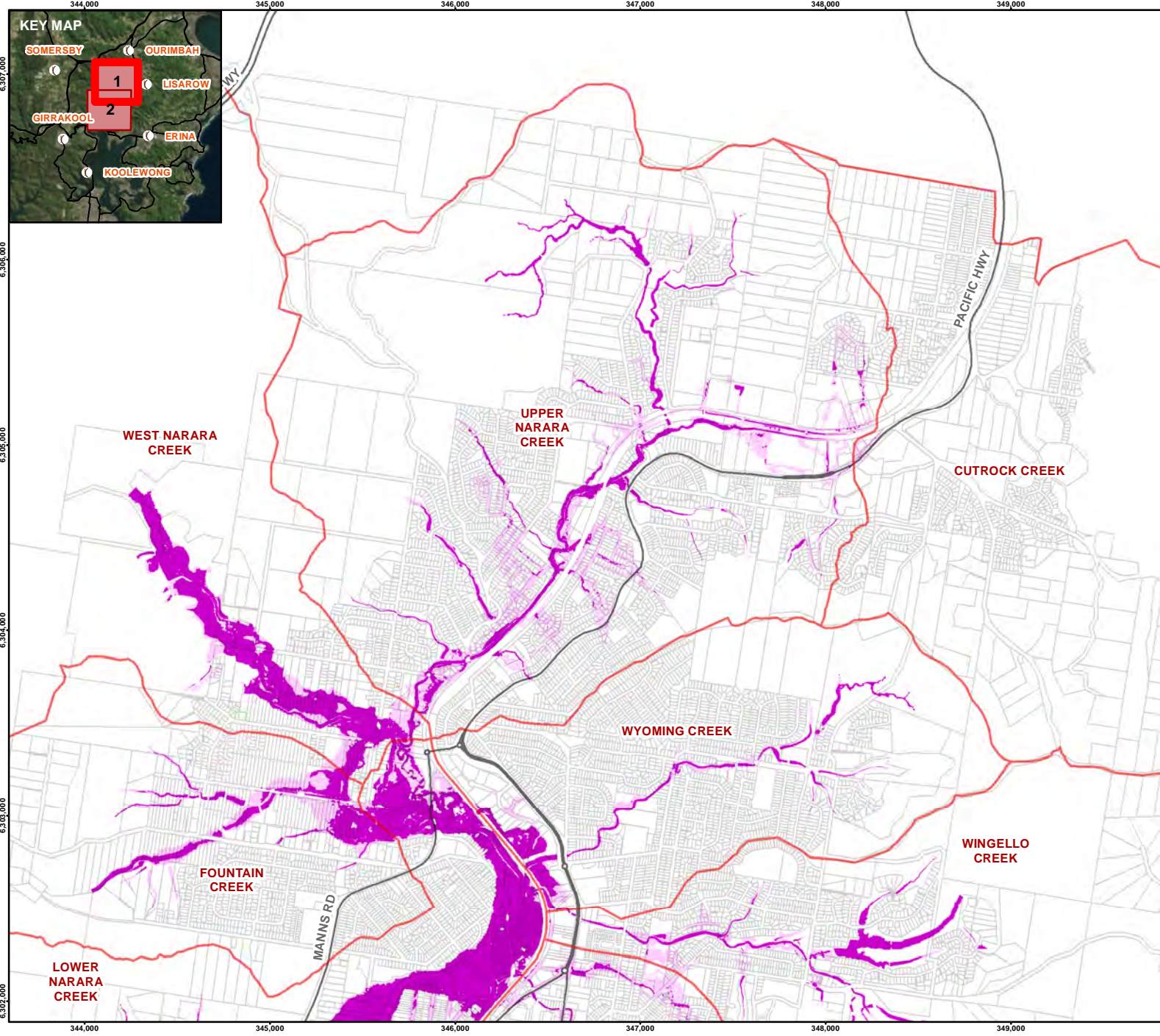
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 5% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

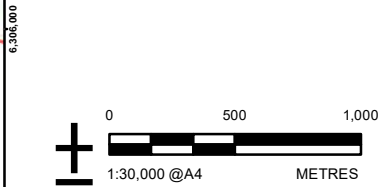
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	45B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
  - Main Roads
  - Drainage Sub-Catchment
  - Cadastral Boundary
- Provisional Flood Hazard**
- Low Hazard
  - High Hazard



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL FLOOD HAZARD  
 5% AEP EVENT**

CONSULTANT



DD/MM/YYYY    3/04/2018

DESIGNED        SL

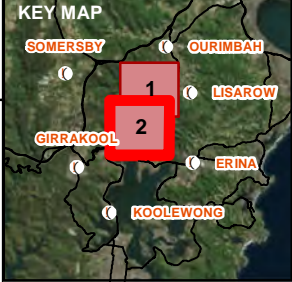
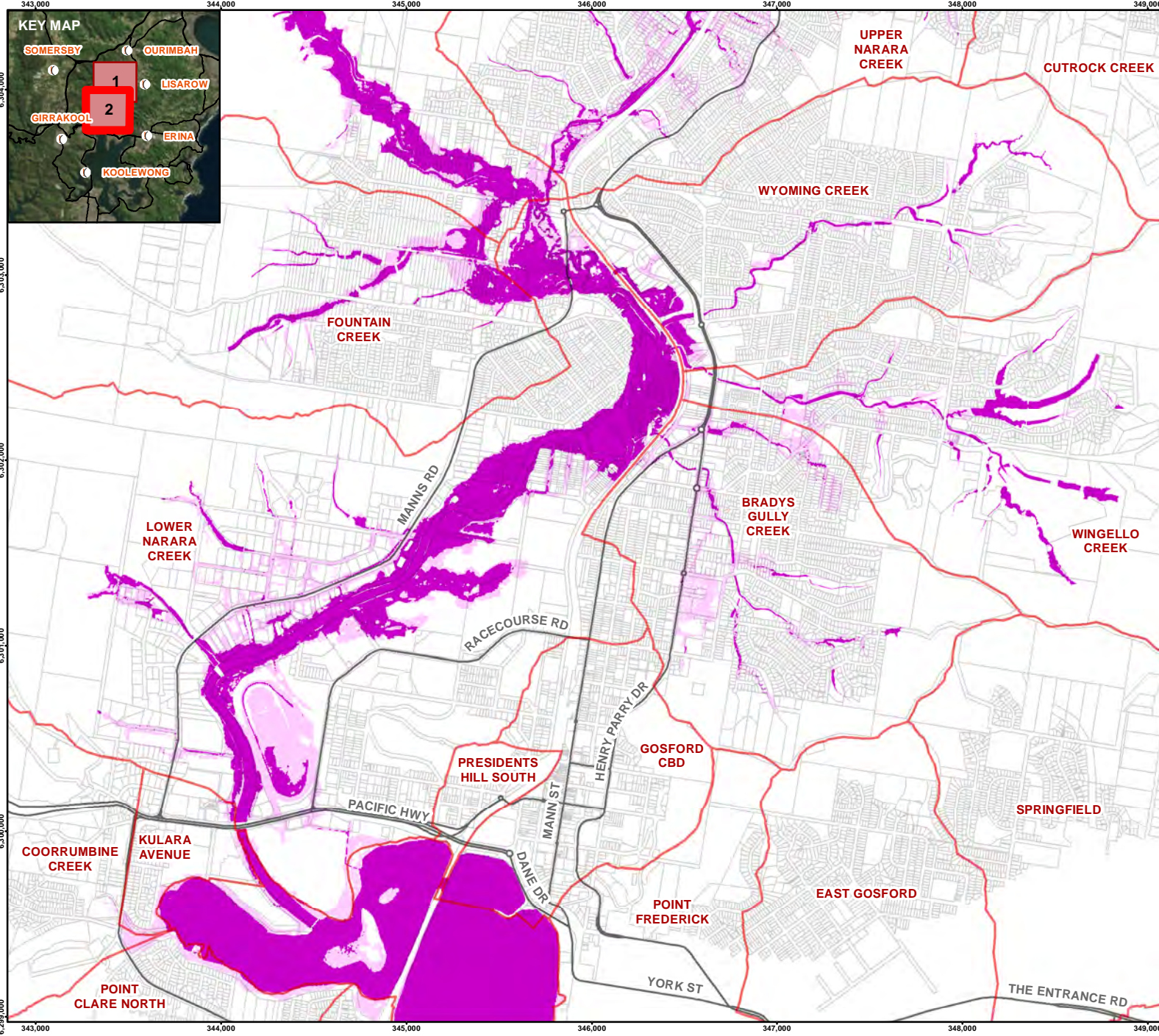
PREPARED        HB

REVIEWED        NM

APPROVED        NM

PROJECT NO.    CONTROL    REV.    FIGURE  
**097626068    006        G        46A**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

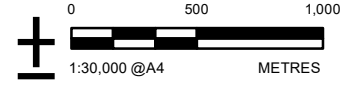


**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastr, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL FLOOD HAZARD  
 5% AEP EVENT**

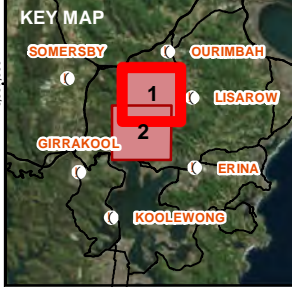
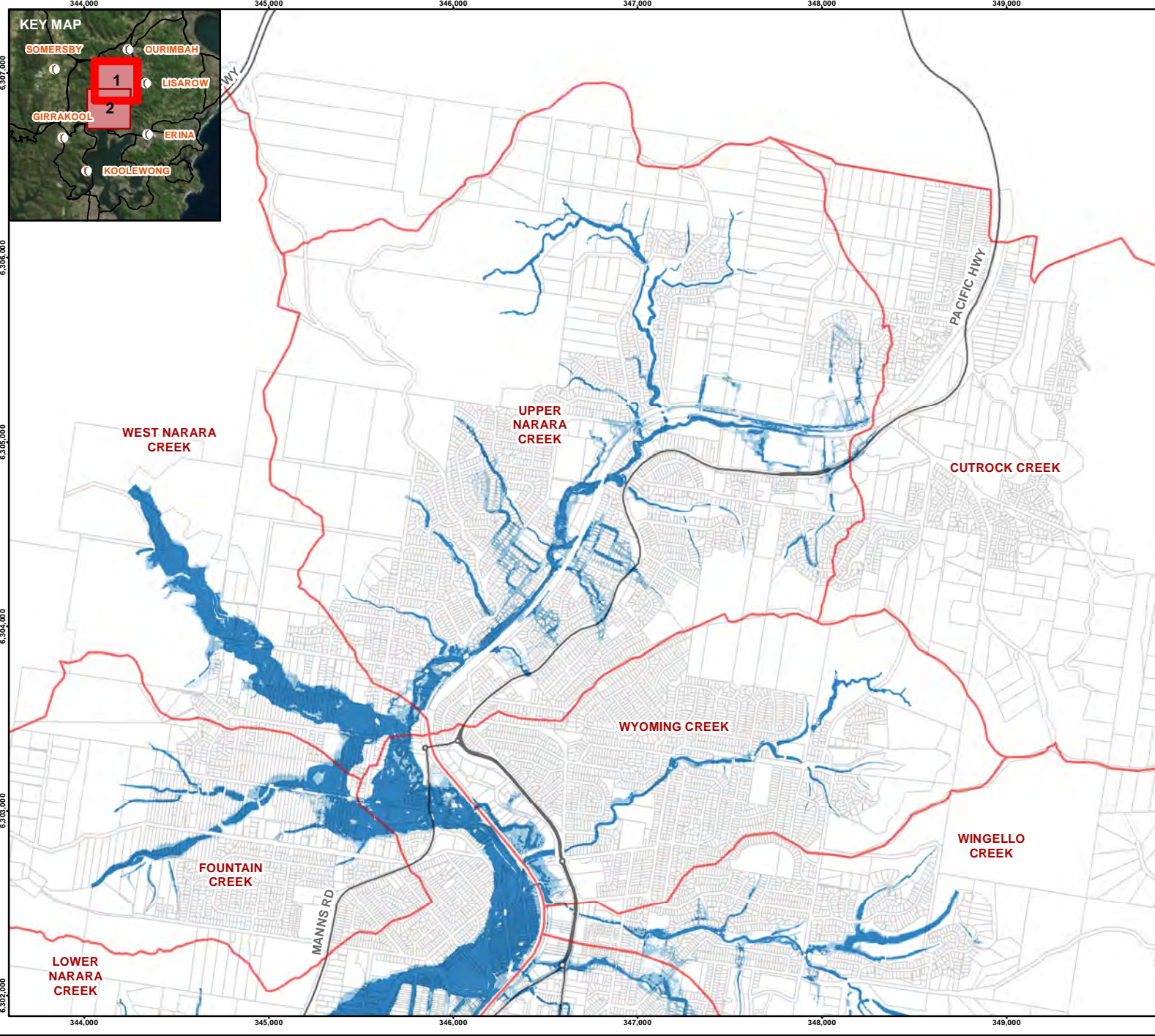
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	46B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4





**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Hydraulic Categories Category**

- ▭ Flood Fringe
- ▭ Flood Storage
- ▭ Floodway

0 500 1,000  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC CATEGORIES  
 5% AEP EVENT**

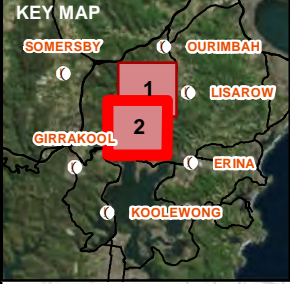
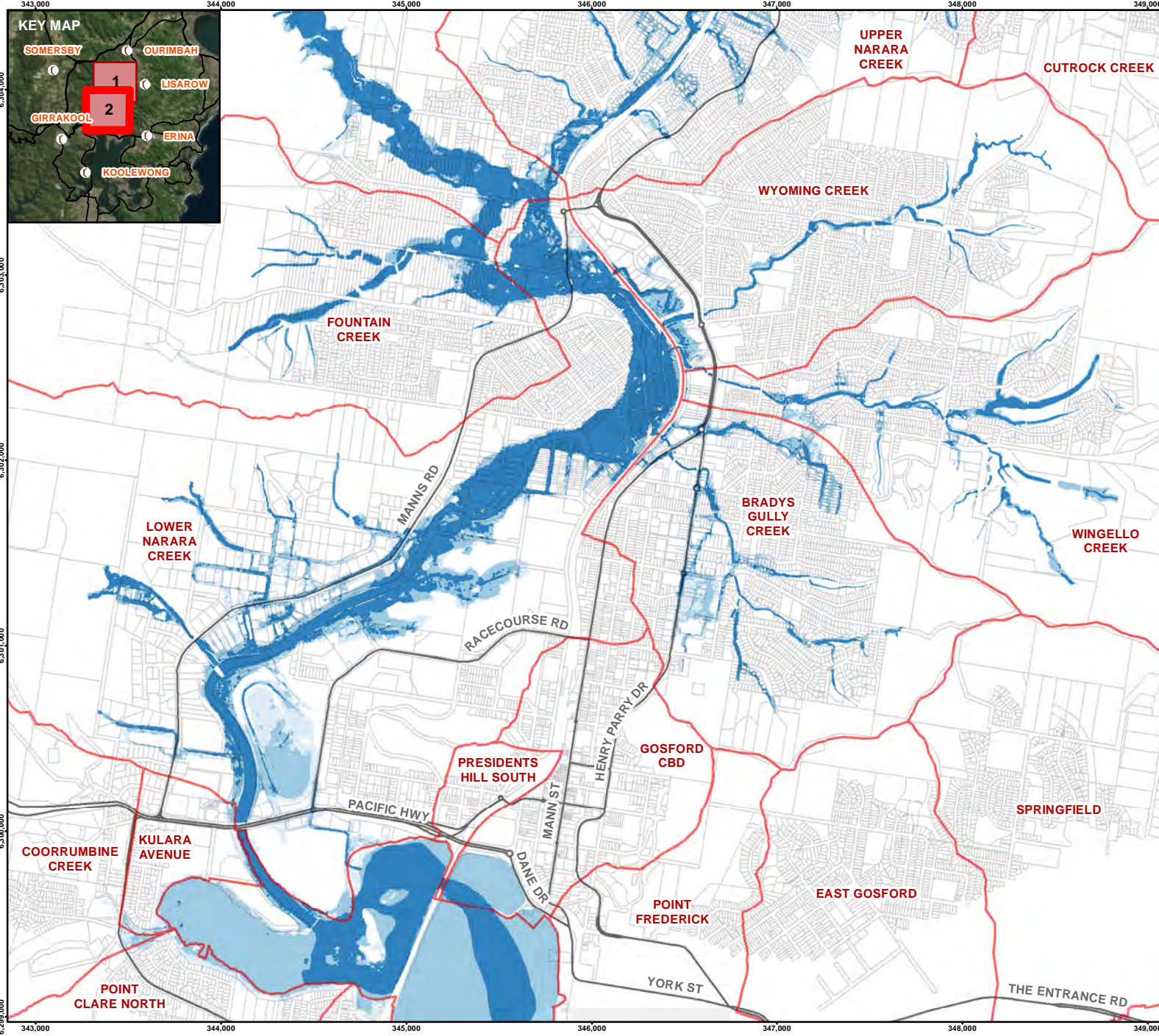
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	47A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Hydraulic Categories Category**

- ▭ Flood Fringe
- ▭ Flood Storage
- ▭ Floodway

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC CATEGORIES  
 5% AEP EVENT**

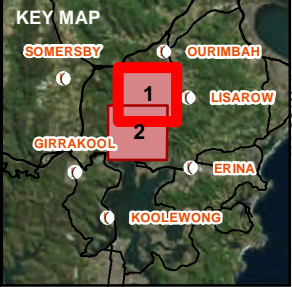
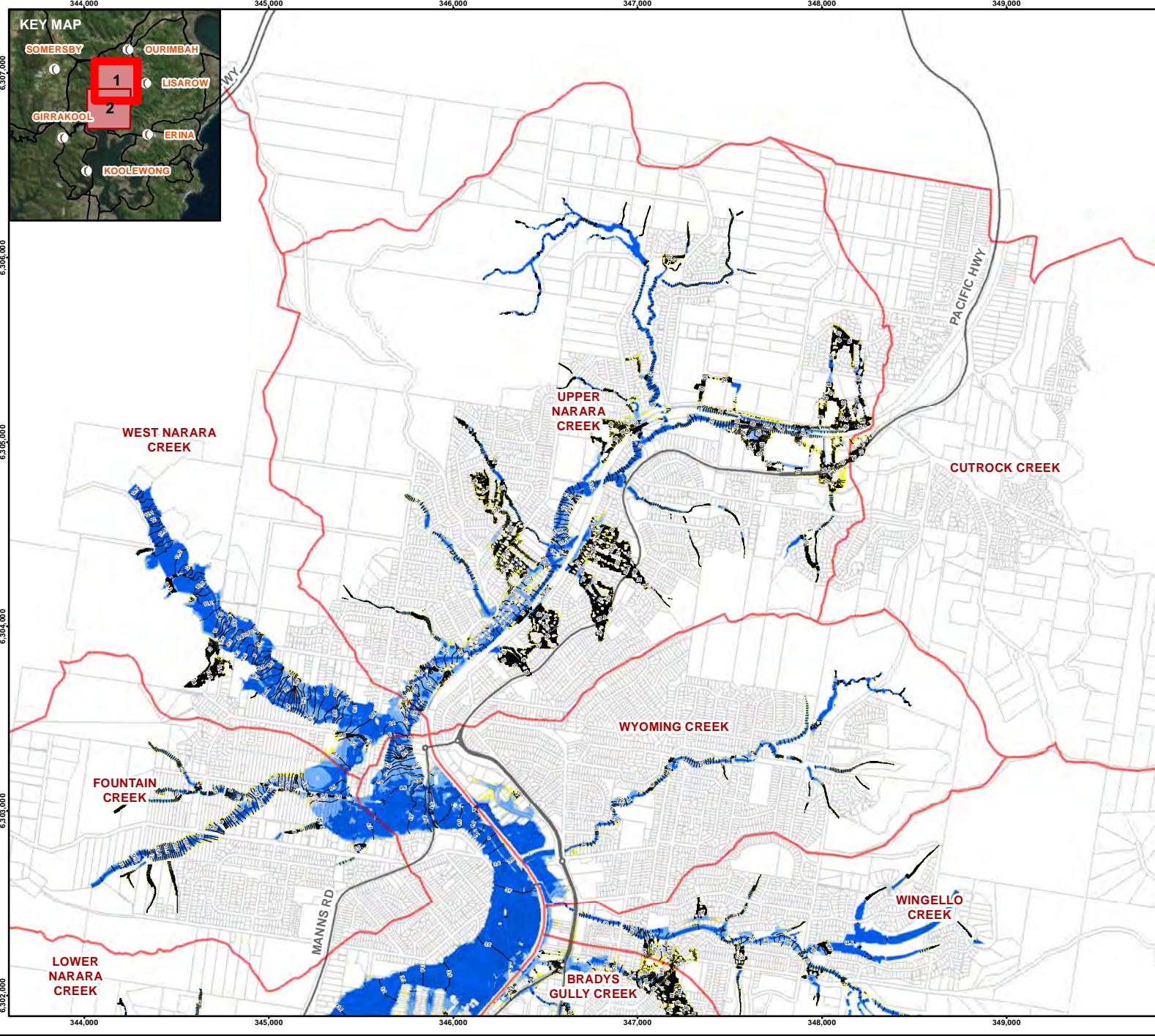
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	47B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Height (mAHD)**

- ▭ < 10 cm
- ▭ 10 to 20 cm
- ▭ 20 to 40 cm
- ▭ 40 cm to 1 m
- ▭ > 1 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

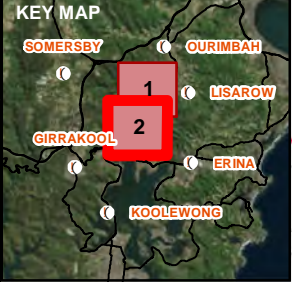
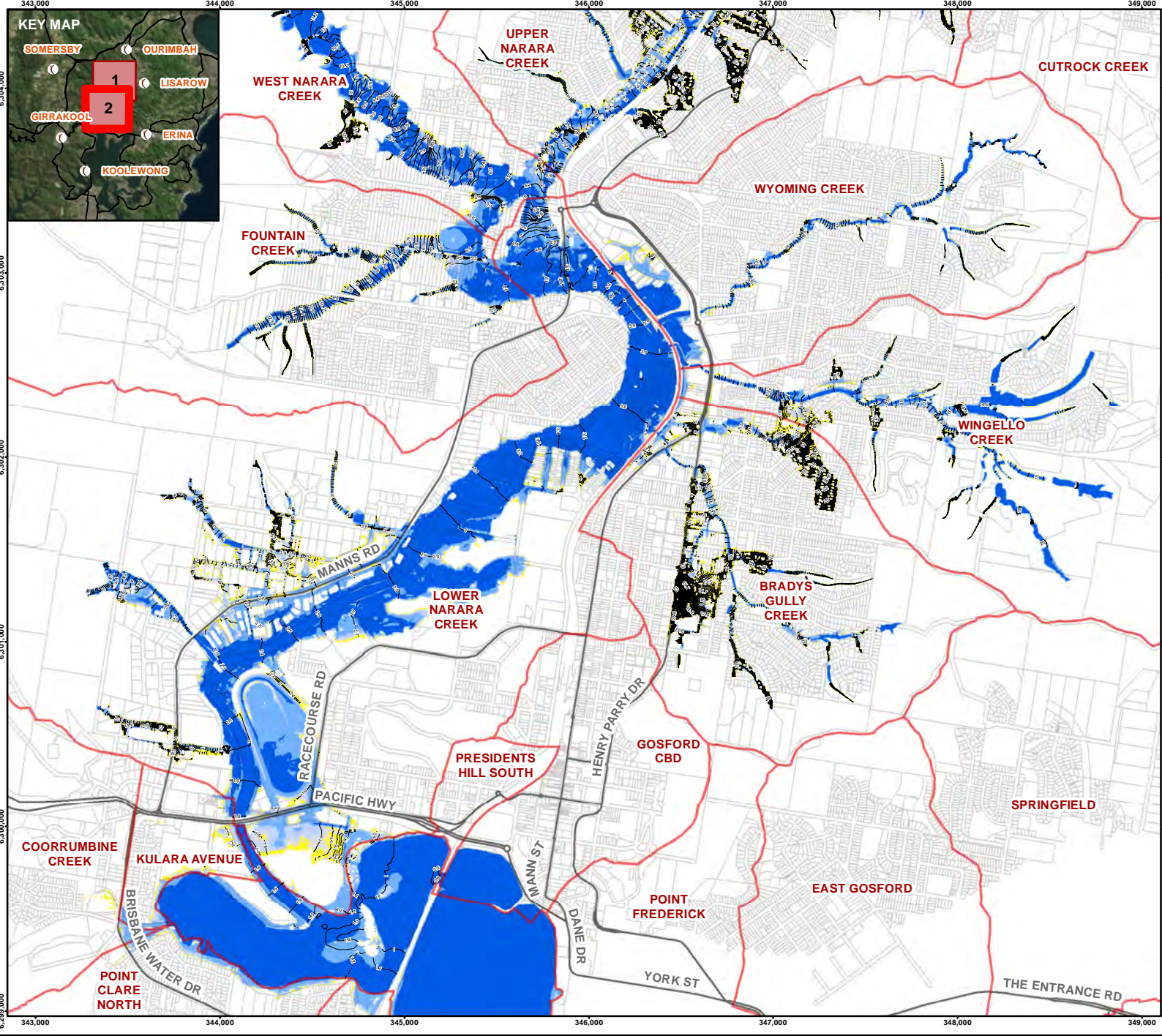
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 2% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	48A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

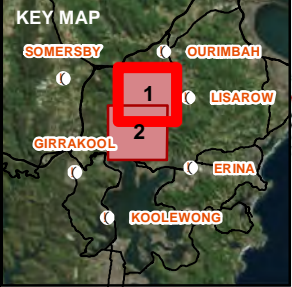
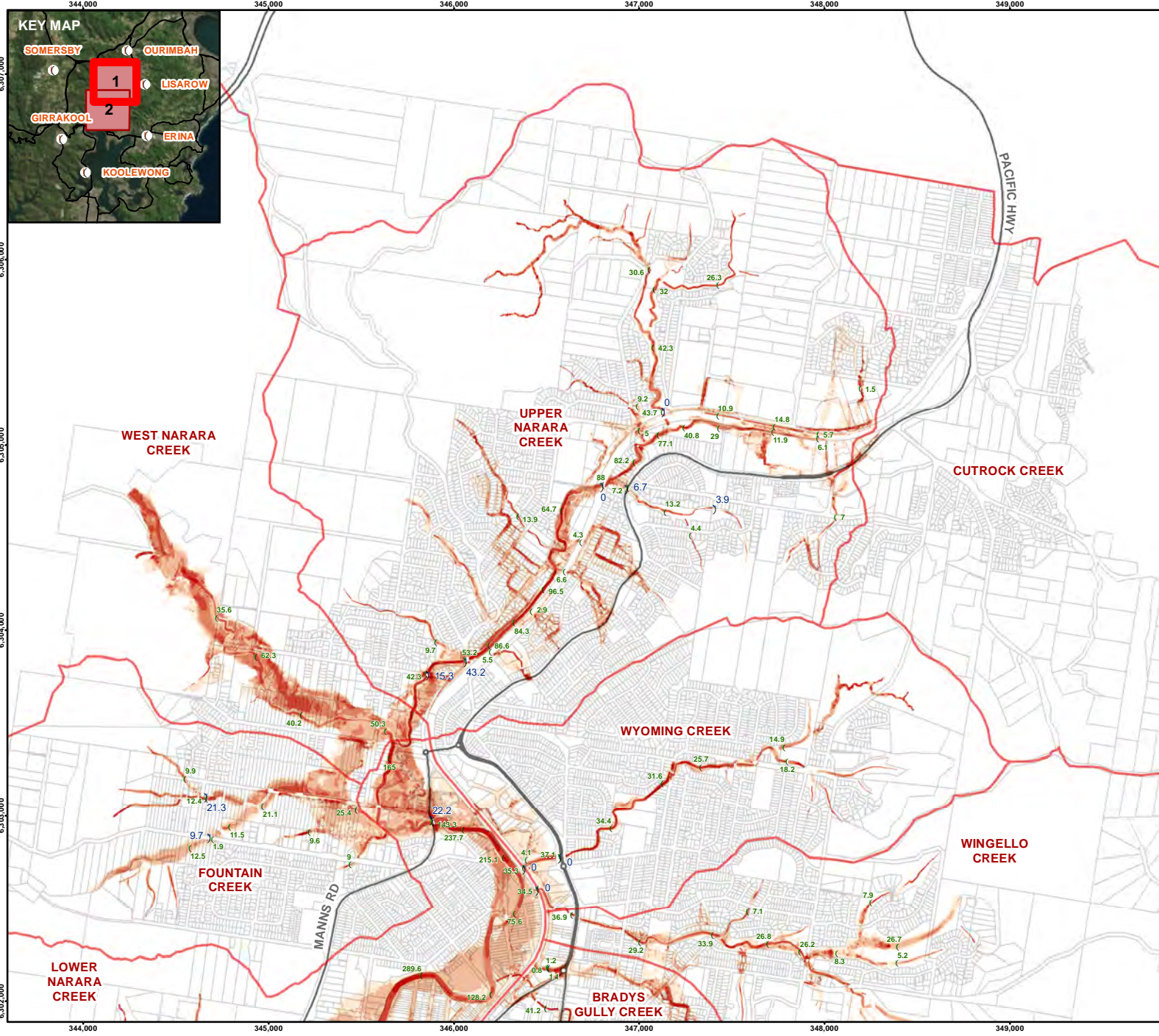
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 2% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	48B

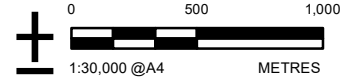
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) 1D Pipe or Open Channel Flow (m³/s)
- ( ) 1D Weir Flow (m³/s)
- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

Flood Velocity (m/s)
< 0.4 m/s
0.4 to 0.8 m/s
0.8 to 1.2 m/s
1.2 to 2 m/s
> 2 m/s



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 2% AEP EVENT**

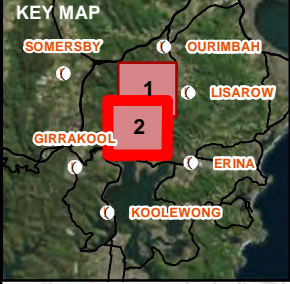
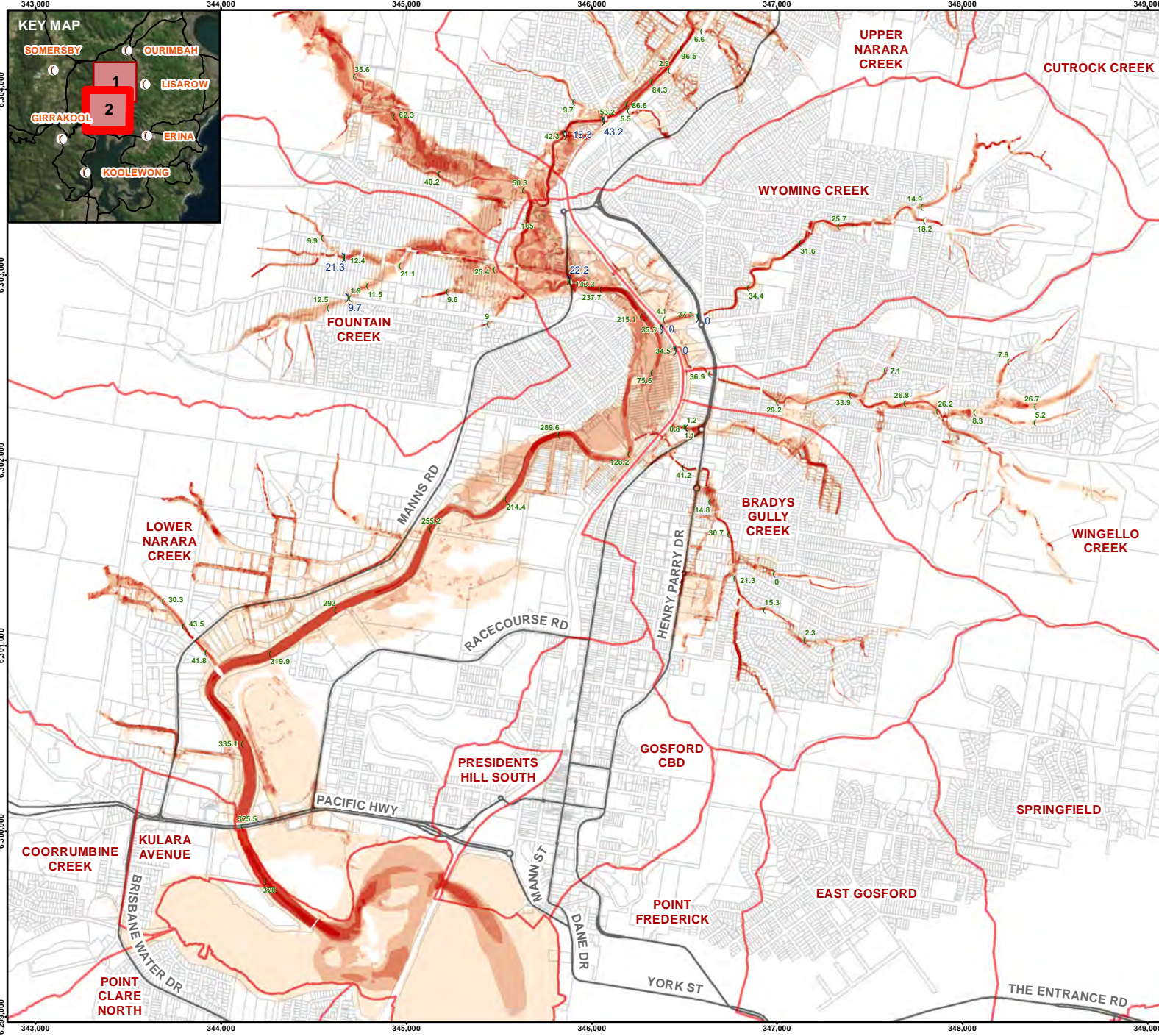
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

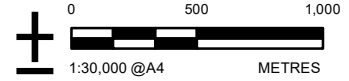
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	49A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
  - ) 1D Weir Flow (m<sup>3</sup>/s)
  - ( ) Localities
  - Main Roads
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary
- | Flood Velocity (m/s) |
|----------------------|
| < 0.4 m/s            |
| 0.4 to 0.8 m/s       |
| 0.8 to 1.2 m/s       |
| 1.2 to 2 m/s         |
| > 2 m/s              |



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 2% AEP EVENT**

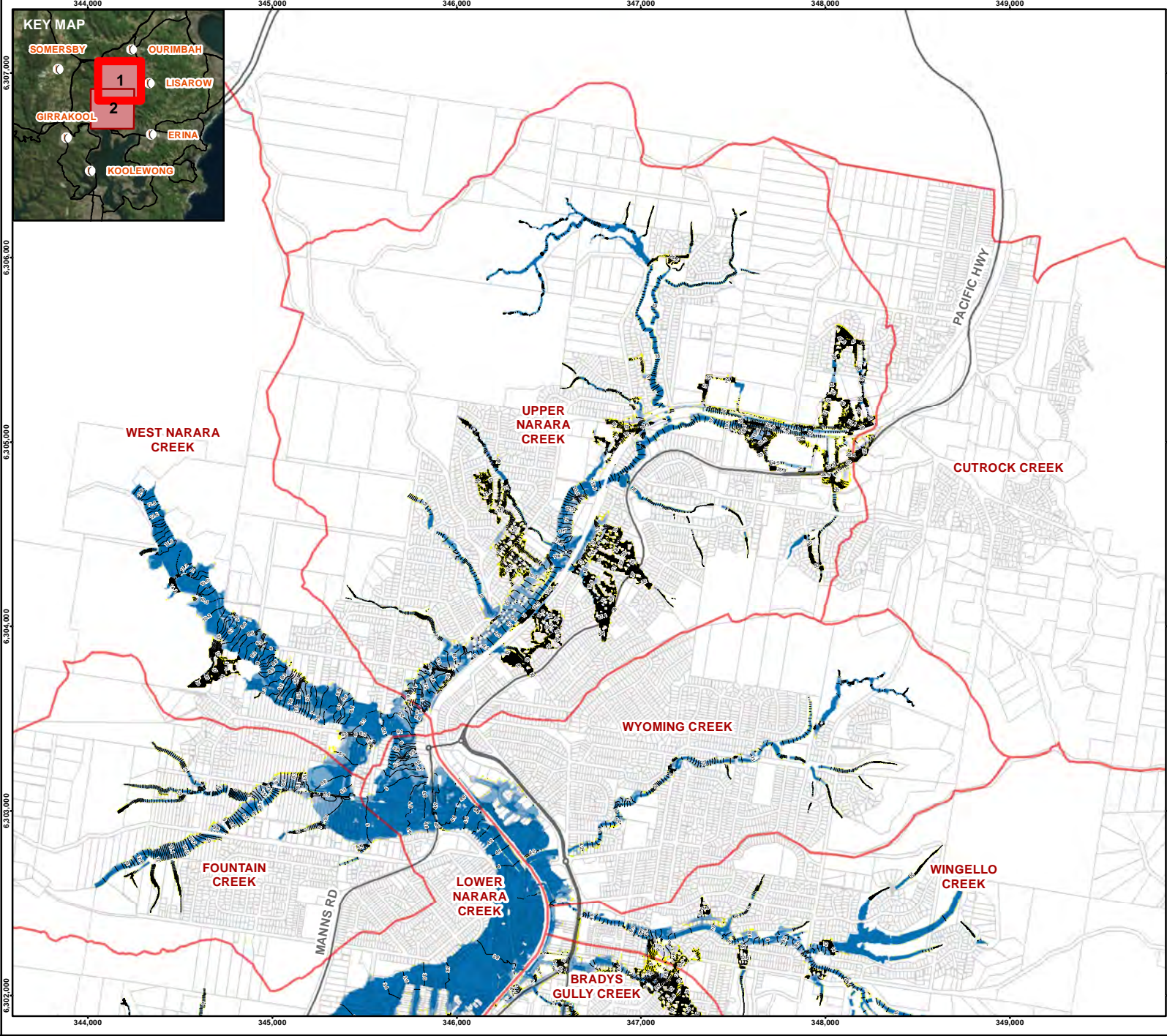
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	49B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

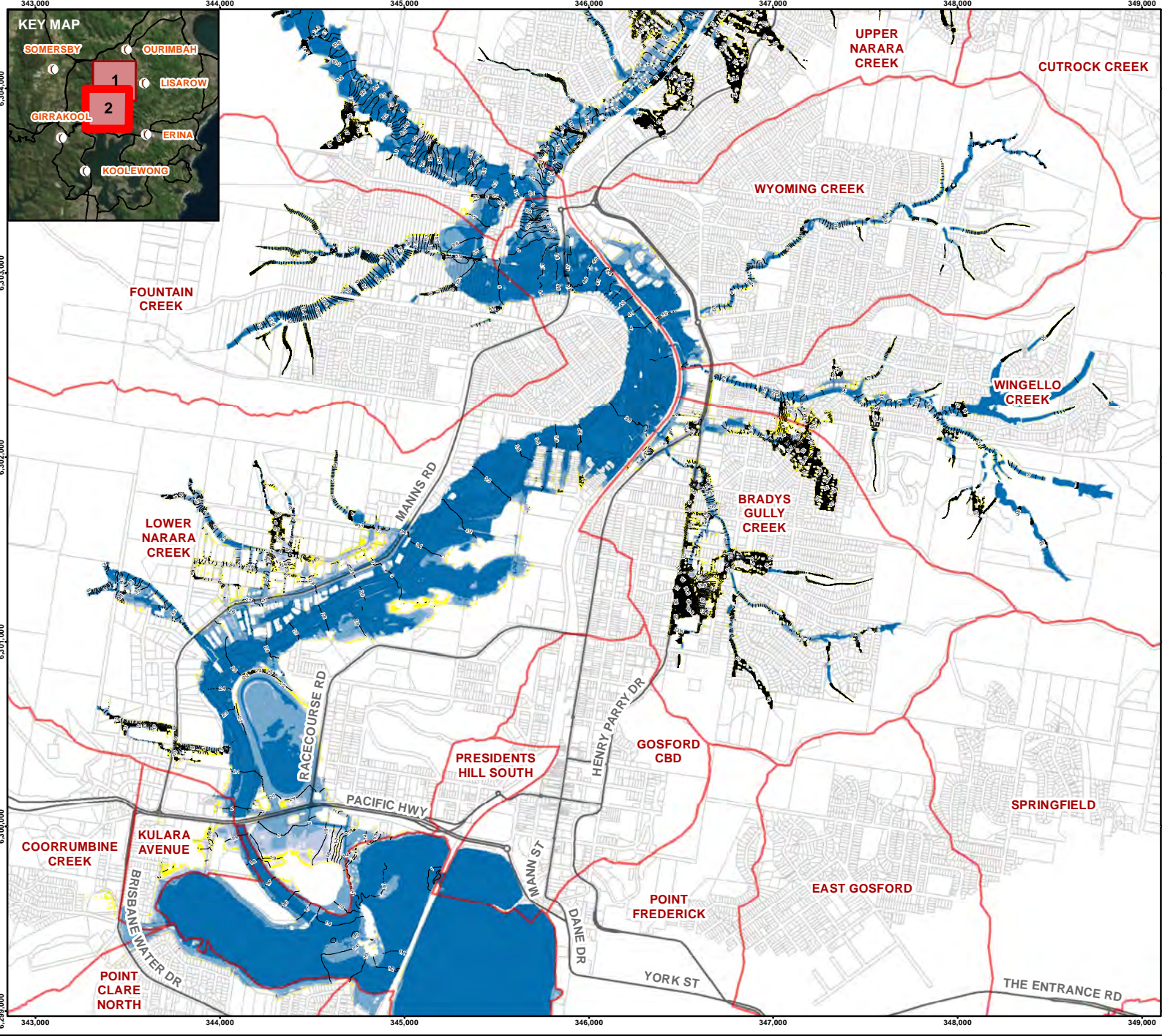
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 1% AEP EVENT**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	50A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Black: > 1 m

0 500 1,000  
  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 1% AEP EVENT**

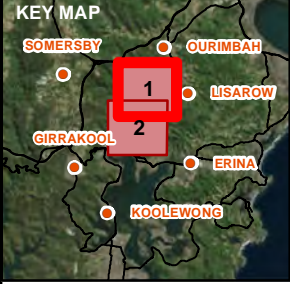
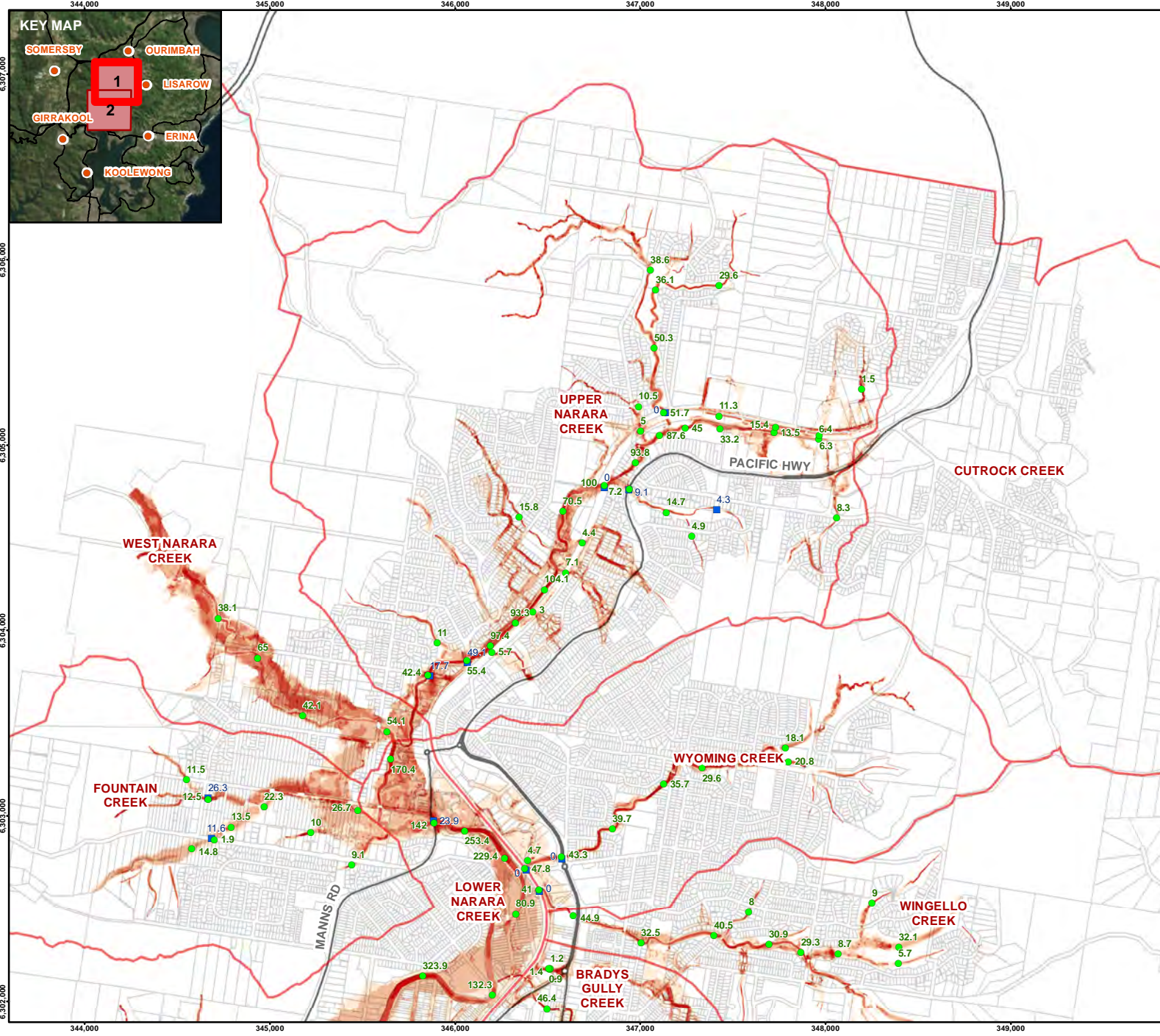
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **50B**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4





**Legend**

- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

**Scale**

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**


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**Cadastrre, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 1% AEP EVENT**

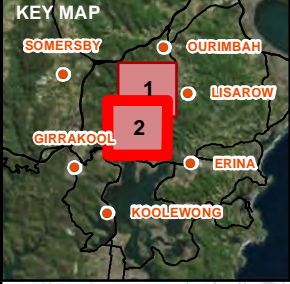
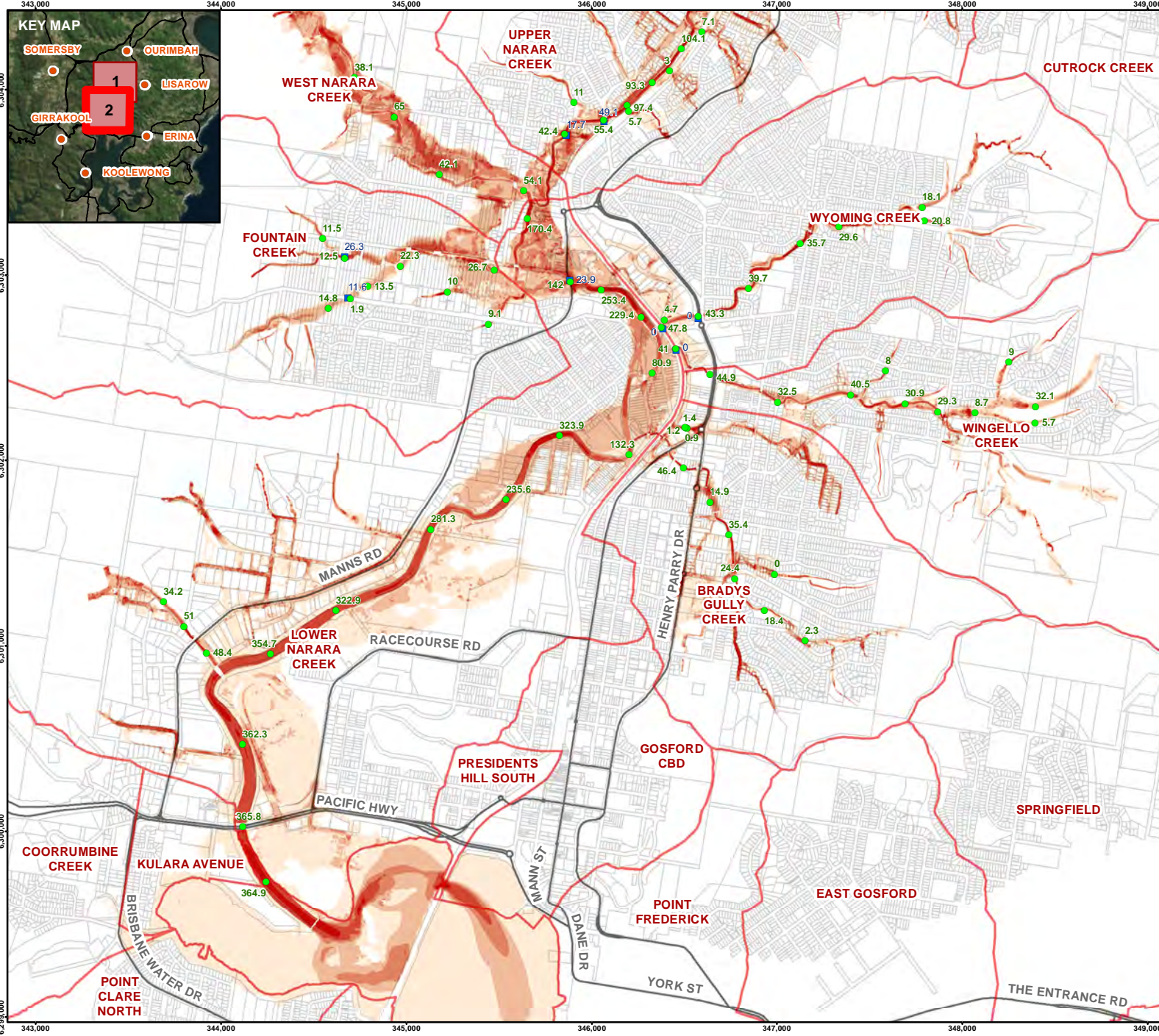
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	51A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44



**Legend**

- 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
- 1D Weir Flow (m<sup>3</sup>/s)
- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4 \text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

**Scale**

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**

CENTRAL COAST COUNCIL


**PROJECT**

NARARA CREEK FLOOD STUDY

**TITLE**

**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 1% AEP EVENT**

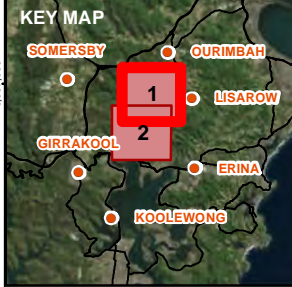
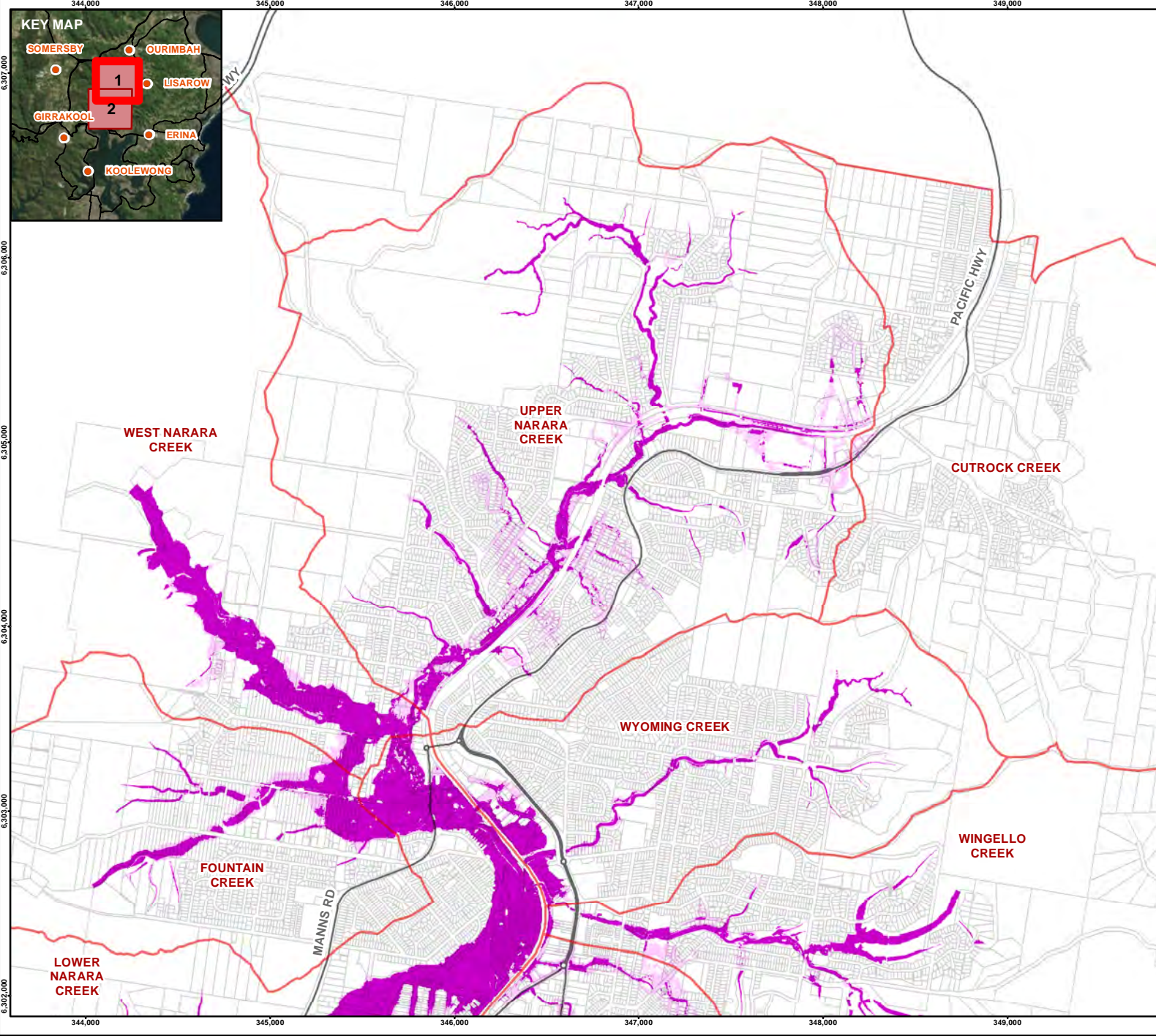
**CONSULTANT**



DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	51B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO 44



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Provisional Flood Hazard**

- Low Hazard
- High Hazard

**Scale and Orientation**

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**


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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL FLOOD HAZARD 1% AEP EVENT**

CONSULTANT



DD/MM/YYYY 3/04/2018

DESIGNED SL

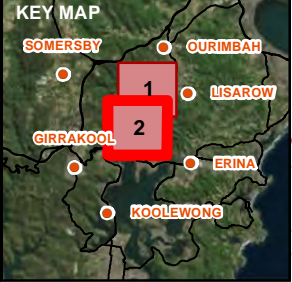
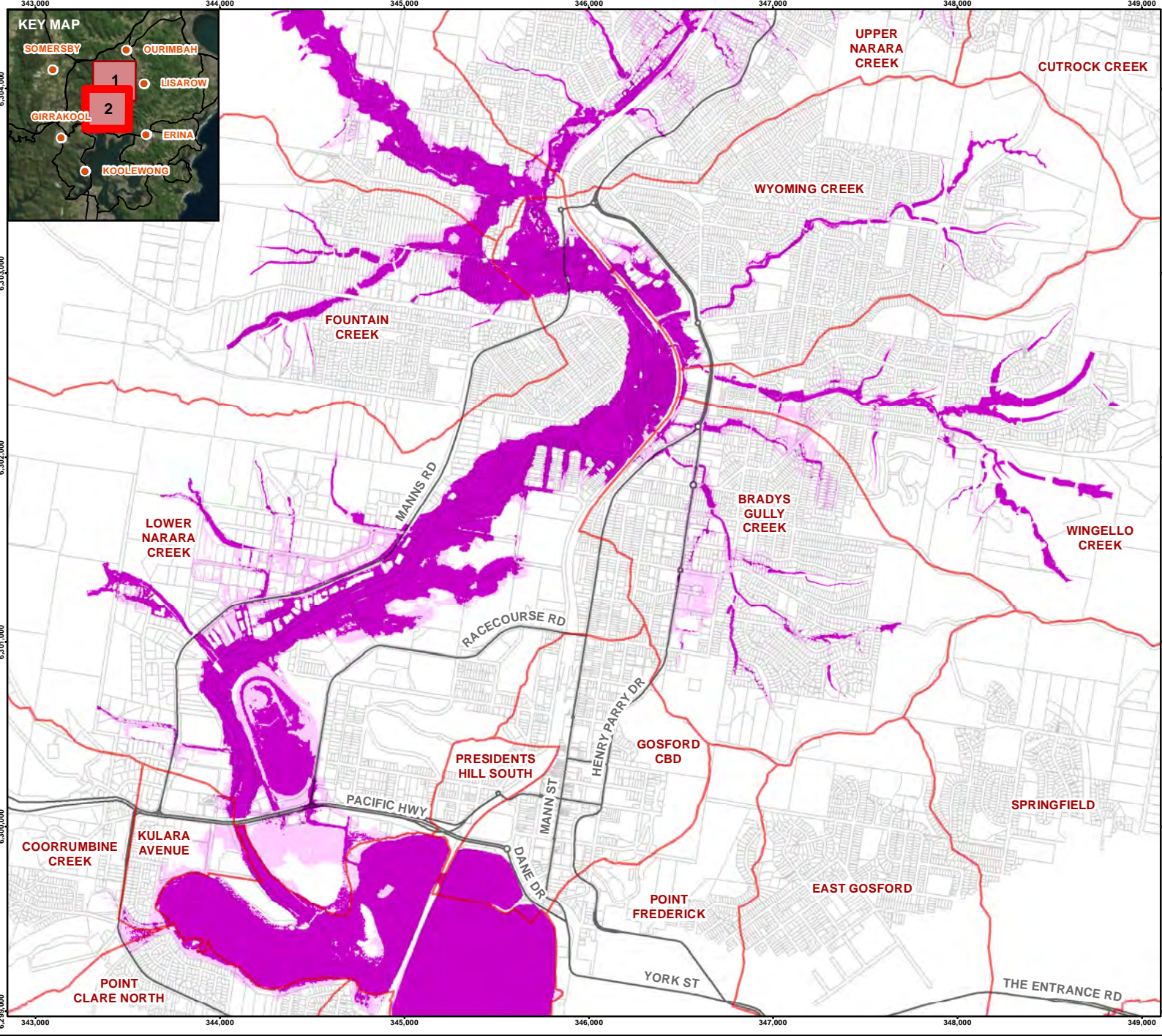
PREPARED HB

REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 52A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Provisional Flood Hazard**

- Low Hazard
- High Hazard

**Scale**

0 500 1,000 METRES

1:30,000 @A4

**Coordinate System:** GDA 1994 MGA Zone 56  
**Projection:** Transverse Mercator  
**Datum:** GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
 CENTRAL COAST COUNCIL

**PROJECT**  
 NARARA CREEK FLOOD STUDY

**TITLE**  
**PROVISIONAL FLOOD HAZARD 1% AEP EVENT**

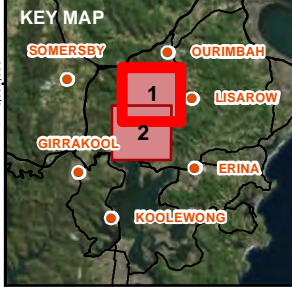
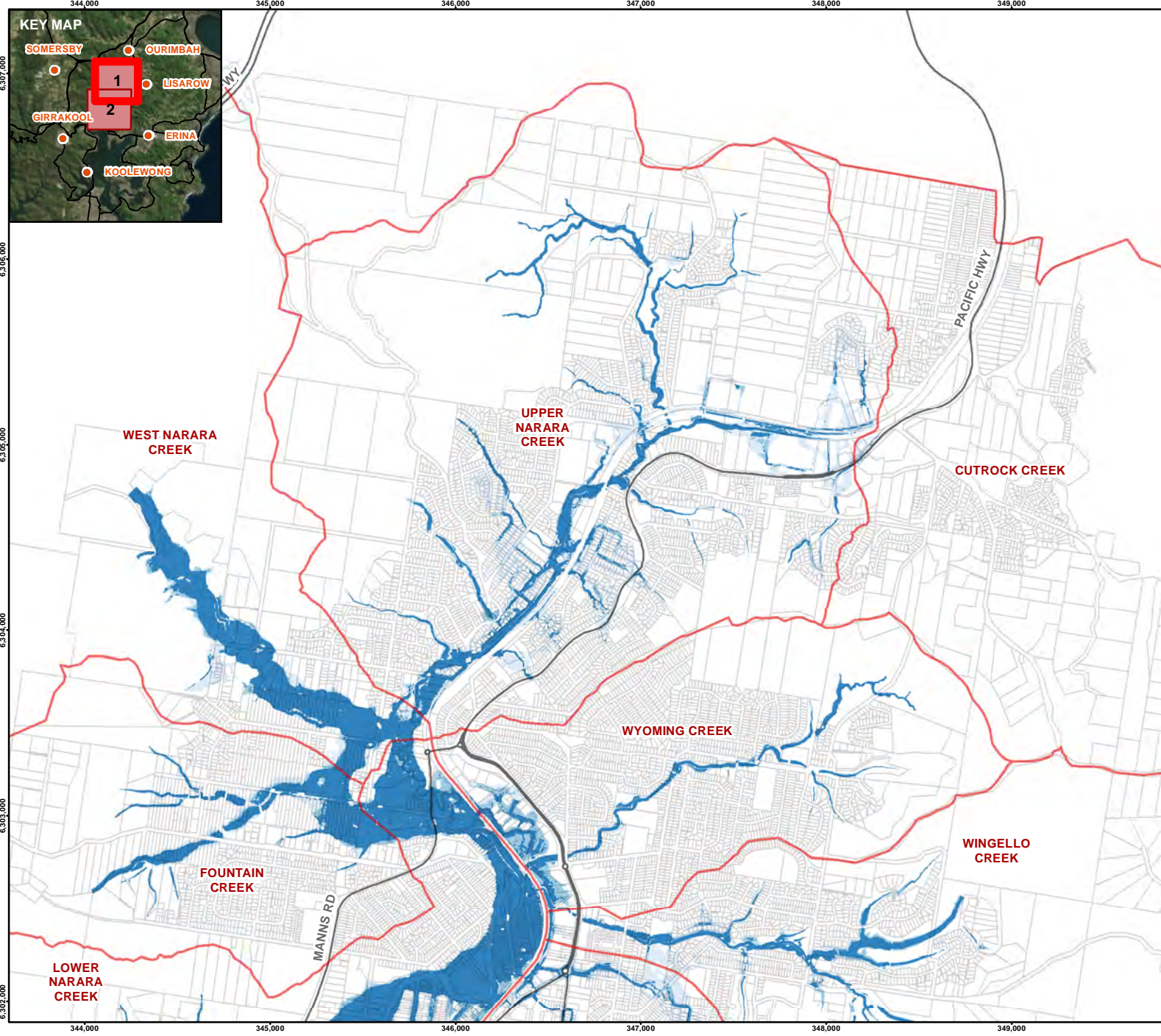
**CONSULTANT**



DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

<b>PROJECT NO.</b>	<b>CONTROL</b>	<b>REV.</b>	<b>FIGURE</b>
097626068	006	G	52B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Hydraulic Categories**

- ▭ Flood Fringe
- ▭ Flood Storage
- ▭ Floodway



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

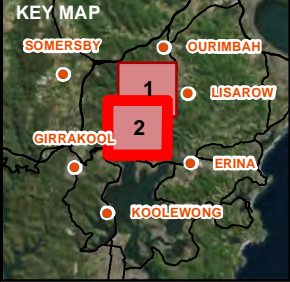
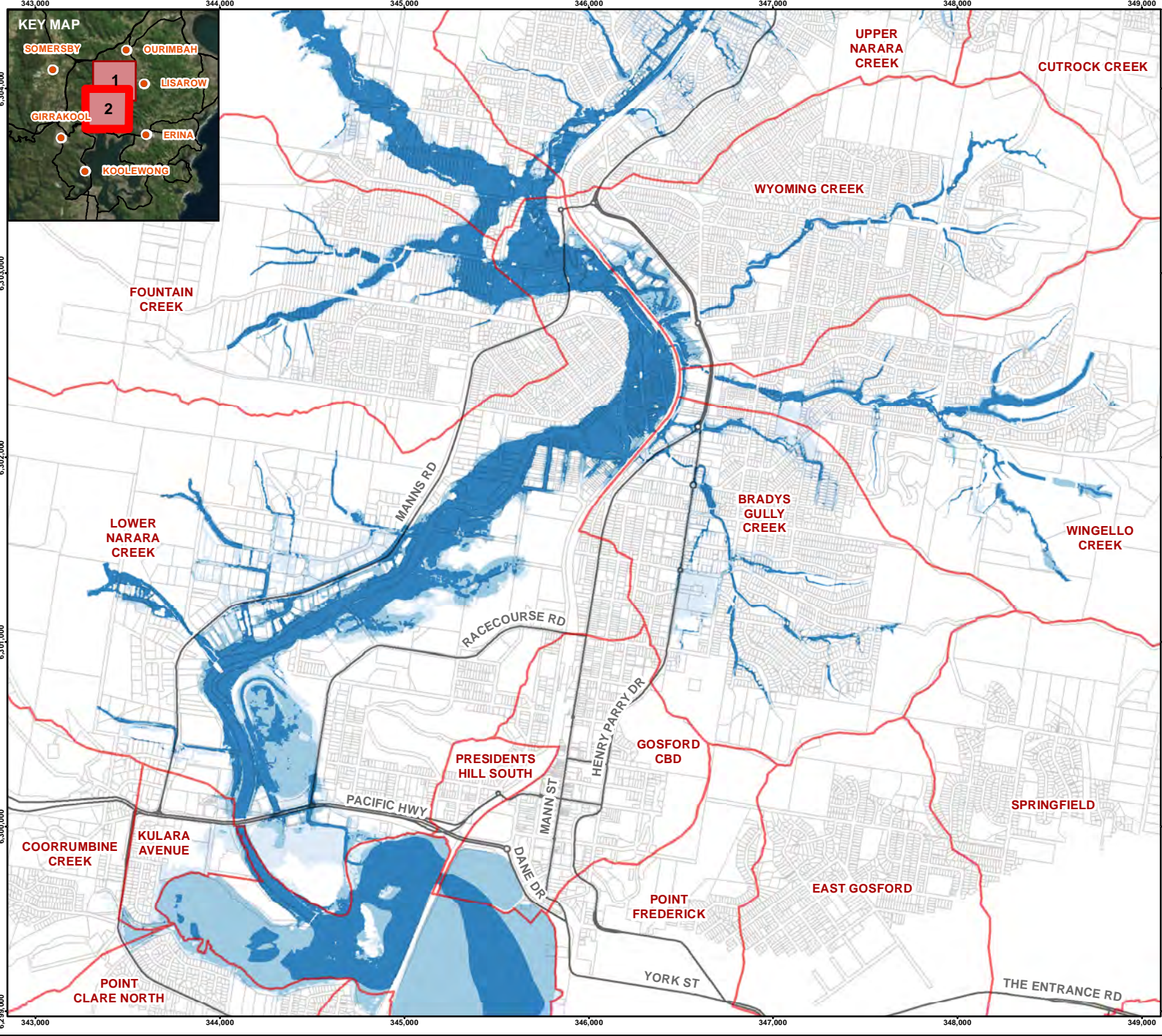
TITLE  
**HYDRAULIC CATEGORIES 1% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **53A**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm

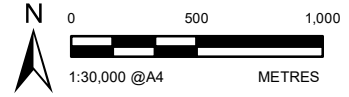


**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Hydraulic Categories**

- ▭ Flood Fringe
- ▭ Flood Storage
- ▭ Floodway



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC CATEGORIES 1% AEP EVENT**

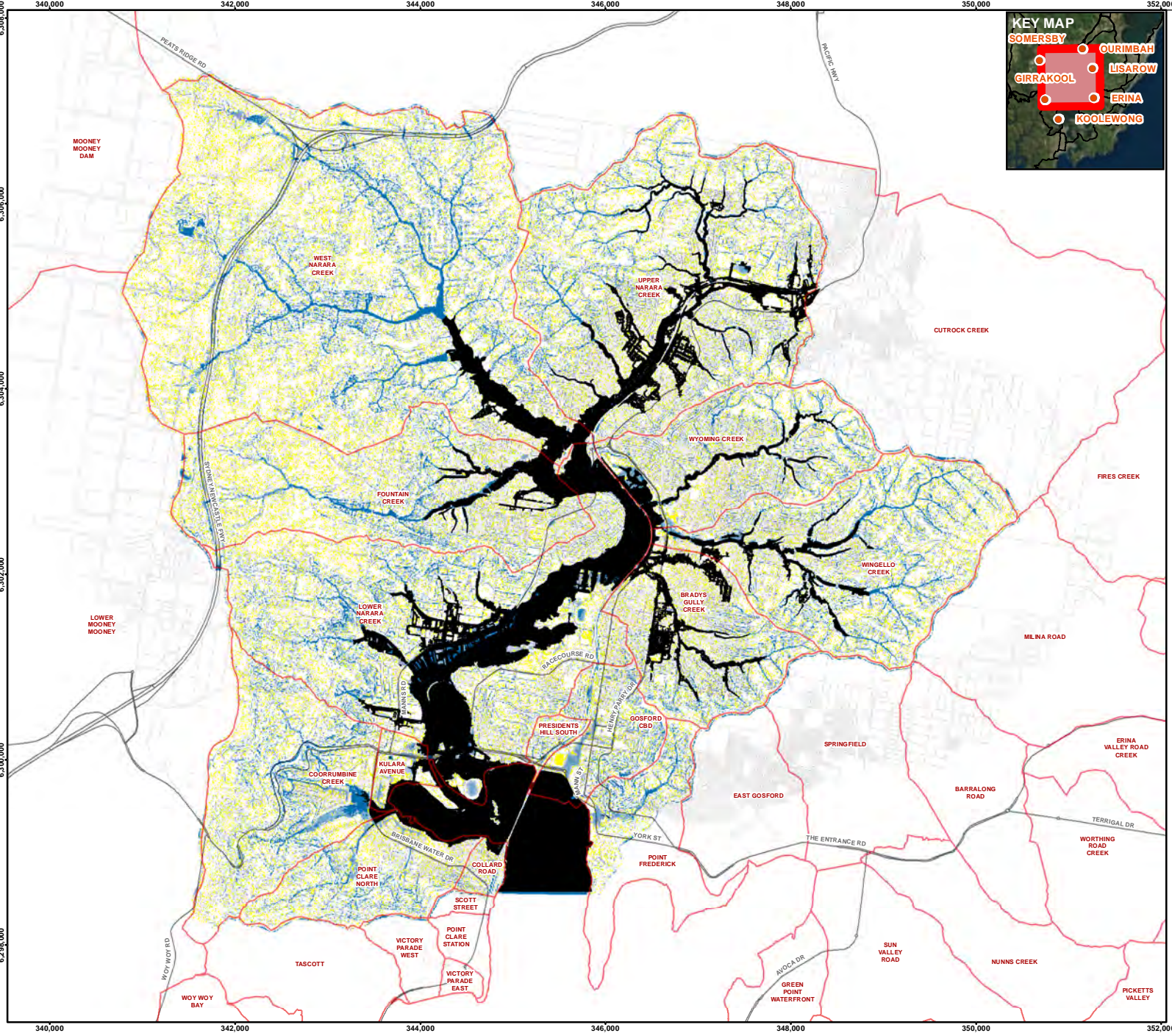
CONSULTANT



DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	53B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO 44



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

	< 10 cm
	10 to 20 cm
	20 to 40 cm
	40 cm to 1 m
	> 1 m

**N**

0 1,000 2,000 METRES  
1:60,000 @A4  
Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
**CENTRAL COAST COUNCIL**

**PROJECT**  
**NARARA CREEK FLOOD STUDY**

**TITLE**  
**PEAK FLOOD DEPTH RAINFALL ON GRID 1% AEP EVENT**

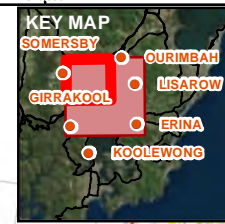
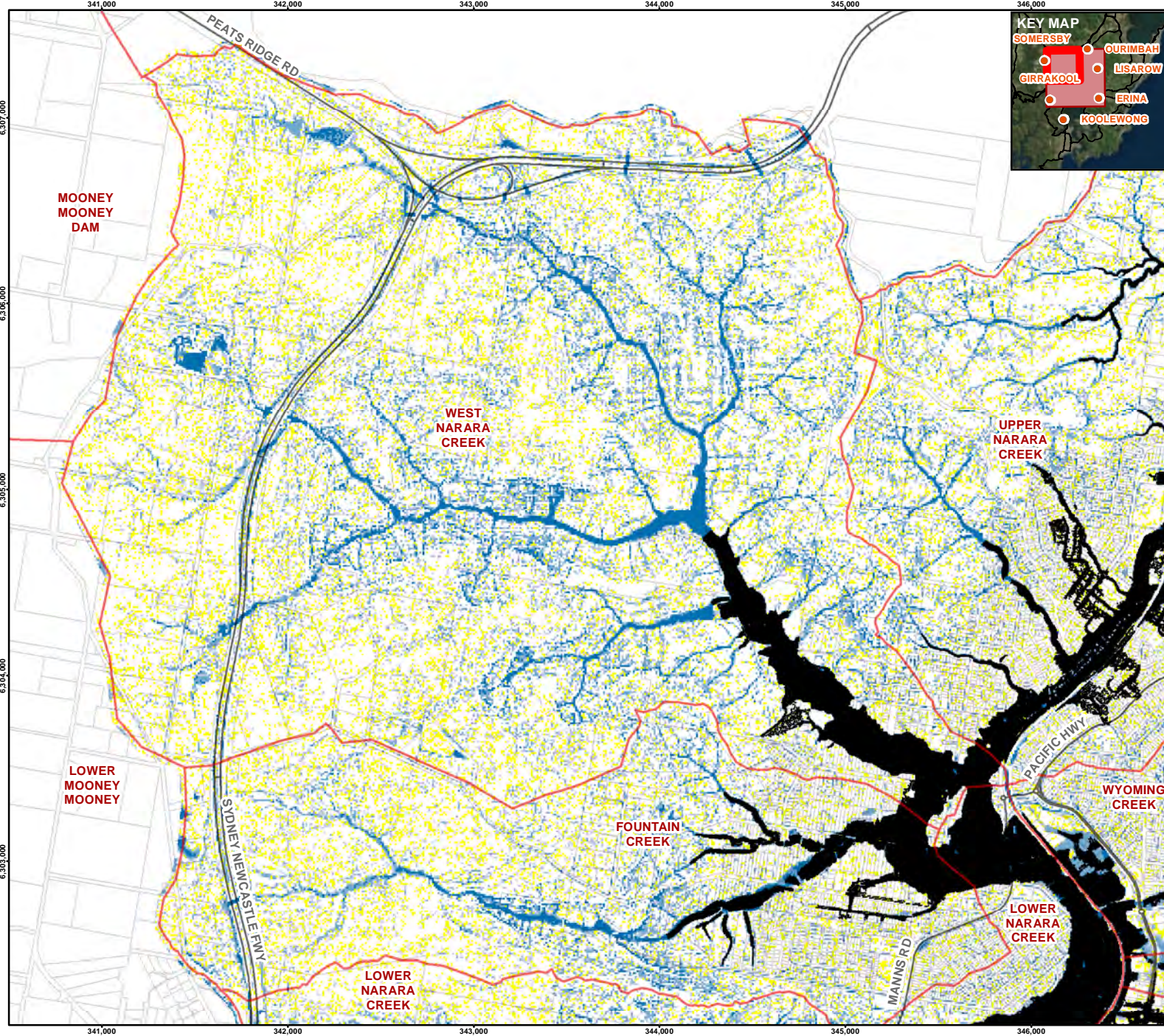
**CONSULTANT**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

<b>PROJECT NO.</b> 097626068	<b>CONTROL</b> 006	<b>REV.</b> G	<b>FIGURE</b> 54A
---------------------------------	-----------------------	------------------	----------------------

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44

25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH RAINFALL ON GRID 1% AEP EVENT**

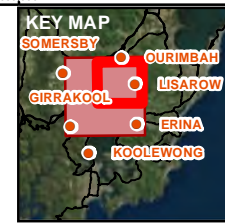
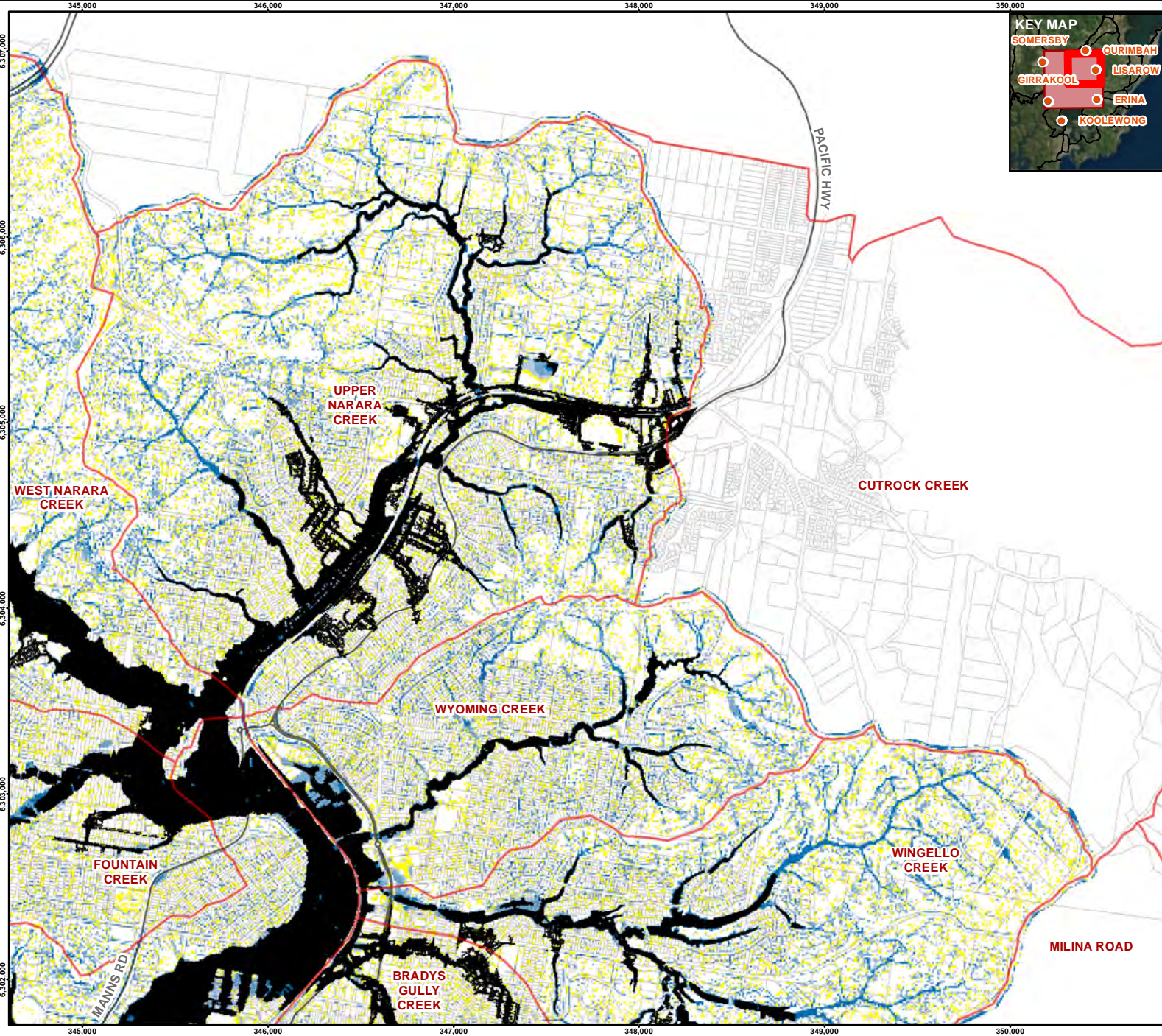
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 54B
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44 25mm





**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

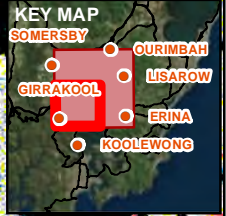
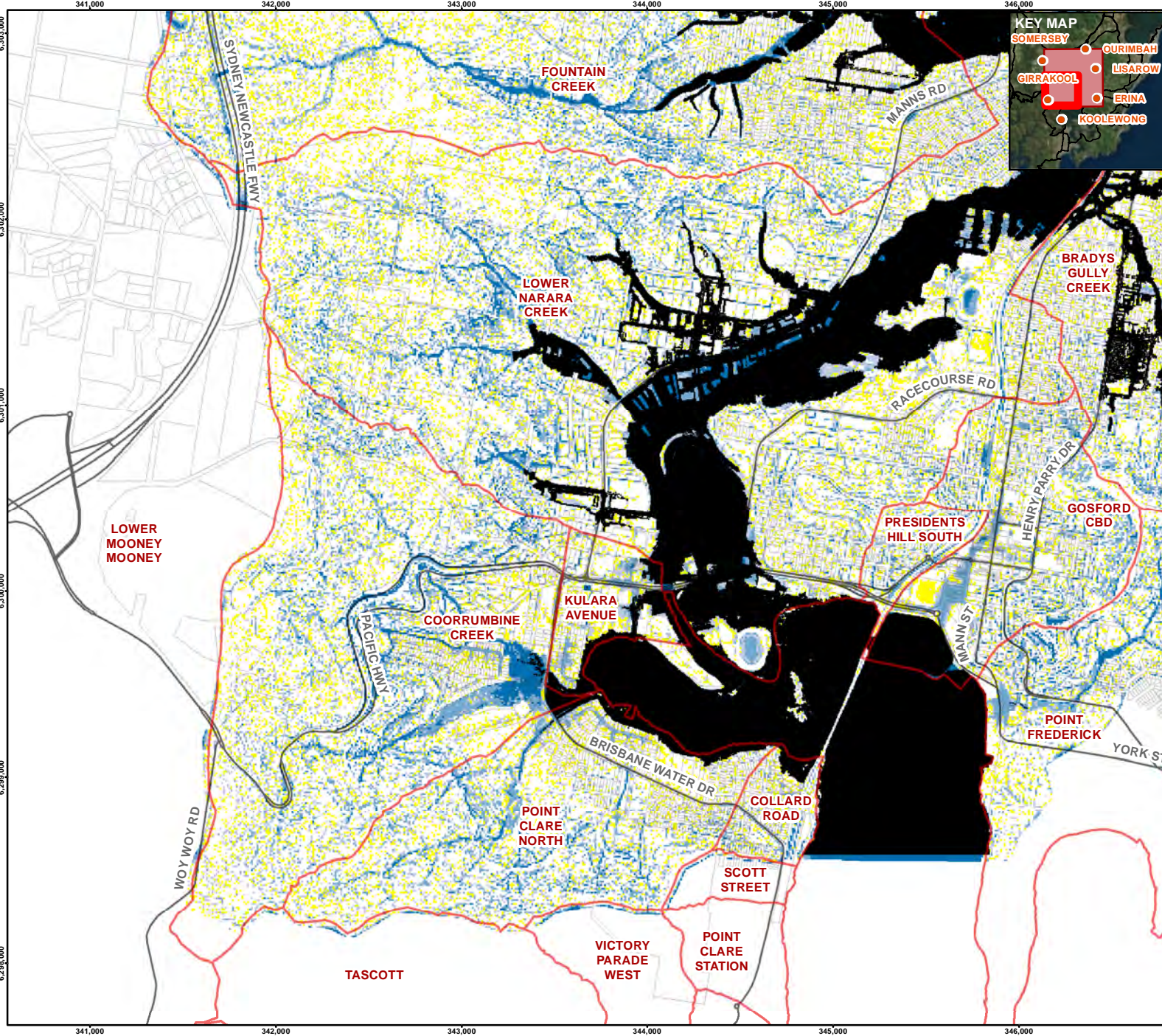
TITLE  
**PEAK FLOOD DEPTH RAINFALL ON GRID 1% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. <b>097626068</b>	CONTROL <b>006</b>	REV. <b>G</b>	FIGURE <b>54C</b>
---------------------------------	-----------------------	------------------	----------------------

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

	< 10 cm
	10 to 20 cm
	20 to 40 cm
	40 cm to 1 m
	> 1 m

**Scale**  
 0 500 1,000 METRES  
 1:30,000 @A4  
 Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994


**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
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 Result filtered for flood depths less than 10 cm

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
 CENTRAL COAST COUNCIL

**PROJECT**  
 NARARA CREEK FLOOD STUDY

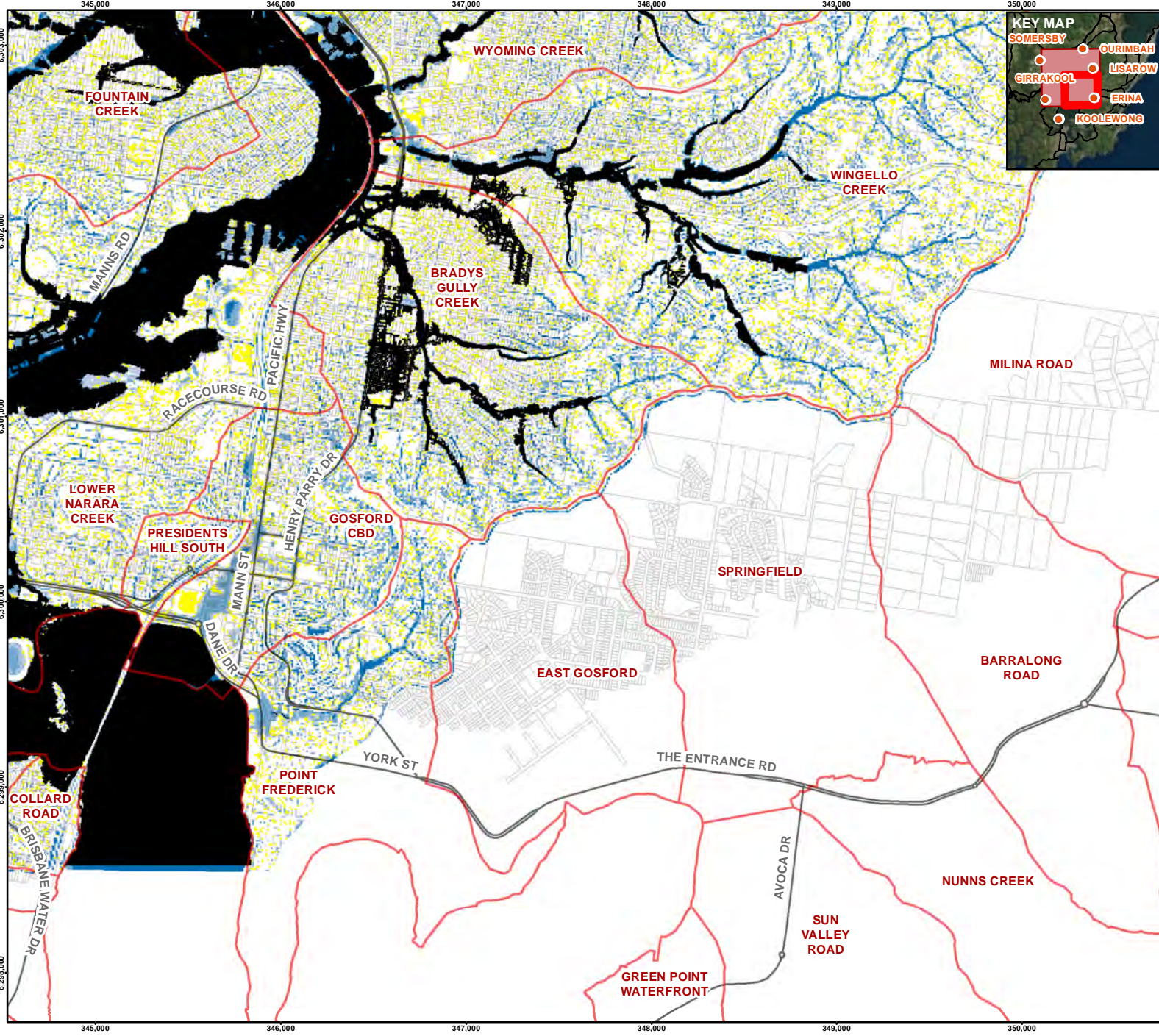
**TITLE**  
 PEAK FLOOD DEPTH  
 RAINFALL ON GRID 1% AEP EVENT

**CONSULTANT**  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

<b>PROJECT NO.</b> 097626068	<b>CONTROL</b> 006	<b>REV.</b> G	<b>FIGURE</b> 54D
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**N**

1:30,000 @A4 METRES  
 Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
 CENTRAL COAST COUNCIL

**PROJECT**  
 NARARA CREEK FLOOD STUDY

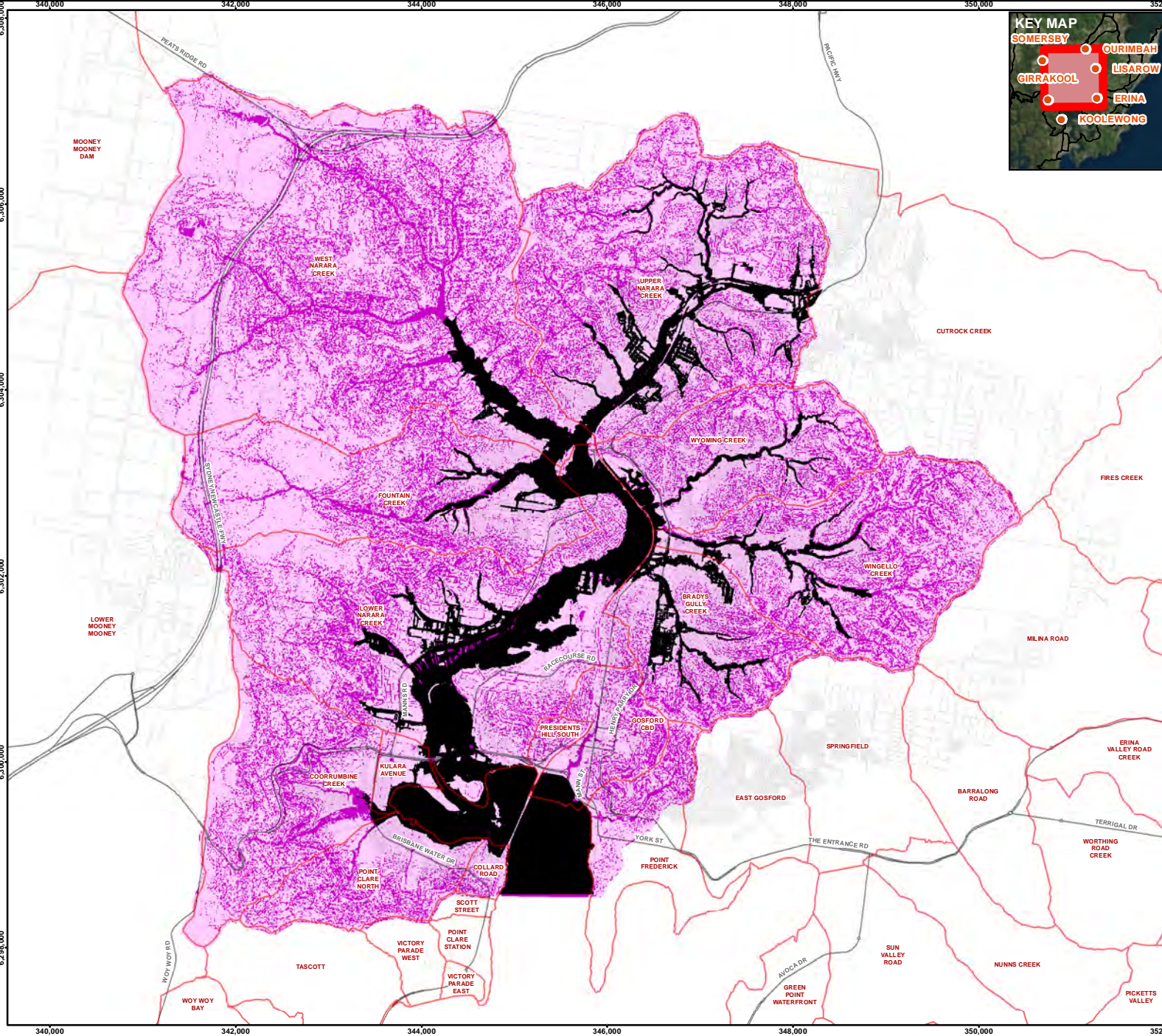
**TITLE**  
 PEAK FLOOD DEPTH  
 RAINFALL ON GRID 1% AEP EVENT

**CONSULTANT**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	54E

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)  
Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:60,000 @A4 METRES  
 Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

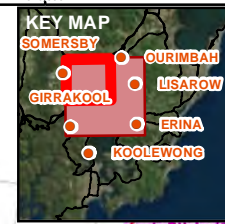
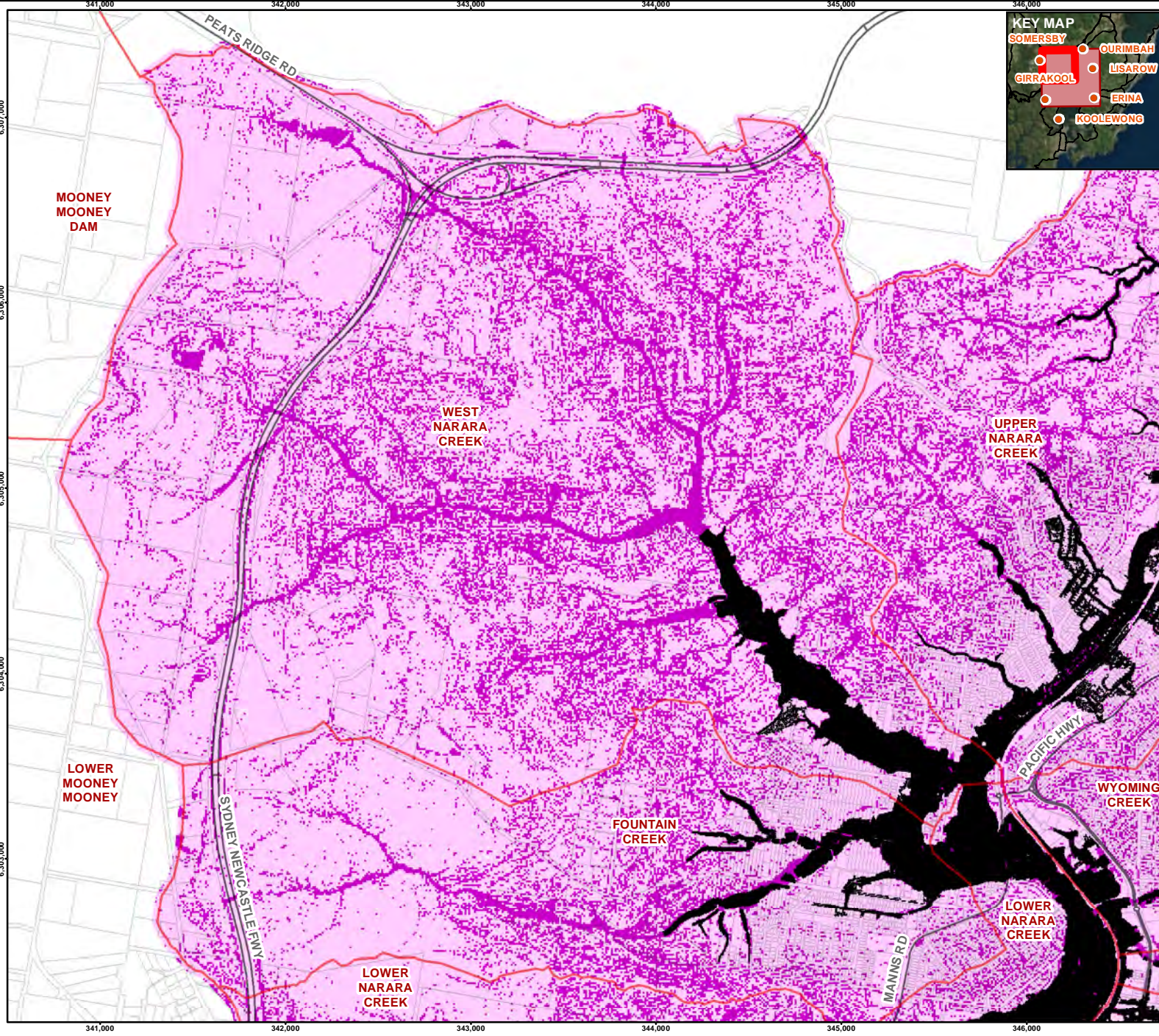
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID 1% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)  
Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES  
 Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastra, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID 1% AEP EVENT**

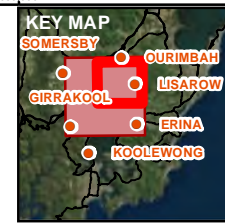
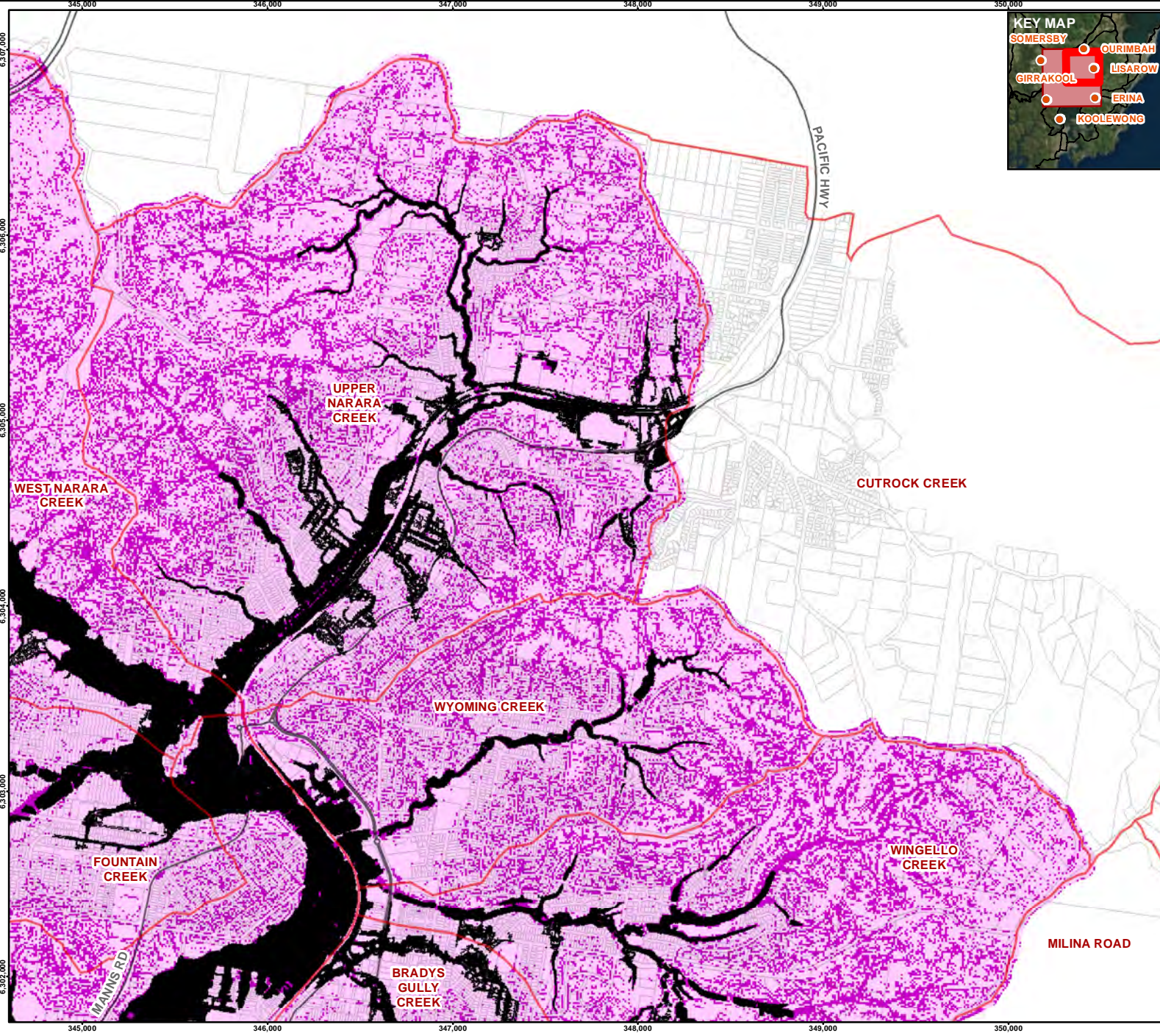
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 55B
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

25mm



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)  
Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N  
0 500 1,000  
1:30,000 @A4 METRES  
Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**


**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID 1% AEP EVENT**

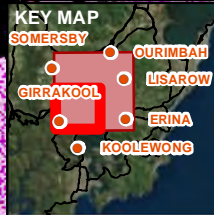
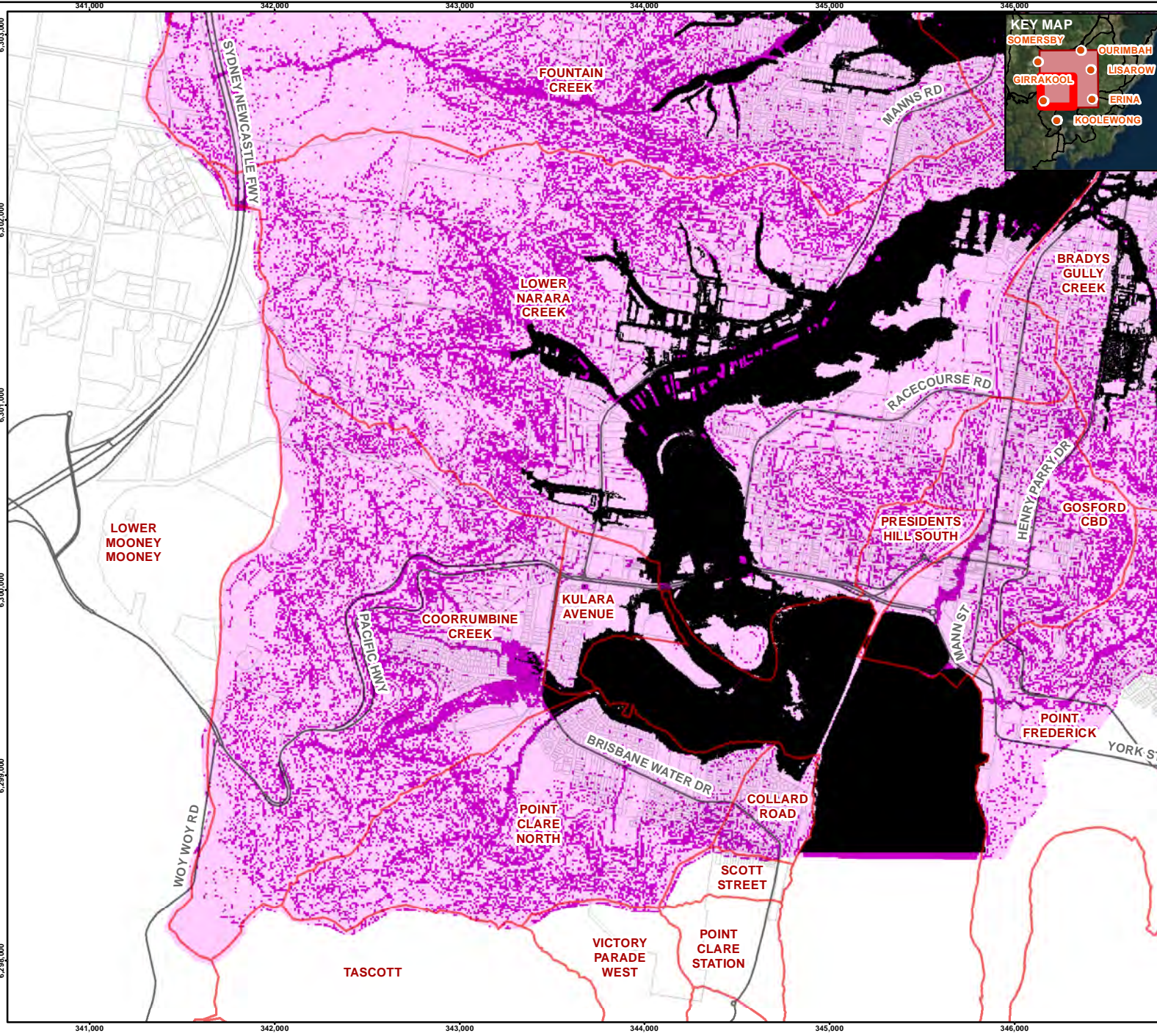
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 55C
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44 25mm



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)  
Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES  
 Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
 CENTRAL COAST COUNCIL

**PROJECT**  
 NARARA CREEK FLOOD STUDY

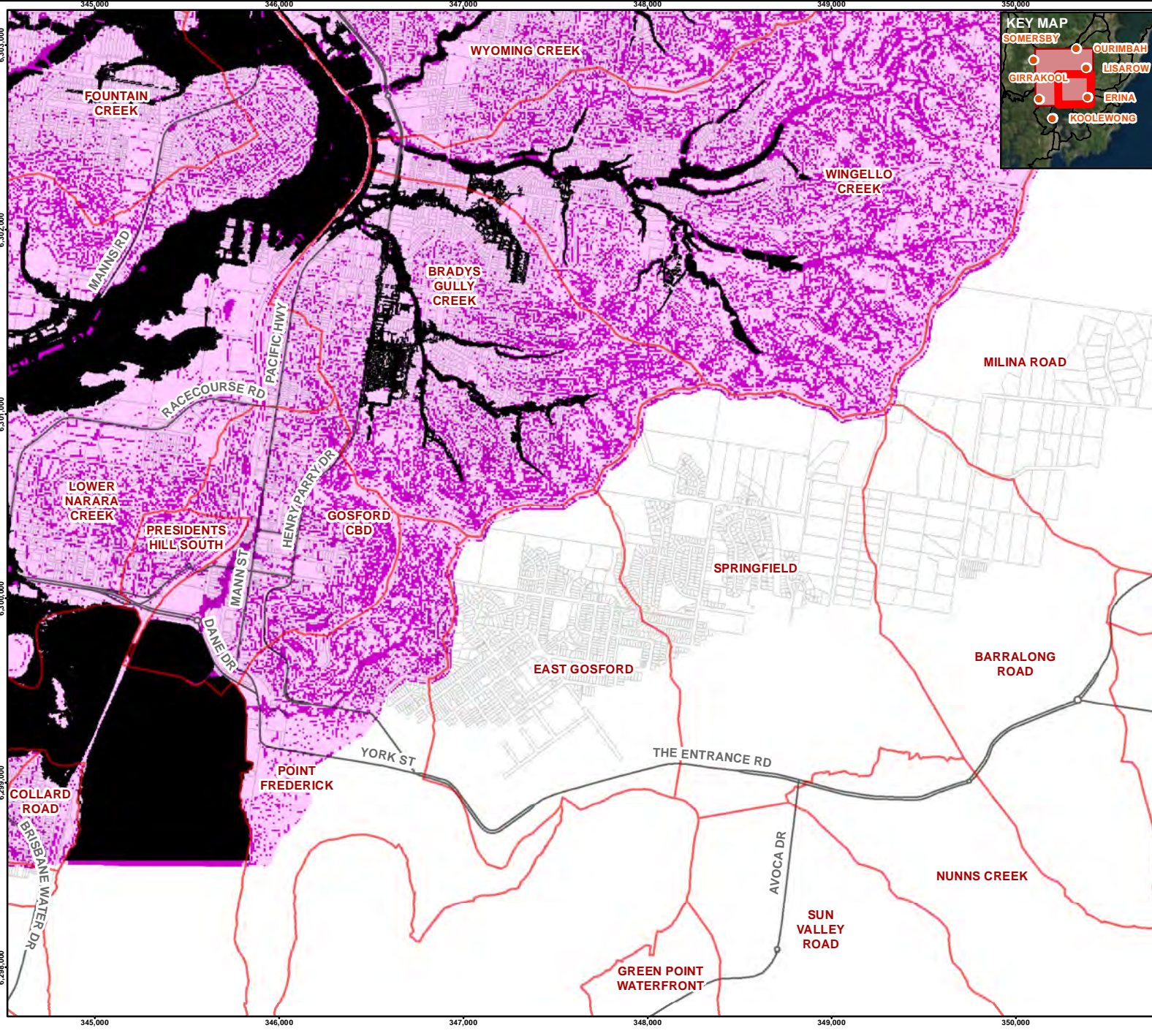
**TITLE**  
 PROVISIONAL HAZARD - RAINFALL ON GRID 1% AEP EVENT

**CONSULTANT**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 55D
--------------------------	----------------	-----------	---------------

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)  
Provisional Flood Hazard**

- Low Hazard
- High Hazard

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**


**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastra, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID 1% AEP EVENT**

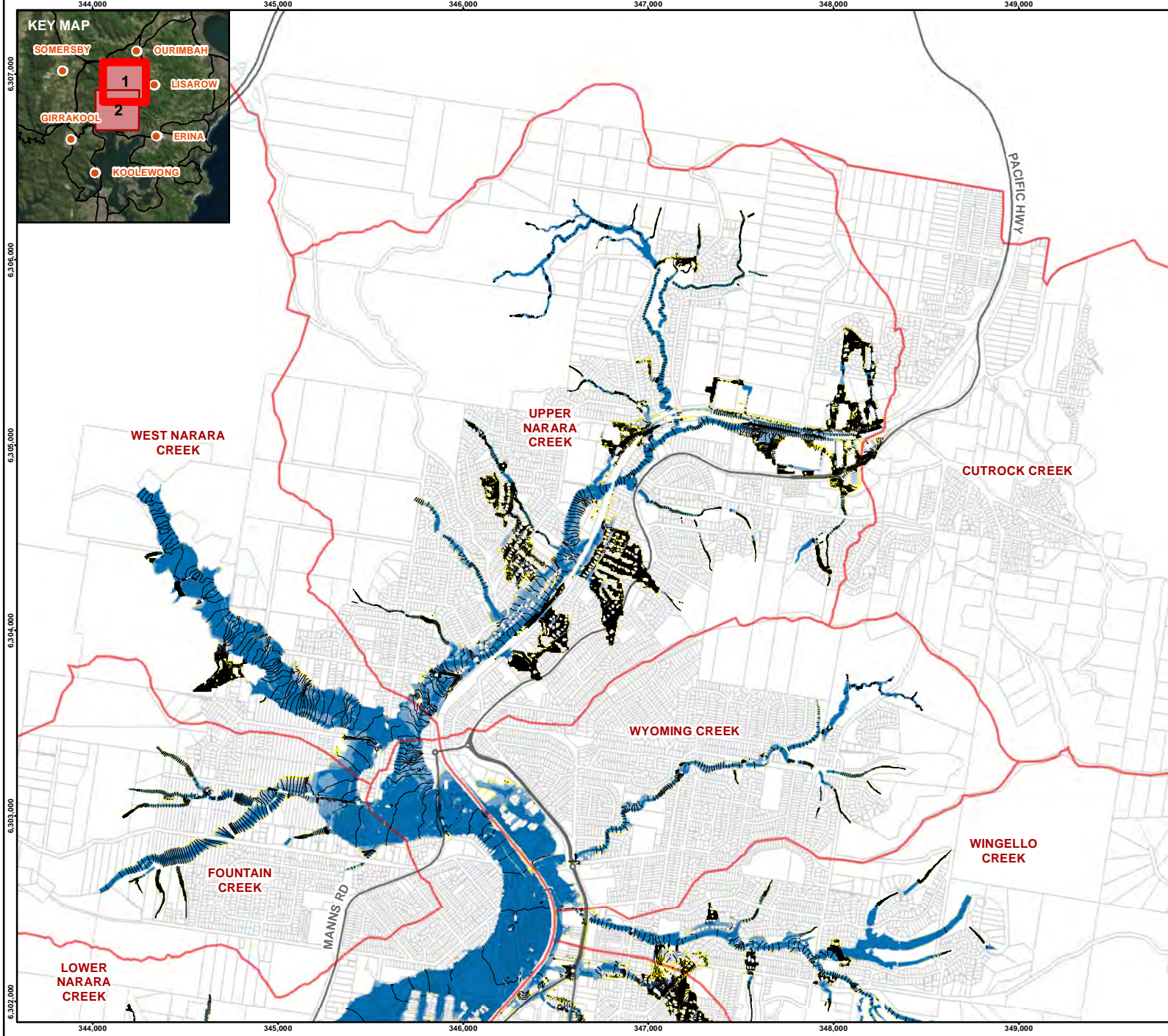
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG 44





**Legend**

- Localities
- Main Roads
- 0.1m Contour
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

0.1m Contour

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

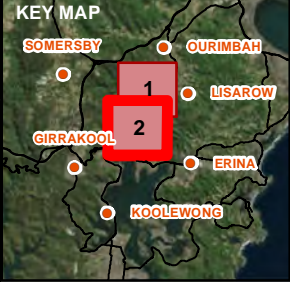
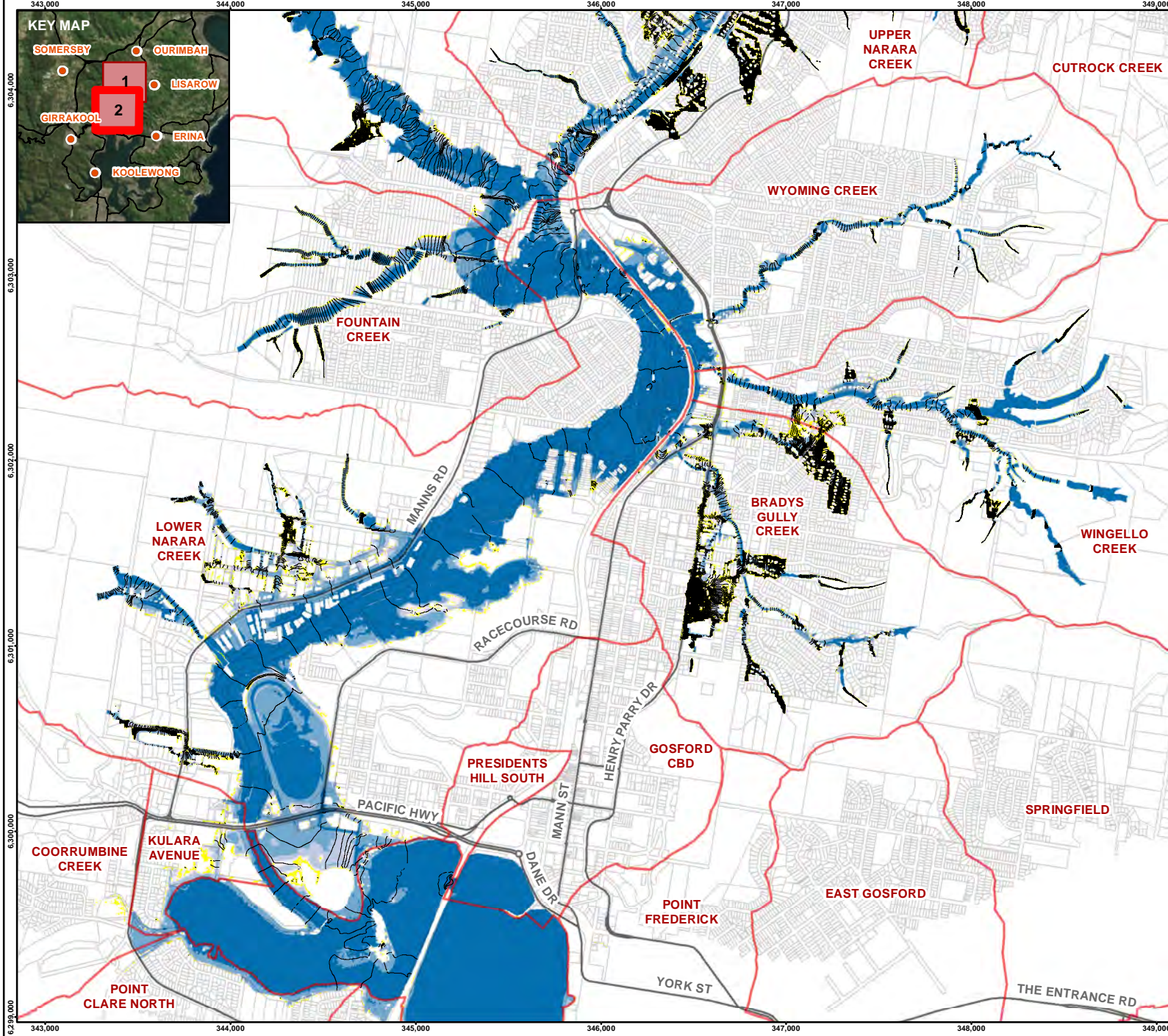
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 0.5% AEP EVENT**

CONSULTANT  
**Golder Associates**

DD/MM/YYYY	2018/03/09
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 56A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- 0.1m Contour
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Depth (cm)**

Yellow	< 10 cm
Light Blue	10 to 20 cm
Medium Blue	20 to 40 cm
Dark Blue	40 cm to 1 m
Very Dark Blue	> 1 m

N  
0 500 1,000  
METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 0.5% AEP EVENT**

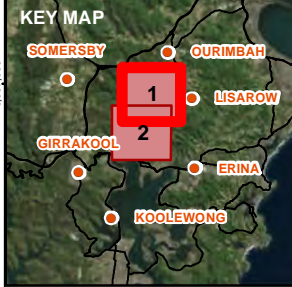
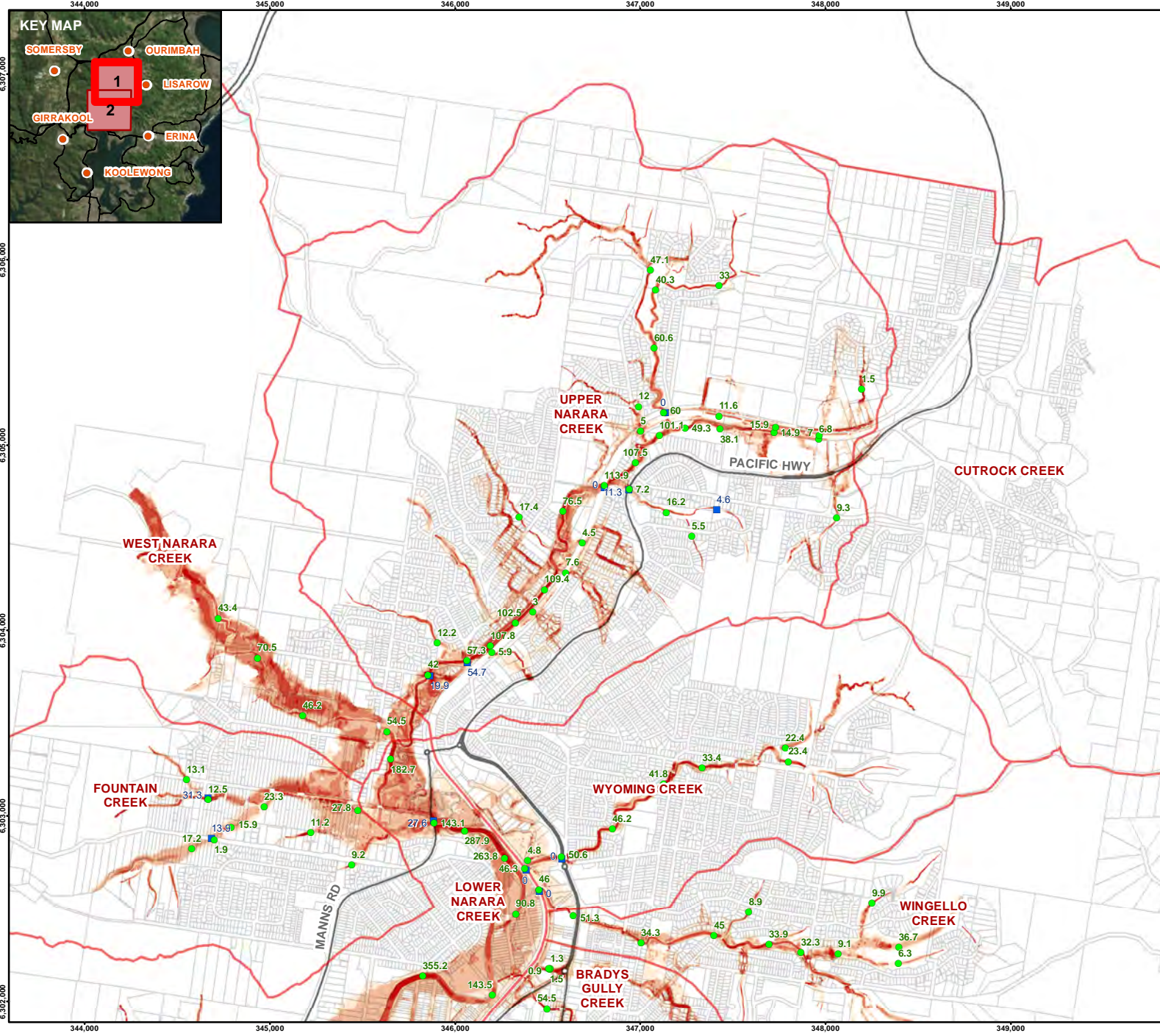
CONSULTANT

DD-MM-YYYY	2018/03/09
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	56B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

25mm



**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m3/s)
- 1D Weir Flow (m3/s)
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4\text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

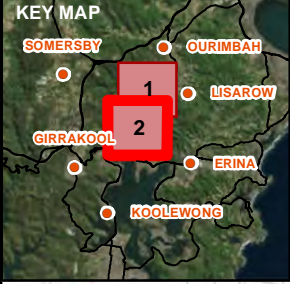
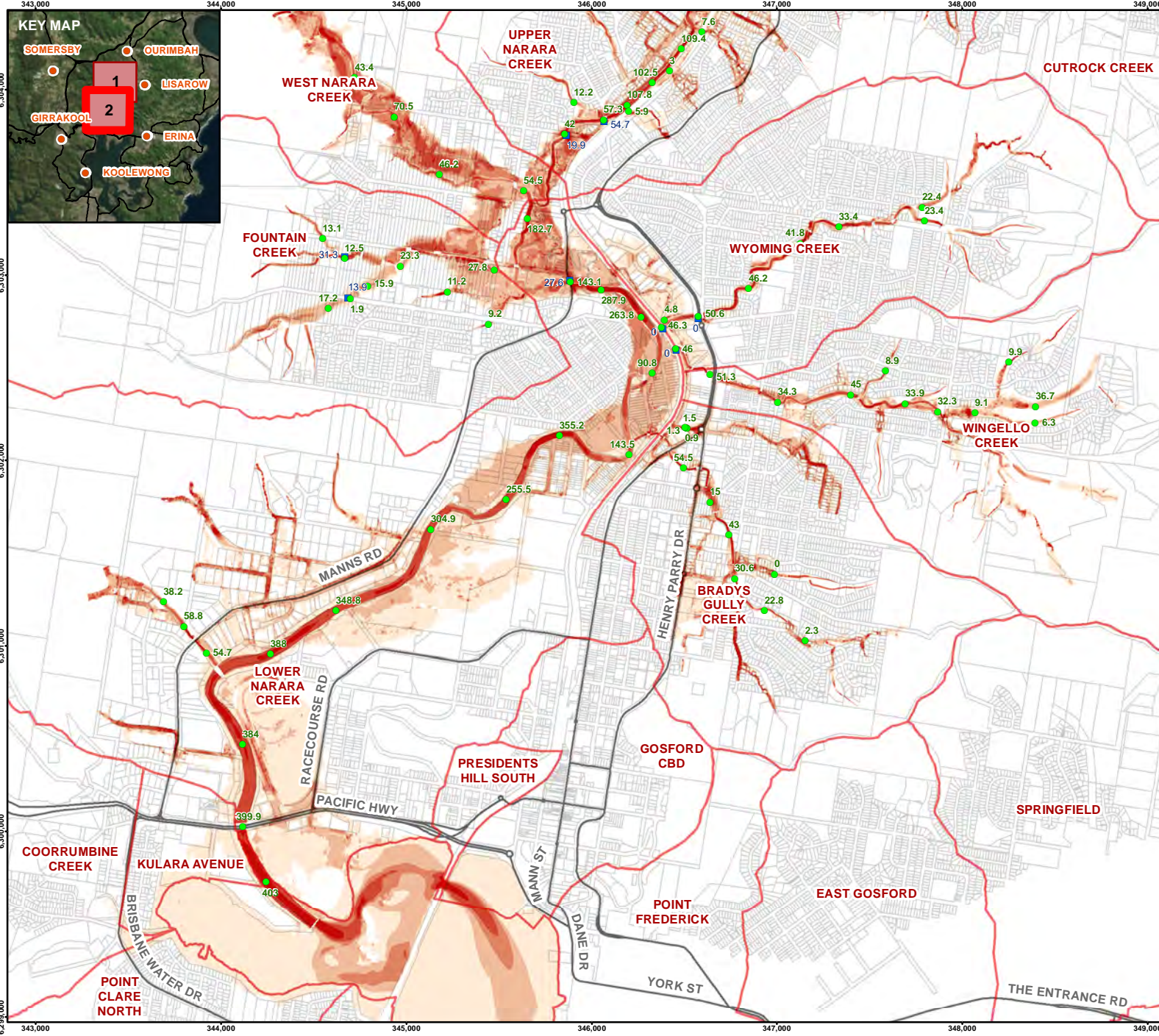
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 0.5% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	57A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
- 1D Weir Flow (m<sup>3</sup>/s)
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4\text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

**Scale**

0 500 1000 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 0.5% AEP EVENT**

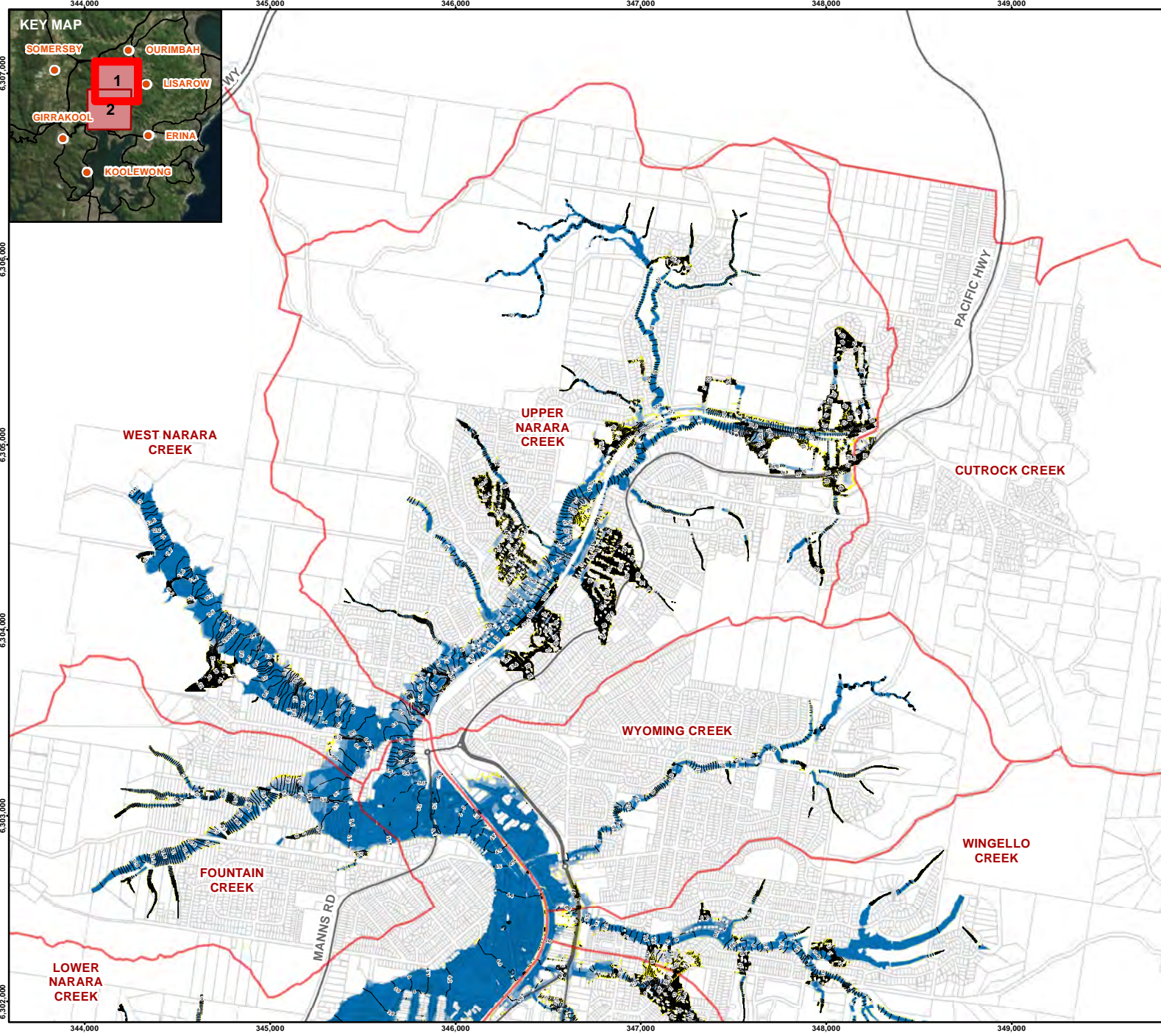
CONSULTANT



DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	57B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO 44



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- 0.1 m Contours

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

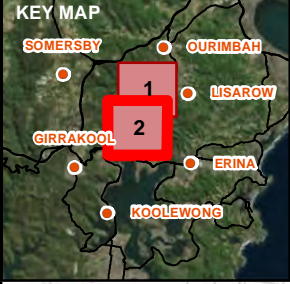
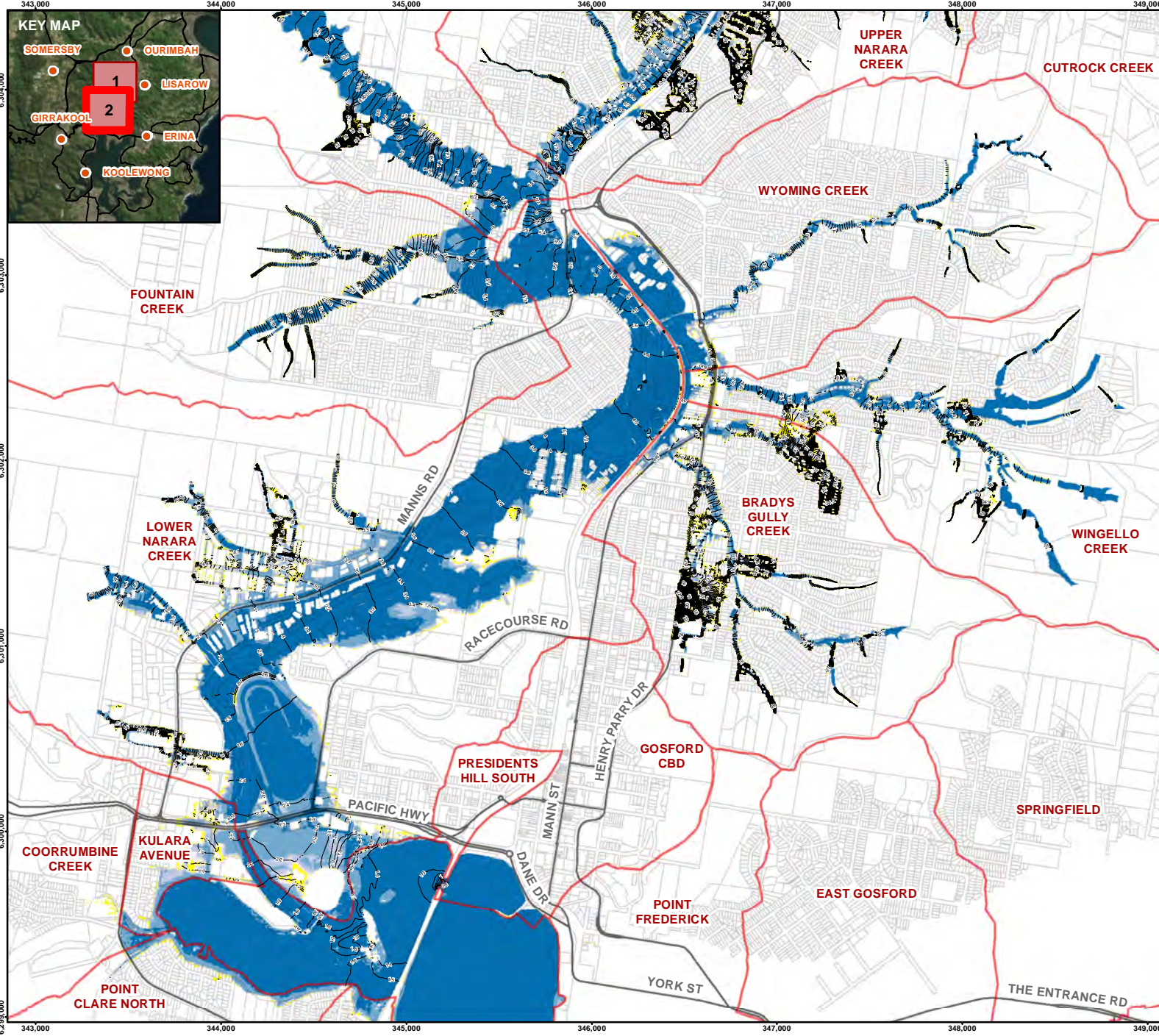
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 0.2% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 58A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- Yellow: < 10 cm
- Light Blue: 10 to 20 cm
- Medium Blue: 20 to 40 cm
- Dark Blue: 40 cm to 1 m
- Very Dark Blue: > 1 m

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

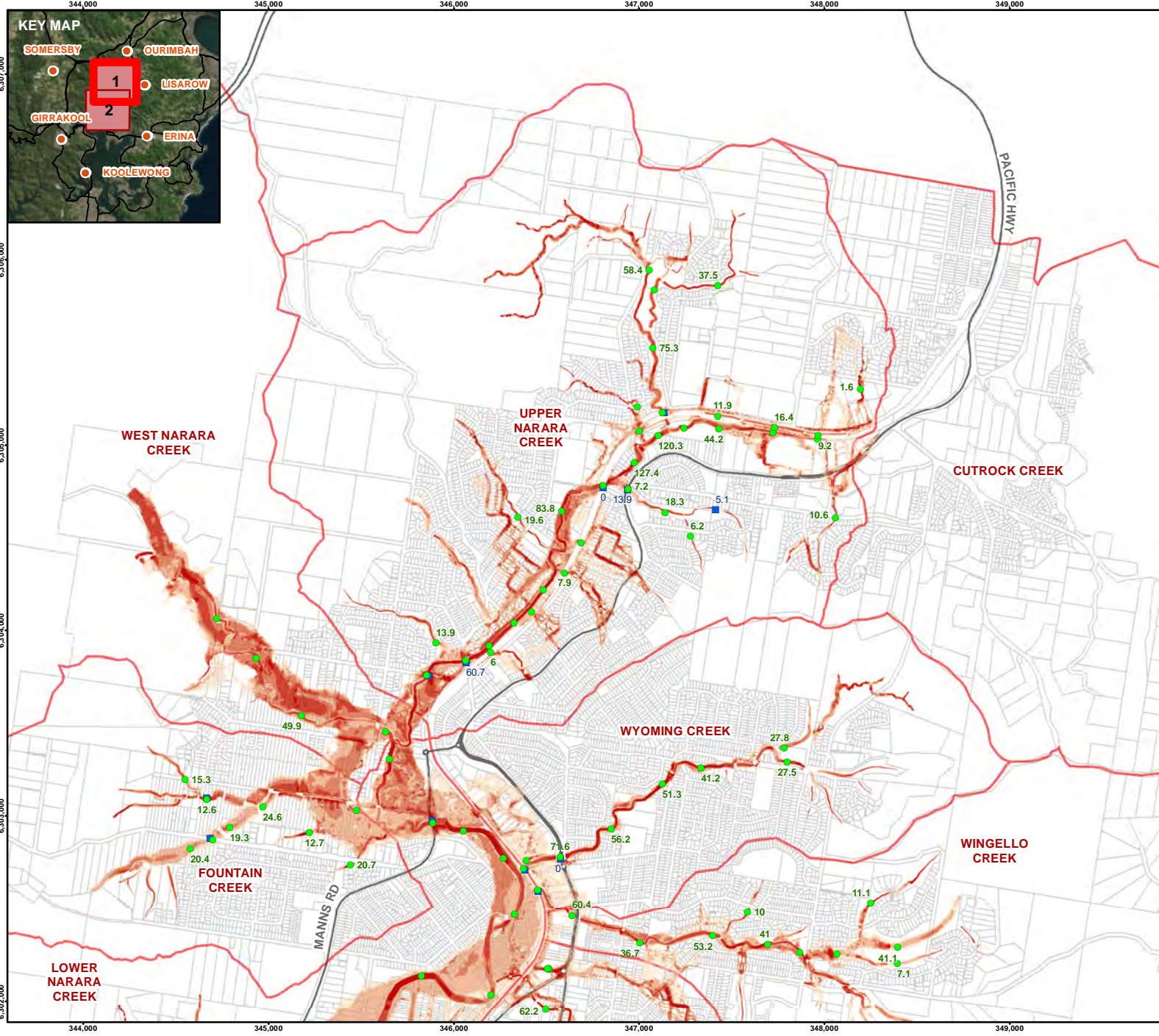
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT 0.2% AEP EVENT**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	58B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
- 1D Weir Flow (m<sup>3</sup>/s)
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Flood Velocity (m/s)**

- < 0.4 m/s
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

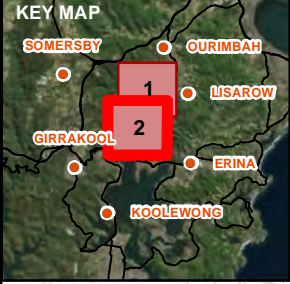
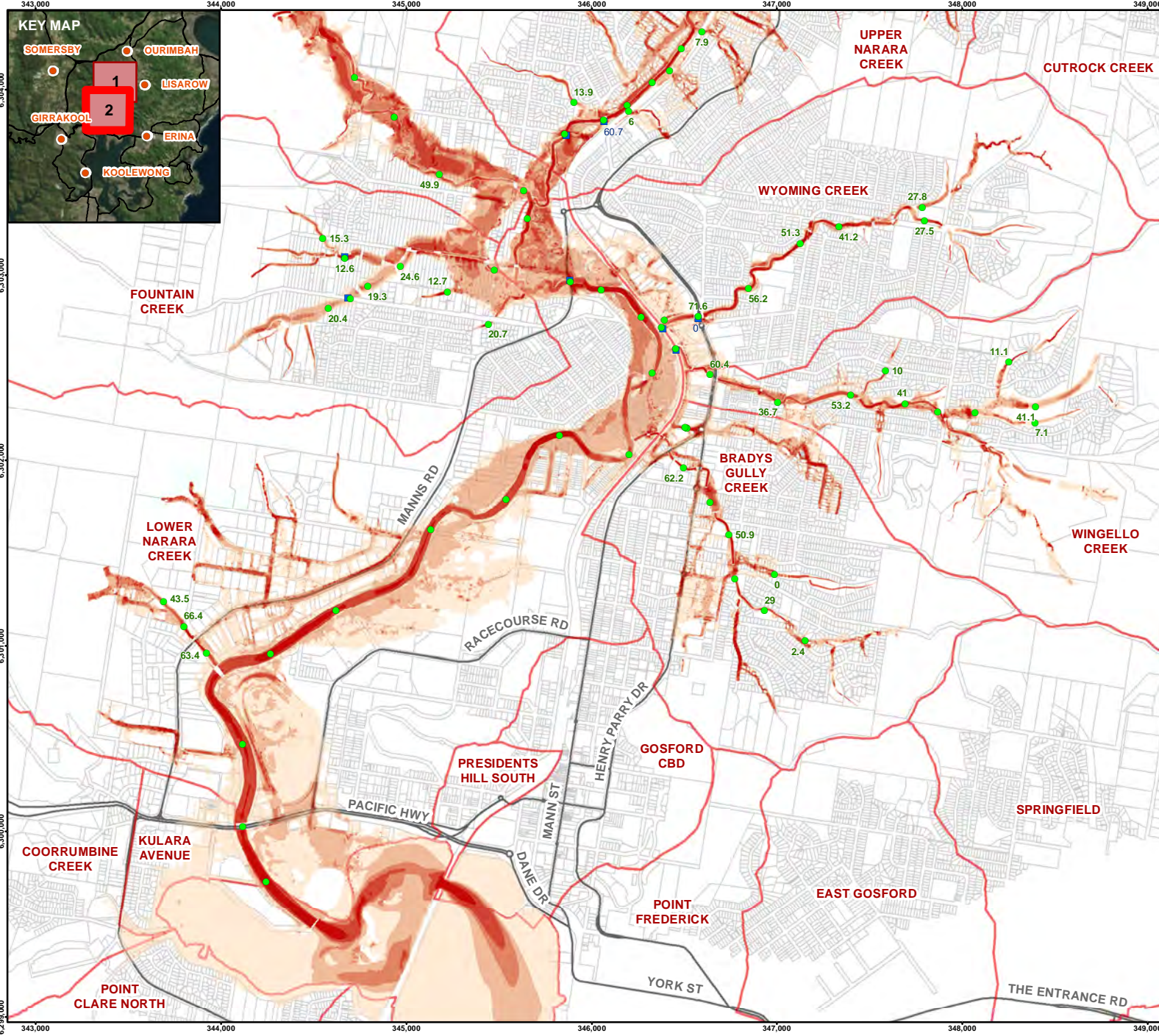
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 0.2% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

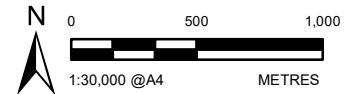
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	59A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
  - 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
  - 1D Weir Flow (m<sup>3</sup>/s)
  - Main Roads
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary
- | Flood Velocity (m/s) |                |
|----------------------|----------------|
|                      | < 0.4 m/s      |
|                      | 0.4 to 0.8 m/s |
|                      | 0.8 to 1.2 m/s |
|                      | 1.2 to 2 m/s   |
|                      | > 2 m/s        |



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**

CENTRAL COAST COUNCIL

**PROJECT**

NARARA CREEK FLOOD STUDY

**TITLE**

**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION 0.2% AEP EVENT**

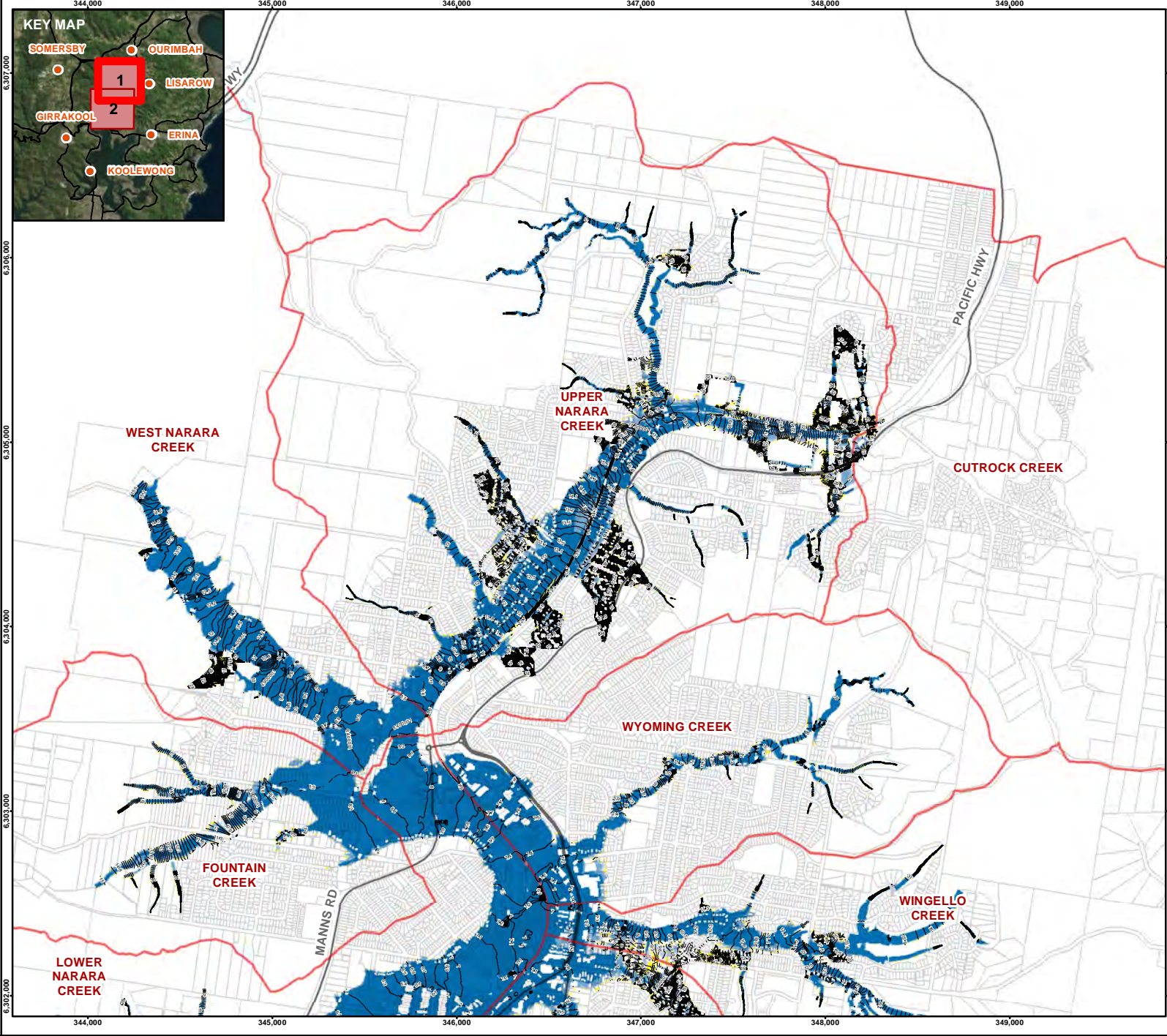
**CONSULTANT**



DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	59B





**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Flood Height (mAHD)**

- 0.1 m Contours

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

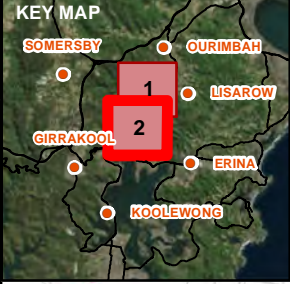
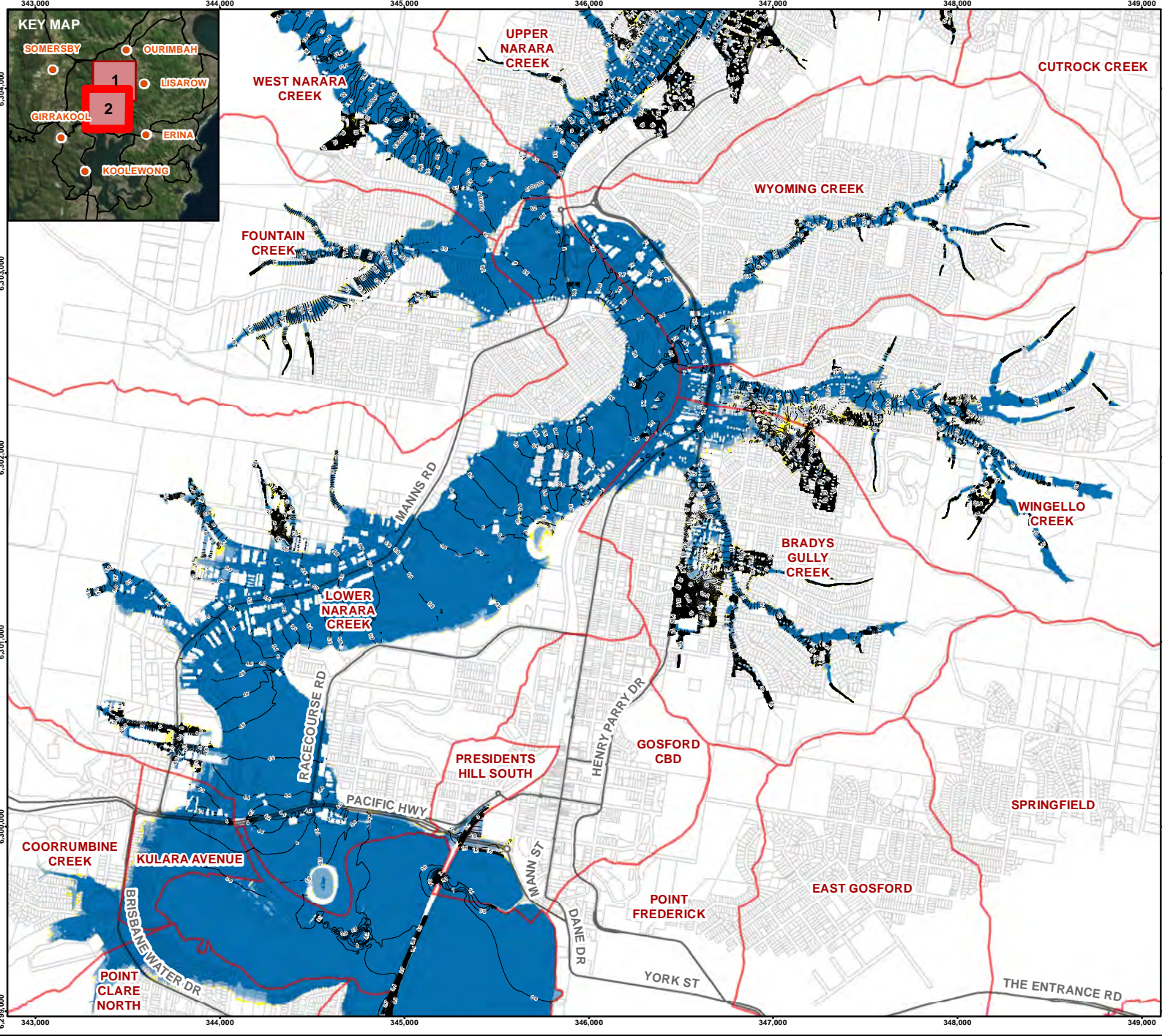
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT PMF EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	60A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm

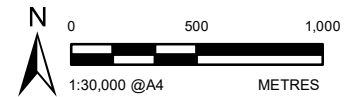


**Legend**

- Localities
- Main Roads
- 0.1 m Contours
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

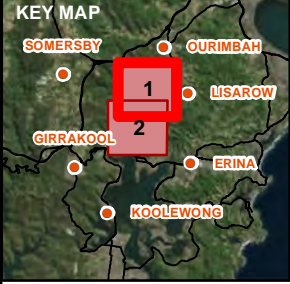
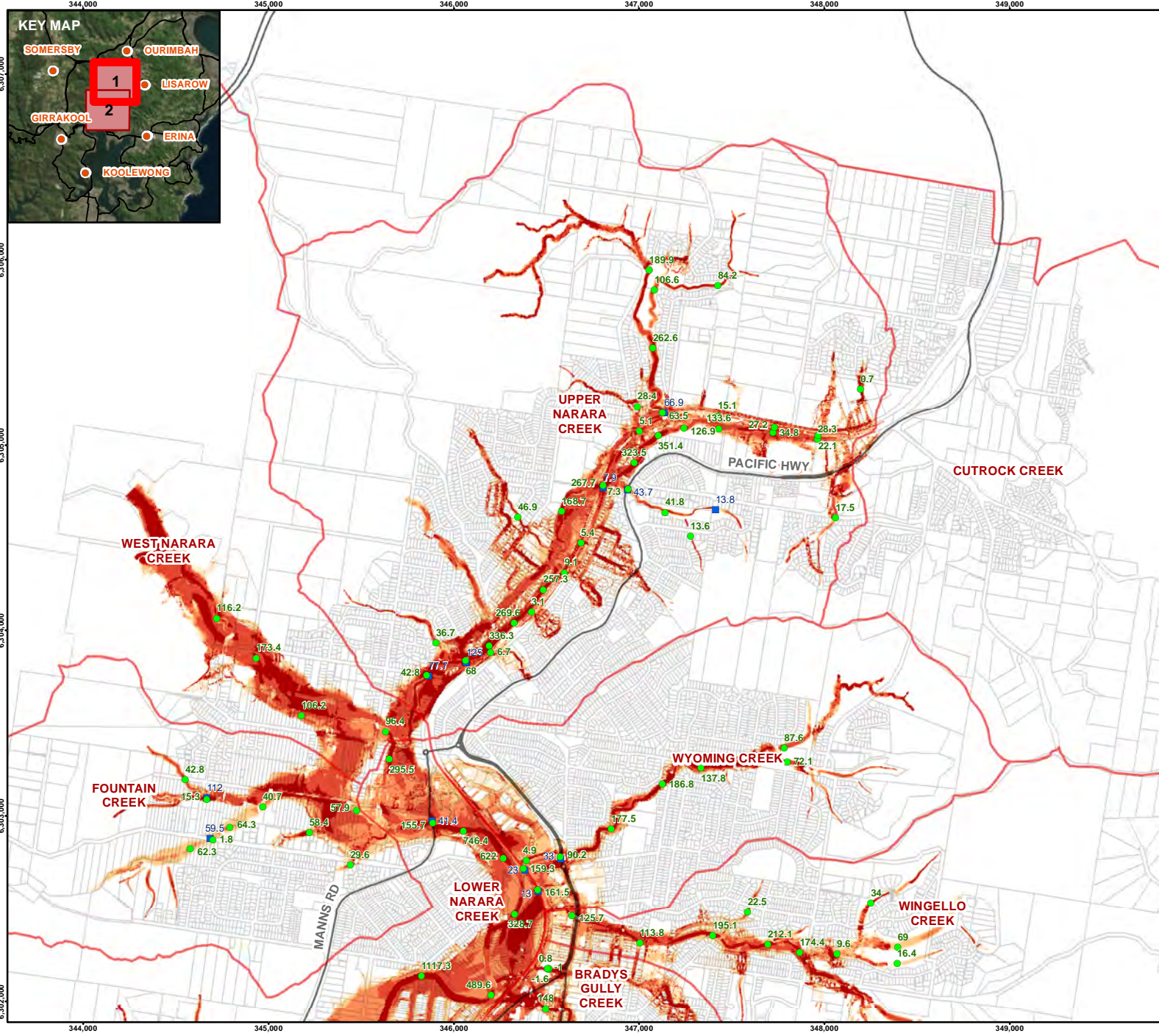
TITLE  
**PEAK FLOOD DEPTH AND FLOOD HEIGHT PMF EVENT**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	60B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
  - 1D Pipe or Open Channel Flow (m<sup>3</sup>/s)
  - 1D Weir Flow (m<sup>3</sup>/s)
  - Main Roads
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary
- | Flood Velocity (m/s) |                |
|----------------------|----------------|
|                      | < 0.4 m/s      |
|                      | 0.4 to 0.8 m/s |
|                      | 0.8 to 1.2 m/s |
|                      | 1.2 to 2 m/s   |
|                      | > 2 m/s        |



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

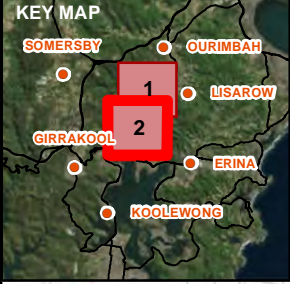
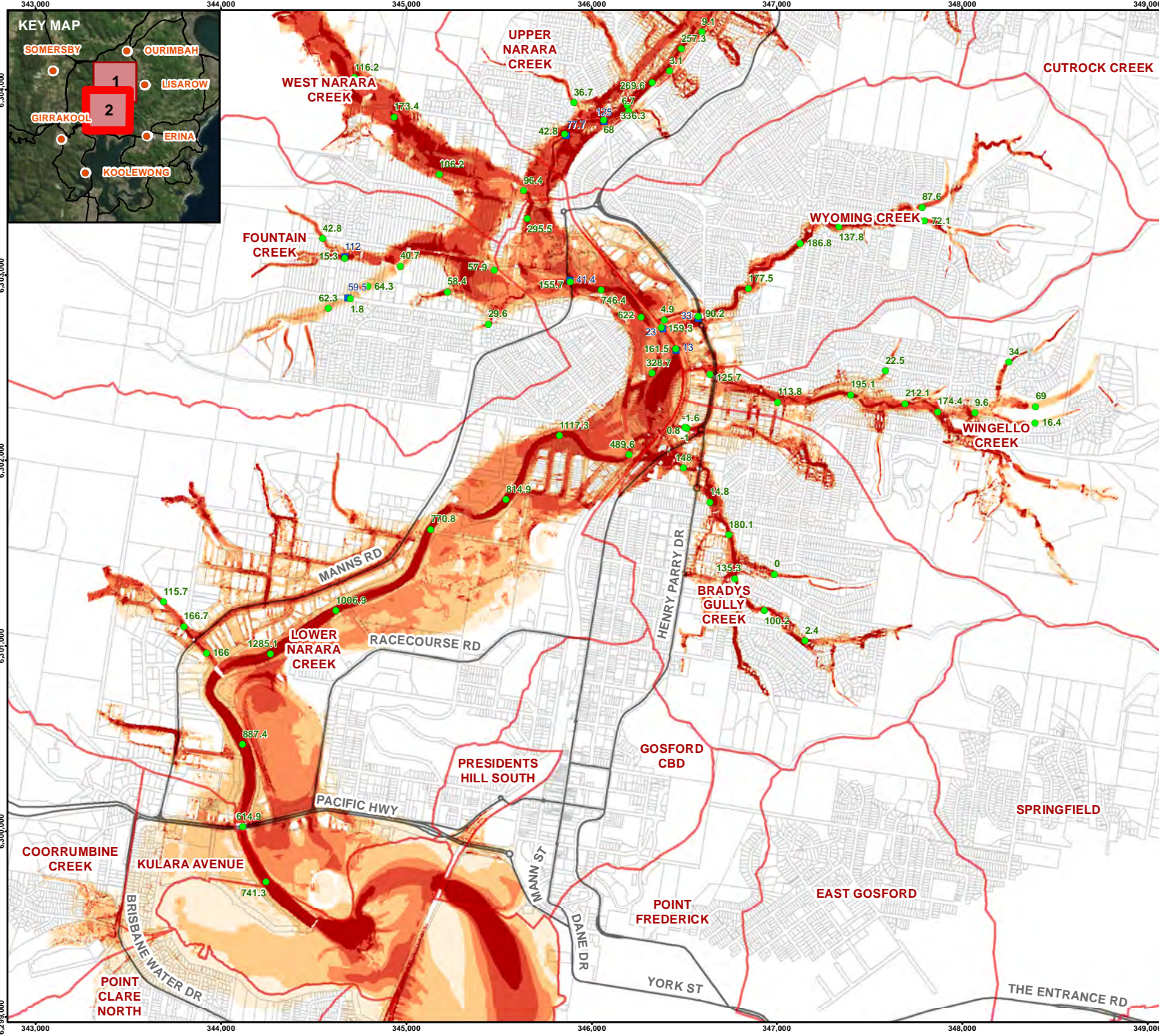
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION PMF EVENT**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	61A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- 1D Pipe or Open Channel Flow (m³/s)
- 1D Weir Flow (m³/s)
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Flood Velocity (m/s)**

- <math>< 0.4 \text{ m/s}</math>
- 0.4 to 0.8 m/s
- 0.8 to 1.2 m/s
- 1.2 to 2 m/s
- > 2 m/s

N  
0 500 1000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastral, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

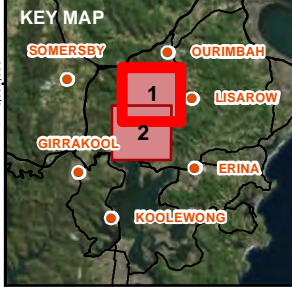
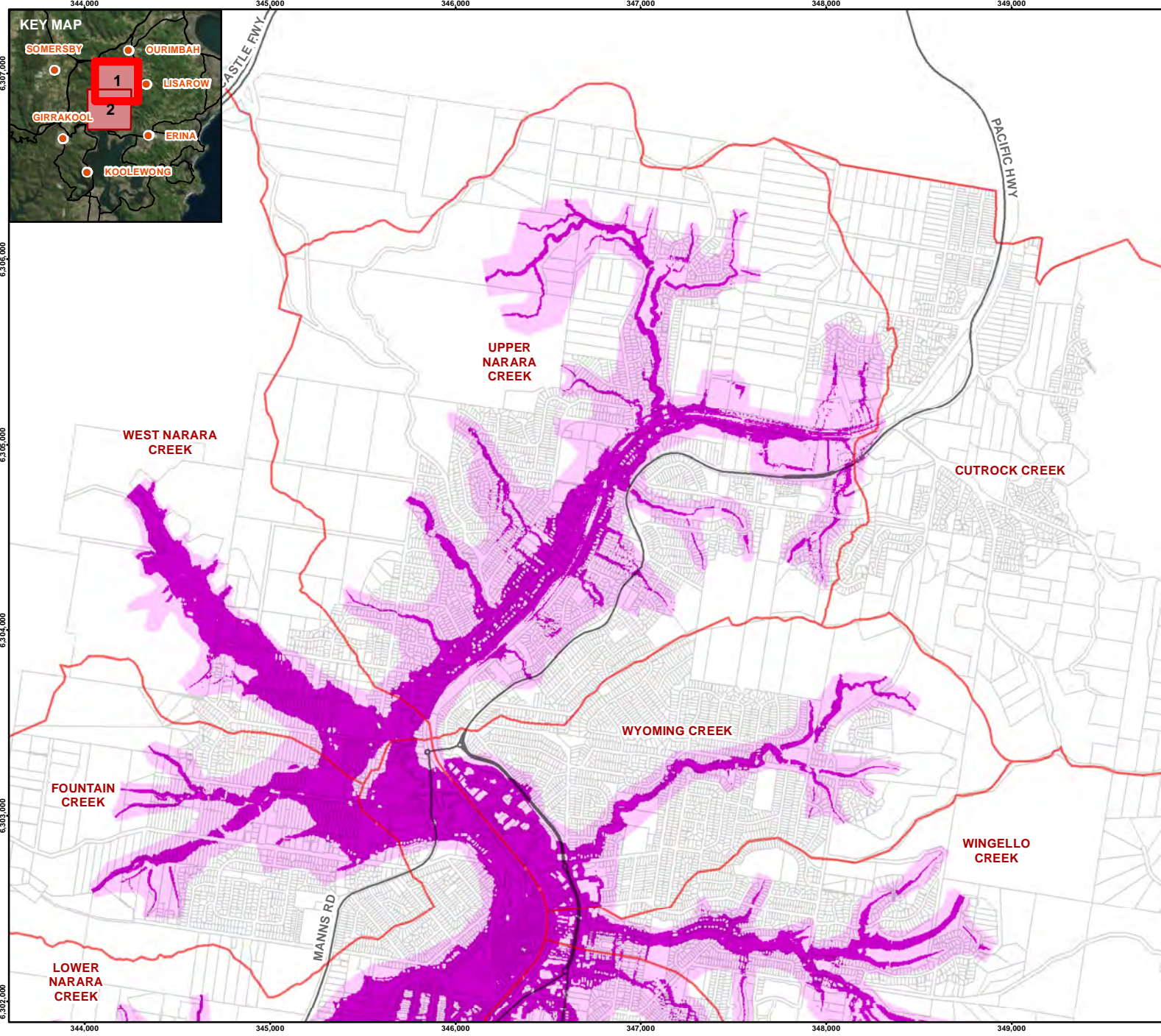
TITLE  
**PEAK FLOOD VELOCITY AND FLOW DISTRIBUTION PMF EVENT**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 61B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

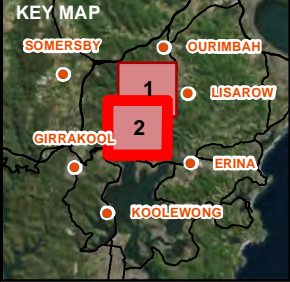
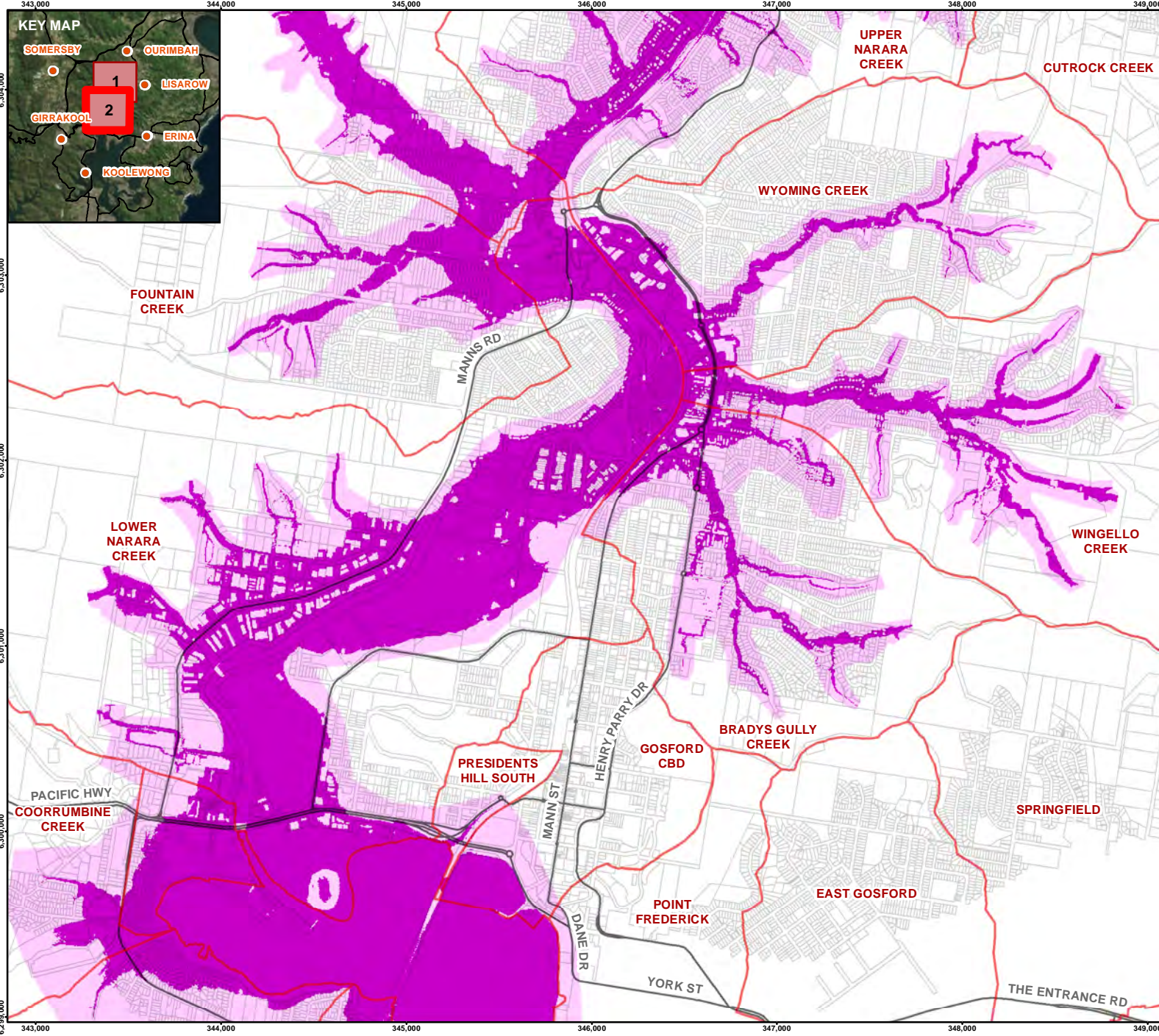
TITLE  
**PROVISIONAL FLOOD HAZARD PMF EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	62A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG A4



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Provisional Flood Hazard**

- ▭ Low Hazard
- ▭ High Hazard

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

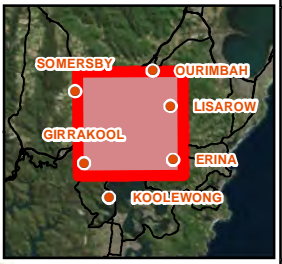
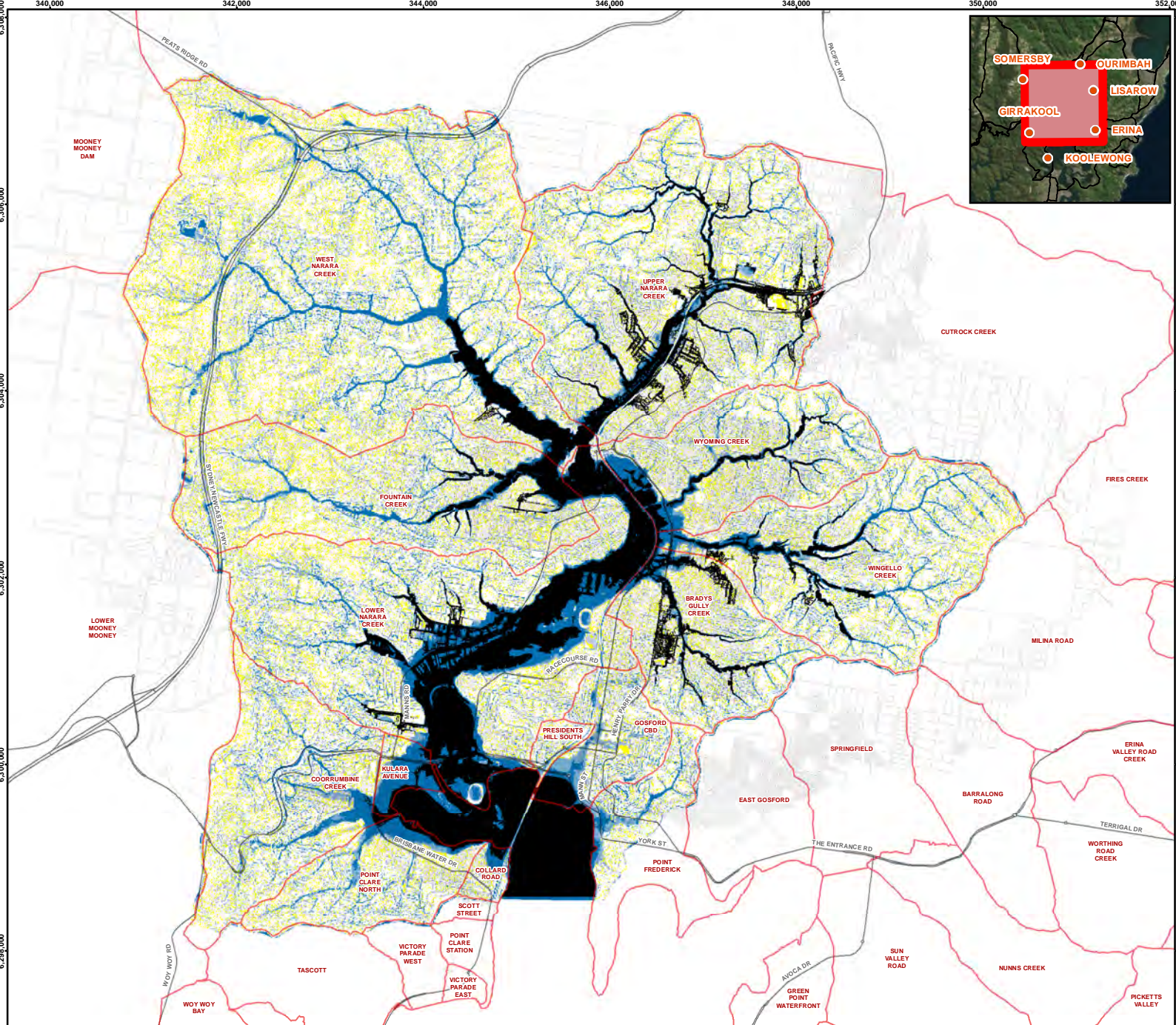
TITLE  
**PROVISIONAL FLOOD HAZARD PMF EVENT**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

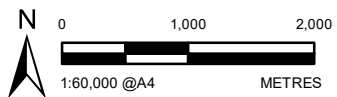
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	62B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISG A4



**Legend**

- Localities
  - Main Roads
  - Drainage Sub-Catchment
  - Cadastral Boundary
  - Refer to Detailed Model Results in this Area
- | Flood Depth (cm) |              |
|------------------|--------------|
|                  | < 10 cm      |
|                  | 10 to 20 cm  |
|                  | 20 to 40 cm  |
|                  | 40 cm to 1 m |
|                  | > 1 m        |



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

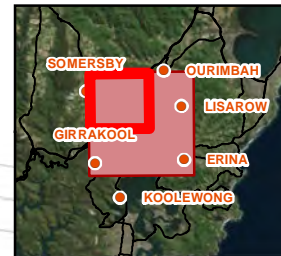
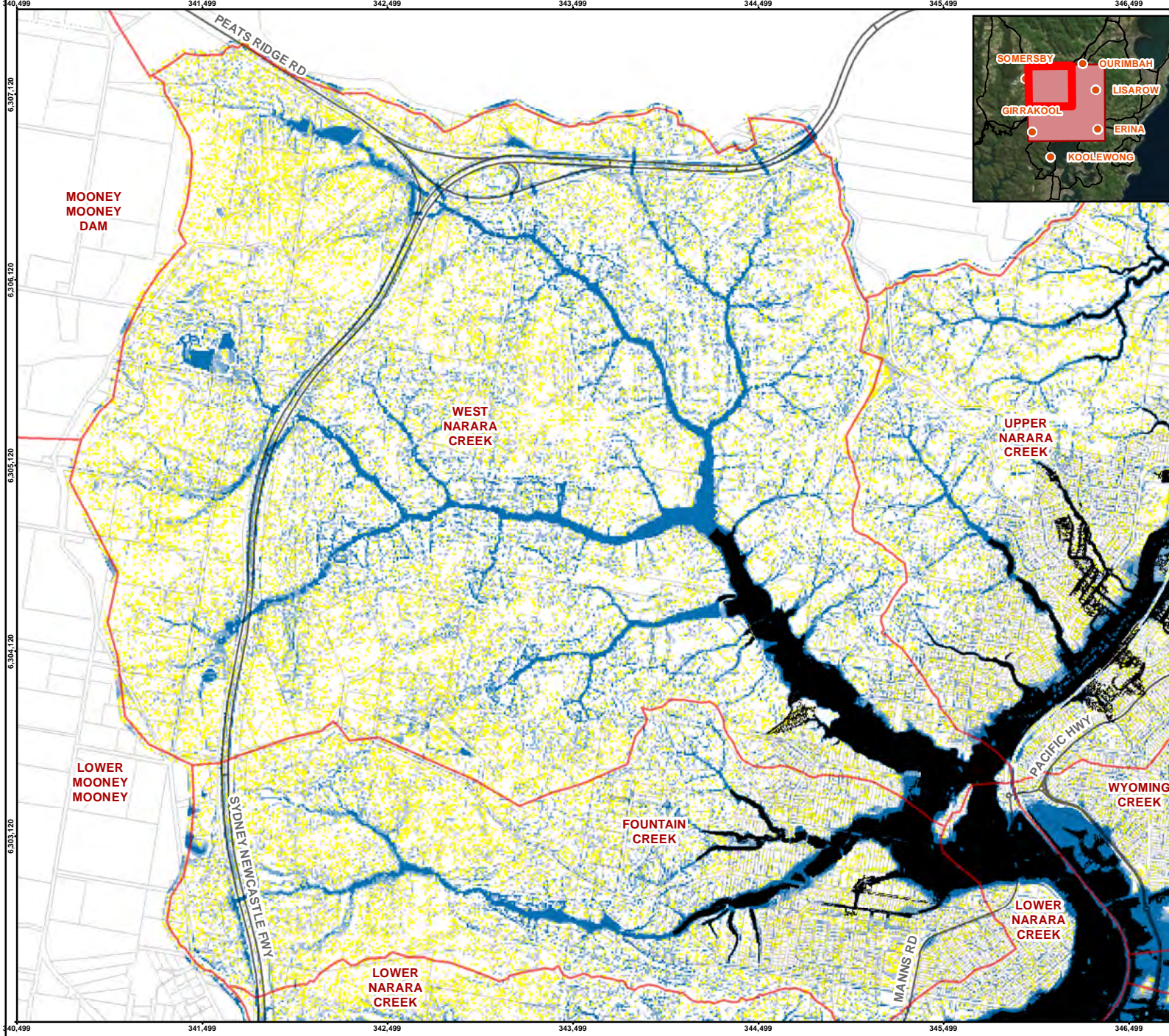
TITLE  
**PEAK FLOOD DEPTH - RAINFALL ON GRID PMF EVENT**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	63A

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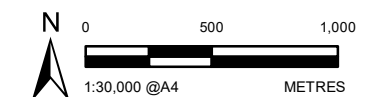


**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for flood depths less than 10 cm.  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH - RAINFALL ON GRID PMF EVENT**

CONSULTANT

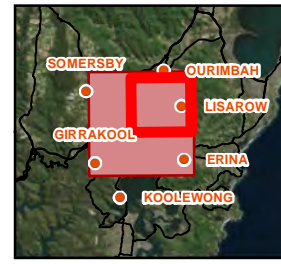
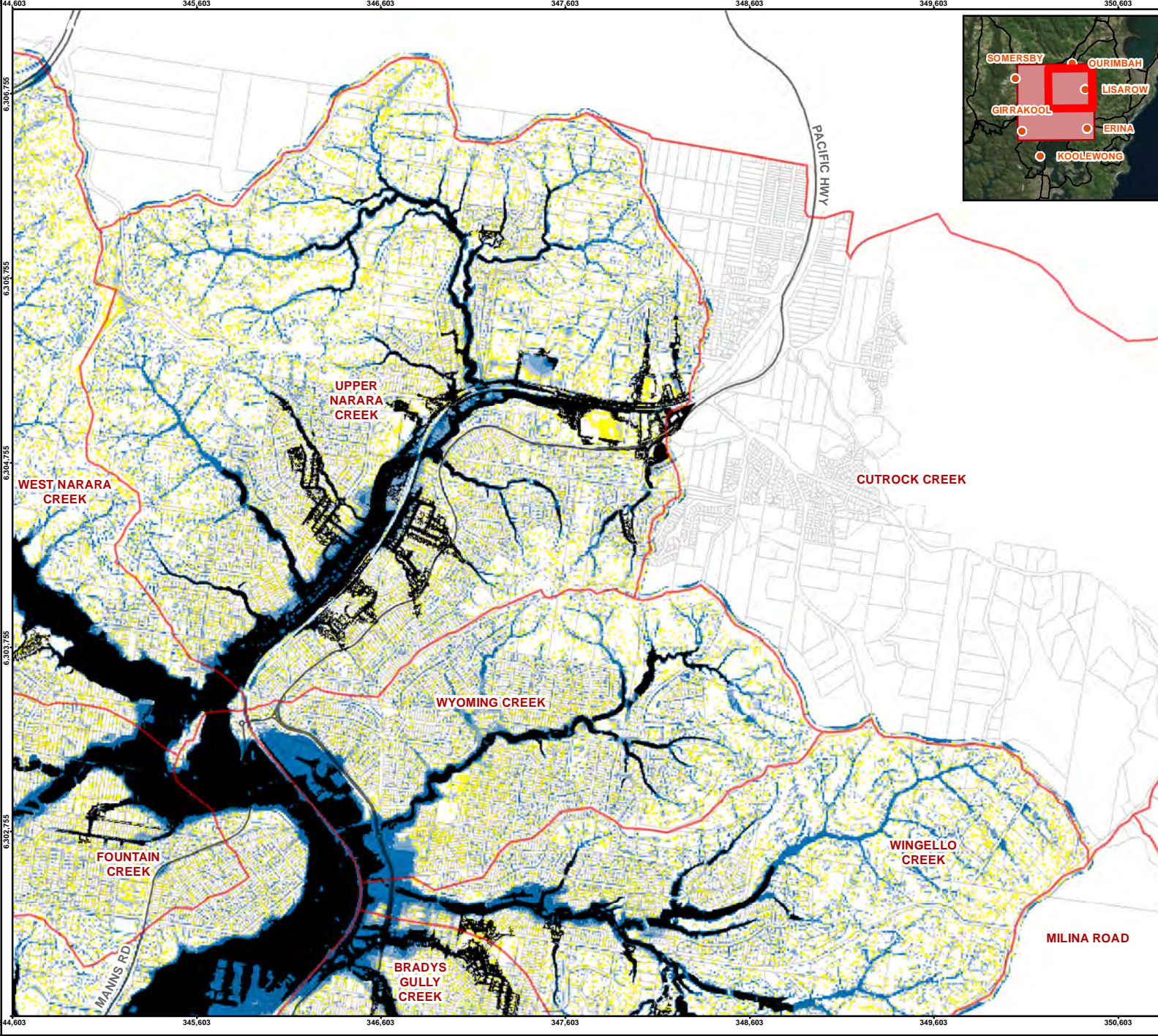


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	63B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4





**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**N**

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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Result filtered for flood depths less than 10 cm.

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

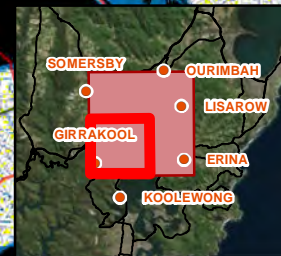
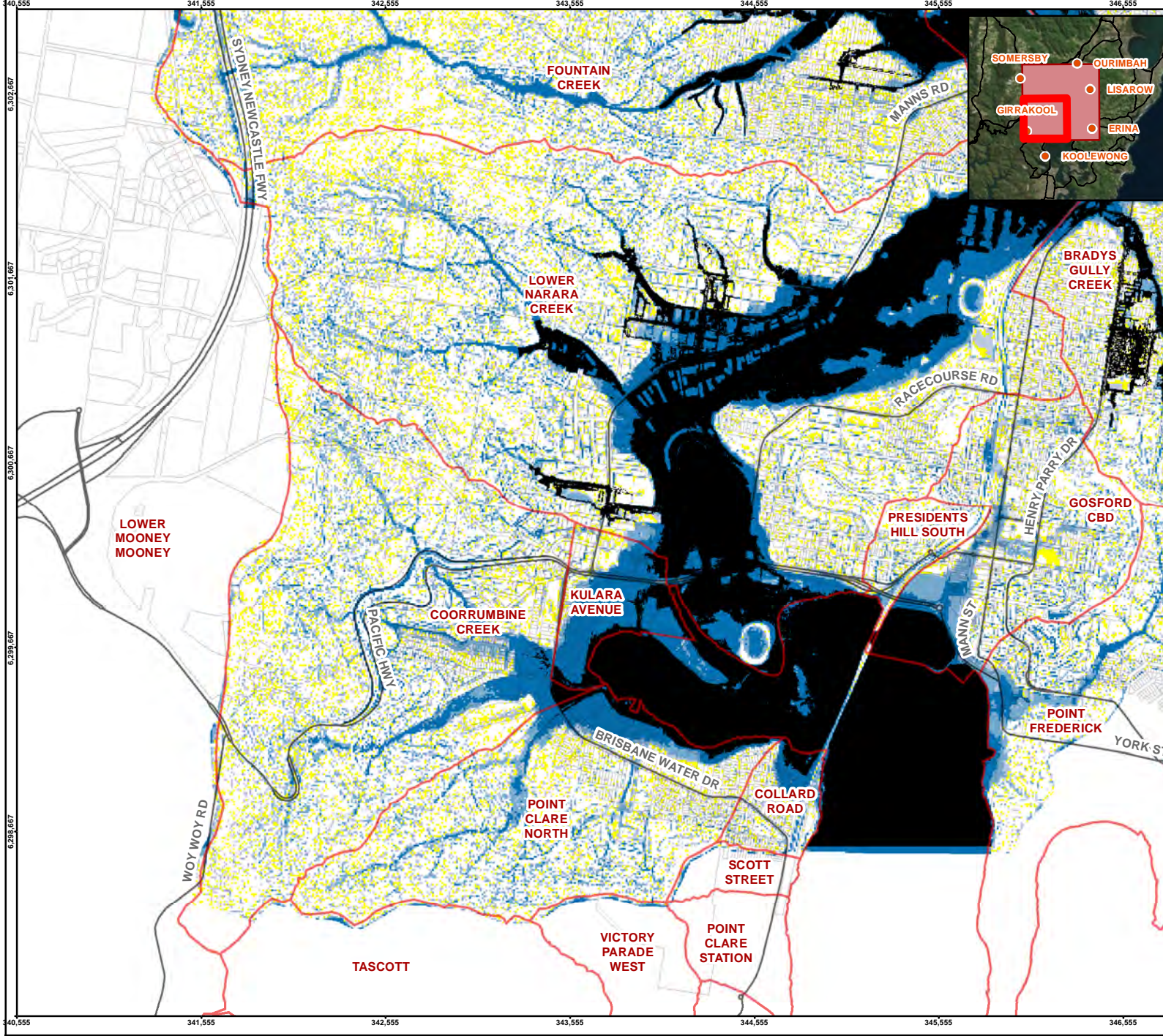
TITLE  
**PEAK FLOOD DEPTH - RAINFALL ON GRID PMF EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	63C

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4

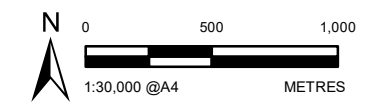


**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

	< 10 cm
	10 to 20 cm
	20 to 40 cm
	40 cm to 1 m
	> 1 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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 Result filtered for flood depths less than 10 cm.  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH - RAINFALL ON GRID PMF EVENT**

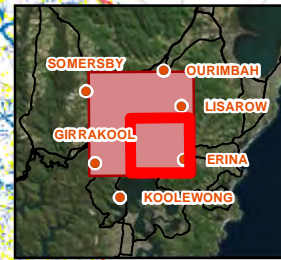
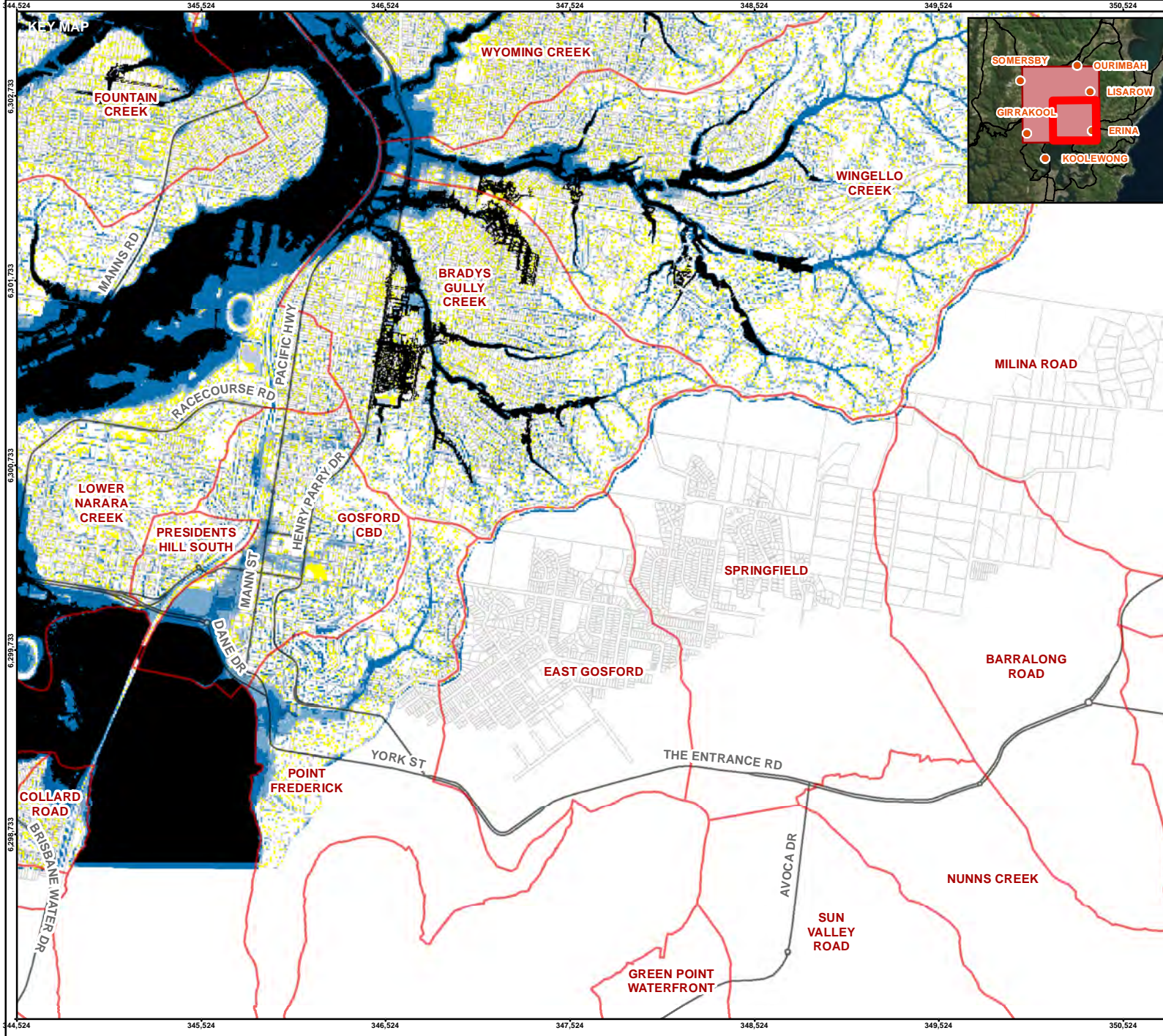
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	63D

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- < 10 cm
- 10 to 20 cm
- 20 to 40 cm
- 40 cm to 1 m
- > 1 m

**Scale**

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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Result filtered for flood depths less than 10 cm.

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**REFERENCE(S)**


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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PEAK FLOOD DEPTH - RAINFALL ON GRID PMF EVENT**

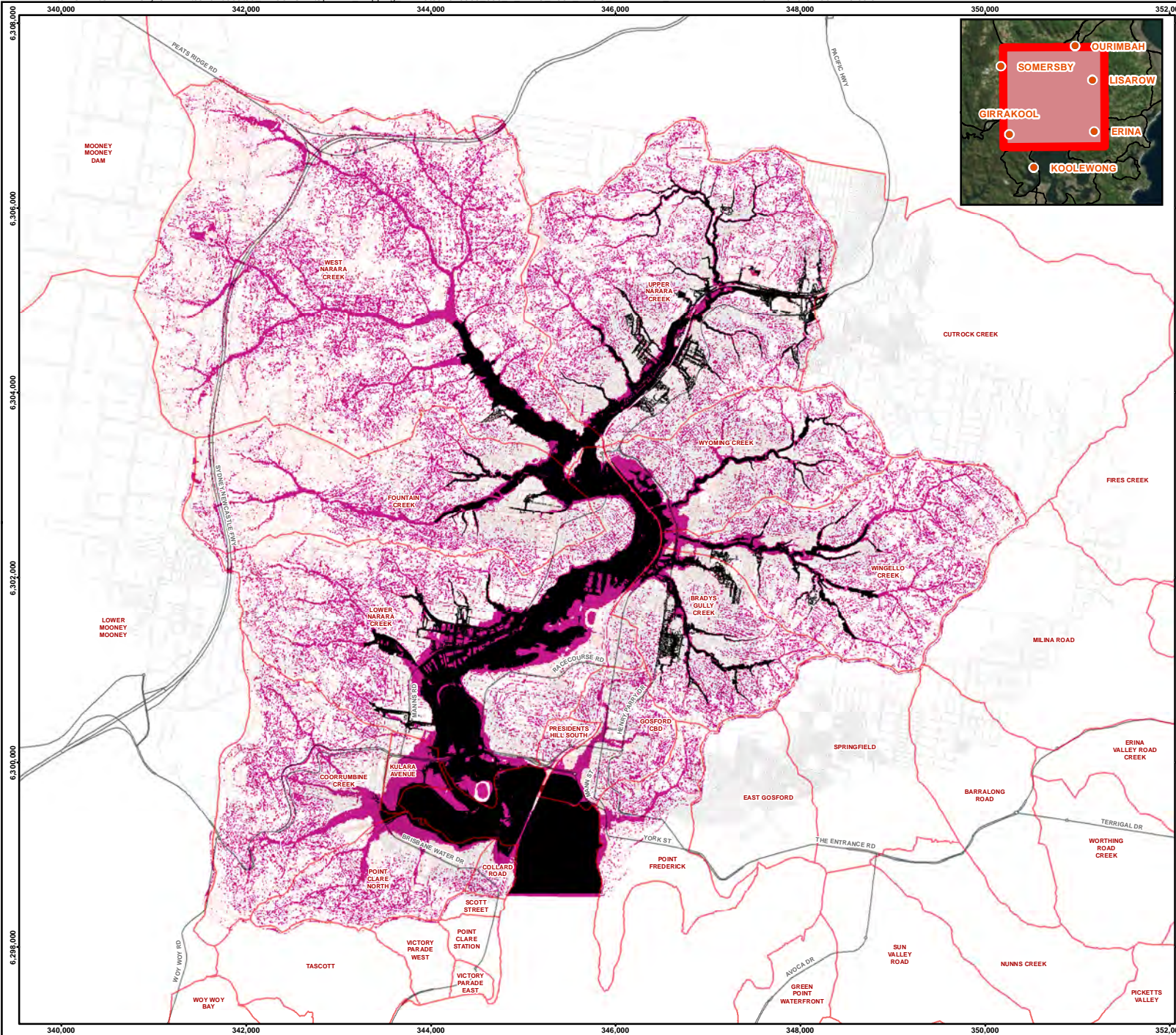
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	63E

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary
- ▭ Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- ▭ Low Hazard
- ▭ High Hazard

N  
0 1,000 2,000  
1:60,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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Result filtered for flood depths less than 10 cm

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID PMF EVENT**

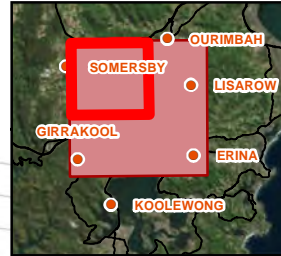
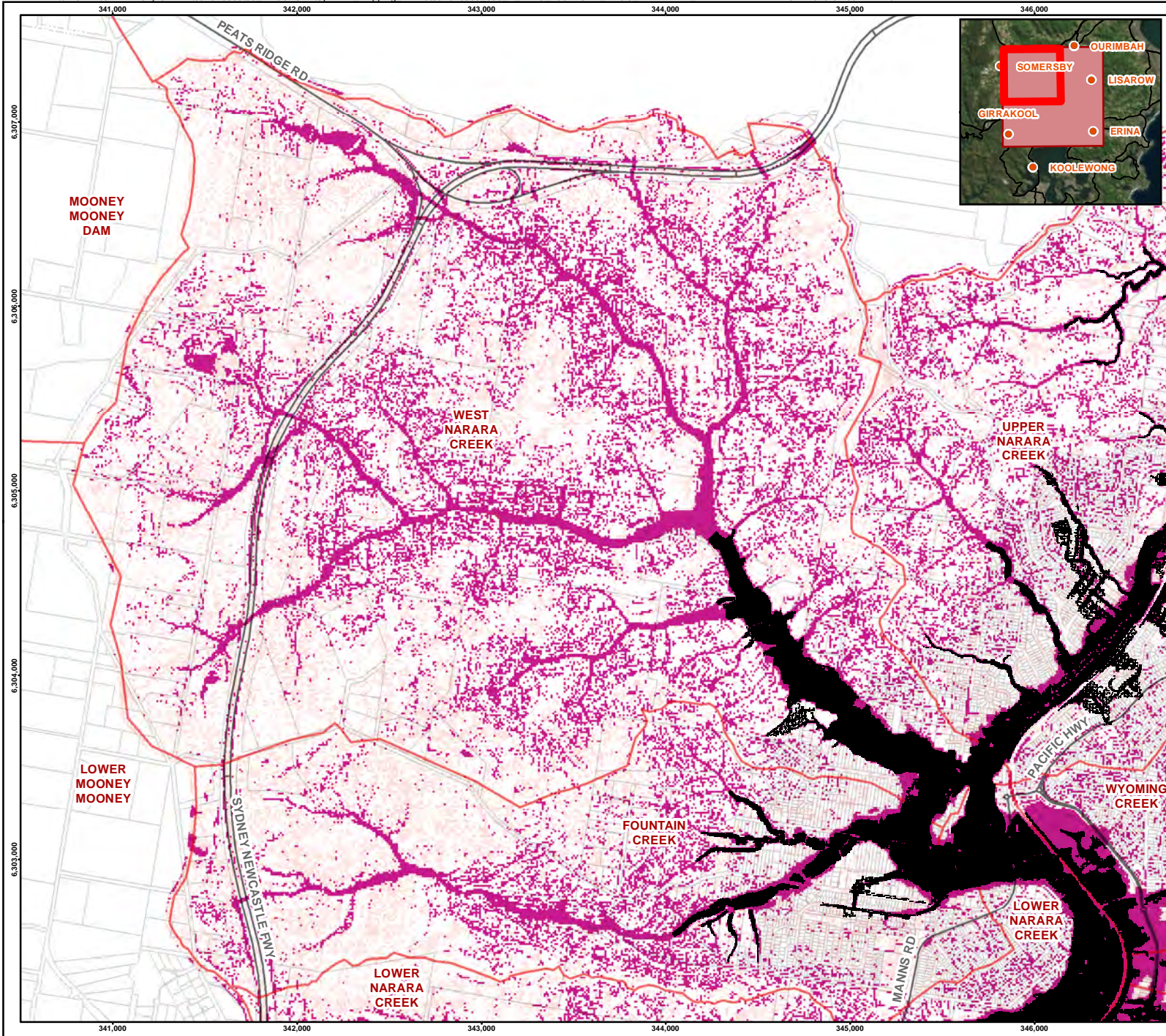
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	64A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- Low Hazard
- High Hazard

**Scale**

0 500 1,000 METRES

1:30,000 @A4

**Coordinate System:** GDA 1994 MGA Zone 56  
**Projection:** Transverse Mercator  
**Datum:** GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Result filtered for flood depths less than 10 cm.

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

**CLIENT**  
**CENTRAL COAST COUNCIL**

**PROJECT**  
**NARARA CREEK FLOOD STUDY**

**TITLE**  
**PROVISIONAL HAZARD - RAINFALL ON GRID PMF EVENT**

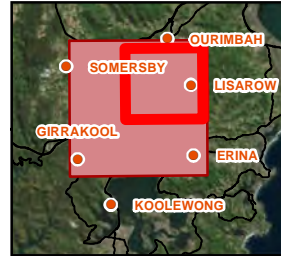
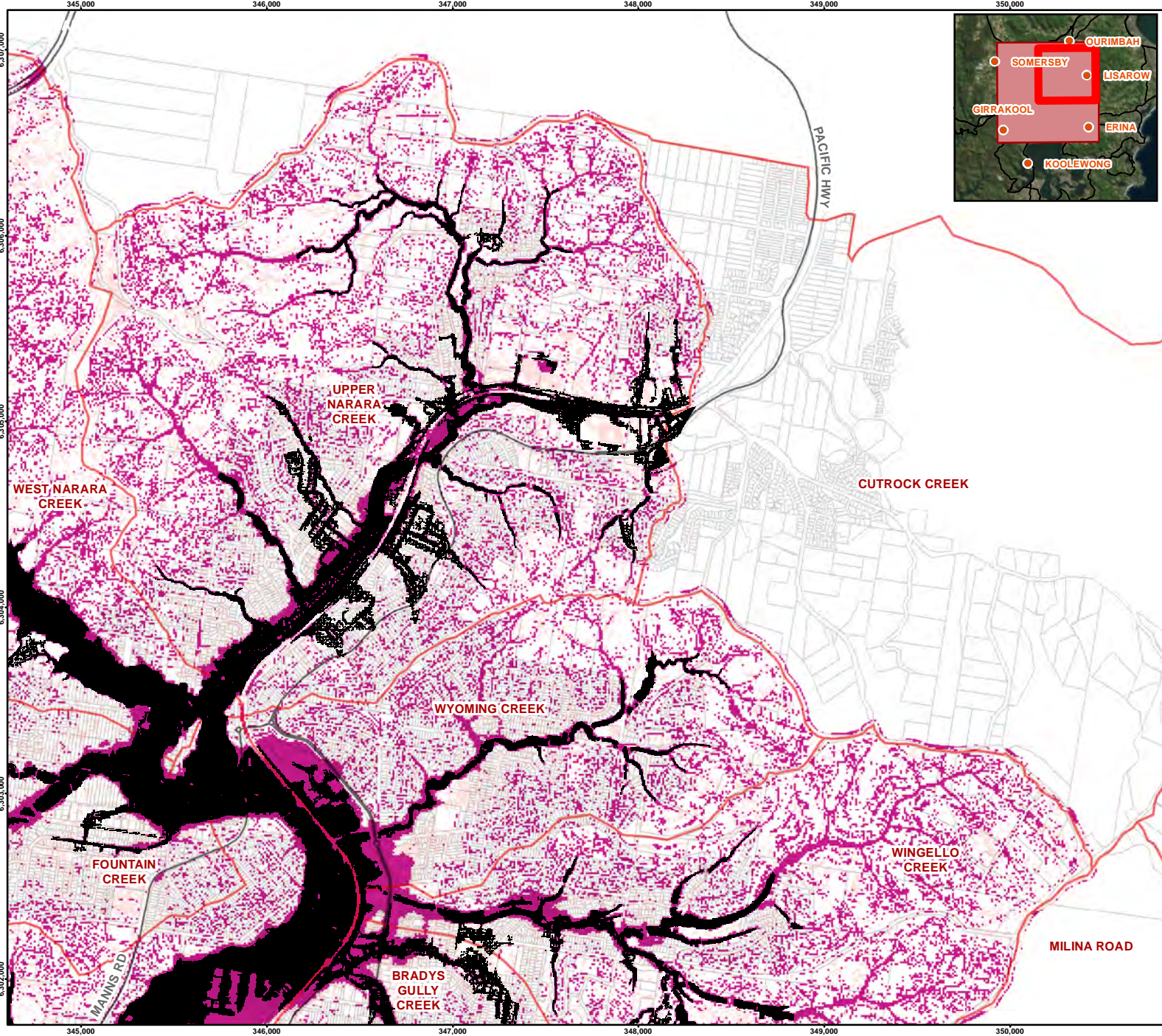
**CONSULTANT**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

<b>PROJECT NO.</b> 097626068	<b>CONTROL</b> 006	<b>REV.</b> G	<b>FIGURE</b> 64B
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- Low Hazard
- High Hazard

N

0 500 1,000

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Result filtered for flood depths less than 10 cm.

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**REFERENCE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID PMF EVENT**

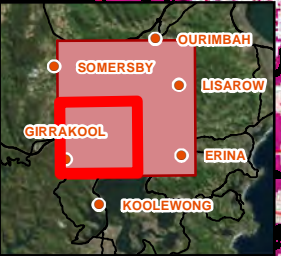
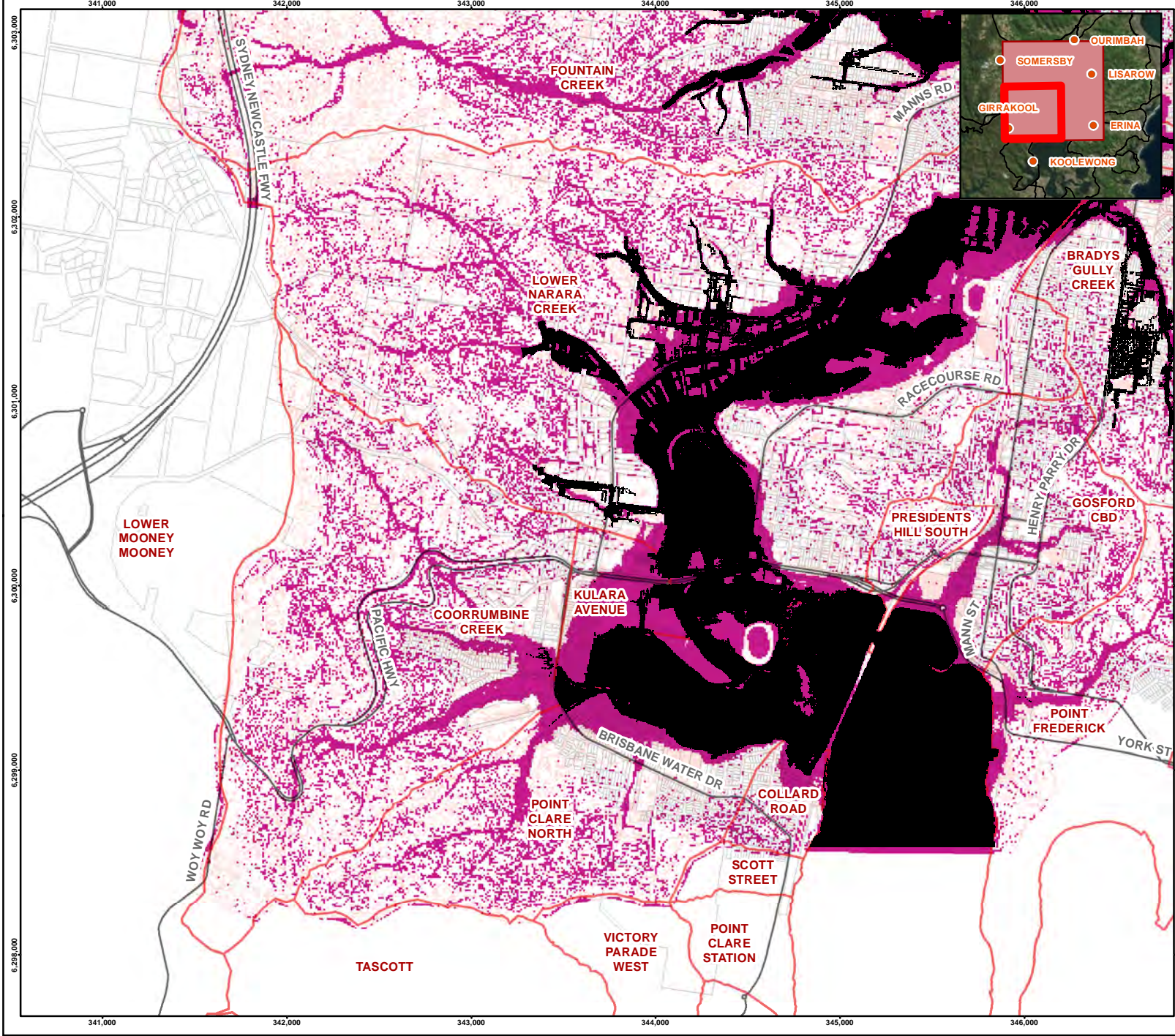
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	64C

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- Low Hazard
- High Hazard

N  
0 500 1000  
1:30,000 @A4 METRES


Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

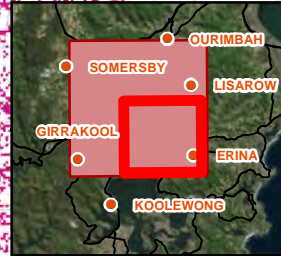
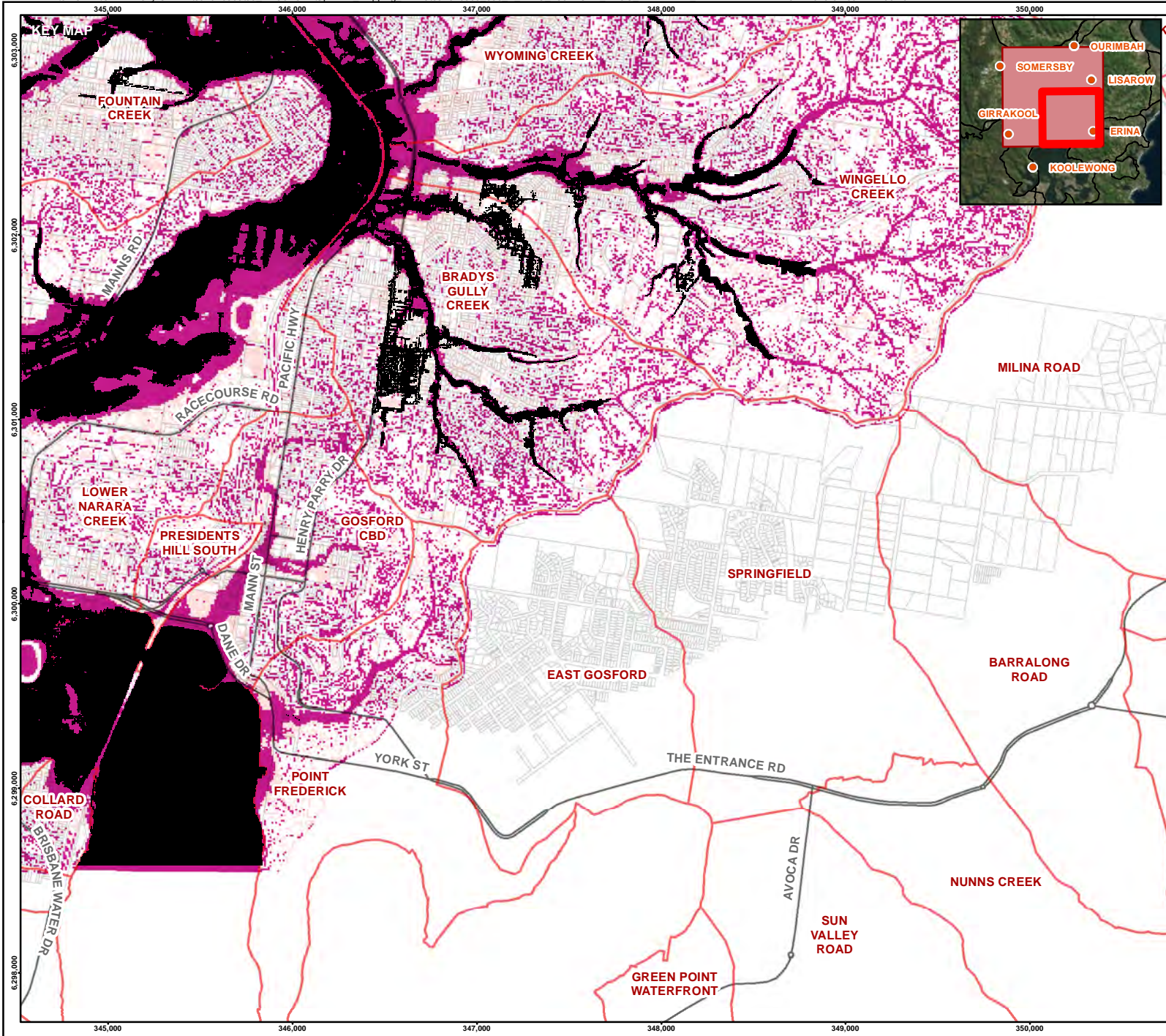
Result filtered for flood depths less than 10 cm.

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT	CENTRAL COAST COUNCIL		
PROJECT	NARARA CREEK FLOOD STUDY		
TITLE	PROVISIONAL HAZARD - RAINFALL ON GRID PMF EVENT		
CONSULTANT			
DD/MM/YYYY	3/04/2018		
DESIGNED	SL		
PREPARED	HB		
REVIEWED	NM		
APPROVED	NM		
PROJECT NO.	097626068	CONTROL	006
REV.	G	FIGURE	64D

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary
- Refer to Detailed Model Results in this Area

**Flood Depth (cm)**

- Low Hazard
- High Hazard

N  
0 500 1000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Result filtered for flood depths less than 10 cm.

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PROVISIONAL HAZARD - RAINFALL ON GRID PMF EVENT**

CONSULTANT

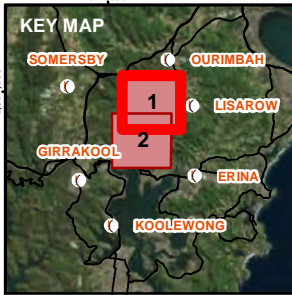
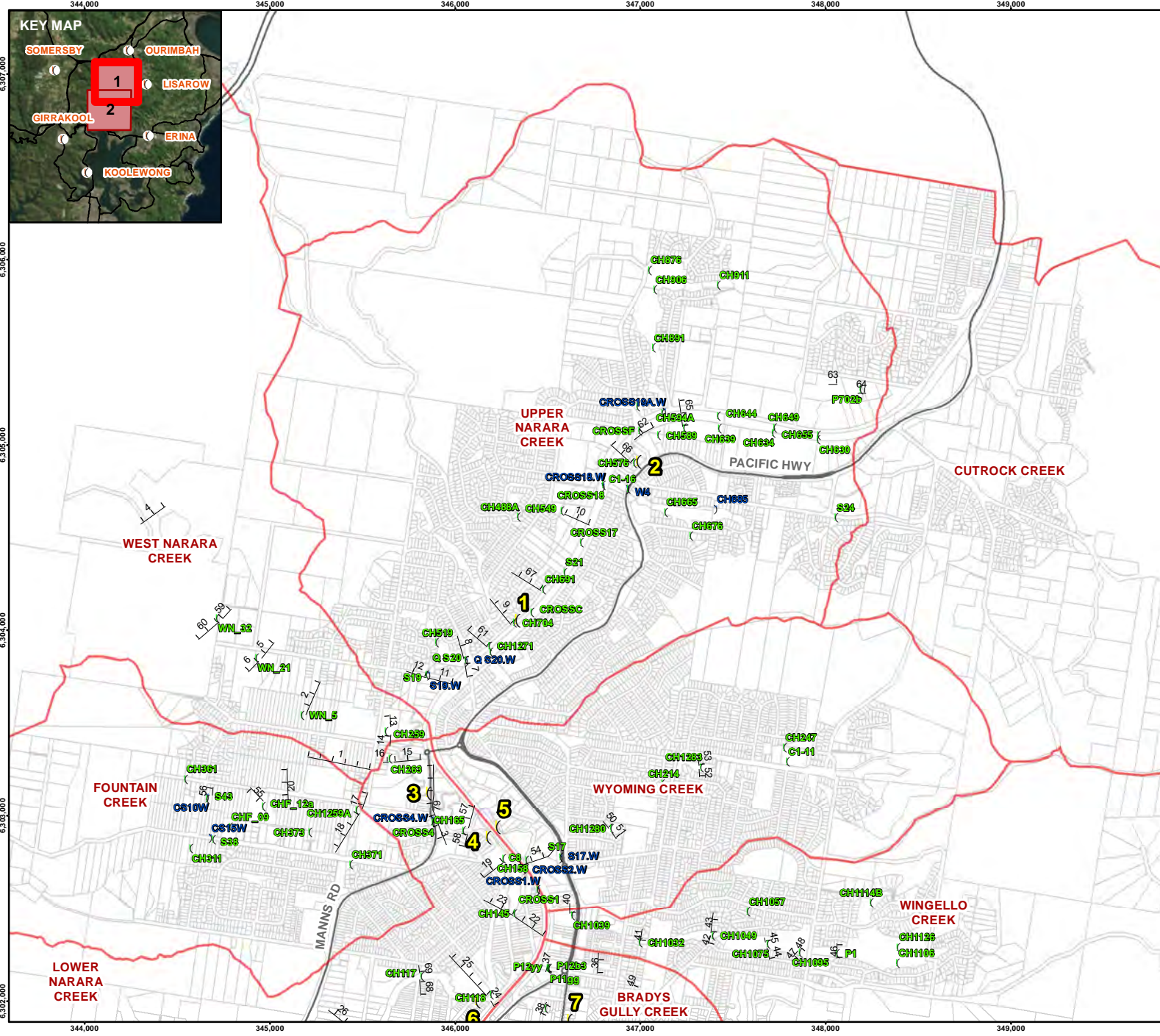


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	64E

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4





**Legend**

- ( ) Localities
- ( ) 1D Pipe or Open Channel Flow
- ) 1D Weir Flow
- ( ) Typical Dwelling Locations
- Main Roads
- ▬▬▬▬ 2D Floodplain Flow
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

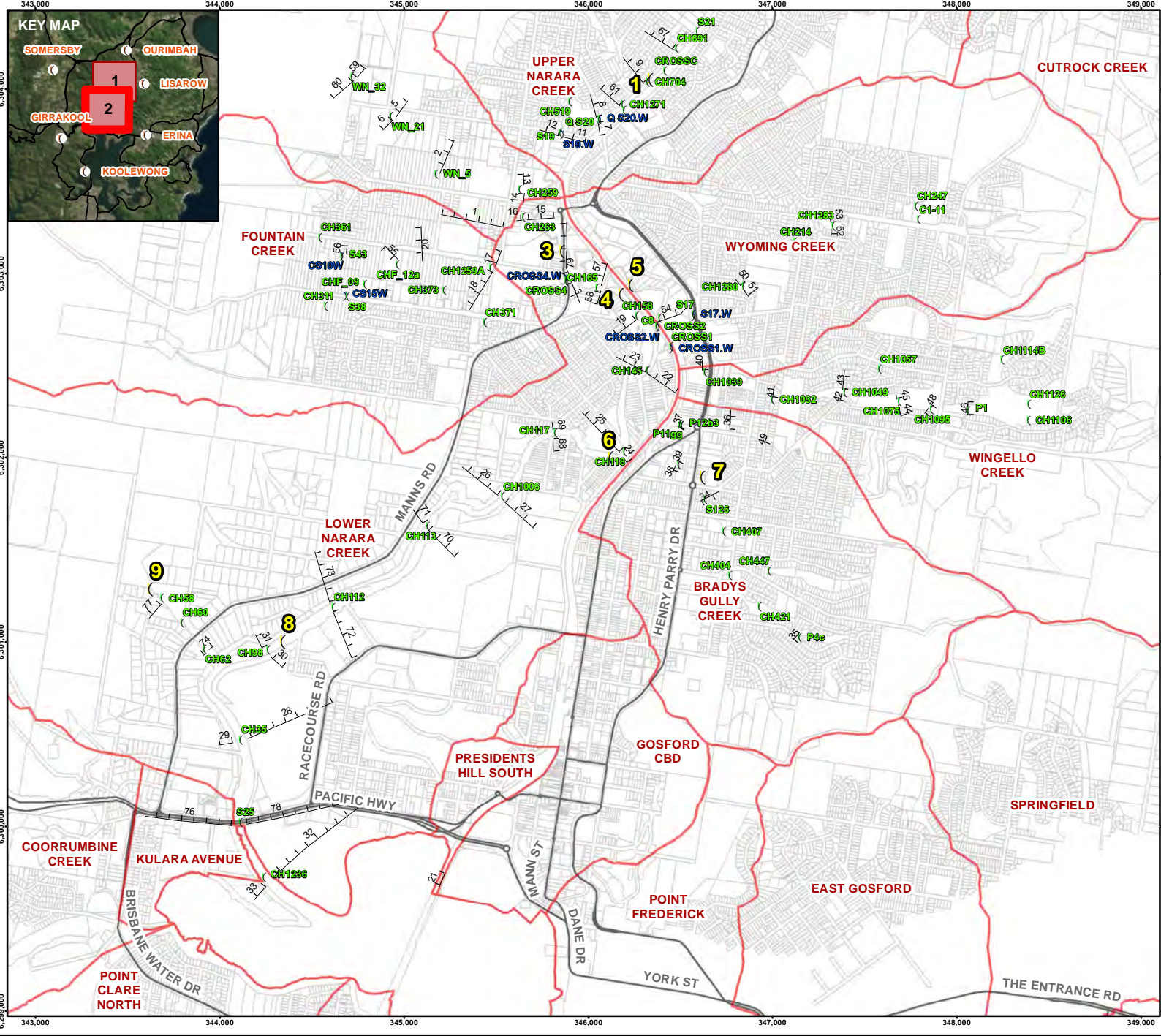
TITLE  
**REPORTING LOCATIONS FOR TABULATED RESULTS**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	65A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- ( ) 1D Pipe or Open Channel Flow
- ) ) 1D Weir Flow
- ( ) Typical Dwelling Locations
- Main Roads
- ▬▬▬▬ 2D Floodplain Flow
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

0 500 1000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**REPORTING LOCATIONS FOR TABULATED RESULTS**

CONSULTANT



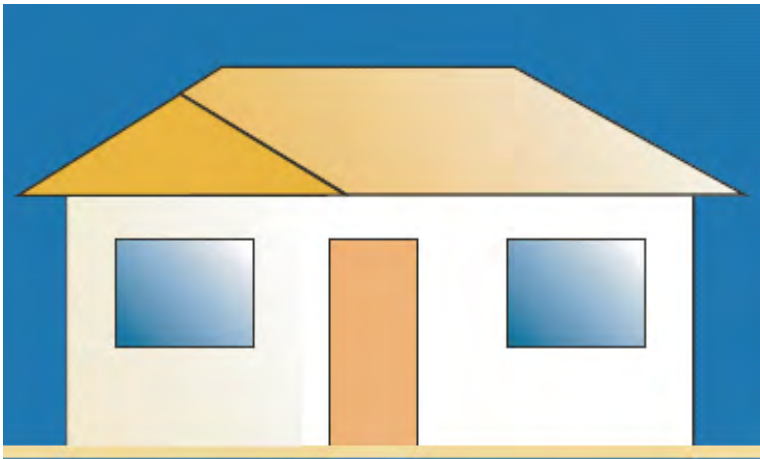
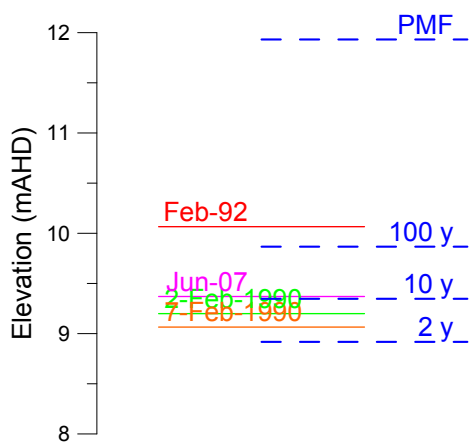
DD/MM/YYYY 3/04/2018

DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	65B

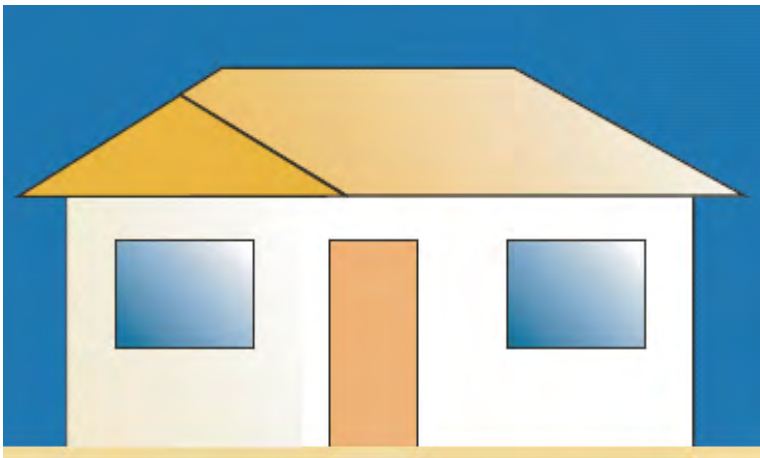
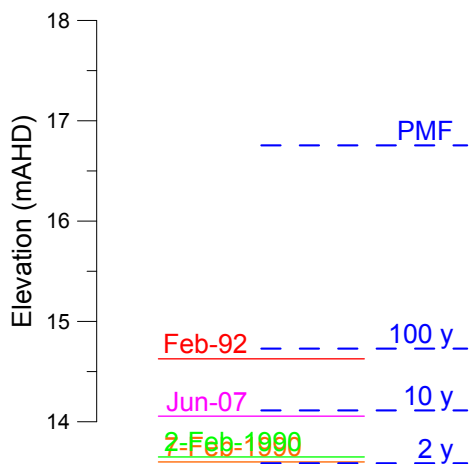
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

### Koninderie Parade



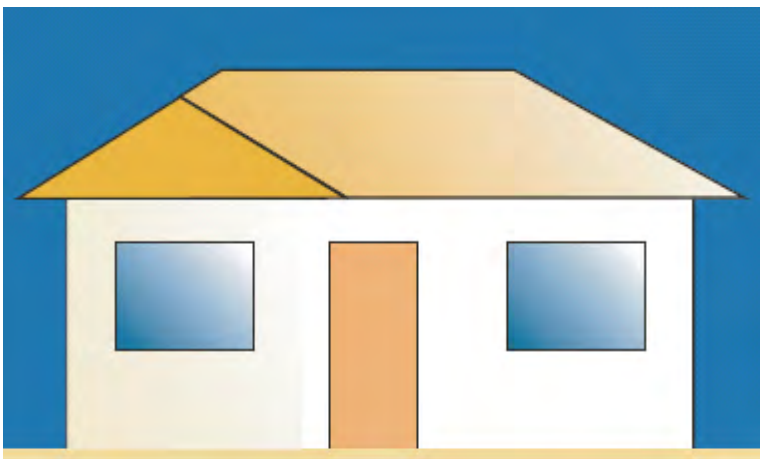
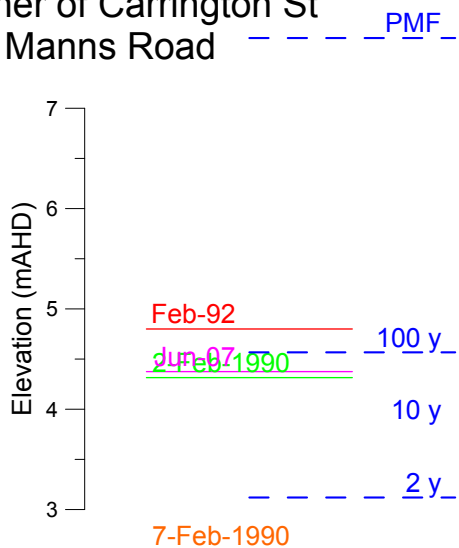
Model Node: CH703.2

### Kathleen Morreau Parade



Model Node: CH575.2

### Corner of Carrington St and Manns Road



Model Node: CROSS5.1

TITLE

#### FLOOD LEVELS IN RELATION TO TYPICAL DWELLINGS

CLIENT  
CENTRAL COAST COUNCIL

CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT

NARARA CREEK FLOOD STUDY

REFERENCE(S)

Provided by Central Coast Council February 2018

NOTE(S)

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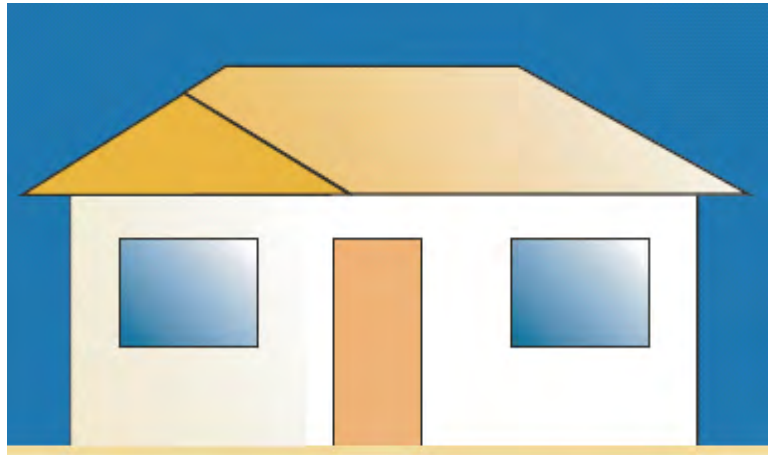
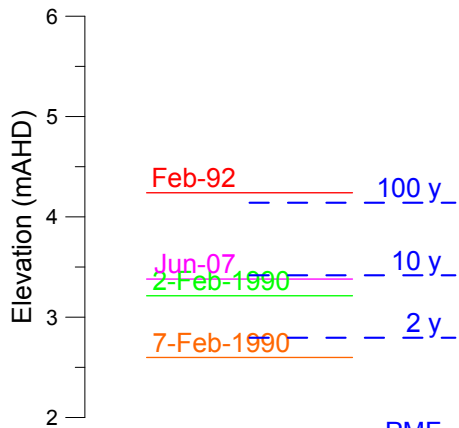
PROJECT NO.  
097626068

CONTROL  
006

REV.  
G

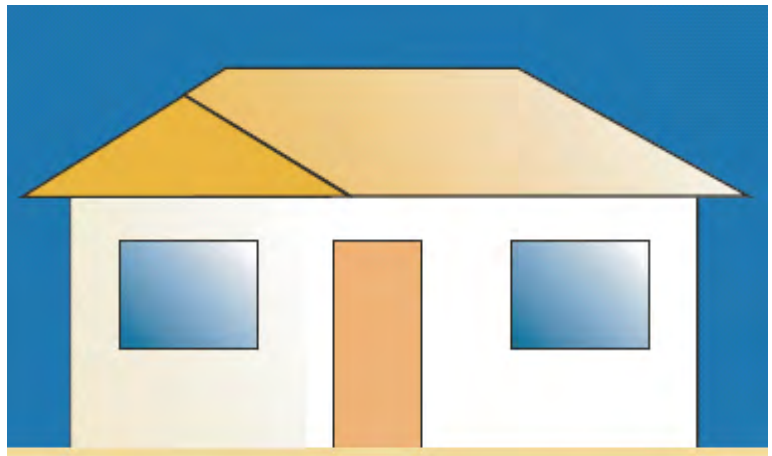
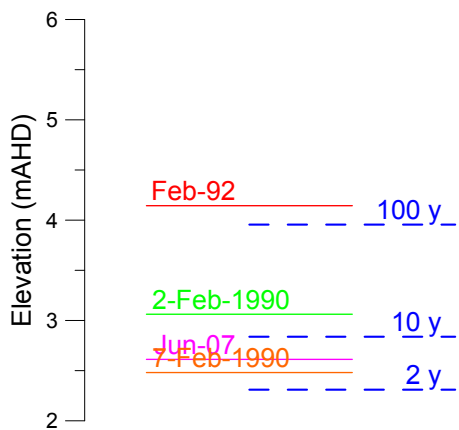
FIGURE  
66

Corner of Showground and Manns Road PMF



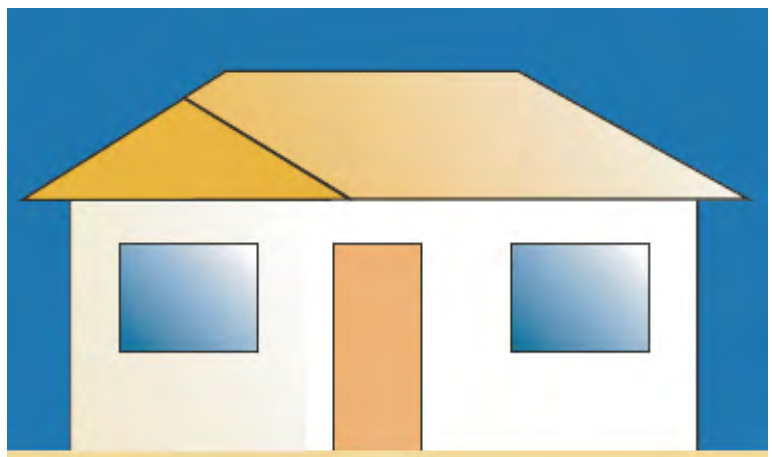
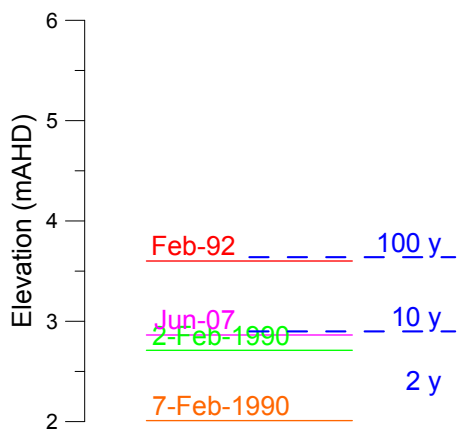
Model Node: CH153.1

Brooks Avenue PMF



Model Node: S145.2

Showground Road near Glennie St West PMF



Model Node: CH119.2

Narara Creek Flood Study

TITLE

**FLOOD LEVELS IN RELATION TO TYPICAL DWELLINGS**

CLIENT  
CENTRAL COAST COUNCIL

CONSULTANT



DD/MM/YYYY 3/04/2018

DESIGNED SL

PREPARED DC

REVIEWED NM

APPROVED NM

PROJECT

NARARA CREEK FLOOD STUDY

REFERENCE(S)

Provided by Central Coast Council February 2018

NOTE(S)

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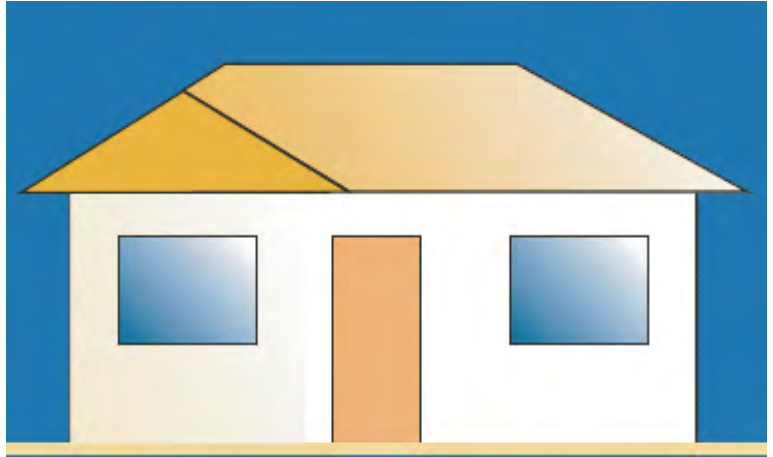
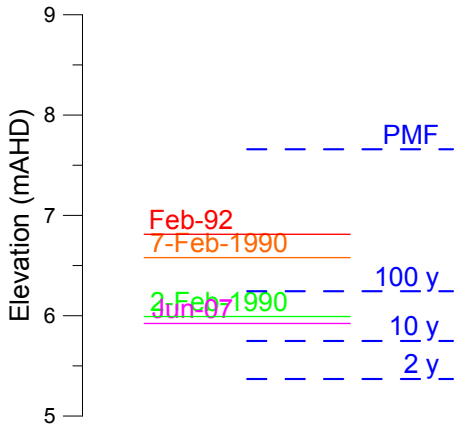
PROJECT NO.  
097626068

CONTROL  
006

REV.  
G

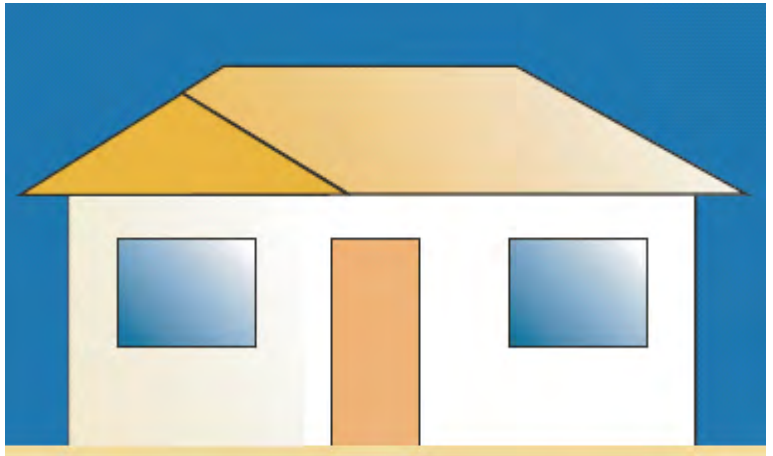
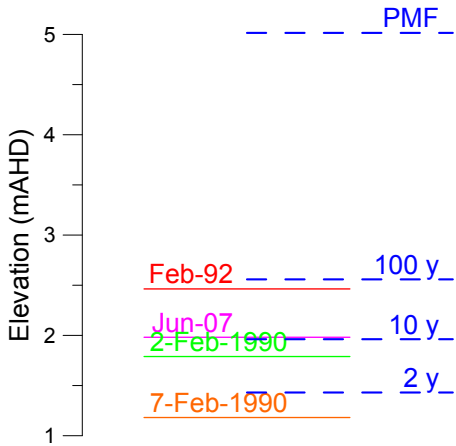
FIGURE  
67

### Cary St



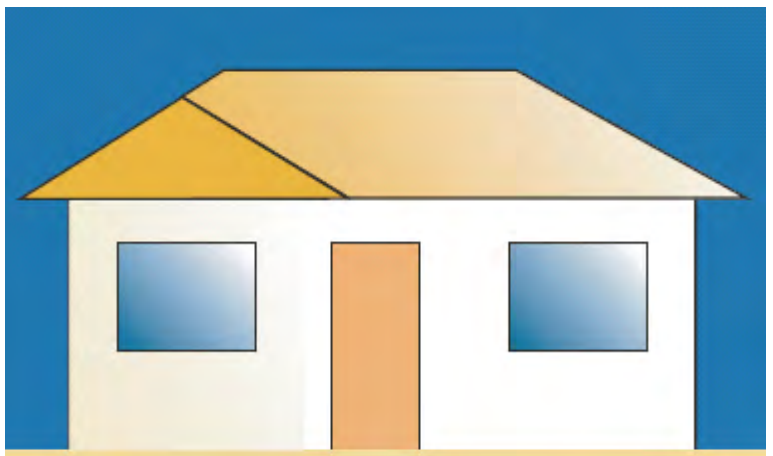
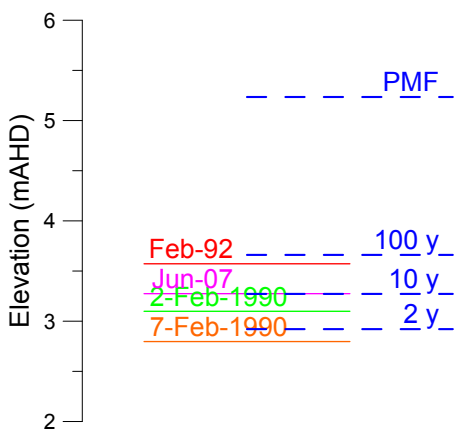
Model Node: CH397.2

### Dignity Close



Model Node: CH98.1

### Tathra Street




Model Node: CH51.2

TITLE

#### FLOOD LEVELS IN RELATION TO TYPICAL DWELLINGS

CLIENT  
CENTRAL COAST COUNCIL

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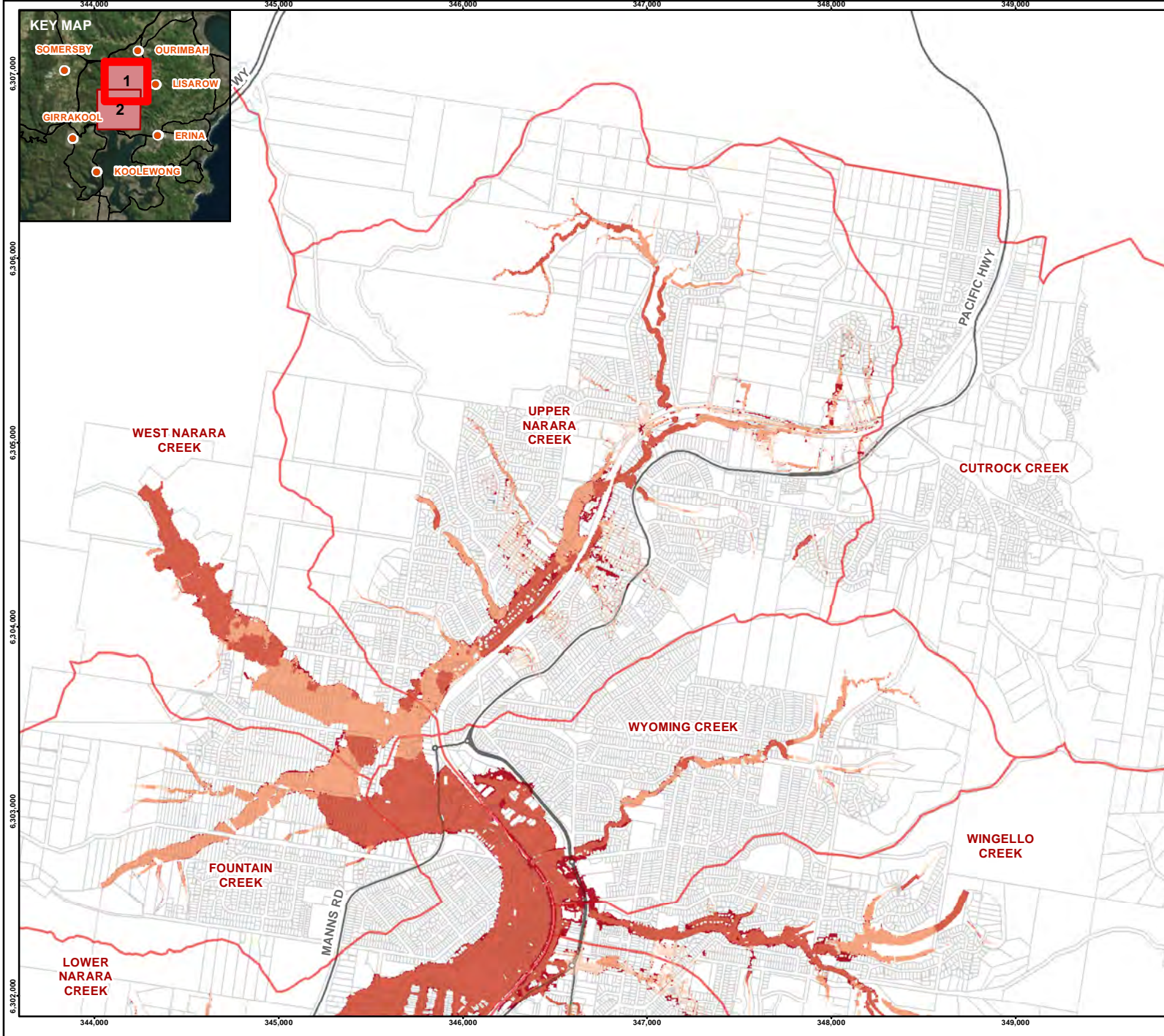
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT  
NARARA CREEK FLOOD STUDY

REFERENCE(S)  
Provided by Central Coast Council February 2018

NOTE(S)  
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PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 68
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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

No Change
0.01 m - 0.05 m
0.05 m - 0.20 m
0.20 m - 1.0 m
More than 1.0 m

N

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
INCREASED PEAK DISCHARGE**

CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED SL

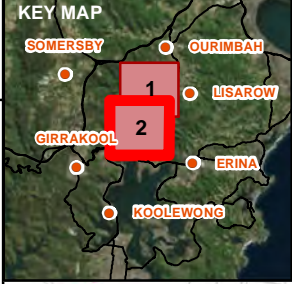
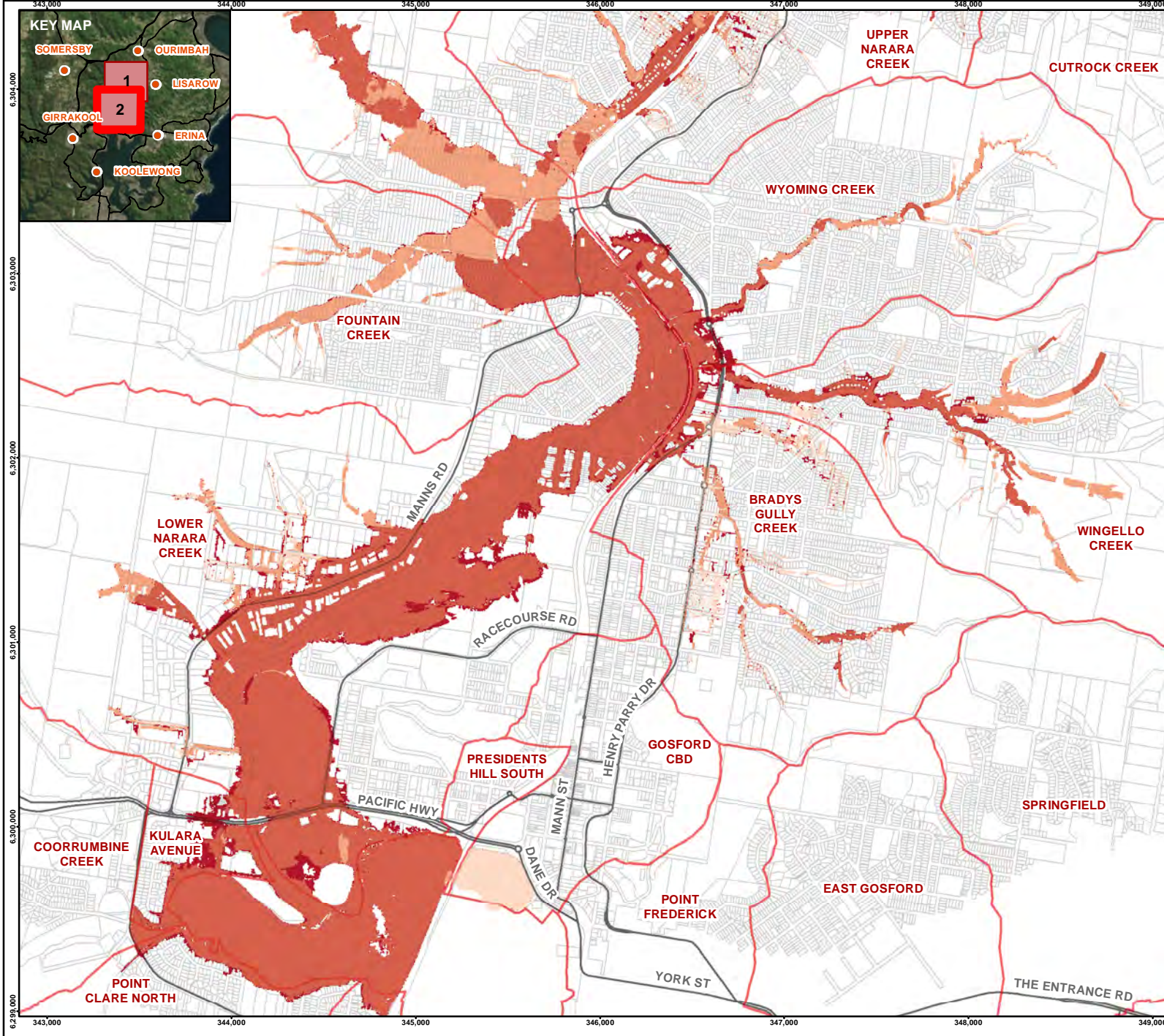
PREPARED HB

REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 69A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

No Change
0.01 m - 0.05 m
0.05 m - 0.20 m
0.20 m - 1.0 m
More than 1.0 m

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

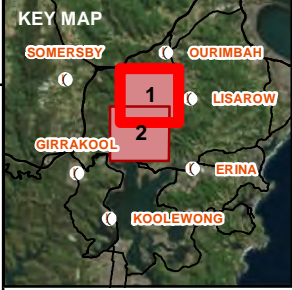
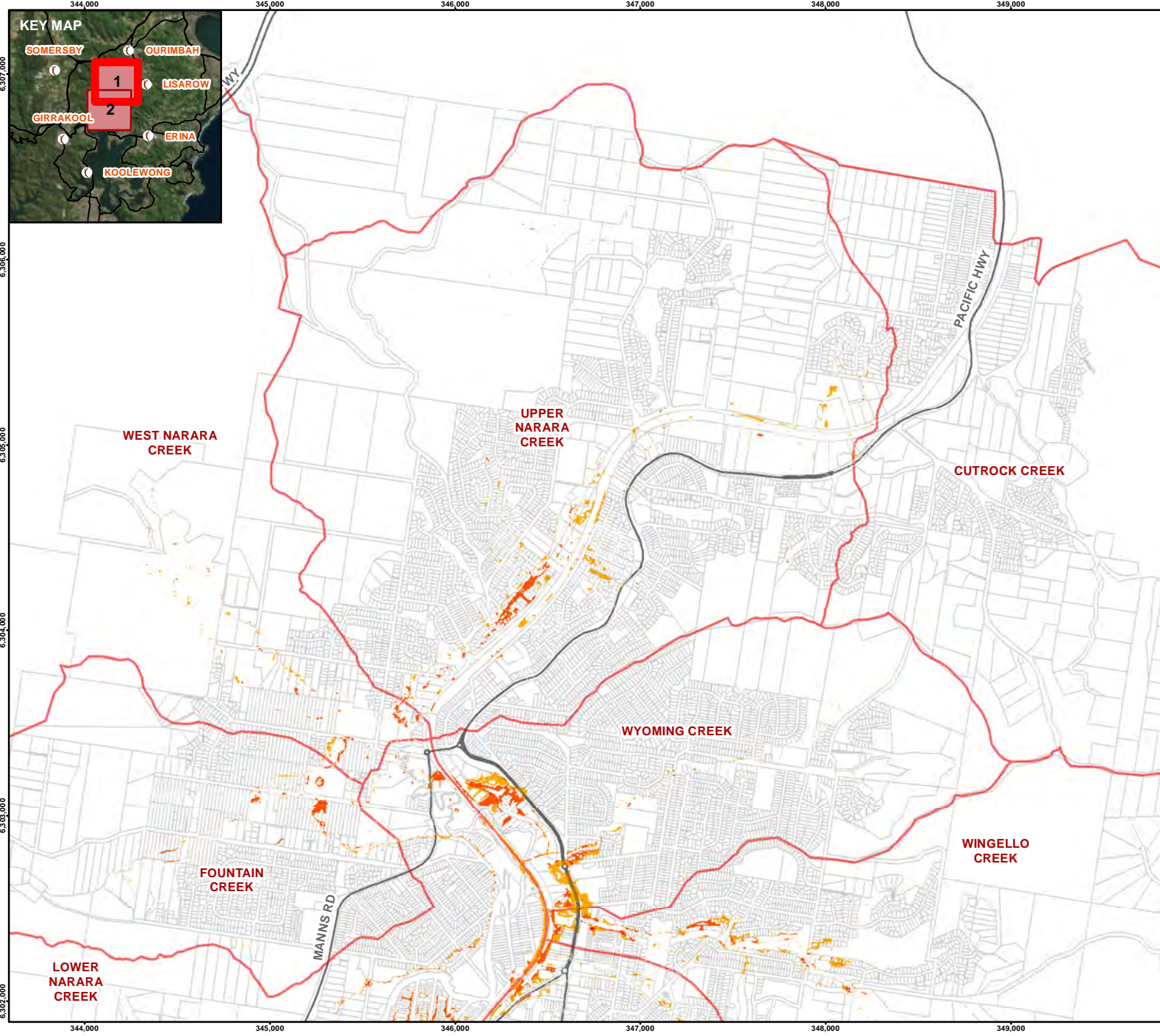
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
INCREASED PEAK DISCHARGE**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. <b>097626068</b>	CONTROL <b>006</b>	REV. <b>G</b>	FIGURE <b>69B</b>
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED PEAK DISCHARGE**

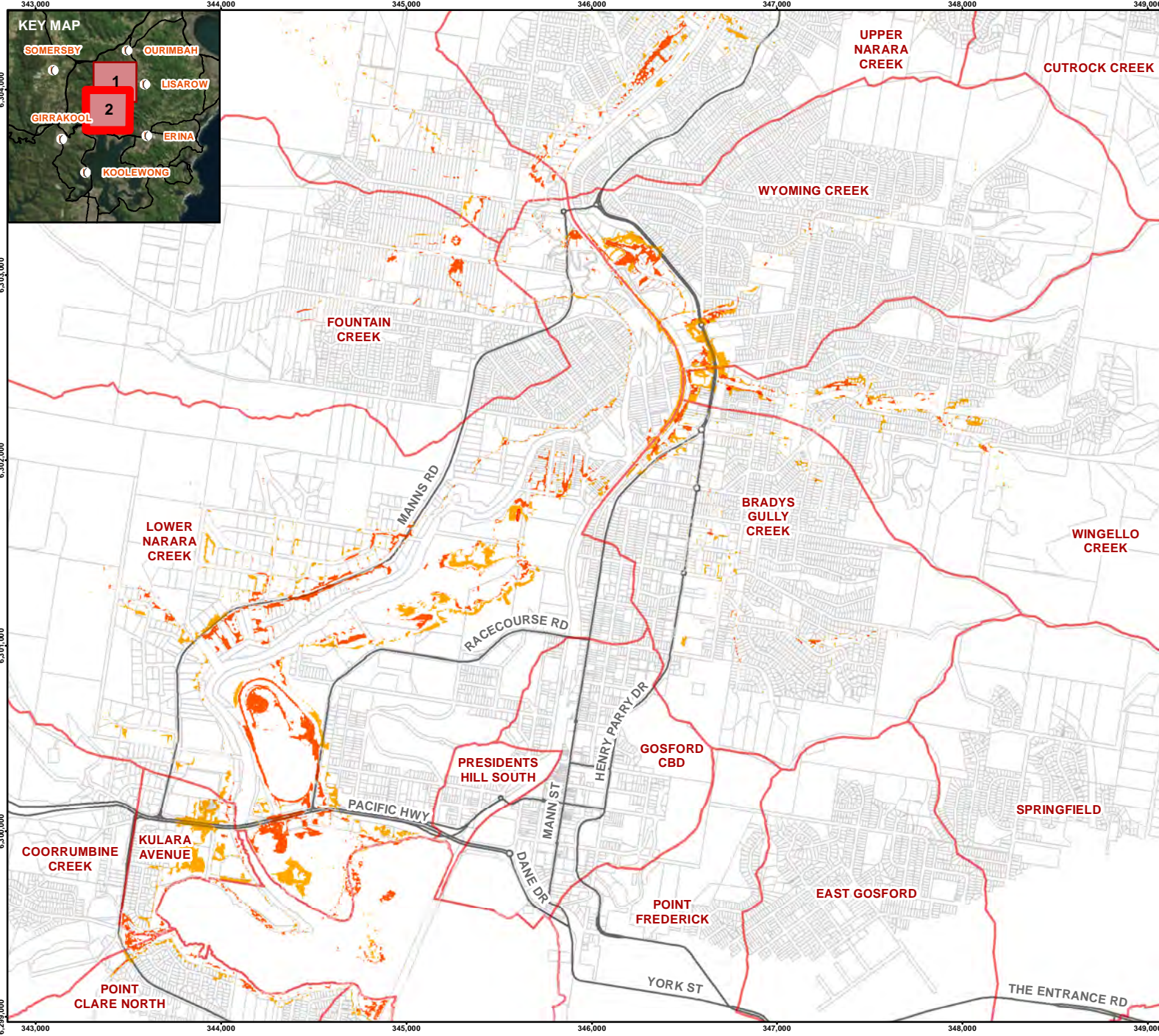
CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	70A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4





**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

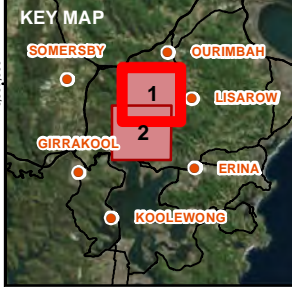
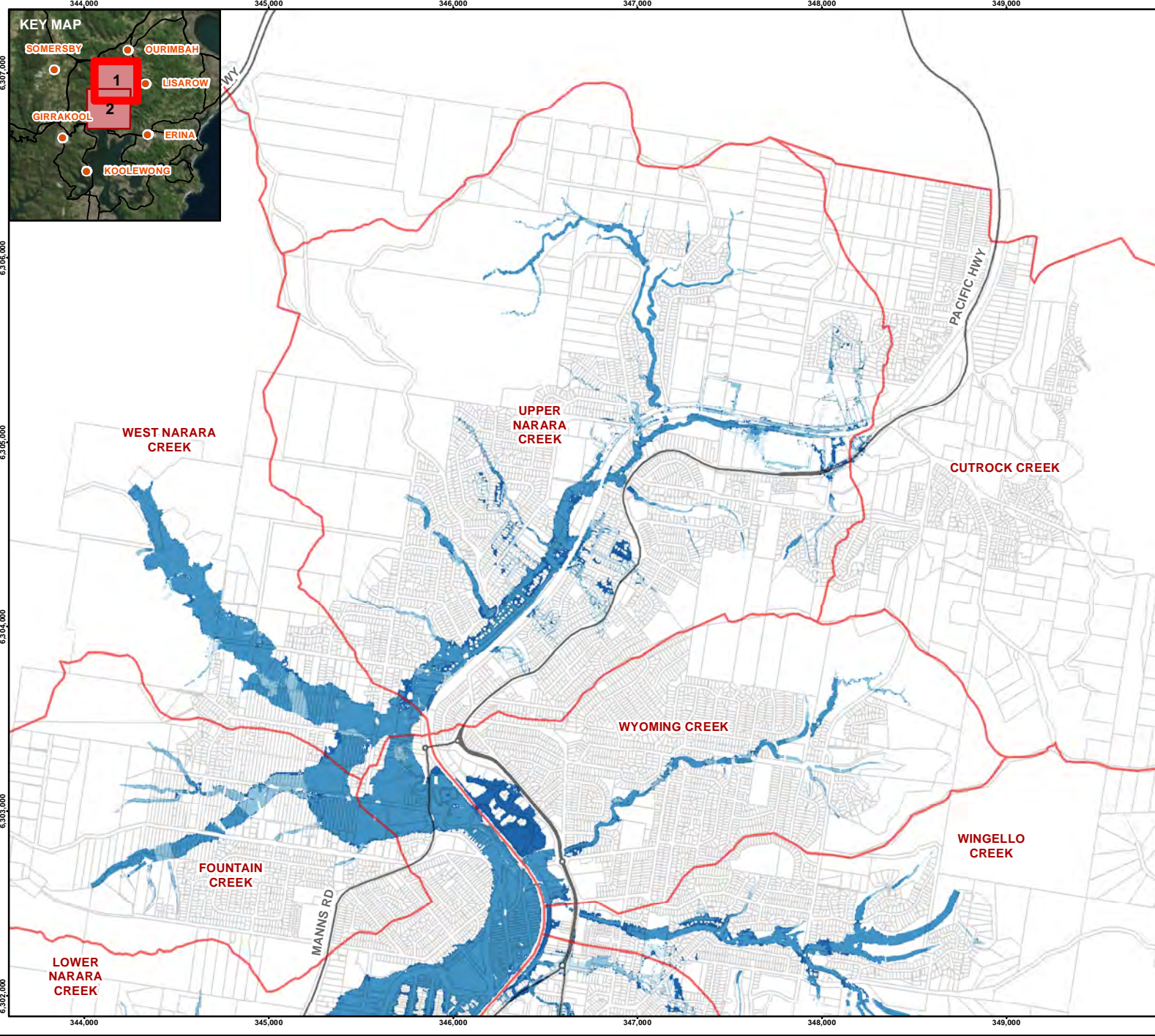
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED PEAK DISCHARGE**

CONSULTANT

DD-MM-YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	70B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

	Less than -1.0 m
	-0.20 m to -1.0 m
	-0.05 m to -0.20 m
	-0.01 m to -0.05 m
	No Change

**N**

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of greater than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT

**CENTRAL COAST COUNCIL**

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

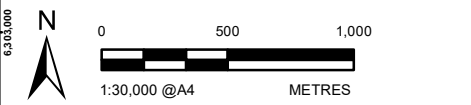
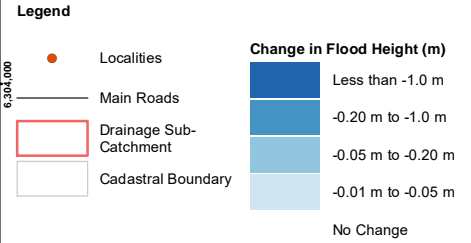
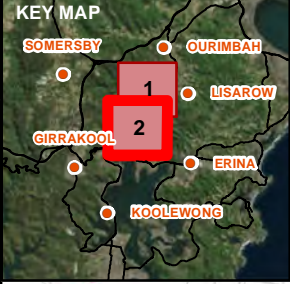
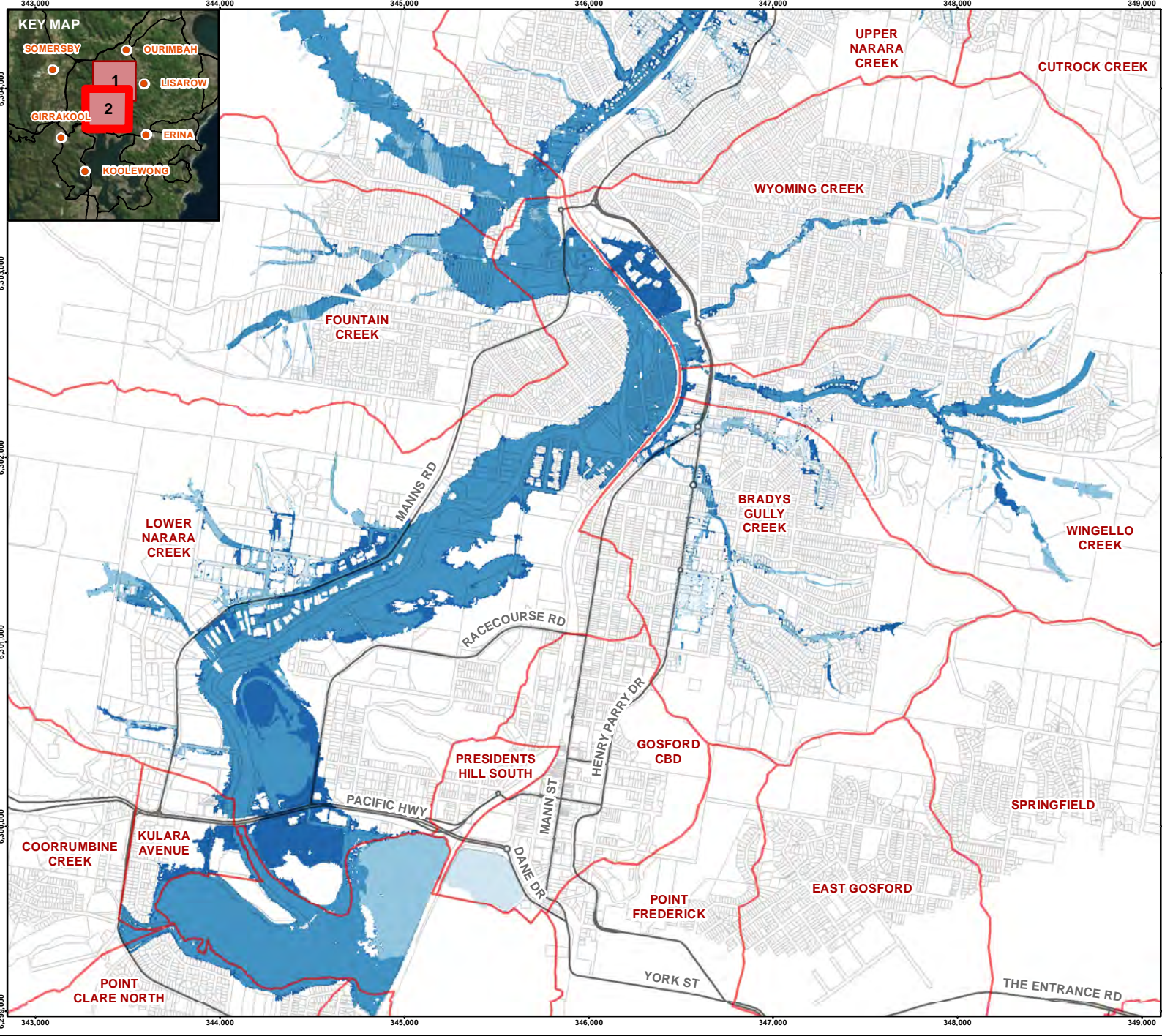
**CHANGE IN FLOOD HEIGHT (M)  
 DECREASED PEAK DISCHARGE**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	71A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of greater than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

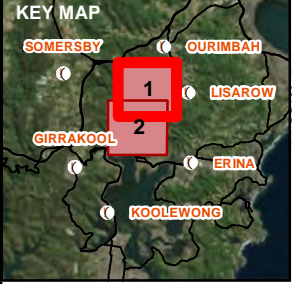
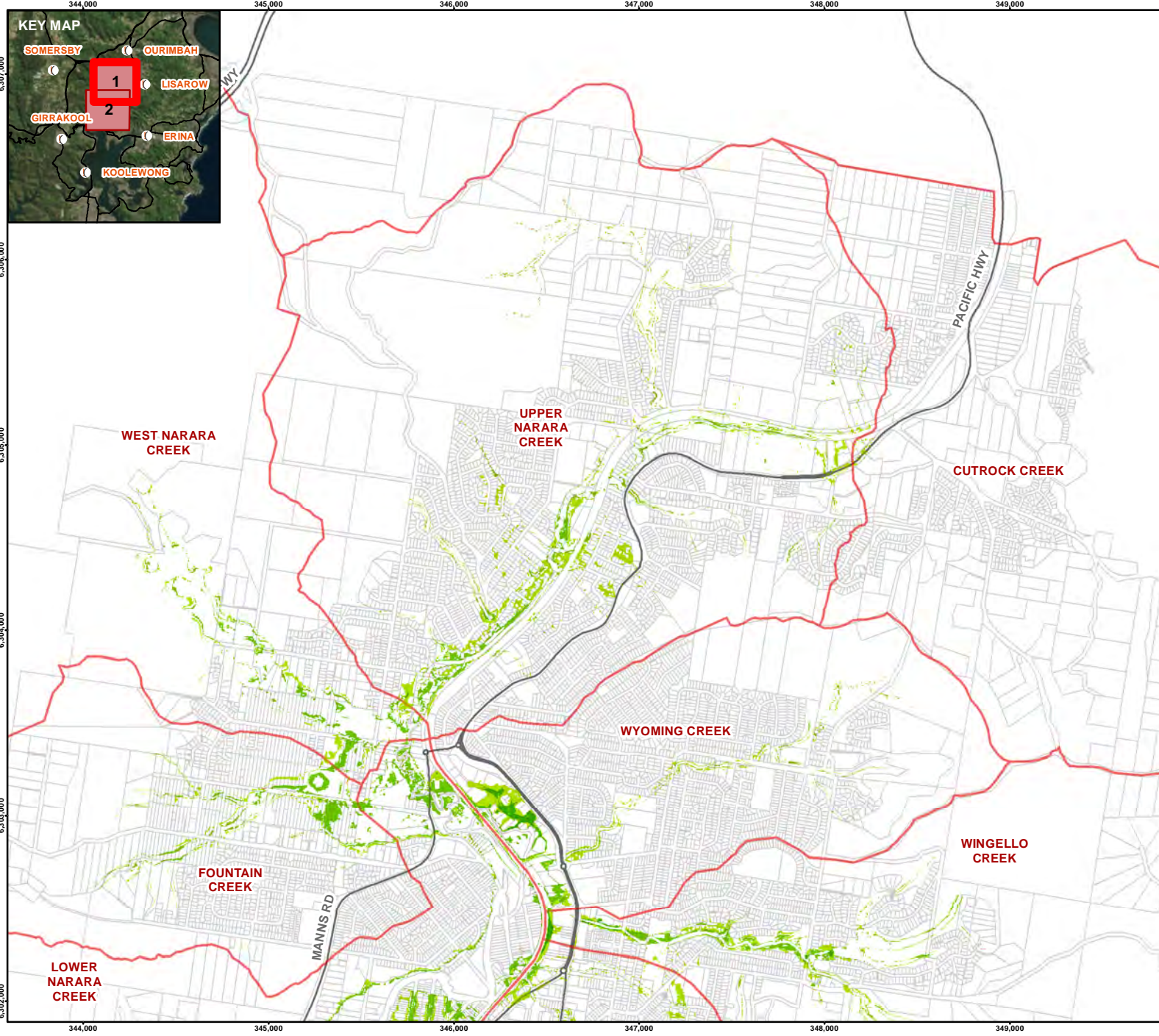
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 DECREASED PEAK DISCHARGE**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **71B**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
  - Main Roads
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary
- Change in Provisional Flood Hazard**
- High to Dry
  - High to Low
  - Low to Dry
  - No Change
  - Dry to Low
  - Low to High
  - Dry to High



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

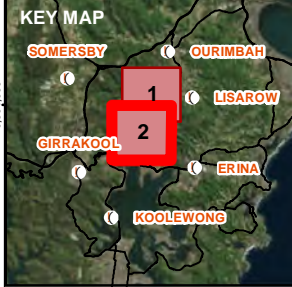
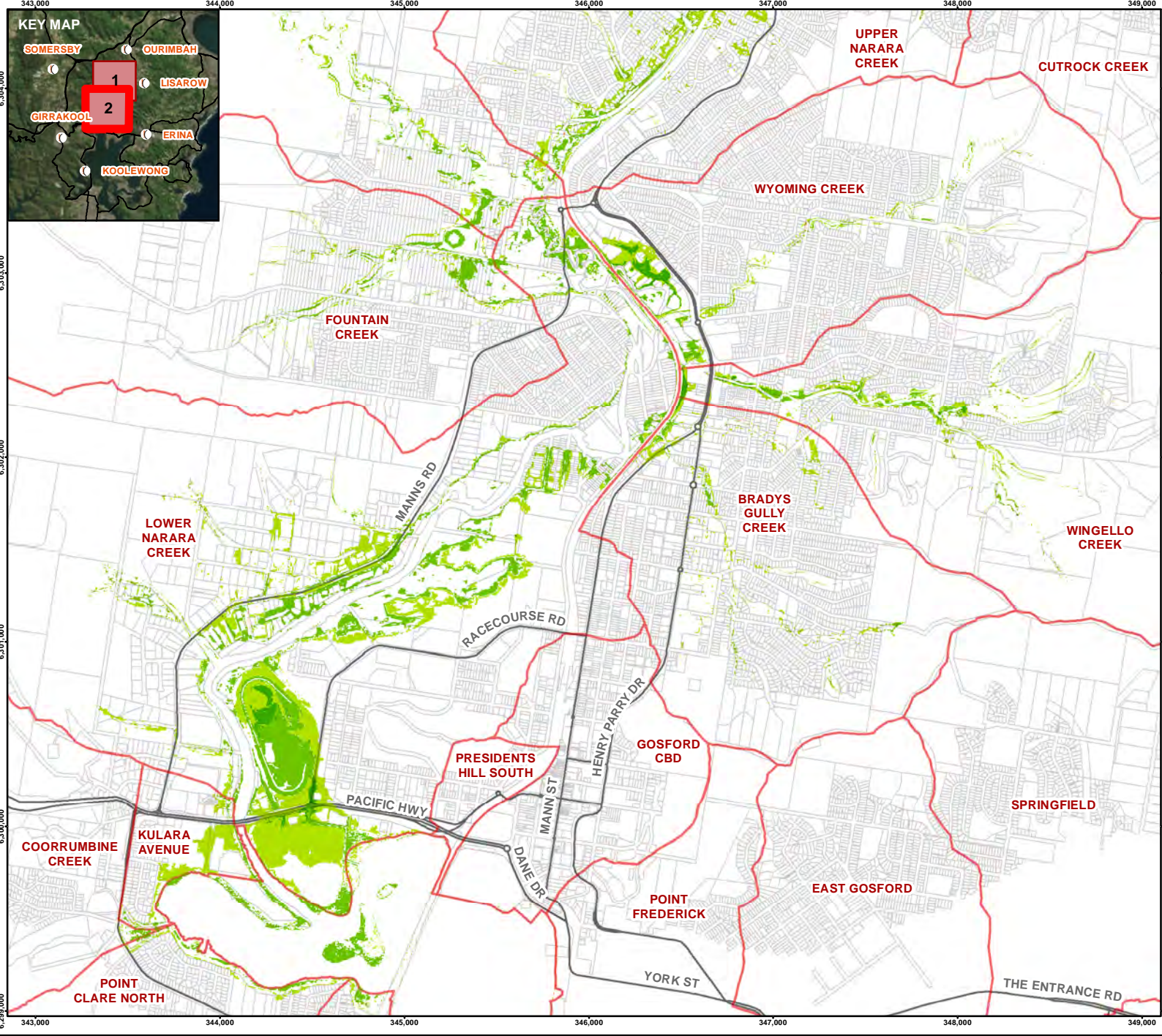
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD DECREASED PEAK DISCHARGE**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	72A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

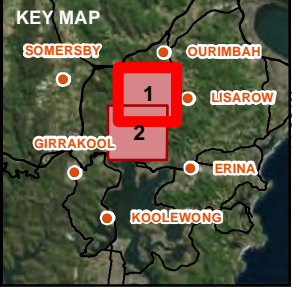
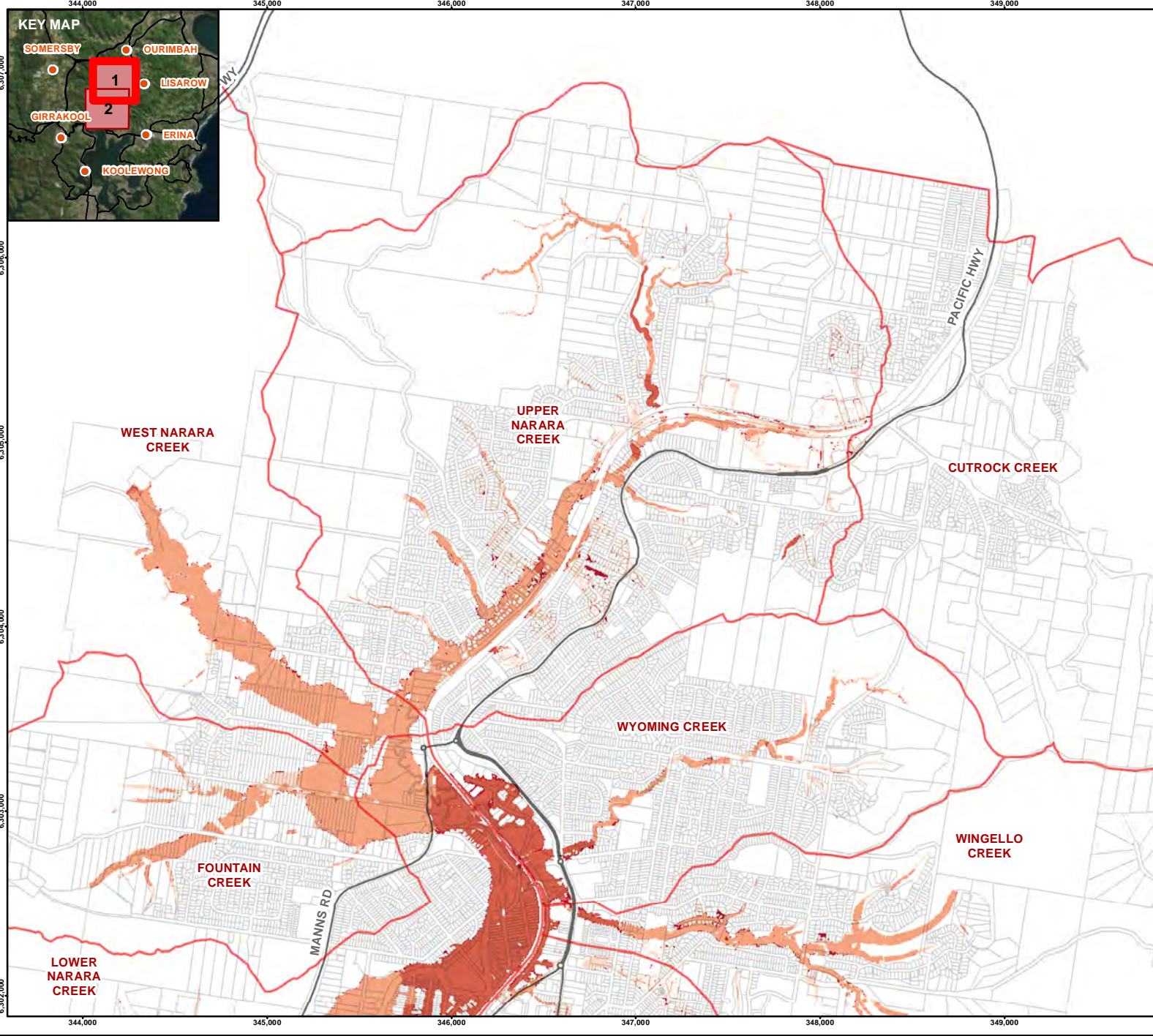
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD DECREASED PEAK DISCHARGE**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	72B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

N

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

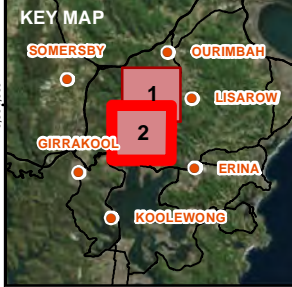
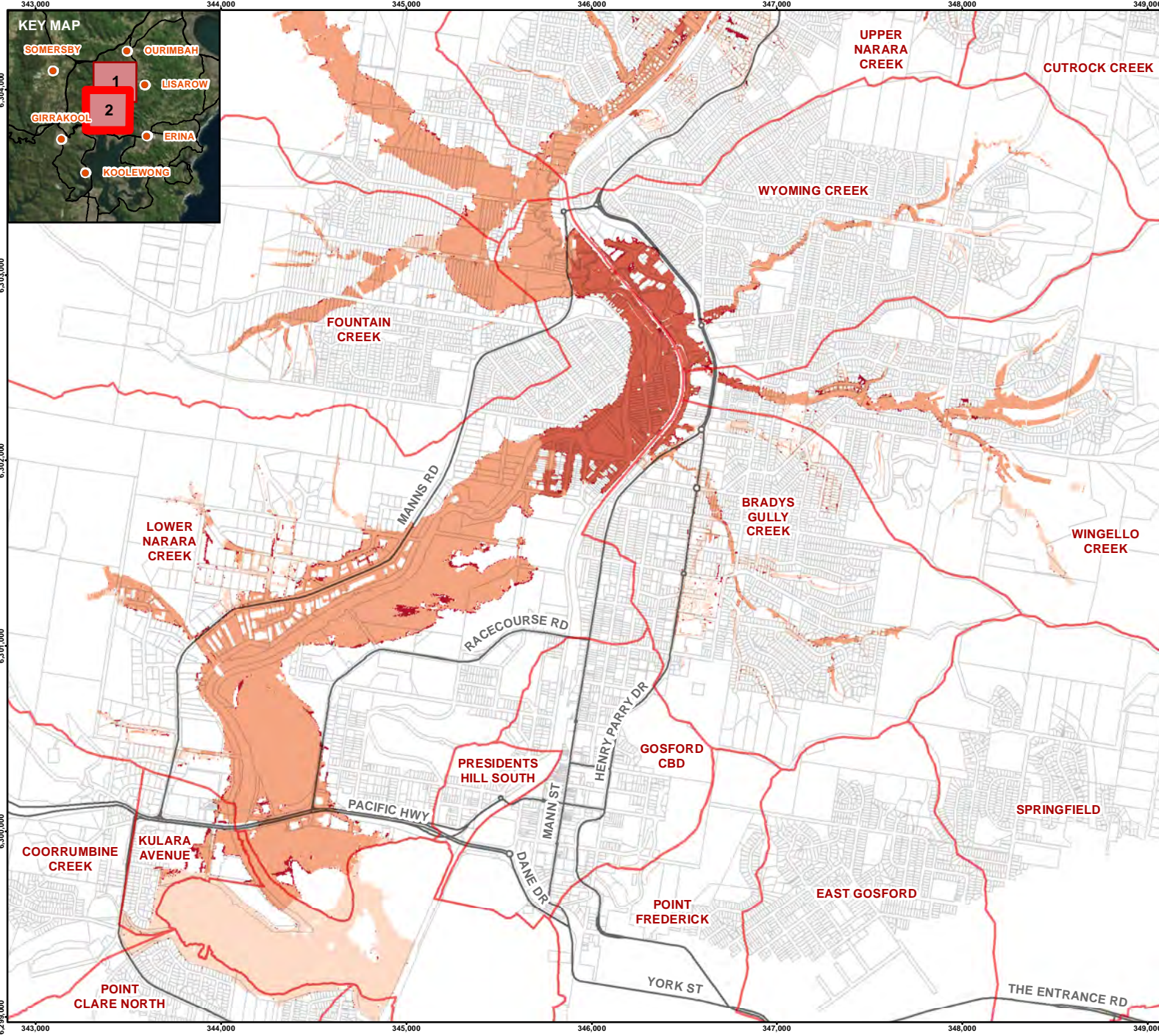
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED HYDRAULIC ROUGHNESS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	73A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

N

0 500 1,000

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

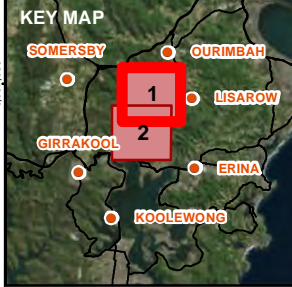
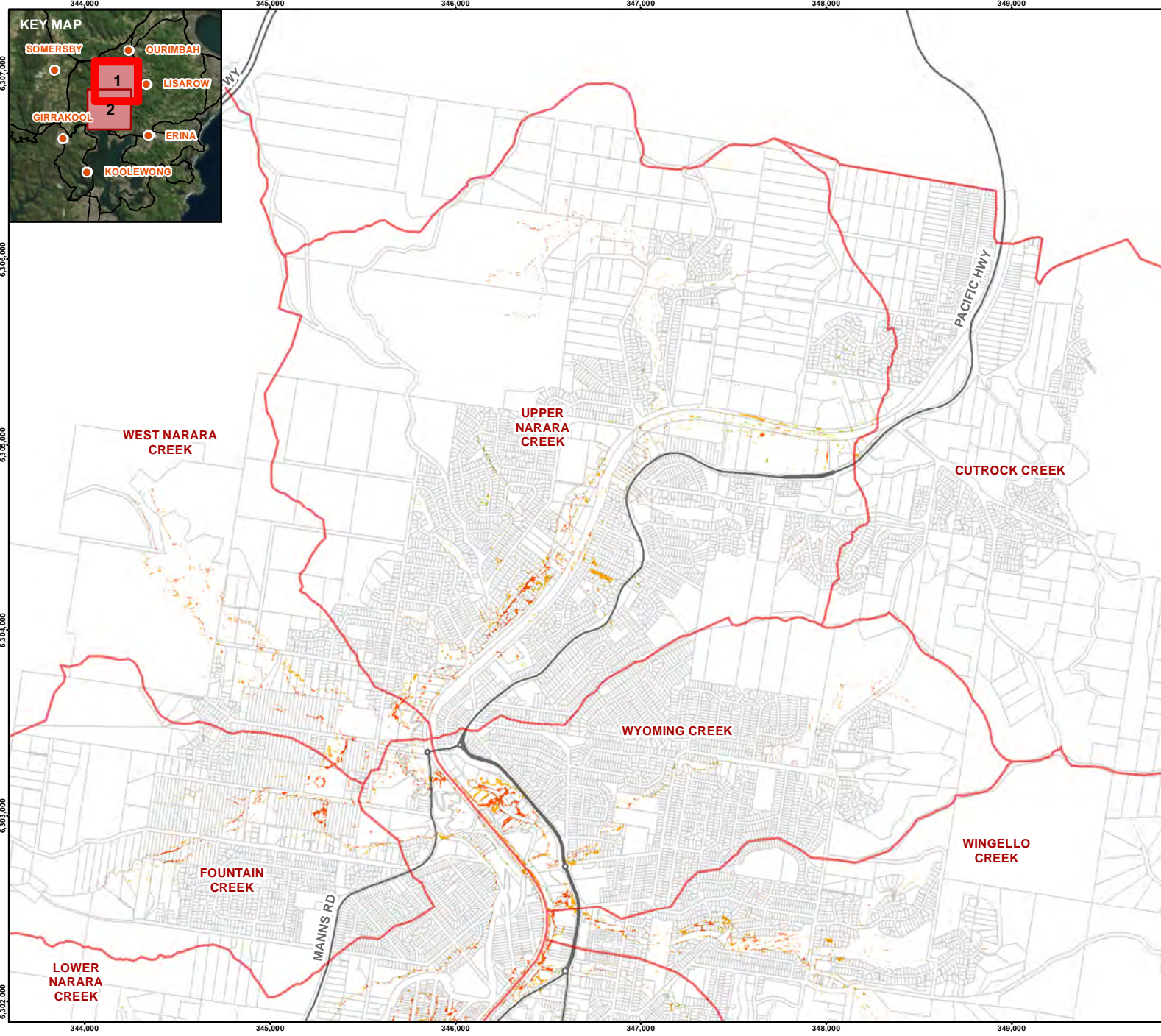
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED HYDRAULIC ROUGHNESS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	73B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018


**CLIENT**  
CENTRAL COAST COUNCIL

**PROJECT**  
NARARA CREEK FLOOD STUDY

**TITLE**  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
INCREASED HYDRAULIC ROUGHNESS**

**CONSULTANT**

**CONSULTANT**



DD/MM/YYYY 3/04/2018

DESIGNED SL

PREPARED HB

REVIEWED NM

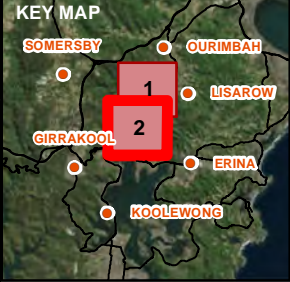
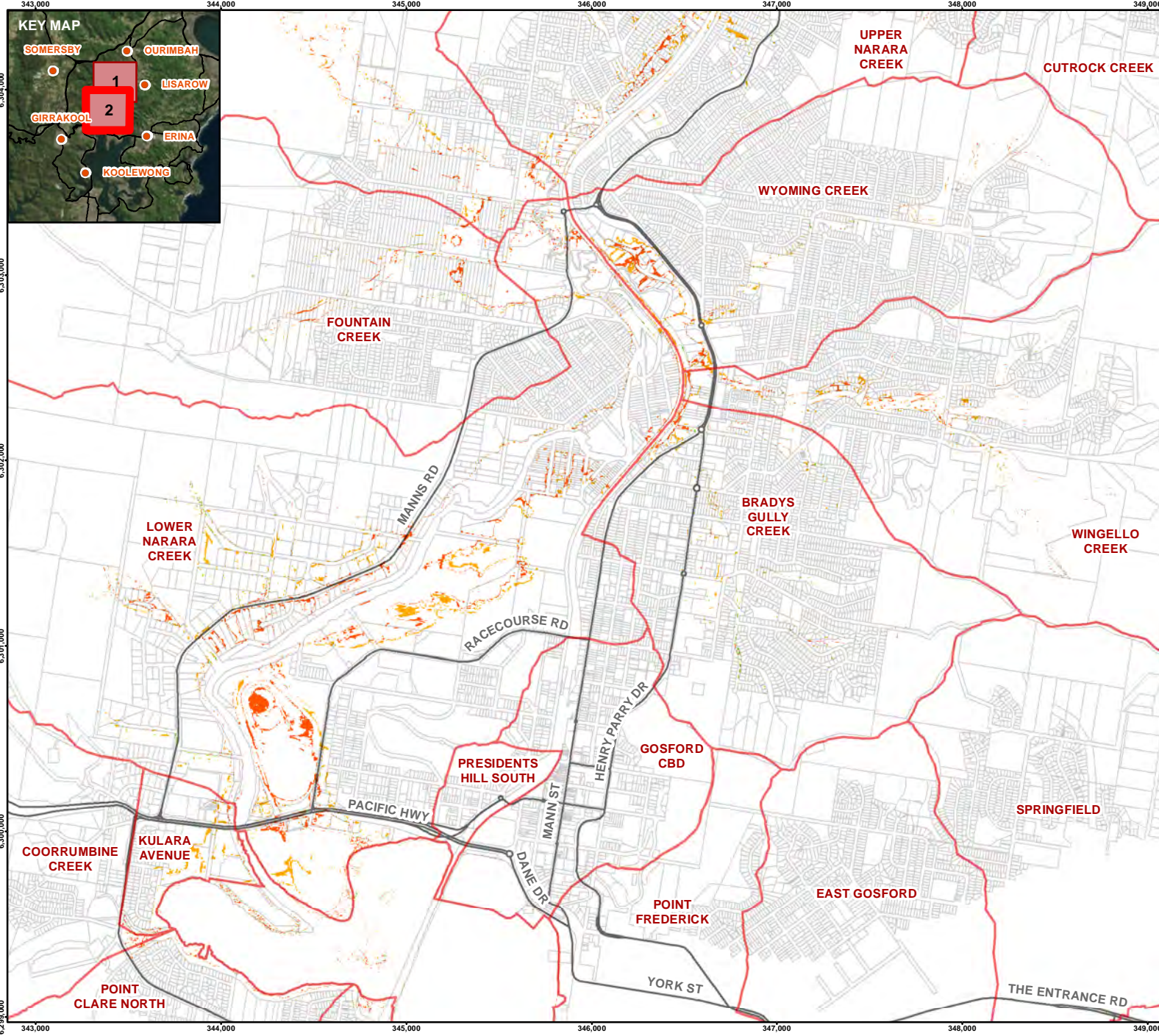
APPROVED NM

**PROJECT NO.** 097626068    **CONTROL** 006    **REV.** G    **FIGURE** 74A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

25mm





**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

N

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

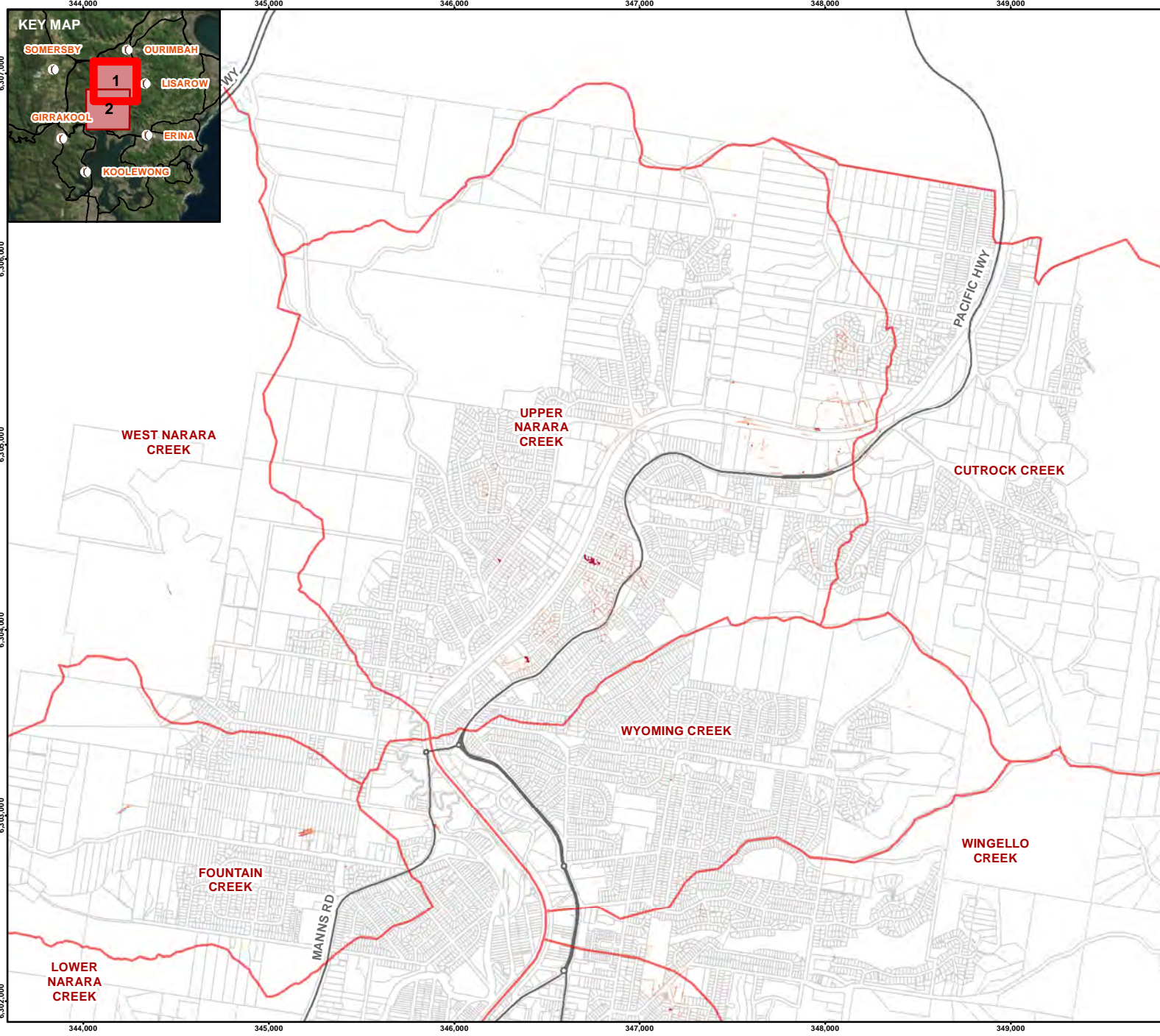
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 INCREASED HYDRAULIC ROUGHNESS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	HB
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **74B**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
  - Main Roads
  - [Red Outline] Drainage Sub-Catchment
  - [White Box] Cadastral Boundary
- Change in Flood Height (m)**
- No Change
  - 0.01 m to 0.05 m
  - 0.05 m to 0.20 m
  - 0.20 m to 1.0 m
  - More than 1.0 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

**CLIENT**

CENTRAL COAST COUNCIL

**PROJECT**

NARARA CREEK FLOOD STUDY

**TITLE**

**CHANGE IN FLOOD HEIGHT (M)  
 DECREASED HYDRAULIC ROUGHNESS**

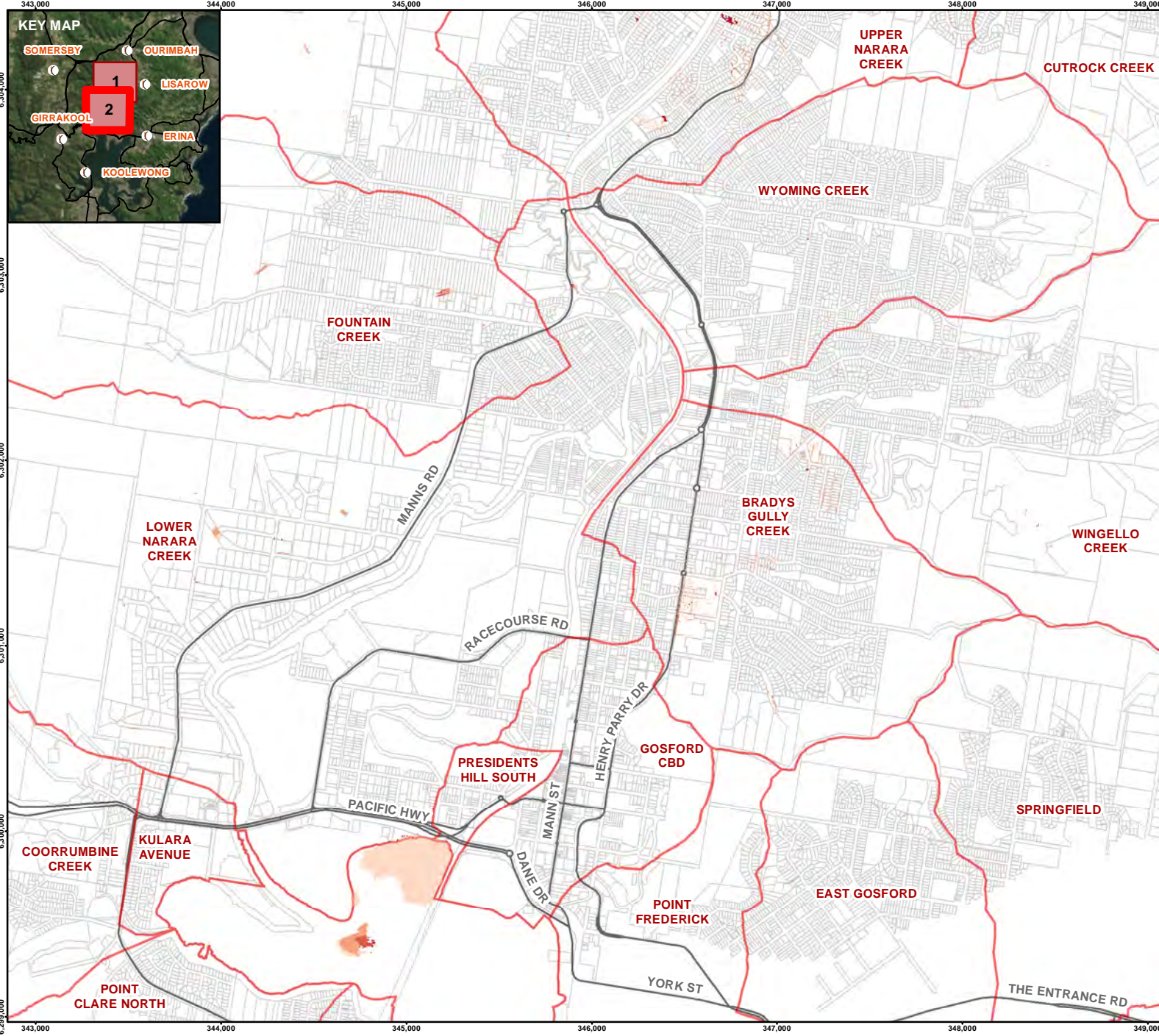
**CONSULTANT**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

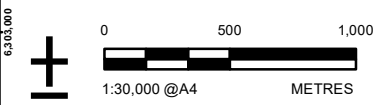
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	75A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
  - Main Roads
  - Drainage Sub-Catchment
  - Cadastral Boundary
- Change in Flood Height (m)**
- No Change
  - 0.01 m to 0.05 m
  - 0.05 m to 0.20 m
  - 0.20 m to 1.0 m
  - More than 1.0 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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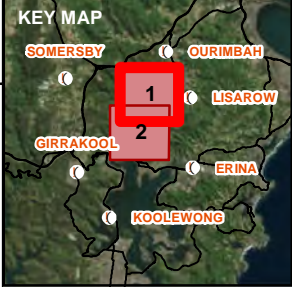
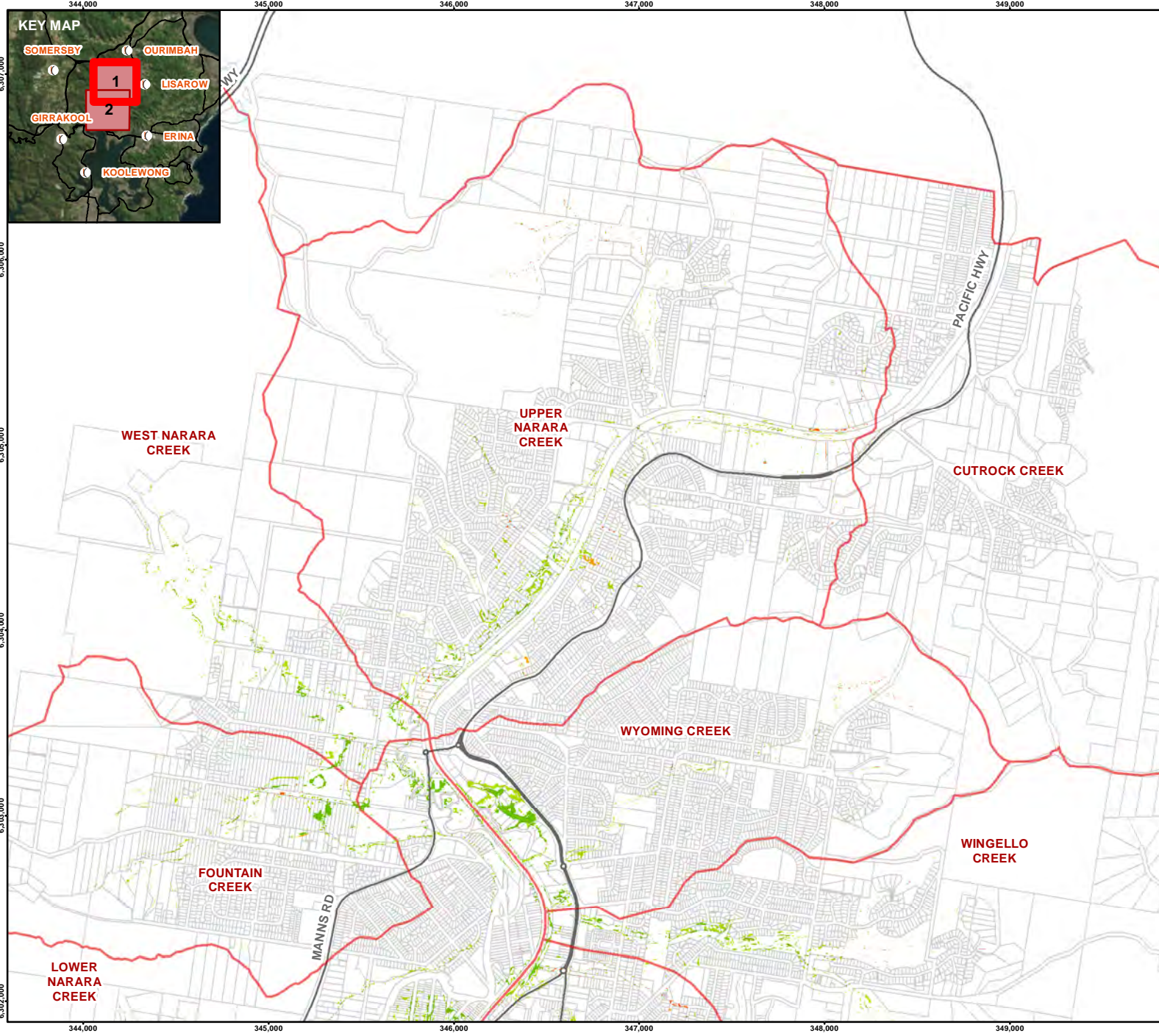
Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

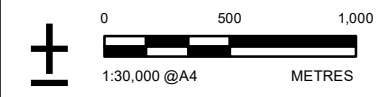
CLIENT			
CENTRAL COAST COUNCIL			
PROJECT			
NARARA CREEK FLOOD STUDY			
TITLE			
<b>CHANGE IN FLOOD HEIGHT (M) DECREASED HYDRAULIC ROUGHNESS</b>			
CONSULTANT			
DD/MM/YYYY	3/04/2018		
DESIGNED	SL		
PREPARED	DC		
REVIEWED	NM		
APPROVED	NM		
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	75B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

( )	Localities		Change in Provisional Flood Hazard
—	Main Roads	■	High to Dry
▭	Drainage Sub-Catchment	■	High to Low
▭	Cadastral Boundary	■	Low to Dry
		■	No Change
		■	Dry to Low
		■	Low to High
		■	Dry to High



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
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**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD DECREASED HYDRAULIC ROUGHNESS**

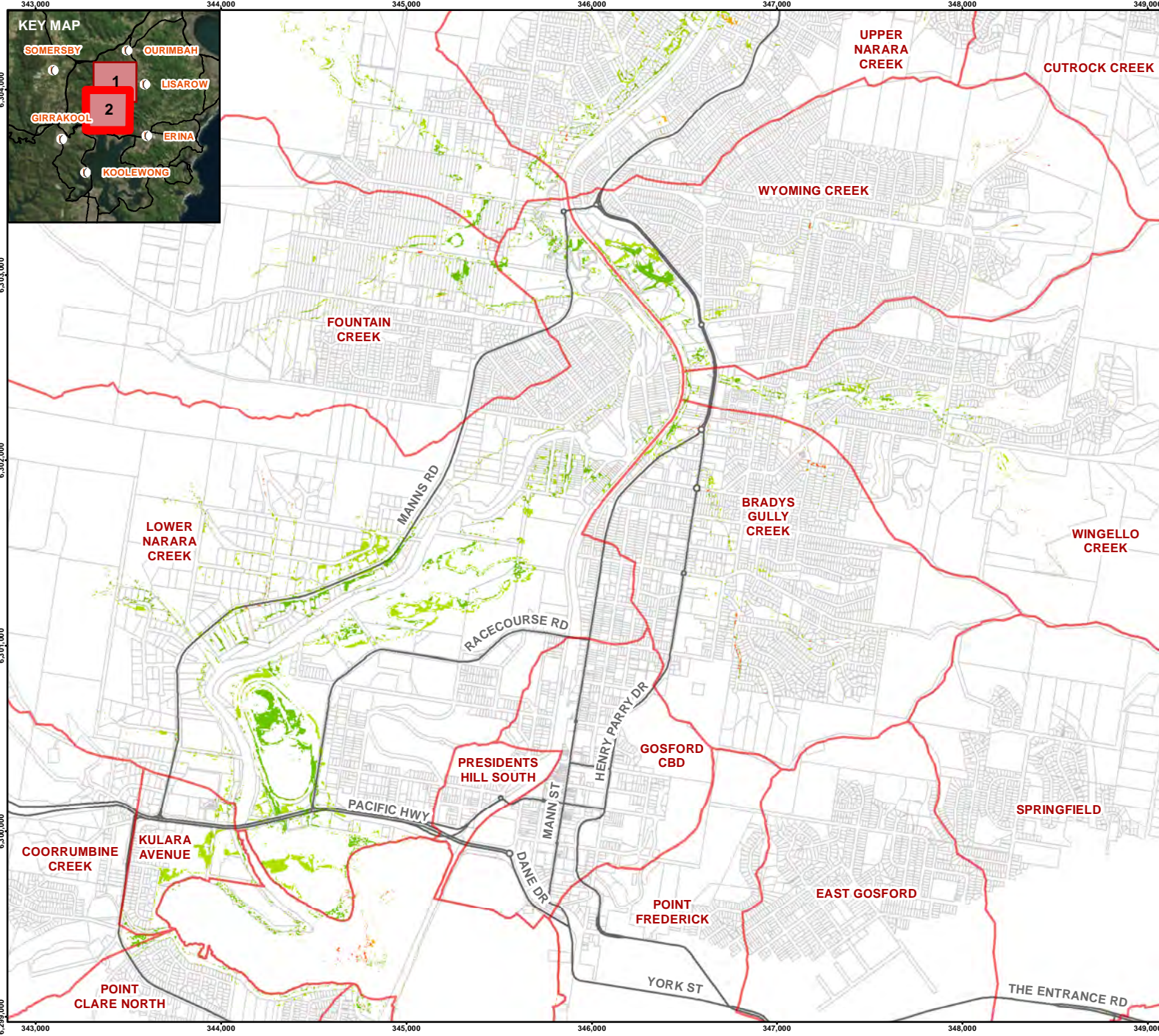
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	76A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
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**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

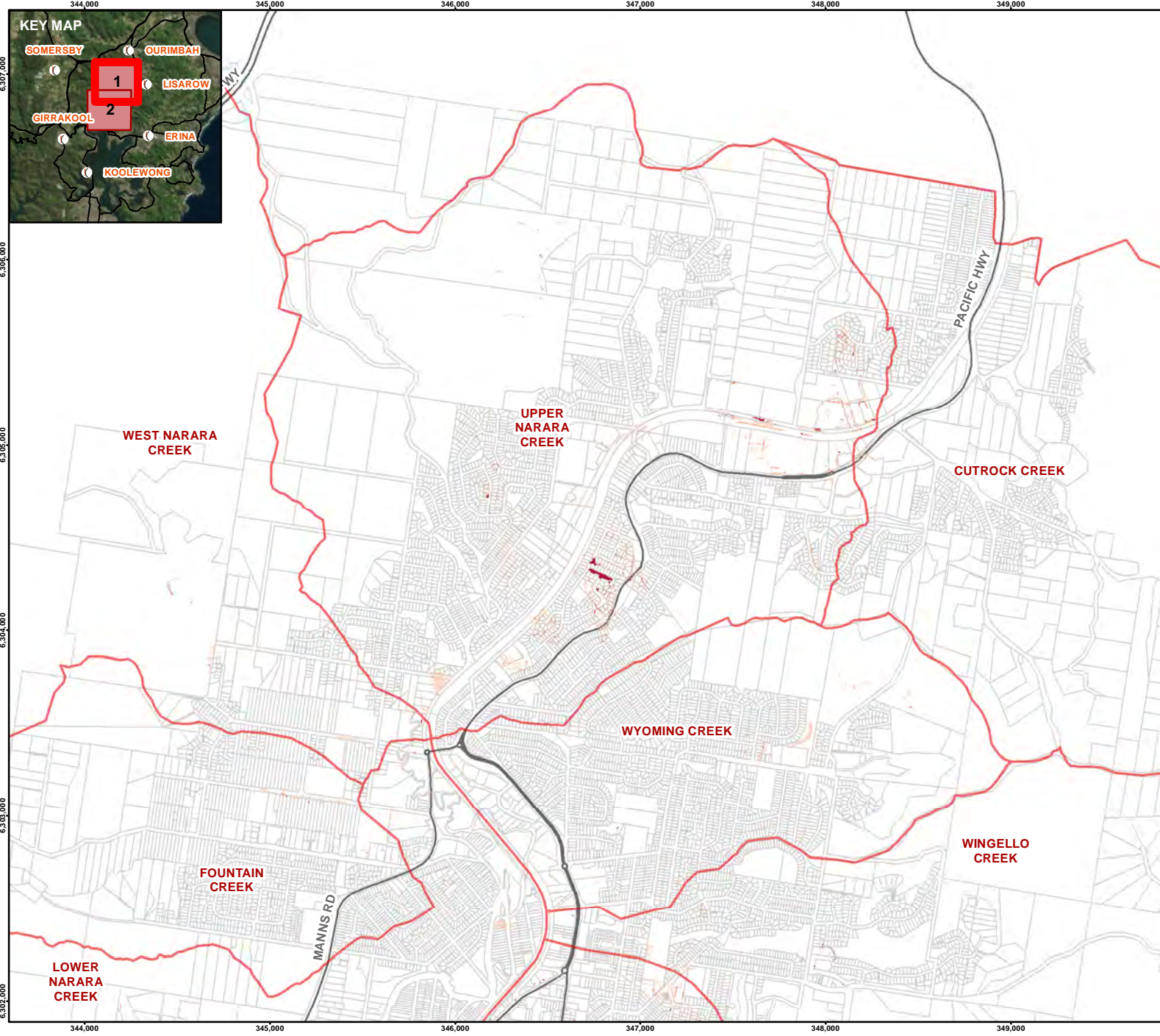
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 DECREASED HYDRAULIC ROUGHNESS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	76B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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 Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

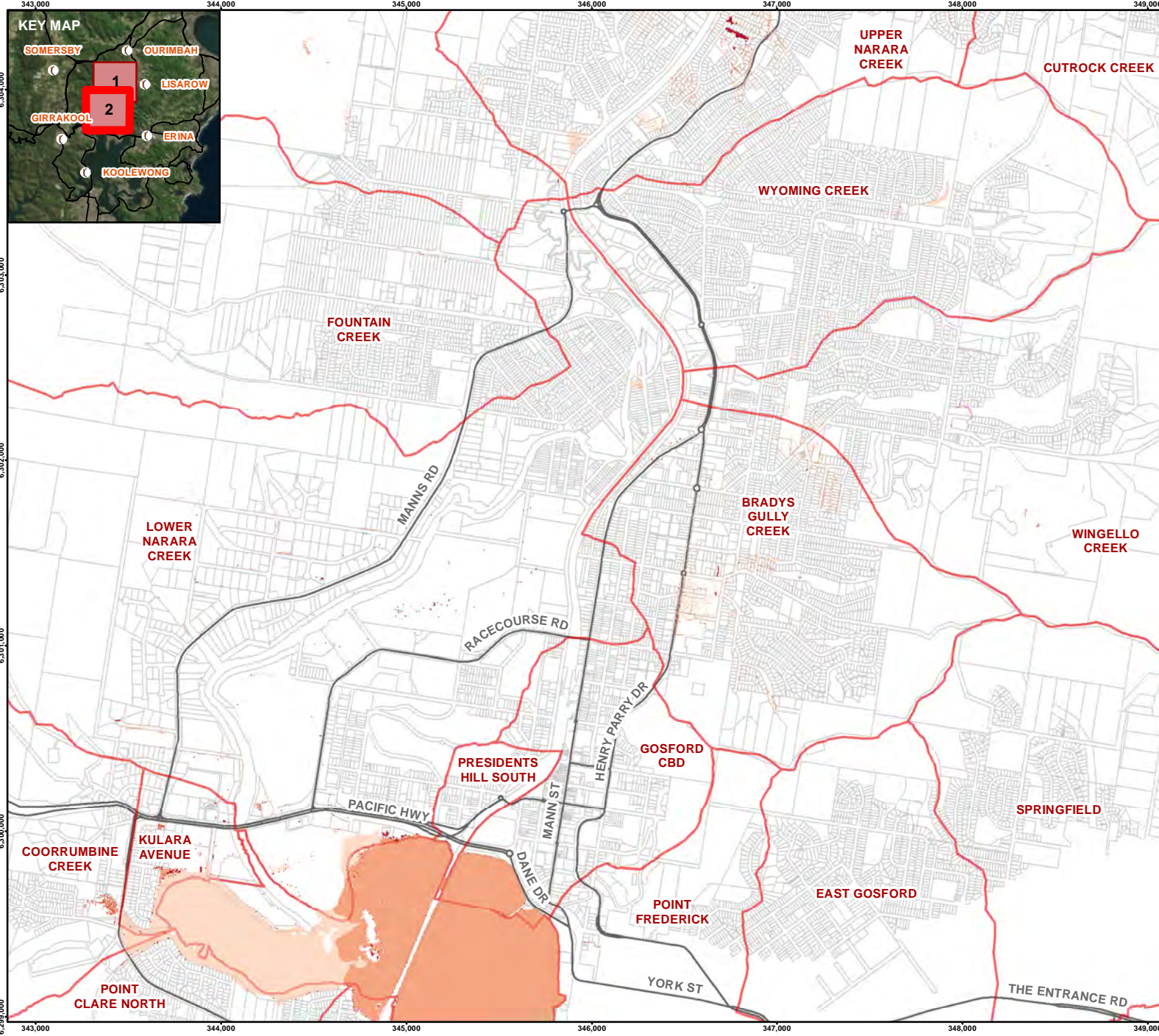
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED TAILWATER LEVEL**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	77A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Result filtered for changes in flood height of less than 0 m

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

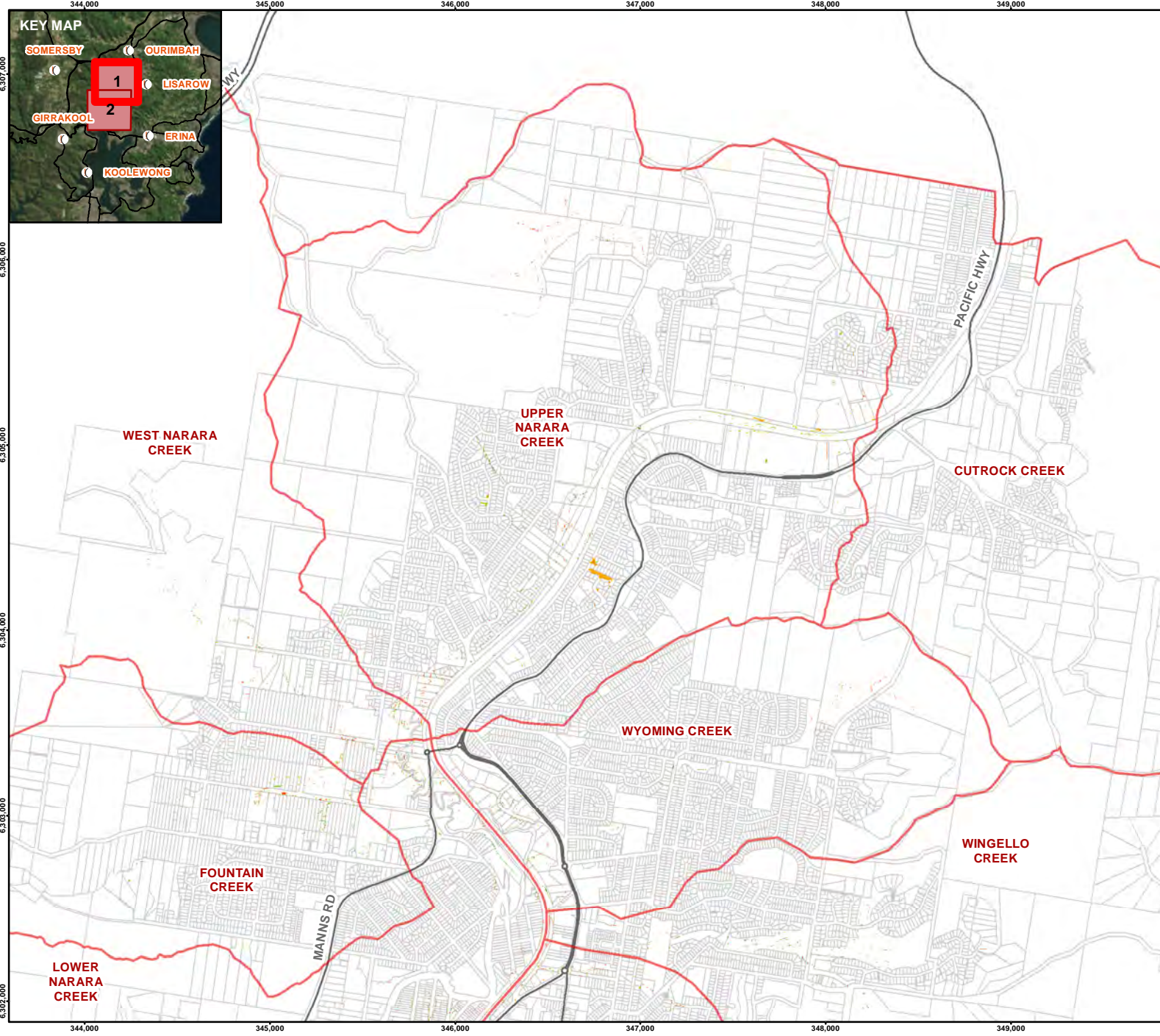
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED TAILWATER LEVEL**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **77B**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED TAILWATER LEVEL**

CONSULTANT



DD/MM/YYYY 3/04/2018

DESIGNED SL

PREPARED DC

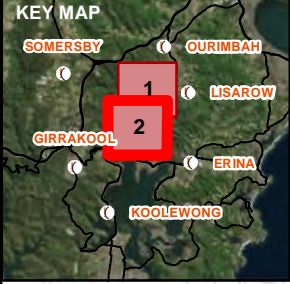
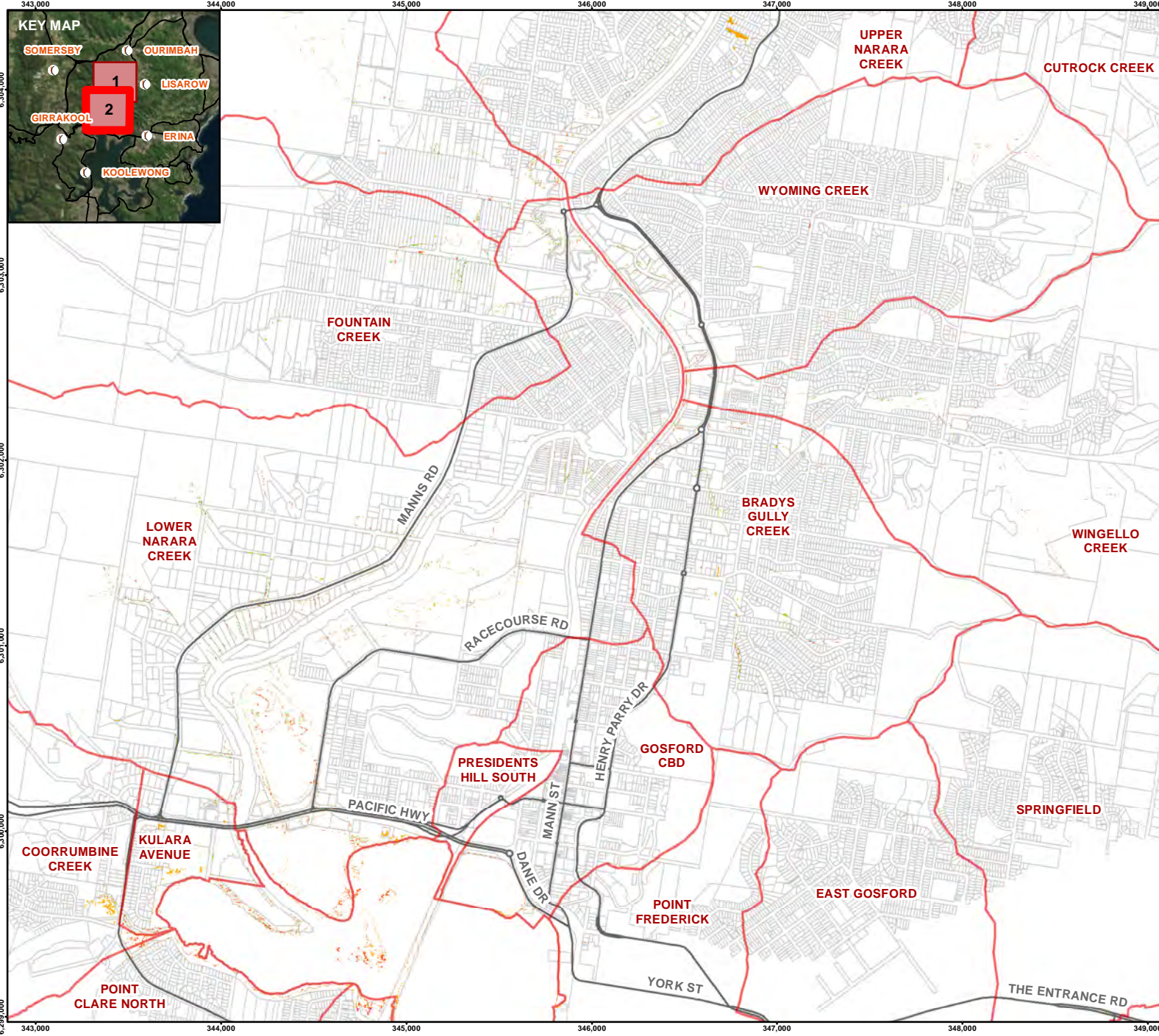
REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 78A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



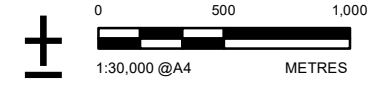


**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

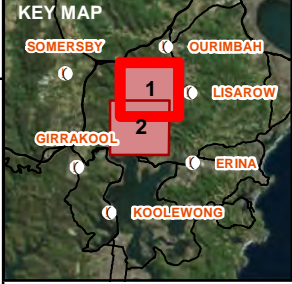
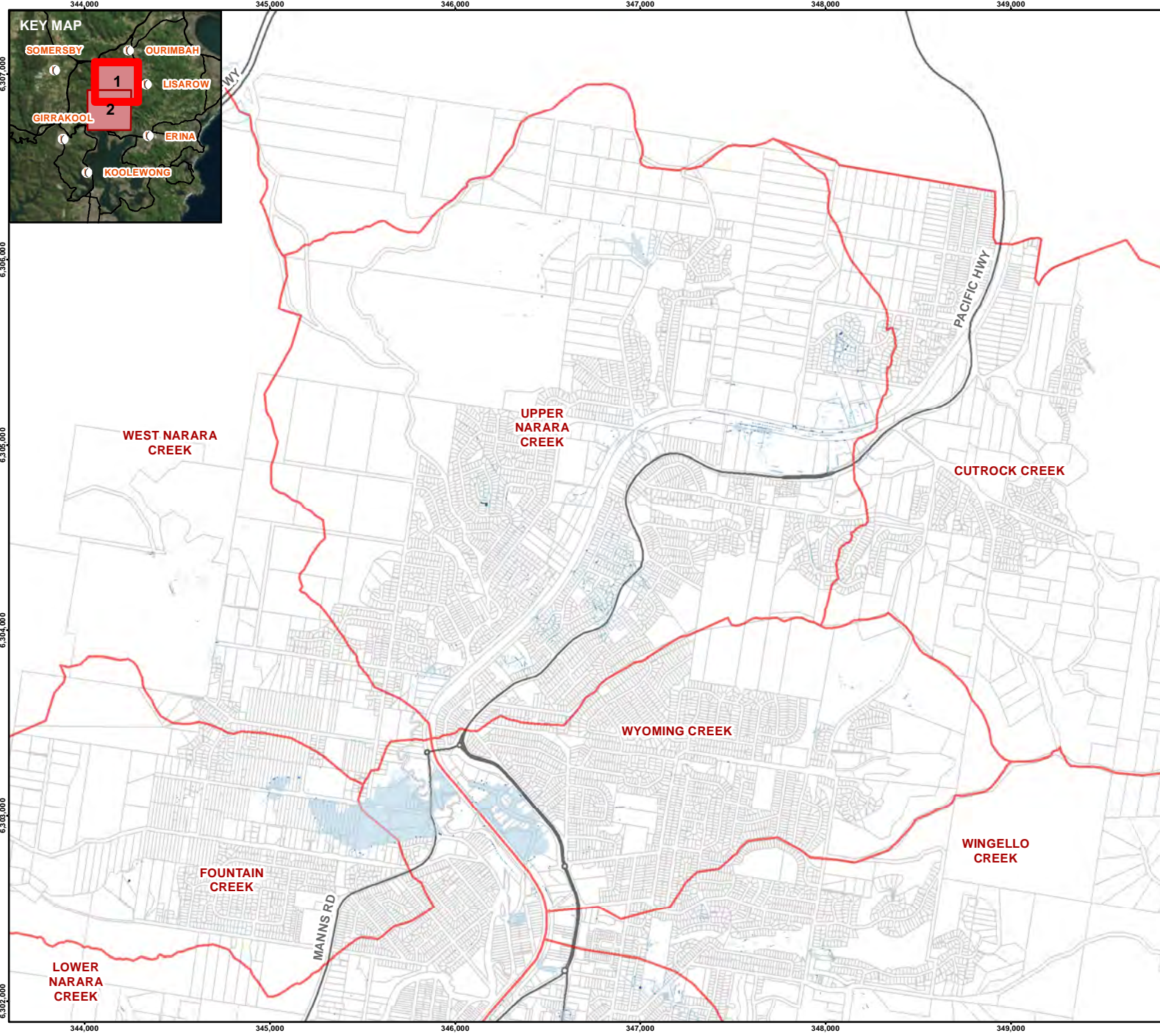
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED TAILWATER LEVEL**

CONSULTANT  
**Golder Associates**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **78B**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- Less than -1.0 m
- 0.20 m to -1.0 m
- 0.05 m to -0.20 m
- 0.01 m to -0.05 m
- No Change

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Result filtered for changes in flood height of greater than 0 m.

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 DECREASED TAILWATER LEVEL**

CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED SL

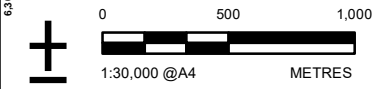
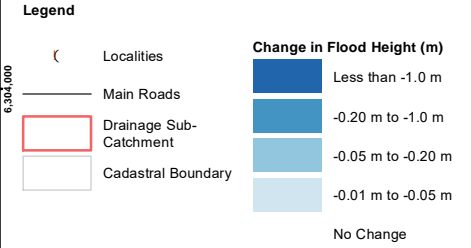
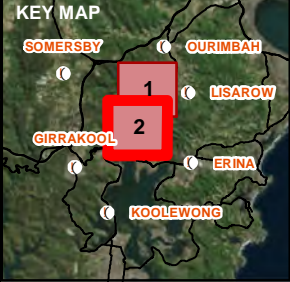
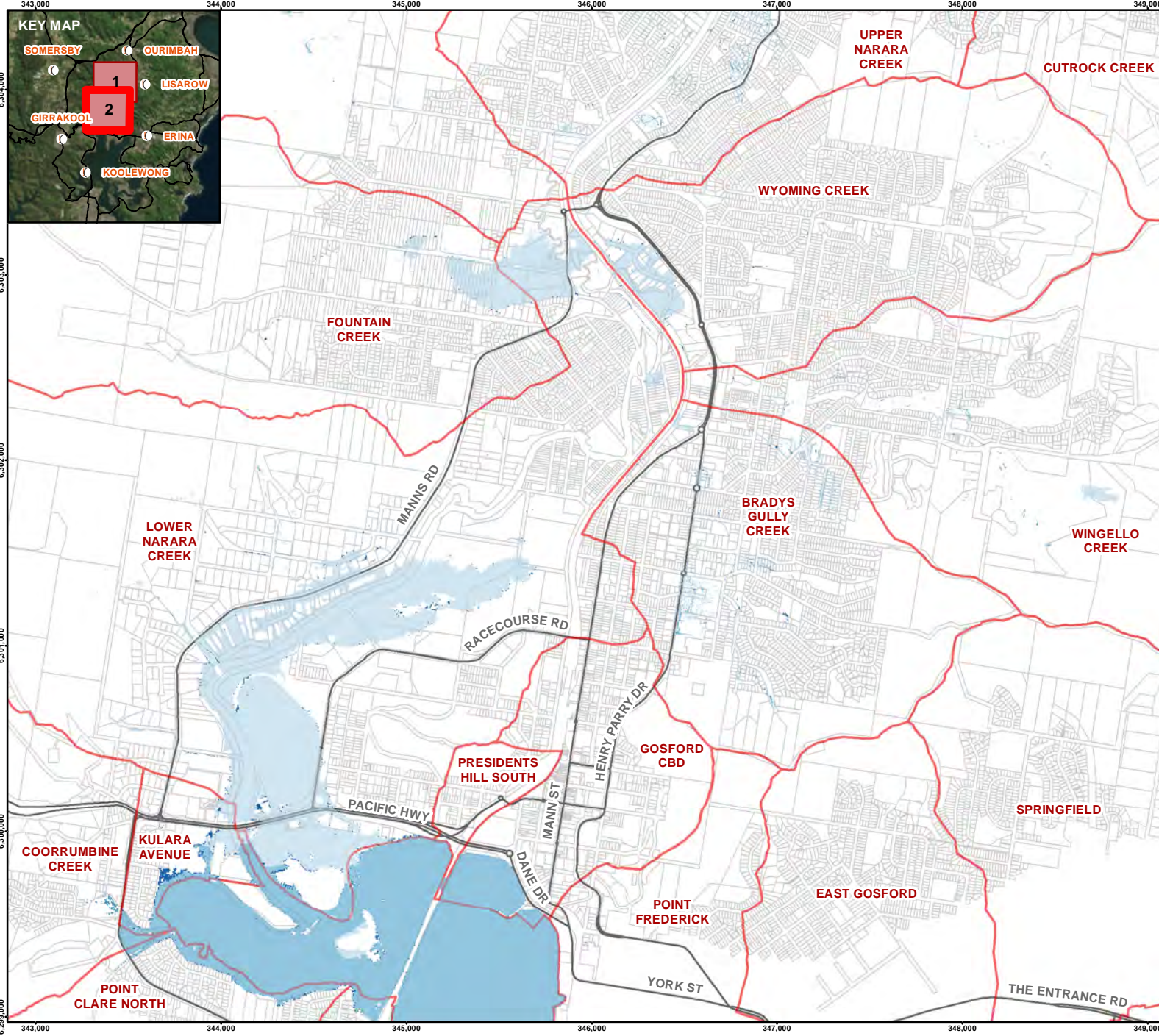
PREPARED DC

REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 79A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Result filtered for changes in flood height of greater than 0 m.  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

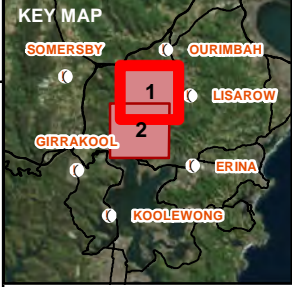
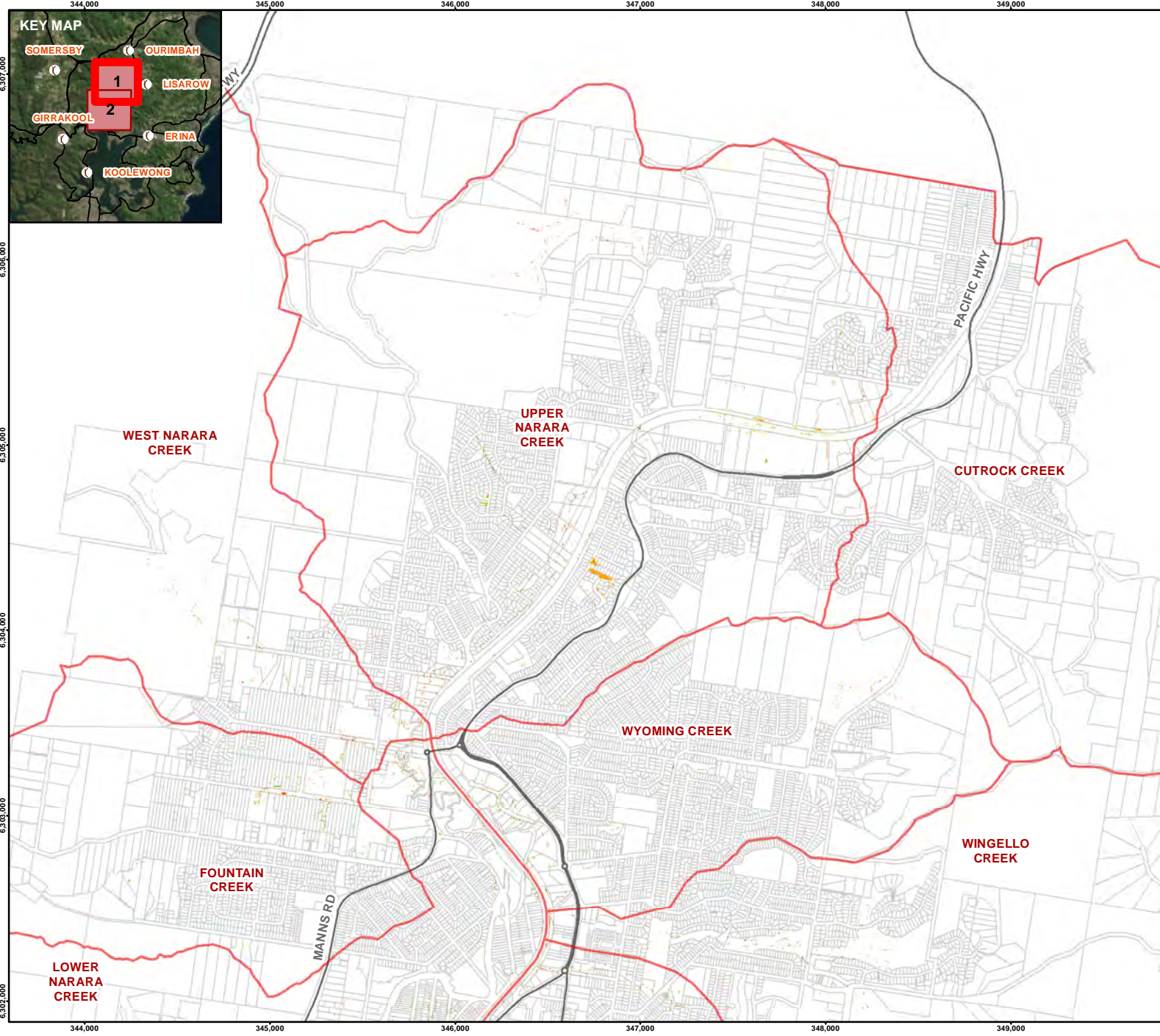
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 DECREASED TAILWATER LEVEL**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **79B**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
 CENTRAL COAST COUNCIL

PROJECT  
 NARARA CREEK FLOOD STUDY

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD DECREASED TAILWATER LEVEL**

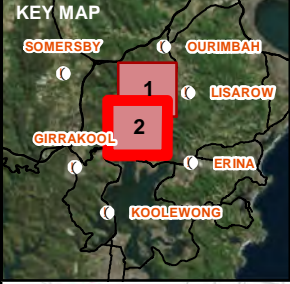
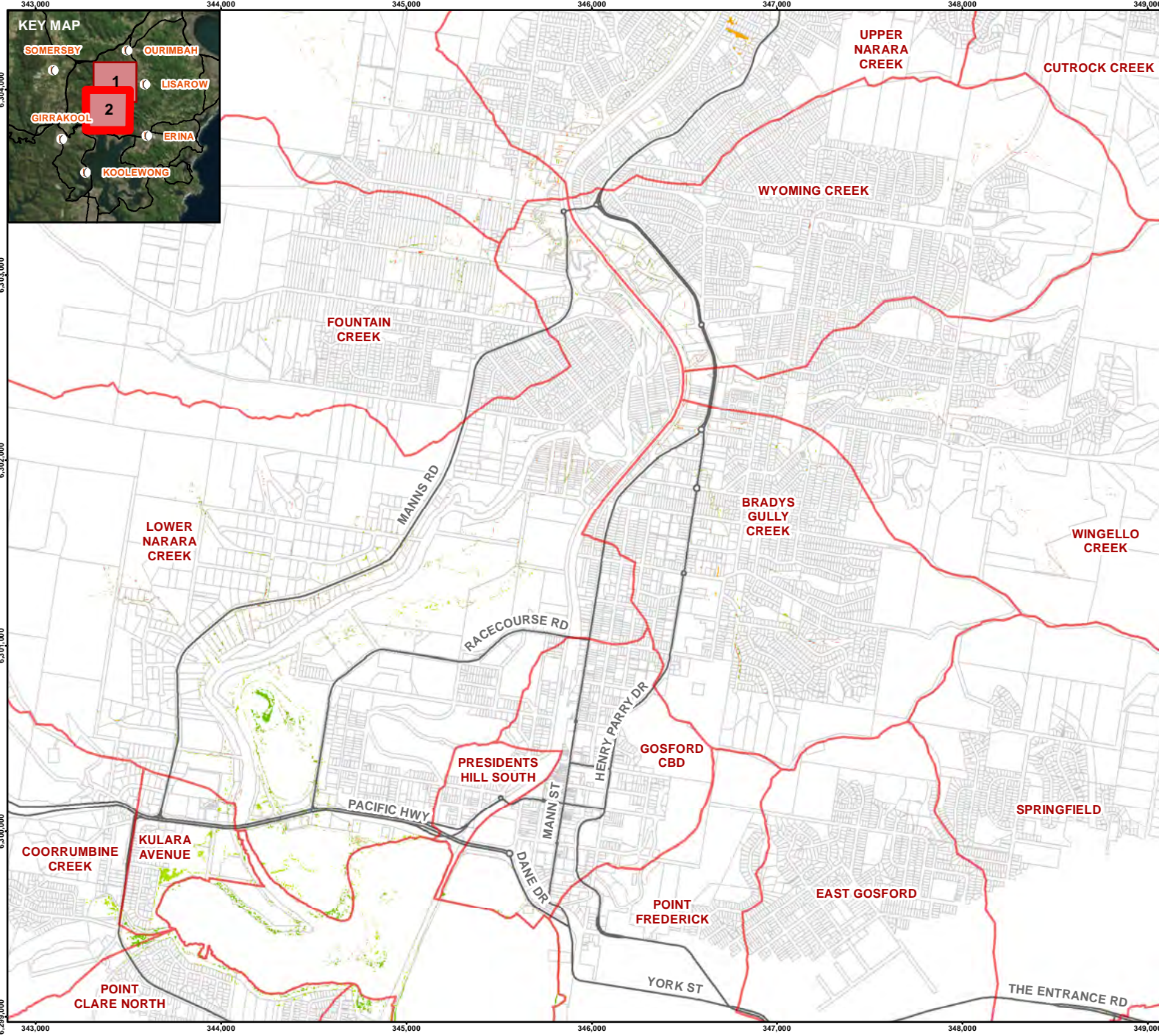
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068	CONTROL 006	REV. G	FIGURE 80A
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastre, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

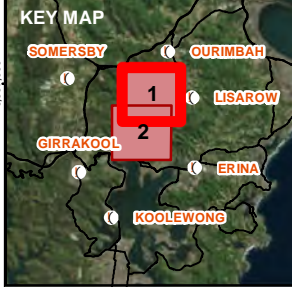
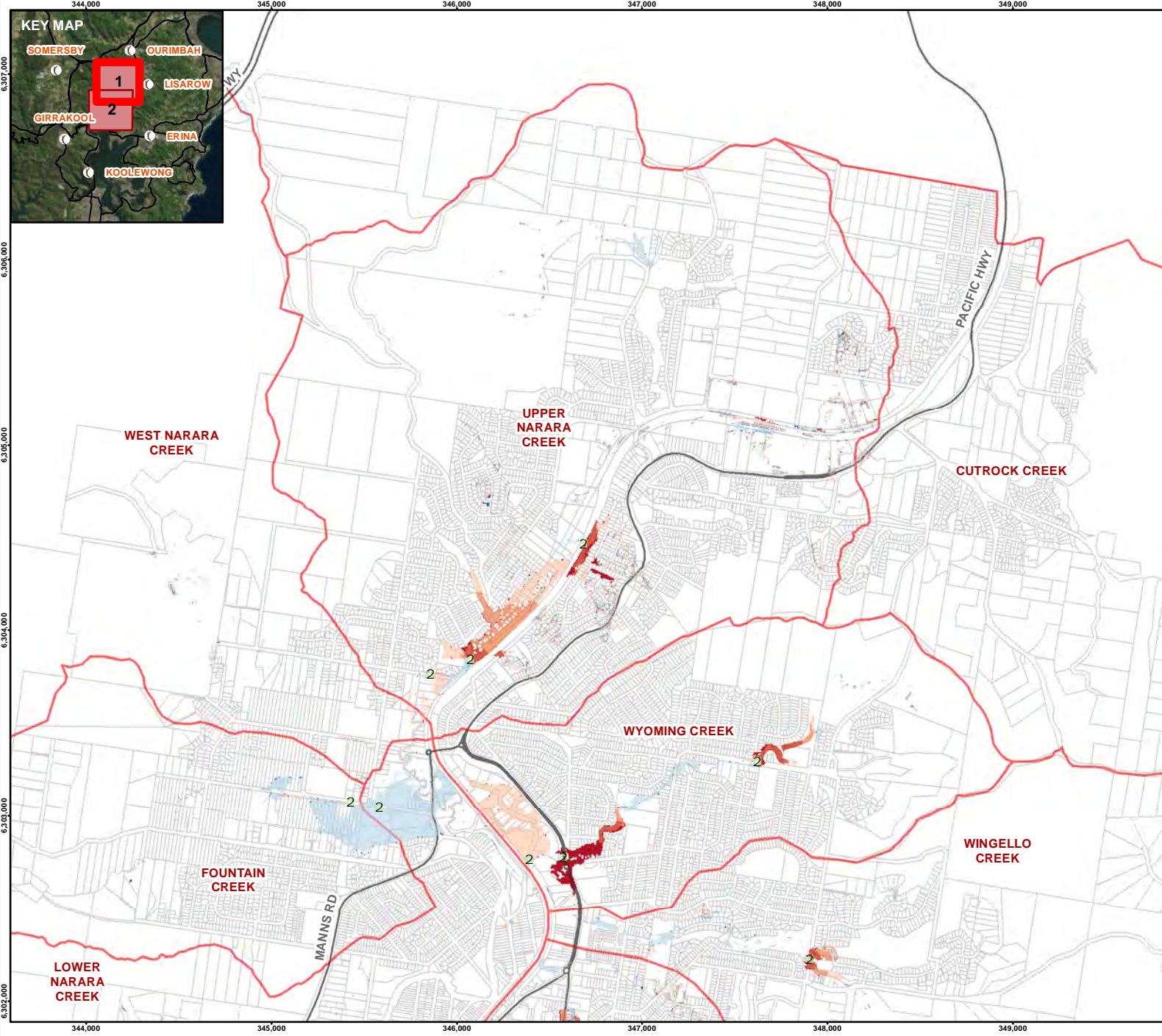
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD DECREASED TAILWATER LEVEL**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 80B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
- 2 Blockage Locations
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- Less than -1.0 m
- 0.20 m to -1.0 m
- 0.05 m to -0.20 m
- 0.01 m to -0.05 m
- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

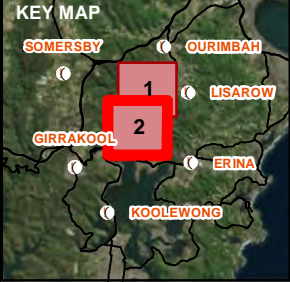
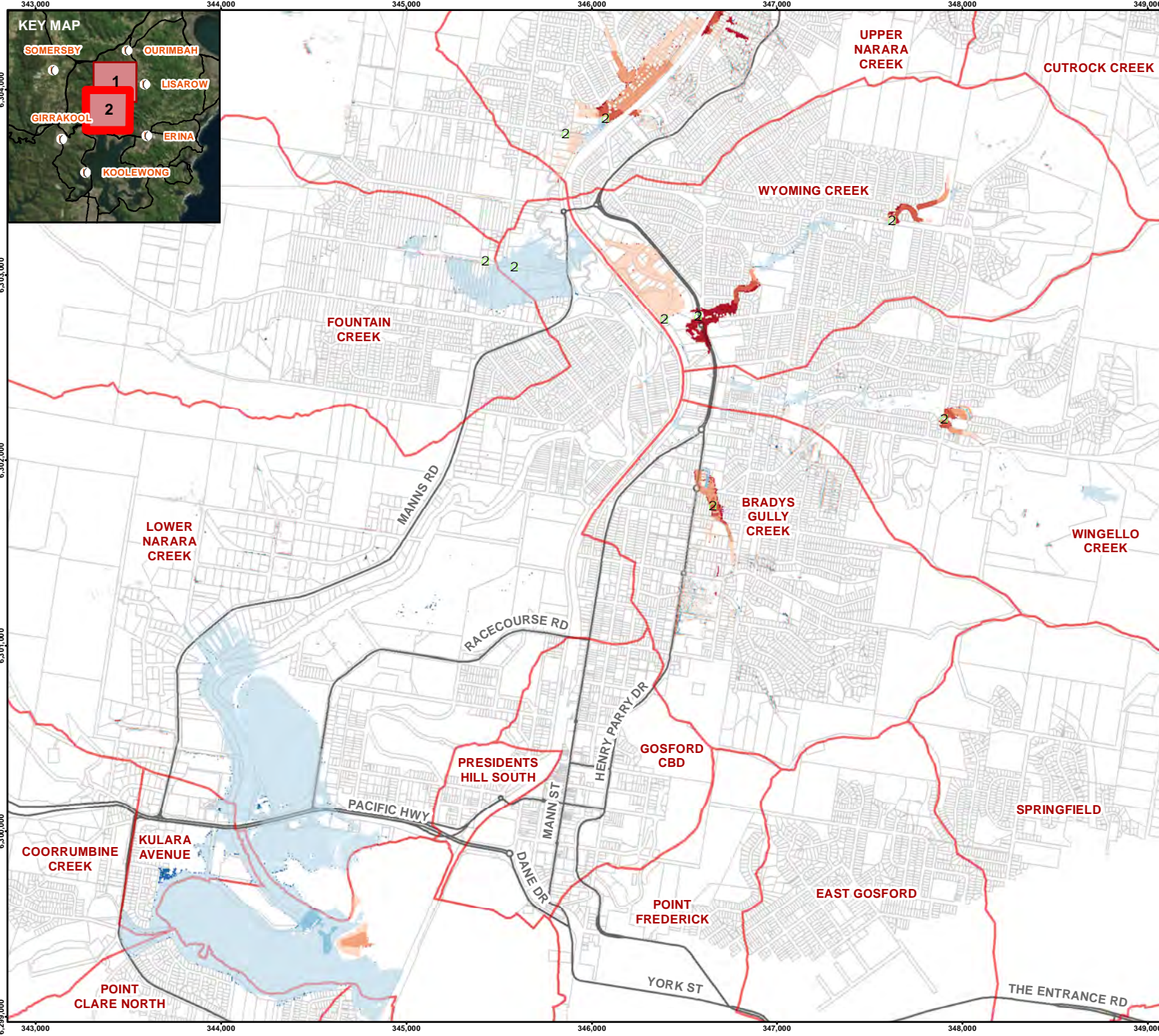
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 100% BLOCKAGE AT 10 LOCATIONS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	81A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- 2 Blockage Locations
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- Less than -1.0 m
- 0.20 m to -1.0 m
- 0.05 m to -0.20 m
- 0.01 m to -0.05 m
- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchments: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

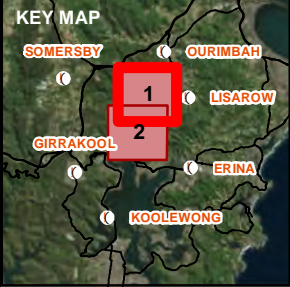
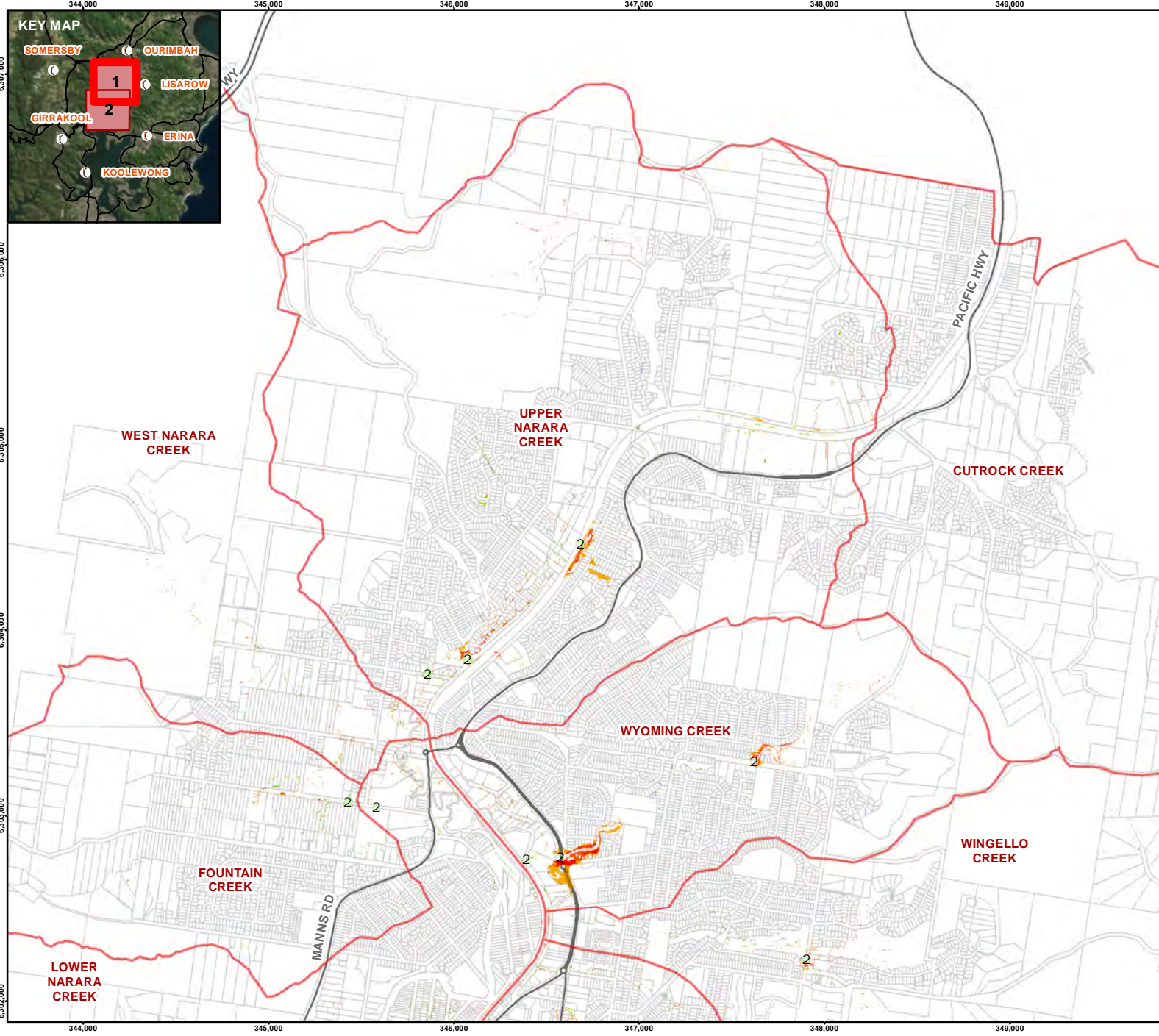
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
100% BLOCKAGE AT 10 LOCATIONS**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	81B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4

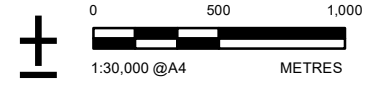


**Legend**

- ( ) Localities
- 2 Blockage Locations
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 100% BLOCKAGE AT 10 LOCATIONS**

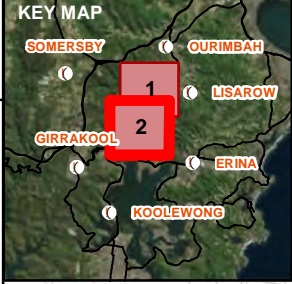
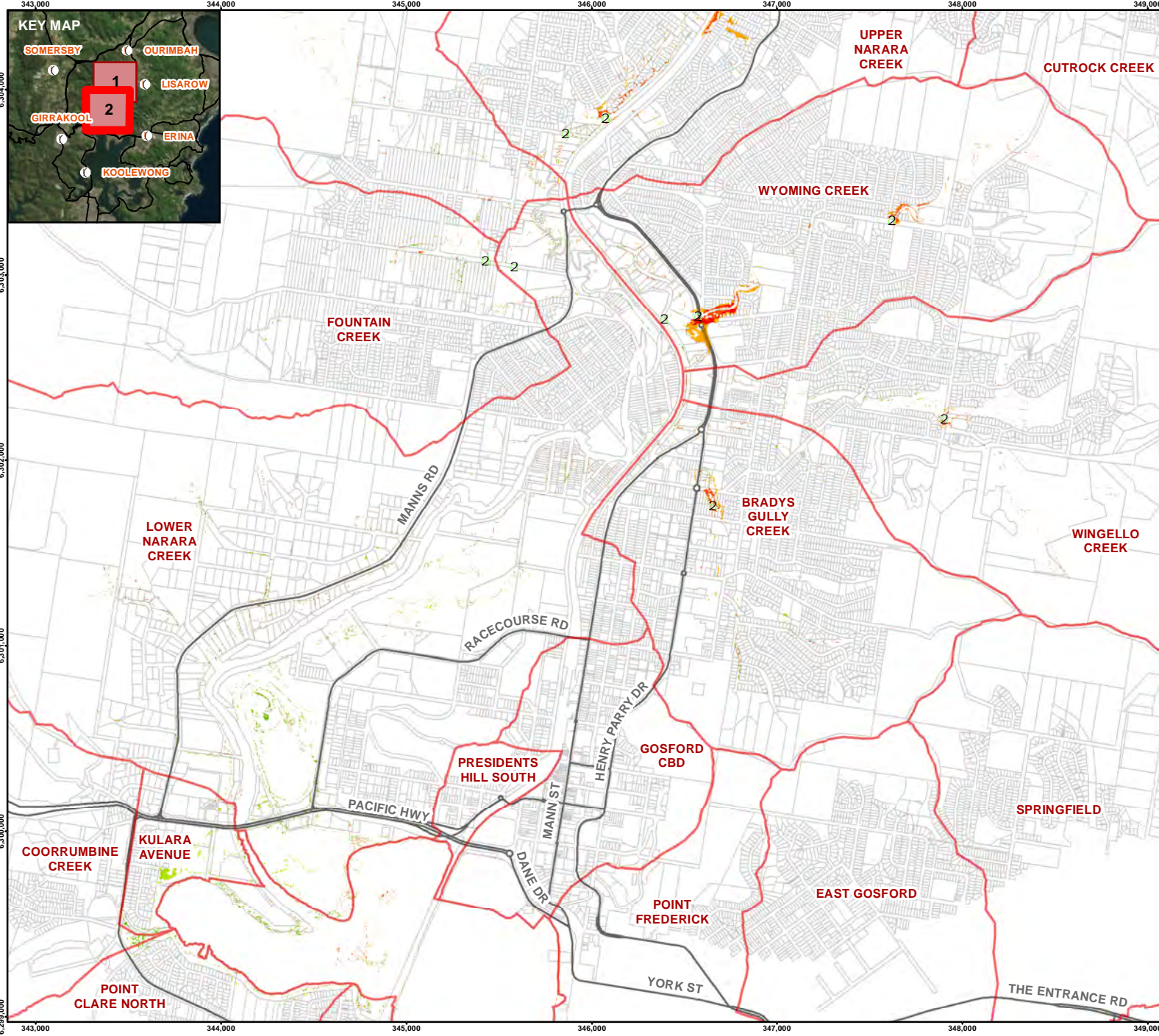
CONSULTANT

DD/MM/YYYY 3/04/2018  
 DESIGNED SL  
 PREPARED DC  
 REVIEWED NM  
 APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 82A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ITS ORIGINAL STATE



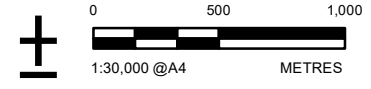


**Legend**

- ( ) Localities
- 2 Blockage Locations
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 100% BLOCKAGE AT 10 LOCATIONS**

CONSULTANT

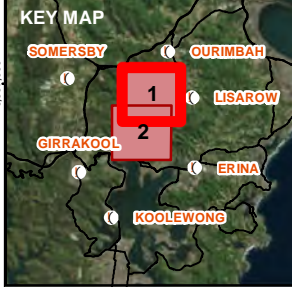
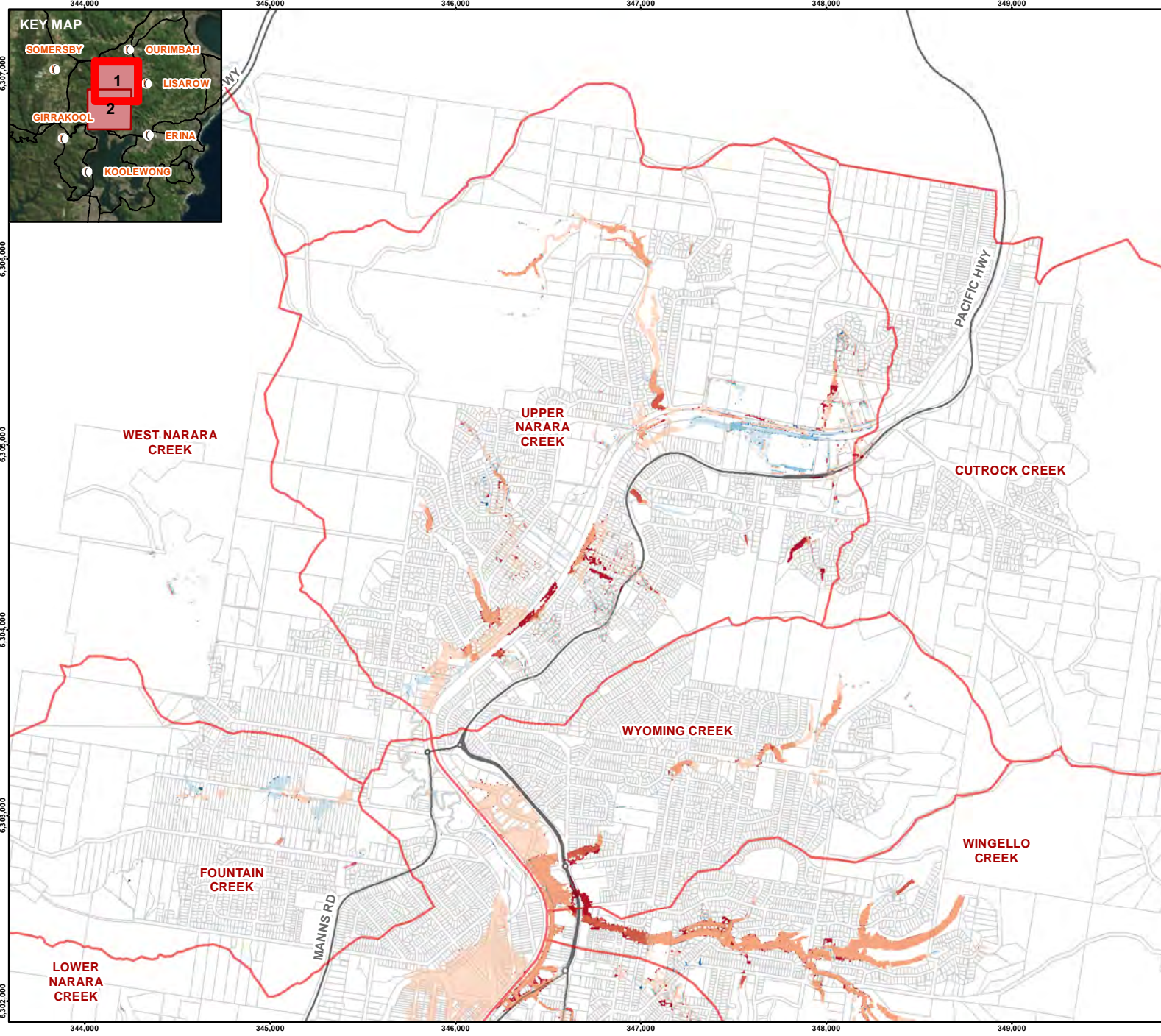


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	82B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM IIS9 A4

25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- Less than -1.0 m
- 0.20 m to -1.0 m
- 0.05 m to -0.20 m
- 0.01 m to -0.05 m
- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 PARTIAL BLOCKAGE**

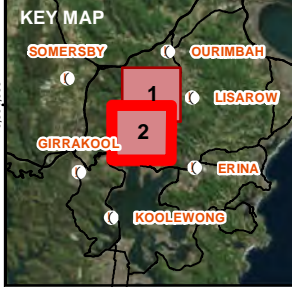
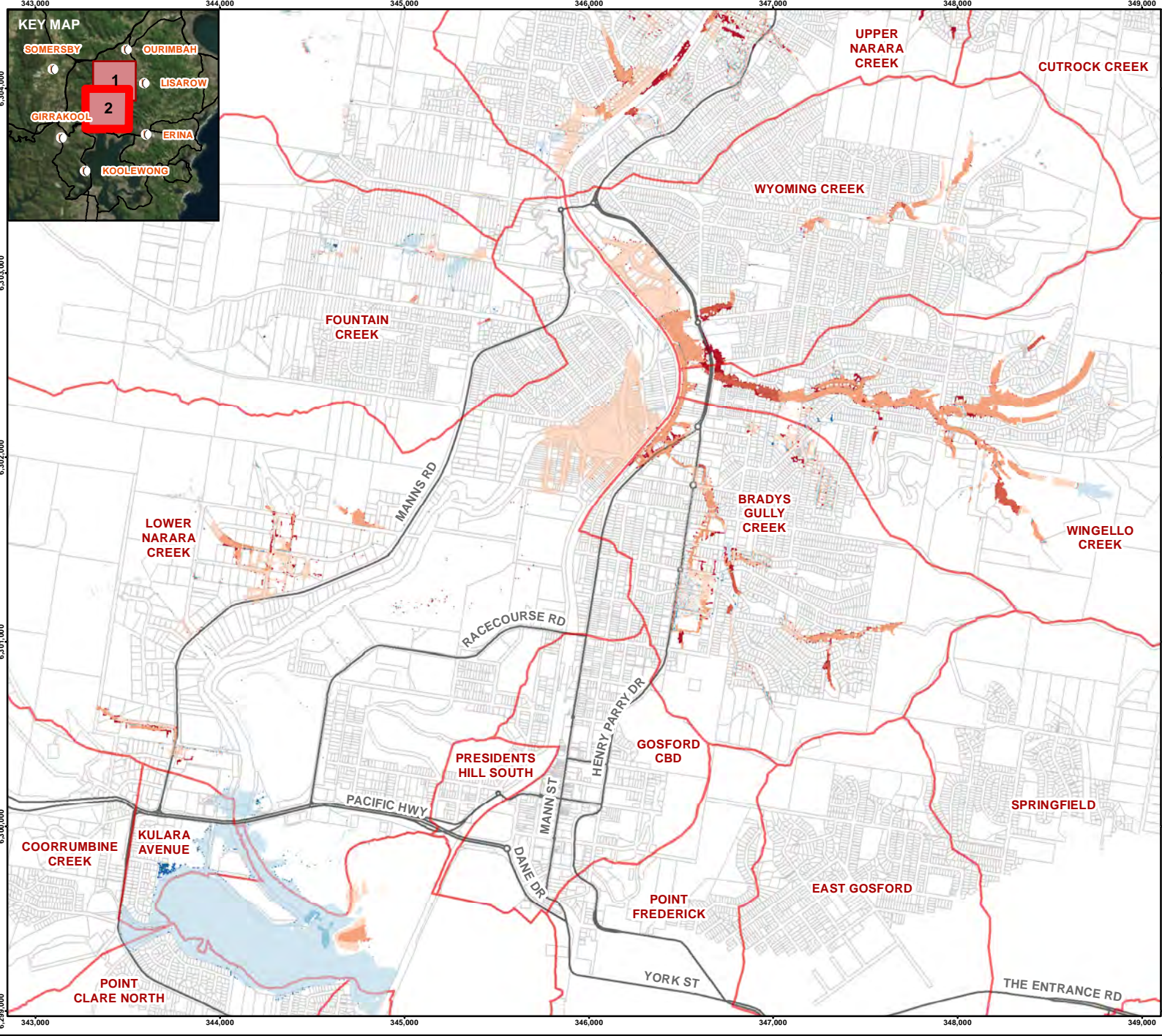
CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 83A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- Less than -1.0 m
- 0.20 m to -1.0 m
- 0.05 m to -0.20 m
- 0.01 m to -0.05 m
- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

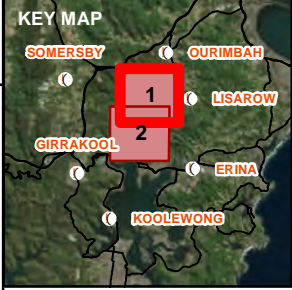
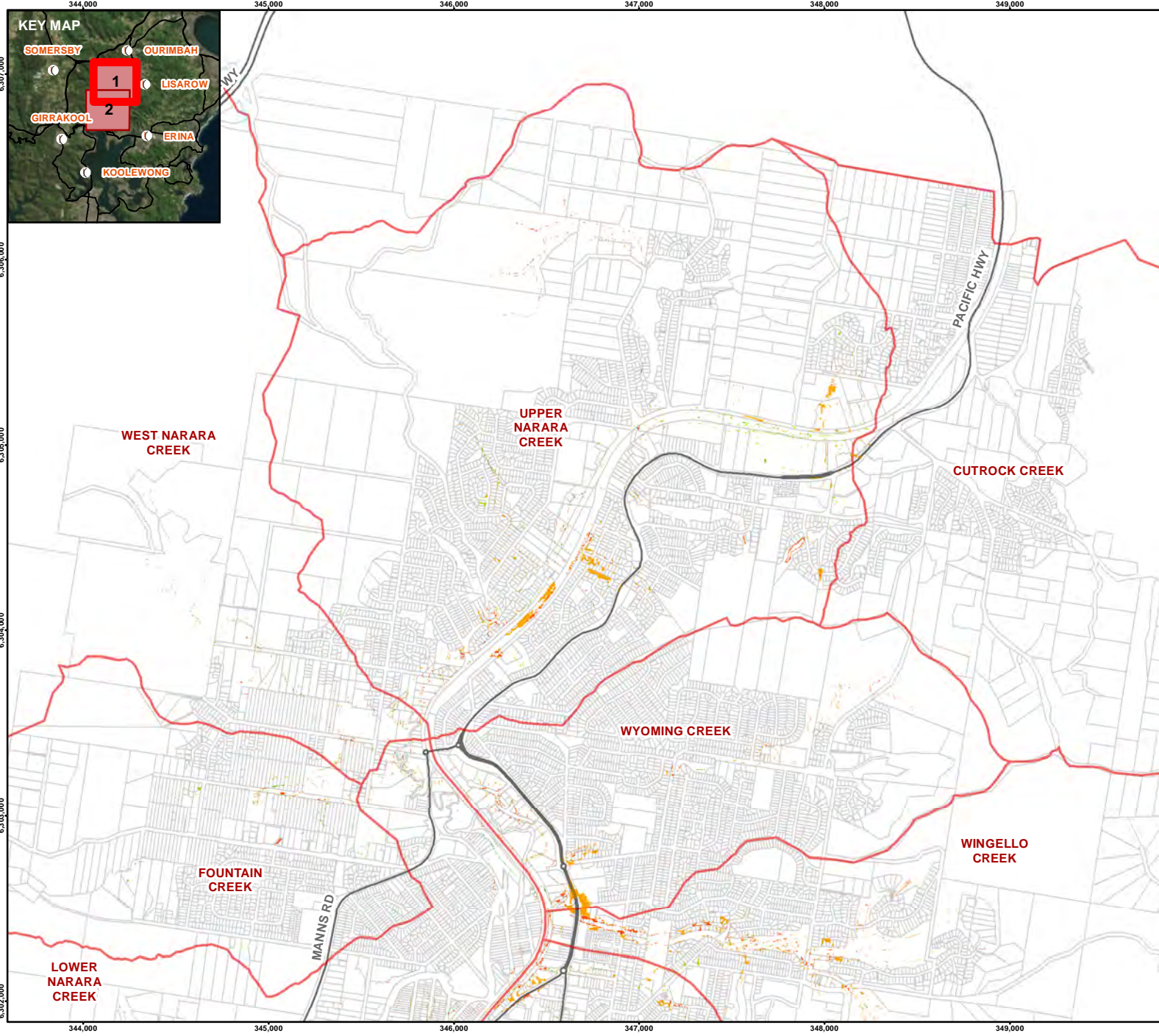
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 PARTIAL BLOCKAGE**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	83B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

(	Localities	Change in Provisional Flood Hazard
—	Main Roads	High to Dry
□	Drainage Sub-Catchment	High to Low
□	Cadastral Boundary	Low to Dry
		No Change
		Dry to Low
		Low to High
		Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

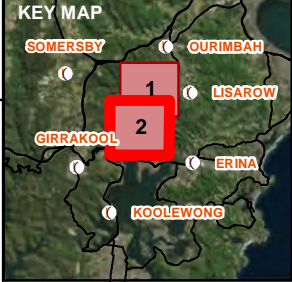
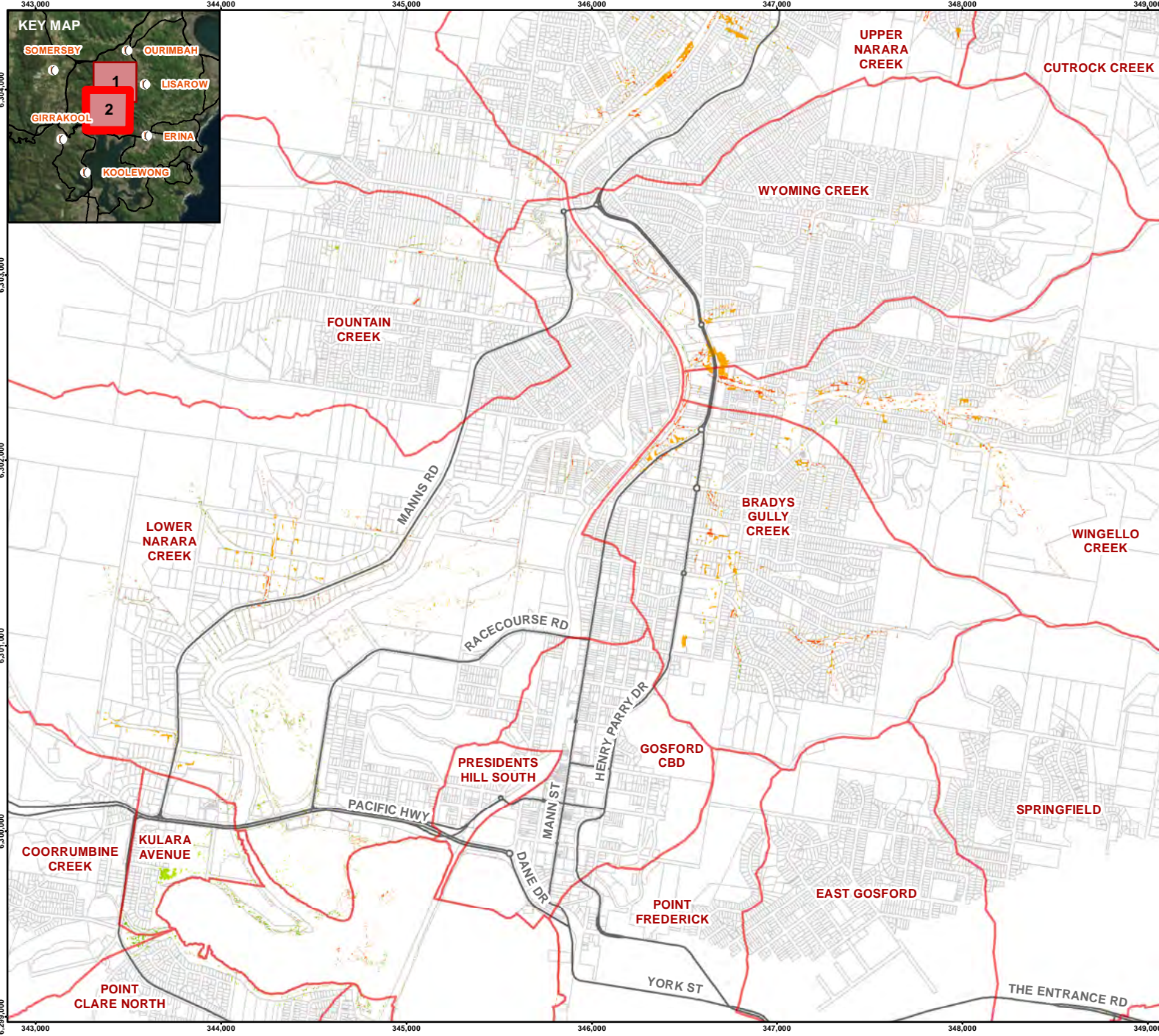
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD PARTIAL BLOCKAGE**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	84A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

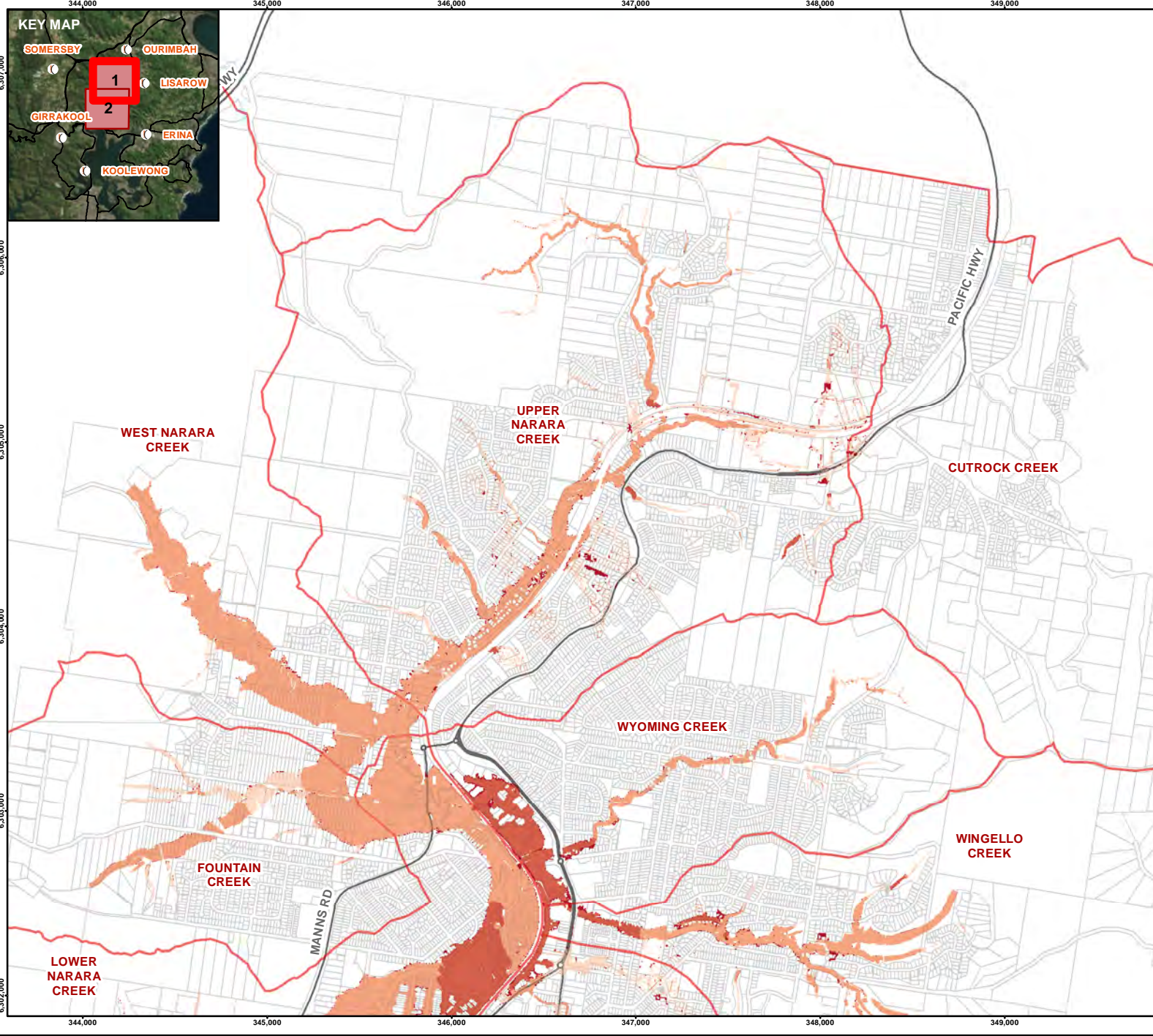
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD PARTIAL BLOCKAGE**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. **097626068** CONTROL **006** REV. **G** FIGURE **84B**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Results filtered for changes in flood height of less than 0 m.

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
INCREASED RAINFALL INTENSITY (10%)**

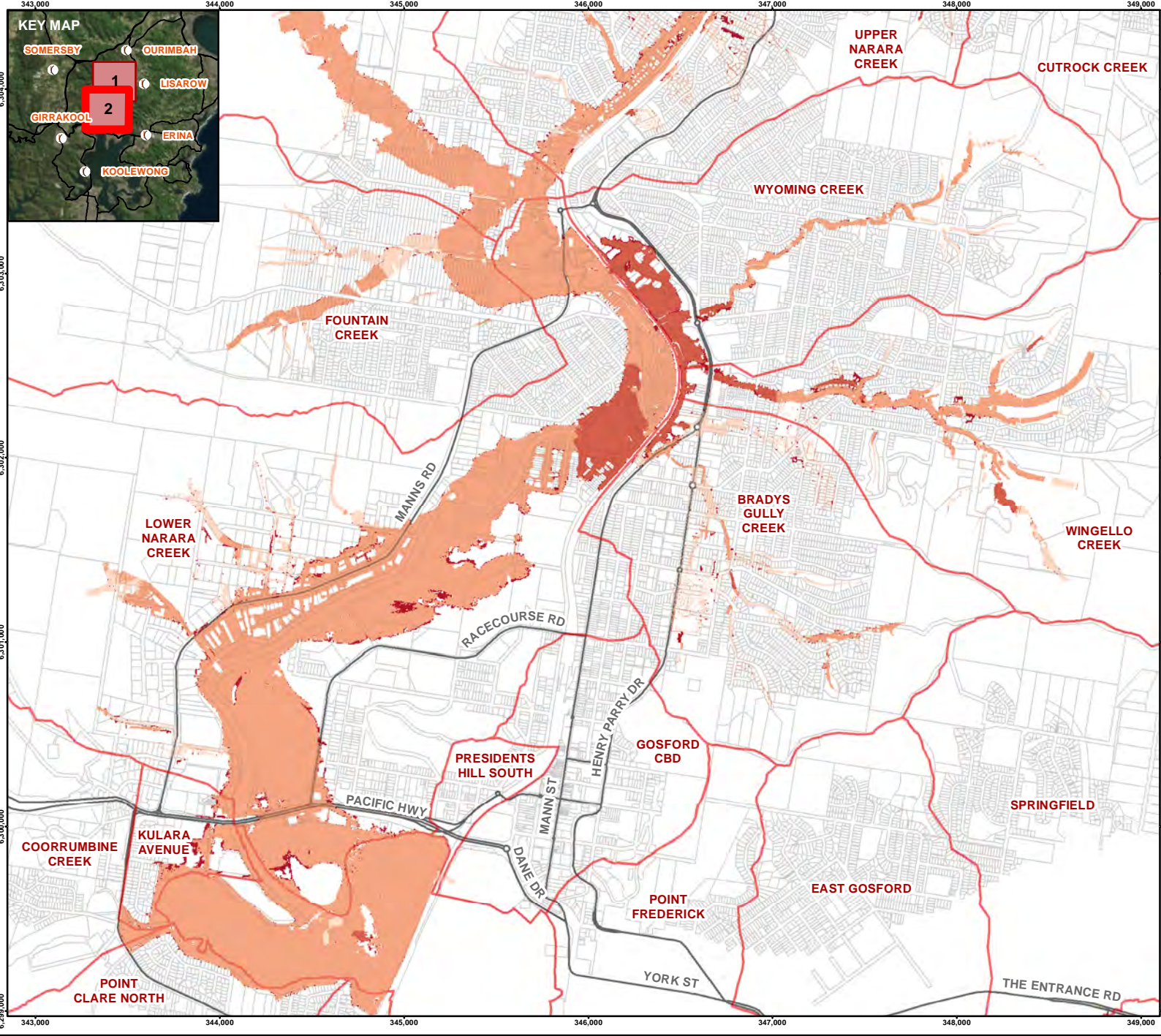
CONSULTANT



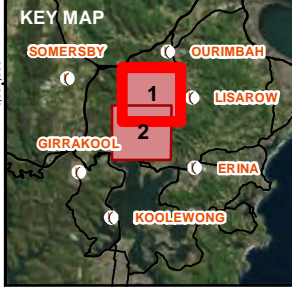
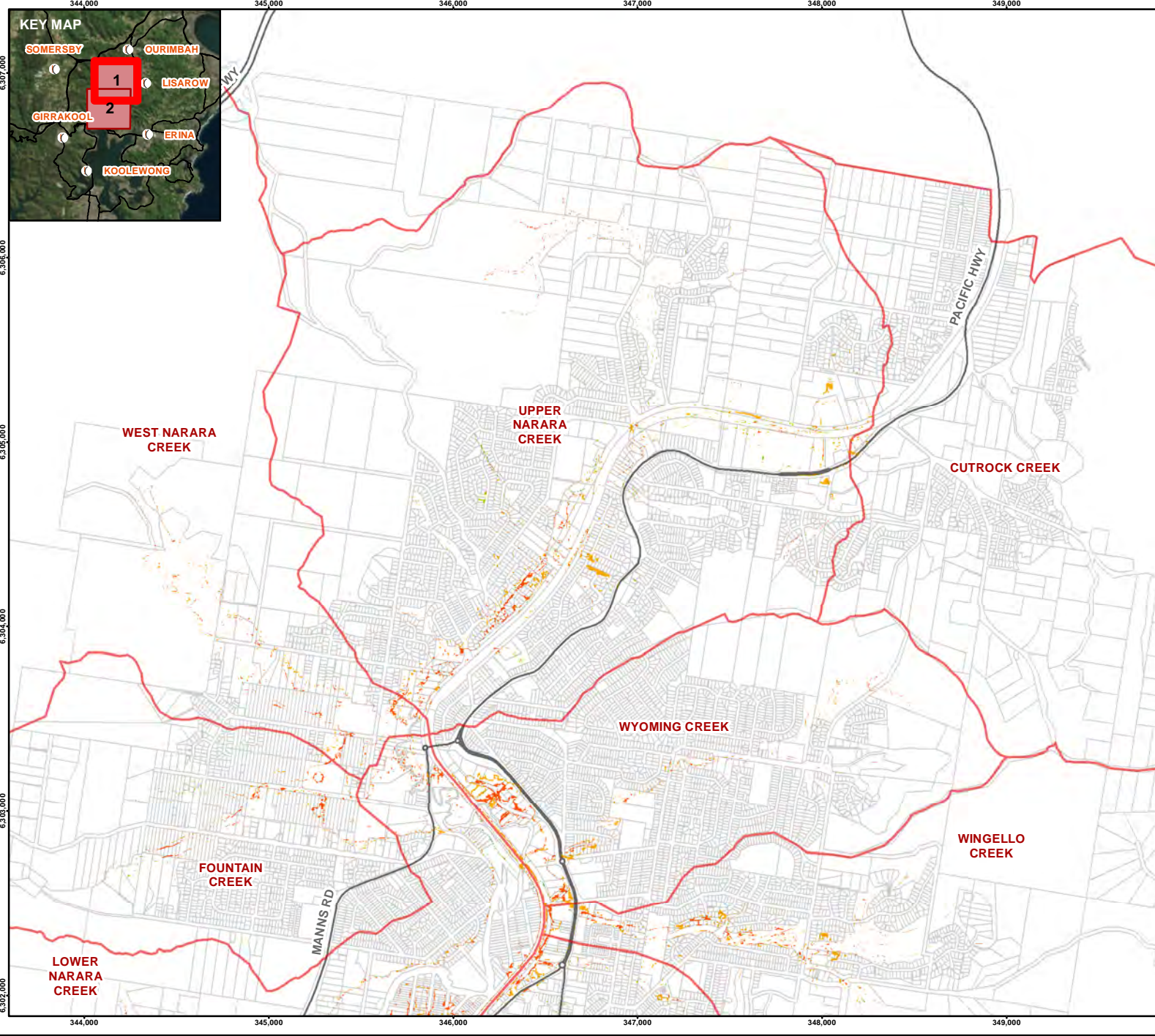
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. <b>097626068</b>	CONTROL <b>006</b>	REV. <b>G</b>	FIGURE <b>85A</b>
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
  
 1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (10%)**

CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED SL

PREPARED DC

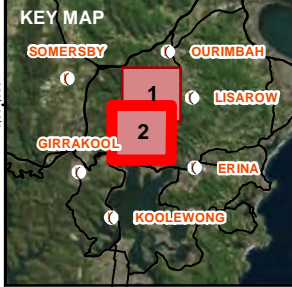
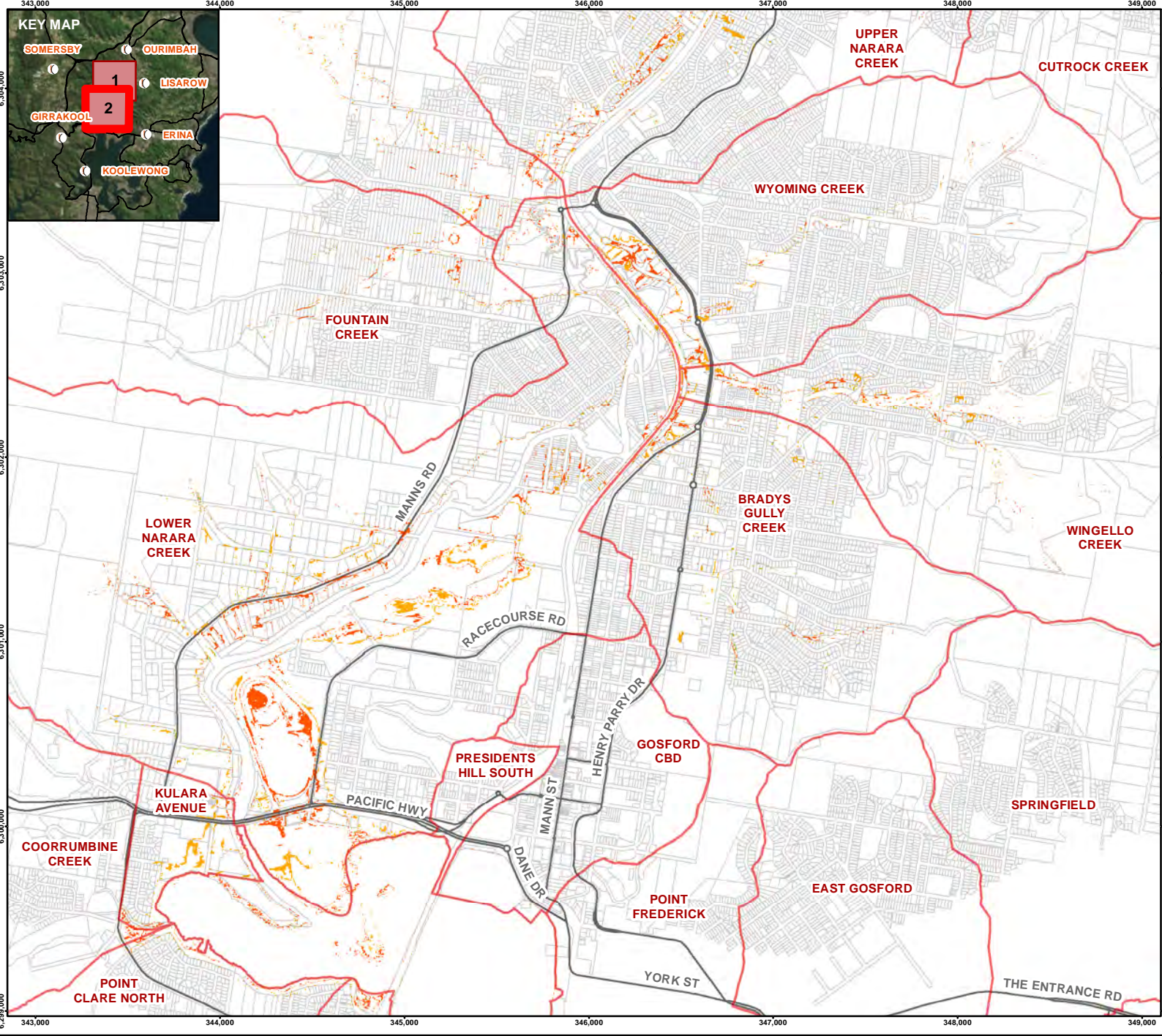
REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 86A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4





**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

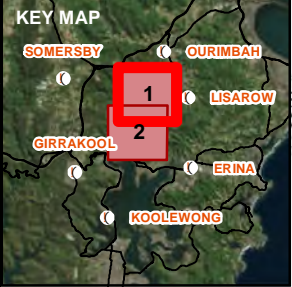
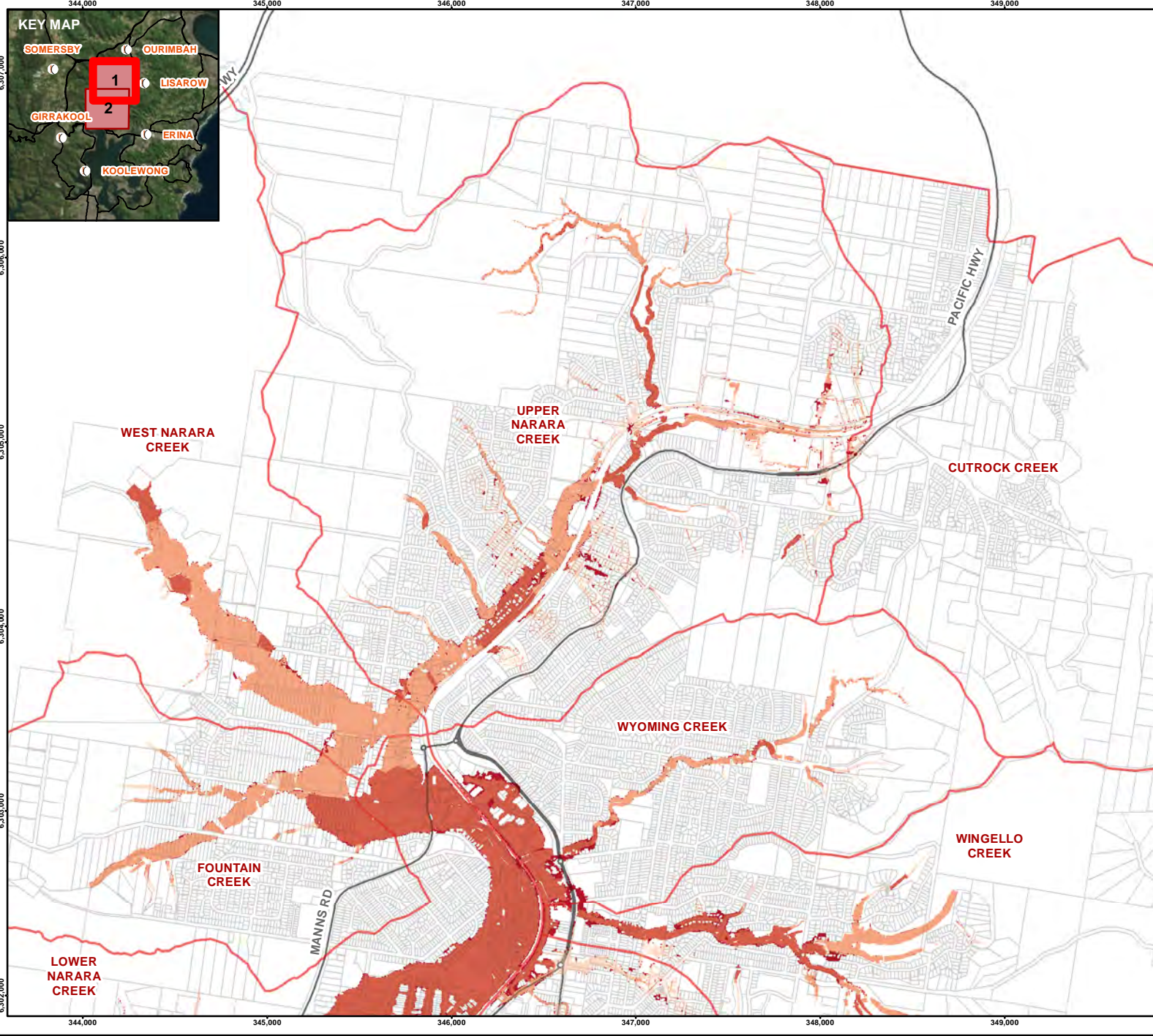
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (10%)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 86B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height of less than 0 m.  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (20%)**

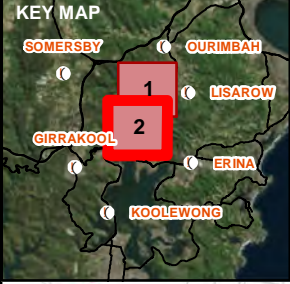
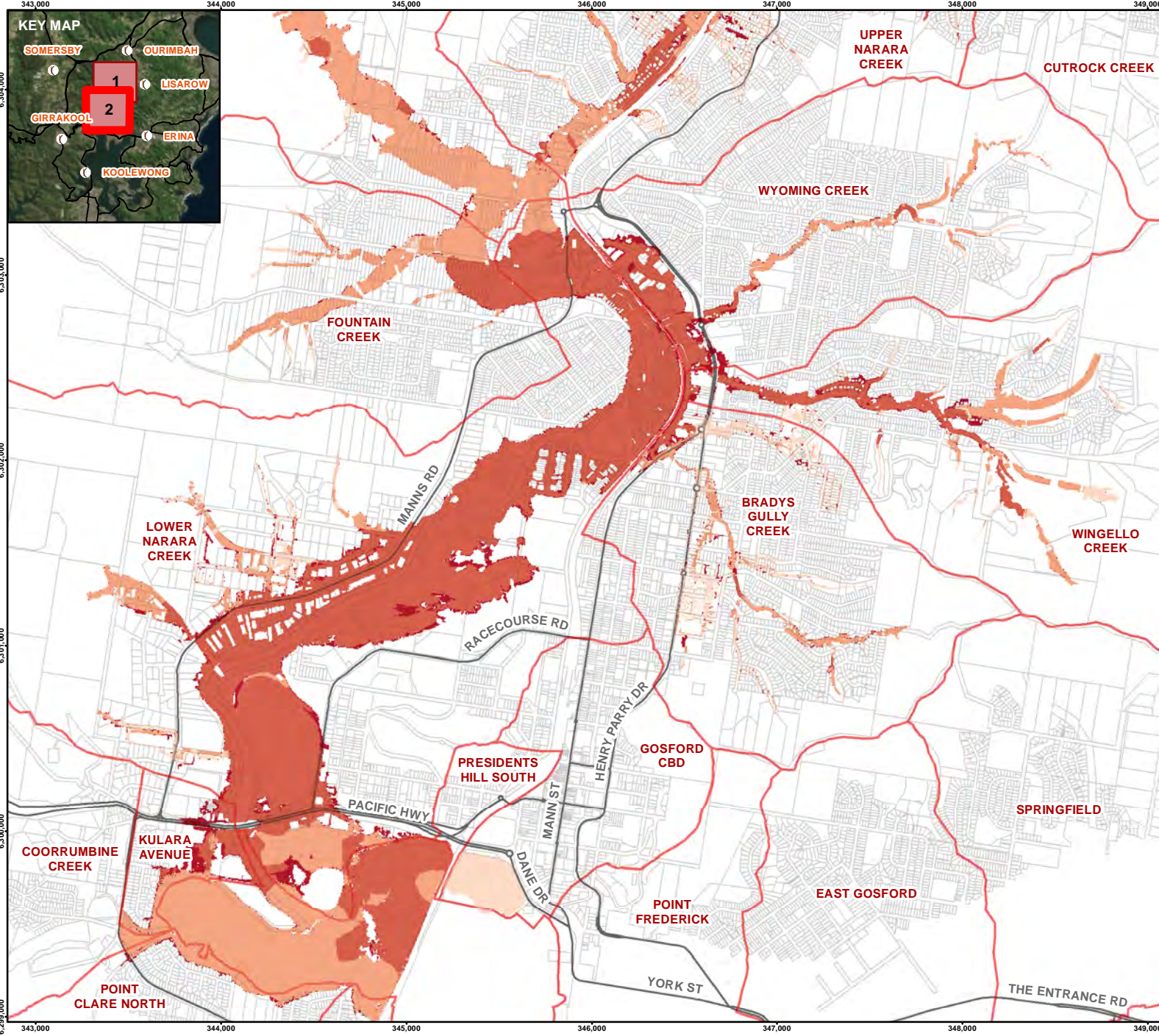
CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	87A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m to 0.05 m
- 0.05 m to 0.20 m
- 0.20 m to 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height of less than 0 m.  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

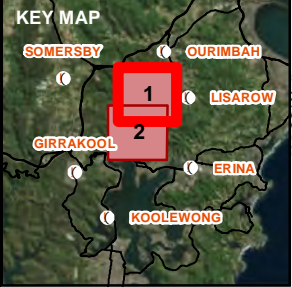
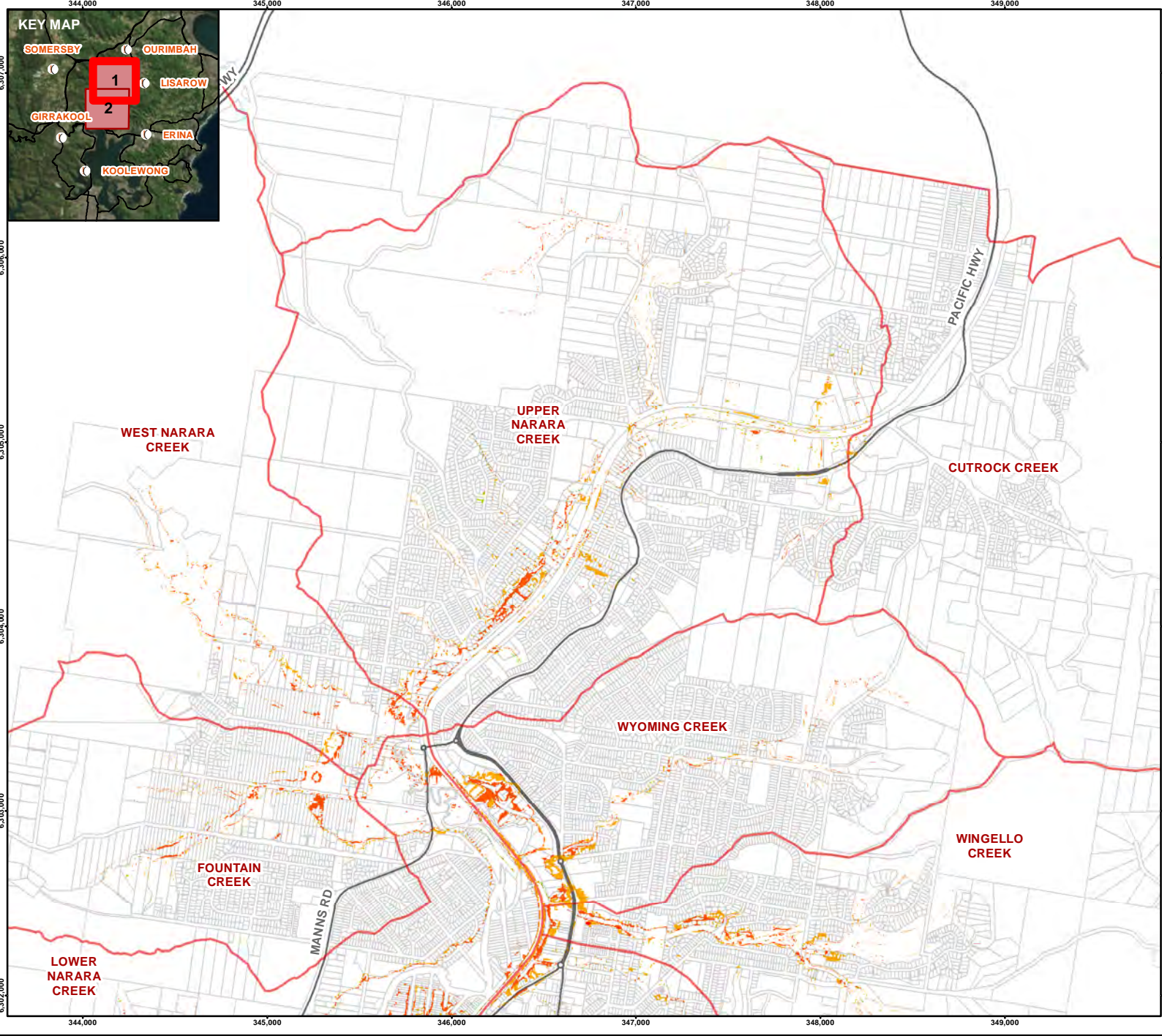
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (20%)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	87B

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

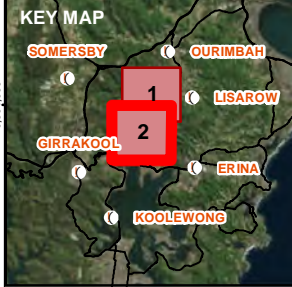
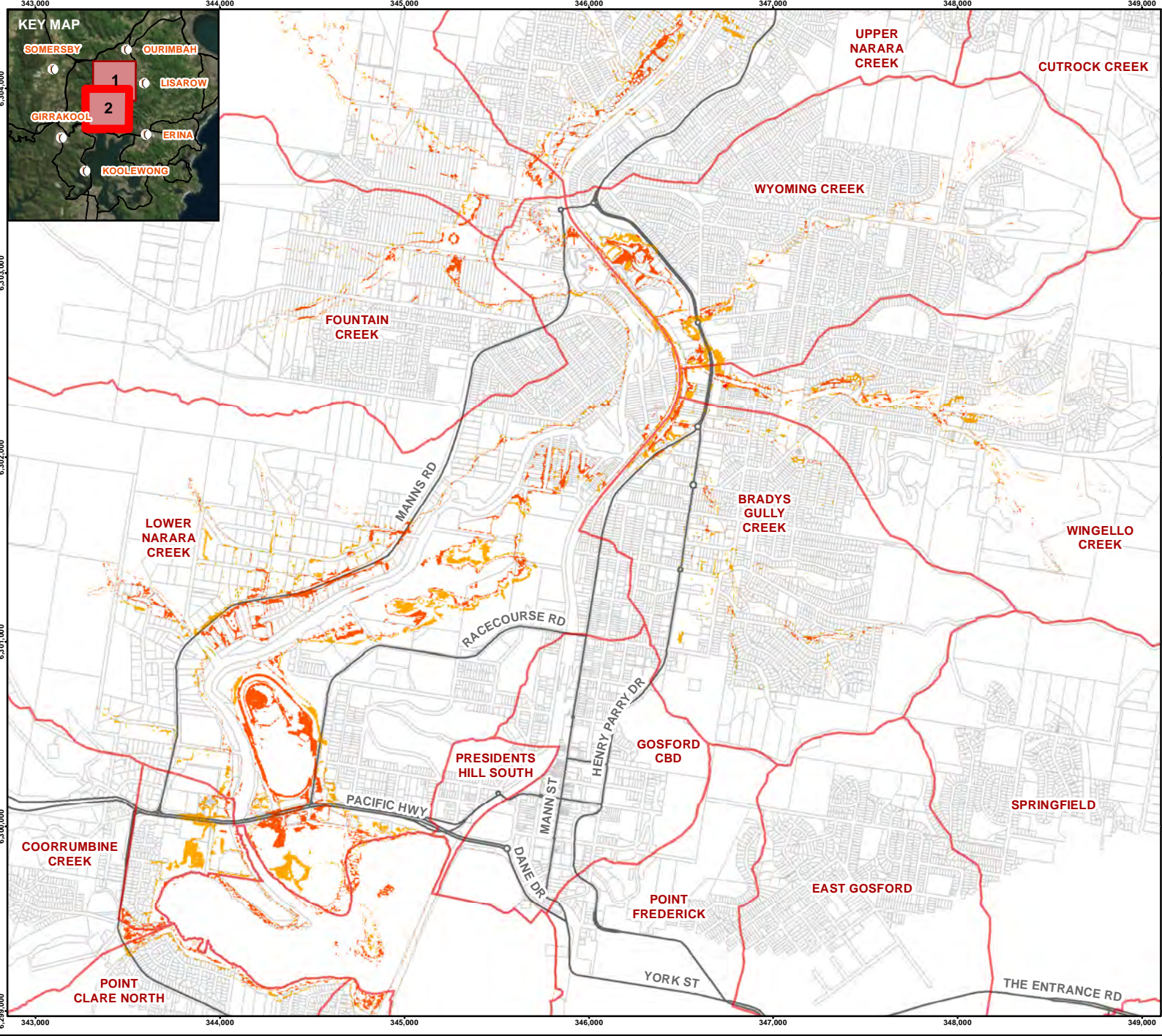
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (20%)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	88A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

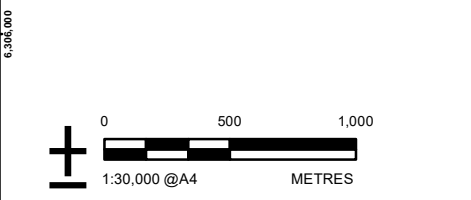
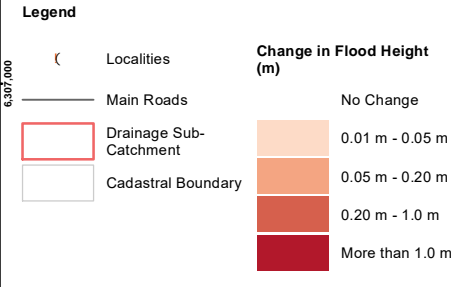
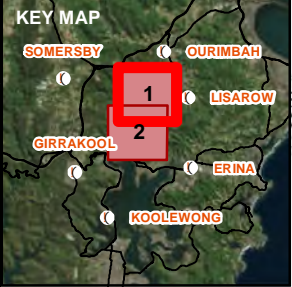
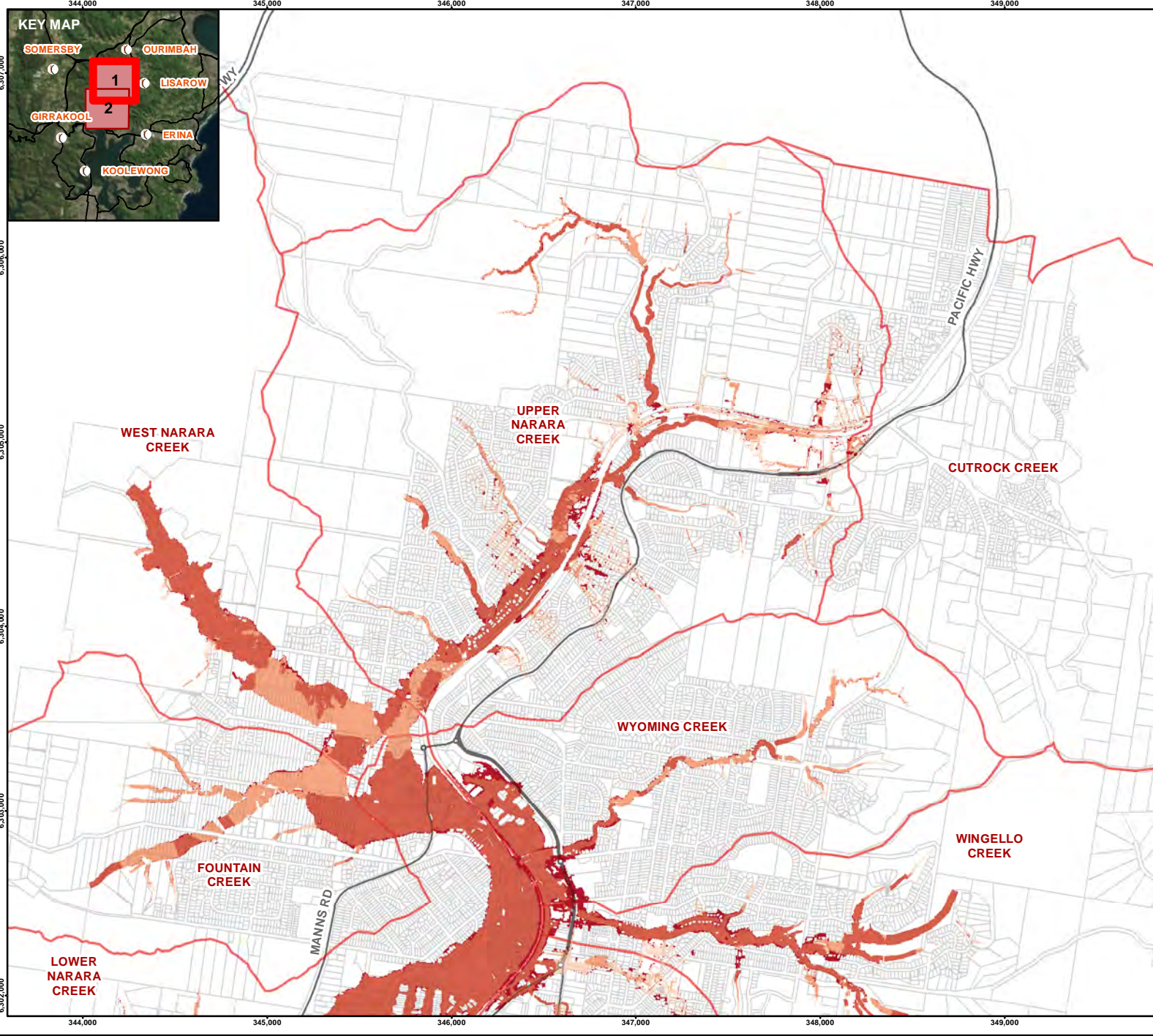
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (20%)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 88B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISS 9 A4



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

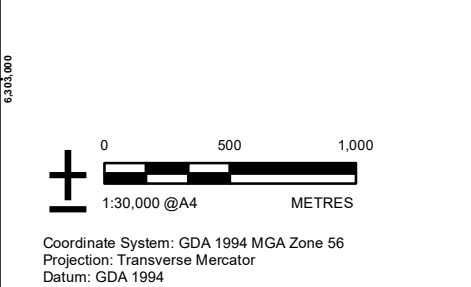
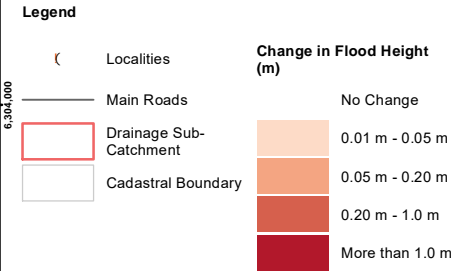
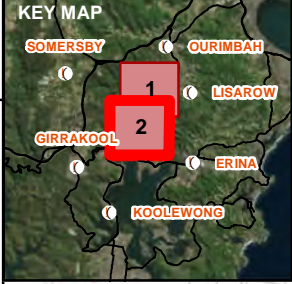
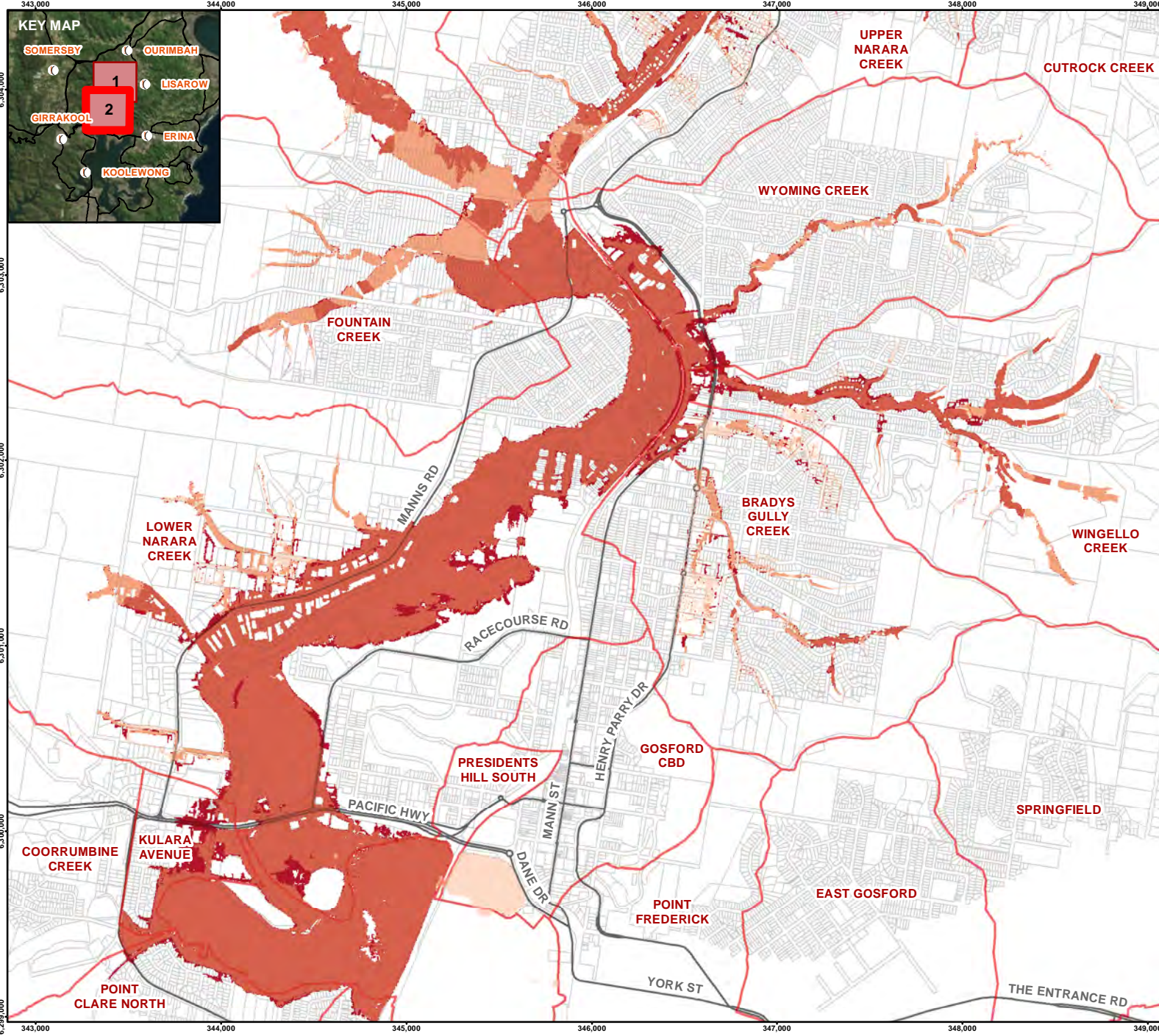
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (30%)**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 89A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



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 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

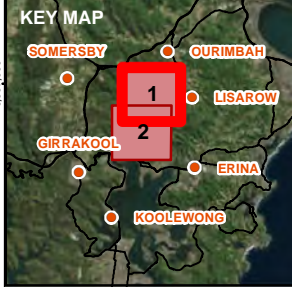
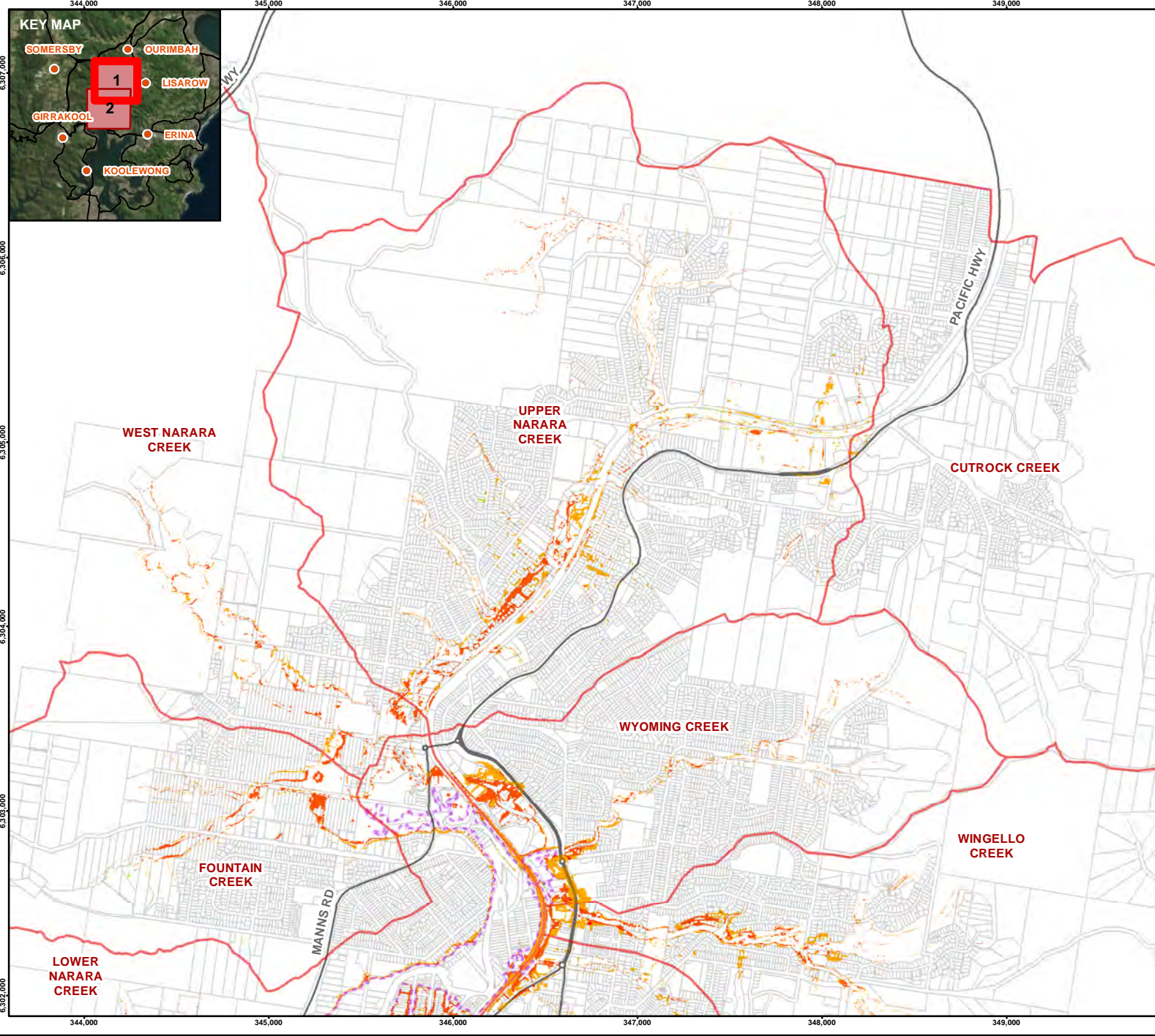
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (30%)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	89B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (30%)**

CONSULTANT



DD/MM/YYYY 6/04/2018

DESIGNED SL

PREPARED DC

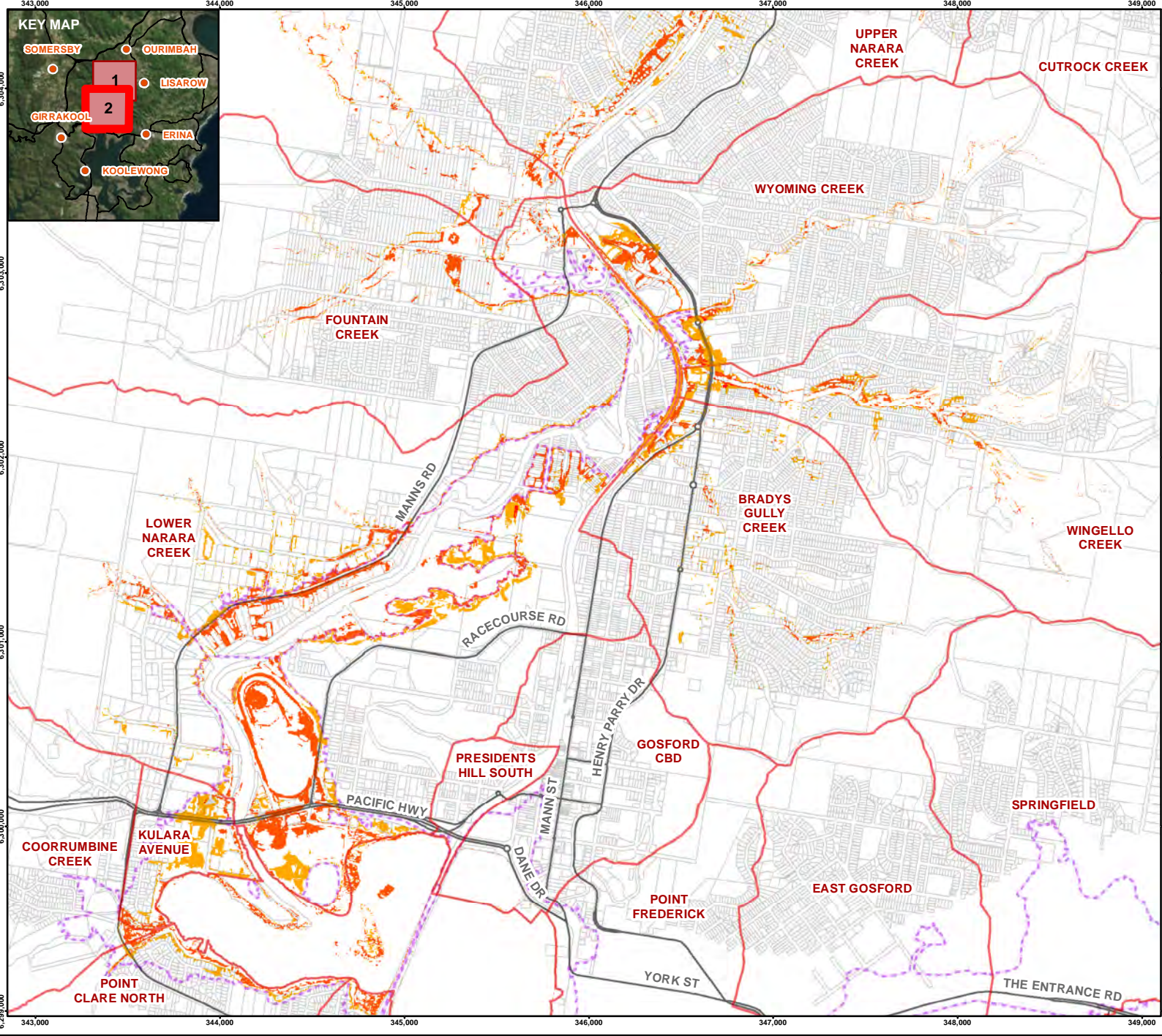
REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 90A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4 25mm





**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (30%)**

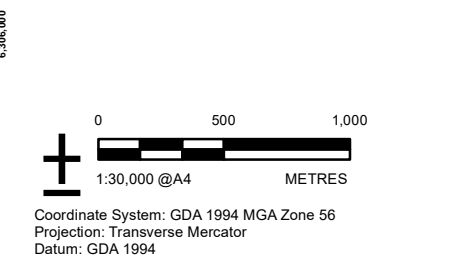
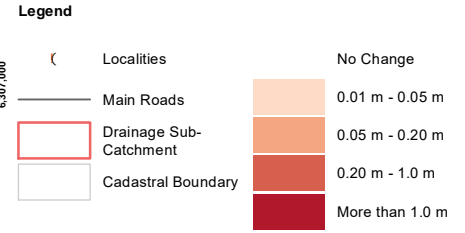
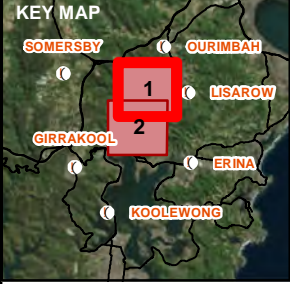
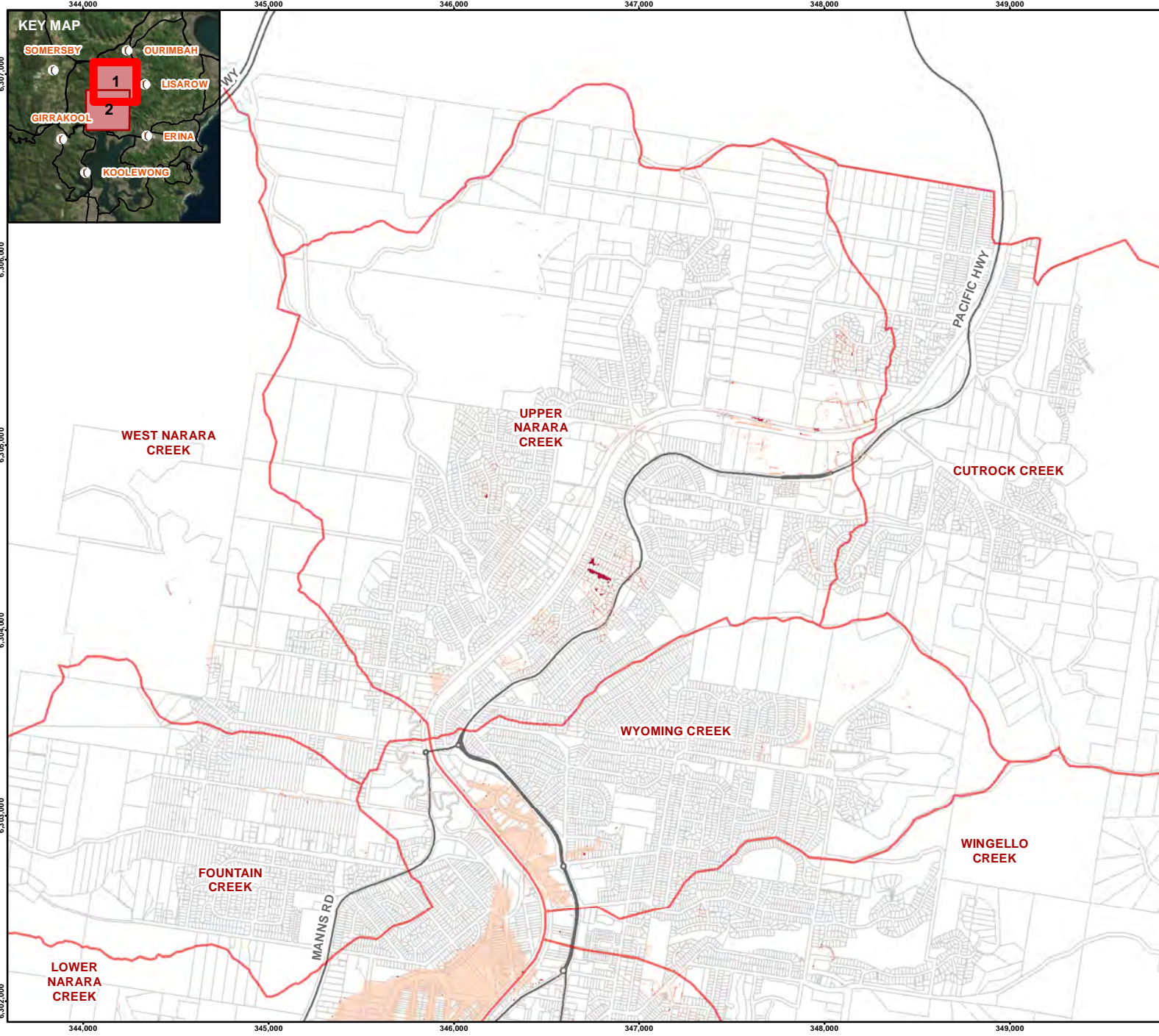
CONSULTANT

DD/MM/YYYY	6/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 90B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4

25mm



**NOTE(S)**

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Result filtered for changes in flood height greater than 0 m

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**Cadastr, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

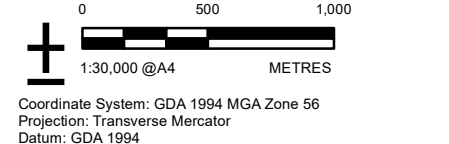
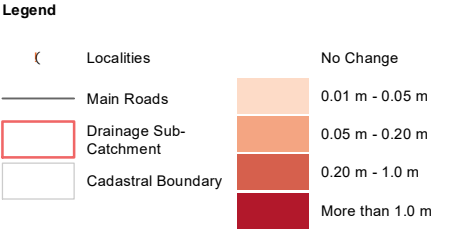
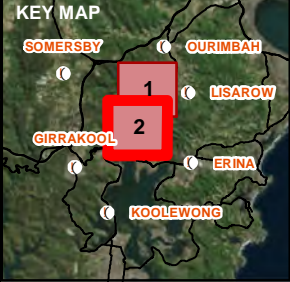
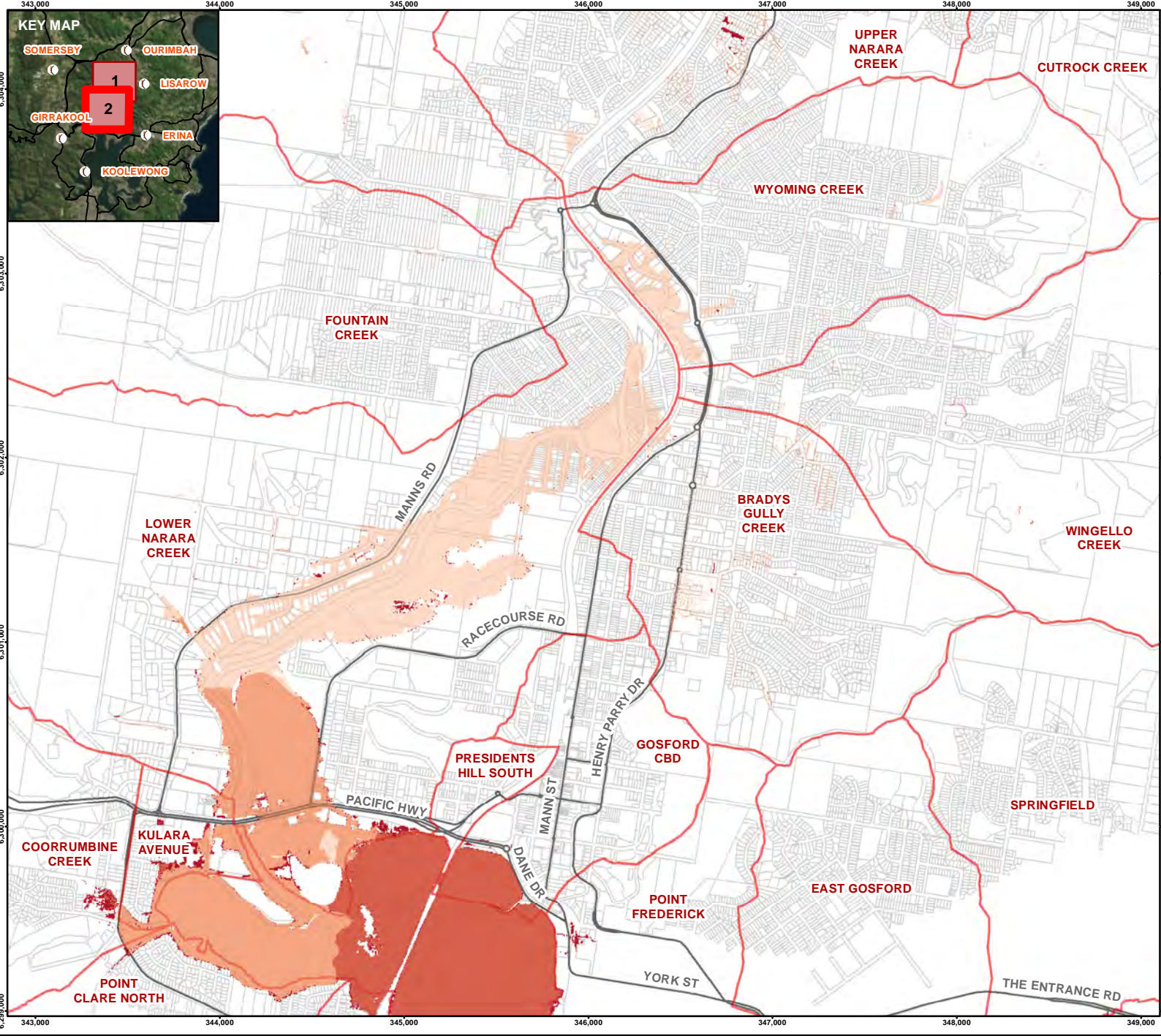
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
SEA LEVEL RISE (40 CM)**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. <b>097626068</b>	CONTROL <b>006</b>	REV. <b>G</b>	FIGURE <b>91A</b>
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
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**Cadastre, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**  
 PROJECT  
**NARARA CREEK FLOOD STUDY**

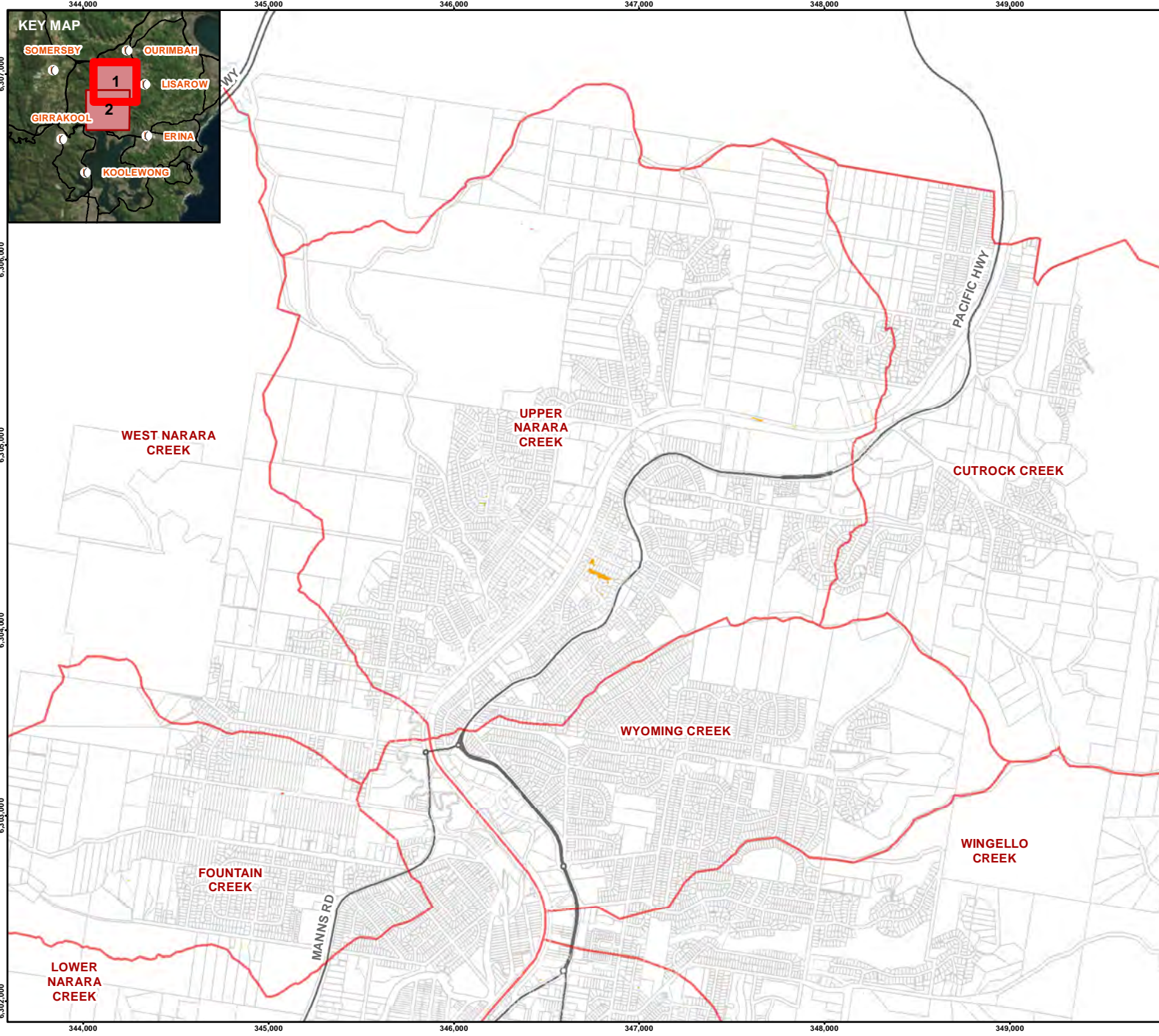
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 SEA LEVEL RISE (40 CM)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	91B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 SEA LEVEL RISE (40 CM)**

CONSULTANT  


DD/MM/YYYY 3/04/2018

DESIGNED SL

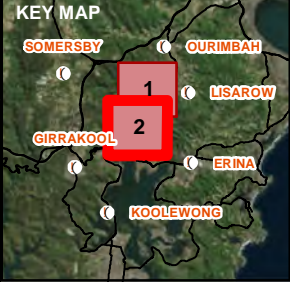
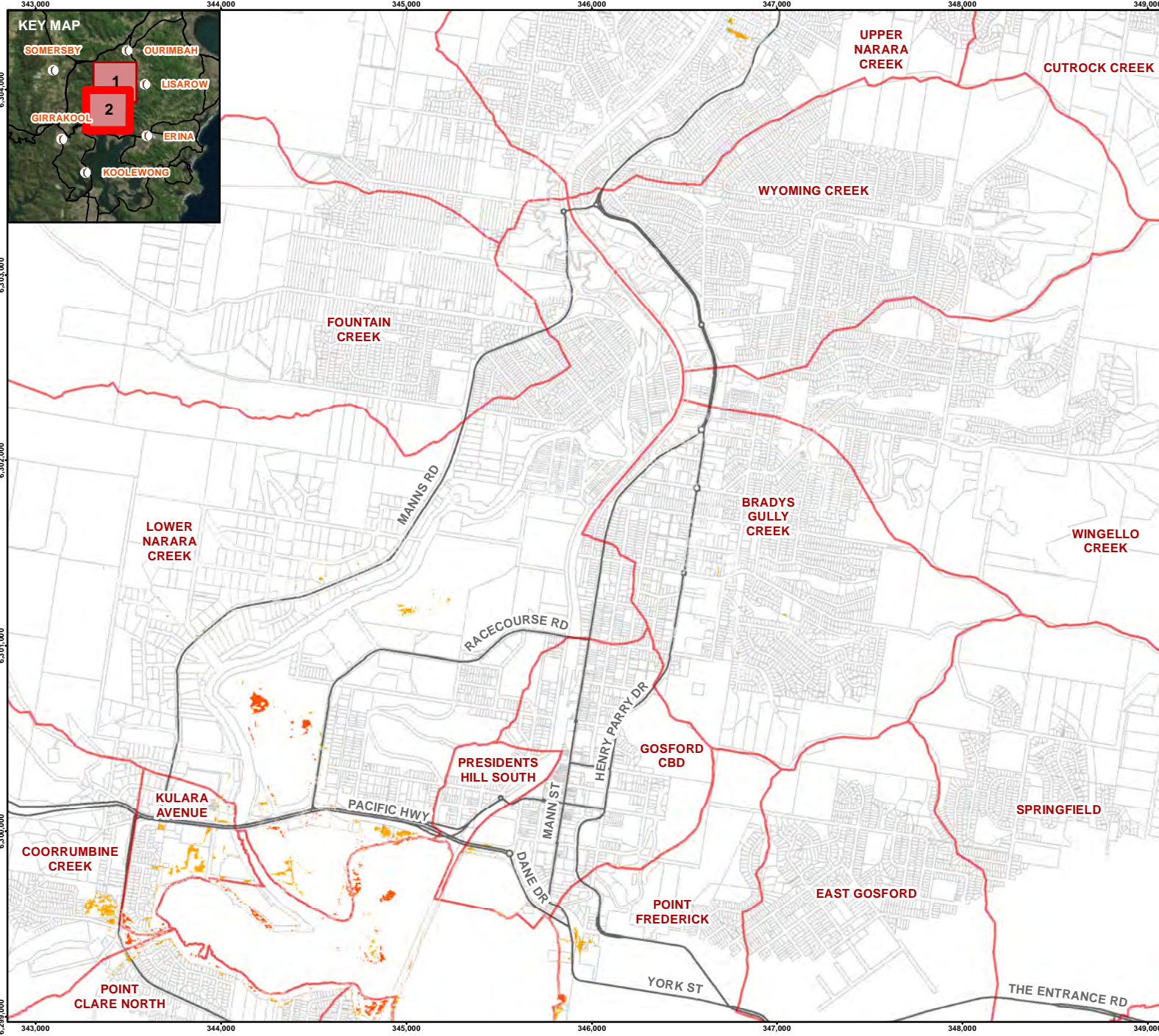
PREPARED DC

REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 92A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

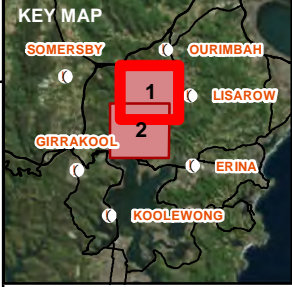
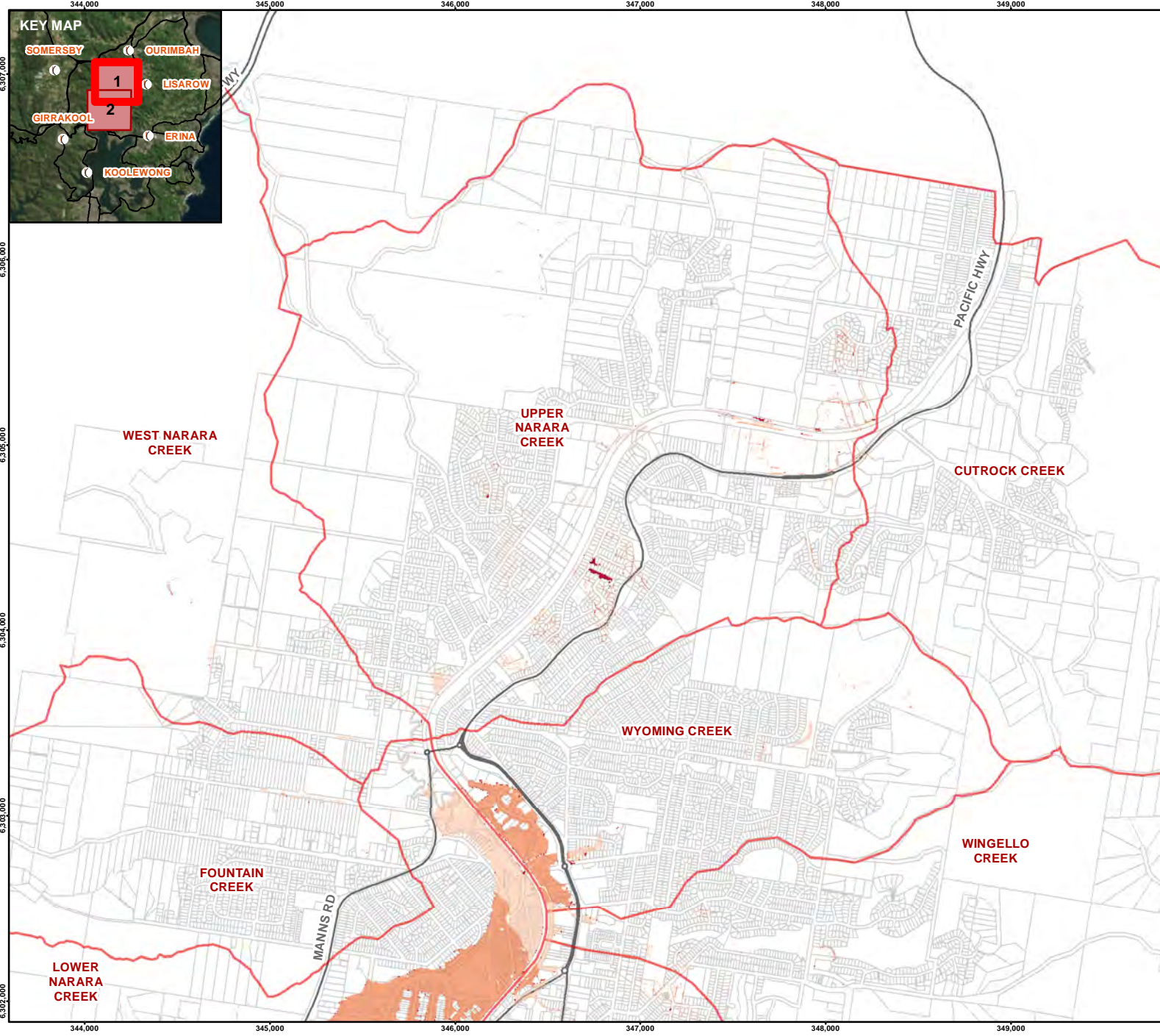
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 SEA LEVEL RISE (40 CM)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 92B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

(	Localities		<b>Change in Flood Height (m)</b>
—	Main Roads		No Change
□	Drainage Sub-Catchment	□	0.01 m - 0.05 m
□	Cadastral Boundary	□	0.05 m - 0.20 m
		□	0.20 m - 1.0 m
		□	More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994


**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m  
 This figure and data is the property of Central Coast Council and is not to be distributed or published without their consent.

**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

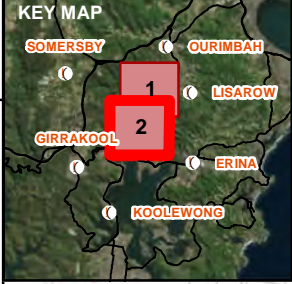
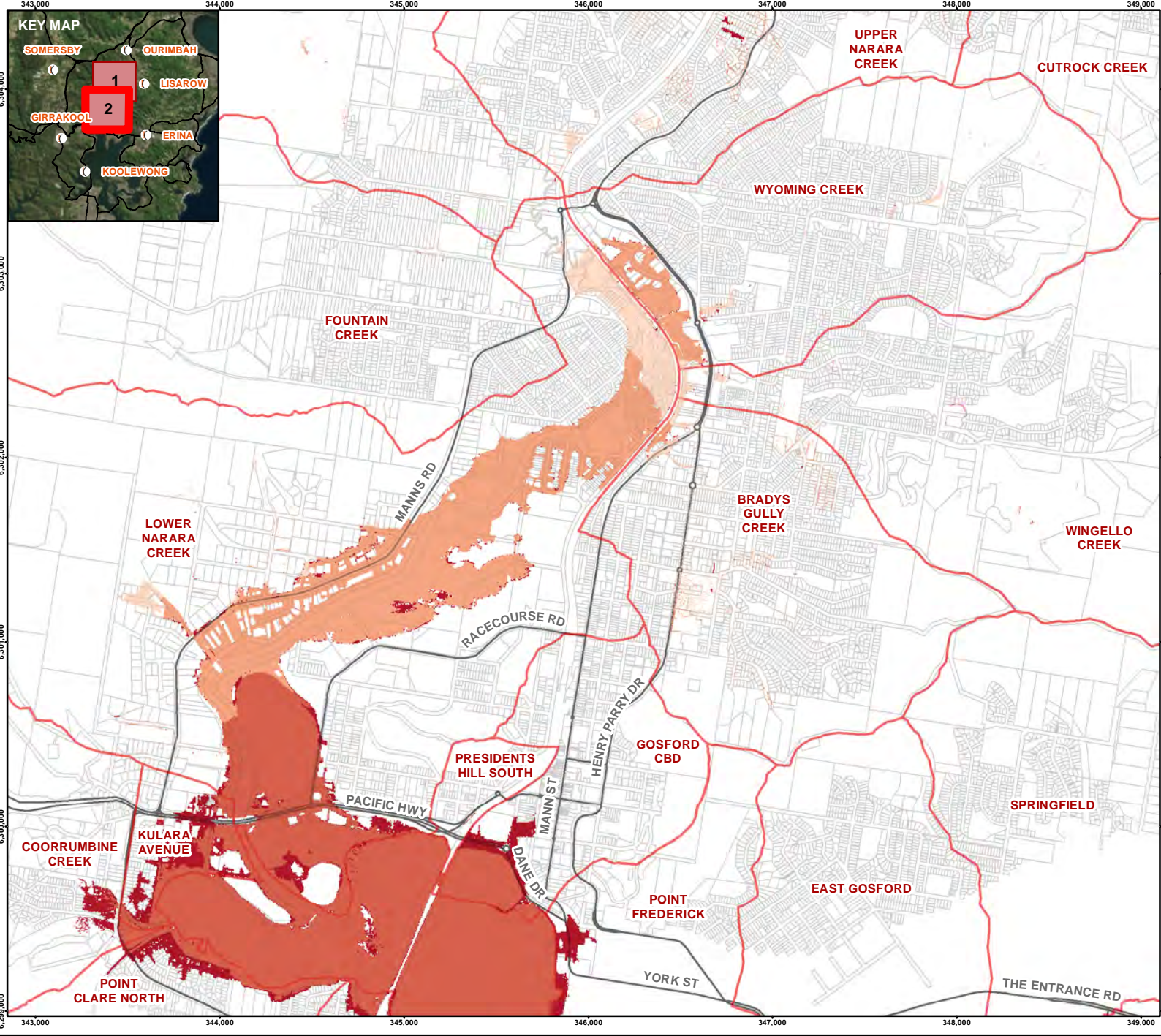
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 SEA LEVEL RISE (90 CM)**

CONSULTANT  
  
 DD/MM/YYYY 3/04/2018  
 DESIGNED SL  
 PREPARED DC  
 REVIEWED NM  
 APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 93A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m - 0.05 m
- 0.05 m - 0.20 m
- 0.20 m - 1.0 m
- More than 1.0 m

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

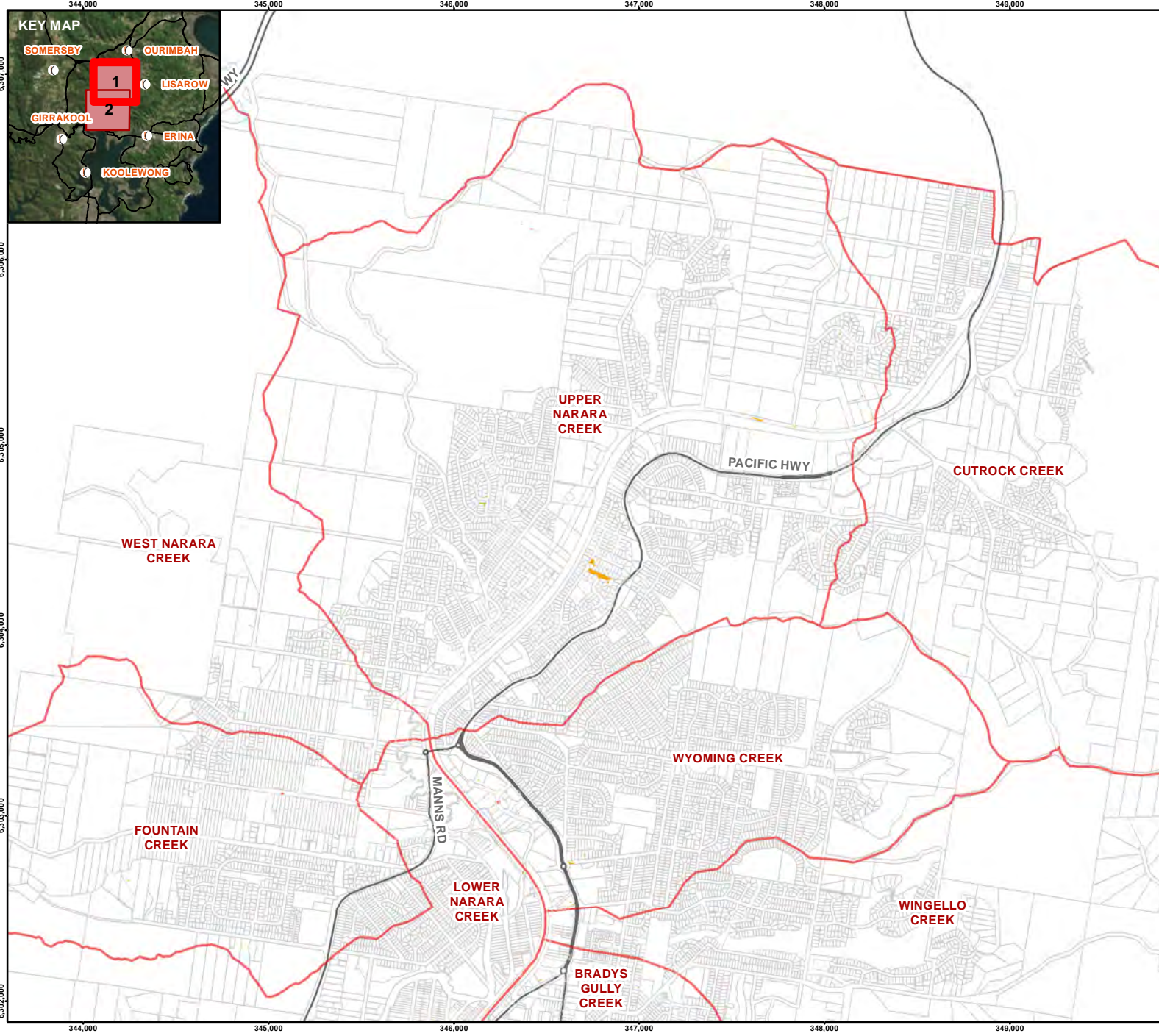
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 SEA LEVEL RISE (90 CM)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	93B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
 METRES  
 1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 SEA LEVEL RISE (90 CM)**

CONSULTANT

DD/MM/YYYY 3/04/2018

DESIGNED SL

PREPARED DC

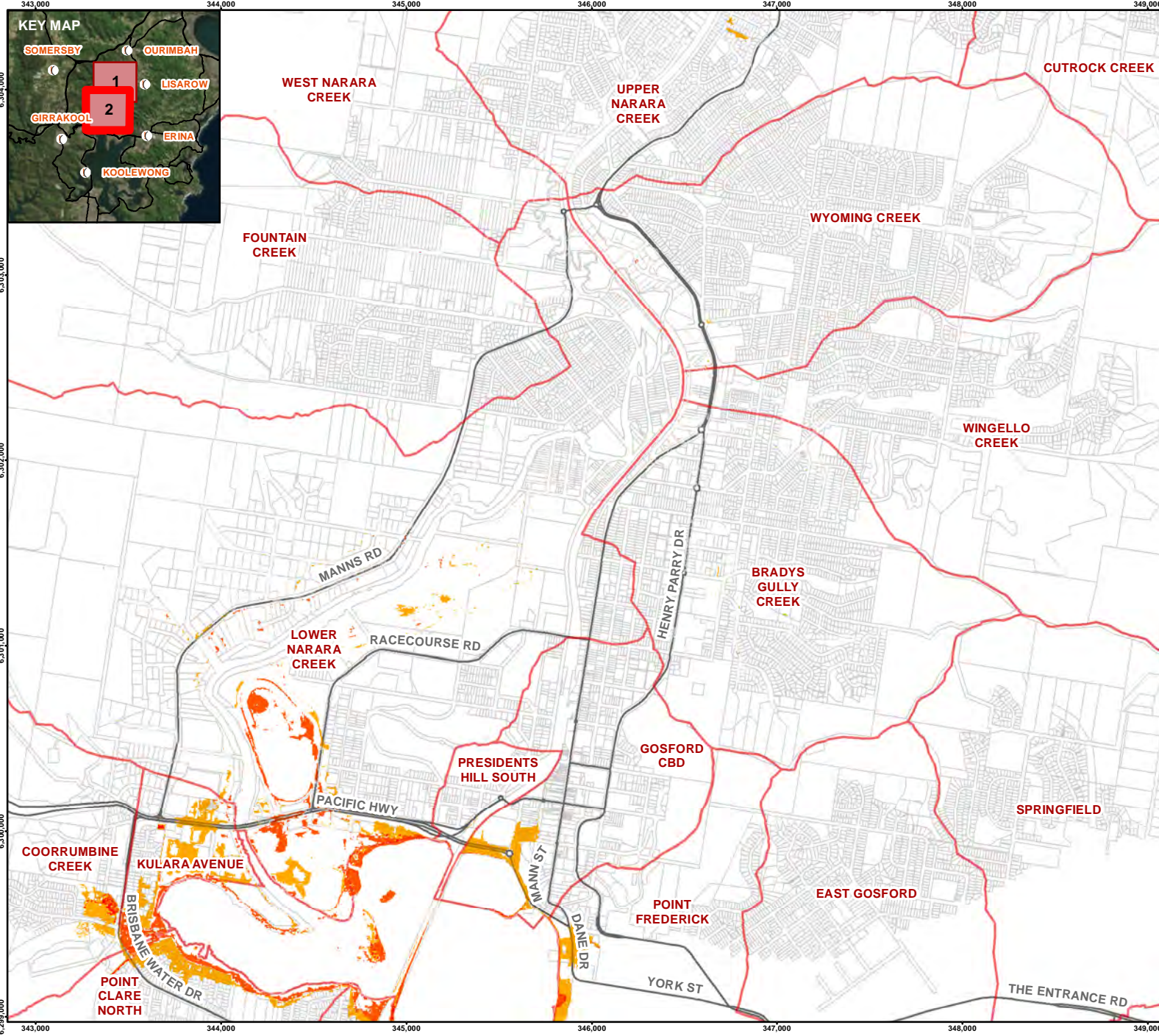
REVIEWED NM

APPROVED NM

PROJECT NO. 097626068 CONTROL 006 REV. G FIGURE 94A

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISS 44





**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

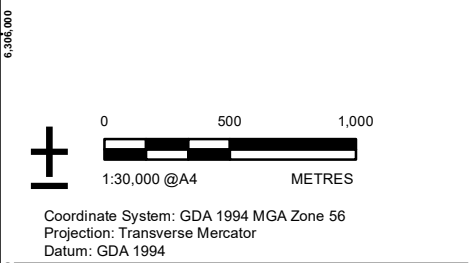
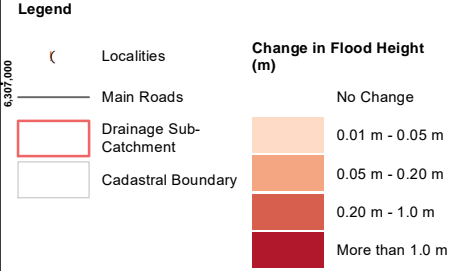
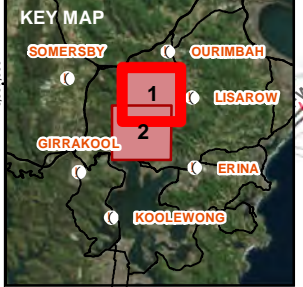
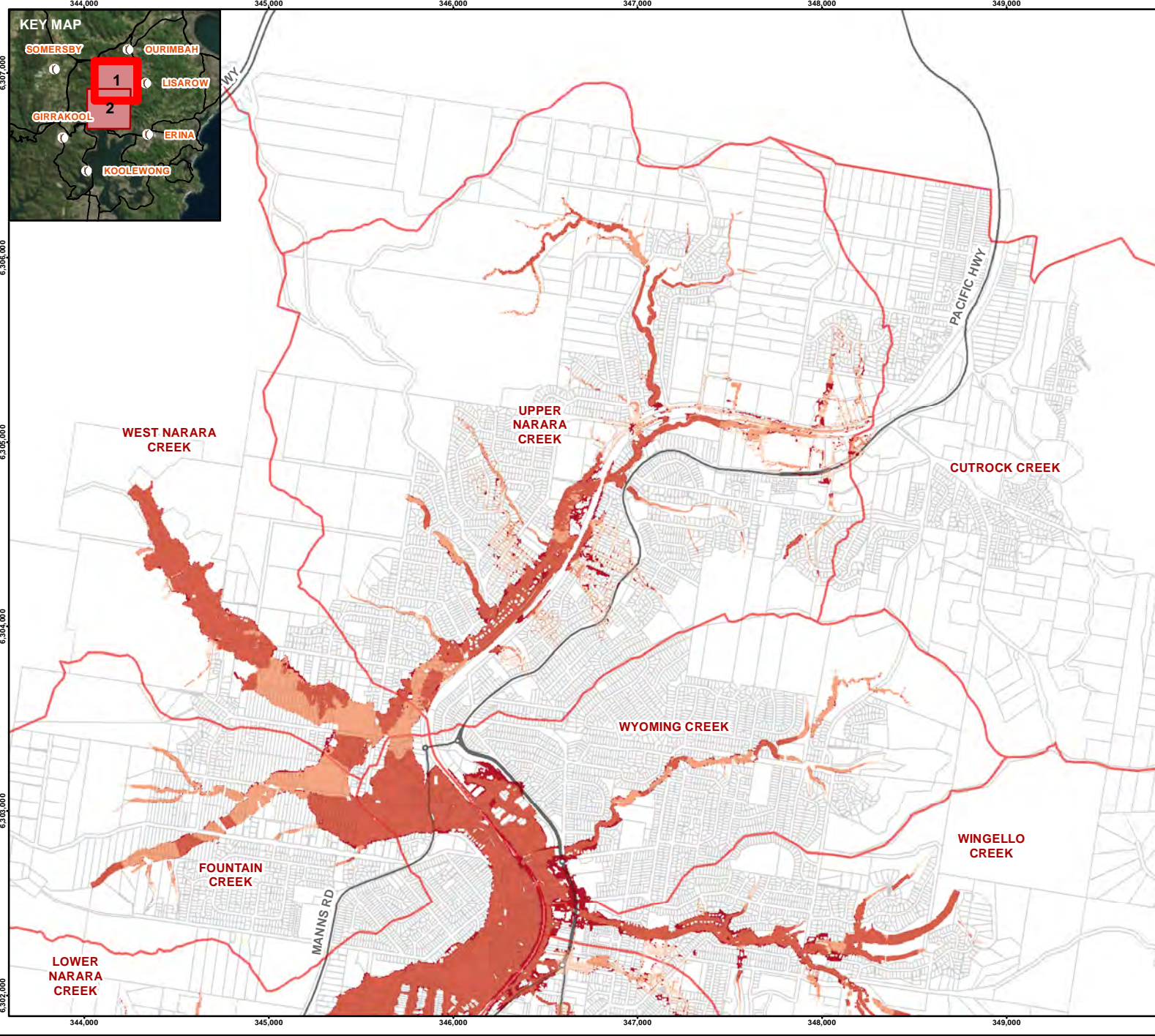
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD  
 SEA LEVEL RISE (90 CM)**

CONSULTANT  


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	94B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

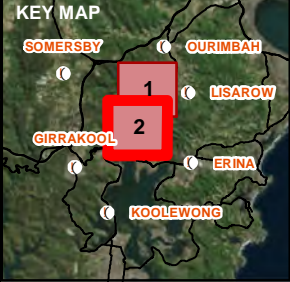
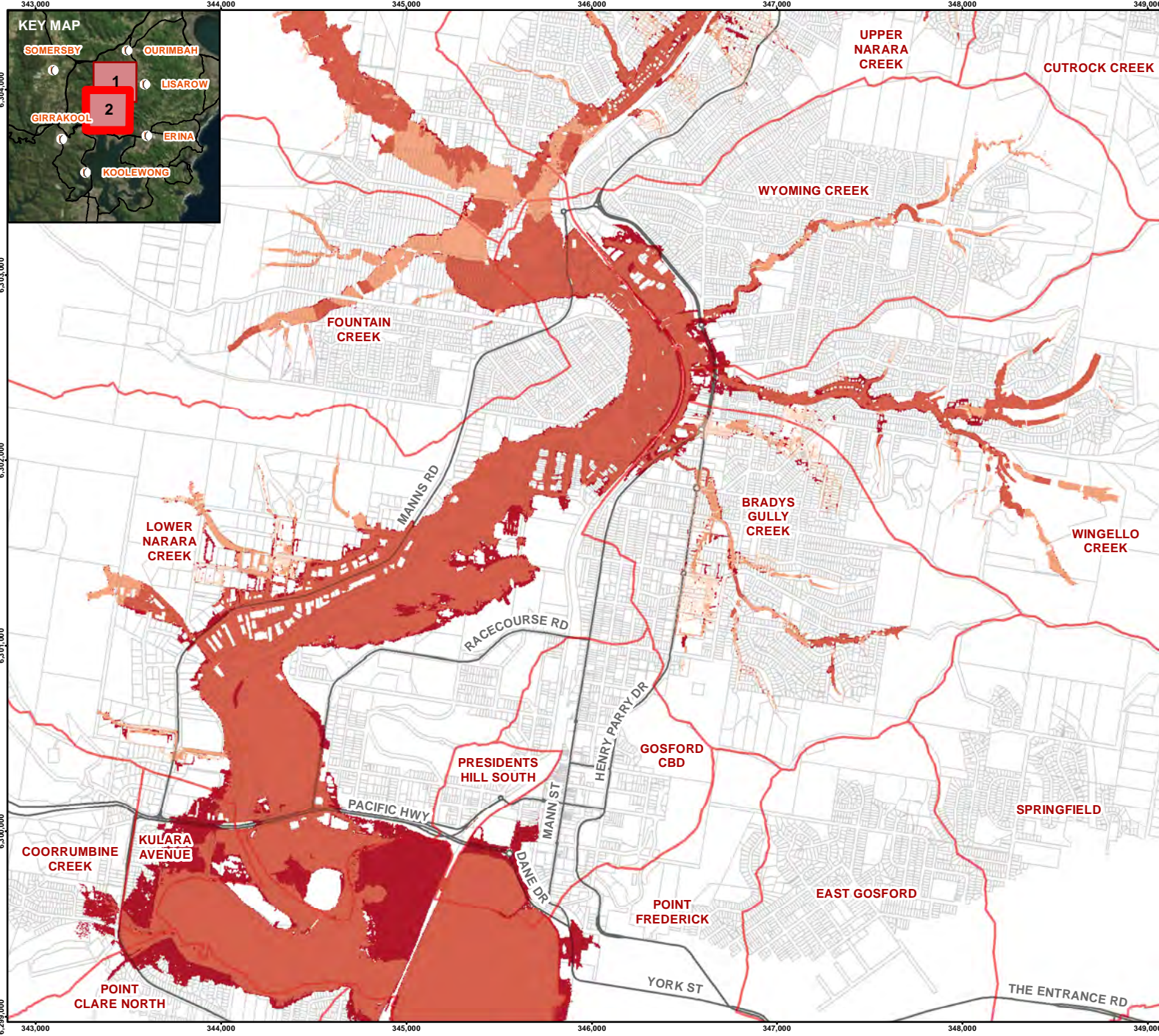
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (30%)  
 AND SEA LEVEL RISE (90 CM)**

CONSULTANT  
**Golder Associates**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	95A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

**Change in Flood Height (m)**

- No Change
- 0.01 m - 0.05 m
- 0.05 m - 0.20 m
- 0.20 m - 1.0 m
- More than 1.0 m

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
 Result filtered for changes in flood height greater than 0 m

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastre, Sub-Catchments:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

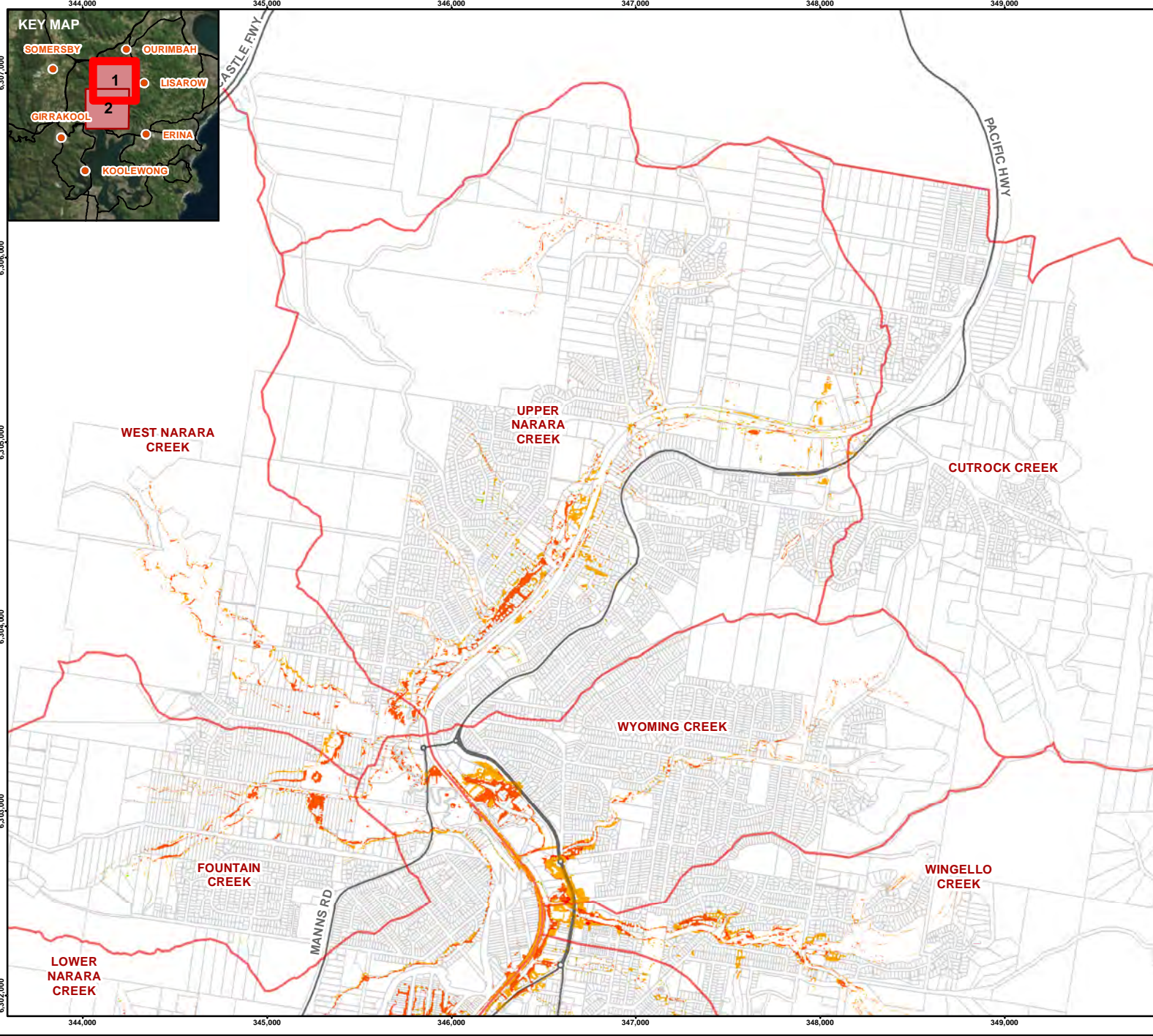
TITLE  
**CHANGE IN FLOOD HEIGHT (M)  
 INCREASED RAINFALL INTENSITY (30%)  
 AND SEA LEVEL RISE (90 CM)**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	95B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

N

0 500 1,000

1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

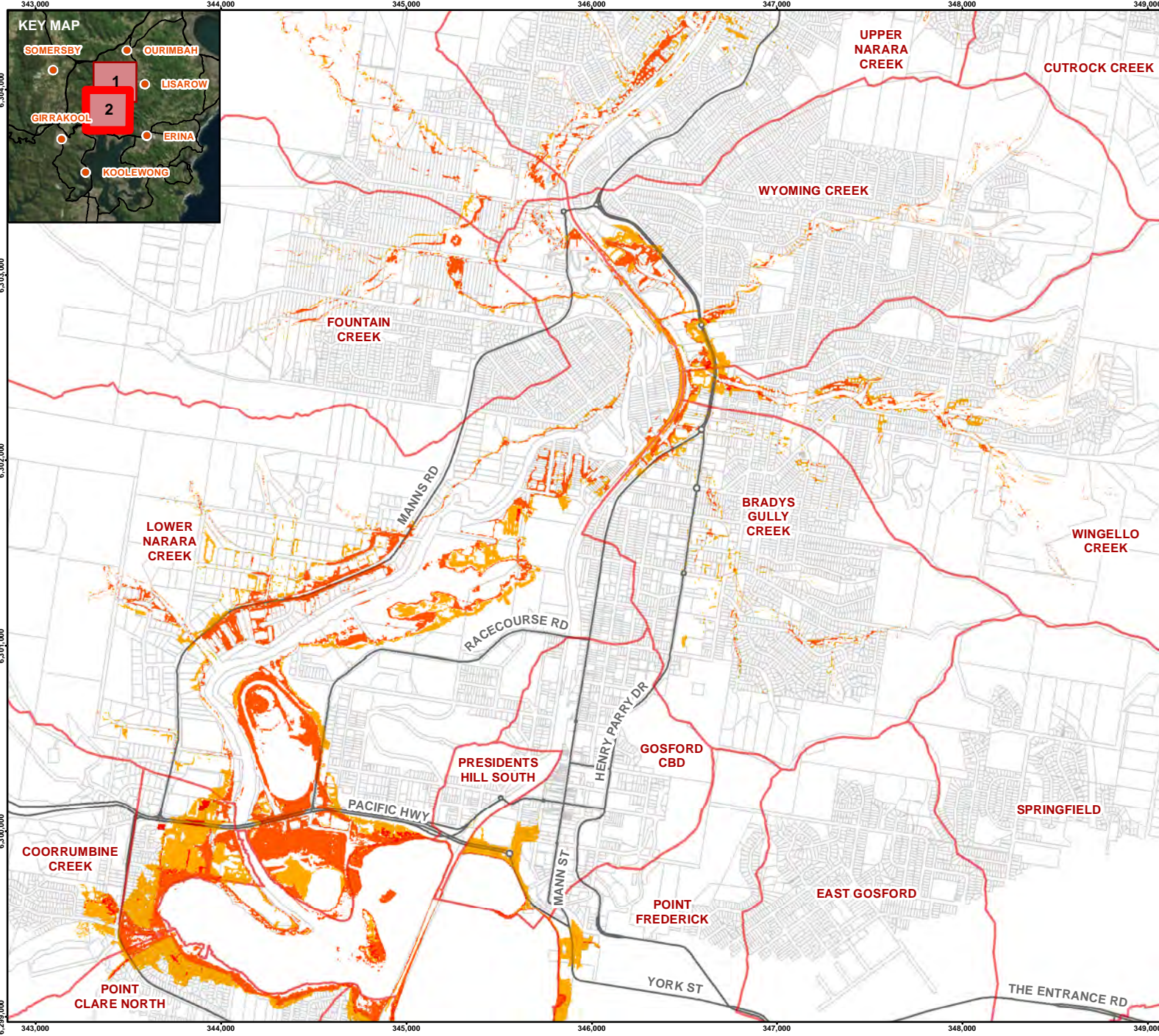
TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (30%) AND SEA LEVEL RISE (90 CM)**

CONSULTANT

DD/MM/YYYY	6/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	96A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Change in Provisional Flood Hazard**

- High to Dry
- High to Low
- Low to Dry
- No Change
- Dry to Low
- Low to High
- Dry to High

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CHANGE IN PROVISIONAL FLOOD HAZARD INCREASED RAINFALL INTENSITY (30%) AND SEA LEVEL RISE (90 CM)**

CONSULTANT

DD/MM/YYYY	6/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	96B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4

APPENDIX A

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**APPENDIX B**

**Community Survey**



February 2010

## NARARA CREEK SUBCATCHMENT FLOOD STUDY

# Community Flood Survey

**Submitted to:**  
Gosford City Council  
49 Mann Street,  
Gosford, NSW 2250

REPORT



A world of  
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**Report Number:** 097626068\_013\_R\_RevA

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## Table of Contents

<b>1.0 INTRODUCTION</b>	<b>1</b>
1.1 Survey summary	1
1.2 Narara Creek Subcatchments	2
1.3 Flood Management Areas	2
<b>2.0 A - WEST NARARA CREEK SUBCATCHMENT</b>	<b>3</b>
2.1 FMA13 – West Narara Creek	3
2.2 Other Flood Prone Areas as Indicated by Respondents	3
2.3 Flood Management Measures	3
2.4 Development Control	4
2.5 Flood Warning	4
2.6 Flood Awareness	4
2.7 Community Education	4
<b>3.0 B UPPER NARARA CREEK SUBCATCHMENT</b>	<b>5</b>
3.1 FMA6 – Koninderie Parade Channel	5
3.2 FMA10 – Kathleen Morreau Road	5
3.3 FMA11 – Siletta Road Retarding Basin	5
3.4 FMA15 – Mountain View Avenue	5
3.5 FMA16 – Sylvan Valley Close	6
3.6 Other Flood Prone Areas as Indicated by Respondents	6
3.7 Flood Management Measures	6
3.8 Development Control	7
3.9 Flood Warning	7
3.10 Flood Awareness	7
3.11 Community Education	7
<b>4.0 C FOUNTAIN CREEK SUBCATCHMENT</b>	<b>8</b>
4.1 FMA5 – Carrington Street Floodway and Narara Valley High School	8
4.2 FMA14 – Fountain Creek	9
4.3 Other Flood Prone Areas as Indicated by Respondents	9
4.4 Flood Management Measures	9
4.5 Development Control	10
4.6 Flood Warning	10



## RESULTS OF COMMUNITY FLOOD SURVEY

4.7	Flood Awareness .....	10
4.8	Community Education .....	11
<b>5.0</b>	<b>D WYOMING CREEK SUBCATCHMENT .....</b>	<b>11</b>
5.1	FMA4 – Brooks Avenue Flood Storage Area .....	11
5.2	FMA7 – Wyoming Creek .....	11
5.3	Other Flood Prone Areas as Indicated by Respondents .....	12
5.4	Flood Management Measures .....	12
5.5	Development Control .....	12
5.6	Flood Warning .....	13
5.7	Flood Awareness .....	13
5.8	Community Education .....	13
<b>6.0</b>	<b>E WINGELLO CREEK SUBCATCHMENT .....</b>	<b>13</b>
6.1	FMA8 – Wingello Creek .....	14
6.2	Other Flood Prone Areas as Indicated by Respondents .....	14
6.3	Flood Management Measures .....	14
6.4	Development Control .....	15
6.5	Flood Warning .....	15
6.6	Flood Awareness .....	15
6.7	Community Education .....	15
<b>7.0</b>	<b>F BRADY’S GULLY CREEK SUBCATCHMENT .....</b>	<b>16</b>
7.1	FMA9 – Brady’s Gully Creek .....	16
7.2	FMA12 – North Gosford Hospital Site .....	16
7.3	Other Flood Prone Areas as Indicated by Respondents .....	16
7.4	Flood Management Measures .....	16
7.5	Development Control .....	17
7.6	Flood Warning .....	17
7.7	Flood Awareness .....	18
7.8	Community Education .....	18
<b>8.0</b>	<b>G LOWER NARARA CREEK SUBCATCHMENT .....</b>	<b>18</b>
8.1	FMA1 – West Gosford Industrial Area .....	18
8.2	FMA2 – Rowena Road Protection Area .....	19
8.3	FMA3 – Manns Road / Deane Street / Narara Valley Drive Floodway Area .....	19
8.4	Other Flood Prone Areas as Indicated by Respondents .....	19
8.5	Flood Management Measures .....	20



## RESULTS OF COMMUNITY FLOOD SURVEY

8.6	Development Control .....	21
8.7	Flood Warning.....	21
8.8	Flood Awareness .....	21
8.9	Community Education .....	22
<b>9.0</b>	<b>FLOOD DATA USED FOR MODEL CALIBRATION .....</b>	<b>22</b>
<b>10.0</b>	<b>REPORTED PROPERTY DAMAGE .....</b>	<b>22</b>

### CHARTS

Chart 1:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the West Narara Creek Catchment .....	3
Chart 2:	Bar Chart showing preferred methods for communication in the West Narara Creek Subcatchment.....	4
Chart 3:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Upper Narara Creek Subcatchment .....	6
Chart 4:	Bar Chart showing preferred methods for communication in the Upper Narara Creek Subcatchment .....	8
Chart 5:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Fountain Creek Subcatchment.....	9
Chart 6:	Bar Chart showing preferred methods for communication in the Fountain Creek Subcatchment .....	11
Chart 7:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Wyoming Creek Subcatchment.....	12
Chart 8:	Bar Chart showing preferred methods for communication in the Wyoming Creek Subcatchment .....	13
Chart 9:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Wingello Creek Subcatchment.....	14
Chart 10:	Bar Chart showing preferred methods for communication in the Wingello Creek Subcatchment .....	16
Chart 11:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Brady's Gully Creek Subcatchment .....	17
Chart 12:	Bar Chart showing preferred methods for communication in the Brady's Gully Creek Subcatchment.....	18
Chart 13:	Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Lower Narara Creek Subcatchment .....	20
Chart 14:	Bar Chart showing preferred methods for communication in the Brady's Gully Creek Subcatchment.....	22

### TABLES

Table 1:	Calibration Dates of Flooding .....	1
Table 2:	Reported Damages.....	10

### FIGURES

- Figure 1: Narara Creek Subcatchments and Flood Management Areas
- Figure 2: A - West Narara Creek Subcatchment
- Figure 3: B – Upper Narara Creek Subcatchment
- Figure 4: C – Fountain Creek Subcatchment
- Figure 5: D – Wyoming Creek Subcatchment



Figure 6: E – Wingello Creek Subcatchment

Figure 7: F – Brady's Creek Subcatchment

Figure 8: G – Lower Narara Creek Subcatchment

### APPENDICES

#### APPENDIX A

Community Flood Survey

#### APPENDIX B

Photographs Provided by Respondents

#### APPENDIX C

Community Flood Questionnaire Results

#### APPENDIX D

Calibration and Damages Table

#### APPENDIX E

Survey Responses

DRAFT



### 1.0 INTRODUCTION

Gosford City Council (Council) is responsible for local planning and land management including the flood liable land in the Narara Creek Catchment. The New South Wales (NSW) State Government's Floodplain Development Manual specifies a Floodplain Risk Management Process that Council is committed to implementing in the Narara Creek Catchment.

Council has commissioned Golder Associates Pty Ltd (Golder) to provide technical services in the preparation of the Floodplain Risk Management Plan for the Narara Creek Catchment. This report presents the results of the Community Flood Survey that was completed for the Narara Creek Catchment as part of the floodplain management process.

The Community Flood Survey was developed for essentially two purposes. The first was to obtain information on historical flooding and associated damages in the Narara Creek Catchment to assist in the calibration of the flood model. The second purpose was to gauge the opinion of residents on flood related issues including flood awareness and the most appropriate flood warning systems, flood mitigation and flood management options.

The data acquired through this survey process has been collated and assessed by Golder. The results of this survey are presented in this report.

### 1.1 Survey summary

A questionnaire was prepared in consultation with Council to undertake the community survey. A copy of the questionnaire is presented in APPENDIX A.

The survey was mailed to 1,578 property owners in November 2009 within the area derived from the 1% Annual Exceedence Probability (AEP) Flood Extent by including areas that lay 15 metres above this extent. The flood extent was provided by Council. A total of 342 responses were received which equates to a response rate of approximately 22%.

The responses were received over a period of ten weeks from 26 November 2009 to 5 February 2010. Overall Respondents reported a total of 495 locations where they had observed flooding or overland flows in the study area.

Of the 322 respondents that noted how long they had "lived/worked/shopped/run a business in the study area" 261 (81%) had been in the area greater than five years, 205 (64%) greater than ten years, 133 (41%) greater than twenty years, and 16 (5%) greater than forty years. Based on the total number of years the respondents have observed the flood study area, the data obtained is considered to provide a reasonable history of flooding in the area, and not focus solely on recent flood events.

Twenty-seven surveys were "returned to sender". These surveys were addressed to a variety of Government departments, private residences and commercial premises. This is not expected to affect the overall quality of the data obtained from the survey.

Several respondents provided photos of flooding events which are provided in APPENDIX B.

Out of a total of 342 responses, 113 (33%) respondents indicated that their property had flooded and 22 (6%) of these properties were reported to have flooding within structures on their property.

The results from the survey have been tabulated and are included in APPENDIX C.

Survey questions were answered by respondents with varying degrees of accuracy. One distinction this report makes is that between reports of flooding at "general" and "specific" locations. The distinction arises where one respondent may describe a flood location as "Narara Valley Drive" where another may describe the flood location as "Narara Valley Drive from Yurunga Street to Deane Street". For the purposes of this report the former is considered a "general" flood location and the latter a "specific" flood location.

The report is discussed on a subcatchment basis with reference to the Flood Management Areas as outlined by Council. Figure 1 shows the Narara Creek subcatchment boundaries and the Flood Management Areas.



### 1.2 Narara Creek Subcatchments

Narara Creek Catchment has been divided into seven subcatchments that represent the major creek systems in the area. These subcatchments provide the main sections for this report, listed below and shown in Figure 1.

- A - West Narara Creek
- B - Upper Narara Creek
- C - Fountain Creek
- D - Wyoming Creek
- E - Wingello Creek
- F – Brady's Gully Creek
- G - Lower Narara Creek

### 1.3 Flood Management Areas

Council has identified twelve Flood Management Areas (FMA) in the Narara Creek Catchment within the subcatchments noted above. Flooding has been known to occur at varying frequencies in these areas for which Council requires detailed analysis in this study. The Flood Management Areas are listed below with the associated subcatchment area.

- FMA1 – West Gosford Industrial Area - *G Lower Narara Creek*
- FMA2 – Rowena Road Protection Area - *G Lower Narara Creek*
- FMA3 – Manns Road / Deane Street / Narara Valley Drive Floodway Area - *G Lower Narara Creek*
- FMA4 – Brooks Avenue Flood Storage Area - *D Wyoming Creek*
- FMA5 – Carrington Street Floodway and Narara Valley High School - *C Fountain Creek*
- FMA6 – Koninderie Parade Channel - *B Upper Narara Creek*
- FMA7 – Wyoming Creek - *D Wyoming Creek*
- FMA8 – Wingello Creek - *E Wingello Creek*
- FMA9 – Brady's Gully Creek - *F Brady's Gully Creek*
- FMA10 – Kathleen Morreau Road - *B Upper Narara Creek*
- FMA11 – Siletta Road Retarding Basin - *B Upper Narara Creek*
- FMA12 – North Gosford Hospital Site - *G Lower Narara Creek*

Four additional Flood Management Areas were identified:

- FMA13 – West Narara Creek - *A West Narara Creek*
- FMA14 – Fountain Creek - *C Fountain Creek*
- FMA15 – Mountain View Avenue - *B Upper Narara Creek*
- FMA16 – Slyvan Valley Close - *B Upper Narara Creek*





The following sections provide analysis of resident responses for various subcatchments.

### 2.0 A - WEST NARARA CREEK SUBCATCHMENT

The West Narara Creek subcatchment contains FMA 13 as shown on Figure 2. Sixteen residents in the West Narara Creek Subcatchment responded to the community survey.

The distribution of responses in Flood Management Areas and other areas is discussed below:

#### 2.1 FMA13 – West Narara Creek

The portion of West Narara Creek runs west-east and is bounded in the north by Deane Street and to the south by Fountains Road. There were ten reports of flooding on private properties fronting onto Deane Street and Fountains Road.

Ten respondents noted non-specific flooding on Fountains Road. Two respondents stated that this cut off access to Narara Valley High School. The precise location of the flooding is unclear from the residents responses, however likely refers to the eastern end of the road.

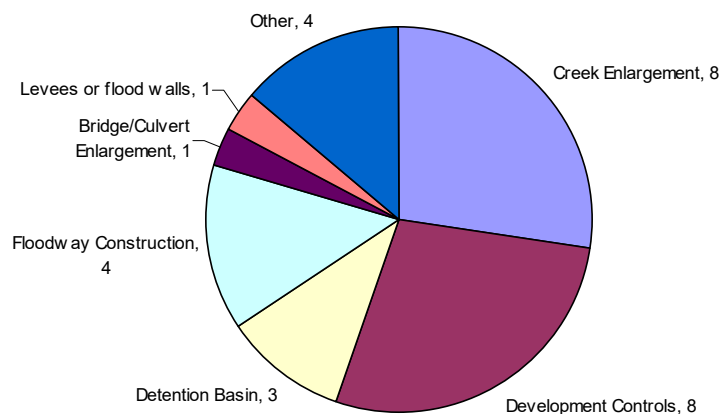
#### 2.2 Other Flood Prone Areas as Indicated by Respondents

No other flood prone areas were identified by the survey in the West Narara Creek Catchment.

Other important information received from the residents is discussed below.

#### 2.3 Flood Management Measures

Ten respondents in the subcatchment presented opinions on the most suitable flood mitigation measures. Many of these selected more than one measure. These results are presented in the pie chart below.



*Chart 1: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the West Narara Creek Catchment*

The survey results showed the preferred mitigation measures were Creek Enlargement and Development Controls.

The responses included in “Other” are:

- “Reinstate the old Creek line away from houses on Fountains Road”, one respondent;
- “Sand Dredge in Narara Creek”, one respondent; and
- “Clear/ Clean the Creek”, two respondents.



### 2.4 Development Control

Thirteen (13) respondents answered the question about development in flood prone areas follows:

- 5 believed development should be allowed after the application of appropriate development controls; and
- 8 believed no development should be allowed in these areas.

### 2.5 Flood Warning

Six respondents (6) answered this question of which two (2) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the four who had received flood warnings the following sources were noted:

- Four (4) received a warning from Local Radio/Television;
- One (1) from the Bureau of Meteorology (BOM); and
- One (1) from the State Emergency Services (SES).

### 2.6 Flood Awareness

Of the fourteen (14) respondents who answered this question most were aware of the risk of flooding to their properties. Survey results are summarised as follows:

- Four (4) respondents did **not** think their property was liable to flood, however two of these were partially within the preliminary 1%AEP flood extent.
- Ten (10) respondents believed their property was liable to flood, however preliminary modelling suggested that two (2) of these were not in the 1%AEP flood plain.

### 2.7 Community Education

The twelve (12) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

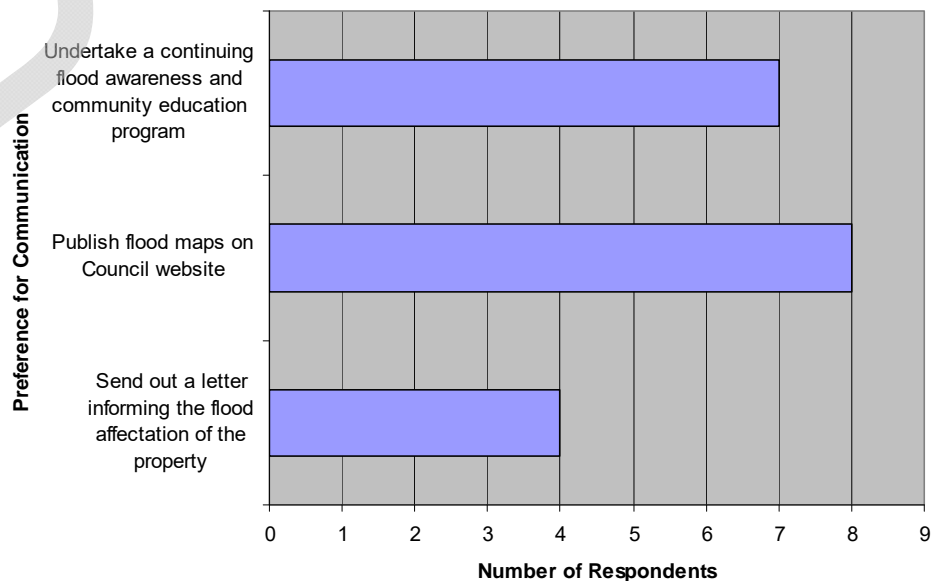


Chart 2: Bar Chart showing preferred methods for communication in the West Narara Creek Subcatchment.



### 3.0 B UPPER NARARA CREEK SUBCATCHMENT

The Upper Narara Creek subcatchment contains the five FMAs FMA 6, FMA10, FMA11, FMA15, and FMA16, respectively, *Koninderie Parade Channel*, *Kathleen Morreau Road*, *Siletta Road Retarding Basin*, *Mountain View Avenue* and *Slyvan Valley Close*.

These are shown on Figure 3. Eighty-eight (88) residents in the West Narara Creek Subcatchment responded to the community survey.

The distribution of responses in Flood Management Areas and other areas is discussed below:

#### 3.1 FMA6 – Koninderie Parade Channel

The majority of reported flooding in the Upper Narara Creek Subcatchment related to FMA6. This area is shown in Figure 3, and can be described as encompassing the length of Koninderie Parade and a wide margin around Koninderie Parade. The area includes Narara Station and Narara Valley Drive where it crosses Narara Creek near Narara Station. Flooding can be summarised as follows:

- Properties in the FMA, 17 reports of flooding at 13 different properties in the FMA;
- Koninderie Parade, 7 general and specific reports of flooding in this area;
- Narara Valley Drive bridge over Narara Creek, four specific reports of flooding;
- Reserve next to Narara Valley Drive bridge, one report of flooding;
- Narara Valley Drive, 9 non-specific reports of flooding on this road, likely relating to this FMA.
- Narara Valley Drive from Yurunga Street to Deane Street, four reports of flooding on this stretch of road;
- Narara Train Station, one report of flooding;
- Haggerty Close, one report of flooding; and
- Reserve south of Haggerty Close, one report of flooding.

The area around the southern portion of Koninderie Parade, including the western side of Narara Station and Narara Valley Drive where it crosses Narara Creek near Narara Station is located almost entirely within the 1%AEP Floodplain.

#### 3.2 FMA10 – Kathleen Morreau Road

There were four (4) reports of flooding in this area. The areas reported as flooded included two private residences and two report of flooding at the culvert on Kathleen Morreau Road.

#### 3.3 FMA11 – Siletta Road Retarding Basin

There were no reports of flooding in the Siletta Road Retarding Basin FMA.

#### 3.4 FMA15 – Mountain View Avenue

The community flood survey responses included a total of three (3) reports of flooding in FMA15.

- Flooding/Overland flow was observed by one respondent on Mountain View Avenue. This note was accompanied by the qualification that “Mountain View Avenue is a short street with a steep slope. Stormwater runs off easily into the creek”;
- Overland flow observed at the rear of one property in Pinetop Avenue;
- 3-4ft of water was reported at the rear of a property in the lower reaches of the unnamed tributary passing through FMA15.



### 3.5 FMA16 – Sylvan Valley Close

There were no reports of flooding in the Sylvan Valley Close FMA.

### 3.6 Other Flood Prone Areas as Indicated by Respondents

The survey results highlighted flooding in other areas within the Upper Narara Creek Subcatchment:

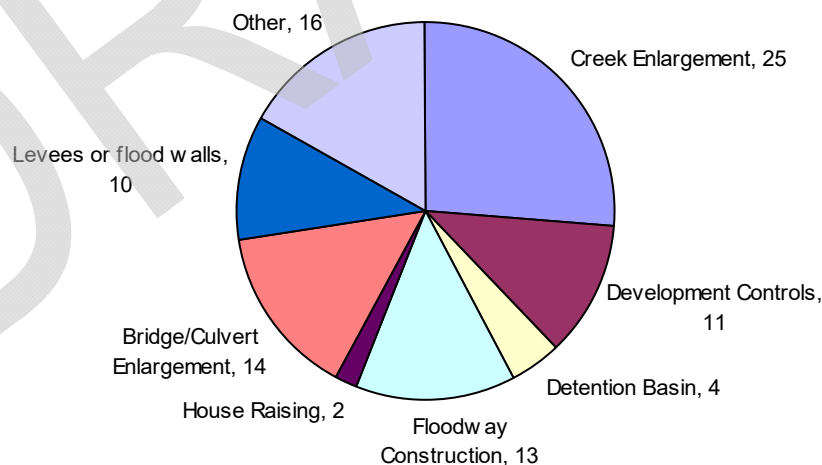
- Five respondents reported general flooding of Railway Crescent.
- Two reports of flooding at Lisarow shopping centre carpark.
- Three reports of overland flow on and in the vicinity of Neeworra Road and two reports of flooding of residential dwellings down stream of these locations. The path of the unnamed tributary can be traced by the locations of the reported flood locations 164f, 339, 223, 30 and 209a.

Flooding was reported at several other points in the Upper Narara Creek Catchment, however there were no other obvious clusters of reported floods.

Other important information received from the residents is discussed below.

### 3.7 Flood Management Measures

Fifty-six (56) respondents in the Upper Narara Creek Subcatchment answered the question relating to possible mitigation measures. Respondents who answered this question often selected one or more mitigation measure they considered would ease flooding. These results are presented in the pie chart below.



*Chart 3: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Upper Narara Creek Subcatchment*

A large number of respondents nominated flood mitigation measures that were not listed on the questionnaires. The measures they recommended are listed below:

- Clearing/Cleaning Creek of Rubbish/Debris/Weeds, nine (9) respondents;
- Raising Roads e.g. Carrington St, Showground Rd, two (2) respondents;
- Curbing & Proper drainage “many flood-prone streets have dirt edges e.g. Deane St, Hanlan Street”, two (2) respondents;
- Council purchase of flood affected properties, one (1) respondent;



- Creek Dredging, one (1) respondent; and
- Drain storm water into creek, from affected properties, one (1) respondent.

Creek enlargement is the preferred mitigation method for the Upper Narara Creek Subcatchment.

### 3.8 Development Control

Seventy-seven (77) respondents answered the question about development in flood prone areas follows:

- Twenty-eight (28) believed development should be allowed after the application of appropriate development controls;
- Forty-eight (48) believed no development should be allowed in these areas; and
- One (1) respondent believed Council should not impose any controls on development in flood prone areas.

### 3.9 Flood Warning

Thirty respondents (30) answered this question of which nineteen (19) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the eleven (11) who had received flood warnings the following sources were noted:

- Ten (10) received a warning from Local Radio/Television;
- One (1) from the Bureau of Meteorology (BOM);
- One (1) from local knowledge; and
- One (1) from neighbours.

### 3.10 Flood Awareness

Of the seventy-eight (78) respondents who answered this question most were aware of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Sixty (60) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that five (5) of these were partially within the 1%AEP flood plain.
- Eighteen (18) respondents believed their property was liable to flood, however preliminary modelling suggested that four (4) of these were not in the 1%AEP flood plain.

### 3.11 Community Education

The seventy-six (76) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

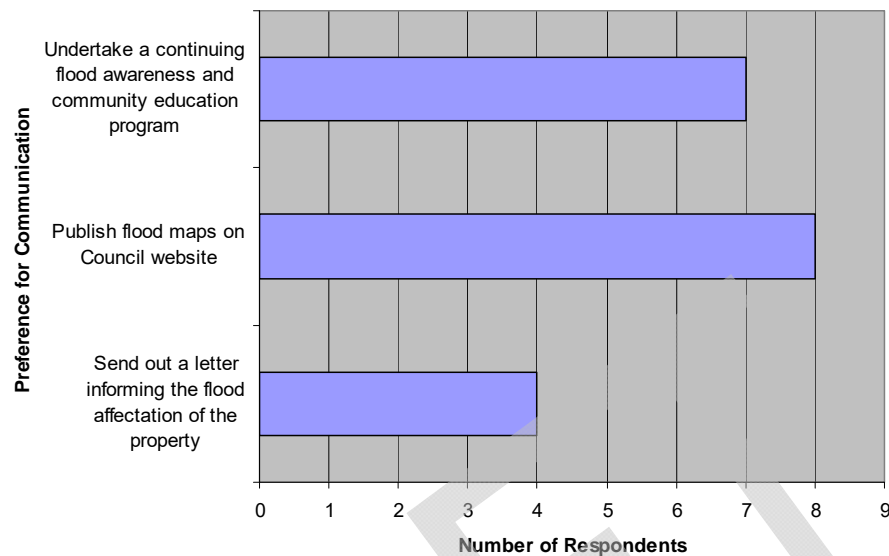


Chart 4: Bar Chart showing preferred methods for communication in the Upper Narara Creek Subcatchment

## 4.0 C FOUNTAIN CREEK SUBCATCHMENT

The Fountain Creek subcatchment contains FMA 5, *Carrington Street Floodway and Narara Valley High School* and FMA14, *Fountain Creek* as shown on Figure 4. Forty-three (43) respondents had addresses within the Fountain Creek Subcatchment.

The distribution of responses in Flood Management Areas and other areas is discussed below:

### 4.1 FMA5 – Carrington Street Floodway and Narara Valley High School

This area is located predominantly in the C Fountain Creek Subcatchment however also covers the lower reaches of two other subcatchments. There were numerous reports of flooding in this FMA.

The most numerous reports of flooding within the Fountain Creek Subcatchment relate to Carrington Street. Carrington Street is located in both the Fountain Creek Subcatchment and the Wyoming Creek Subcatchment, with the eastern half of Carrington Street within the 1%AEP floodplain. Note that flooding in the lower (eastern) part of Carrington Street is discussed with FMA 3 in Section 8.3 of this report. A summary of reported floods in FMA5 includes:

#### Carrington Street and Pandala Road

- Five (5) specific reports of flooding between 63 and 93 Carrington Street;
- Two (2) reports of flooding at the culvert on Carrington Street, near southern boundary of Narara Valley High;
- Twenty-three (23) non-specific reports of flooding on Pandala Road and Carrington Street;
- One (1) report that the entire length of Carrington Street was flooded in a storm in 1970;
- One (1) report of flooding from the Carrington Street culvert bridge Manns Road; and
- Five (5) reports of flooding at the corner of Pandala and Carrington Streets.

#### School and Community Centre

- Three (3) general and one specific report of flooding at Narara Valley High School.



- Three (3) specific reports of flooding at the community centre and carpark on the corner of Pandala Road and Carrington Street
- Three (3) reports of flooding at the oval adjacent to the Community Centre

### 4.2 FMA14 – Fountain Creek

FMA14 includes several tributaries to Fountain Creek and is shown in Figure 4.

Flooding was reported at twenty-seven (27) private properties within FMA14. There were three (3) non-specific reports of flooding on Reeves Street, and notably there were twelve (12) specific reports of flooding on Reeves Street at the culvert/causeway.

### 4.3 Other Flood Prone Areas as Indicated by Respondents

The majority of reported floods in the Fountain Creek Subcatchment are captured by FMA5 and FMA14. Two other areas with low density clusters of reported floods are also noted below.

#### Rear of properties 0-26 Reeves Street and Anne Close

On the northern side of the southern portion of Reeves Street, Narara, flooding was reported at three specific addresses, and non-specifically in Anne Close and the general area. Four of these five reports of flooding were made by the same respondent.

#### Unnamed Tributary to Fountain Creek

Three (3) adjacent properties to the north of the western end of Narara Creek Road reported flooding at their properties. This area is west of FMA14, and therefore some distance upstream. One of the reports of flooding in this area by Respondent 48a included above floor level flooding.

Other important information received from the residents is discussed below.

### 4.4 Flood Management Measures

Thirty-five (35) respondents for the Fountain Creek Subcatchment answered the question on the flood mitigation measures they considered most appropriate. Respondents often selected one or more mitigation measures they considered would ease flooding. These results are presented in the pie chart below.

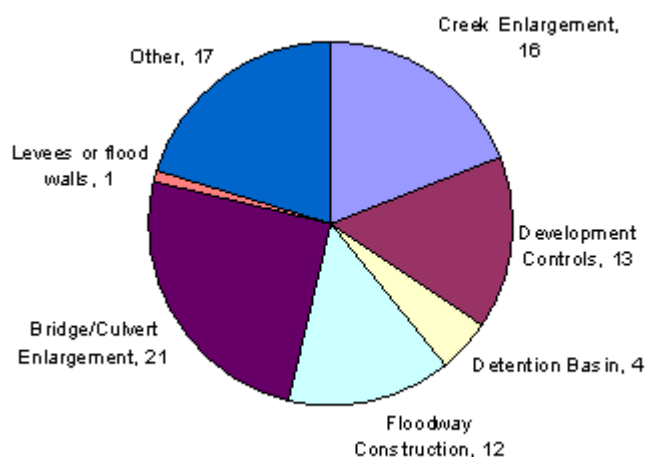


Chart 5: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Fountain Creek Subcatchment



The survey results showed the preferred mitigation measure was Bridge/Culvert Enlargement.

A total of seventeen (17) responses not prescribed in the survey were noted by respondents and included in the “Other” category shown on the pie chart above. These are:

- Clearing/cleaning Creeks/Storm drains of weeds/debris/rubbish, six respondents;
- “Dredge [Narara] Creek”, two respondents;
- “[Build] a bridge over the [Reeves Street] culvert”, one respondent;
- “Raise level of Carrington Street”, one respondent;
- “Improve passage way (open drainage) from Reeves Street to Carrington Street”, one respondent;
- “Enlarge and improve Carrington Street drainage”, one respondent;
- “Better drainage works... at northern end of Cross Street (undeveloped portion intersecting with Carrington St)”, one respondent;
- “Reduced development in outer catchment areas”, one respondent;
- “Pipes laid on Reeves Street causeway”, one respondent;
- “Raise level of backyard”, one respondent; and
- “Lowering the level of the railway dam at the top of Reeves St”.

### 4.5 Development Control

Forty (40) respondents answered the question about development in flood prone areas follows:

- 23 respondents believed development should be allowed after the application of appropriate development controls; and
- 17 respondents believed no development should be allowed in these areas.

### 4.6 Flood Warning

Twenty-one (21) respondents answered this question of which seven (7) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the fourteen who had received flood warnings the following sources were noted:

- Eleven (11) received a warning from Local Radio/Television;
- Two (2) from the Bureau of Meteorology (BOM);
- One (1) from Neighbours;
- One (1) from Police;
- One (1) from Friends; and
- One (1) from the State Emergency Services (SES).

### 4.7 Flood Awareness

Of the forty (40) respondents who answered this question many were **unaware** of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Nineteen (19) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that fifteen (15) of these were partially within the 1%AEP flood plain.





- Twenty-one (21) respondents believed their property was liable to flood, however preliminary modelling suggested that one (1) of these were not in the 1%AEP flood plain.

### 4.8 Community Education

The thirty-nine (39) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

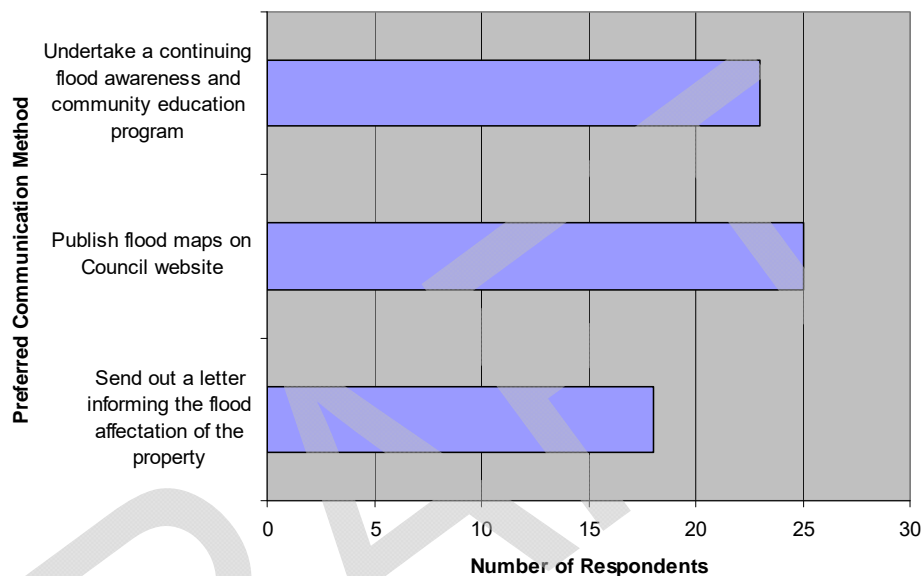


Chart 6: Bar Chart showing preferred methods for communication in the Fountain Creek Subcatchment

## 5.0 D WYOMING CREEK SUBCATCHMENT

The Wyoming Creek subcatchment contains FMA4 *Brooks Avenue Flood Storage Area* and FMA7 *Wyoming Creek* as shown on Figure 5. Forty eight (48) residents in the Wyoming Creek Subcatchment responded to the community survey.

The distribution of responses in Flood Management Areas and other areas is discussed below:

### 5.1 FMA4 – Brooks Avenue Flood Storage Area

The Brooks Avenue Flood Storage Area runs north-west to south-east and is bounded by to the north by Pacific Highway and to the south by the railway. There were two (2) general reports of flooding within this flood management area: Pacific Highway and Brooks Ave.

### 5.2 FMA7 – Wyoming Creek

The FMA7 Wyoming Creek runs east-west and consists of the floodplain and surrounding residential properties. There were thirty four (34) reports of flooding within the Wyoming Creek flood management area and thirteen (13) residents reported flooding on their property.

Seven (7) respondents noted non-specific flooding within the area at the following locations:

- Renwick Street;
- Giselle Ave;
- Chamberlain Road; and
- Day St.



Specific areas of flooding that were noted were Alan Davidson Oval and flooding behind the houses at 33 & 35 Crawford Crescent.

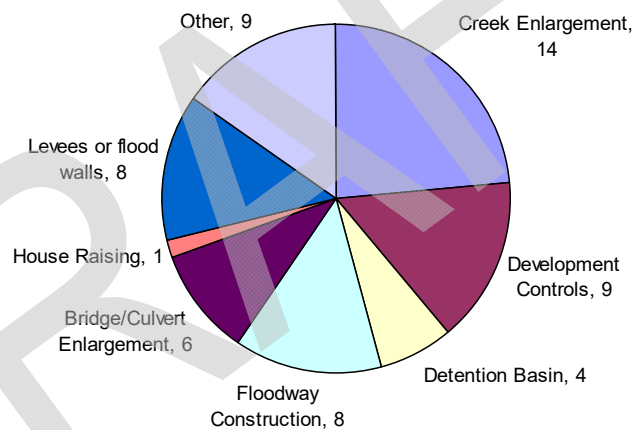
### 5.3 Other Flood Prone Areas as Indicated by Respondents

Three respondents reported flooding outside of the Brooks Avenue Flood Storage Area or Wyoming creek flood management areas. Two of these respondents reported flooding on their properties. One specific point of flooding was reported at Wyoming Creek and Chamberlain Road.

Other important information received from the residents is discussed below.

### 5.4 Flood Management Measures

Thirty (30) respondents for the Wyoming Creek Subcatchment answered the question on the flood mitigation measures they considered most appropriate. Respondents often selected one or more mitigation measures they considered would ease flooding. These results are presented in the pie chart below.



*Chart 7: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Wyoming Creek Subcatchment*

The survey results showed the preferred mitigation measure was Creek Enlargement.

A total of nine (9) responses not prescribed in the survey were noted by respondents and included in the “Other” category shown on the pie chart above. These are:

- “Clear/clean the Creek of weeds/debris/rubbish”, five respondents;
- “Underground tanks”, one respondent;
- “Parks - leave as wet land”, one respondent;
- “Narara Creek could be weir so water could be used to irrigate ovals”, one respondent; and
- “Dredge creek”, one respondent.

### 5.5 Development Control

Forty four (44) respondents answered the question about development in flood prone areas follows:

- 17 respondents believed development should be allowed after the application of appropriate development controls;



## RESULTS OF COMMUNITY FLOOD SURVEY

- 25 respondents believed no development should be allowed in these areas; and
- 2 respondents believed that there should not be any control on development in the flood prone areas.

### 5.6 Flood Warning

Eighteen (18) respondents answered this question of which eleven (11) had never received a flood warning. Of the seven (7) who had received flood warnings the following sources were noted:

- Six (6) received a warning from Local Radio/Television; and
- One (1) from their Neighbour.

### 5.7 Flood Awareness

Of the forty-five (45) respondents who answered this question most respondents were aware of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Thirty-two (32) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that seven (7) of these were partially or entirely within the 1%AEP flood plain.
- Thirteen (13) respondents believed their property was liable to flood, however preliminary modelling suggested that three (3) of these were not in the 1%AEP flood plain.

### 5.8 Community Education

The forty two (42) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

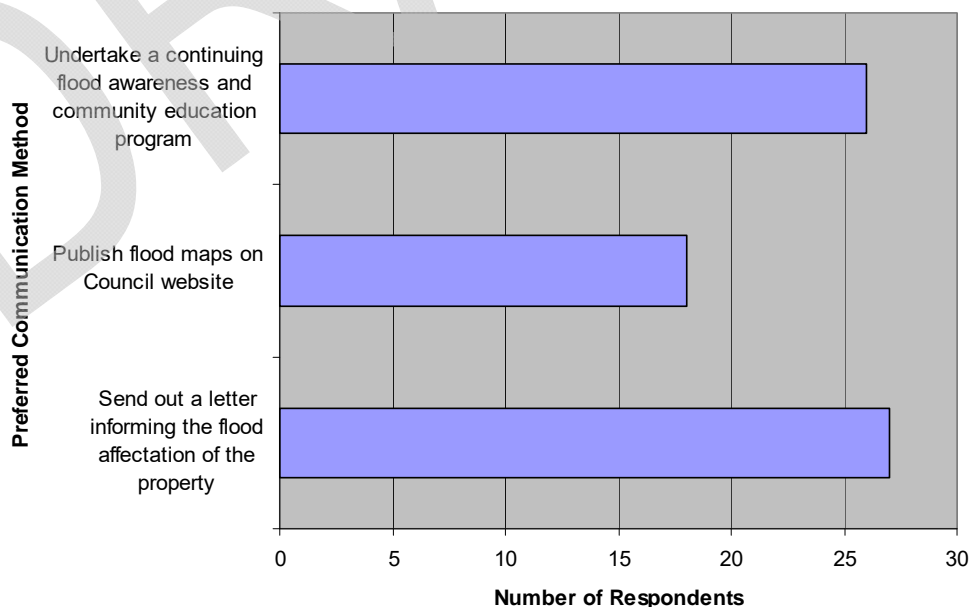


Chart 8: Bar Chart showing preferred methods for communication in the Wyoming Creek Subcatchment

## 6.0 E WINGELLO CREEK SUBCATCHMENT

The Wingello Creek subcatchment contains FMA8 *Wingello Creek* as shown on Figure 6. Thirty nine (39) residents in the Wingello Creek Subcatchment responded to the community survey.

The distribution of responses in Flood Management Areas and other areas is discussed below:



### 6.1 FMA8 – Wingello Creek

The FMA8 Wingello Creek runs east-west and consists of the floodplain and surrounding residential properties. There were sixteen (16) reports of flooding within the Wingello Creek flood management area and eight (8) residents reported flooding on their property.

Three (3) respondents noted non-specific flooding within the area at the following locations:

- Roselands Ave; and
- Wingello Reserve, North of Dalton St.

Specific areas of flooding that were noted were:

- Rainforest Road at Wingello Creek tributary; and
- Maidens Brush Road at Wingello Creek tributary.

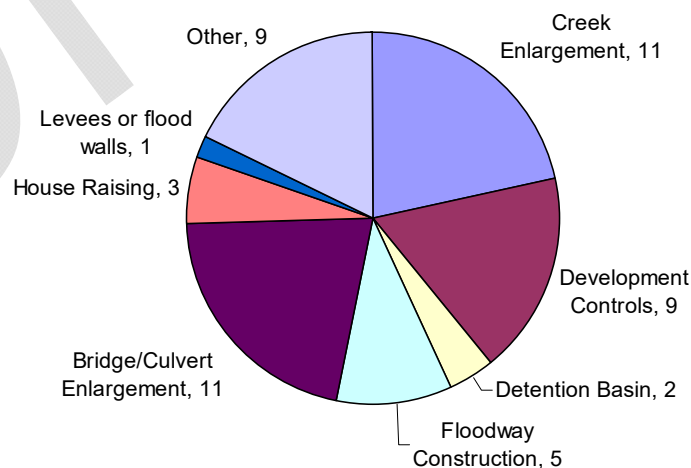
### 6.2 Other Flood Prone Areas as Indicated by Respondents

Four respondents reported flooding outside of the Wingello Creek flood management area. Two of these respondents reported flooding on their properties. One respondent reported flooding at Turpentine St. at Wingello Creek and one respondent reported flooding along Akora Road.

Other important information received from the residents is discussed below.

### 6.3 Flood Management Measures

Twenty-eight (28) respondents for the Wingello Creek Subcatchment answered the question on the flood mitigation measures they considered most appropriate. Respondents often selected one or more mitigation measures they considered would ease flooding. These results are presented in the pie chart below.



*Chart 9: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Wingello Creek Subcatchment*

The survey results showed the preferred mitigation measures were Creek Enlargement and Bridge/Culvert Enlargement.

A total of nine (9) responses not prescribed in the survey were noted by respondents and included in the “Other” category shown on the pie chart above. These are:

- “Clear/clean the Creek of weeds/debris/rubbish”, eight respondents; and



- “Keep roads clean”, one respondent.

### 6.4 Development Control

Thirty five (35) respondents answered the question about development in flood prone areas follows:

- 13 respondents believed development should be allowed after the application of appropriate development controls;
- 21 respondents believed no development should be allowed in these areas; and
- 1 respondent believed that there should not be any control on development in the flood prone areas.

### 6.5 Flood Warning

Fourteen (14) respondents answered this question of which eleven (11) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the three who had received flood warnings the following sources were noted:

- Three (3) received a warning from Local Radio/Television;
- One (1) from the Bureau of Meteorology (BOM); and
- One (1) from the State Emergency Services (SES).

### 6.6 Flood Awareness

Of the thirty-four (34) respondents who answered this question most were aware of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Twenty-seven (27) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that six (6) of these were at least partially within the 1%AEP flood plain.
- Seven (7) respondents believed their property was liable to flood, however preliminary modelling suggested that six (6) of these were not in the 1%AEP flood plain.

### 6.7 Community Education

The thirty seven (37) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

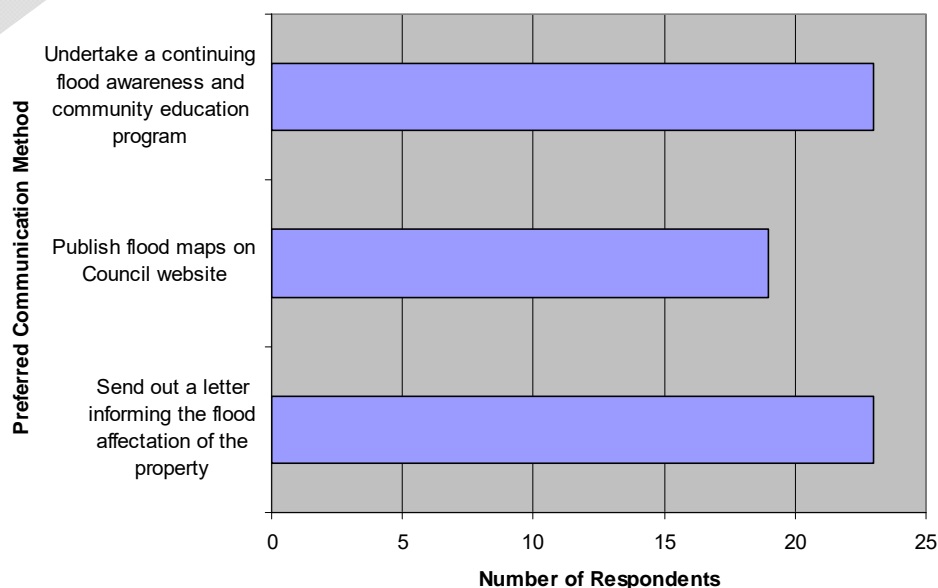




Chart 10: Bar Chart showing preferred methods for communication in the Wingello Creek Subcatchment

### 7.0 F BRADY'S GULLY CREEK SUBCATCHMENT

The Brady's Gully Creek subcatchment contains FMA9 *Brady's Gully Creek* and FMA12 *North Gosford Hospital* as shown on Figure 7. Thirty seven (37) residents in the Brady's Gully Creek Subcatchment responded to the community survey.

The distribution of responses in Flood Management Areas and other areas is discussed below:

#### 7.1 FMA9 – Brady's Gully Creek

The FMA9 Brady's Gully Creek runs south-east to north-west and consists of the floodplain and surrounding residential properties. There were fourteen (14) reports of flooding within the Brady's Gully Creek flood management area and six (6) residents reported flooding on their property and their neighbours.

Four (4) respondents reported flooding along Kirkness Ave and Callemondah Ave and one respondent noted flooding along Cary St. and Henry Parry Dr.

Specific areas of flooding that were noted were:

- Brady's Gully Road and Jarrett St; and
- Blanche St. and North Crescent.

#### 7.2 FMA12 – North Gosford Hospital Site

No reports were made of flooding within the North Gosford Hospital Flood Management Area.

#### 7.3 Other Flood Prone Areas as Indicated by Respondents

Thirteen respondents reported flooding outside of the Brady's Gully Creek and North Gosford Hospital flood management areas. Four of these respondents reported flooding on their properties. The other reported locations where flooding was reported were:

- North Crescent;
- Callemondah Ave;
- Belltrees Cl and behind the houses on Belltrees Cl along Brady's Gully Creek;
- Brady's Gully Reserve.

Other important information received from the residents is discussed below.

#### 7.4 Flood Management Measures

Nineteen (19) respondents for the Brady's Gully Creek Subcatchment answered the question on the flood mitigation measures they considered most appropriate. Respondents often selected one or more mitigation measures they considered would ease flooding. These results are presented in the pie chart below.



## RESULTS OF COMMUNITY FLOOD SURVEY

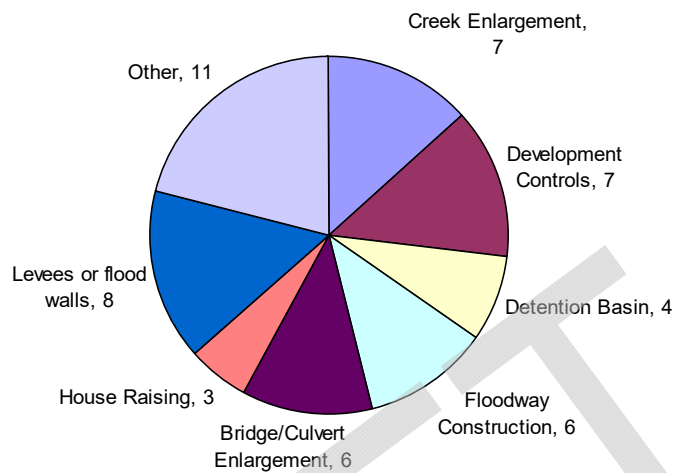


Chart 11: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Brady's Gully Creek Subcatchment

A total of nine (11) responses not prescribed in the survey were noted by respondents and included in the "Other" category shown on the pie chart above. These are:

- Clearing/cleaning Creeks/Storm drains of weeds/debris/rubbish, seven respondents;
- "Piping the two existing open drains" [at Belltrees Close, North Gosford], one respondent;
- "Tree planting and wetlands", one respondent;
- "Kerb and gutters" [in the vicinity of Blanche Street], one respondent; and
- "Dredge Narara Creek", one respondent.

Respondent 316 noted: "The open drains in Blanche St are overgrown and are in urgent need of cleaning and upgrading. The estate is also in urgent need of kerb and guttering to avoid run off from streets into properties." This sentiment was repeated by other respondents in the area.

### 7.5 Development Control

Twenty eight (28) respondents answered the question about development in flood prone areas follows:

- 10 respondents believed development should be allowed after the application of appropriate development controls; and
- 18 respondents believed no development should be allowed in these areas.

### 7.6 Flood Warning

Sixteen (16) respondents answered this question of which seven (7) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the nine who had received flood warnings the following sources were noted:

- Eight (8) received a warning from Local Radio/Television;
- Two (2) from the Bureau of Meteorology (BOM);
- One (1) from the State Emergency Services (SES); and
- One (1) from the School during the 1950's and 1960's.



## 7.7 Flood Awareness

Of the thirty-two (32) respondents who answered this question most respondents were aware of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Twenty-nine (29) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that seven (7) of these were partially within the 1%AEP flood plain.
- Three (3) respondents believed their property was liable to flood, however preliminary modelling suggested that one (1) of these was not in the 1%AEP flood plain.

## 7.8 Community Education

The twenty seven (27) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the Bar Chart below.

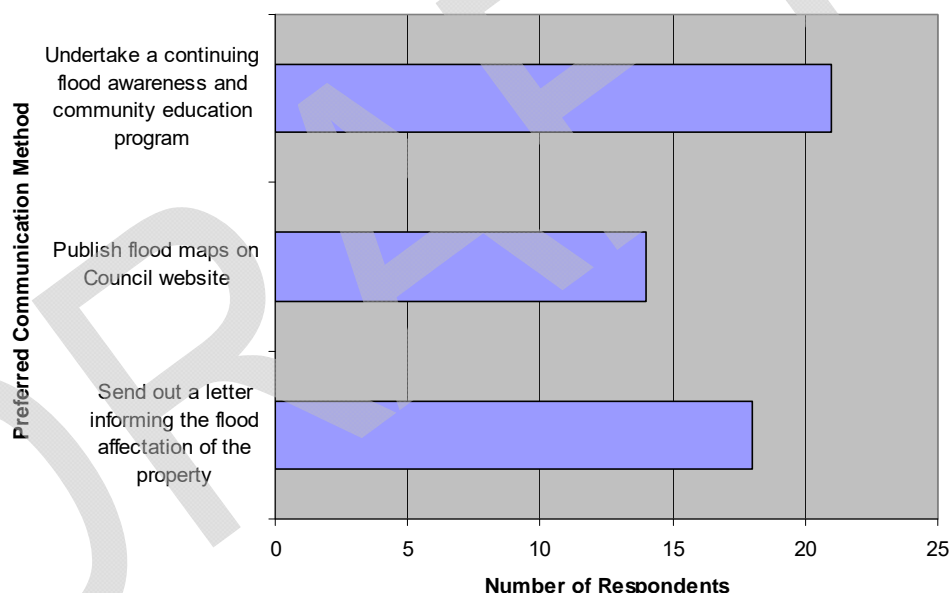


Chart 12: Bar Chart showing preferred methods for communication in the Brady's Gully Creek Subcatchment

## 8.0 G LOWER NARARA CREEK SUBCATCHMENT

The Lower Narara Creek subcatchment contains three FMAs including: FMA 1- *West Gosford Industrial Area*; FMA2 – *Rowena Road Protection Area*; and FMA3 – *Manns Road / Deane Street / Narara Valley Drive Floodway Area*. The Lower Narara Creek Subcatchment including these FMAs is presented in Figure 8.

Fifty-six (56) survey respondents had addresses in the Lower Narara Creek Subcatchment.

The distribution of responses in Flood Management Areas and other areas is discussed below:

### 8.1 FMA1 – West Gosford Industrial Area

There were fourteen (14) reports of flooding within the West Gosford Industrial Flood Management Area and two (2) residents reported flooding on their property.

Nine (9) respondents noted non-specific flooding within the area at the following locations:

- Manns Rd near Yandina Rd;
- Tathra St near Yandina Rd;





- Dignity Crescent; and
- Manns Rd.

A specific area of flooding that was noted was Central Coast Brick Supplies at the corner of Dell Rd and Manns Rd.

### 8.2 FMA2 – Rowena Road Protection Area

The survey results included twelve reports of flooding in the Rowena Road Protection Area. Reported flooding in the area includes:

- Reports of flooding at five (5) separate residential locations; and
- 5 reports of general and specific flooding of Rowena Road.

Adjacent to the Rowena Road FMA, there were five reports of flooding at Gavenlock Oval.

### 8.3 FMA3 – Manns Road / Deane Street / Narara Valley Drive Floodway Area

This FMA is located predominantly in the G Lower Narara Creek Subcatchment however also covers the lower reaches of three other subcatchments. There were 16 specific reports of flooding in this area. The main areas of concern were:

- Four (4) specific reports of flooding in the lower part of Carrington Street. (Reports of flooding on other parts of Carrington Street are discussed in Section 4.1.)
- Eight (8) specific reports of flooding on properties in the FMA
- Four (4) specific reports of flooding at the road bridge near the shops on Deane Street.
- Four (4) respondents noted non-specifically that they had observed Manns Road flood.
- Eight (8) respondents noted non-specifically that they had observed Deane Street flood. It is assumed they are refereeing to the lower portion of the street

#### Hanlan Street South

Hanlan Street South is located adjacent to FMA3. The flood study results for this road are discussed below.

There were five (5) reports of flooding at specific locations and fourteen (14) non-specific reports of flooding on Hanlan Street. The specific reports of flooding on this street pointed to:

- the corner of Fountains Road and Hanlan Street South; and
- the bridge immediately north of the corner of Fountains Road and Hanlan Street South.

### 8.4 Other Flood Prone Areas as Indicated by Respondents

The survey results included reports of flooding at various properties along the length of Narara River. The locations of these floods are shown on Figure 8. These results are not discussed in further detail in this report. Clusters of reports of flooding within the Lower Narara Creek Subcatchment not included in the three FMAs discussed above include:

#### Showground Road

Reports of flooding along showground road are summarised as follows:

- 30 non-specific reports of Flooding on Showground Road;



- 7 specific reports of flooding at the corner of Maliwa Road and Showground Road; and
- 2 specific reports of flooding near the Skate Park.

### Industrial Area accessed by Glennie Street West

The industrial area accessed by Glennie Street West and including the properties services by Tatura Avenue, Wollong Street, Kirrawee Road and Birru Road had a cluster of reported floods.

The survey responses included sixteen (16) specific and two (2) non-specific reports of flooding in this area. Flooding was reported at ten (10) commercial premises.

See Figure xx for locations of the reported floods.

### End of Jirrang Road and East of Manns Road

The area bounded by Narara Creek and Manns Road, and south of Jirrang Road is largely undeveloped. There were 5 specific and 2 non-specific reports of flooding in this area.

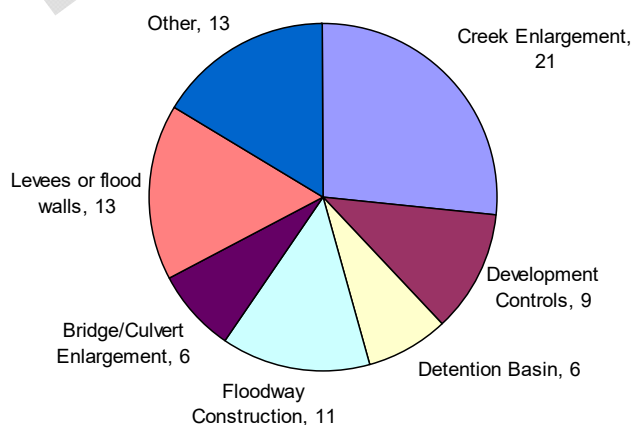
### Central Coast Highway and Racecourse Road

Five (5) Survey respondents noted that the intersection between the Central Coast Highway (also referred to as the Pacific Highway) and Racecourse Road was regularly flooded. One respondent noted flooding at their property adjacent to this intersection.

Other important information received from the residents is discussed below.

## 8.5 Flood Management Measures

Forty-three (43) respondents in the Lower Narara Creek Subcatchment answered the question relating to possible mitigation measures. Respondents who answered this question often selected one or more mitigation measure they considered would ease flooding. These results are presented in the pie chart below.



*Chart 13: Pie Chart showing Flood Mitigation Measures Recommended by Respondents in the Lower Narara Creek Subcatchment*

A large number of respondents nominated flood mitigation measures that were not listed on the questionnaires. The measures they recommended, with the number of residents making the recommendation included in brackets, are listed below:

- (5) Creek Dredging eg. Fagan Bay and Narara Creek “as far as Maliwa Road”



- (3) Clearing/Cleaning Creek of Rubbish/Debris/Weeds
- (1) Raising Roads
- (1) House Raising
- (1) Monitor water craft speeds to reduce erosion of creek banks
- (1) Construct retaining walls on creek banks
- (1) demolition of the train bridge across the mouth of the river

Interestingly, Respondent 17 who advocates dredging of Narara Creek states,

“Development over the years within this area has deposited silt that has blocked the [Narara River] outlet. In my youth I was on a yacht that was built up the creek and it was towed down to Brisbane water 5' {feet} draught now have trouble with outboard motor.”

Creek enlargement is the preferred mitigation method for the Upper Narara Creek Subcatchment.

### 8.6 Development Control

Forty-two (42) respondents answered the question about development in flood prone areas follows:

- Twenty-seven (27) believed development should be allowed after the application of appropriate development controls; and
- Fifteen (15) believed no development should be allowed in these areas.

### 8.7 Flood Warning

Twenty-three (23) respondents answered this question of which eleven (11) had never received a flood warning. Respondents who received flood warnings often received them from multiple sources. Of the twelve (12) who had received flood warnings the flowing sources were noted:

- Nine (9) received a warning from Local Radio/Television;
- Three (3) from the Bureau of Meteorology (BOM);
- One (1) from Gosford Council;
- One(1) from a warning siren on the creek in the park;
- One (1) from the State Emergency Services (SES); and
- One (1) from “looking out the window”.

### 8.8 Flood Awareness

Of the fifty-one (51) respondents who answered this question several were unaware of the risk of flooding to their properties based on preliminary modelling. Survey results are summarised as follows:

- Twenty-nine (29) respondents did **not** think their property was liable to flood, however preliminary modelling suggested that twelve of these were at least partially within the 1%AEP flood plain. Six of these respondents had properties located entirely within the preliminary modelled 1%AEP flood plain.
- The twenty-two (22) respondents who believed their property was liable to flood all had properties located partially or entirely within the preliminary modelled 1%AEP flood plain.



### 8.9 Community Education

The forty-nine (49) respondents who answered this question selected multiple methods they preferred for communication. The results of the survey are presented in the bar chart below.

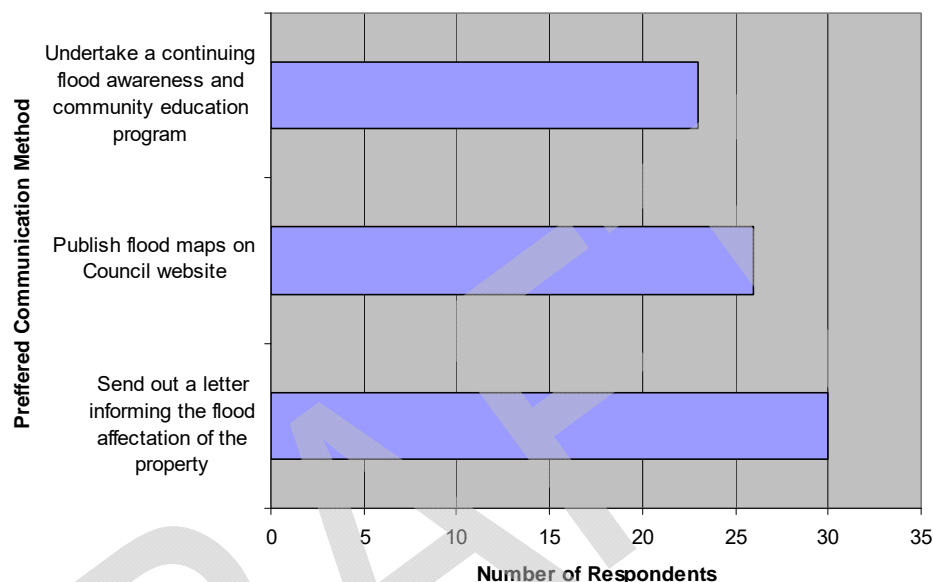


Chart 14: Bar Chart showing preferred methods for communication in the Brady's Gully Creek Subcatchment

### 9.0 FLOOD DATA USED FOR MODEL CALIBRATION

The main reported flood events occurred in February 1992 and June 2007. Floods were reported every June since 2005; however the 2007 June long weekend was widely reported as the most significant remembered flood.

Respondents also commented that there is a connection between King Tides and heavy rain and that the most severe flooding occurs when both of these events happen simultaneously.

The responses that outlined dates of flooding are provided in Appendix D.

### 10.0 REPORTED PROPERTY DAMAGE

Sixty-five respondents throughout the catchment reported damage to their property. Property damages included damage to backyards and gardens, outside property, garages, cars and houses. Forty three respondents reported damage to their backyards and gardens including fences, BBQ patio areas, arbours and pools. Other outside property damage included sheds, livestock, retaining walls, dunny and clothesline.

Sixteen respondents identified damage to their garage which included damage to the concrete slab and driveways and garage doors. Items within the garages were also damaged which included electronics/appliances, tools, furniture and carpet. Three respondents reported damage to their cars.

Six respondents reported damage to their houses which included damage to carpets, furniture, kitchens, cracked walls, exterior paint and supports under the house. One respondent reported a tree falling on their house.

The cost of damages ranged from \$200 to approximately \$400,000.



The responses that outlined property damages are provided in Appendix D.

### Report Signature Page

Justin Bell  
Senior Environmental Engineer

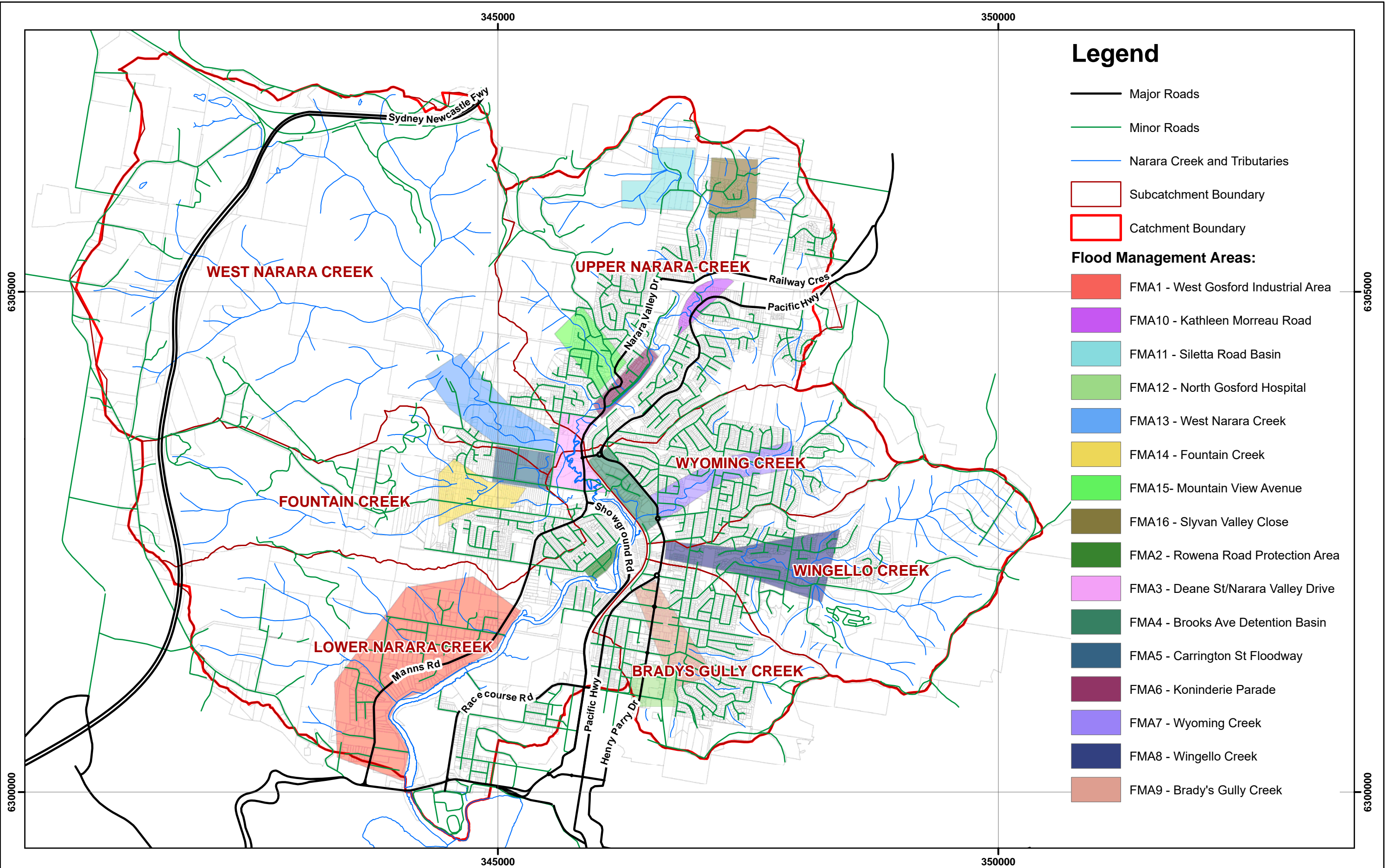
Habib Rehman  
Principle Water Engineer

AWS:MK/HR/aws:mk

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### Legend

- Major Roads
  - Minor Roads
  - Narara Creek and Tributaries
  - Subcatchment Boundary
  - Catchment Boundary
- Flood Management Areas:**
- FMA1 - West Gosford Industrial Area
  - FMA10 - Kathleen Morreau Road
  - FMA11 - Siletta Road Basin
  - FMA12 - North Gosford Hospital
  - FMA13 - West Narara Creek
  - FMA14 - Fountain Creek
  - FMA15- Mountain View Avenue
  - FMA16 - Slyvan Valley Close
  - FMA2 - Rowena Road Protection Area
  - FMA3 - Deane St/Narara Valley Drive
  - FMA4 - Brooks Ave Detention Basin
  - FMA5 - Carrington St Floodway
  - FMA6 - Koninderie Parade
  - FMA7 - Wyoming Creek
  - FMA8 - Wingello Creek
  - FMA9 - Brady's Gully Creek

# DRAFT



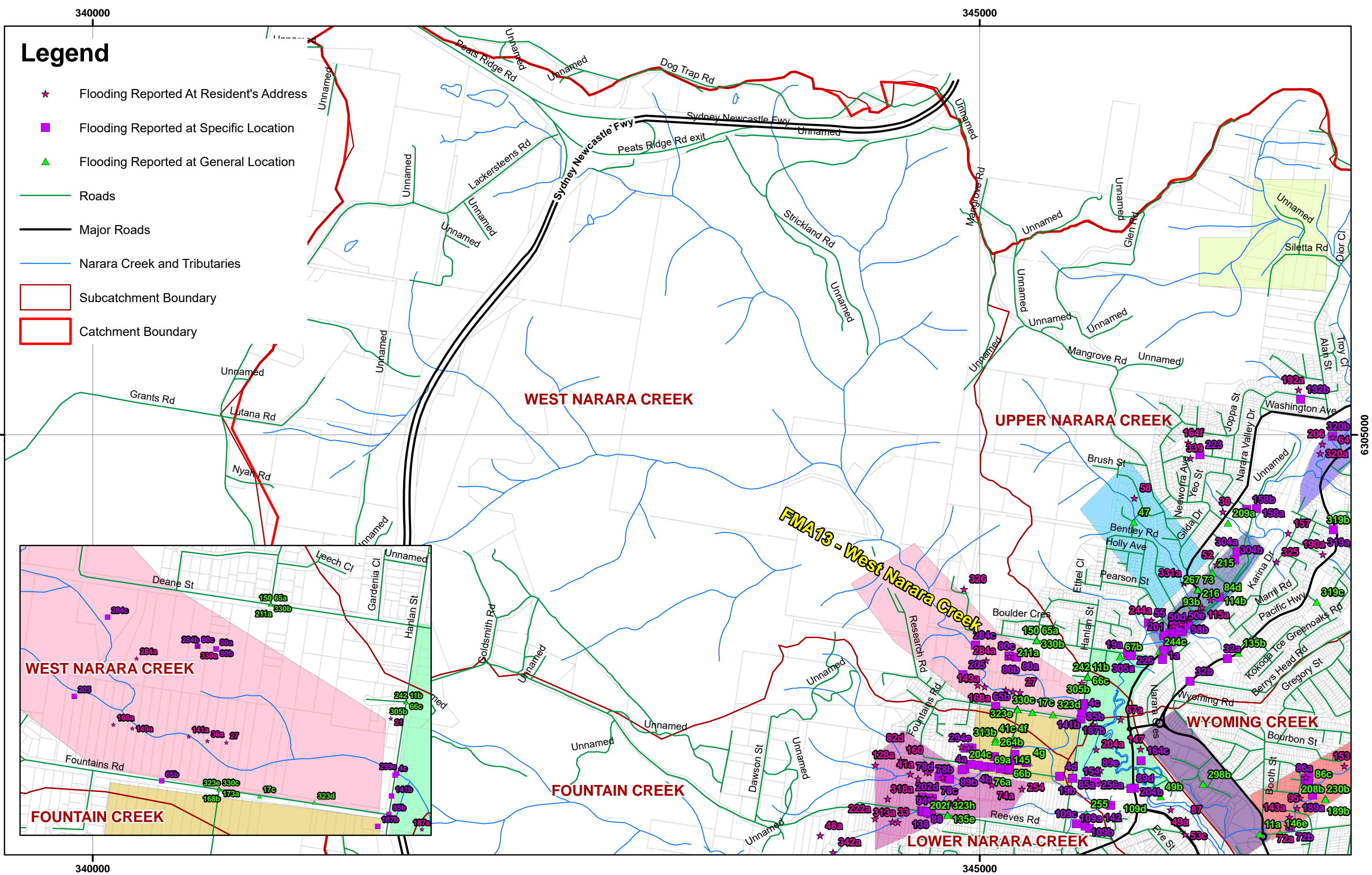
CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY FLOOD MANAGEMENT AREAS</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 1
SCALE 1:35,000		REV No A	<b>A3</b>

File Location: J:\hyd\2009\097626068\_Gosford Council\_Floodplain Risk Management\_Narara\Technical Doc\GIS\Project  
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# Legend

- ★ Flooding Reported At Resident's Address
- Flooding Reported at Specific Location
- ▲ Flooding Reported at General Location
- Roads
- Major Roads
- Narara Creek and Tributaries
- ▭ Subcatchment Boundary
- ▭ Catchment Boundary



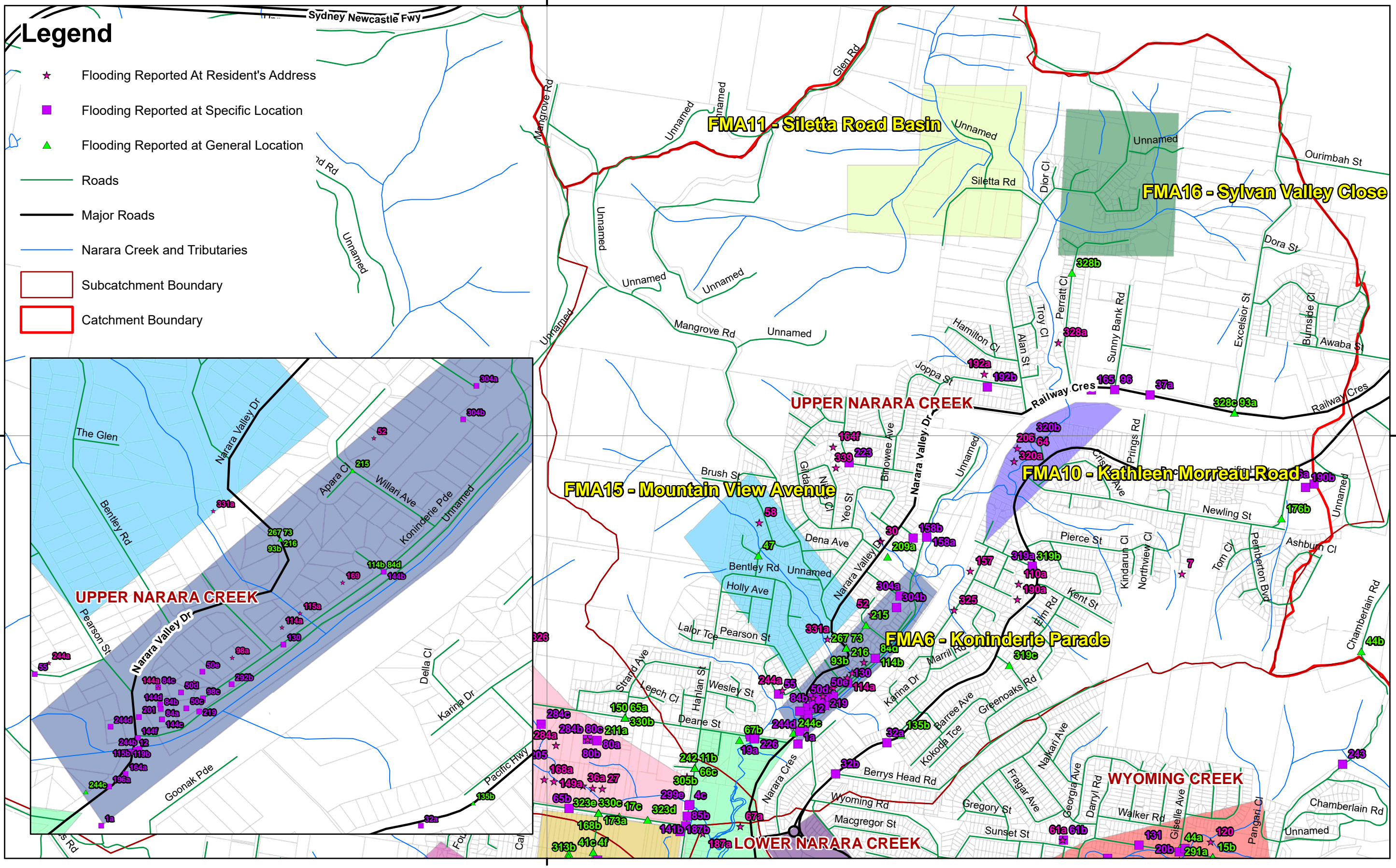
# DRAFT



CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY WEST NARARA CK SUBCATCHMENT</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 2
SCALE 1:20,000		REV No A	A3

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CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY</b> UPPER NARARA CK SUBCATCHMENT	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 3
SCALE 1:15,000		REV No A	A3

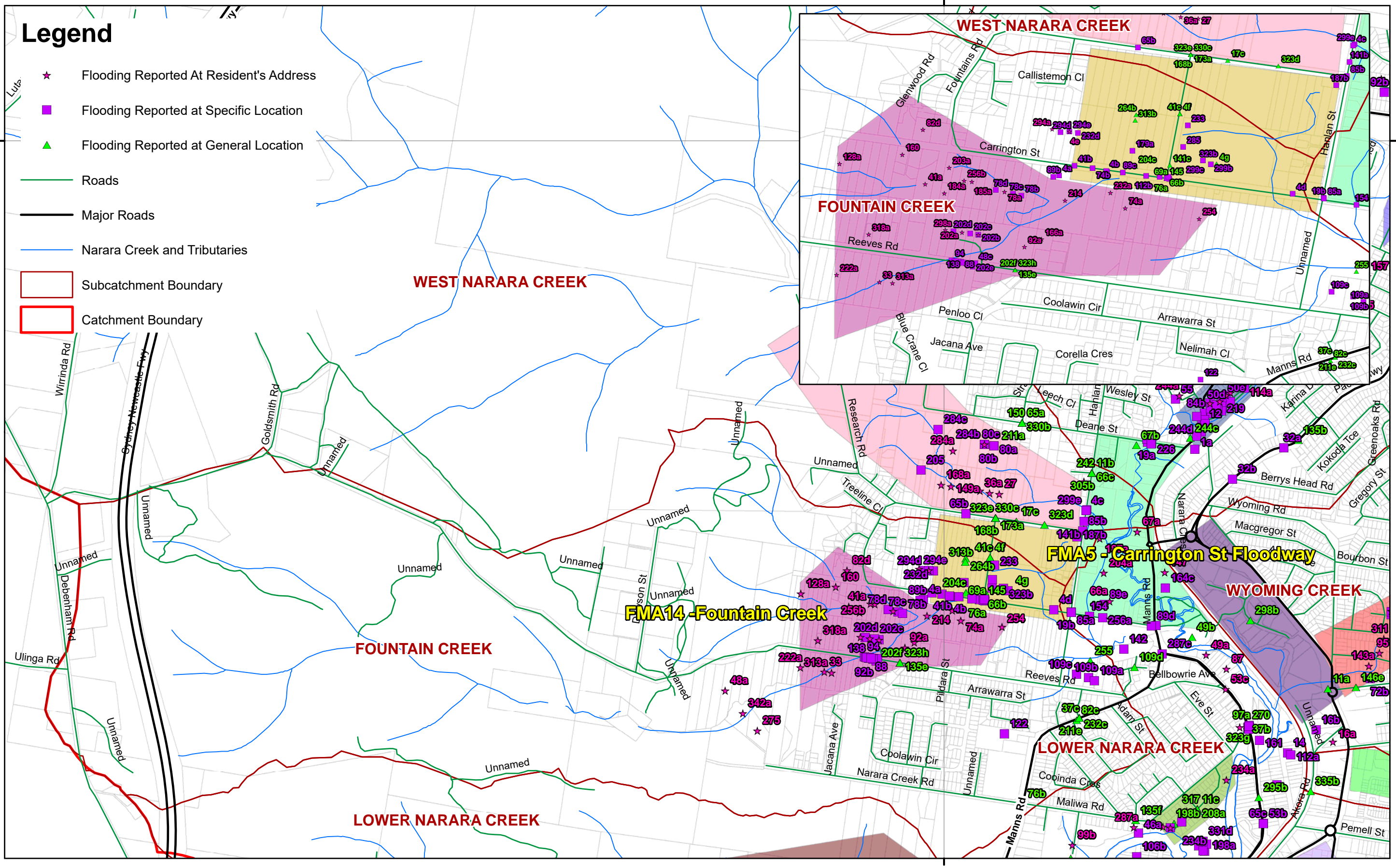
File Location: J:\hyd\2009\097626068\_Gosford Council\_Floodplain Risk Management\_Narara\Technical Doc\GIS\Project  
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- Major Roads
- Narara Creek and Tributaries
- ▭ Subcatchment Boundary
- ▭ Catchment Boundary



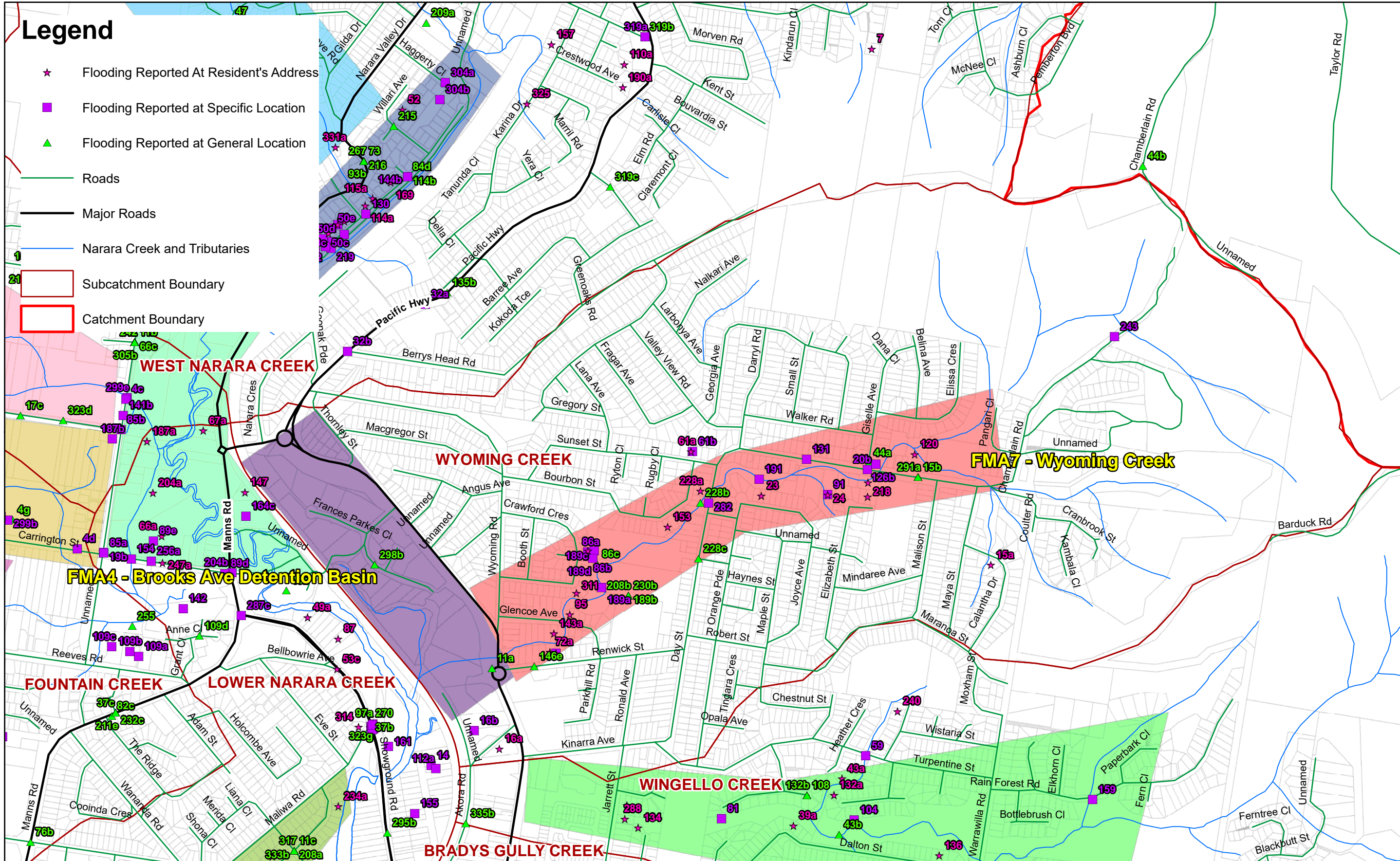
# DRAFT



CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY FOUNTAIN CK SUBCATCHMENT</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 4
SCALE 1:15,000		REV No A	A3

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**DRAFT**

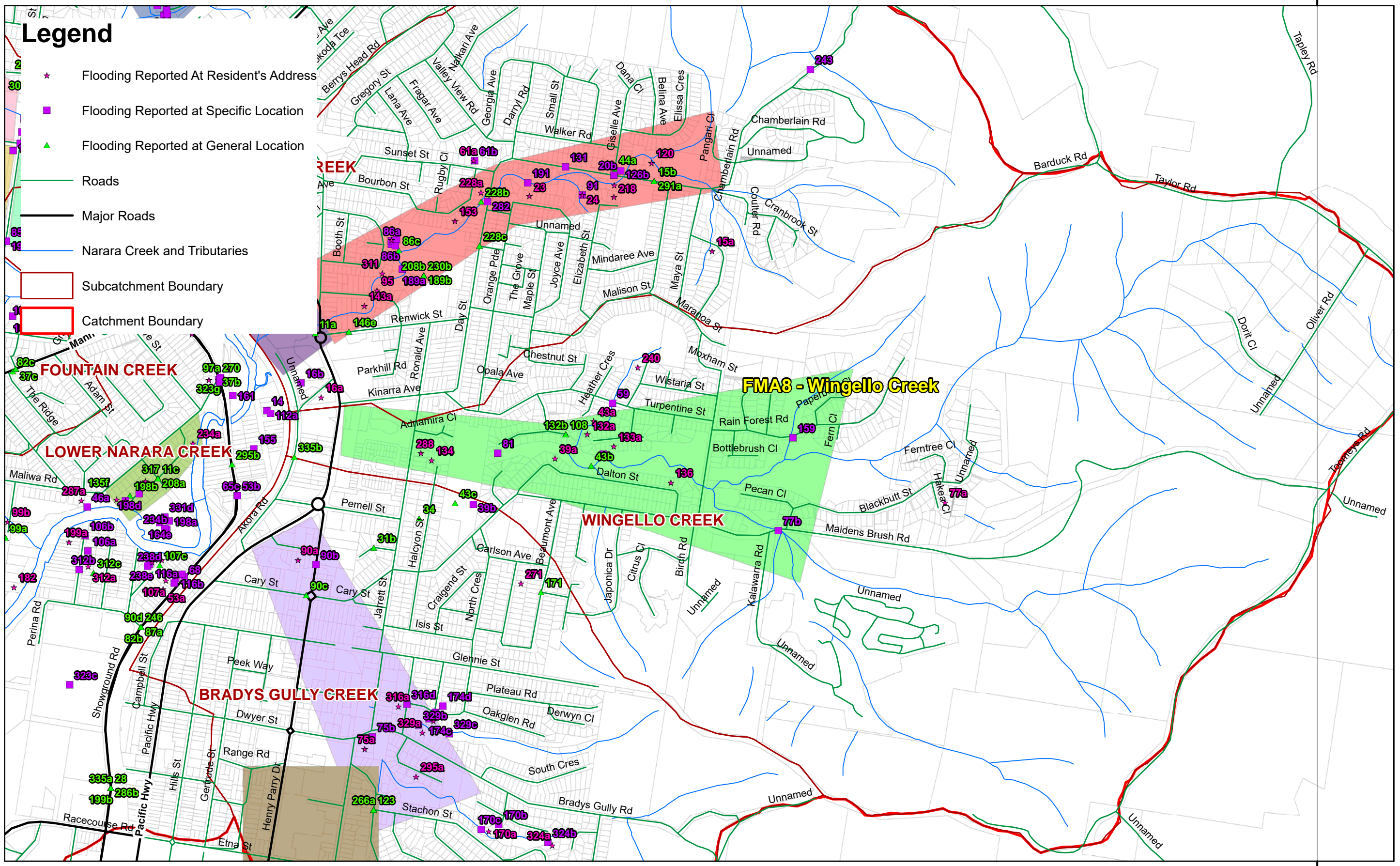


CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY WYOMING CK SUBCATCHMENT</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 5
SCALE 1:10,000		REV No A	A3

File Location: J:\hyd\2009\097626068\_Gosford Council\_Floodplain Risk Management\_Narara\Technical Doc\GIS\Project  
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# Legend

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- Roads
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- Narara Creek and Tributaries
- ▭ Subcatchment Boundary
- ▭ Catchment Boundary



# DRAFT



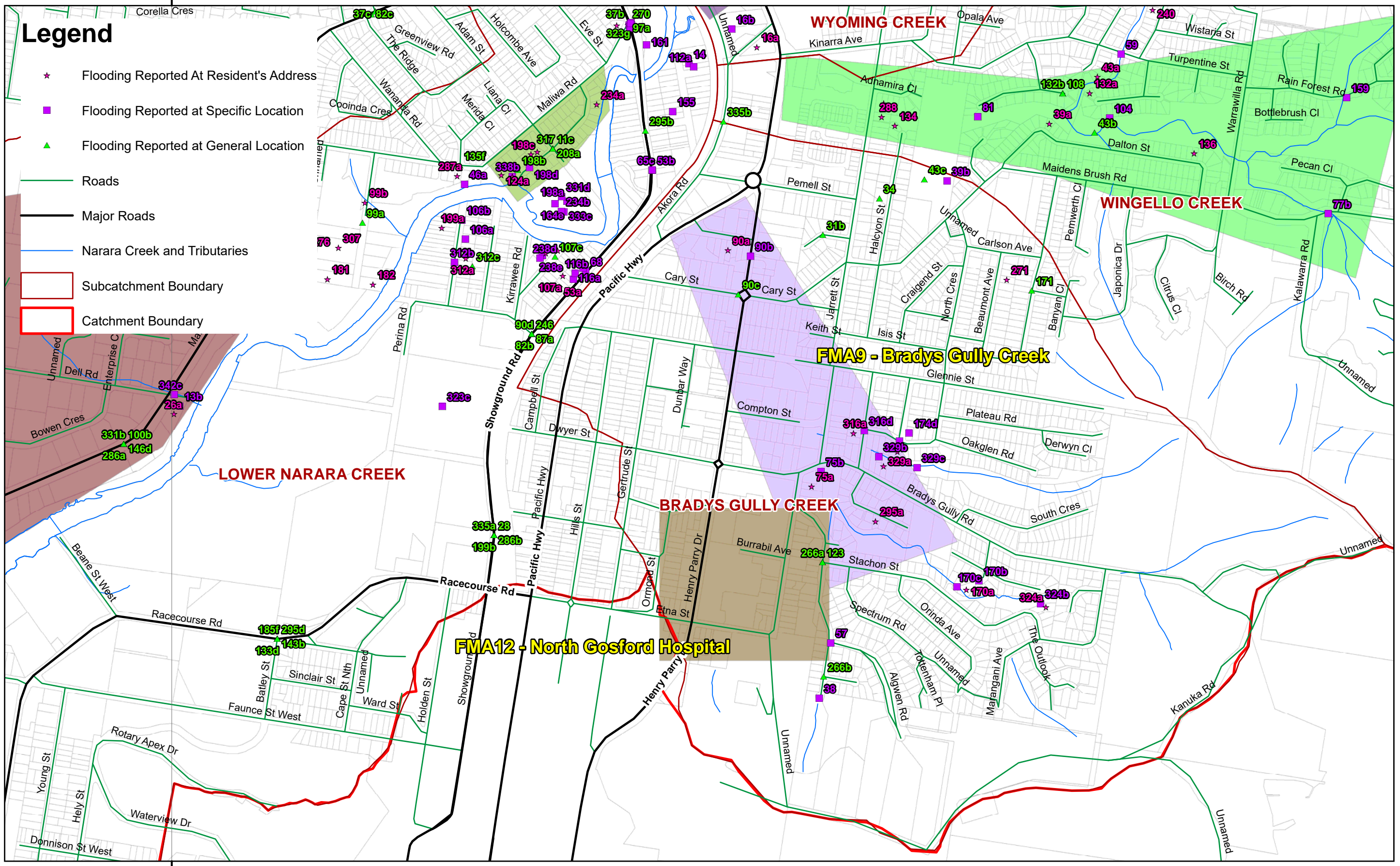
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DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY WINGELLO CK SUBCATCHMENT</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 6
SCALE 1:12,500		REV No A	A3

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345000

# Legend

- ★ Flooding Reported At Resident's Address
- Flooding Reported at Specific Location
- ▲ Flooding Reported at General Location
- Roads
- Major Roads
- Narara Creek and Tributaries
- ▭ Subcatchment Boundary
- ▭ Catchment Boundary



345000

# DRAFT



CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE <b>COMMUNITY SURVEY BRADYS GULLY SUBCATCHMENT</b>	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 7
SCALE 1:10,000		REV No A	A3

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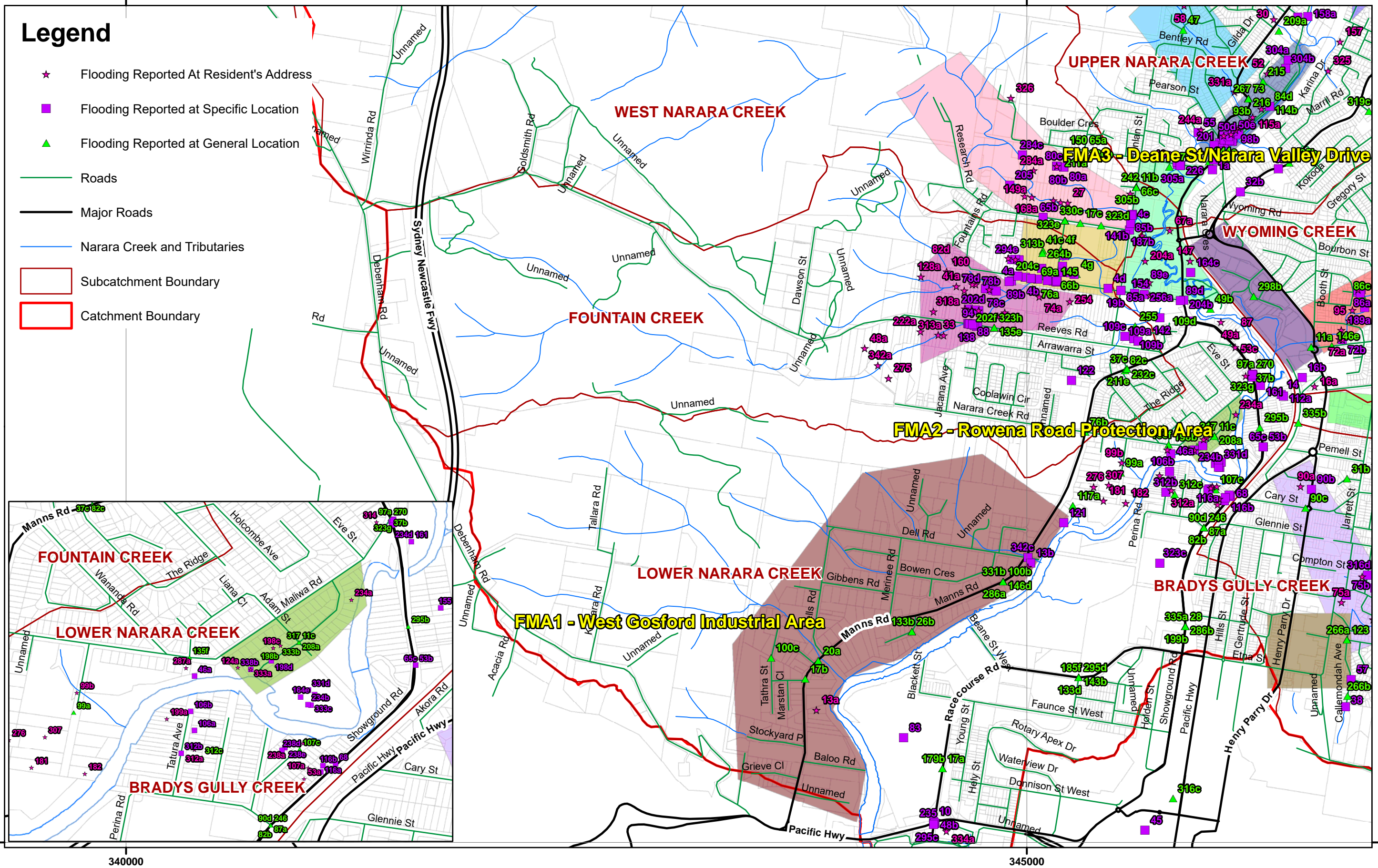
File Location: J:\hyd\2009\097626068\_Gosford Council\_Floodplain Risk Management\_Narara\Technical Doc\GIS\Project  
 Note: The \* beside the typed initials denotes the original drawing issue was signed or initialised by that respective person.

340000

345000

# Legend

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- Catchment Boundary



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# DRAFT



CLIENT Gosford City Council		PROJECT NARARA CREEK FLOOD STUDY	
DRAWN JRB	DATE 11-02-10	TITLE COMMUNITY SURVEY LOWER NARARA CK SUBCATCHMENT	
CHECKED AS*	DATE 11-02-10	PROJECT No 097626068-013	FIGURE No 8
SCALE 1:20,000		REV No A	A3

File Location: J:\hyd\2009\097626068\_Gosford Council\_Floodplain Risk Management\_Narara\Technical Doc\GIS\Project  
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# APPENDIX A

## Community Flood Survey

DRAFT

Golder Associates has been commissioned by Gosford Council to undertake a Review of the Narara Creek Flood Study, Floodplain Risk Management Study and Plan. The catchment covers the suburbs of Somersby, Narara, Niagara Park, the western part of Lisarow, Wyoming, the southern part of Mount Elliot, North Gosford, West Gosford and part of Gosford itself. Major creeks in the study area include Fountain Creek, Stoney Creek, Wyoming Creek, Wingello Creek and Bradys Gully.

As part of this study, we are seeking information from the community. Please answer the following questions as best as you can. When you have finished answering the questions, please return these pages in the enclosed "reply-paid" envelope.

We appreciate your time to complete this questionnaire as the information provided by you is critical to the success of this study.

**Q1.** Could you please provide us with your contact details as we may need to verify some of the information with you (Your contact details will remain completely CONFIDENTIAL).

Name: .....

Address: .....

.....

.....

Day time phone number: .....

E-mail: .....

**Q2.** How long have you lived / worked / shopped / run a business in the study area?

..... months

..... years

**Q3.** Have you ever experienced flooding at your property?

YES       NO (If NO, Please go to Q7)

If you answered YES, please give us the specific time of flooding as best as you can remember. Please also circle the largest flood in the list.

No.	Date	Time of the day
1		
2		
3		
4		

Would you be able to provide some details of the largest flood:

.....  
.....  
.....  
.....

**Q4.** Can you describe the area of the property that was affected during the largest flood? (You may tick more than one box)

FRONTYARD	<input type="checkbox"/>	BUILDING (ABOVE FLOOR LEVEL)	<input type="checkbox"/>
BACKYARD	<input type="checkbox"/>	BUILDING (BELOW FLOOR LEVEL)	<input type="checkbox"/>
GARAGE	<input type="checkbox"/>	OTHER	<input type="checkbox"/>

If 'OTHER', please specify: .....

**Q5.** Can you provide an estimate of the depth of flooding for the largest flood event? (Please indicate the units for depth: e.g. m, cm, mm, feet, inches)

FRONTYARD	.....	BUILDING (ABOVE FLOOR LEVEL)	.....
BACKYARD	.....	BUILDING (BELOW FLOOR LEVEL)	.....
GARAGE	.....	OTHER (as per Q4 above)	.....

**Q6.** Can you provide details of the damaged property and an estimate of damages caused by the largest flood?

PROPERTY DAMAGED .....  
(such as building, fence, garage etc.) .....  
.....

DAMAGE \$.....

**Q7.** Have you ever observed or experienced flooding or overland flows in the study area other than your property? If so can you describe what type of property was affected?

For example, you may have observed flooding or overland flow in your street that affected a neighbour's property or perhaps near where you work or shop (Please tick the appropriate box).

RESIDENTIAL	<input type="checkbox"/>	ROADS & PATHS	<input type="checkbox"/>
COMMERCIAL	<input type="checkbox"/>	OTHER	<input type="checkbox"/>
PARKS	<input type="checkbox"/>		

If 'OTHER', please specify: .....



**Q8.** If possible, can you please provide the address of the flood affected property/area?

Address: .....  
.....  
.....

**Q9.** Do you remember when this flooding or overland flow occurred? Can you please provide us the dates for this flooding?

No.	Date	Time of the day
1		
2		
3		
4		

**Q10.** If you have experienced flooding or overland flow in and around your property or anywhere in study area, do you have any evidence of the extent of the affected areas? (Tick one box)

YES  NO

If you answered YES, please give as much detail as possible.

It could be a photograph or a video that you may have taken of the event. You may be able to point out a mark on the wall or a post in the street that relates to the depth of flooding or flow during a particular flood event.

We would also appreciate if you could inquire from someone you know, who has lived in the area for a long time and may have the above information.

Details of the event:

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

**Q11.** Is there anything else you would like to tell us about flooding or overland flows in the study area?

If so, please provide the information below:

.....  
.....  
.....  
.....  
.....  
.....  
.....

**Q12.** Have you ever received warning for an impending flood? If yes, what has been your source of information?

- 1. State Emergency Services (SES)
- 2. Bureau of Meteorology (BOM)
- 3. Local Radio/TV
- 4. Gosford Council
- 5. Other (please specify) .....

**Q13.** Do you think your property is liable to flooding from the nearby creek?

YES  NO

**Q14.** Which of the following measures do you think would provide relief from flooding to your property or in the study area? (You may tick more than one box)

- Detention Basin
- Levees or flood walls
- Creek enlargement
- Bridge/Culvert enlargement
- Floodway construction
- House Raising
- Development Controls
- Other (please specify) .....

.....  
.....  
.....

**Q15. Setting development controls is an important part of floodplain management. Which of the following development scenarios do you think is most appropriate (Please select one)?**

No development should be allowed in any area that is currently flooded or is likely to flood in future

Development should be allowed in the flood prone areas after due consideration of flood hazard and application of appropriate development controls

There should not be any control on development in the flood prone areas

**Q16. Which of the following methods should Council use to inform the community about flooding issues in the study area? (You may tick more than one box)**

Send out a letter informing the flood affectation of the property

Publish flood maps on Council website

Undertake a continuing flood awareness and community education program

Thank you for providing the above information.



## APPENDIX B

### Photographs Provided by Respondents

DRAFT



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



**Photograph 2 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 3 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



**Photograph 4 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 5 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



**Photograph 6 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 7 of 7:** provided by Respondent 75.

**Location:** Jarrett St and Bradys Gully Road, North Gosford

Photograph shows partially overgrown easement. Note that the respondent's concern was that trees in the easement had been removed and mulched, resulting in a change in the water course and erosion close to their property.



**Photograph 1 of 1:** provided by Respondent 83.

**Location:** Gosford Racecourse

Photograph shows Gosford Racetrack being flooded after receiving 388 mm of rain over a 24 hour period in July 2007.





## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing water crossing the road outside 11 Koninderie Pde Narara



**Photograph 2 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing water crossing the road outside 11 Koninderie Pde Narara



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 3 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing water flooding into front garden of 11 Koninderie Pde Narara



**Photograph 4 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing water crossing the road outside 11 Koninderie Pde Narara



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 5 of 7:** provided by Respondent 98.

**Location:** Narara Valley Drive, Narara

Photograph showing the bridge across Narara Valley Drive near Narara Railway Station, the morning of the flood of February 1992.



**Photograph 6 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing flooding outside 11 Koninderie Pde, looking out from the veranda. The water easement is beyond the trees. This side of the trees is the road.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 7 of 7:** provided by Respondent 98.

**Location:** 11 Koninderie Pde Narara

Photograph showing water crossing the road outside 11 Koninderie Pde Narara



**Photograph 1 of 1:** provided by Respondent 113.

**Location:** Entrance to Narara Station from Narara Valley Drive.

Photograph shows Narara Creek flooding onto Narara Valley Drive.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 1:** provided by Respondent 119.

**Location:** Entrance to Narara Station from Narara Valley Drive.  
Photograph shows Narara Creek flooding onto Narara Valley Drive.



**Photograph 1 of 1:** provided by Respondent 141.

**Location:** Aerial photograph of the Narara Creek area.

The photograph illustrates the respondent's thoughts on diverting the creeks flow back to its former position, away from the houses.



## APPENDIX B Photographs Provided by Respondents

15 Carrington St, Narara

Prepared on 14 November 2009

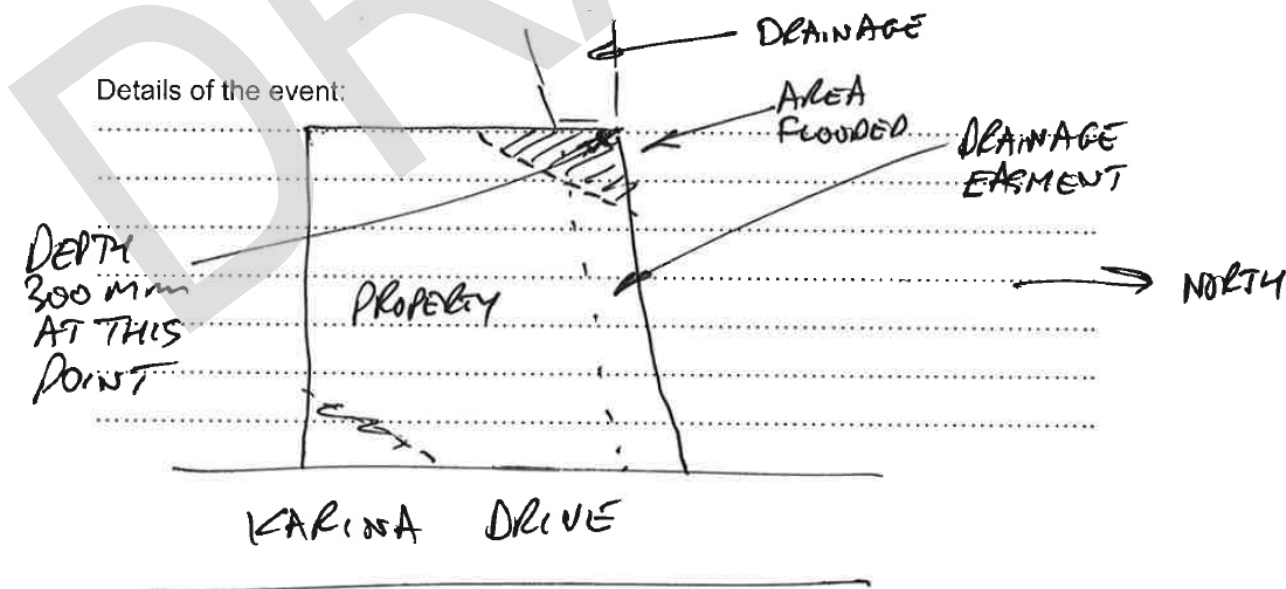
### Property Description

UBD:	CCT77, A9	Lot Plan:	L6/DP771474	
Zoning:	Scenic Protection			
Land Use:	General Rural			
Area:	18840 m <sup>2</sup>	VGM:		
<b>Sales History:</b>				
			10/07/01	1
			01/05/98	107,000

**Photograph 1 of 1:** provided by Respondent 142.

**Location:** 15 Carrington St, Narara

Photograph shows the council land in the area between the respondent's property and the creek that has been known to flood.



**Diagram 1 of 1:** provided by Respondent 157.

**Location:** 72 Karina Drive, Niagara Park



## APPENDIX B

### Photographs Provided by Respondents



Water  
level

**Photograph 1 of 2:** provided by Respondent 168.

**Location:** 60 Fountains Road, Narara

Photograph shows the water level of a flood as indicated by the mark left on a nearby tree (right hand side of photograph).



**Photograph 2 of 2:** provided by Respondent 168.

**Location:** 60 Fountains Road, Narara

Photograph shows the sand deposits left from flooding event.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 2:** provided by Respondent 185.

**Location:** Carrington Street Narara, NSW 2250

Photograph showing the flooding of a driveway that comes off Carrington St, Houses 105 – 111, Creek line well over bridge.



**Photograph 2 of 2:** provided by Respondent 185.

**Location:** Carrington Street Narara, NSW 2250

Photograph showing floodwaters at Carrington Street Narara.





## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 2:** provided by Respondent 202.

**Location:** 96 Reeves Street Narara

Photograph showing neighbours driveway from 96 Reeves Street Narara.



**Photograph 2 of 2:** provided by Respondent 202.

**Location:** 96 Reeves Street Narara

Photograph showing “Gum and fern are in a hexagonal treated pine garden down the front of our yard”



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing flooding of the respondents stables



**Photograph 2 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing the flood breaking its banks at the respondents' property.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 3 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing sand deposits from a flood burying a fence on the respondents' property.



**Photograph 4 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing damage to their chicken coop caused by the flood.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 5 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing the extent of flooding on the respondents' property.



**Photograph 6 of 6:** provided by Respondent 204.

**Location:** 16 Hanlan St South, Narara NSW 2250

Photograph showing the extent of flooding on the respondent's property.



## APPENDIX B

### Photographs Provided by Respondents



**Photographs 1 & 2 of 4:** provided by Respondent 244.

**Location:** Narara Valley Drive and Narara Creek, opposite Narara train station, Narara NSW 2250

Photograph showing the extent of flooding on at this location on the 8<sup>th</sup> of June 2007.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 3 & 4 of 4:** provided by Respondent 244.

**Location:** Narara Valley Drive and Narara Creek, opposite Narara train station, Narara  
Photograph showing the extent of flooding on at this location on the 8<sup>th</sup> of June 2007 (Take note of the water level against the fence).



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 1 of 15:** provided by Respondent 298.

**Location:** 92-96 Reeves St, Narara

Photograph shows flooding on both sides of Reeves St in (approx) 1988



**Photograph 2 of 15:** provided by Respondent 298.

**Location:** Reeves St Causeway, Narara

Photograph shows flooding on both sides of Reeves St in (approx) 1988.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 3 of 15:** provided by Respondent 298.

**Location:** Reeves St Causeway Narara

Photograph shows flooding on both sides of Reeves St in (approx) 1988.



**Photograph 4 of 15:** provided by Respondent 298.

**Location:** Front of 98-100 Reeves St, Narara

Photograph shows flooding on Reeves St in 2003/4





## APPENDIX B

### Photographs Provided by Respondents



**Photograph 5 of 15:** provided by Respondent 298.

**Location:** Front of 98-100 Reeves St, Narara

Photograph shows flooding on Reeves St in 2003/4



**Photograph 6 of 15:** provided by Respondent 298.

**Location:** Front of 94-100 Reeves St, Narara

Photograph shows flooding of Reeves St in 2003/4.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 7 of 15:** provided by Respondent 298.

**Location:** Access Bridge, 92-102 Reeves St, Narara

Photograph shows debris from flooding on Reeves St after June 2007 flood.



**Photograph 8 of 15:** provided by Respondent 298.

**Location:** Access Bridge, 92-102 Reeves St, Narara

Photograph shows debris from flooding on Reeves St after June 2007 flood.



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 9 of 15:** provided by Respondent 298.

**Location:** Access Bridge, 92-102 Reeves St, Narara

Photograph shows flooding of Reeves St access Bridge in 2000-2002.



**Photograph 10 of 15:** provided by Respondent 298.

**Location:** Front of, 96, 98 and 100 Reeves St, Narara

Photograph shows flooding of Reeves St on 9/12/2007



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 11 of 15:** provided by Respondent 298.  
**Location:** Front of, 96, 98 and 100 Reeves St, Narara  
Photograph shows flooding of Reeves St on 9/12/2007



**Photograph 12 of 15:** provided by Respondent 298.  
**Location:** 92-96 Reeves St, Narara  
Photograph shows flooding of Reeves St in 1988



**APPENDIX B**  
**Photographs Provided by Respondents**



**Photograph 13 of 15:** provided by Respondent 298.

**Location:** Front 94-100 Reeves St, Narara

Photograph shows flooding of Reeves St in 2003/4



**Photograph 14 of 15:** provided by Respondent 298.

**Location:** Front 94-100 Reeves St, Narara

Photograph shows flooding of Reeves St in 2003/4



## APPENDIX B

### Photographs Provided by Respondents



**Photograph 15 of 15:** provided by Respondent 298.

**Location:** Front 100-92 Reeves St, Narara

Photograph shows flooding of Reeves St in 2003/4



# APPENDIX C

## Community Flood Questionnaire Results

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# APPENDIX D

## Calibration and Damages Table

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## RESULTS OF COMMUNITY FLOOD SURVEY

**Table 1: Calibration Dates of Flooding**

Dates of Flooding	ID	Address	Details of Event
1963-1965 - afternoon	90	18 Laycock St, Wyoming, NSW 2250	The largest one I can remember was when Whitton Street {90b} (now Henry Parry Dr.) was cut off by floodwaters which came up to our back door in Laycock St in 1964
1973 3 days	232	77 Carrington Street, Narara, NSW 2250	1973, stranded for 3 days with new born baby supplies boated up to me. At the time Carrington st was a 1 way unformed, unsealed single lane. Water did not cover my property to the extent that it does now. Since Council did extensive 'flood mitigation' work mid '80;s' problem increased.
Late 70's - High tide	67	8 Narara Valley Drive, Narara, NSW 2250	Covered 3/4 of my backyard for 10' wide
Late 1970's	153	54 Bourbon Street, Wyoming, NSW 2250	
Feb 1977 (Coincided with King Tide and heavy rain)	144	67 Narara Valley Dr, Narara, NSW 2250	Street behind us (Koninderie Pde {144b}) next to creek was knee deep in water which flowed through houses and back yards through to our backyard.
1979-1980	246	35 Calantha Drive, Wyoming, NSW 2250	
1980 floods regularly	232	77 Carrington Street, Narara, NSW 2250	Since Council did extensive 'flood mitigation' work mid '80;s' problem increased.
Approx 1980 Midday	295	50 Mooramba Avenue, North Gosford, NSW 2250	Property backs onto creek in Brady's Gully and twice in the first few years. We were here, we had the creek rise to approx 1/3 of the back yard.
1980's - Midday	31	18 Renwick St, Wyoming, NSW 2250	Heavy rainfall blocked creek at back and it was high tide
Approx 1981 Midday	295	50 Mooramba Avenue, North Gosford, NSW 2250	Property backs onto creek in Brady's Gully and twice in the first few years. We were here, we had the creek rise to approx 1/3 of the back yard.
1983	149	56 Fountains Rd, Narara, NSW 2250	
1984 AM	132	27 Fuchsia St, Wyoming, NSW 2250	Water came into backyard
Nov 1985 Night	98	11 Koninderie Pde, Narara, NSW 2250	Flooding occurred approx 1.30 to 2.30 during the night
1986	149	56 Fountains Rd, Narara, NSW 2250	
June 1986	147	26 Aldenham Road, Warnervale NSW 2259 (Business Address for property in Question is number 2-6 Manns Rd, Narara, NSW 2250)	The water level broke the Narara Creek embankment and flooded the family property and business
Late 1980's	72	16 Renwick St, Wyoming, NSW 2250	Wyoming creek rose after a week or so of heavy rain. The waters flooded our backyard smashing through 2 fibro walls in our garage, buckling the garage roller door
1986/1988	13	Mara' 134 Silvesters Road, Somersby NSW 2250. Property in question: 346 Manns Rd, West Gosford, NSW 2250	The flooding was caused by poor Council drainage off Manns Road and poor stormwater control from adjacent property(s) to the South
April 1988?	147	26 Aldenham Road, Warnervale NSW 2259	The water level broke the Narara Creek embankment and flooded the family



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
		(Business Address for property in Question is number 2-6 Manns Rd, Narara, NSW 2250	property and business
June 1988	89	88 Carrington St, Narara, NSW 2250	Carrington St was really flooded, about a metre deep at times and on my property the little creek flowed extensively, as did a 'drain" made by me on the other side of a low lying area, well hack from my very dry house.
November 1988	323	124 Reeves Street, Narara, NSW 2250	
1989	185	109 Carrington Street, Narara, NSW, 2250	1989 not much drainage
Feb 1989 - midday	77	5 Hakea Cl, Wyoming, NSW 2250	Development of land behind our house - altered the natural water course - very heavy storm caused water to enter our property dumping water, silt - not necessarily because of the creek
1989 Early 1990's and minor floods in subsequent years (Three one Hundred Year floods in 4 years)	181	146 Manns Road Narara NSW 2250 * Lot 22 Manns Road (Total Flood Plain) {understand this is Lot 22, Sect 20, DP2240}	Lot 22 Manns Road completely under water. Water up to two metres high in the one hundred year flood
17-April-1990 daylight	89	88 Carrington St, Narara, NSW 2250	Carrington St was really flooded, about a metre deep at times and on my property the little creek flowed extensively, as did a 'drain" made by me on the other side of a low lying area, well hack from my very dry house.
10-December-1990 daylight	89	88 Carrington St, Narara, NSW 2250	
Approx Feb 1990 - Night	110	8 Windara Cl, Niagara Park, NSW 2250	Severe rainstorm and flooding of creek/major drain
8/2/1990 overnight, 15/2/1990 afternoon	325	52 Karina Drive, Narara, NSW 2250	Council cut grass in reserve in the rain which washed cutting into drains blocking them. Creek overflowed with stormwater and flooded my property and home. Fences were also demolished by the weight of the water.
April 1990 - Daytime; April 17 1990 - Late afternoon	89	88 Carrington St, Narara, NSW 2250	
Early 1990's - early a.m	72	16 Renwick St, Wyoming, NSW 2250	Wyoming creek rose after a week or so of heavy rain. The waters flooded our backyard smashing through 2 fibro walls in our garage, buckling the garage roller door
Approx 1990	16	514 Pacific Hwy, Wyoming, NSW 2250	
1991 Early AM (High Tide)	114	15 Koninderie Parade, Narara, NSW 2250	Came over front verandah - 900cm above ground happened at high tide - pressure cracked fibro fence and pushed wooden gates that normally opened in, outwards.
1991	149	56 Fountains Rd, Narara, NSW 2250	
1991 Feb - Daylight	107	104 Showground Rd, Gosford, NSW 2250	



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
Feb 1991 Night, 2 or 3 times during the eighties	228	66 Bourbon Street, Wyoming, NSW 2250	1991 level went above the councils 1 in 100 year flood marker
19/10/1991	95	16 Glencoe Ave, Wyoming, NSW 2250	
1992	185	109 Carrington Street, Narara, NSW, 2250	1989 not much drainage
1992	187	28 Hanlan Street South, Narara, NSW 2250	
1992 all day	256	111 Carrington Street, Narara, NSW 2250	Closed Carrington St for 2 days. 1m of water over the lower part of Carrington Street {256a}, car washed away
About 1992 Saturday morning	133	16 Fuchsia St, Wyoming, NSW 2250	A large part of Gosford was flooded Wingello Creek flooded and water came in the back corner of our backyard. It didn't cause us any problems
1992 - ingress into home	49	89 Showground Rd, Narara, NSW 2250	Yes by retained photos
1992 - Morning	58	24 Pinetop Ave, Narara, NSW 2250	Fast flowing water
Approx Feb 1992 - Night	110	8 Windara Cl, Niagara Park, NSW 2250	Severe rainstorm and flooding of creek/major drain
Feb 1992 at 2am	147	26 Aldenham Road, Warnervale NSW 2259 (Business Address for property in Question is number 2-6 Manns Rd, Narara, NSW 2250	The water level broke the Narara Creek embankment and flooded the family property and business
Feb 1992 - Night	98	11 Koninderie Pde, Narara, NSW 2250	Flooding occurred approx 1.30 to 2.30 during the night
Feb 1992 (Coincided with King Tide and heavy rain)	144	67 Narara Valley Dr, Narara, NSW 2250	Street behind us (Koninderie Pde) next to creek was knee deep in water which flowed through houses and back yards through to our backyard.
Feb 1992 Early AM (High Tide)	114	15 Koninderie Parade, Narara, NSW 2250	Came over front verandah - 900cm above ground happened at high tide - pressure cracked fibro fence and pushed wooden gates that normally opened in, outwards.
1993	149	56 Fountains Rd, Narara, NSW 2250	
1994 - Morning	58	24 Pinetop Ave, Narara, NSW 2250	Fast flowing water
1996	149	56 Fountains Rd, Narara, NSW 2250	
1996 March - Daylight	107	104 Showground Rd, Gosford, NSW 2250	
1998(7?)	89	88 Carrington St, Narara, NSW 2250	
1998	256	111 Carrington Street, Narara, NSW 2250	Closed Carrington St for 2 days. 1m of water over the lower part of Carrington Street {256a}, car washed away
1999 after heavy rain depending on tide	232	77 Carrington Street, Narara, NSW 2250	
(I think) Feb 2001 3-5am	312	18 Tatura Avenue, North Gosford, NSW 2250	Yes as it came up too close to our factory roller shutter door
2002	256	111 Carrington Street, Narara, NSW 2250	Closed Carrington St for 2 days. 1m of water over the lower part of Carrington Street. car washed away



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
2002 - 6am to 8am	41	119 Carrington St, Narara, NSW 2250	Submerged and damaged driveway bridge. Prevented access to the property due to depth of flowing water over the bridge
2002 (march) 7am	222	131 Reeves Street, Narara, NSW 2250	
Easter Thursday 2002? Morning	204	16 Hanlan Street Sth, Narara NSW 2250	Long weekend when 1.2 metres deep in paddock many tonnes of sand deposited.
2003 - Night	66	2-6 Hanlan St South, Narara, NSW 2250	Heaps of river sand, trees, in garage, steps etc.
April/May 2003 Afternoon	339	PO Box 343, Gosford NSW 2250	A 3 feet wall of water went across the lowest part of the backyard - on top of stormwater drain. It managed to partially escape down cement access drain at the right hand corner of my property - but flattened everything in its path.
25 May 2003 Afternoon	325	52 Karina Drive, Narara, NSW 2250	Council cut grass in reserve in the rain which washed cutting into drains blocking them. Creek overflowed with stormwater and flooded my property and home. Fences were also demolished by the weight of the water.
2004	187	28 Hanlan Street South, Narara, NSW 2250	
May 2004(?) - 7am to 9am, by far the worst	89	88 Carrington St, Narara, NSW 2250	Rain fell from about 7am to 7.45 or 8am (ABC broadcast that we'd had 113mm) and the water level arose fast enough to trap horses on the land opposite {89b}. Road really covered {89c}.
2005 - Night	66	2-6 Hanlan St South, Narara, NSW 2250	Heaps of river sand, trees, in garage, steps etc.
June 2005 due to heavy rain	75	39a Jarrett St, North Gosford, NSW 2250	Have photos of mulching into creek but can't find at moment
2006?	185	109 Carrington Street, Narara, NSW, 2250	1989 not much drainage
11 May 2006 - Night	66	2-6 Hanlan St South, Narara, NSW 2250	Heaps of river sand, trees, in garage, steps etc.
2006 (june) 3pm	222	131 Reeves Street, Narara, NSW 2250	2006 storms, flooded back of property (borders the creek) plus flooding from the road down the sides of the house and into the pool.
June 2006 - Fri afternoon Sunday	331	82 Narara Valley Dr, Narara, NSW 2250	
June 2006 storms	287	57 Maliwa Rd, Narara, NSW 2250	
2007?	230	33 Crawford Crescent, Wyoming, NSW 2250	Did not affect the dwelling, just the backyard and shed.
2007 all day and night	185	109 Carrington Street, Narara, NSW, 2250	1989 not much drainage
2007 1 day	232	77 Carrington Street, Narara, NSW 2250	
2007	75	39a Jarrett St, North Gosford, NSW 2250	Have photos of mulching into creek but can't find at moment
Anzac Day 2007 (All Day)	313	119 Reeves Street, Narara, NSW 2250	Whole backyard under water about 1/2 metre deep.
June Queens Bday Weekend 2007	27	64 Fountains Rd, Narara, NSW 2250	Moved in on Queens bday weekend. Road flooded at Hanlan St and bottom of property flooded. Any heavy rain - property floods although is a flood plain!



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
Long Weekend, June 07 - 3.30pm, Other times in heavy rain	43	10 Camphor Cl, Wyoming, NSW 2250	Very heavy rain
June 2007 - 3 days	50	5 Koninderie Pde, Narara, NSW 2250	Entire property was surrounded by floodwater for 3 days
June 2007 - 3 Days, Various since - at least 6 times, 24hrs	33	121 Reeves St, Narara, NSW 2250	June 07 storms - Reeves Street. We were cut off for over 2 days
June 2007	52	12 Willari Ave, Narara, NSW 2250	We have lived at 12 Willari Avenue, Narara for three years in a house standing on a concrete slab. The block of land is flat and there are no stairs at the main entrance to the house. Normally our garden and yard drain satisfactorily during and after heavy rain. However, in June 2007 there was stormy weather with heavy rain for days and the rear of our block became waterlogged, with puddles in the vegetable patch near the rear fence. This cleared as soon as fine weather arrived - probably helped by the vacant reserve beyond the back fence. No rain or flood water entered our house; therefore we have not been affected by flooding since living here
June 2007 PM	234	8 Rowena Road, Narara, NSW 2250	Occurred during June long weekend, property adjacent to Gavenlock oval
June 2007 - approx 11pm	53	116 Showground Rd, North Gosford, NSW 2250	Flood peaked on high tide approx 300mm through the ground floor
June 2007 - Morning	58	24 Pinetop Ave, Narara, NSW 2250	Fast flowing water
June 2007	64	17 Kathleen Morreau Rd, Niagara Park, NSW 2250	
Sat June 9th 2007 - 4am	83	8 Fay St, Lake Munmorah, NSW 2250	Approx half the racetrack was flooded after we received 388mm of rain in the 24hr period
June 2007 Highest tide approx 0400-0500 hrs	124	63 Maliwa Rd, Narara, NSW 2250	Cyclonic weather for a weekend. Narara Creek came up to the large tree in backyard
June long weekend 2007?	120	49 Chamberlain Rd, Wyoming, NSW 2250	The water level rose to the floor level of our chicken coup. Maybe 1m depth
June Long Weekend 2007 4.30am	115	17 Koninderie Parade, Narara, NSW 2250	
June Long weekend approx. 4 other times	328	5 Perratt Close, Niagara Park, NSW 2250	Our street was in accessible, as was railway crescent
June Long Weekend 2007, All Day	247	12/A Carrington Street, Narara, NSW 2250	June long weekend 2007 didn't actually flood our property but flooded the access to it. i.e. Carrington St near the school and at the private end of Carrington st. Our garage always floods due to the run off from the lie of the land.
June long weekend 2007	284	89 Deane Street, Narara, NSW 2250	June public holiday weekend 2007 water rose rapidly up to 1-100 year flood line (?).



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
(Daytime), Numerous floodings since residence (30+)			1st time water flowed rapidly at paddock gate.
June 2007 long weekend (largest flood)	329	17 Brady's Gully Road, North Gosford, NSW 2250	The bottom half of our backyard was under water, for 2 days. Moderate erosion for the over flow drain from the dam next door. Side fence was damaged from dam over flow. Gumtree next door fell over and thru our garden shed due to the softened ground.
June longweekend 10/06/2007 Large downpours regularly	174	12 North Crescent, North Gosford, NSW 2250	10/07/2007 The water came over the road at North Crescent {174b} and Linden Street {174c} that it ran down our driveway flooding the garage down the side of the house and guttering. Deaths at Somersby of a family.
Multiple Occasion, Largest June 2007	146	7 Republican Cl, Narara, NSW 2250	
June 2007 (long weekend) the worst and Numerous times/cant remember the dates	168	60 Fountains Road, Narara, NSW 2250	
June Long weekend 07 - 5.30pm	66	2-6 Hanlan St South, Narara, NSW 2250	Heaps of river sand, trees, in garage, steps etc.
June/July 2007 (Overnight and Early Morning), There have been other occasions due to heavy rain and tides - usually overnight and early morning.	144	67 Narara Valley Dr, Narara, NSW 2250	Street behind us (Koninderie Pde) next to creek was knee deep in water which flowed through houses and back yards through to our backyard.
Queens Birthday 2007 (All weekend), Anzac Day 2007 (All Day)	313	119 Reeves Street, Narara, NSW 2250	Whole backyard under water about 1/2 metre deep.
June Long weekend 2007 afternoon	320	13 Kathleen Morreau Rd, Niagara Park, NSW 2250	Long weekend June 2007
June floods 07?	206	5 Kathleen Morreau Rd, Niagara Park, NSW 2250	Large enough to move a 20ft container
June long weekend (Saturday) 2007 4am	169	23 Koninderie Parade, Narara, NSW 2250	Flood water from creek across the street came into front yard and up to base of house slab. Water was 600mm deep at front gate.
June 2007	199	26 Maitland Road, Springfield (Business premises at 29 Tatura Ave, Gosford)	



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
June 2007 Tidal	166	84 Reeves Street, Narara, NSW 2250	Day that Narara had highest rainfall for state was the highest that flood waters had in our yard. Over the years have had creek raise up but that was the highest we have ever seen
9-6-2007 5:00am	292	9 Koninderie Parade, Narara, NSW 2250	9-6-2007 June long weekend, our house was flooded by 30cm of water from the creek that runs parallel to Koninderie Pde, Narara and flows into Narara Creek. It flooded our house, backyard, front yard and garage.
June Long weekend 2007 (started Friday evening and had subsided noticeably by Sunday Afternoon).	324	8 Stachon Street, North Gosford, NSW 2250	Brady's Gully rose and broke over the bank, spreading about 1m into the reserve area directly beside our backyard.
June 2007 (can be anytime, might be day, morning), while we have been here, we can't remember the dates or even some of the years that we have had bad floods, it's always been flooding in 2 hours if we had 60ml of rain after freeway was build	149	56 Fountains Rd, Narara, NSW 2250	2007 last worst flood that we had, water level was higher than ever before you could not see the fence posts. Water was that high we lost the fence plants and water damaged the stone wall that my husband build up to support the creek bank. We had big clean up after. There was huge logs, tree stumps and debris. Also there was lots of sand dunes. We did get all that from upper part of the creek. We called the council to come and have a look.
June 2007 (long weekend)	276	140 Manns Road, Narara, NSW 2250	Water was about knee height in our back yard. Took a few days to subside completely
June 07 (2pm)	323	124 Reeves Street, Narara, NSW 2250	June 2007 couldn't get home due to flooding
June 2007 Worst - 9/6/2007, 10/06/2007 and 16/06/007- Numerous ties in 3 years and peaked 3-4pm	141	44 Fountains Rd, Narara, NSW 2250	Friday 9/6/07 - 1.5m deep across back yard (backs on to Narara Creek) All road into Fountains Road blocked by water.
8th June 2007 at 2pm and 9th June 2007 at 3am	135	92 Reeves St, Narara, NSW 2250	The long weekend of 2007 due to excessive rain flooding occurred several times across our front yard and over our access bridge.
June Long Weekend 2007 (Friday afternoon & Saturday Afternoon), unsure of dates but we have had the creek break	204	16 Hanlan Street Sth, Narara NSW 2250	Long weekend when 1.2 metres deep in paddock many tonnes of sand deposited.



## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
its banks I think twice since the long weekend.			
8 June 2007 2pm, 9 June 2007 3am	298	100 Reeves Street, Narara, NSW 2250	June 07 first time our access bridge had gone under water (photo) bridge to 1.100 Council specifications.
July 2007	275	133 Narara Creek Road, Narara, NSW 2250	
30 November 2007 afternoon	298	100 Reeves Street, Narara, NSW 2250	
November 20th 2007 at 3am	135	92 Reeves St, Narara, NSW 2250	
9th December 2007 at 1.00pm	135	92 Reeves St, Narara, NSW 2250	
9 December 2007 afternoon	298	100 Reeves Street, Narara, NSW 2250	
2008	41	119 Carrington St, Narara, NSW 2250	Submerged and damaged driveway bridge. Prevented access to the property due to depth of flowing water over the bridge
2008	256	111 Carrington Street, Narara, NSW 2250	Closed Carrington St for 2 days. 1m of water over the lower part of Carrington Street, car washed away
Feb 2008 - Night	98	11 Koninderie Pde, Narara, NSW 2250	Flooding occurred approx 1.30 to 2.30 during the night
9 Feb 2008 13:10pm	244	3 Brancourt Crescent, Narara, NSW 2250	Back patio area flooded during rain. Drains were backed up I think
March 2008	203	115 Carrington Street, Narara NSW 2250	The largest flood was during the storms in about Mar/Apr 2008. The water level in the creek at the bottom of my yard rose approx 2m.
June Long weekend 2008 - 11.00am	36	40 Fountains Rd, Narara, NSW 2250	
June 2008 (can be anytime, might be day, morning)	149	56 Fountains Rd, Narara, NSW 2250	
June 2008 - 2 days straight	128	139 Carrington St, Narara, NSW 2250	During the 'heavy' rain of June 2008. Bottom of property - where creek runs - flowed onto plains - broke creek walls, lost trees, soils etc
June 2008	170	6 Belltrees Close, North Gosford, NSW 2250	June 2008 following several days of extensive rain, major pooling of water (approximately the amount in an average swimming) accumulated on our property as well as two of the neighbouring properties {uncertain which two properties}.
2009 high tide	232	77 Carrington Street, Narara, NSW 2250	
16 February 2009 Minor	298	100 Reeves Street, Narara, NSW 2250	





## RESULTS OF COMMUNITY FLOOD SURVEY

Dates of Flooding	ID	Address	Details of Event
flooding Reeves Street Causeway			
2009 (march) 9am	222	131 Reeves Street, Narara, NSW 2250	
Easter 2009, on high tide	326	8 Farrand Crescent, Terrigal NSW 2260 (inrelation to 14 Nursery Street, Narara)	Floor level of house approx 2m's
9 June 2009 - all weekend	78	101 Carrington St, Narara, NSW 2250	Have photos of backyard
June 2009 (can be anytime, might be day, morning)	149	56 Fountains Rd, Narara, NSW 2250	
June 2009 - Night	98	11 Koninderie Pde, Narara, NSW 2250	Flooding occurred approx 1.30 to 2.30 during the night
July 2009 - 9.00am	36	40 Fountains Rd, Narara, NSW 2250	
July 2009 PM	160	13 Kateena Avenue, Tascott (in relation to 125A Carrington Street)	Lower yard area only



## RESULTS OF COMMUNITY FLOOD SURVEY

**Table 2: Reported Damages**

ID	Address	Damages	Estimated Cost
7	52 Pierce Street, Lisarow, NSW 2250	Soil Erosion	\$500-\$1000
13	Mara' 134 Silvesters Road, Somersby NSW 2250. Property in question: 346 Manns Rd, West Gosford, NSW 2250	Mud, external doors, Paint work	\$10,000
15	24 Calantha Dr, Wyoming, NSW 2250	Garden Plants and quite large shrubs were washed out, Gosford council acted quickly and remedied the sewerage line to take overflow water.	\$15,000 in todays costs
16	514 Pacific Hwy, Wyoming, NSW 2250	General clean up - mud, rocks etc.	
21	33 Hanlan St (South) Narara, NSW 2250	Shed undermined	approx \$1000
26	260 Manns Rd, West Gosford, NSW 2250	Garage/Property (SOLD)	
31	18 Renwick St, Wyoming, NSW 2250	Lifted bitumen at car park. Burst council stormwater pipe. {address uncertain}	
36	40 Fountains Rd, Narara, NSW 2250	Fences, soil erosion along creek bed	\$500
41	119 Carrington St, Narara, NSW 2250	Bridge (driveway) was submerged and could not be used for vehicle traffic due to the damage	\$7,000
49	89 Showground Rd, Narara, NSW 2250	Pool popped from ground, fences left and right, usually clean up expenses inside house and exterior	\$10,000
50	5 Koninderie Pde, Narara, NSW 2250	Frozen food in freezer in garage (no power for 4 days) , items on floor of garage	\$550
53	116 Showground Rd, North Gosford, NSW 2250	Electronic controls in machine got wet and burned out when restarted	\$5,000
61	58 Sunset St, Wyoming, NSW 2250	Garage - Constant stream, Building (Below floor level) - Pooling	None
66	2-6 Hanlan St South, Narara, NSW 2250	Garage, lawn mowers, freezers, fridges	\$20,000
68	9-11 Wollong St, North Gosford, NSW 2250	All - Front yard, Backyard, Garage, Building (above floor level), Building (below floor level)	
72	16 Renwick St, Wyoming, NSW 2250	Two holes in walls of garage, buckled garage roller door	\$600 approx.
75	39a Jarrett St, North Gosford, NSW 2250	Earth washed away due to easement being filled in by construction across the creek	
90	18 Laycock St, Wyoming, NSW 2250	Outside dunny floated away	
95	16 Glencoe Ave, Wyoming, NSW 2250	Pool area - clean pool out of dirt and sand	\$800
98	11 Koninderie Pde, Narara, NSW 2250	Contents of home including complete new kitchen, carpets to all rooms	



## RESULTS OF COMMUNITY FLOOD SURVEY

ID	Address	Damages	Estimated Cost
110	8 Windara Cl, Niagara Park, NSW 2250	Carpet, cabinet, fence	\$Several Thousands
114	15 Koninderie Parade, Narara, NSW 2250	Fence piers under house, gates, car	\$Several Thousands
115	17 Koninderie Parade, Narara, NSW 2250	Car	\$10,000
120	49 Chamberlain Rd, Wyoming, NSW 2250	Boundary fence destroyed	\$2,000
124	63 Maliwa Rd, Narara, NSW 2250	Entire backyard fence destroyed (old)	\$2000 put new powder coated
128	139 Carrington St, Narara, NSW 2250	Bridges over creek Lawn/Plants	
141	44 Fountains Rd, Narara, NSW 2250	100 meters of rural fencing destroyed. Rubbish/Trees deposited on block	
143	10 Coolahbah St, Ettalong Beach NSW 2257; formerly 11 Glencoe Ave, Wyoming, NSW 2250	Previously damage was to clothesline, fence and BBQ setting	\$2,000
146	7 Republican Cl, Narara, NSW 2250	Fences	Minimal
147	26 Aldenham Road, Warnervale NSW 2259 (Business Address for property in Question is number 2-6 Manns Rd, Narara, NSW 2250	Building floor coverings furniture - vehicles - plant and equipment nursery items	\$400,000
149	56 Fountains Rd, Narara, NSW 2250	Fences, Plants	
153	54 Bourbon Street, Wyoming, NSW 2250	Lost Bird Cages and Shed. Lost 1/3 Backyard	
166	84 Reeves Street, Narara, NSW 2250	Only backyard	
168	60 Fountains Road, Narara, NSW 2250	Garden bridge and arbour	\$3,000
174	12 North Crescent, North Gosford, NSW 2250	Garage is not usable	\$5,000
185	109 Carrington Street, Narara, NSW, 2250	Erosion and loss of plants and deadbury trapped	Unable to put a price as it was a lot of top soil erosion
190	2 Crestwood Ave, Niagara Park, NSW 2250	Stormwater flooding up to the base of window frame	Nil
199	26 Maitland Road, Springfield (Business premises at 29 Tatura Ave, Gosford)	Washing away of fill from rear filled area causing slab cracking and subsidence	\$10,000
203	115 Carrington Street, Narara NSW 2250	Fences pushed over, Trees and shrubs destroyed	\$3,000
204	16 Hanlan Street Sth, Narara NSW 2250	Fence, Equipment in shed, livestock	\$1,000
206	5 Kathleen Morreau Rd, Niagara Park, NSW 2250	Gardens destroyed, container damaged	Cost of retrieving container out of creek \$1000
222	131 Reeves Street, Narara, NSW 2250	Pool & garden. However due to flooding a tree fell on the house	Pool & surrounds = \$2,000, House \$120,000



## RESULTS OF COMMUNITY FLOOD SURVEY

ID	Address	Damages	Estimated Cost
228	66 Bourbon Street, Wyoming, NSW 2250	Side fences and retaining wall, carpets	\$10,000
232	77 Carrington Street, Narara, NSW 2250	4WD written off - rescuing a vehicle that washed over creek edge outside 77 Carrington	\$87,000
234	8 Rowena Road, Narara, NSW 2250	Fence, White goods, furniture, personal effects	\$15,000
238	38 Duke Street, Forestville NSW 2087 (in relation to Lot 7, 8, 9 - Birru Rd, Nth Gosford, NSW 2250)	Vacant land eroded - needs to be re-claimed	
240	15 Lemon Tree Street, Wyoming, NSW 2250	Back fence disappeared	
247	12/A Carrington Street, Narara, NSW 2250	Garage floor - no cost involved, just a clean up	no cost
254	59 Carrington Street, Narara, NSW 2250	Just debris on fencing	
271	74 Beaumont Avenue, Wyoming, NSW 2250	Water went through garage damaging fridge motor. Also shoes washed away from backyard.	\$1,000 cost of fridge
275	133 Narara Creek Road, Narara, NSW 2250	Damage to Flora	
284	89 Deane Street, Narara, NSW 2250	Creek bank seriously eroded - changing course	
287	57 Maliwa Rd, Narara, NSW 2250	Just plants & Lawn	Not much
292	9 Koninderie Parade, Narara, NSW 2250	House, Carpets, all laminate flooring, fence and furniture	\$14,269
298	100 Reeves Street, Narara, NSW 2250	Fences	\$200
307	7B Maliwa Road, Narara, NSW 2250	We minimise property damage by moving equipment to higher ground. Cost to us is time lost to business due to floods.	
313	119 Reeves Street, Narara, NSW 2250	Tree fell over broke two other trees and damaged clothesline.	\$100.00 + Trees
316	3 Blanche Street, North Gosford, NSW 2250	No damage to buildings, mud had to be shovelled out of carport and garage	No cost, cleaned up by ourselves
325	52 Karina Drive, Narara, NSW 2250	Carpets, electrical equipment, tools, furniture, mower, snipper, fences and gates	\$15,000
326	8 Farrand Crescent, Terrigal NSW 2260 (in relation to 14 Nursery Street, Narara)	Replaced fencing on three occasions	
329	17 Brady's Gully Road, North Gosford, NSW 2250	Garden Shed, Garden Fence	Garden Shed: \$5,000 and Garden Fence: \$2,000
330	79 Deane Street, Narara, NSW 2250	Lost Fences	
333	25 Rowena Road, Narara NSW 2250	2007 NRMA would not pay damage to house cracked walls + supporter under house	



## RESULTS OF COMMUNITY FLOOD SURVEY

ID	Address	Damages	Estimated Cost
339	PO Box 343, Gosford NSW 2250	Damaged fence, lost plants	\$2,000
341	3 Adnamira Close, Wyoming NSW 2250	Carpet, Furniture	\$700 - \$800 estimate

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# APPENDIX E

## Survey Responses

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At Golder Associates we strive to be the most respected global group of companies specialising in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organisational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

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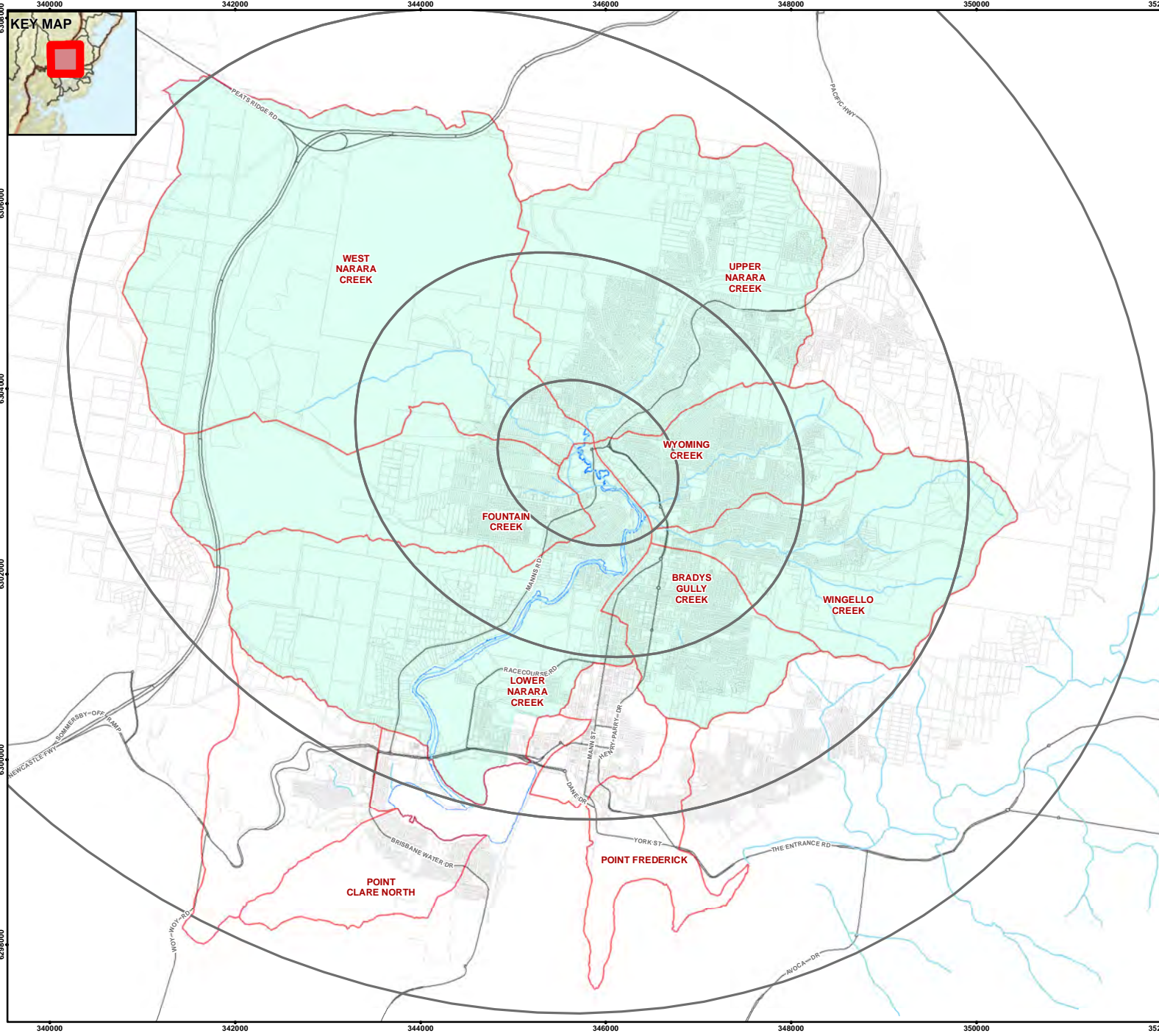


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**T: +61 2 9478 3900**

APPENDIX C

Rainfall Data





**Legend**

- Localities
- Catchment Boundary
- Creeklines
- Drainage Sub-Catchment
- Main Roads
- Cadastral Boundary
- PMP Ellipses
- Waterways

N  
 0 1,000 2,000  
 1:60,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Creeklines, Narara Creeks, Waterways, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PMP ELLIPSES REGIONS**

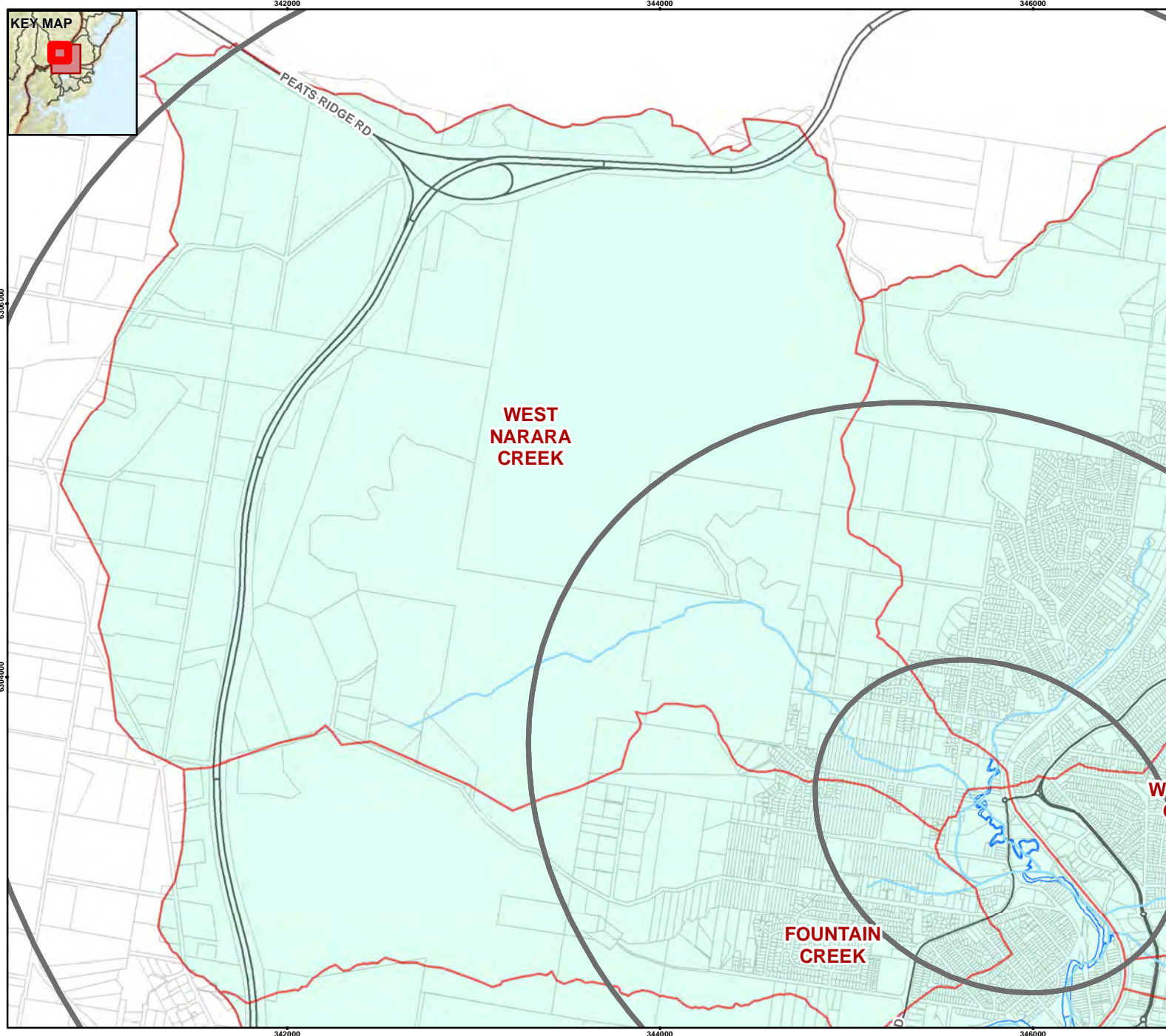
CONSULTANT



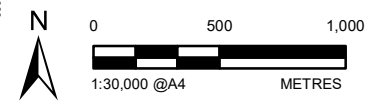
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
 097626068 006 G Appendix CA

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



- Legend**
- Localities
  - Creeklines
  - Main Roads
  - PMP Ellipses
  - Waterways
  - Catchment Boundary
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**Cadastral, Creeklines, Narara Creeks, Waterways, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

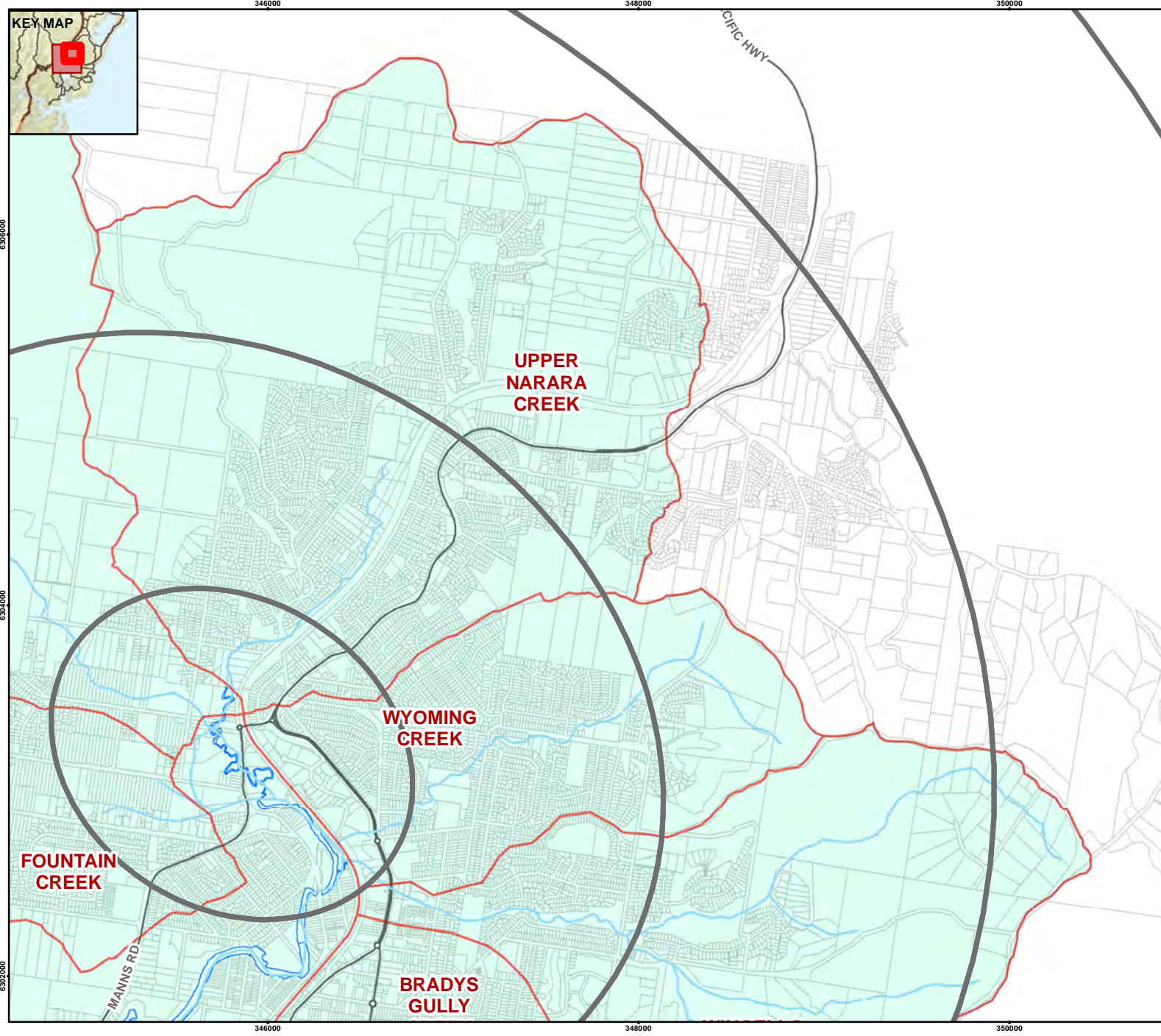
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PMP ELLIPSES REGIONS**

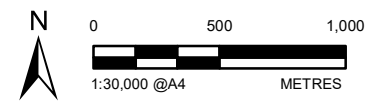


DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

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- Legend**
- Localities
  - Catchment Boundary
  - Creeklines
  - Drainage Sub-Catchment
  - Main Roads
  - Cadastral Boundary
  - PMP Ellipses
  - Waterways



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**Cadastral, Creeklines, Narana Creeks, Waterways, Sub-Catchment:** Provided by Central Coast Council February 2018

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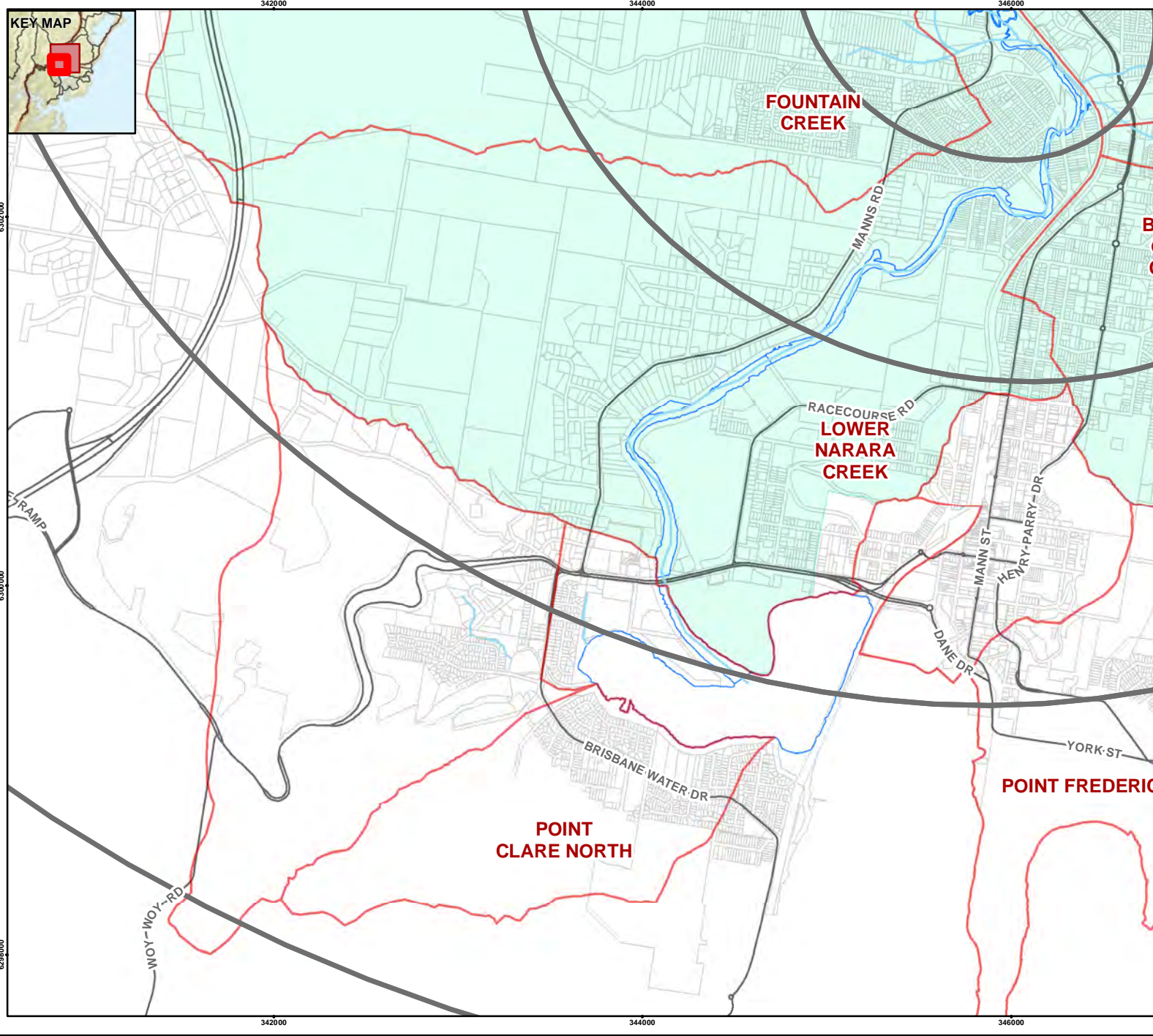
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PMP ELLIPSES REGIONS**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Catchment Boundary
- Creeklines
- Drainage Sub-Catchment
- Main Roads
- Cadastral Boundary
- PMP Ellipses
- Waterways

N  
0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
Main Roads, Localities: Provided by MapInfo StreetPro.  
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PROJECT  
**NARARA CREEK FLOOD STUDY**

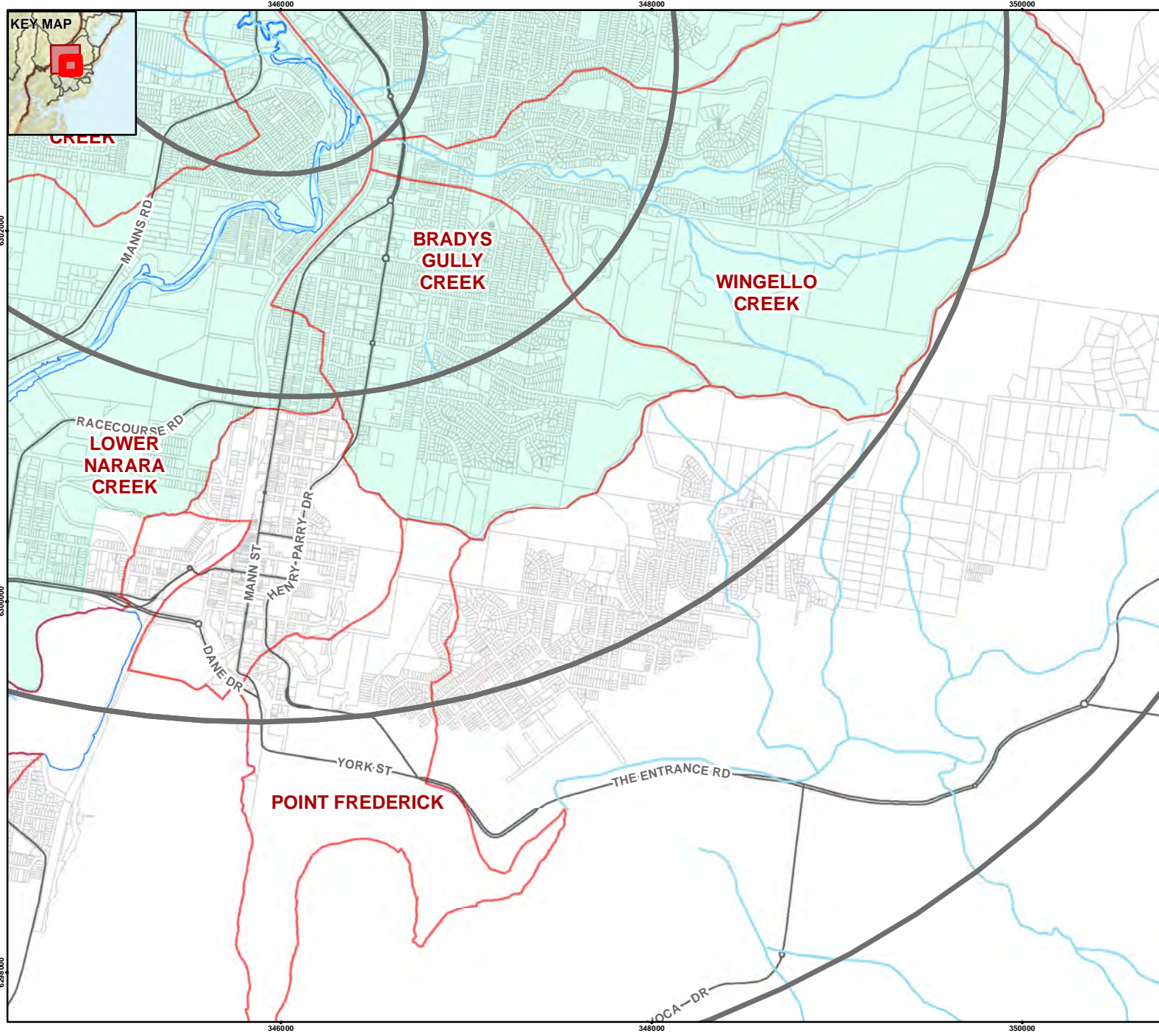
TITLE  
**PMP ELLIPSES REGIONS**

CONSULTANT

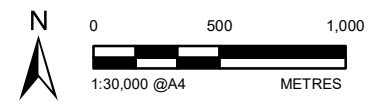
DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
097626068 006 G Appendix CD

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



- Legend**
- Localities
  - Catchment Boundary
  - Creeklines
  - Drainage Sub-Catchment
  - Main Roads
  - Cadastral Boundary
  - PMP Ellipses
  - Waterways



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
 Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), MapmyIndia, NGCC, © OpenStreetMap contributors, and the GIS User Community

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**REFERENCE(S)**  
 Main Roads, Localities: Provided by MapInfo StreetPro.  
 Cadastre, Creeklines, Narana Creeks, Waterways, Sub-Catchment: Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**PMP ELLIPSES REGIONS**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	BG
REVIEWED	NM
APPROVED	NM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO/A4

Pluviograph Records (mm): 2 February 1990

Lisarrow	Narara	Mt Elliot	Wyoming	Strickland
2/02/1990 0:00	0	0.5	0	0
2/02/1990 0:06	0	0	0	0
2/02/1990 0:12	0	0	0	0
2/02/1990 0:18	0	0	0	0
2/02/1990 0:24	0	0	0	0
2/02/1990 0:30	0	0	0	0.5
2/02/1990 0:36	0	0	0	0
2/02/1990 0:42	0.5	0.5	0	0
2/02/1990 0:48	0	0	0	0.5
2/02/1990 0:54	0	0	0	0
2/02/1990 1:00	0.5	0	0.5	0
2/02/1990 1:06	0	0.5	0	0
2/02/1990 1:12	0	0.5	0	0
2/02/1990 1:18	0	0	0	0
2/02/1990 1:24	0	0	0	0
2/02/1990 1:30	0	0	0	0
2/02/1990 1:36	0	0.5	0	0.5
2/02/1990 1:42	0	0	0	0
2/02/1990 1:48	0	0	0	0
2/02/1990 1:54	0.5	0	0	0
2/02/1990 2:00	0	0	0	0.5
2/02/1990 2:06	0	0	0	0
2/02/1990 2:12	0	0	0	0
2/02/1990 2:18	0	0	0	0
2/02/1990 2:24	0	0	0	0.5
2/02/1990 2:30	0	0	0	0
2/02/1990 2:36	0	0	0	0
2/02/1990 2:42	0	0	0	0
2/02/1990 2:48	0	0	0	0
2/02/1990 2:54	0	0	0	0
2/02/1990 3:00	0	0	0	0
2/02/1990 3:06	0	0	0	0
2/02/1990 3:12	0	0	0	0
2/02/1990 3:18	0	0	0	0
2/02/1990 3:24	0	0	0	0
2/02/1990 3:30	0	0	0	0
2/02/1990 3:36	0	0	0	0
2/02/1990 3:42	0	0	0	0
2/02/1990 3:48	0	0	0	0
2/02/1990 3:54	0	0	0	0
2/02/1990 4:00	0	0	0	0
2/02/1990 4:06	0	0	0	0
2/02/1990 4:12	0	0	0	0
2/02/1990 4:18	0	0	0	0
2/02/1990 4:24	0	0	0	0
2/02/1990 4:30	0	0	0	0
2/02/1990 4:36	0	0	0.5	0
2/02/1990 4:42	0	0	0	0
2/02/1990 4:48	0	0	0	0
2/02/1990 4:54	0	0	0	0
2/02/1990 5:00	0	0	0	0
2/02/1990 5:06	0	0	0	0
2/02/1990 5:12	0	0	0	0
2/02/1990 5:18	0	0	0	0
2/02/1990 5:24	0	0	0.5	0
2/02/1990 5:30	0.5	0.5	0	0
2/02/1990 5:36	0	0	0	0
2/02/1990 5:42	0	0	0	0
2/02/1990 5:48	0	0	0	0
2/02/1990 5:54	0	0	0.5	0
2/02/1990 6:00	0.5	0	0	0
2/02/1990 6:06	1.5	0	0.5	0
2/02/1990 6:12	0.5	0	0.5	0
2/02/1990 6:18	0.5	0.5	0.5	0
2/02/1990 6:24	1	0.5	0	0
2/02/1990 6:30	0	0	0.5	0.5
2/02/1990 6:36	0.5	0.5	0.5	0
2/02/1990 6:42	1.5	0	1	0
2/02/1990 6:48	2	0.5	1	0
2/02/1990 6:54	1	0.5	1.5	0
2/02/1990 7:00	0.5	0.5	1	0
2/02/1990 7:06	2.5	0.5	0	0
2/02/1990 7:12	0.5	0.5	0.5	0.5
2/02/1990 7:18	1	0.5	0.5	0.5
2/02/1990 7:24	1	1.5	0.5	0
2/02/1990 7:30	0	1	0.5	0
2/02/1990 7:36	0.5	2	0.5	0.5
2/02/1990 7:42	2.5	2	0.5	0.5
2/02/1990 7:48	0	2	0.5	0.5
2/02/1990 7:54	0.5	1	0.5	0.5
2/02/1990 8:00	0	1.5	0	0.5
2/02/1990 8:06	0.5	0	1	0.5
2/02/1990 8:12	0.5	0.5	0	0.5
2/02/1990 8:18	0	0	0	0.5
2/02/1990 8:24	0	0	0.5	2.5
2/02/1990 8:30	0.5	0.5	0	3
2/02/1990 8:36	0.5	0.5	0.5	2
2/02/1990 8:42	1	0.5	0.5	2
2/02/1990 8:48	0	0.5	0.5	2
2/02/1990 8:54	0.5	0	0	1
2/02/1990 9:00	0	0	0	0.5
2/02/1990 9:06	0	0	0.5	0
2/02/1990 9:12	0	0.5	0	0.5
2/02/1990 9:18	0	0	0	0
2/02/1990 9:24	0	0	0	0.5
2/02/1990 9:30	0.5	0	0	0.5
2/02/1990 9:36	0	0	1	0.5
2/02/1990 9:42	0.5	2.5	0.5	0.5
2/02/1990 9:48	1.5	1	1	0.5
2/02/1990 9:54	3	1.5	0.5	0
2/02/1990 10:00	1	1	0	0.5
2/02/1990 10:06	0.5	1	0.5	0.5
2/02/1990 10:12	0	0.5	0	0
2/02/1990 10:18	0	0.5	0	0
2/02/1990 10:24	0.5	0	0	0
2/02/1990 10:30	0	0	0	0
2/02/1990 10:36	1	0.5	0	1
2/02/1990 10:42	3.5	2	0.5	1
2/02/1990 10:48	1.5	2	1.5	1.5
2/02/1990 10:54	1.5	3	1.5	1
2/02/1990 11:00	1	0.5	1	1
2/02/1990 11:06	1.5	2	1	0.5
2/02/1990 11:12	1	1	1	0.5
2/02/1990 11:18	1	1	0.5	0
2/02/1990 11:24	1	1	0.5	0.5
2/02/1990 11:30	1	1.5	0	0
2/02/1990 11:36	1	1.5	1	0
2/02/1990 11:42	1.5	1.5	1	0
2/02/1990 11:48	4	3.5	0	0.5
2/02/1990 11:54	4	1.5	0	1
2/02/1990 12:00	3.5	3	2.5	3
2/02/1990 12:06	2.5	2	2.5	2
2/02/1990 12:12	1	2.5	1.5	0.5
2/02/1990 12:18	1	2.5	1.5	1.5
2/02/1990 12:24	0.5	0.5	0.5	2.5
2/02/1990 12:30	0.5	1	0.5	0.5
2/02/1990 12:36	0.5	0.5	0.5	2
2/02/1990 12:42	1.5	1	1	1.5
2/02/1990 12:48	1.5	0.5	1	1.5
2/02/1990 12:54	2.5	2.5	1.5	2
2/02/1990 13:00	4.5	2	4	3.5
2/02/1990 13:06	5.5	3.5	4.5	4
2/02/1990 13:12	2	5.5	3	2.5
2/02/1990 13:18	2.5	4	3.5	1
2/02/1990 13:24	2	4	2.5	0.5
2/02/1990 13:30	2	2.5	3	1
2/02/1990 13:36	2.5	2.5	2	0.5
2/02/1990 13:42	1	2	1	1
2/02/1990 13:48	1.5	2	2	2
2/02/1990 13:54	2.5	1	2	1.5
2/02/1990 14:00	1.5	2	2	3
2/02/1990 14:06	1	1.5	2	5.5
2/02/1990 14:12	2.5	2	1.5	2
2/02/1990 14:18	4	1.5	2	4.5
2/02/1990 14:24	5.5	0.5	2	2.5
2/02/1990 14:30	3	3	1.5	2
2/02/1990 14:36	2	1.5	1	1.5
2/02/1990 14:42	2	2	1	2
2/02/1990 14:48	2	3.5	2.5	1
2/02/1990 14:54	2.5	2	1.5	4









Pluviograph Records (mm): 7 February 1990

Lisarow		Narara		Mt Elliot		Wyoming		Strickland	
7/02/1990 0:00	0	7/02/1990 0:00	0	7/02/1990 0:00	0			7/02/1990 0:00	0
7/02/1990 0:06	0	7/02/1990 0:06	0	7/02/1990 0:06	0			7/02/1990 0:06	0
7/02/1990 0:12	0	7/02/1990 0:12	0	7/02/1990 0:12	0			7/02/1990 0:12	0
7/02/1990 0:18	0	7/02/1990 0:18	0	7/02/1990 0:18	0			7/02/1990 0:18	0
7/02/1990 0:24	0	7/02/1990 0:24	0	7/02/1990 0:24	0			7/02/1990 0:24	0
7/02/1990 0:30	0	7/02/1990 0:30	0	7/02/1990 0:30	0			7/02/1990 0:30	0
7/02/1990 0:36	0	7/02/1990 0:36	0	7/02/1990 0:36	0			7/02/1990 0:36	0
7/02/1990 0:42	0	7/02/1990 0:42	0	7/02/1990 0:42	0			7/02/1990 0:42	0
7/02/1990 0:48	0	7/02/1990 0:48	0	7/02/1990 0:48	0			7/02/1990 0:48	0
7/02/1990 0:54	0	7/02/1990 0:54	0	7/02/1990 0:54	0			7/02/1990 0:54	0
7/02/1990 1:00	0	7/02/1990 1:00	0	7/02/1990 1:00	0			7/02/1990 1:00	0
7/02/1990 1:06	0	7/02/1990 1:06	0	7/02/1990 1:06	0			7/02/1990 1:06	0
7/02/1990 1:12	0.5	7/02/1990 1:12	0	7/02/1990 1:12	0.5			7/02/1990 1:12	0
7/02/1990 1:18	0	7/02/1990 1:18	0	7/02/1990 1:18	0			7/02/1990 1:18	0
7/02/1990 1:24	0	7/02/1990 1:24	1	7/02/1990 1:24	0			7/02/1990 1:24	0
7/02/1990 1:30	0	7/02/1990 1:30	1	7/02/1990 1:30	0			7/02/1990 1:30	0
7/02/1990 1:36	0	7/02/1990 1:36	1	7/02/1990 1:36	0			7/02/1990 1:36	0
7/02/1990 1:42	0	7/02/1990 1:42	2	7/02/1990 1:42	0			7/02/1990 1:42	0
7/02/1990 1:48	0.5	7/02/1990 1:48	1.5	7/02/1990 1:48	0			7/02/1990 1:48	0
7/02/1990 1:54	0	7/02/1990 1:54	4.5	7/02/1990 1:54	0			7/02/1990 1:54	0
7/02/1990 2:00	0	7/02/1990 2:00	9.5	7/02/1990 2:00	1.5			7/02/1990 2:00	0
7/02/1990 2:06	2	7/02/1990 2:06	7	7/02/1990 2:06	0.5			7/02/1990 2:06	0
7/02/1990 2:12	4.5	7/02/1990 2:12	4.5	7/02/1990 2:12	0.5			7/02/1990 2:12	0.5
7/02/1990 2:18	4.5	7/02/1990 2:18	1	7/02/1990 2:18	3.5			7/02/1990 2:18	0.5
7/02/1990 2:24	2.5	7/02/1990 2:24	0	7/02/1990 2:24	5			7/02/1990 2:24	0.5
7/02/1990 2:30	4	7/02/1990 2:30	0.5	7/02/1990 2:30	4.5			7/02/1990 2:30	0.5
7/02/1990 2:36	3.5	7/02/1990 2:36	0.5	7/02/1990 2:36	2.5			7/02/1990 2:36	0.5
7/02/1990 2:42	7	7/02/1990 2:42	1	7/02/1990 2:42	7			7/02/1990 2:42	0.5
7/02/1990 2:48	4.5	7/02/1990 2:48	3	7/02/1990 2:48	4.5			7/02/1990 2:48	9.5
7/02/1990 2:54	2.5	7/02/1990 2:54	1.5	7/02/1990 2:54	5			7/02/1990 2:54	20.5
7/02/1990 3:00	2.5	7/02/1990 3:00	2	7/02/1990 3:00	1.5			7/02/1990 3:00	0.5
7/02/1990 3:06	5.5	7/02/1990 3:06	0.5	7/02/1990 3:06	3			7/02/1990 3:06	2.5
7/02/1990 3:12	7	7/02/1990 3:12	0.5	7/02/1990 3:12	5.5			7/02/1990 3:12	1
7/02/1990 3:18	2	7/02/1990 3:18	1	7/02/1990 3:18	8.5			7/02/1990 3:18	2
7/02/1990 3:24	3	7/02/1990 3:24	1	7/02/1990 3:24	5			7/02/1990 3:24	0
7/02/1990 3:30	2	7/02/1990 3:30	1	7/02/1990 3:30	1.5			7/02/1990 3:30	1.5
7/02/1990 3:36	3	7/02/1990 3:36	2	7/02/1990 3:36	8.5			7/02/1990 3:36	1
7/02/1990 3:42	6	7/02/1990 3:42	2.5	7/02/1990 3:42	12.5			7/02/1990 3:42	0.5
7/02/1990 3:48	2	7/02/1990 3:48	1.5	7/02/1990 3:48	12			7/02/1990 3:48	0
7/02/1990 3:54	0.5	7/02/1990 3:54	1	7/02/1990 3:54	4.5			7/02/1990 3:54	0.5
7/02/1990 4:00	0	7/02/1990 4:00	0.5	7/02/1990 4:00	3.5			7/02/1990 4:00	1
7/02/1990 4:06	0.5	7/02/1990 4:06	0	7/02/1990 4:06	2			7/02/1990 4:06	0.5
7/02/1990 4:12	1	7/02/1990 4:12	1	7/02/1990 4:12	2.5			7/02/1990 4:12	0
7/02/1990 4:18	0.5	7/02/1990 4:18	1	7/02/1990 4:18	1			7/02/1990 4:18	0
7/02/1990 4:24	1	7/02/1990 4:24	0.5	7/02/1990 4:24	1			7/02/1990 4:24	0
7/02/1990 4:30	0.5	7/02/1990 4:30	0.5	7/02/1990 4:30	1			7/02/1990 4:30	0.5
7/02/1990 4:36	0.5	7/02/1990 4:36	1	7/02/1990 4:36	1			7/02/1990 4:36	0
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7/02/1990 5:06	0.5	7/02/1990 5:06	0	7/02/1990 5:06	0.5			7/02/1990 5:06	0.5
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7/02/1990 5:18	0	7/02/1990 5:18	0	7/02/1990 5:18	0			7/02/1990 5:18	0
7/02/1990 5:24	0.5	7/02/1990 5:24	0	7/02/1990 5:24	0			7/02/1990 5:24	0
7/02/1990 5:30	0	7/02/1990 5:30	0	7/02/1990 5:30	0			7/02/1990 5:30	0
7/02/1990 5:36	0	7/02/1990 5:36	0	7/02/1990 5:36	0.5			7/02/1990 5:36	0.5
7/02/1990 5:42	0	7/02/1990 5:42	0	7/02/1990 5:42	0			7/02/1990 5:42	0
7/02/1990 5:48	0	7/02/1990 5:48	0	7/02/1990 5:48	0			7/02/1990 5:48	0
7/02/1990 5:54	0	7/02/1990 5:54	0	7/02/1990 5:54	0			7/02/1990 5:54	0
7/02/1990 6:00	0	7/02/1990 6:00	0	7/02/1990 6:00	0			7/02/1990 6:00	0

Lisarrow	Narara	Mt Elliot	Wyoming	Strickland
8/02/1992 0:00	0	0	0	0
8/02/1992 0:06	0	0.5	0	0
8/02/1992 0:12	0	0	0	0.5
8/02/1992 0:18	0	0	0	0
8/02/1992 0:24	0	0	0	0
8/02/1992 0:30	0.5	0	0	0
8/02/1992 0:36	0	0	0	0
8/02/1992 0:42	0	0	0.5	0
8/02/1992 0:48	0	0	0	0
8/02/1992 0:54	0	0	0	0
8/02/1992 1:00	0	0	0	0
8/02/1992 1:06	0	0	0	0.5
8/02/1992 1:12	0	0.5	0	0
8/02/1992 1:18	0	0	0	0
8/02/1992 1:24	0	0	0	0
8/02/1992 1:30	0.5	0	0	0
8/02/1992 1:36	0	0	0	0.5
8/02/1992 1:42	0	0	0.5	0
8/02/1992 1:48	0	0	0	0
8/02/1992 1:54	0	0	0	0
8/02/1992 2:00	0	0	0	0
8/02/1992 2:06	0.5	0	0	0
8/02/1992 2:12	0	0.5	0	0
8/02/1992 2:18	0	0	0	0.5
8/02/1992 2:24	0	0	0	0
8/02/1992 2:30	0	0	0.5	0
8/02/1992 2:36	0	0	0	0
8/02/1992 2:42	0.5	0	0	0.5
8/02/1992 2:48	0	0.5	0.5	0
8/02/1992 2:54	0	0	0	0
8/02/1992 3:00	0.5	0	0	0
8/02/1992 3:06	0	0.5	0.5	0.5
8/02/1992 3:12	0	0	0	0
8/02/1992 3:18	0	0	0	0
8/02/1992 3:24	0	0	0	0
8/02/1992 3:30	0	0.5	0	0.5
8/02/1992 3:36	0.5	0	0.5	0
8/02/1992 3:42	0	0	0	0
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8/02/1992 3:54	0	0	0	0
8/02/1992 4:00	0	0.5	0.5	0
8/02/1992 4:06	0	0.5	0	0.5
8/02/1992 4:12	0	0.5	0	0
8/02/1992 4:18	0	0	0.5	0
8/02/1992 4:24	0.5	0	0	0.5
8/02/1992 4:30	0	0.5	0	0
8/02/1992 4:36	0	0	0.5	0
8/02/1992 4:42	0	0	0	0.5
8/02/1992 4:48	0.5	0.5	0.5	0
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8/02/1992 7:00	0.5	0	0	0.5
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8/02/1992 7:24	0	0.5	0.5	0
8/02/1992 7:30	0.5	0	0	0.5
8/02/1992 7:36	0.5	0	0	0
8/02/1992 7:42	0.5	0	0.5	0.5
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8/02/1992 8:06	1	0.5	0	0.5
8/02/1992 8:12	1	0	0.5	0
8/02/1992 8:18	1	0.5	0.5	0.5
8/02/1992 8:24	1	0.5	0.5	0.5
8/02/1992 8:30	0.5	0.5	0.5	0
8/02/1992 8:36	0.5	0.5	0.5	0.5
8/02/1992 8:42	0.5	0.5	0.5	0.5
8/02/1992 8:48	0.5	0.5	0.5	0.5
8/02/1992 8:54	0.5	0.5	0.5	0.5
8/02/1992 9:00	0.5	0	0.5	0
8/02/1992 9:06	0	0	0	0.5
8/02/1992 9:12	0.5	0.5	0.5	0.5
8/02/1992 9:18	0	0.5	0	0.5
8/02/1992 9:24	0.5	0.5	0.5	0
8/02/1992 9:30	1	0	0.5	0.5
8/02/1992 9:36	0	0.5	0.5	0.5
8/02/1992 9:42	0	0	0	0.5
8/02/1992 9:48	0	0.5	0.5	0.5
8/02/1992 9:54	0.5	0.5	0.5	0.5
8/02/1992 10:00	0.5	0	0.5	0.5
8/02/1992 10:06	0	0	0	0.5
8/02/1992 10:12	0.5	0	0	0.5
8/02/1992 10:18	0	0	0	0.5
8/02/1992 10:24	0.5	0.5	0.5	0
8/02/1992 10:30	0	0	0	0
8/02/1992 10:36	0	0.5	0.5	0
8/02/1992 10:42	0	0.5	0.5	0.5
8/02/1992 10:48	0.5	0.5	0.5	0.5
8/02/1992 10:54	0.5	0.5	0.5	0.5
8/02/1992 11:00	0.5	0.5	0.5	0.5
8/02/1992 11:06	0.5	0.5	0.5	0.5
8/02/1992 11:12	1	0	0.5	0.5
8/02/1992 11:18	0.5	0.5	0.5	0.5
8/02/1992 11:24	0.5	0.5	0.5	0.5
8/02/1992 11:30	0.5	0	0.5	0.5
8/02/1992 11:36	0	0.5	0.5	0.5
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8/02/1992 11:54	0	0.5	0.5	0.5
8/02/1992 12:00	0	0	0	0.5
8/02/1992 12:06	0.5	0.5	0	0.5
8/02/1992 12:12	0	0	0.5	0
8/02/1992 12:18	0	0	0	0
8/02/1992 12:24	0	0	0	0
8/02/1992 12:30	0	0	0	0
8/02/1992 12:36	0.5	0.5	0.5	0.5
8/02/1992 12:42	0	0	0.5	0.5
8/02/1992 12:48	0	0	0	0
8/02/1992 12:54	0	0	0	0
8/02/1992 13:00	0	0	0	0.5
8/02/1992 13:06	0	0	0	0.5
8/02/1992 13:12	0	0	0.5	0.5
8/02/1992 13:18	0.5	0.5	0	0
8/02/1992 13:24	0	0	0	0.5
8/02/1992 13:30	0.5	0	0	0.5
8/02/1992 13:36	0	0	0.5	0.5
8/02/1992 13:42	0	0.5	0.5	0.5
8/02/1992 13:48	0.5	1.5	0.5	0.5
8/02/1992 13:54	1	0.5	1	0.5
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8/02/1992 14:18	0.5	0.5	0.5	0.5
8/02/1992 14:24	0.5	0.5	0	0.5
8/02/1992 14:30	0.5	0.5	0.5	0.5
8/02/1992 14:36	0	0.5	0	0.5
8/02/1992 14:42	0.5	1	0.5	0.5
8/02/1992 14:48	0	1	0	0.5
8/02/1992 14:54	0.5	0.5	0.5	0.5
8/02/1992 15:00	0.5	0.5	0.5	0.5
8/02/1992 15:06	1	0.5	1.5	0.5

















APPENDIX D

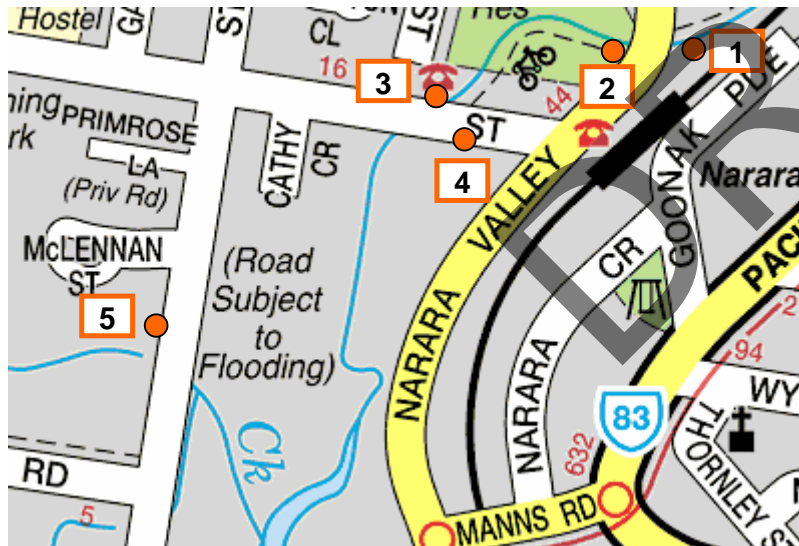
# Water Level Data

# Survey Brief

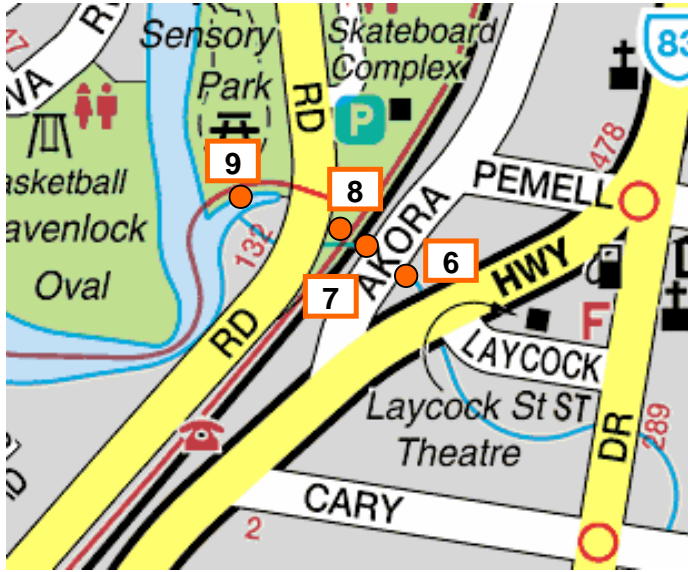
## June 2007 Flood Marks

For each flood mark we require  
(x, y, z) co-ordinates for GIS

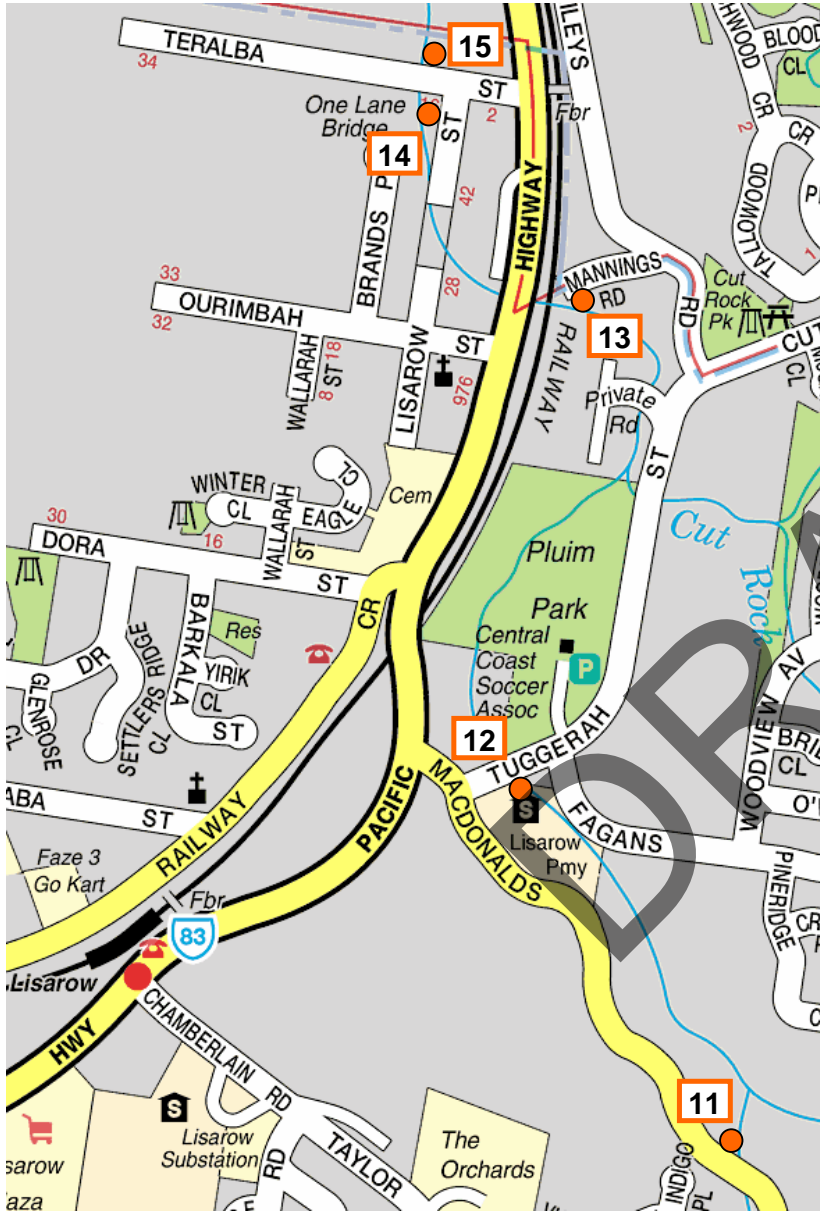
AHD Level (10mm accuracy)  
MGA Co-ordinates (1m accuracy)





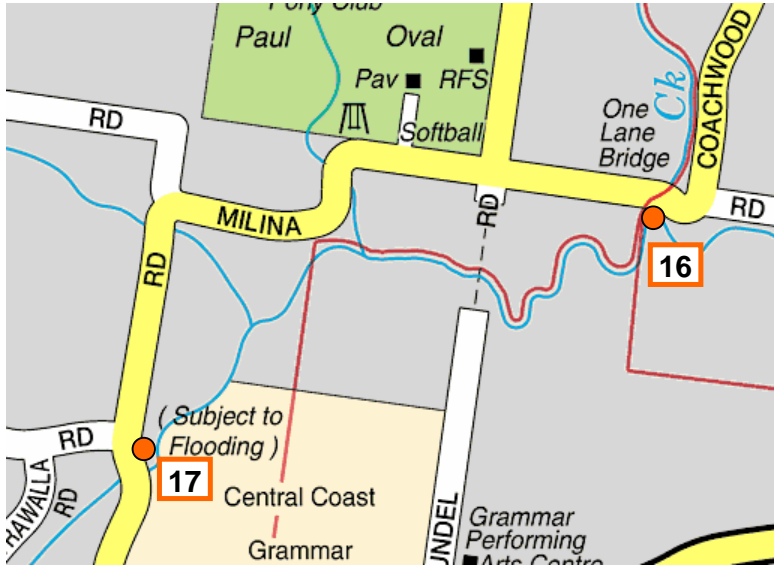


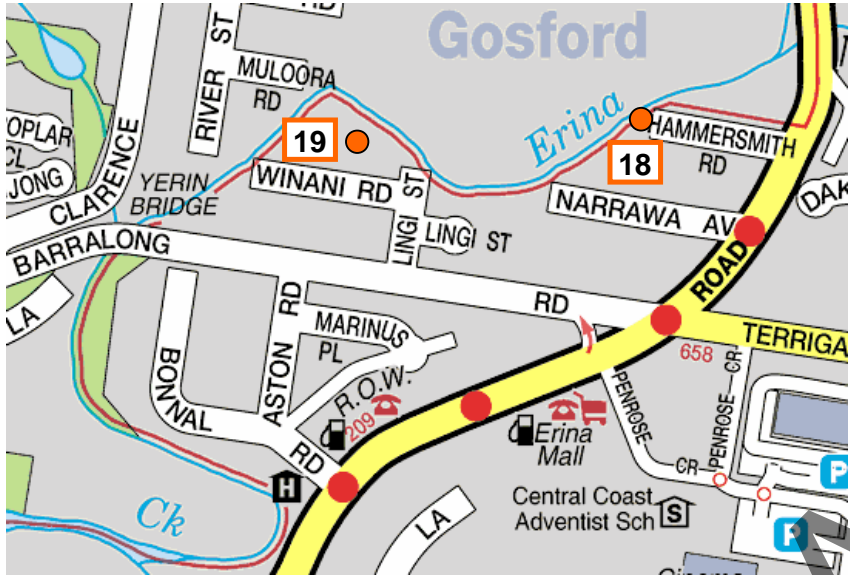


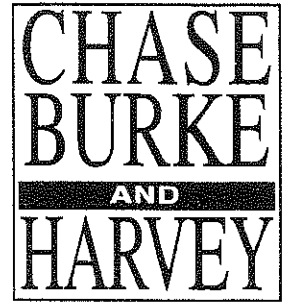












SURVEYING & LAND DEVELOPMENT  
CONSULTANTS

Our Ref: 2007093/1  
Date: 26/7/07

The City Manager  
Gosford City Council  
P.O. Box 21  
GOSFORD NSW 2250  
**Attn: Mr. Peter Sheath, Flood Engineer**

**Subject: LOCATION/LEVEL OF IDENTIFIED FLOOD HEIGHTS FOR NARARA  
CREEK AND TRIBUTARIES, AND ERINA CREEK AND TRIBUTARIES**  
**Reference: Your instruction by email dated 4/07/2007**

Dear Sir

As instructed by you, the twenty locations identified in your instruction brief have been surveyed for position and level.

All marks were located and levelled by Total Station Theodolite and on-board Data Collector. All positions determined are on "Map Grid of Australia" (MGA) coordinates: all levels are on "Australian Height Datum" (AHD). Origin of position and levels for all surveys were State Permanent Marks in the immediate vicinity of each location. Coordinates and levels for these marks were obtained from searches of the SCIMS Lands' Department website.

Attached to this report, please find coordinate listing and level of the twenty surveyed points.

Address all queries with regard to the subject matter to the undersigned.

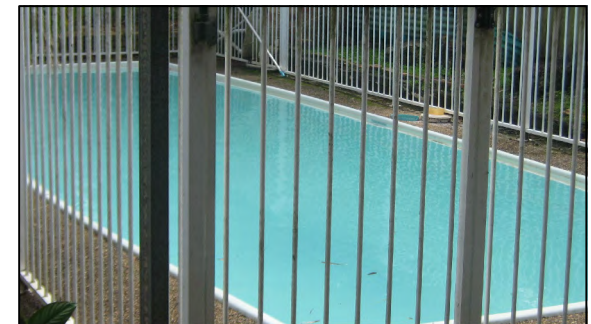
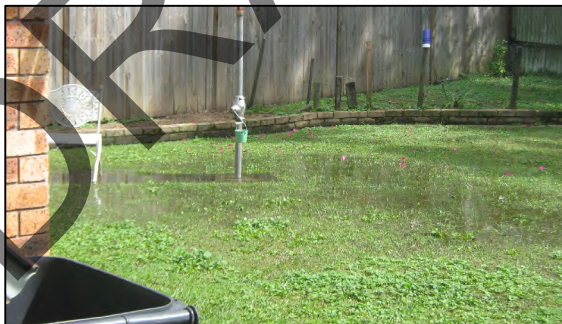
Yours faithfully

IAN L HARVEY B.SURV. (U.N.S.W.) M.I.S. AUST.  
Registered Surveyor  
CHASE BURKE & HARVEY  
Surveying & Land Development Consultants

**JUNE 2007 FLOOD LEVELS**  
**WYOMING, LISAROW, NIAGARA PARK AND ERINA**  
**CBH REFERENCE: 2007093**  
**DATE: 17/07/2007**

<b>CBH SURVEY POINT NUMBER</b>	<b>EASTING</b>	<b>NORTHING</b>	<b>AHD RL</b>	<b>FLOOD LEVEL MARK</b>
21	346098.829	6303843.779	8.510	MARK-1
22	346041.396	6303825.248	8.373	MARK-2
23	345846.981	6303771.504	7.609	MARK-3
24	345928.066	6303738.771	7.233	MARK-4
25	345581.354	6303530.062	6.283	MARK-5
26	346388.393	6302112.270	2.995	MARK-6
27	346374.423	6302131.499	2.492	MARK-7
28	346328.094	6302145.685	2.876	MARK-8
29	346264.270	6302178.824	2.924	MARK-9
30	347131.606	6305153.889	15.678	MARK-10
31	349235.753	6304822.397	26.462	MARK-11
32	348879.171	6305367.499	23.776	MARK-12
33	348984.254	6306044.679	21.878	MARK-13
34	348775.784	6306372.640	20.748	MARK-14
35	348784.259	6306400.466	20.677	MARK-15
36	351446.450	6300905.987	6.559	MARK-16
37	350768.412	6300597.510	4.296	MARK-17
38	350276.053	6299709.285	2.203	MARK-18
39	349906.194	6299684.952	1.906	MARK-19
40	350583.315	6300082.633	3.287	MARK-20

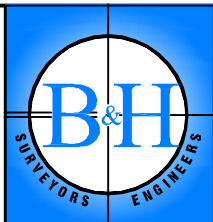
Name		Easting	Northing	RL	REMARKS
Mears	140 manns Rd	345 380.590	6301 960.229	2.07	Shed Floor
	Narara 2250	345 380.58	6301 960.2	2.32	Water Floor (Flood)
		345 376.565	6301 959.534	2.11	N/S Yard
Bigarrelli	9 Koninderie Pde	346 165.173	6303 950.383	8.92	Entry Door
	Narara 2250	346 168.615	6303 953.336	8.81	Garage Floor Level
		346 160.964	6303 955.071	8.90	Back Door
		346 171.440	6303 942.566	8.65	Front Yard N/S
		346 153.569	6303 962.657	8.84	Back Yard N/S
Russell	44 Fountains Rd	345 160.482	6303 528.033	7.40	Floor Level N/S
	Narara 2250	345 162.170	6303 550.353	6.26	Bridge Deck
		345 146.526	6303 539.659	6.65	Yard N/S
Wills	23 Koninderie Pde	346 306.890	6304 069.255	9.16	Patio (Near Front Door)
	Narara 2250				
Abroboard Pty Ltd	18 Tatura Ave	345 803.435	6301 954.642	3.41	Flood Level Driveway
	Nth Gosford 2250	345 804.79	6301 954.018	3.48	Floor Level (Office)
		345 804.244	6301 953.916	3.54	Floor Level (Garage)
		345 781.316	6301 958.244	2.37	Top of Kerb
Jokinen	56 Fountains Rd	345 027.898	6 303 580.097	7.40	Woodshed Floor Level
	Narara 2250			7.88	Stake
		345 034.265	6 303 589.456	6.71	Bridge Deck
		345 031.79	6 303 588.131	5.26	Creek Bed
Woodhead	16 Hanlan St Sth	345 551.169	6 303 157.93	4.69	Floor Level in stable
	Narara 2250				100mm above floor
Cranidge	92 reeves St	344 752.084	6 302 977.91	7.32	Floor Level Driveway
	Narara 2250	344 740.744	6 302 924.913	6.50	Creek bed
		344 738.982	6 302 930.718	8.82	Bridge
		344 741.361	6 302 919.150	8.86	Bridge
		344 738.589	6 302 918.58	8.87	Bridge
		344 736.197	6 302 930.217	8.64	Bridge
		344 756.85	6 302 941.033	7.59	Yard
Meao	12 North Cres	346 981.894	6 301 433.97	19.91	patio front door
	North Gosford 2250	346 994.07	6 301 443.24	21.04	Surface Inlet at Pit
Bean	88 Carrington Street	344 932.92	6 303 148.47	7.60	on road Carrington St
	Narara 2250				
Grat	100 Reeves St	344676.56	6 302 880.59	9.28	Top of Armco Railing
	Narara 2250	344 687.67	6 302 879.11	8.80	northern side of road
		344 696.04	6 302 878.1	9.28	Flood level 800mm
		344 710.07	6 302 875.59	9.38	above armco railing
		344 716.171	6 302 874.88	9.43	
		344 722.47	6 302 874.14	9.62	
Surveyed Flood Levels - Bannister and Hunter, 2010.					



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Tel: 0243242566 Fax: 0243232495

Ref.No: 57107	Date: 10th May 2010
Dwg. No: 57107BIGARELLI	Scale:

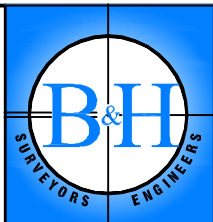
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 Tel: 0243242566 Fax: 0243232495

NARARA CREEK FLOOD STUDY SURVEY

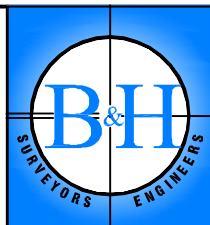
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Tel: 0243242566 Fax: 0243232495

Ref.No: 57107 Date: 10th May 2010

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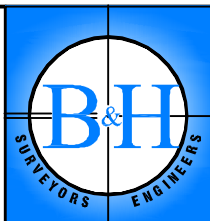
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NARARA CREEK FLOOD STUDY SURVEY

Ref.No: 57107 Date: 10th May 2010

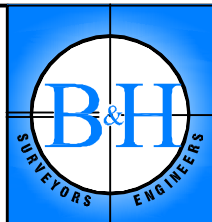
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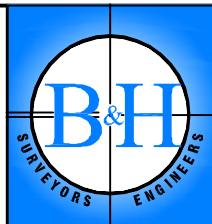
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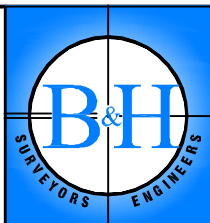
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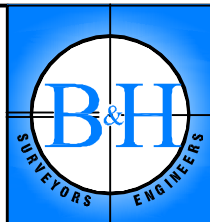
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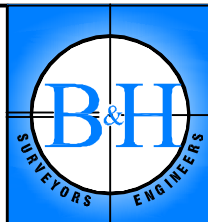
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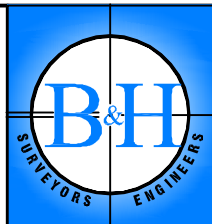
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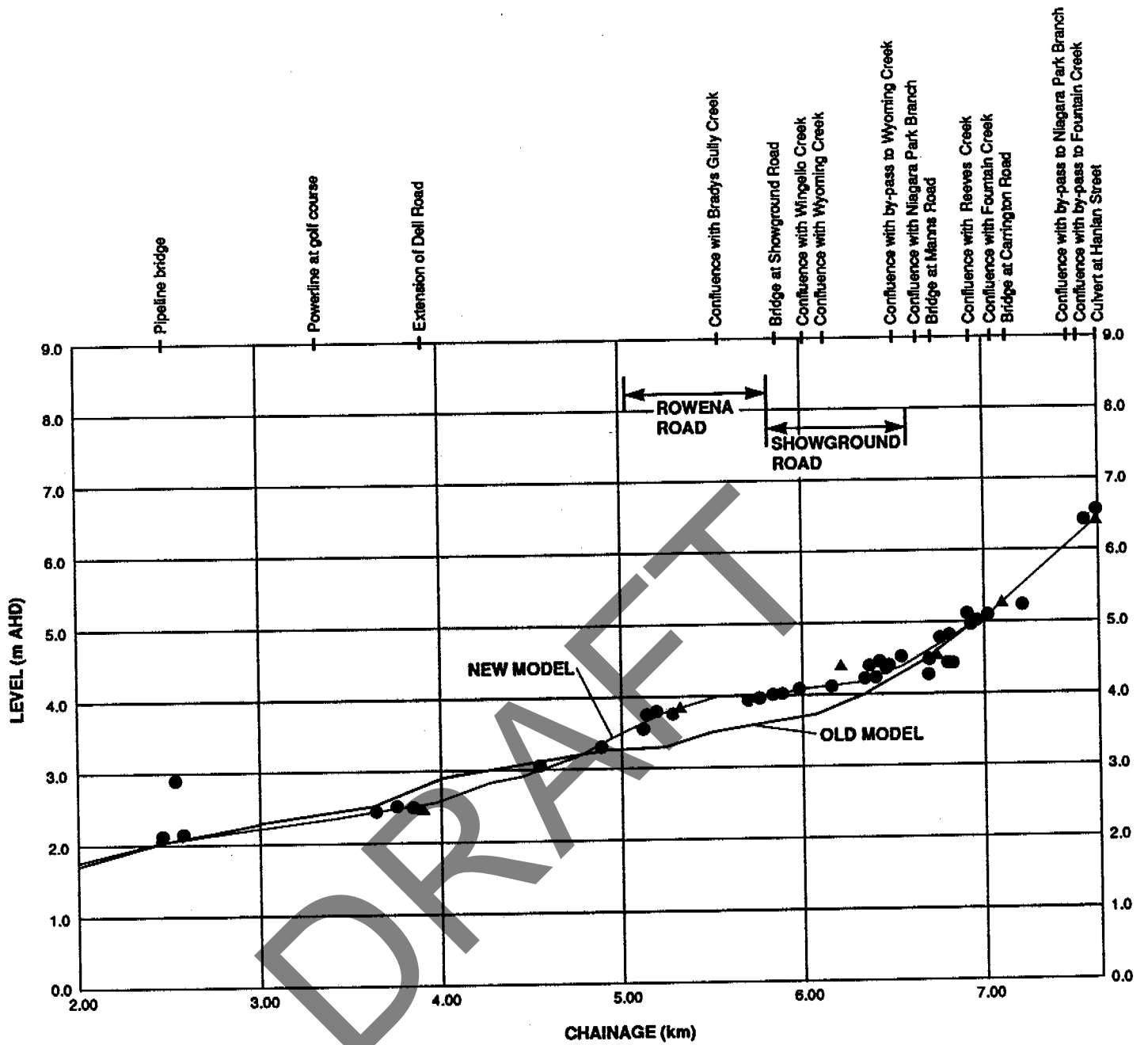
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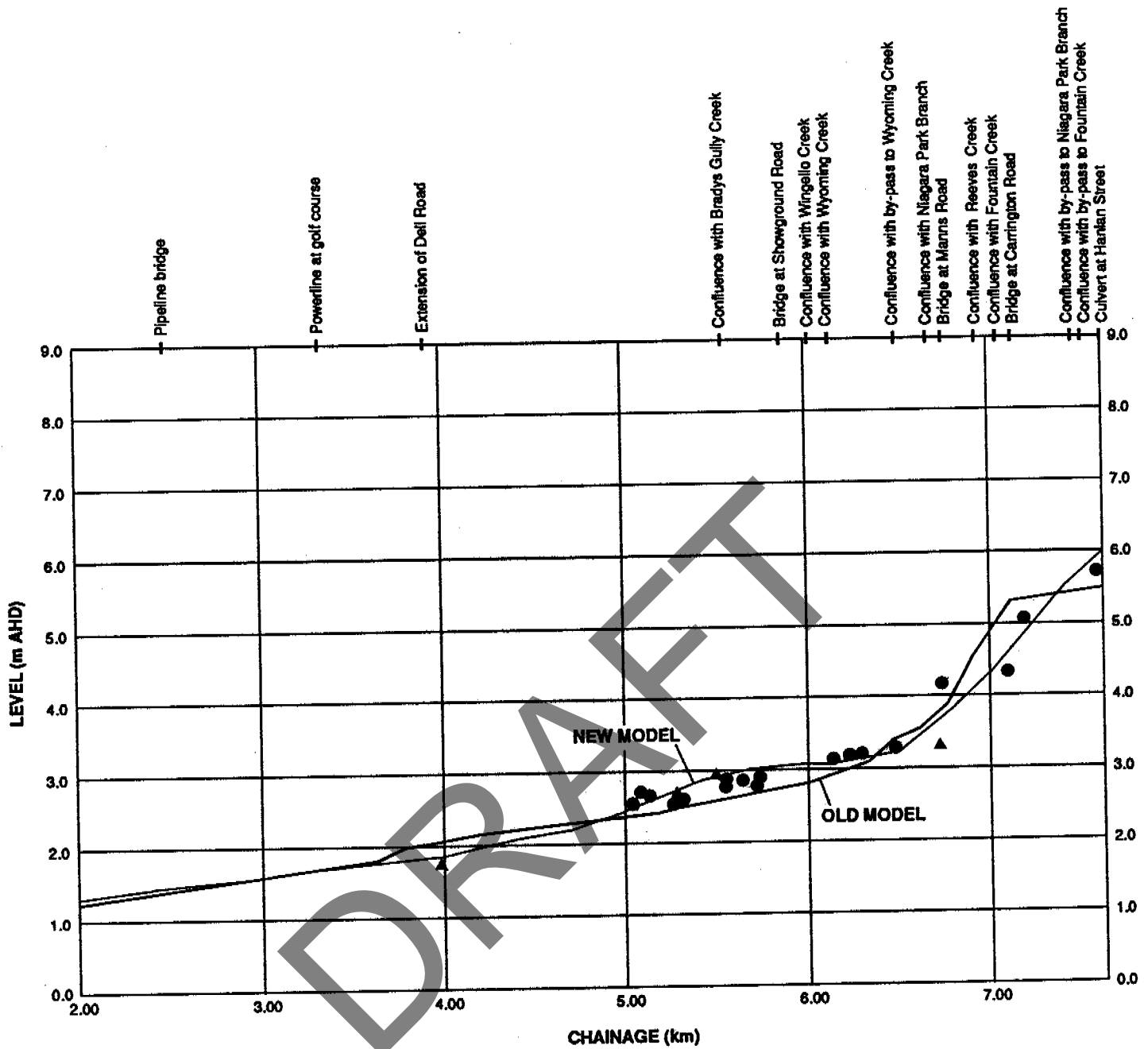




**LEGEND**

- Flood level measured by Gosford City Council
- ▲ PWD maximum height indicator

**FIGURE 22  
FEBRUARY 1992 RECORDED AND  
MODELLED FLOOD LEVELS IN  
NARARA CREEK**



**FIGURE 2.3**  
**FEBRUARY 1990 RECORDED AND**  
**MODELLED FLOOD LEVELS IN**  
**NARARA CREEK**

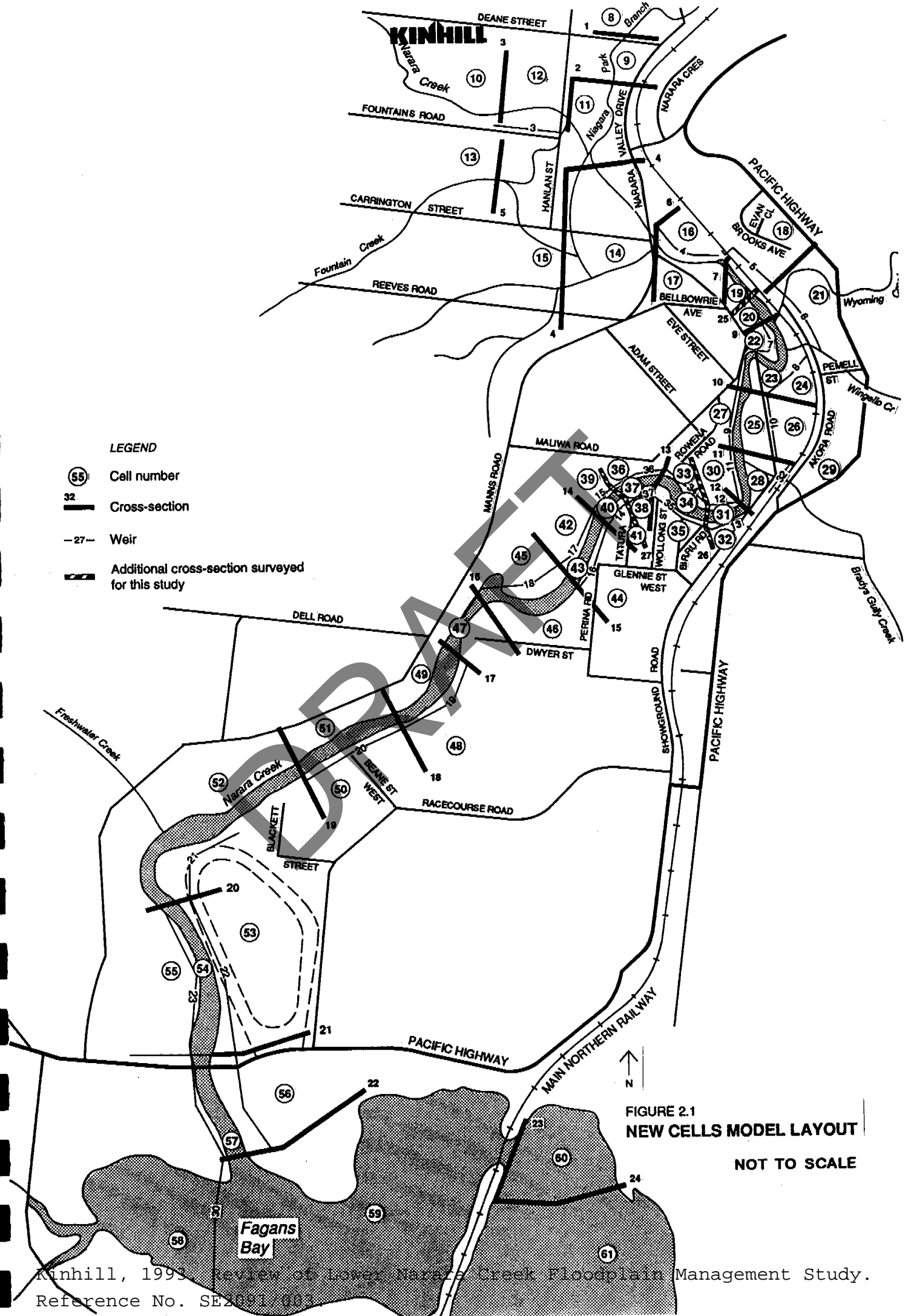


Table 4.3 Flood level records (Bradys Gully Creek)

Approximate Chainage	Location	Level (m) AHD	Source	Remarks
75	10 Laycock Street	4.67	Mr D McNaughton, Resident	
200	24 Laycock Street	5.76	Resident	
280	287 Henry Parry Drive	6.12	Mr Miller, Resident	
310	285 Henry Parry Drive	6.31	Resident	
400	Our Lady of Rosary School (downstream)	6.43	School Teacher	
220	Henry Parry Drive culvert (downstream)	6.07	Gosford Council	
240	Henry Parry Drive culvert (upstream)	6.26	Gosford Council	
280	Upstream of Henry Parry Drive	6.37	Gosford Council	
375	Cary Street culvert (downstream)	6.42	Gosford Council	
394	Cary Street culvert (upstream)	6.77	Gosford Council	
521	Our Lady of Rosary School (upstream)	7.87	Gosford Council	
551	Glennie Street footbridge	7.86	Gosford Council	
694	Jarrett Street	8.01	Gosford Council	
870	Bradys Gully Road culvert (downstream)	9.92	Gosford Council	
900	Bradys Gully Road culvert (upstream)	10.07	Gosford Council	
0	Pacific Hwy culvert (downstream)	3.28	Debris Mark from Lower Narara Creek Report	

Table 4.2 Flood level records (Wingello Creek)

Approximate Chainage	Location	Level (m) AHD	Source	Remarks
120	Reptile Park	5.31	Office personnel of Reptile Park	
275	1 Adnamira Road	5.87	Resident	
425	50 Halcyon Street	7.04	Mr T Horan, Resident	
718	39 Roseland Avenue	7.61	Mrs D Riley, Resident	
1038	18 Fuchia Street	8.41	Resident	
1380	11 Warrawilla Road	9.89	Mrs S James, Resident	
263	Downstream of Jarrett Street Culvert	5.51	Gosford Council	
280	Upstream of Jarrett Street Culvert	6.05	Gosford Council	
450	Maiden Brush Public School	6.77	Gosford Council	
593	Near Lot 68, Veronica Cres	7.34	Gosford Council	
660	Near Lot 27, Roseland Ave	7.35	Gosford Council	
778	Near Lot 23, Roseland Ave	7.27	Gosford Council	
870	Near Lot 91, Dalton Street	7.86	Gosford Council	
970	Near Lot 95, Fushia Street	7.80	Gosford Council	
1051	Near Lot 93, Dalton Street	8.25	Gosford Council	
1215	Near Lot 101 Dalton Street	9.16	Gosford Council	
1280	Near Lot 105 Dalton Street	9.30	Gosford Council	
1380	Downstream of Warrawilla Road culvert	9.715	Gosford Council	
1392	Upstream of Warrawilla Road culvert	10.325	Gosford Council	
275	Upstream of Jarrett Street culvert	5.889	PWD's peak height recorder	M11021
60	Wyoming Baby Health Centre	4.83	Debris Mark	From Lower Narara Creek Report
-50.0	Willows Motel	4.24	Debris Mark	From Lower Narara Creek Report

## 4 7 FEBRUARY 1990 EVENT

*Table 4.1* Flood level records (Wyoming Creek)

Approximate chainage	Location	Level (m) AHD	Source	Remarks
0	Pacific Highway Culvert (Downstream)	3.74	PWD's height recorder	M11023
60	Dental Clinic	4.45	Dr Moran	Working place
700	8 Renwick Street 48 Day Street	11.14	Resident	Level too high, doubtful
797	58 Day Street	8.56	Resident	
810	62 Bourbon Street	8.85	Mrs E Green	Resident
885	73 Day Street	9.77	Mr J Ikin	Resident
1160	36 Chamberlain Road	11.60	Mr Bassett	Resident
1435	1 Giselle Avenue	13.15	Mrs R George	Resident
168	Lot 14	5.16	Gosford Council	
223	Glencoe Avenue	5.215	Gosford Council	
280	Public Reserve	5.45	Gosford Council	
410	Alan Davidson Park	5.765	Gosford Council	
486	Alan Davidson Park	6.12	Gosford Council	
618	Alan Davidson Park	6.65	Gosford Council	
700	Alan Davidson Park	7.175	Gosford Council	
799	58 Day Street	8.9	Gosford Council	
867	Day Street culvert (Downstream)	9.575	Gosford Council	
830	Lot 6 Day Street	9.11	Gosford Council	
885	Day Street culvert (Upstream)	9.63	Gosford Council	
867	Day Street culvert (Downstream)	8.55	PWD's height recorder	M11024 (level too low, doubtful)

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### NOTES

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- 3 FLOOD CONTOURS DENOTE APPROXIMATE WIDTH OF FLOODING ONLY. FLOOD LIABILITY SHOULD BE VERIFIED BY ON-GROUND SURVEY.
- 4 FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
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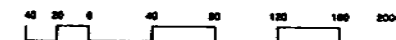
### LEGEND

- 1% AEP flood extent
- CS 520 Flood contour at survey cross section
- 6.6 Flood contour interpolated between cross sections
- House floor levels

212A	212B	213A
212C	212D	213B
228A	228B	228C
228C	228D	229C

### KEY TO ADJOINING SHEETS

Central Mapping Authority Map Reference: **GOSFORD U2797 - 52**



### FLOODPLAIN MANAGEMENT PLAN OVERLAY

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 Consulting Surveyors - JTS RYAN FIRTH & CO

## FLOODPLAIN MANAGEMENT STUDY FOR WYOMING, WINGELLO AND BRADYS GULLY CREEKS

FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR BRADYS GULLY CREEK

SHEET 1 of 2

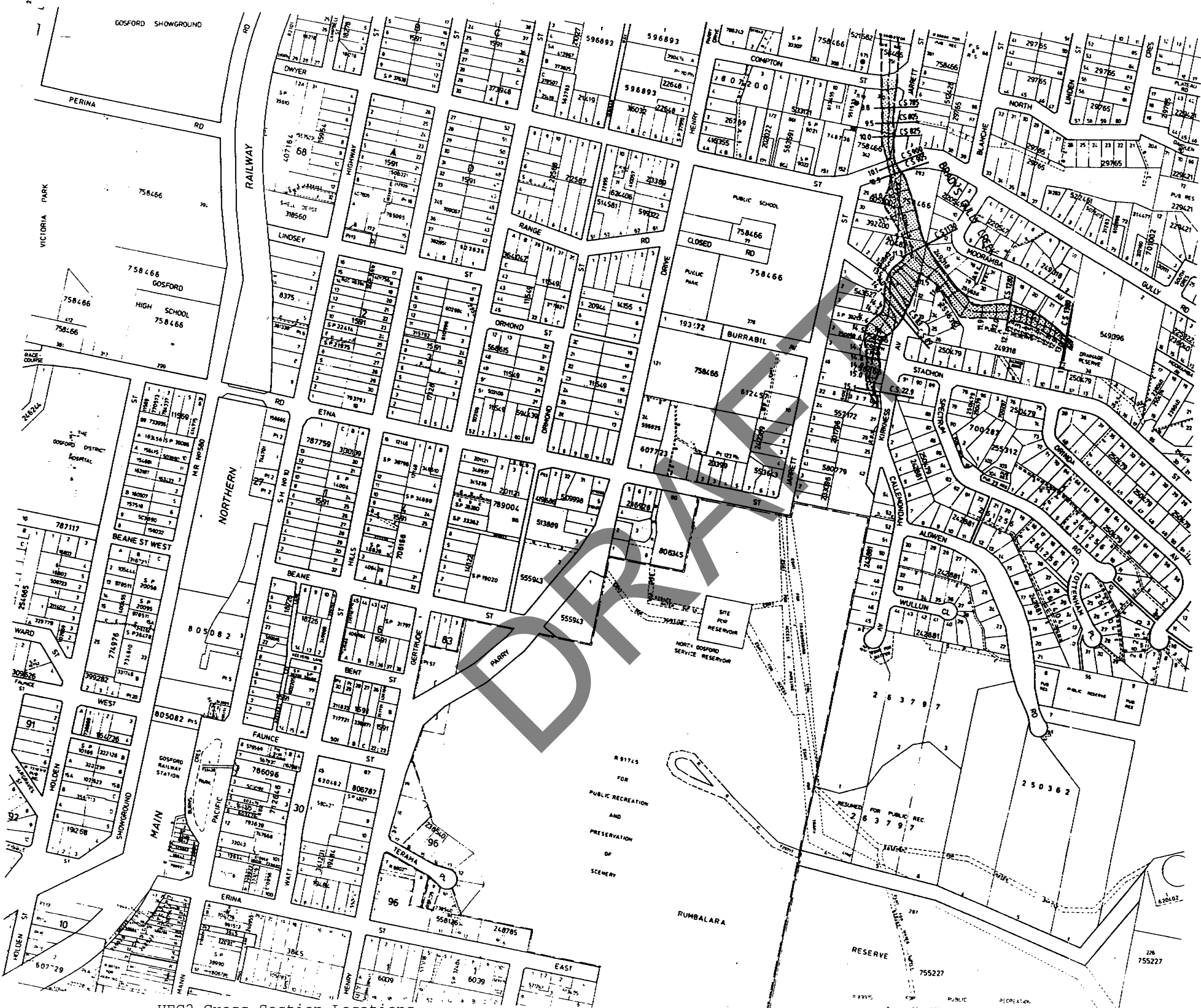
Figure BG3

GOSFORD CITY COUNCIL DRAWING NUMBER 4/118/A1

HEC2 Cross-Section Locations

Kinmill, 1993. Floodplain Management Plan for Bradys Gully Creek. Reference No. S90052/005.

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- LEGEND**
- 1% AEP flood extent
  - CS 5.7 — Flood contour at survey cross section
  - 6.5 — Flood contour interpolated between cross sections
  - 6.8 — Flood contour interpolated between cross sections
  - 1.0 — House floor levels

212A	212B	213A
212C	212D	213C
228A	228B	229A
228C	228D	229C

**KEY TO ADJOINING SHEETS**  
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 Map Reference: **GOSFORD U2797 - 54**



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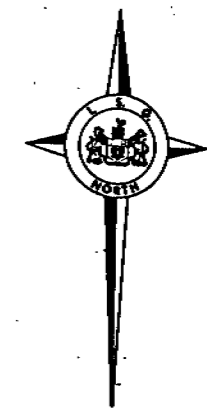
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FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR BRADYS GULLY CREEK

HEC2 Cross-Section Locations  
 Kinhill, 1993. Floodplain Management Plan for Bradys Gully Creek. Reference No. S90052/005.



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- LEGEND**
- 1% AEP flood extent
  - CS 520 Flood contour at survey cross section
  - 6.6 Flood contour interpolated between cross sections
  - House floor levels

212A	212B	213A
212C	212D	213C
228A	228B	229A
228C	228D	229C

KEY TO ADJOINING SHEETS  
 Central Mapping Authority  
 Map Reference: **GOSFORD U2797 - 52**

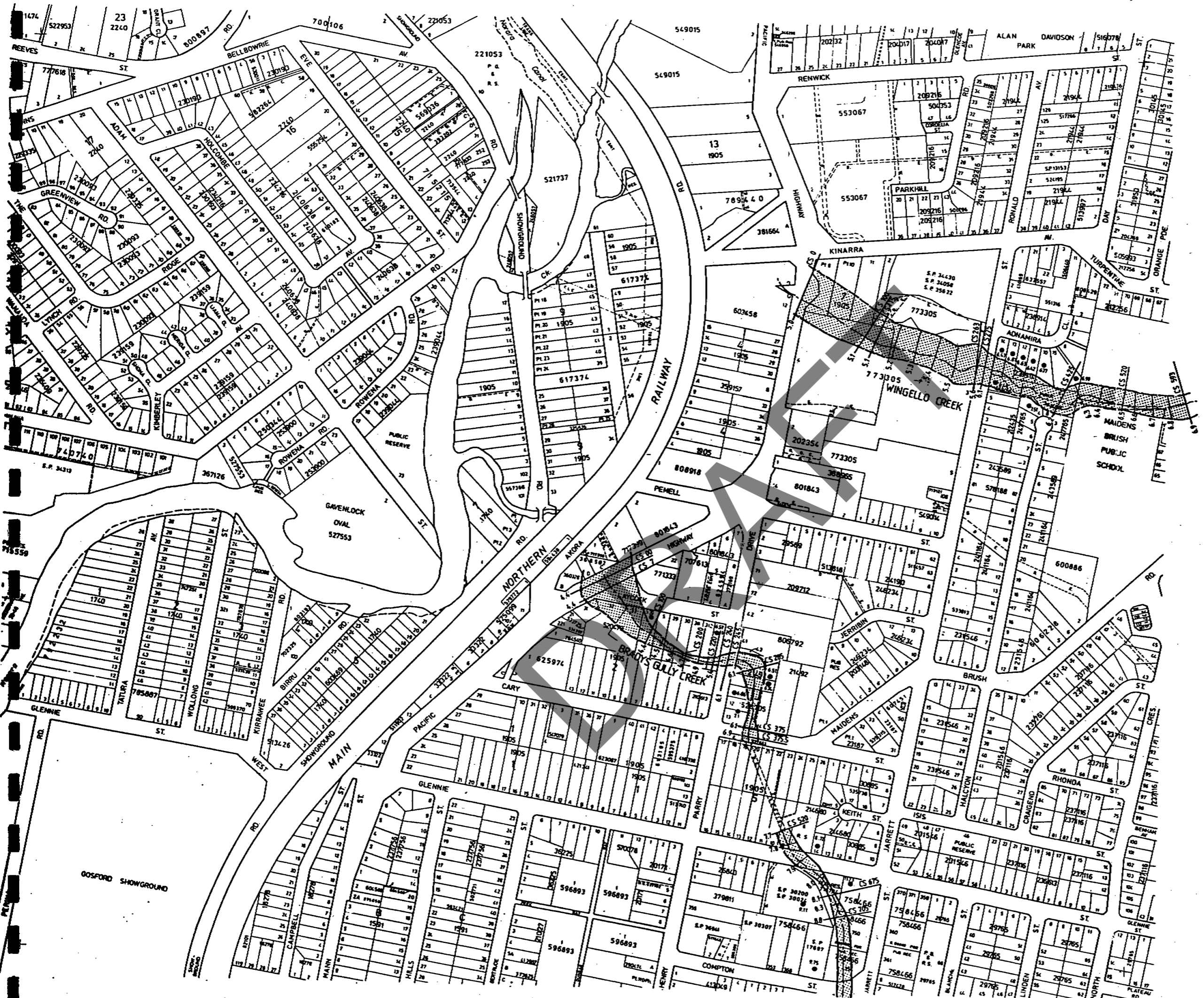


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## FLOODPLAIN MANAGEMENT STUDY FOR WYOMING, WINGELLO AND BRADYS GULLY CREEKS

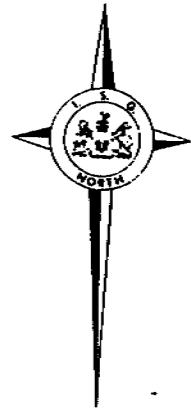
FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR WINGELLO CREEK

SHEET 1 of 2 Figure WG3  
 GOSFORD CITY COUNCIL DRAWING NUMBER 4/14/A1



HEC2 Cross-Section Locations  
 Kinhill, 1993. Floodplain Management Plan for Wingello Creek. Reference No. S90052/004.

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- LEGEND**
- 1% AEP flood extent
  - CS 520 Flood contour at survey cross section
  - Flood contour interpolated between cross sections
  - House floor levels

212A	212B	213A
212C	212D	213D
228A	228B	228C
228C	228D	229C

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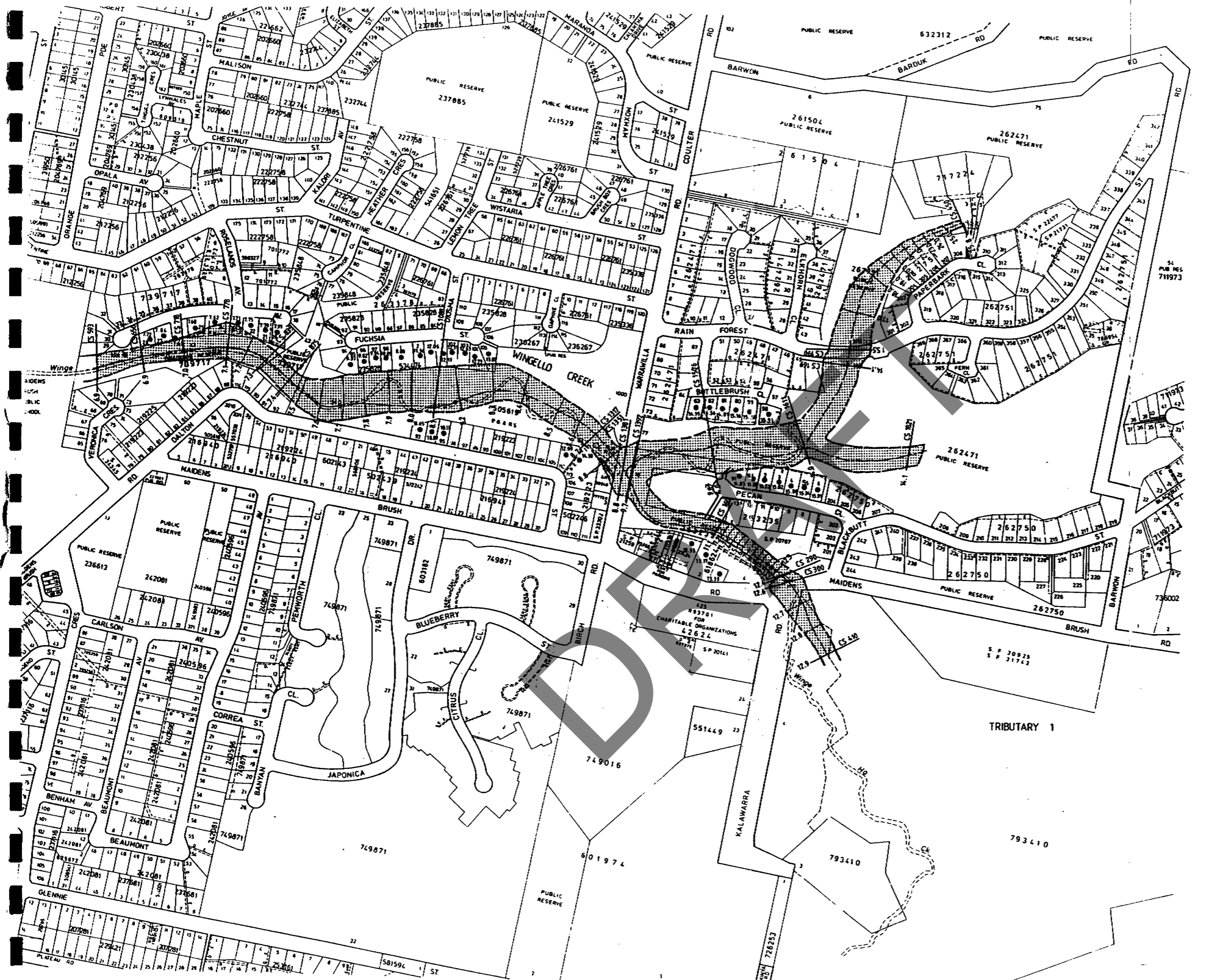


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## FLOODPLAIN MANAGEMENT STUDY FOR WYOMING, WINGELLO AND BRADYS GULLY CREEKS

FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR WINGELLO CREEK

SHEET 2 of 2 Figure WG3



HEC2 Cross-Section Locations  
 Kinhill, 1993. Floodplain Management Plan for Wingello Creek. Reference No. S90052/004.

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### LEGEND

- 1% AEP flood extent
- CS 520 Flood contour at survey cross section
- 6 Flood contour interpolated between cross sections
- ⊕ House floor levels

212A	212B	213A
212C	212D	213C
228A	228B	229A
228C	228D	229C

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## FLOODPLAIN MANAGEMENT STUDY FOR WYOMING, WINGELLO AND BRADYS GULLY CREEKS

FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR WYOMING CREEK

SHEET 1 of 2 Figure WY3

HEC2 Cross-Section Locations Kinhill, 1993. Floodplain Management Plan for Wyoming Creek. Reference No. S90052/003.

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**LEGEND**

- 1% AEP flood extent
- CS 50 Flood contour at survey cross section
- 6.6 Flood contour interpolated between cross sections
- ⊙ House floor levels

212A	212B	213A
212C		
228A		
228C		229C

KEY TO ADJOINING SHEETS  
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FLOOD CONTOURS AT COMPLETION OF PROPOSED WORKS FOR WYOMING CREEK

SHEET 2 of 2 Figure WY3

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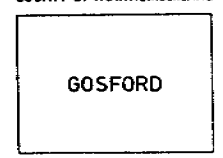


HEC2 Cross-Section Locations  
 Kinhill, 1993. Floodplain Management Plan for Wyoming Creek. Reference No. S90052/003.

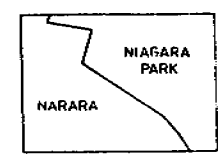
# GOSFORD CITY COUNCIL



COUNTY OF NORTHUMBERLAND



KEY TO PARISH

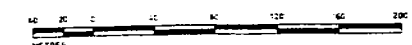


KEY TO LOCALITIES

195C	195D	196C
212A	212B	213A
212C	212D	213C

KEY TO ADJOINING SHEET

This map is not a true copy of the zoning provisions of the Gosford planning instruments. Reference should be made to the official maps deposited in the office of the Gosford City Council for accurate zoning information and later amendments.



CENTRAL MAPPING AUTHORITY  
MAP REFERENCE  
GOSFORD U2797-22



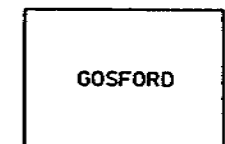
KONINDERIE PDE.  
No 23 Floor 9.39 Flood 9.57  
No 25 Floor 9.58 Flood 9.57  
No 17 Floor 9.48 Flood 9.48

Historical Flood Levels for February 1992 Event - Appendix E  
Kinhill, 1993. Upper Narara Creek Flood Study. Reference No. SE3035/001-RevC.

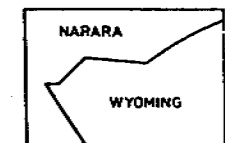
# GOSFORD CITY COUNCIL



COUNTY OF NORTHUMBERLAND



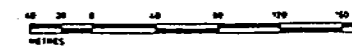
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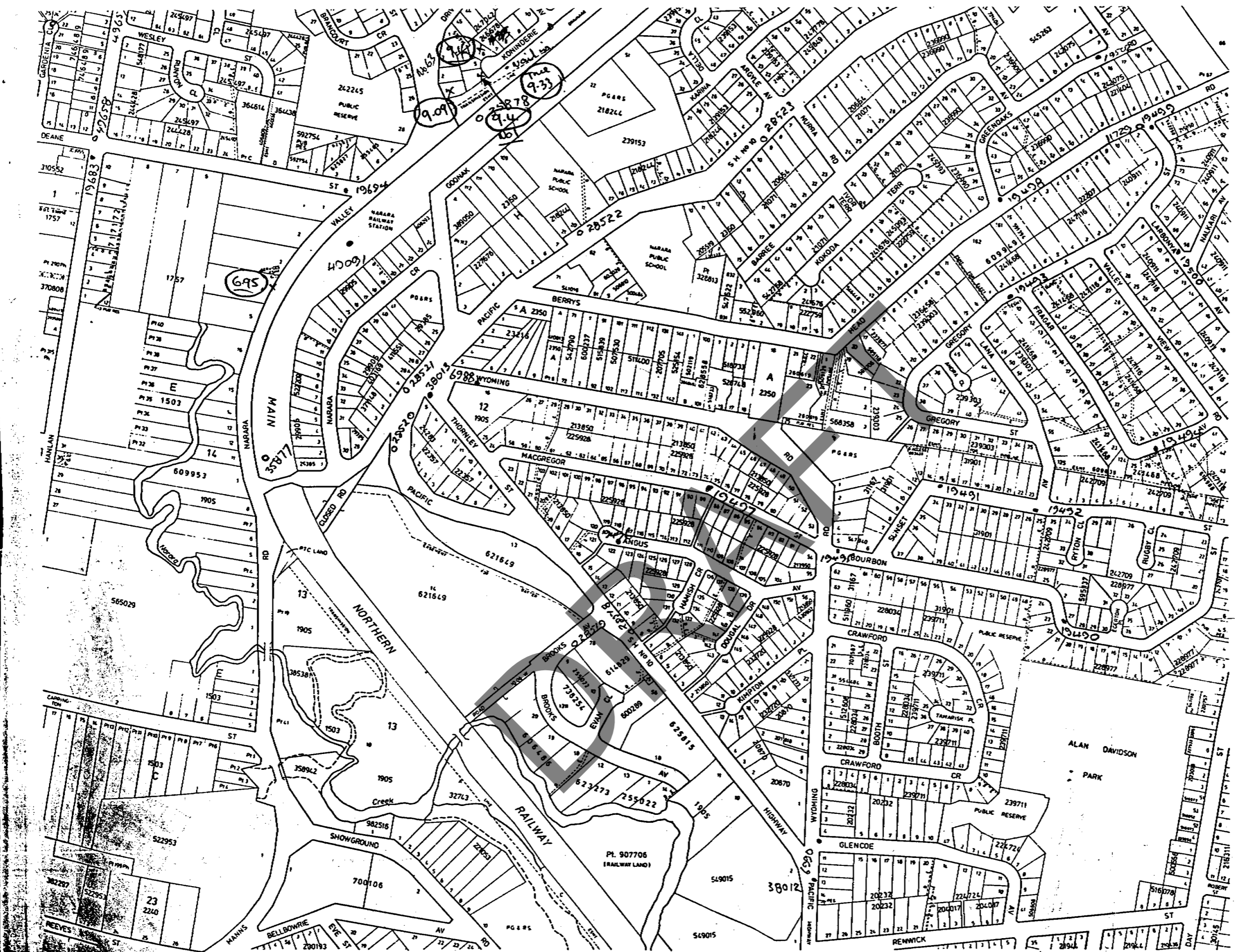
KEY TO LOCALITIES

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212C	212D	213C
228A	228B	229A

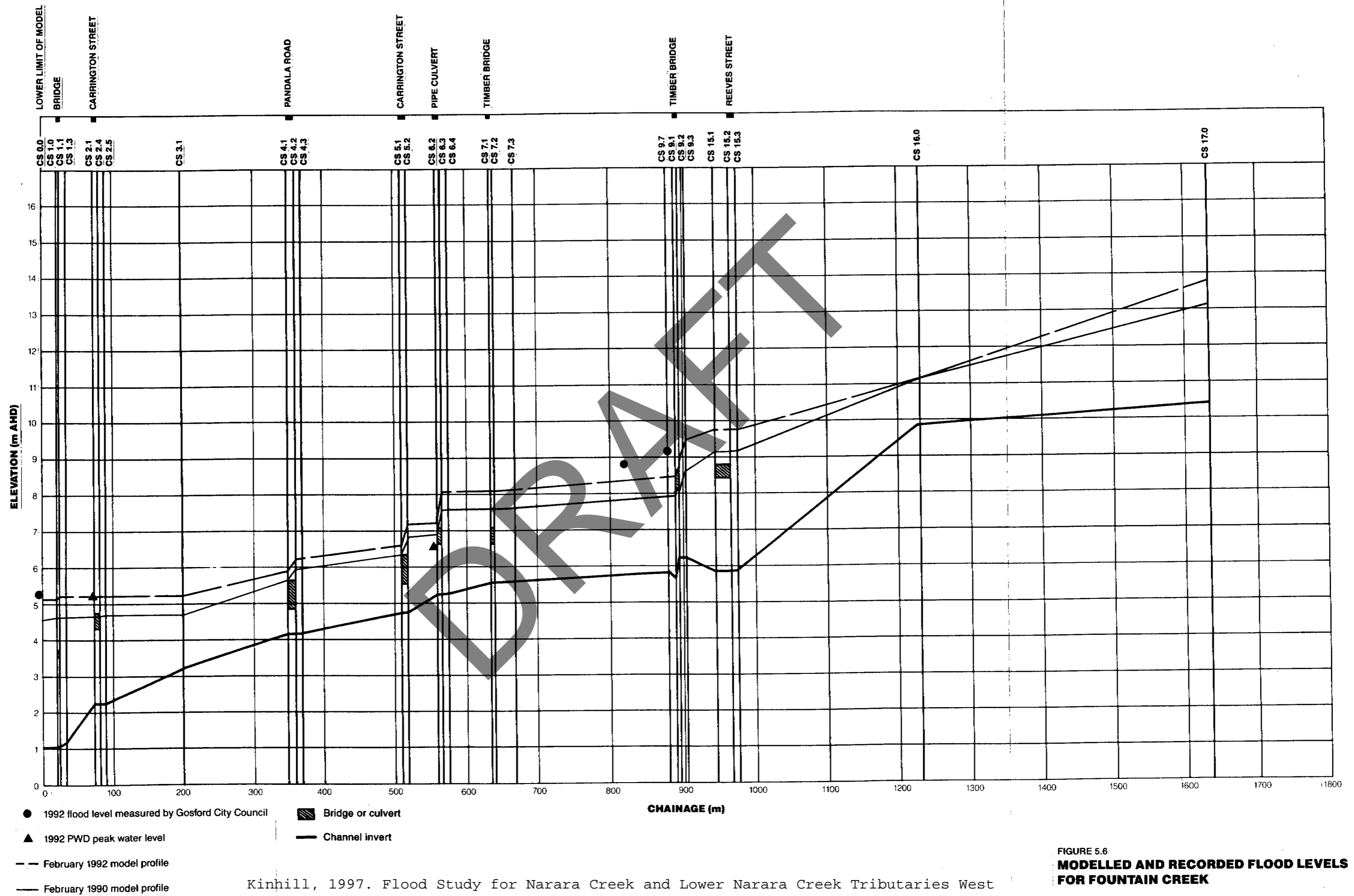
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CENTRAL MAPPING AUTHORITY  
MAP REFERENCE  
GOSFORD U2797-24

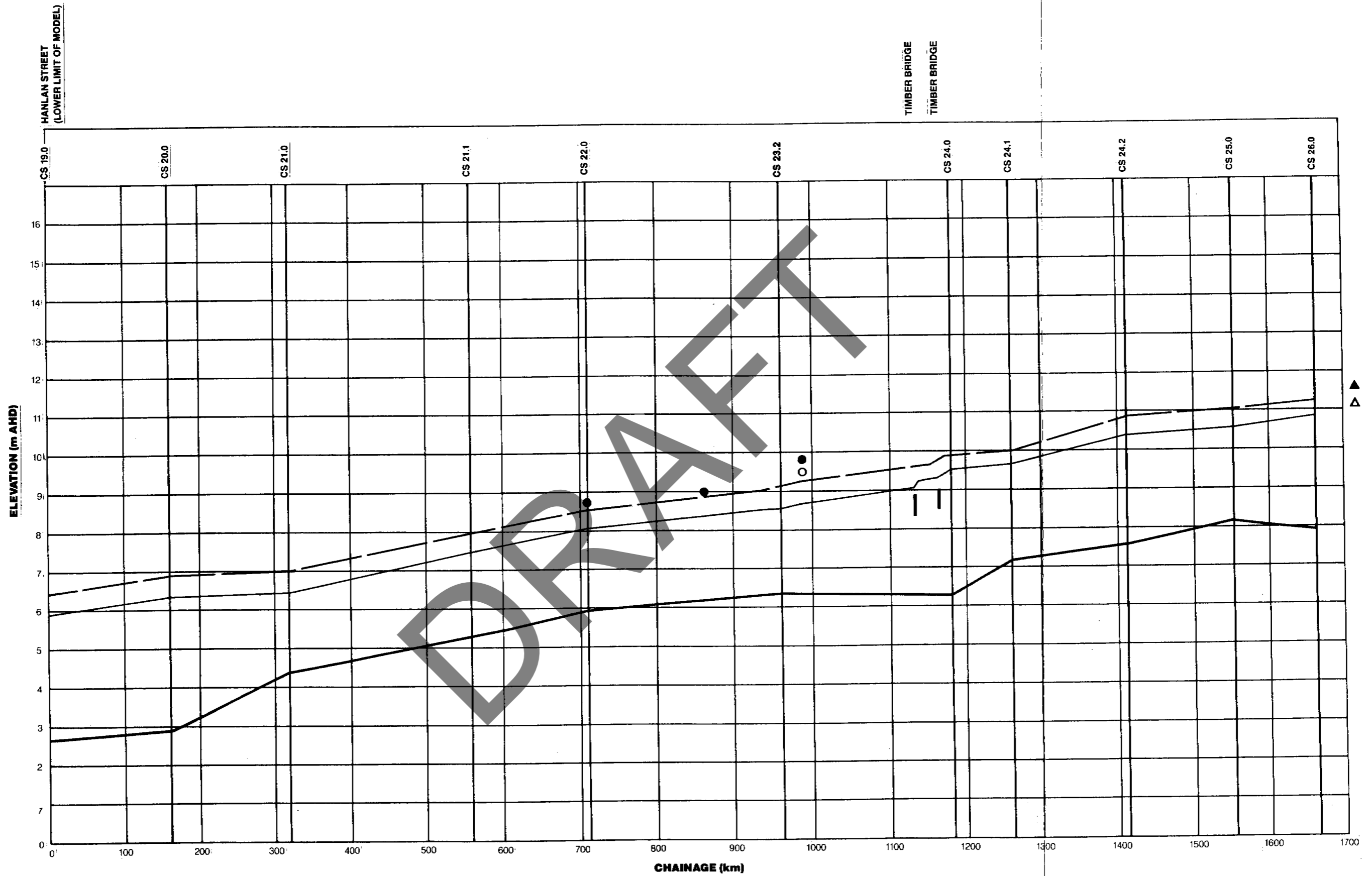


Historical Flood Levels for February 1992 Event - Appendix E  
Kinhill, 1993. Upper Narara Creek Flood Study. Reference No. SE3035/001-RevC.



Kinhill, 1997. Flood Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan Street. Reference No. SE1076-W-100 Rev2.

FIGURE 5.6  
**MODELLED AND RECORDED FLOOD LEVELS  
 FOR FOUNTAIN CREEK**



- 1992 flood level collected by Gosford City Council
- ▲ 1992 PWD peak flood level
- 1990 flood level collected by Gosford City Council
- ▲ 1990 PWD peak flood level
- February 1990 model profile
- - February 1992 model profile
- Channel invert

FIGURE 5.5  
**MODELLLED AND RECORDED FLOOD LEVELS  
 FOR NARARA CREEK**

Kinhill, 1997. Flood Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan Street. Reference No. SE1076-W-100 Rev2.



# GOSFORD CITY COUNCIL



**LEGEND**

- 1% AEP FLOOD EXTENT
- 1% AEP FLOOD CONTOUR
- EXISTING CREEK ALIGNMENT

**Note:**

1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS INDICATE APPROXIMATE WIDTHS OF FLOODING ONLY.
4. THE POSITION OF THE FLOOD EXTENT RELATIVE TO PROPERTY BOUNDARIES IS APPROXIMATE ONLY AND SHOULD BE VERIFIED BY SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HIGH WATER DATUM.
6. FLOOD EXTENTS UPSTREAM OF THE LINE SURPASSING THAT OF THE LOWER NARARA CREEK PRIME.

**Narara Creek & Lower Narara Creek Tributaries FLOODPLAIN MANAGEMENT STUDY**

**RECOMMENDED WORKS AND FLOOD CONTOURS**

FIGURE 6.4 SHEET 1 of 2

	195C	195D
211B	212A	212B
211D	212C	212D

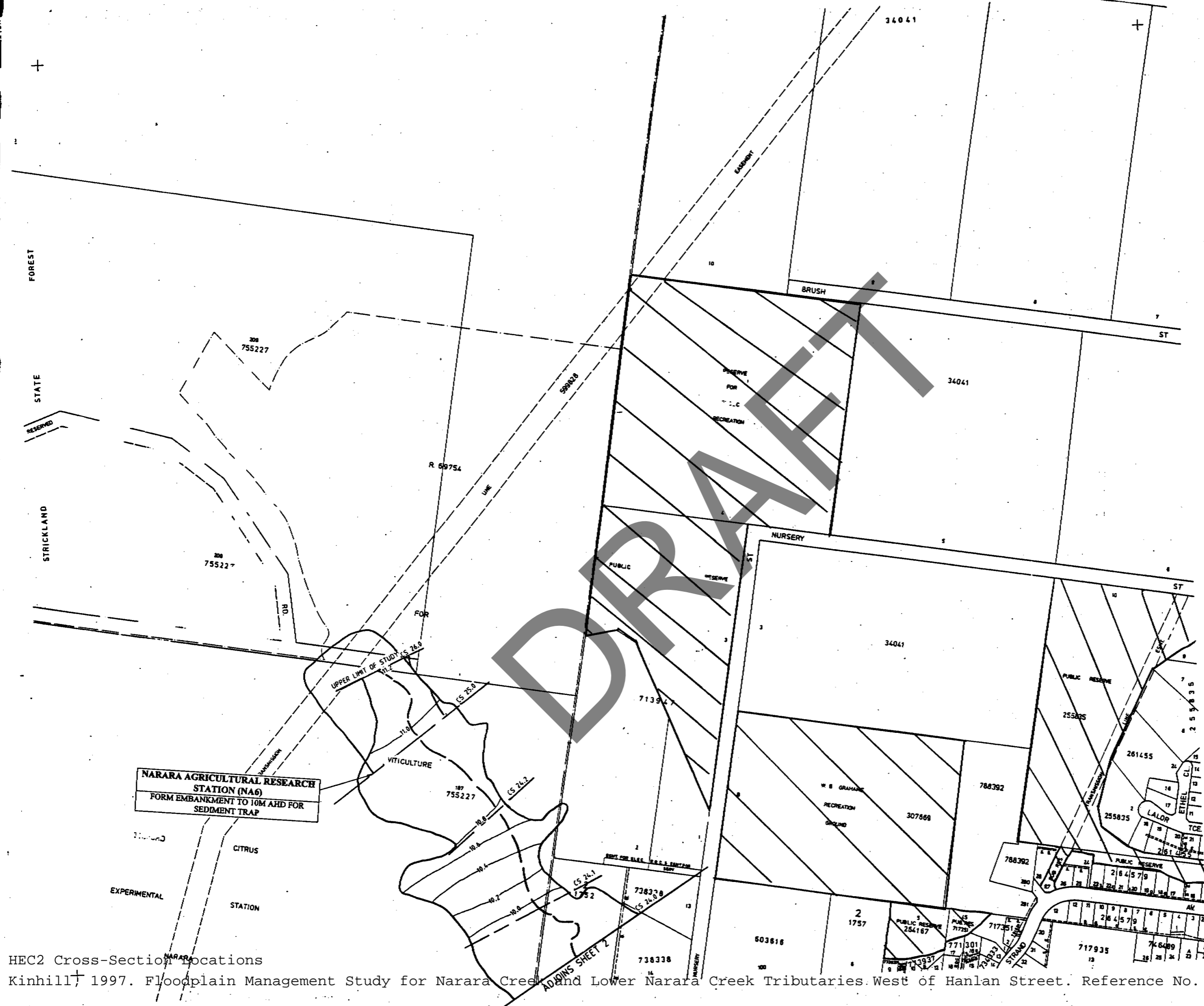
KEY TO ADJOINING SHEET

COUNCIL OWNED LAND



CENTRAL MAPPING AUTHORITY  
MAP REFERENCE  
GOSFORD U2797-21

**FIGURE 6.4**



HEC2 Cross-Section Locations Kinhill, 1997. Floodplain Management Study for Narara Creek and Lower Narara Creek Tributaries West of Hanlan Street. Reference No. SWE10786-W-101 Rev5.

# GOSFORD CITY COUNCIL



REFER TO NOTE 6

**LEGEND**

- 1% AEP FLOOD EXTENT
- 1% AEP FLOOD CONTOUR
- EXISTING CREEK ALIGNMENT

**NOTE:**

1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS INDICATE APPROXIMATE WORKS OF FLOODING ONLY.
4. THE POSITION OF THE FLOOD EXTENT RELATIVE TO PROPERTY BOUNDARIES IS APPROXIMATE ONLY AND SHOULD BE VERIFIED BY SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. FLOOD EXTENTS UPSTREAM OF THIS LINE SUPERSEDES THAT OF THE LOWER NARARA CREEK FPMs.

**Narara Creek & Lower Narara Creek Tributaries FLOODPLAIN MANAGEMENT STUDY**

**RECOMMENDED WORKS AND FLOOD CONTOURS**

FIGURE 6.5 SHEET 2 of 3

	212A	212B
211D	212C	212D
227B	228A	228B

KEY TO ADJOINING SHEETS

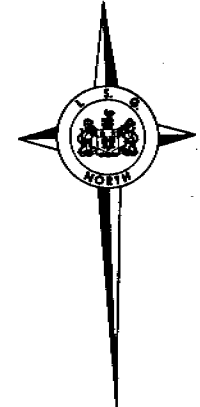
COUNCIL OWNED LAND

REFER TO NOTE 6

CENTRAL MAPPING AUTHORITY  
MAP REFERENCE  
GOSFORD 2797-2-3

FIGURE 6.5

# GOSFORD CITY COUNCIL



**LEGEND**

- 1% AEP FLOOD EXTENT
- 1% AEP FLOOD CONTOUR
- EXISTING CREEK ALIGNMENT

**Notes:**

1. FLOOD LEVELS HAVE BEEN CALCULATED AT CROSS SECTION LOCATIONS ONLY.
2. FLOOD LEVELS AND FLOOD CONTOURS BETWEEN CROSS SECTIONS HAVE BEEN LINEARLY INTERPOLATED.
3. FLOOD CONTOURS INDICATE APPROXIMATE WIDTHS OF FLOODING ONLY.
4. THE POSITION OF THE FLOOD EXTENT RELATIVE TO PROPERTY BOUNDARIES IS APPROXIMATE ONLY AND SHOULD BE VERIFIED BY SURVEY.
5. FLOOD LEVELS ARE GIVEN IN METRES TO AUSTRALIAN HEIGHT DATUM.
6. FLOOD EXTENTS UPSTREAM OF THIS LINE EXCEEDS THAT OF THE LOWER NARARA CREEK FLOOD.

**Narara Creek & Lower Narara Creek Tributaries FLOODPLAIN MANAGEMENT STUDY**

**RECOMMENDED WORKS AND FLOOD CONTOURS**

ROUTE 44 SHEET 1 of 1

211D	212C	212D
227B	228A	228B
227D	228C	228D

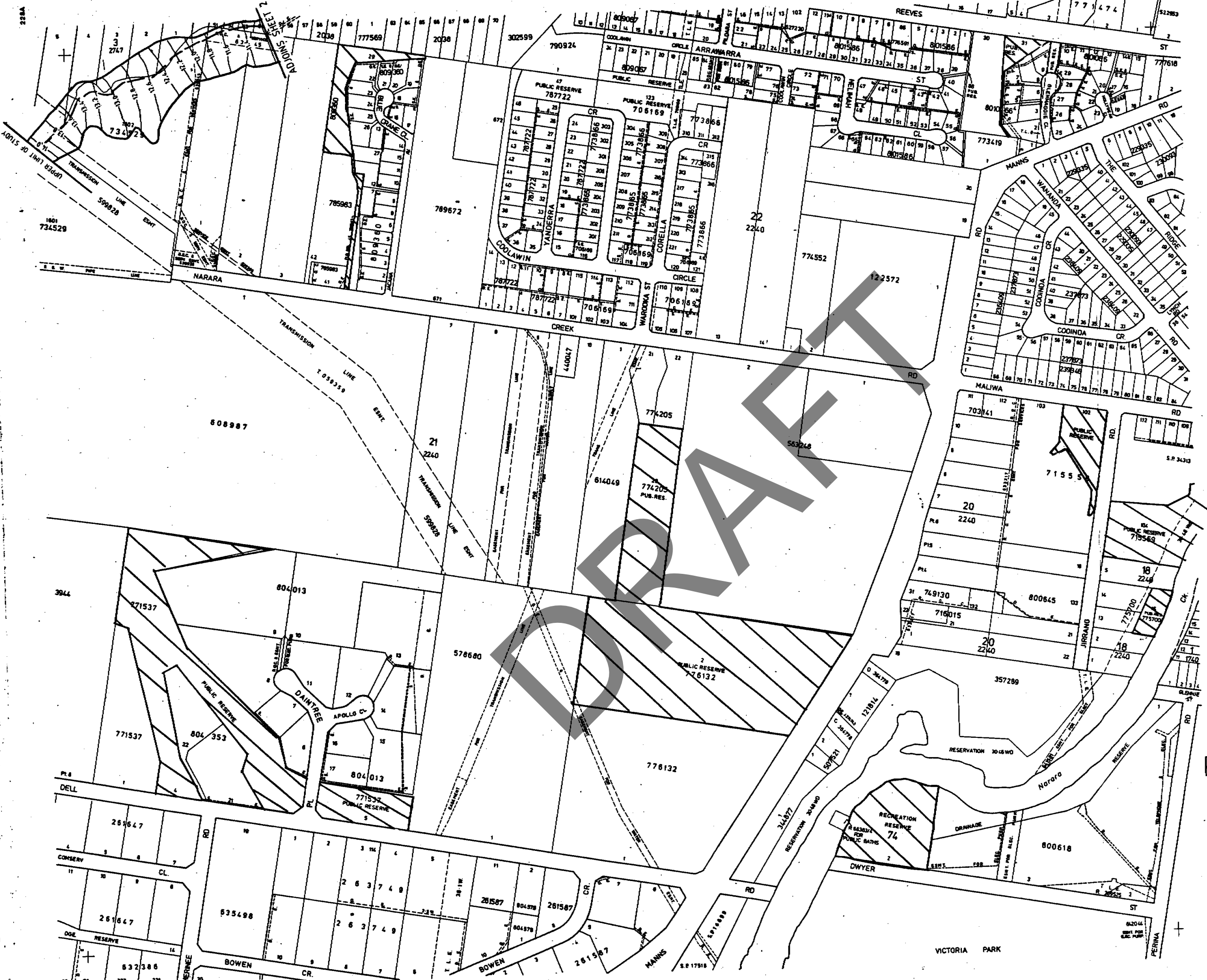
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COUNCIL OWNED LAND



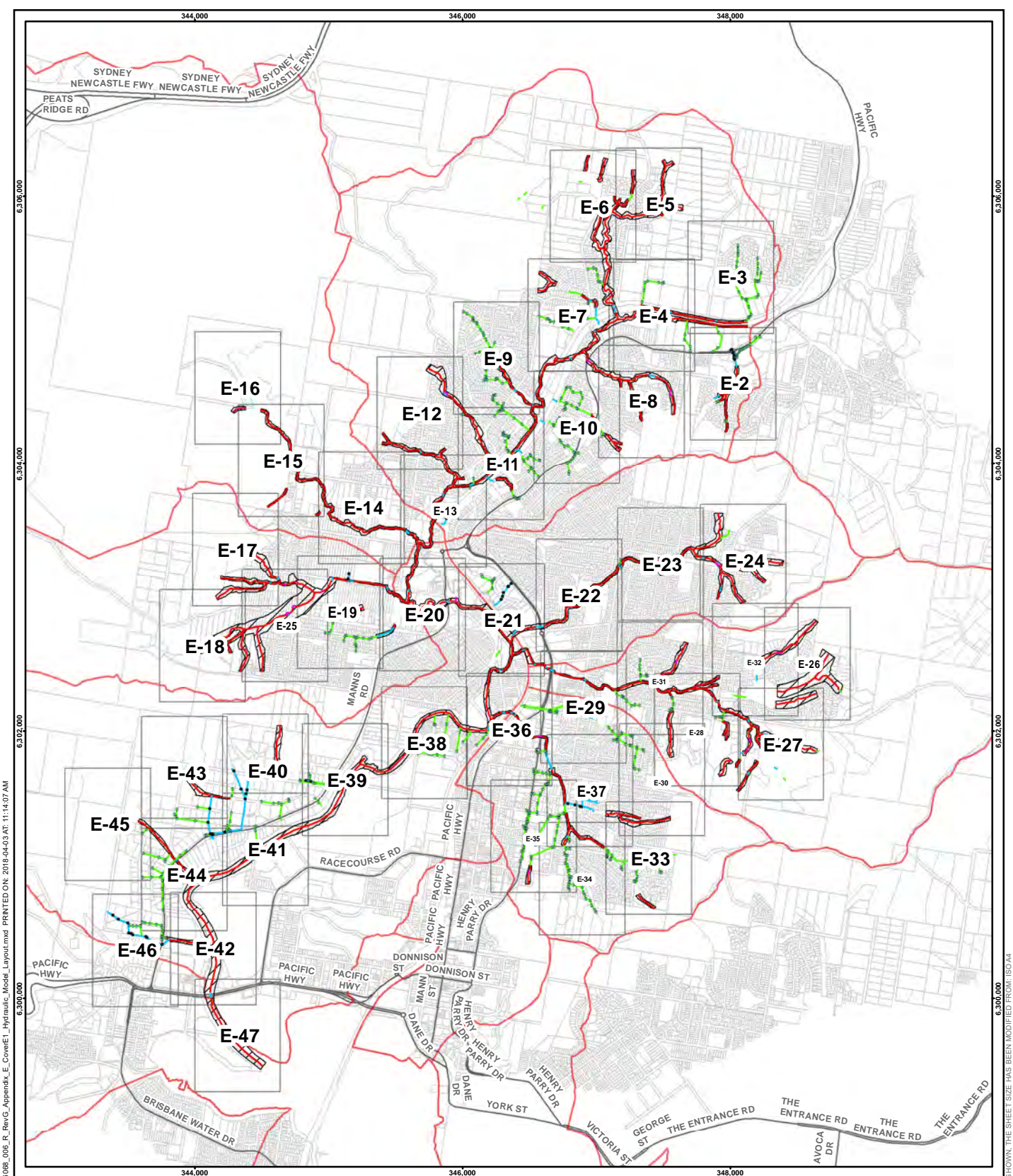
CENTRAL MAPPING AUTHORITY  
MAP REFERENCE  
GOSFORD U2797-51

**FIGURE 6.6**



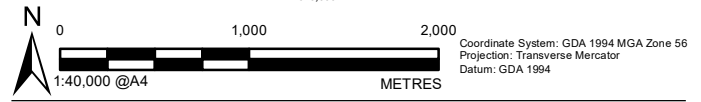
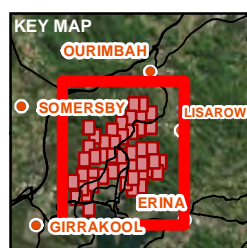
APPENDIX E

# Model Inputs



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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

CONSULTANT	DD/MM/YYYY	3/04/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM



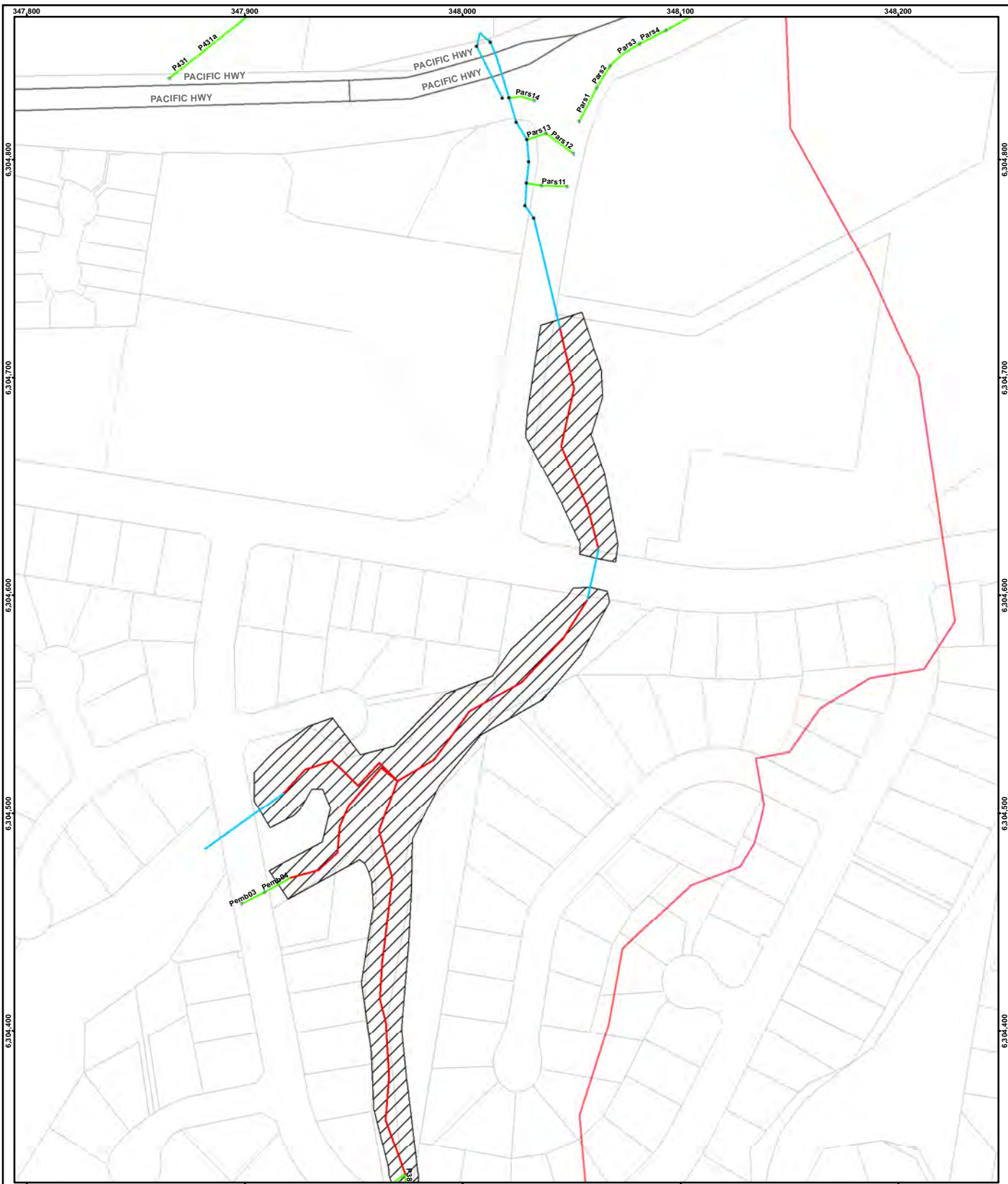
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TITLE		<b>HYDRAULIC MODEL LAYOUT</b>	
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-1

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

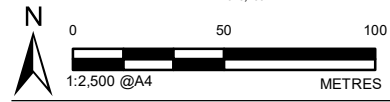
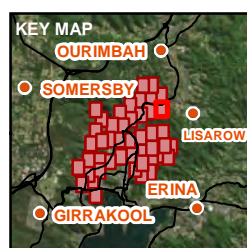
Name	Source	Depth_Col	Flow_Col	Area (m2)	Width (m)
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12%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	12%Horn24	1.000	2.400
12%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	12%RM7	1.000	0.900
16%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	16%RM7	1.000	0.900
2%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	2%Horn24	1.000	2.400
2%Horn2400-S	GA_CON3_pitinlet_curve_06.csv	Depth	2%Horn24	1.000	2.400
2%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	2%RM7	1.000	0.900
2%RM7-S	GA_CON3_pitinlet_curve_06.csv	Depth	2%RM7-S	1.000	0.900
4%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	4%Horn24	1.000	2.400
4%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	4%RM7	1.000	0.900
6%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	6%Horn24	1.000	2.400
6%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	6%RM7	1.000	0.900
8%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	8%Horn24	1.000	2.400
8%RM7	GA_CON3_pitinlet_curve_06.csv	Depth	8%RM7	1.000	0.900
10%Horn2400	GA_CON3_pitinlet_curve_06.csv	Depth	10%Horn24	1.000	2.400

Hydraulic Characteristic Curves

Depth (m)	RAINS: 20% blockage on-grade and 50% blockage				ON-GRADE BLOCKAGE (20%)				SAG BLOCKAGE FACTOR (50%)				0.5				0.8				1.0			
	2%Hom24	2%Hom2400-S	4%Hom2400	8%Hom2400	8%Hom2400	10%Hom2400	12%Hom2400	16%Hom2400	2%RM7	2%RM7-S	4%RM7	8%RM7	8%RM7	10%RM7	12%RM7	16%RM7	2%RM7	2%RM7-S	4%RM7	8%RM7	8%RM7	10%RM7	12%RM7	16%RM7
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.02	0.004	0.0032	0.0016	0.006	0.0048	0.008	0.0064	0.011	0.0088	0.011	0.0088	0.014	0.0112	0.017	0.0136	0.0085	0.02	0.016	0.02	0.016	0.02	0.016	0.02	0.016
0.04	0.012	0.0096	0.0048	0.016	0.0128	0.024	0.0192	0.032	0.0256	0.032	0.0256	0.04	0.032	0.048	0.0384	0.024	0.056	0.0448	0.056	0.0448	0.056	0.0448	0.056	0.0448
0.06	0.022	0.0176	0.0096	0.024	0.0232	0.044	0.0352	0.059	0.0472	0.059	0.0472	0.073	0.0584	0.098	0.0704	0.044	0.102	0.0816	0.102	0.0816	0.102	0.0816	0.102	0.0816
0.08	0.034	0.0272	0.0136	0.045	0.036	0.068	0.0544	0.09	0.072	0.09	0.072	0.113	0.0904	0.135	0.108	0.0675	0.158	0.1264	0.158	0.1264	0.158	0.1264	0.158	0.1264
0.1	0.047	0.0376	0.0198	0.063	0.0504	0.094	0.0752	0.126	0.1008	0.126	0.1008	0.157	0.1256	0.199	0.1512	0.0945	0.22	0.176	0.22	0.176	0.22	0.176	0.22	0.176
0.12	0.062	0.0496	0.0248	0.083	0.0664	0.124	0.0992	0.166	0.1328	0.166	0.1328	0.207	0.1656	0.248	0.1984	0.124	0.29	0.232	0.29	0.232	0.29	0.232	0.29	0.232
0.14	0.078	0.0624	0.0312	0.104	0.0832	0.157	0.1256	0.209	0.1672	0.209	0.1672	0.261	0.2088	0.313	0.2504	0.1565	0.365	0.292	0.365	0.292	0.365	0.292	0.365	0.292
0.16	0.096	0.0768	0.0384	0.127	0.1016	0.191	0.1528	0.255	0.204	0.255	0.204	0.319	0.2552	0.382	0.3056	0.191	0.446	0.3568	0.446	0.3568	0.446	0.3568	0.446	0.3568
0.18	0.114	0.0912	0.0456	0.152	0.1216	0.228	0.1824	0.304	0.2432	0.304	0.2432	0.38	0.304	0.456	0.3648	0.228	0.532	0.4256	0.532	0.4256	0.532	0.4256	0.532	0.4256
0.2	0.128	0.1024	0.0512	0.171	0.1368	0.256	0.2048	0.342	0.2736	0.342	0.2736	0.427	0.3416	0.512	0.4096	0.256	0.598	0.4784	0.598	0.4784	0.598	0.4784	0.598	0.4784
0.22	0.137	0.1096	0.0548	0.183	0.1464	0.275	0.22	0.366	0.2928	0.366	0.2928	0.458	0.3664	0.55	0.44	0.275	0.641	0.5128	0.641	0.5128	0.641	0.5128	0.641	0.5128
0.24	0.146	0.1168	0.0594	0.196	0.156	0.292	0.2336	0.39	0.312	0.39	0.312	0.487	0.3896	0.584	0.4672	0.292	0.682	0.5456	0.682	0.5456	0.682	0.5456	0.682	0.5456
0.26	0.154	0.1232	0.0616	0.208	0.1648	0.309	0.2472	0.411	0.3288	0.411	0.3288	0.514	0.4112	0.617	0.4936	0.3085	0.72	0.576	0.72	0.576	0.72	0.576	0.72	0.576
0.28	0.162	0.1296	0.0648	0.216	0.1728	0.324	0.2592	0.432	0.3456	0.432	0.3456	0.54	0.432	0.648	0.5184	0.324	0.756	0.6048	0.756	0.6048	0.756	0.6048	0.756	0.6048
0.3	0.169	0.1352	0.0676	0.226	0.1808	0.339	0.2712	0.452	0.3616	0.452	0.3616	0.565	0.452	0.678	0.5424	0.339	0.791	0.6328	0.791	0.6328	0.791	0.6328	0.791	0.6328
0.35	0.187	0.1496	0.0748	0.249	0.1992	0.373	0.2984	0.498	0.3984	0.498	0.3984	0.622	0.4976	0.746	0.5968	0.373	0.871	0.6968	0.871	0.6968	0.871	0.6968	0.871	0.6968
0.4	0.202	0.1616	0.0808	0.271	0.216	0.405	0.324	0.539	0.4312	0.539	0.4312	0.674	0.5392	0.809	0.6472	0.4045	0.944	0.7552	0.944	0.7552	0.944	0.7552	0.944	0.7552
0.45	0.217	0.1736	0.0868	0.289	0.2312	0.434	0.3472	0.578	0.4624	0.578	0.4624	0.723	0.5784	0.867	0.6836	0.4335	1.012	0.8096	1.012	0.8096	1.012	0.8096	1.012	0.8096
0.5	0.23	0.184	0.092	0.307	0.2456	0.461	0.3688	0.614	0.4912	0.614	0.4912	0.768	0.6144	0.922	0.7376	0.461	1.075	0.86	1.075	0.86	1.075	0.86	1.075	0.86
0.55	0.243	0.1944	0.0972	0.324	0.2592	0.487	0.3896	0.649	0.5192	0.649	0.5192	0.811	0.6488	0.973	0.7784	0.4865	1.135	0.908	1.135	0.908	1.135	0.908	1.135	0.908
0.6	0.255	0.204	0.102	0.341	0.2728	0.511	0.4088	0.681	0.5448	0.681	0.5448	0.852	0.6816	1.022	0.8176	0.511	1.192	0.9536	1.192	0.9536	1.192	0.9536	1.192	0.9536
1	0.34	0.272	0.136	0.45	0.36	1	0.8	1.34	0.272	1	0.8	1.84	0.36	1	0.8	0.5	1.34	0.272	1	0.8	1.34	0.272	1	0.8
2	0.44	0.352	0.176	0.6	0.48	1.4	1.12	1.44	0.352	1.4	1.12	1.4	0.48	1.4	1.12	0.7	1.44	0.352	1.4	1.12	1.44	0.352	1.4	1.12
3	0.5	0.4	0.2	0.7	0.56	1.7	1.36	1.7	0.5	1.7	1.36	1.7	0.56	1.7	1.36	0.85	1.7	0.5	1.7	1.36	1.7	0.56	1.7	1.36



- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-2

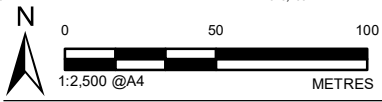
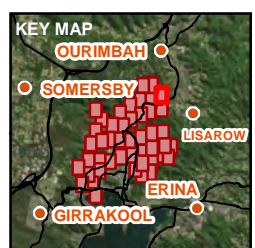
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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

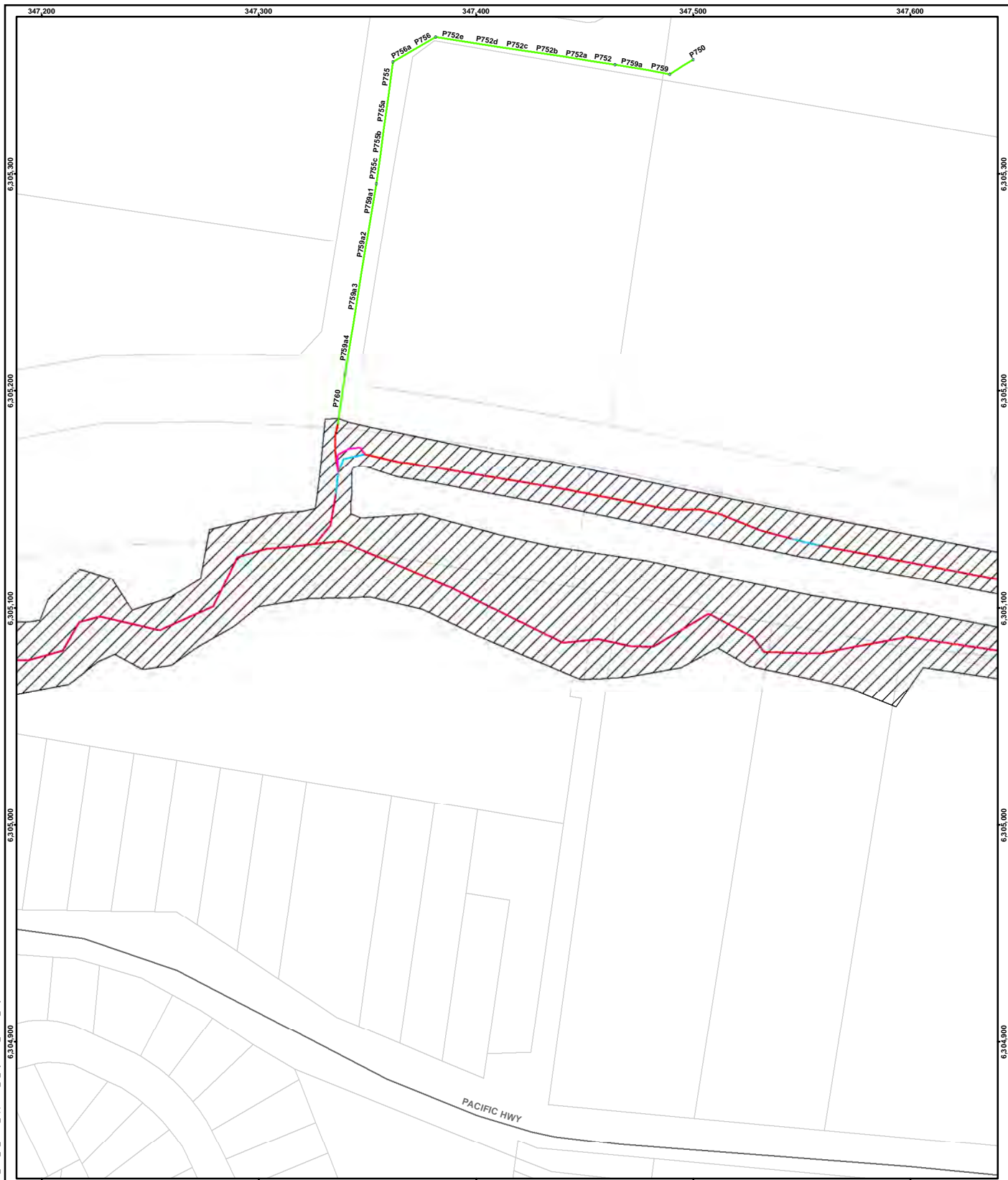
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM



PROJECT		<b>NARARA CREEK FLOOD STUDY</b>	
TITLE		<b>HYDRAULIC MODEL LAYOUT</b>	
PROJECT NO.	CONTROL	REV.	FIGURE
09762068	006	G	Appendix E-3

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

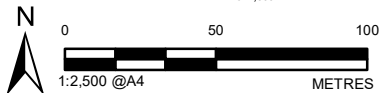
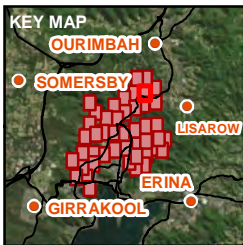


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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

CONSULTANT



DD/MM/YYYY      3/04/2018

DESIGNED          HB

PREPARED        BG

REVIEWED        NM

APPROVED        NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

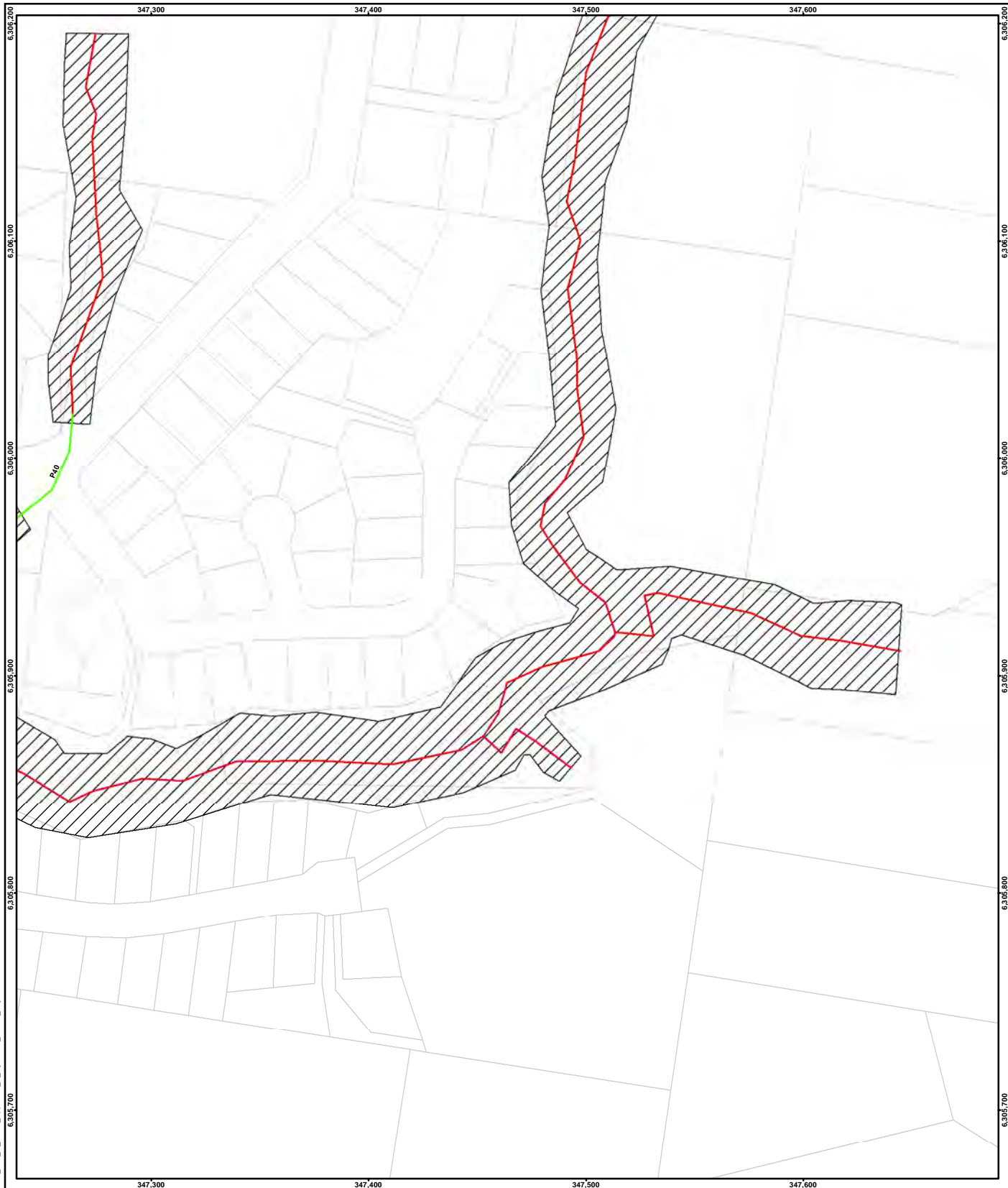
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**097626068**

CONTROL  
**006**

REV.  
**G**

FIGURE

**Appendix E-4**

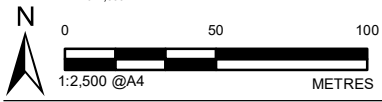
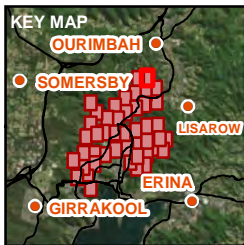


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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Served Structures
- Unserved Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED            BG

REVIEWED            NM

APPROVED            NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

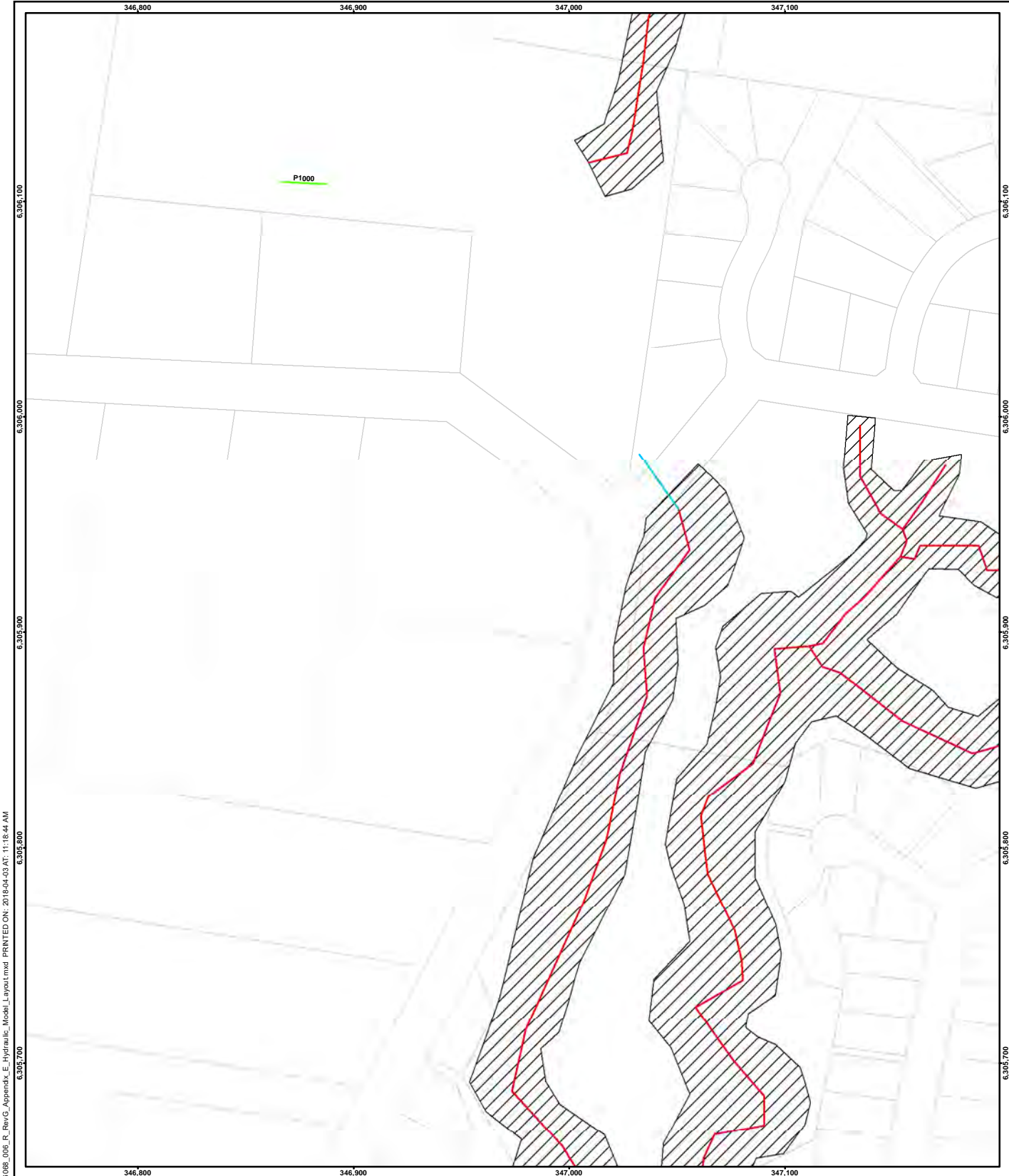
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.  
 097626068

CONTROL  
 006

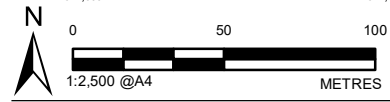
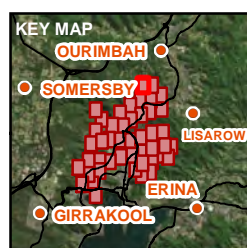
REV.  
 G

FIGURE  
**Appendix E-5**



PATH: R:\01 Client\Gold Coast City Council\097626068\PROJECTS\Updated\Mapping\_Mar18\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:18:44 AM

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

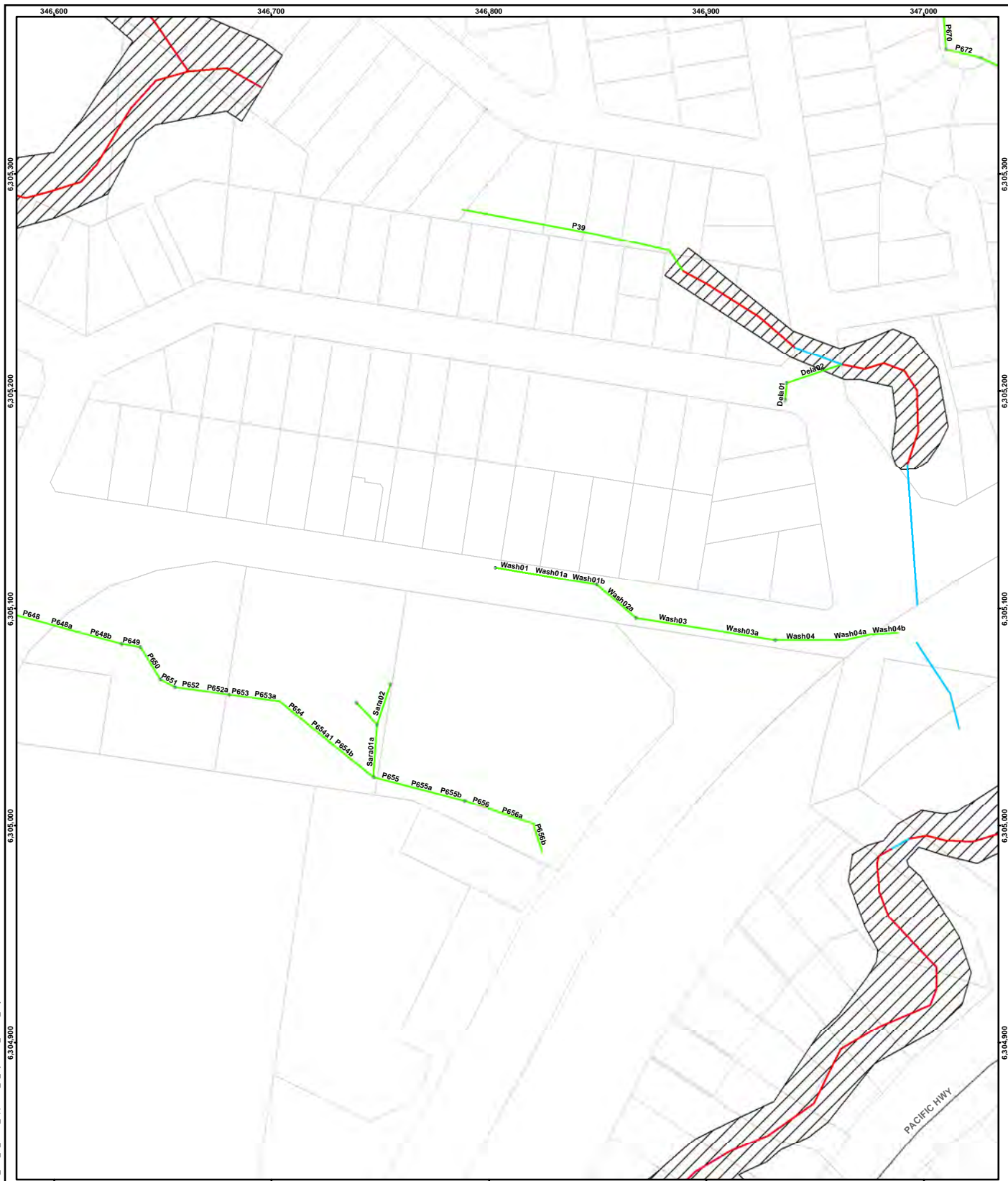


PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

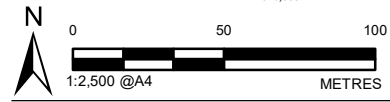
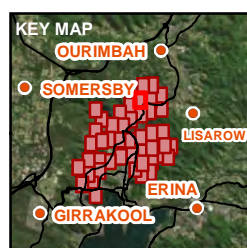
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-6

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



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- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT <b>NARARA CREEK FLOOD STUDY</b>			
TITLE <b>HYDRAULIC MODEL LAYOUT</b>			
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-7

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

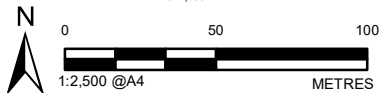
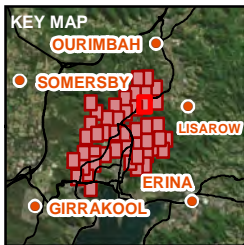


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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

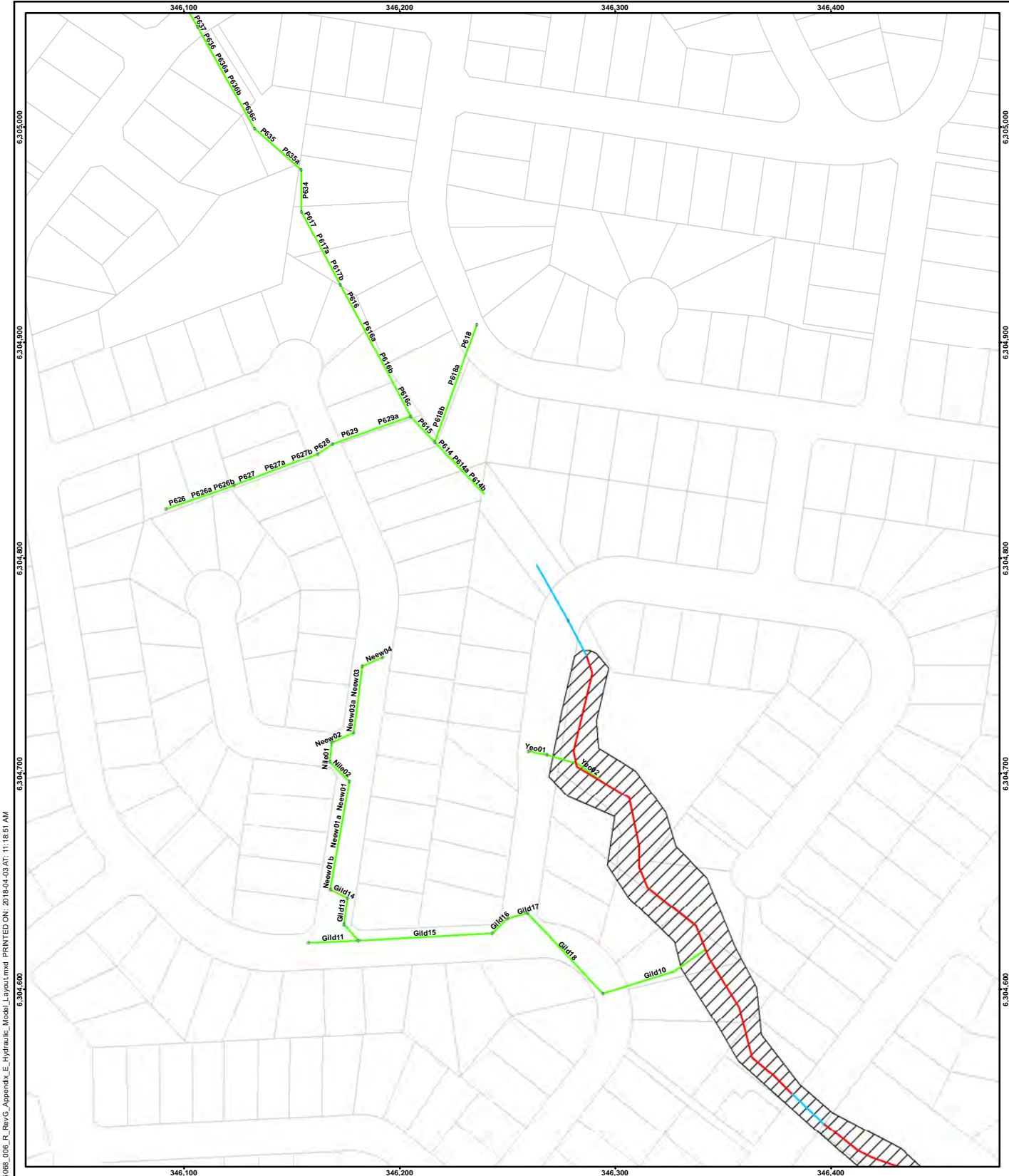
PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
09762068	006	G	Appendix E-8

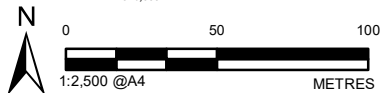
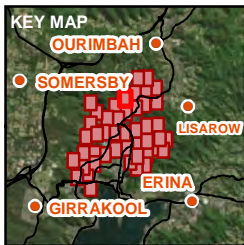


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 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

**PROJECT**

**NARARA CREEK FLOOD STUDY**

**TITLE**

**HYDRAULIC MODEL LAYOUT**

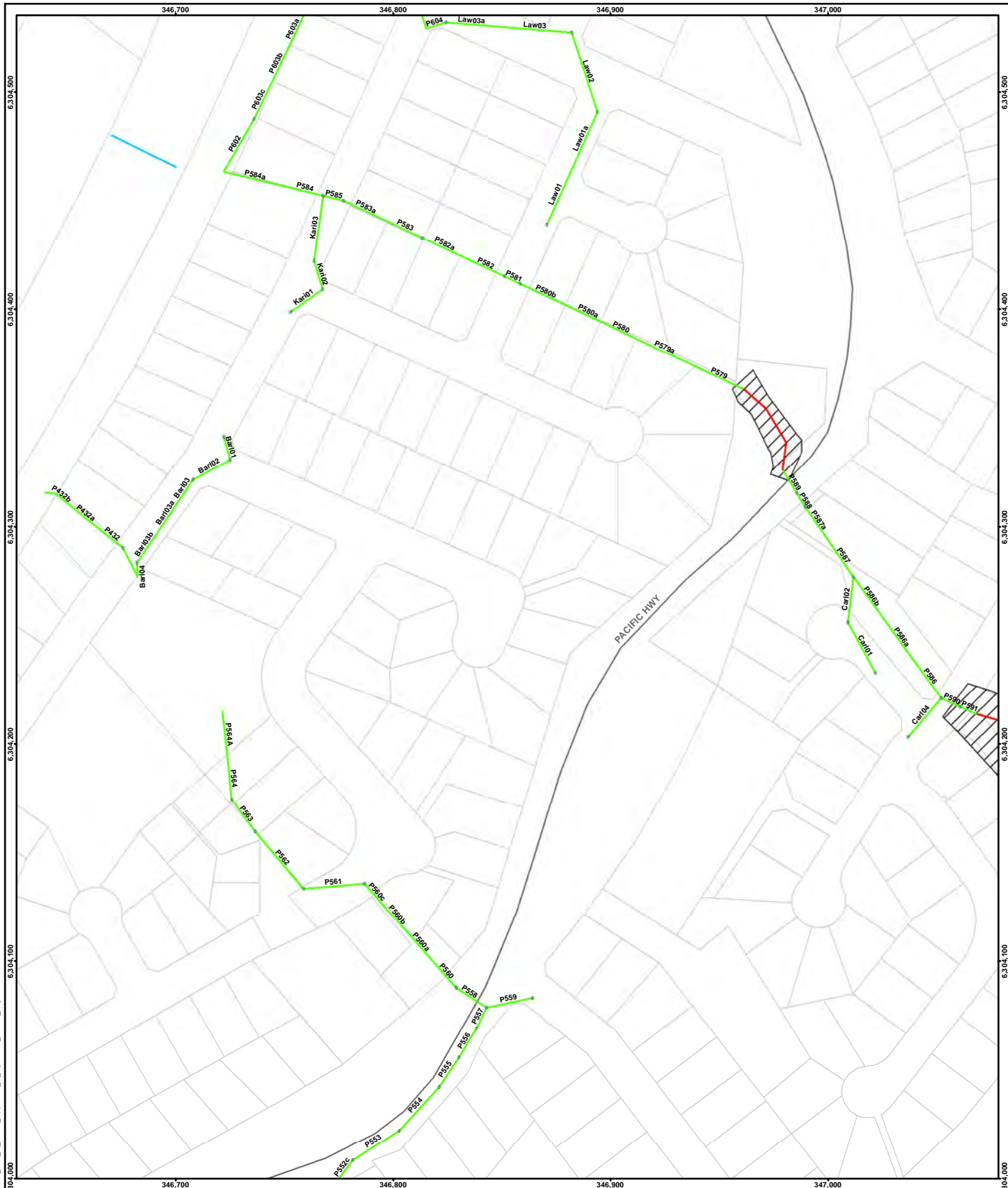
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-9

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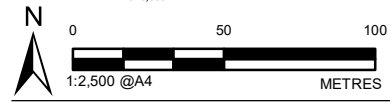
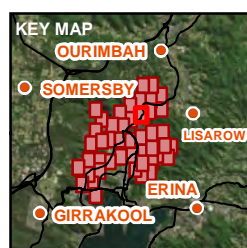
**CONSULTANT**



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastr, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM



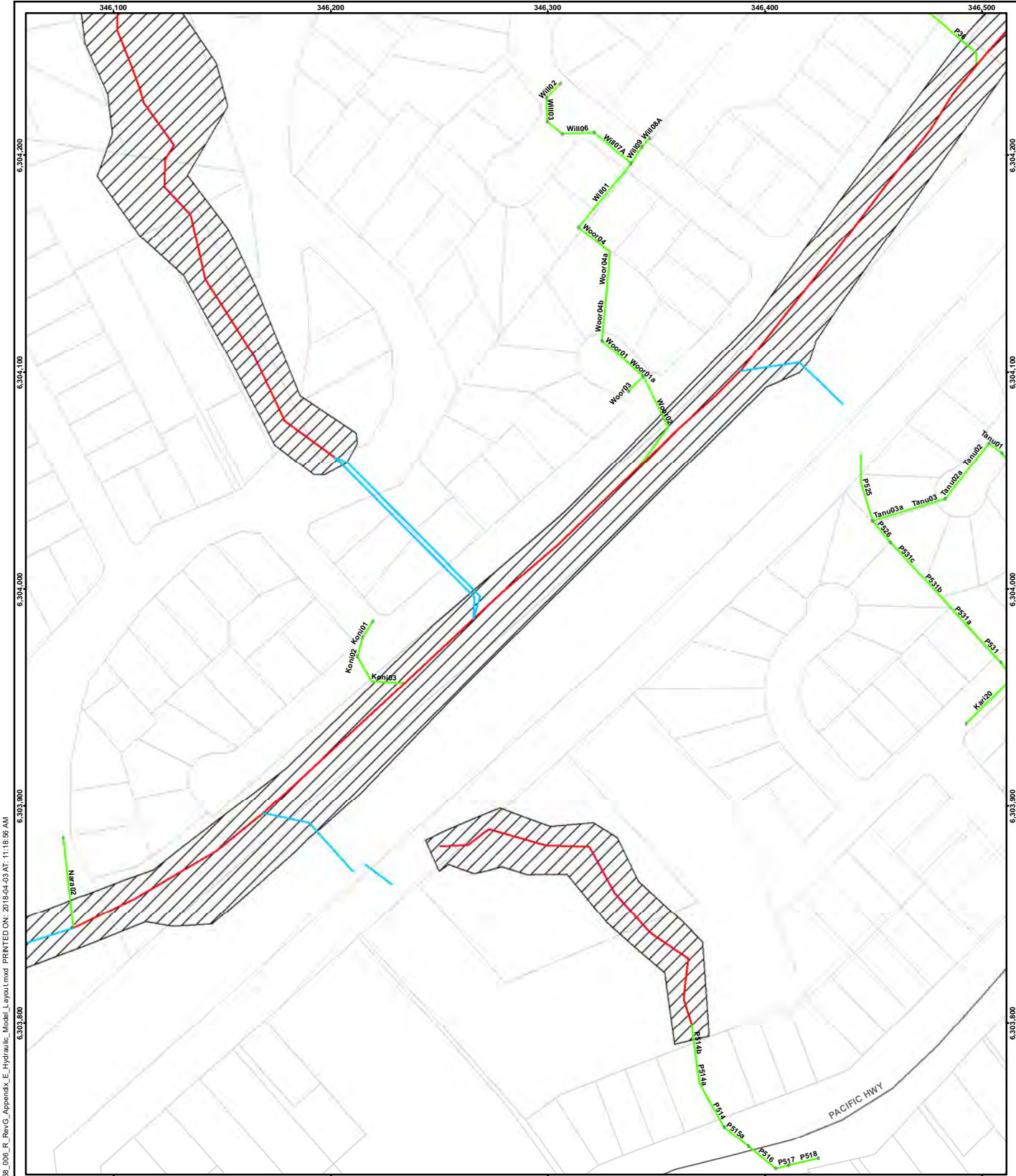
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-10

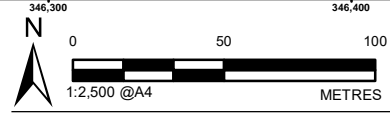
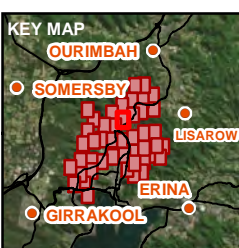
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- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**  
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DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT		NARARA CREEK FLOOD STUDY	
TITLE		HYDRAULIC MODEL LAYOUT	
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-11

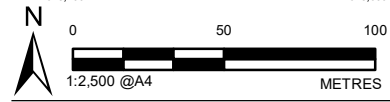
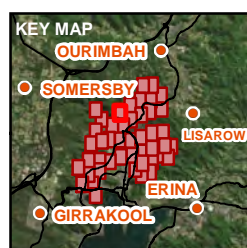
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

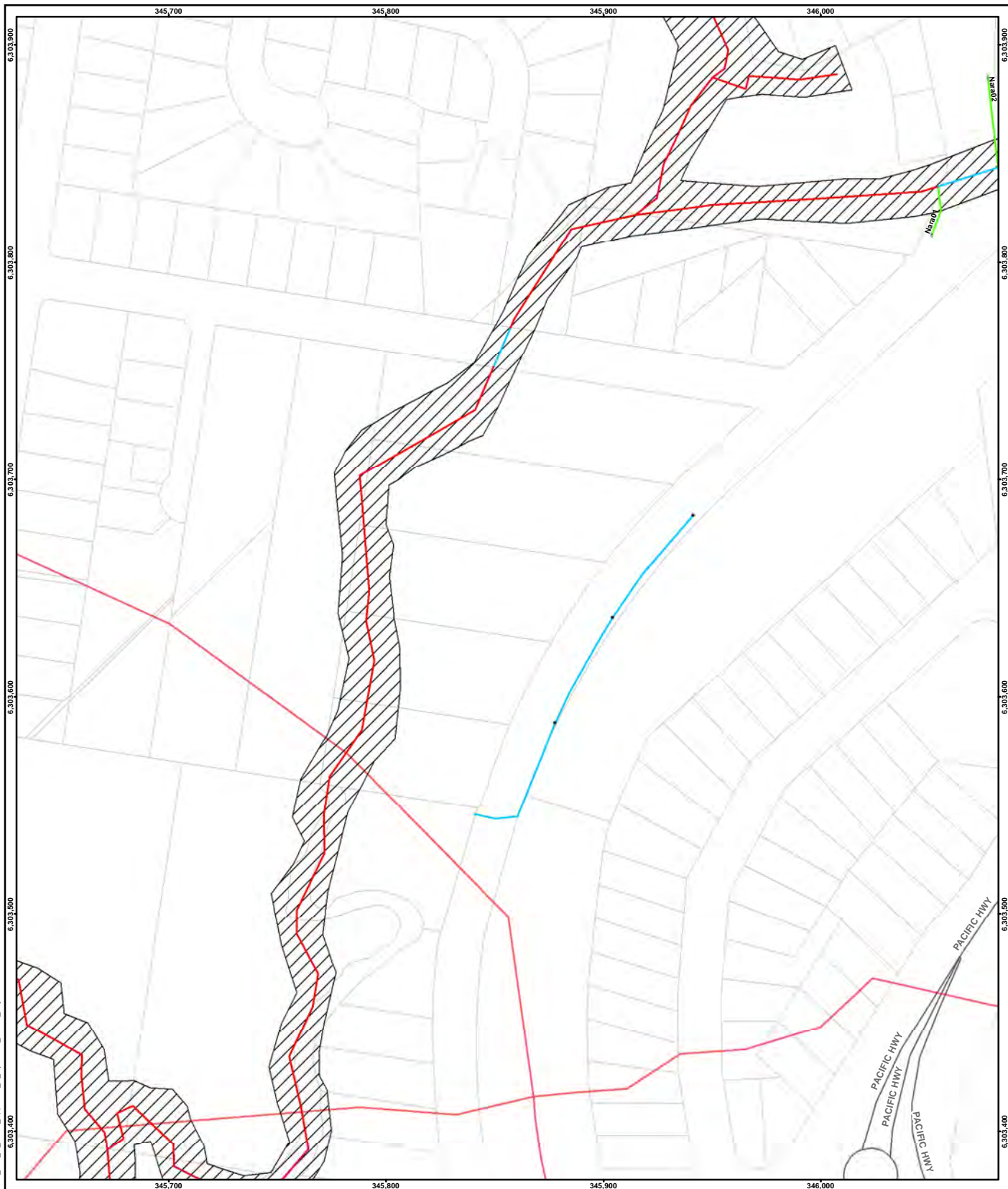
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DESIGNED	HB	
PREPARED	BG	
REVIEWED	NM	
APPROVED	NM	



PROJECT  
**NARARA CREEK FLOOD STUDY**

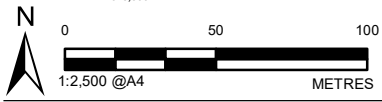
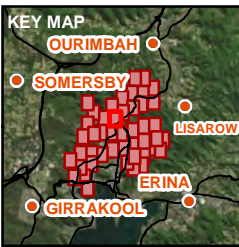
TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097620608	006	G	Appendix E-12



**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- ▨ 1D Extent within 2D Model
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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CONSULTANT



DD/MM/YYYY	3/04/2018
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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-13

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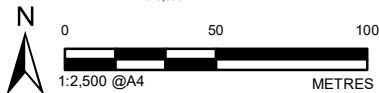
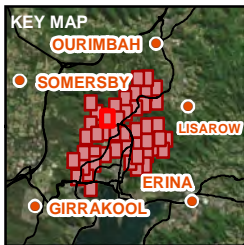


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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Served Structures
- Unserved Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DESIGNED            HB

PREPARED            BG

REVIEWED            NM

APPROVED            NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.  
 097620608

CONTROL  
 006

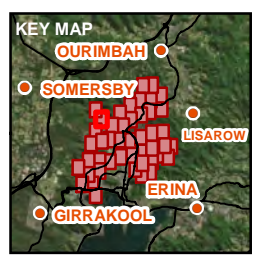
REV.  
 G

FIGURE  
**Appendix E-14**

PATH: R:\01 Client\Geosford City Council\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:04 AM



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

CONSULTANT	DD/MM/YYYY	3/04/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

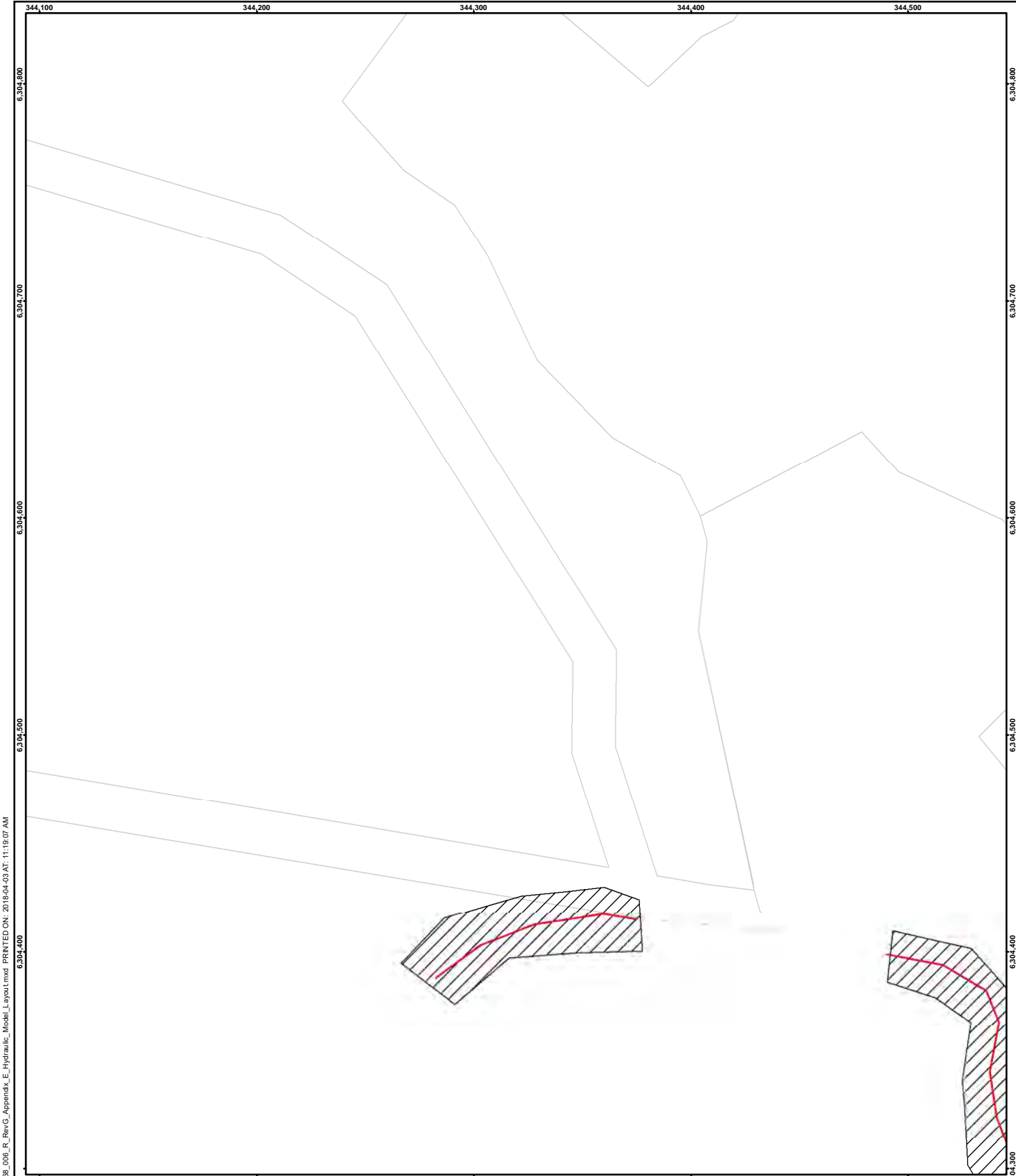


PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

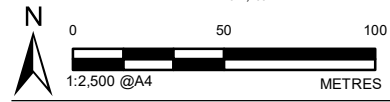
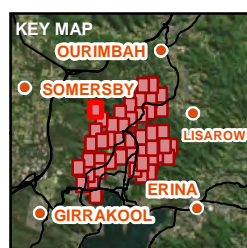
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-15

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



PATH: R:\01 Client\Gosford City Council\097626068\PROJECTS\Updates\Mapping\_Mar18\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:07 AM

- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

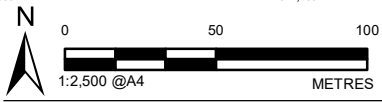
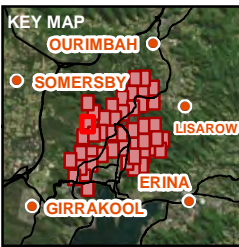
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-16

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- ▨ 1D Extent within 2D Model
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-17

PATH: R:\01 Client\Gosford City Council\097626068\PROJECTS\Updates\Mapping\_Mar18\097626068\_006\_R\_RevG\_Appendix E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:09 AM

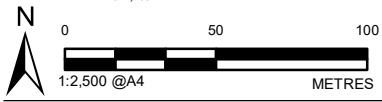
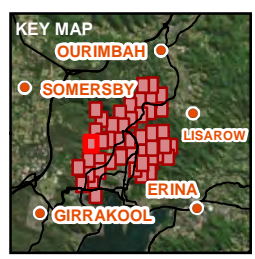
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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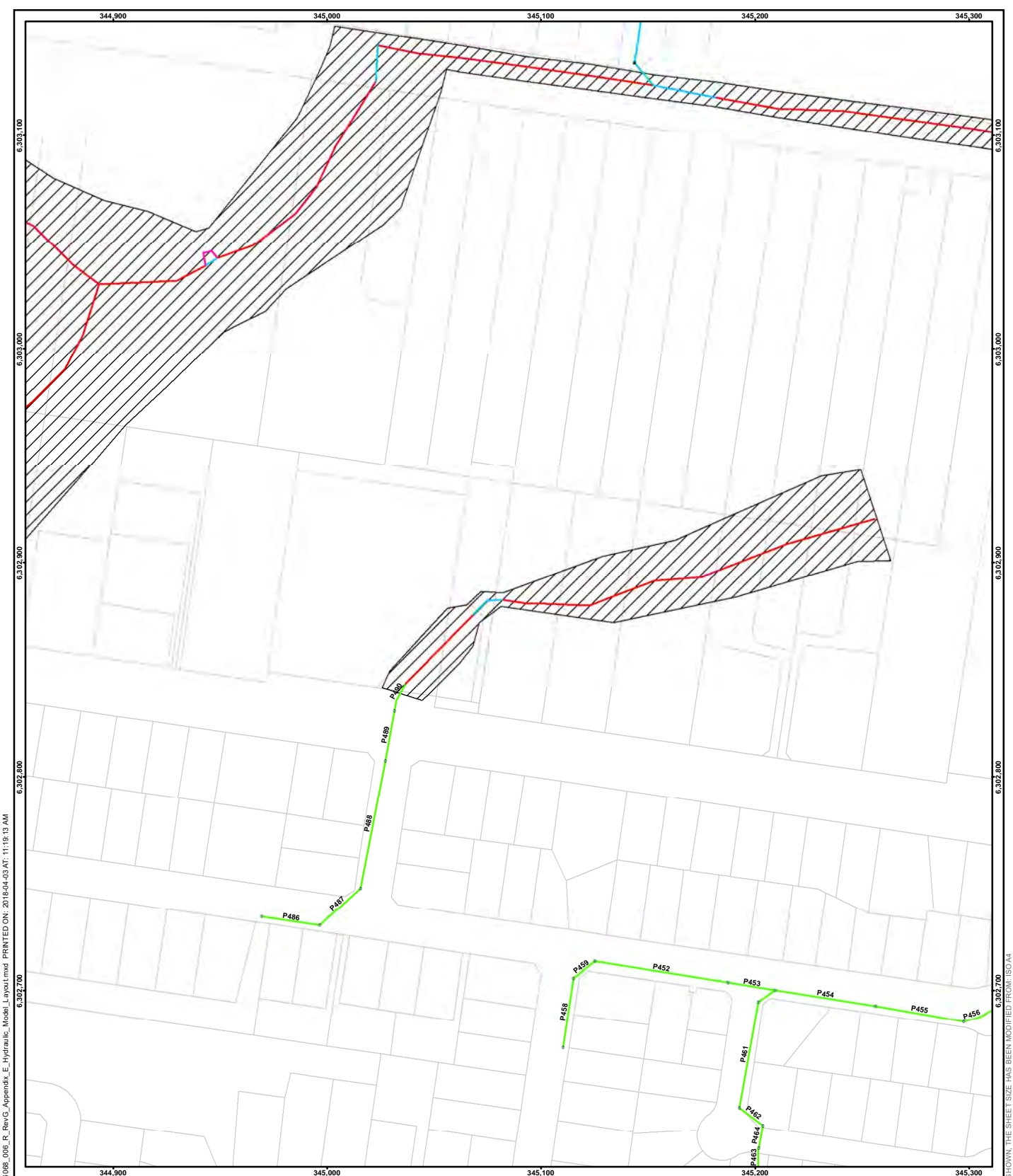
DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-18

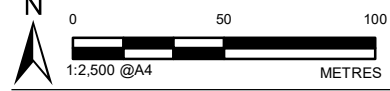
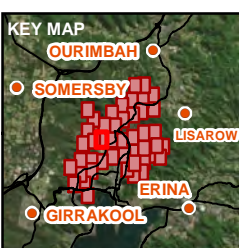




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 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT		<b>NARARA CREEK FLOOD STUDY</b>	
TITLE		<b>HYDRAULIC MODEL LAYOUT</b>	
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-19

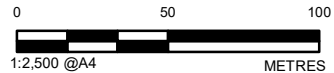
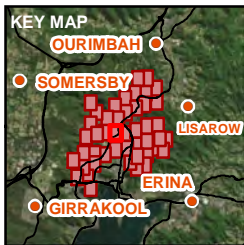


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**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Served Structures
- Unserved Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DESIGNED          HB

PREPARED         BG

REVIEWED        NM

APPROVED        NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

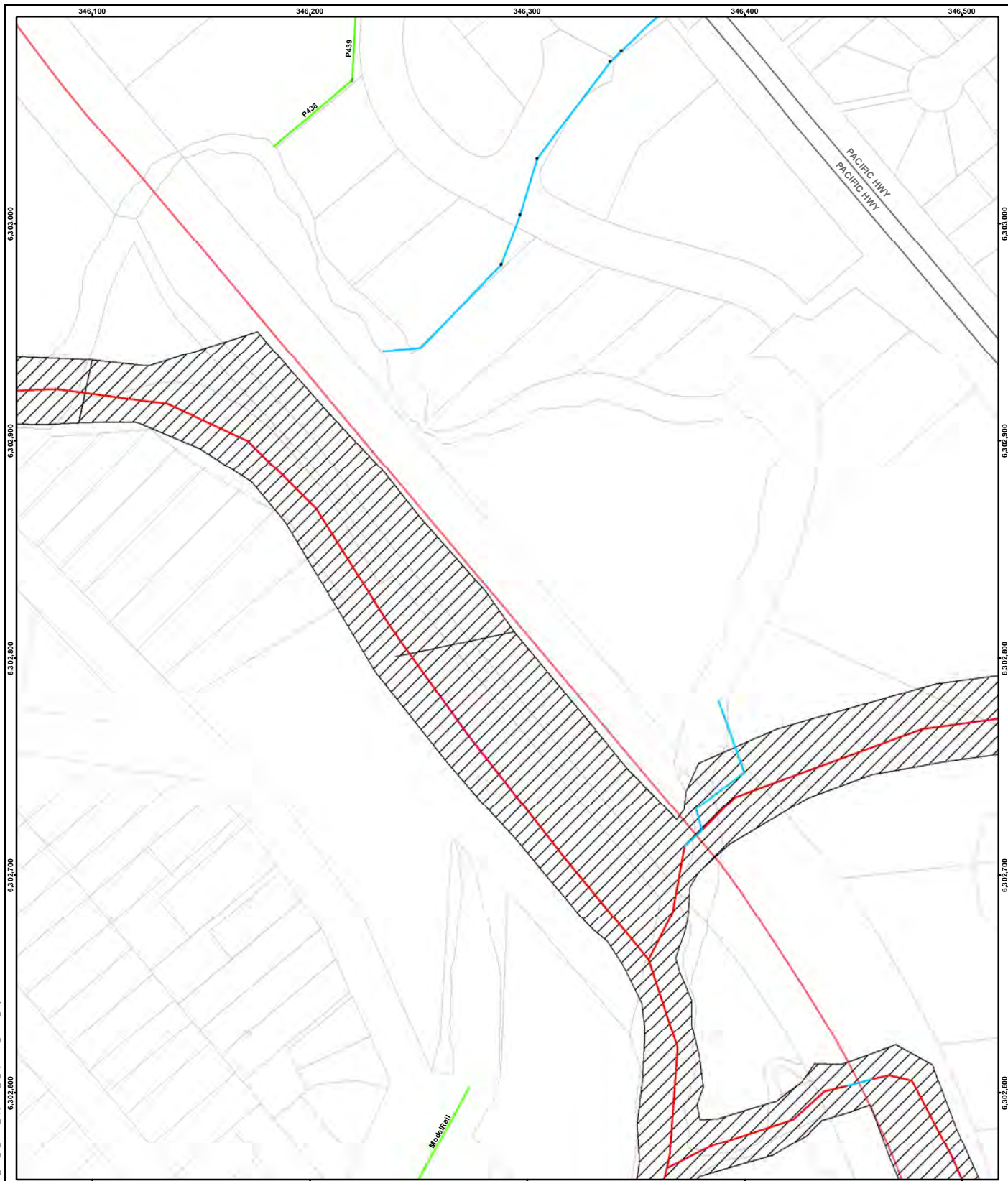
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.  
097626068

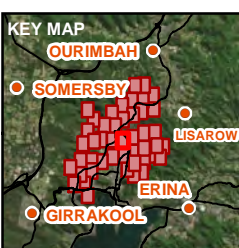
CONTROL  
006

REV.  
G

FIGURE  
Appendix E-20



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastr, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-21

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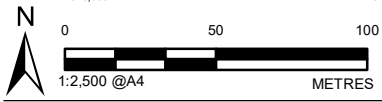
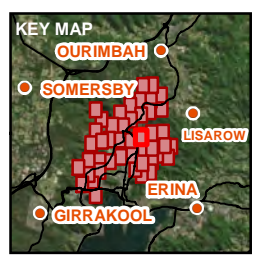
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6,302,800 6,302,900 6,303,000 6,303,100 6,303,200

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

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**REFERENCE(S)**  
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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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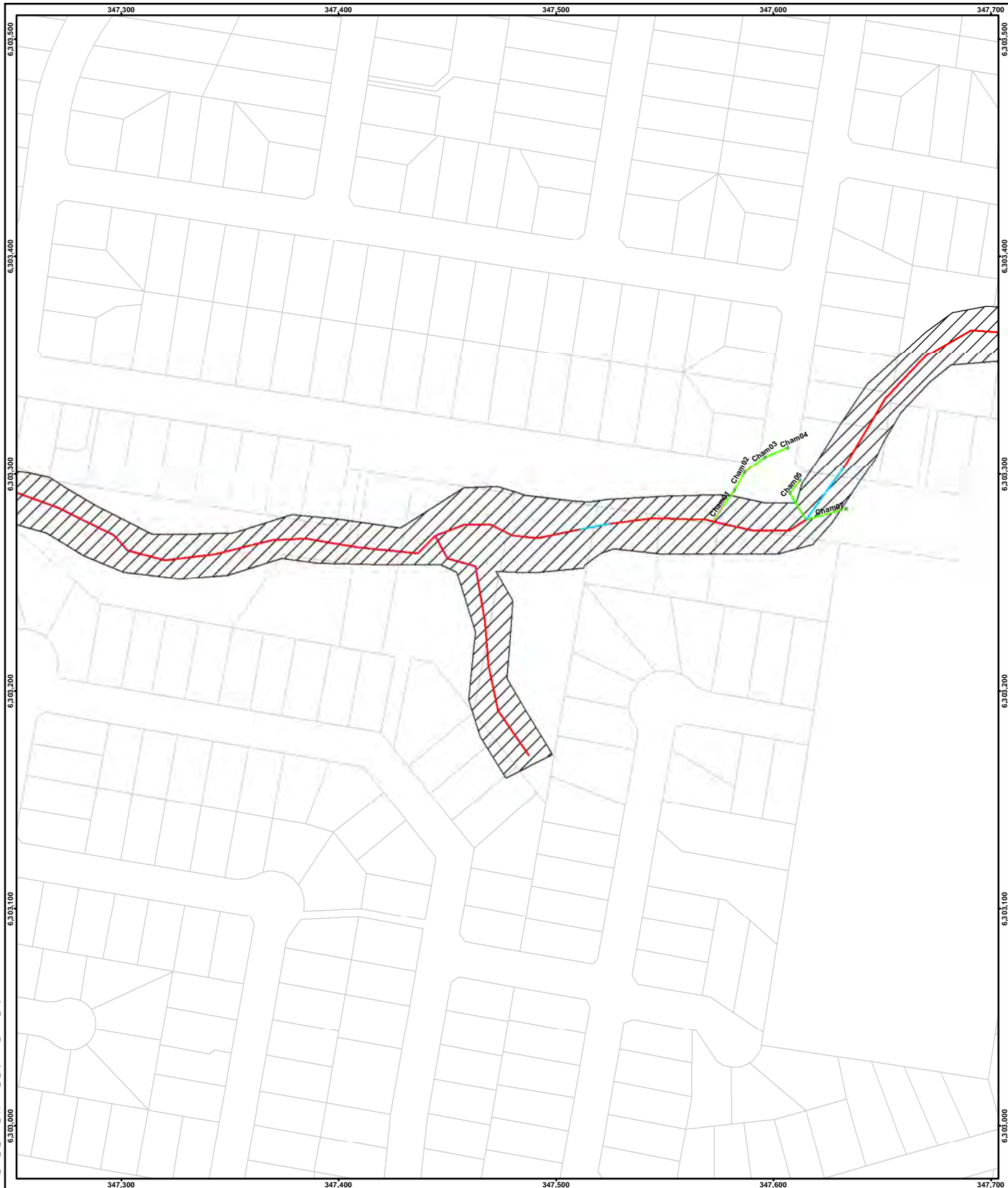
DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

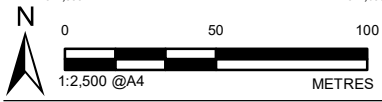
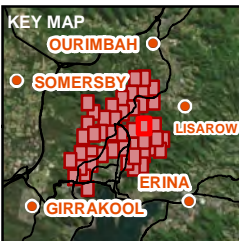
TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-22

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

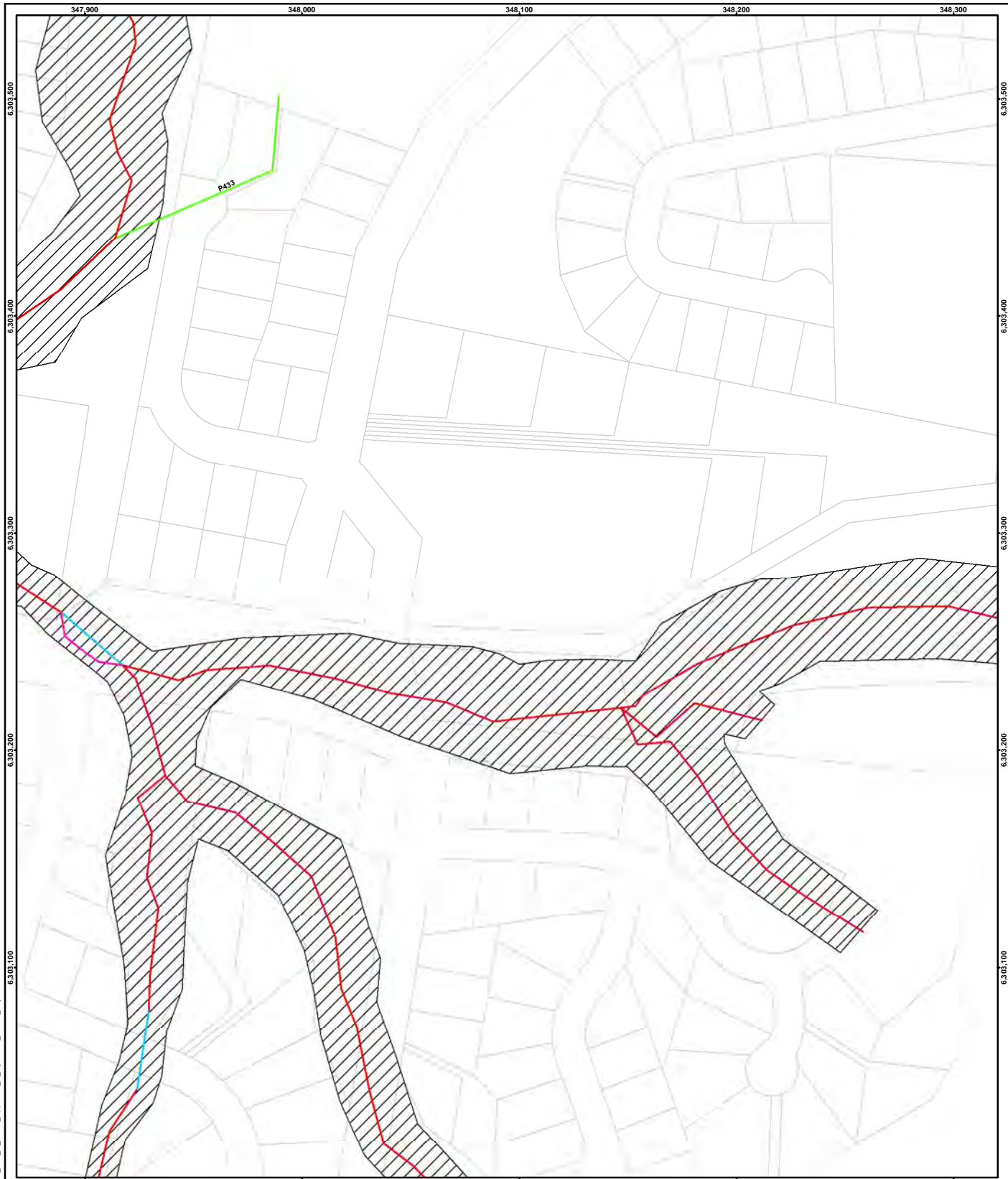
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-23

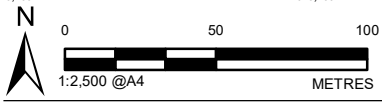
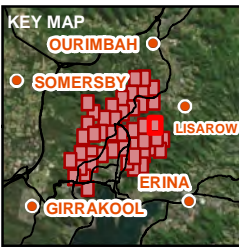
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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- ▨ 1D Extent within 2D Model
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

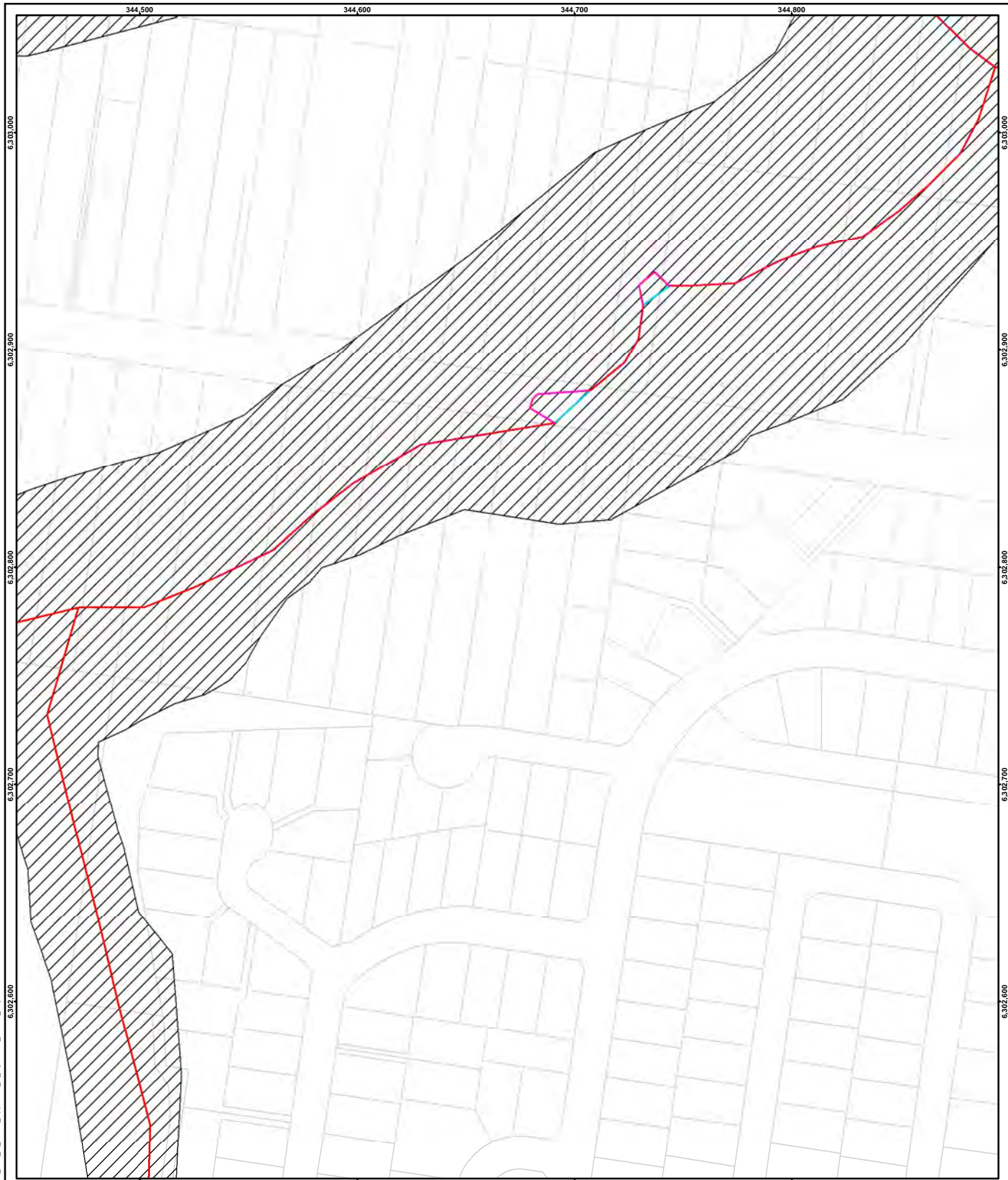
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**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-24

PATH: R:\01 Client\Gosford City Council\097626068\097626068\_006\_R\_RevG\_Appendix E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:25 AM

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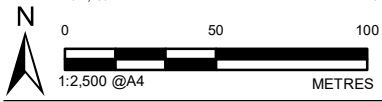
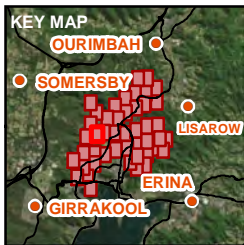


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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-25

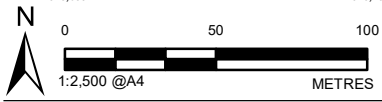
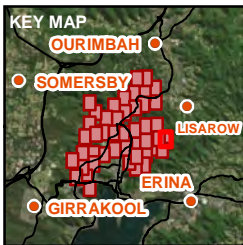


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**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastrre, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DD/MM/YYYY      3/04/2018

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PREPARED           BG

REVIEWED           NM

APPROVED           NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.

**097626068**

CONTROL

**006**

REV.

**G**

FIGURE

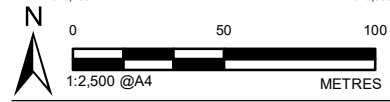
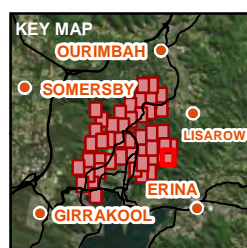
**Appendix E-26**





PATH: R:\01 Client\Gosford City Council\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:32 AM

- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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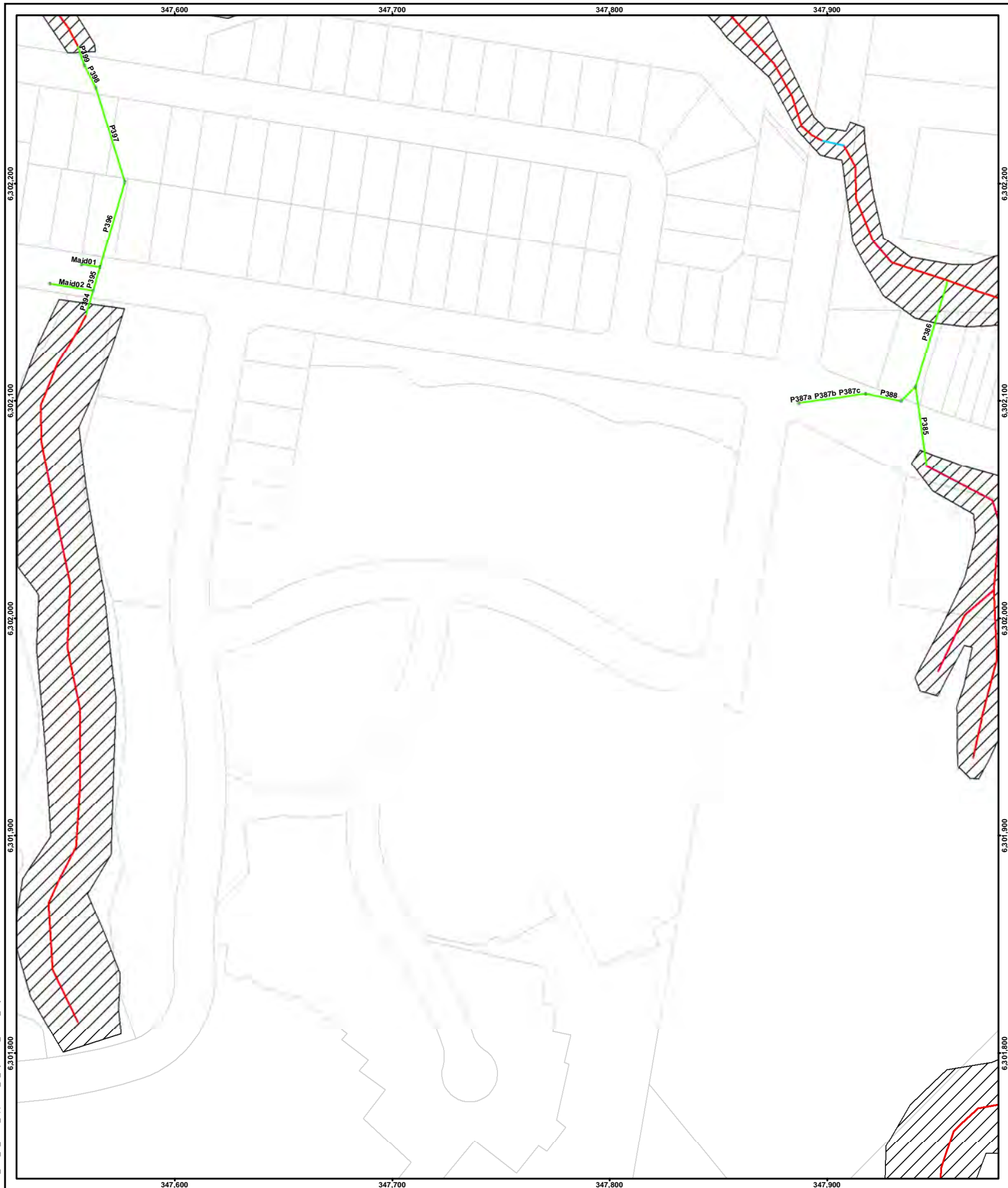
DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-27

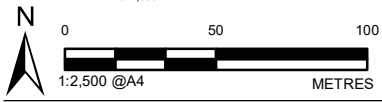
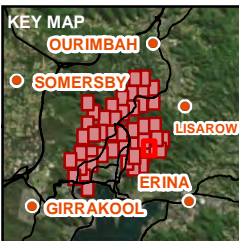
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



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- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastr, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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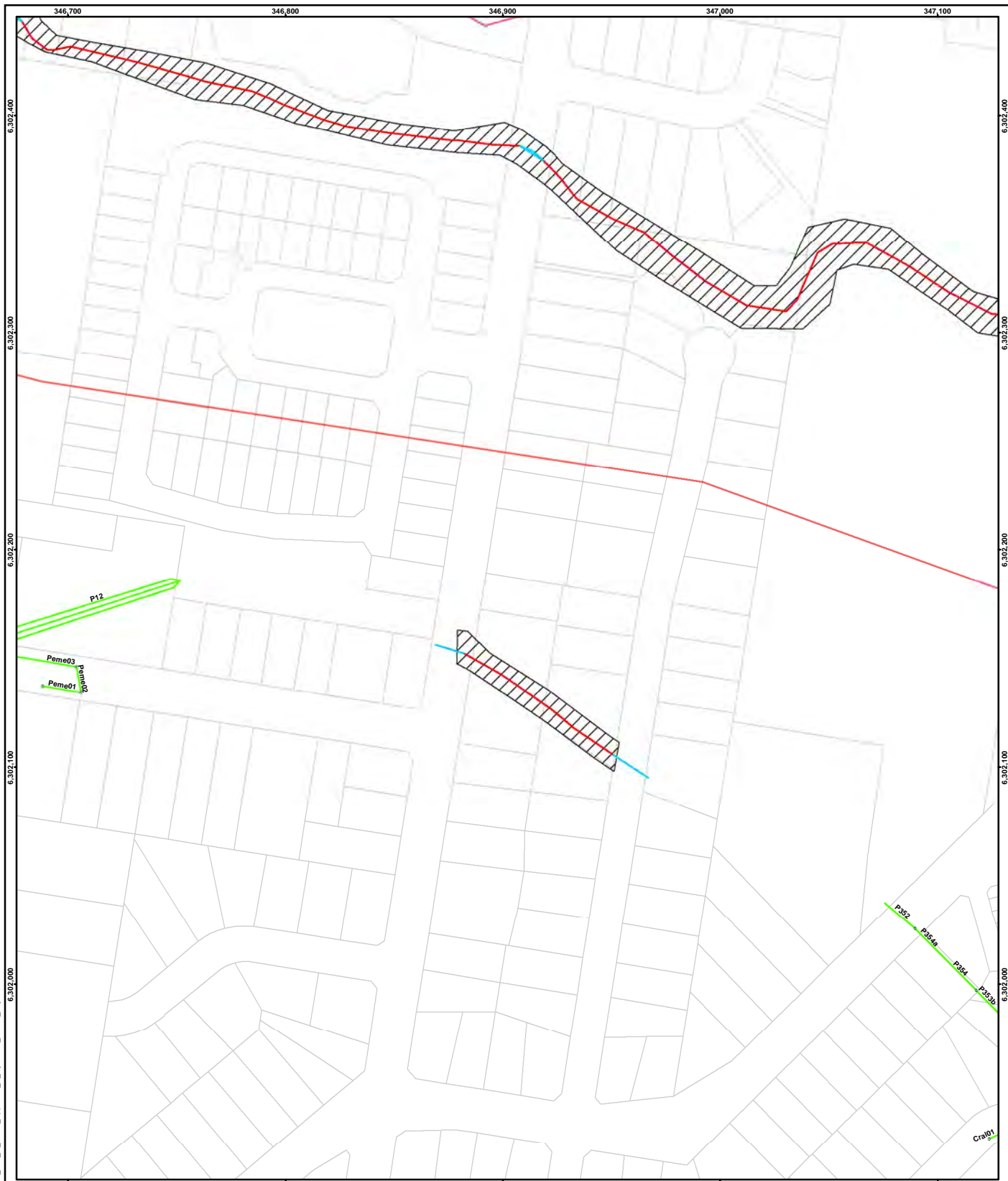
DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

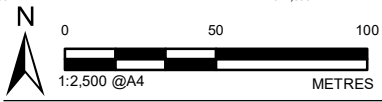
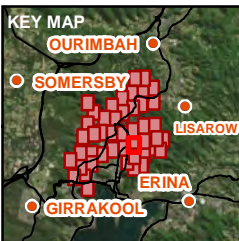
TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-28

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

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DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

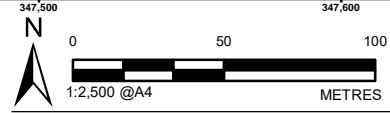
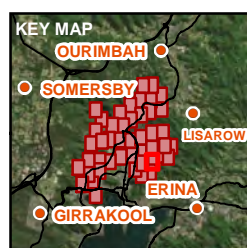
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-29

PATH: R:\01 Client\Gosford City Council\097626068\PROJECTS\Updates\Mapping\_Mar18\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:37 AM  
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- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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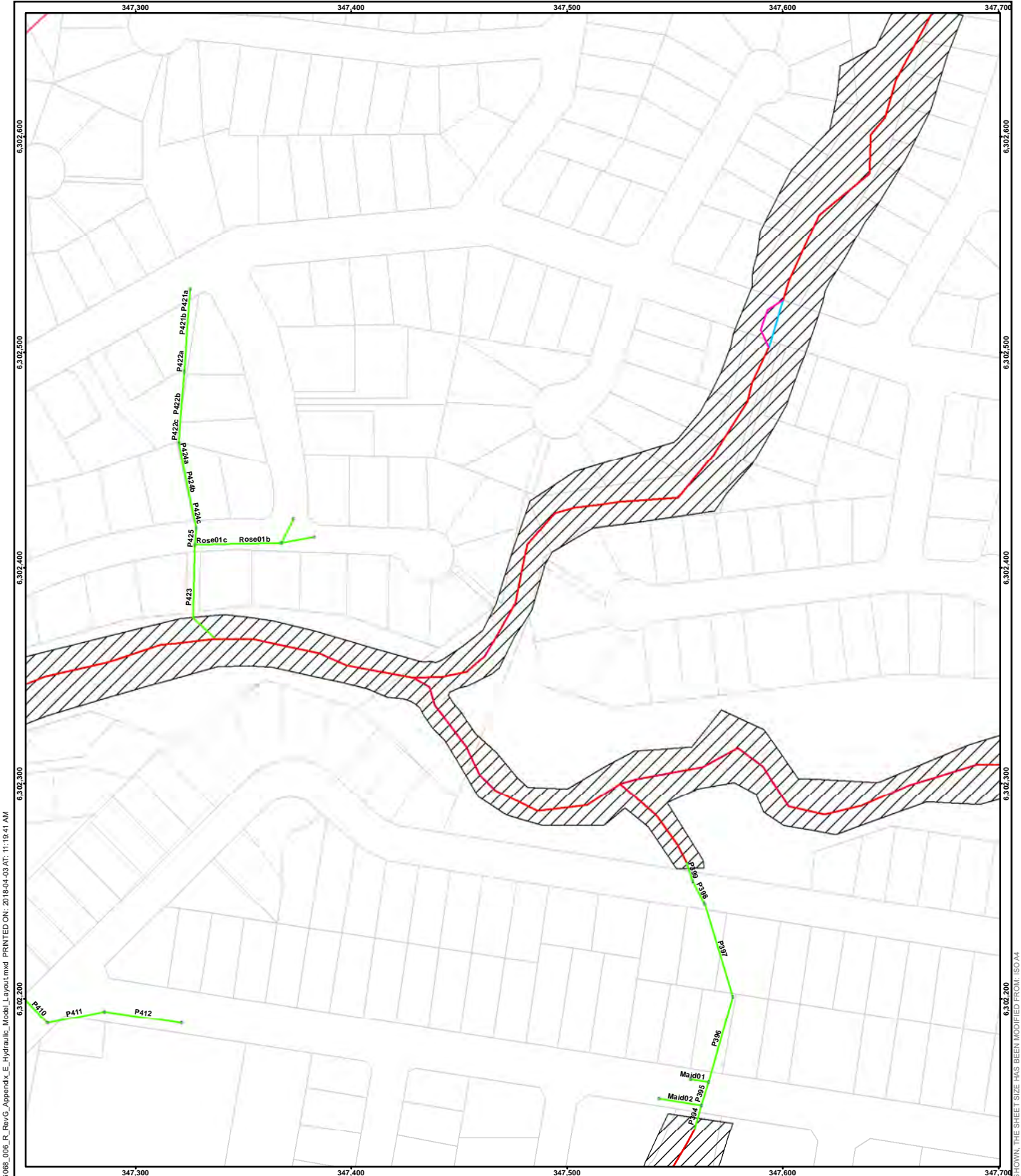
CONSULTANT	DD/MM/YYYY	3/04/2018
	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-30

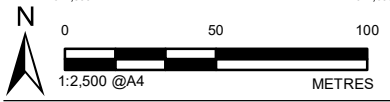
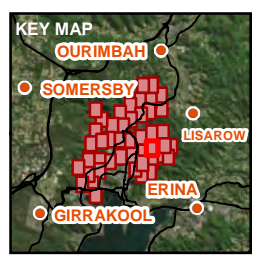
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unsurveyed Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

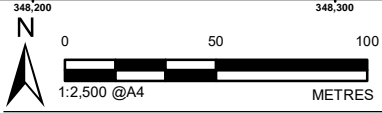
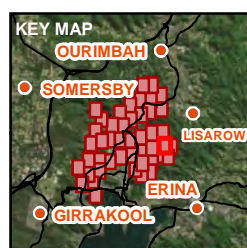
TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-31



PATH: R:\01 Client\Goldara City Council\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:44 AM

- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

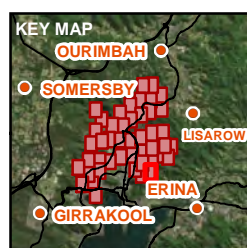
TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-32

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-33

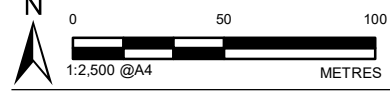
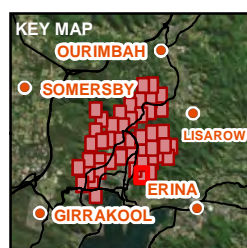
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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
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DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT		<b>NARARA CREEK FLOOD STUDY</b>	
TITLE		<b>HYDRAULIC MODEL LAYOUT</b>	
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-34

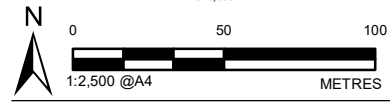
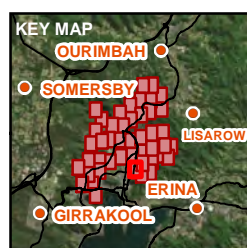
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- Legend**
- Localities
  - Unsurveyed Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



**NOTE(S)**  
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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastra, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

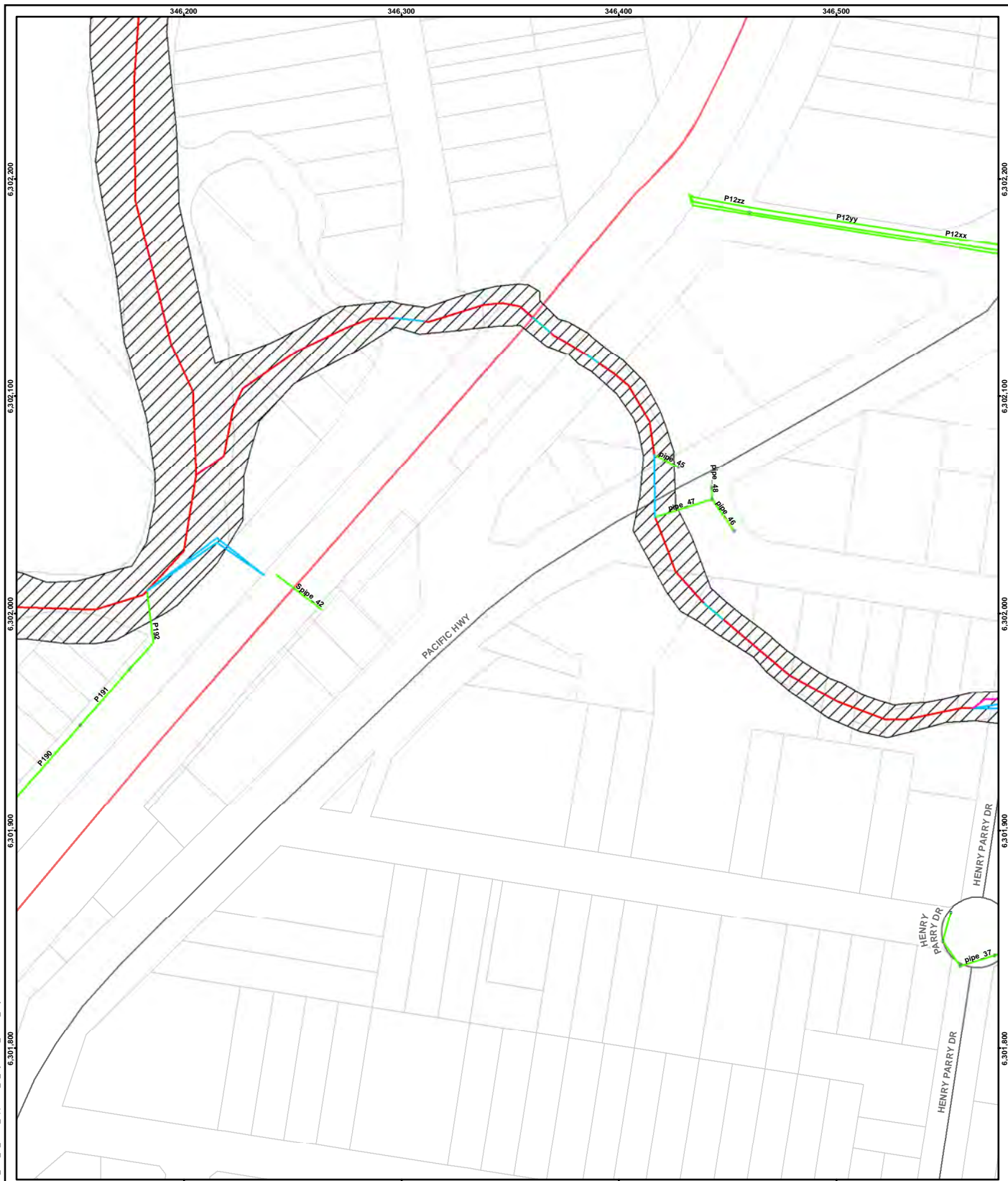


PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

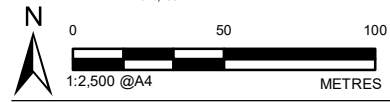
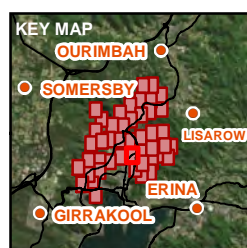
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-35

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 IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



PATH: R:\01 Client\Geosford City Council\097620608\097620608\_006\_r\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:54 AM

- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastr, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

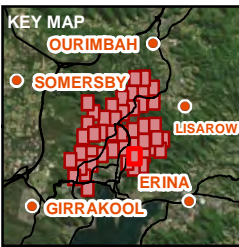
PROJECT NO.	CONTROL	REV.	FIGURE
097620608	006	G	Appendix E-36

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-37

PATH: R:\01 Client\Gosford City Council\097626068\097626068\_006\_R\_RevG\_Appendix E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:56 AM

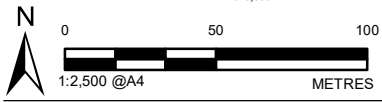
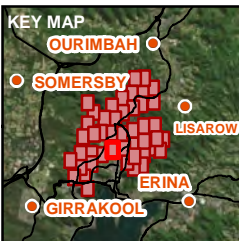
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



PATH: R:\01 Client\Gold Coast City Council\097626068\PROJECTS\Updated\Mapping\_Mar18\097626068\_006\_R\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:19:59 AM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - 1D Extent within 2D Model
  - Drainage Sub-Catchment
  - Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

**CONSULTANT**

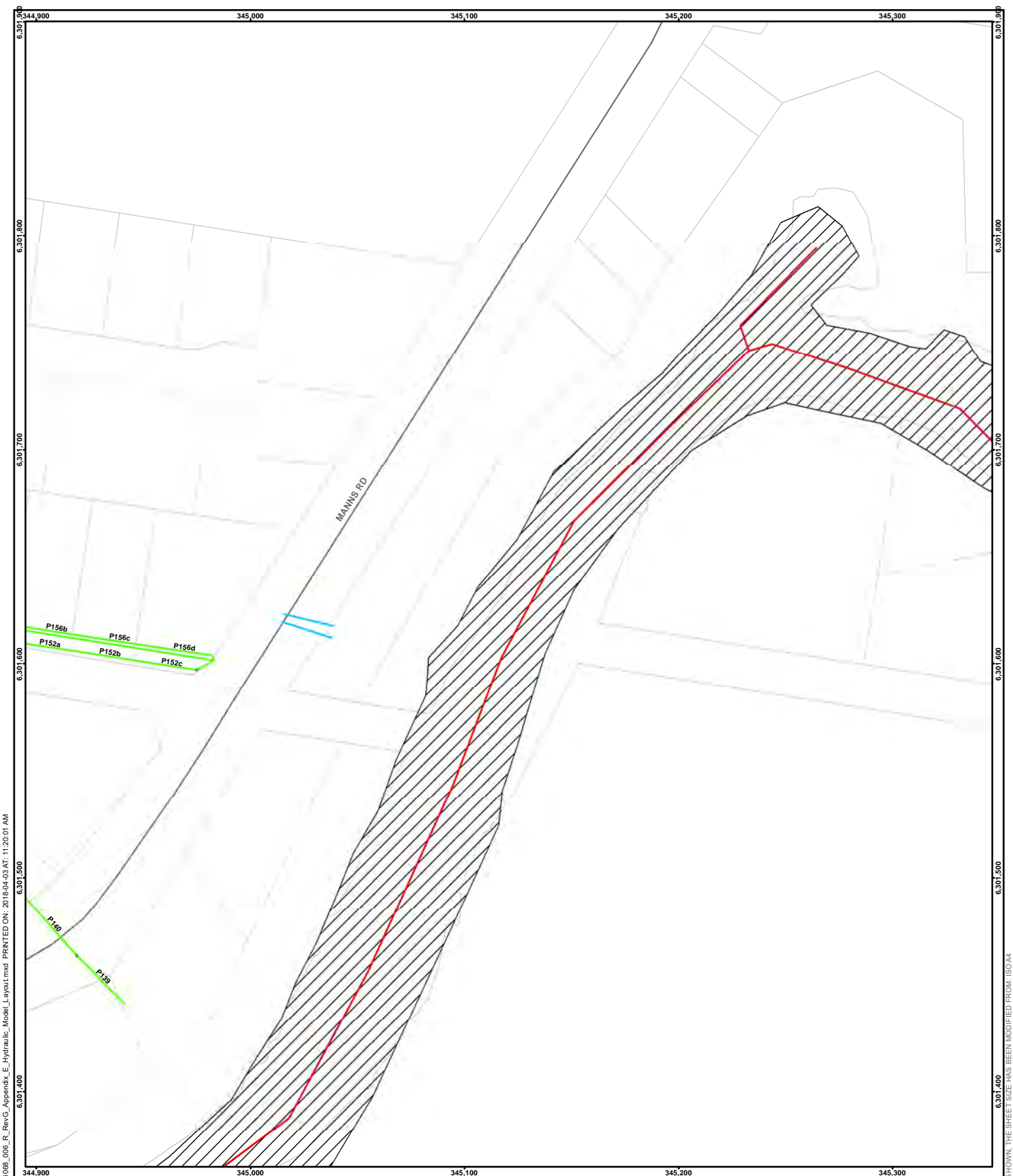


DD/MM/YYYY	3/04/2018
DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

**PROJECT**  
**NARARA CREEK FLOOD STUDY**

**TITLE**  
**HYDRAULIC MODEL LAYOUT**

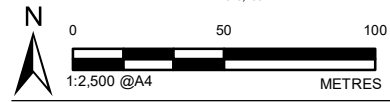
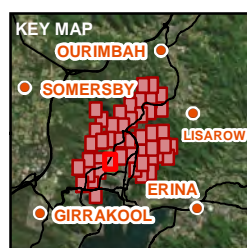
PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-38



PATH: R:\01 Client\Gosford City Council\097626068\_006\_R\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:20:01 AM

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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



**NOTE(S)**  
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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-39

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

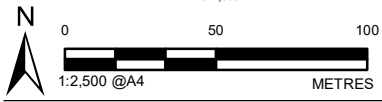
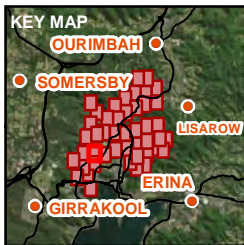


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25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

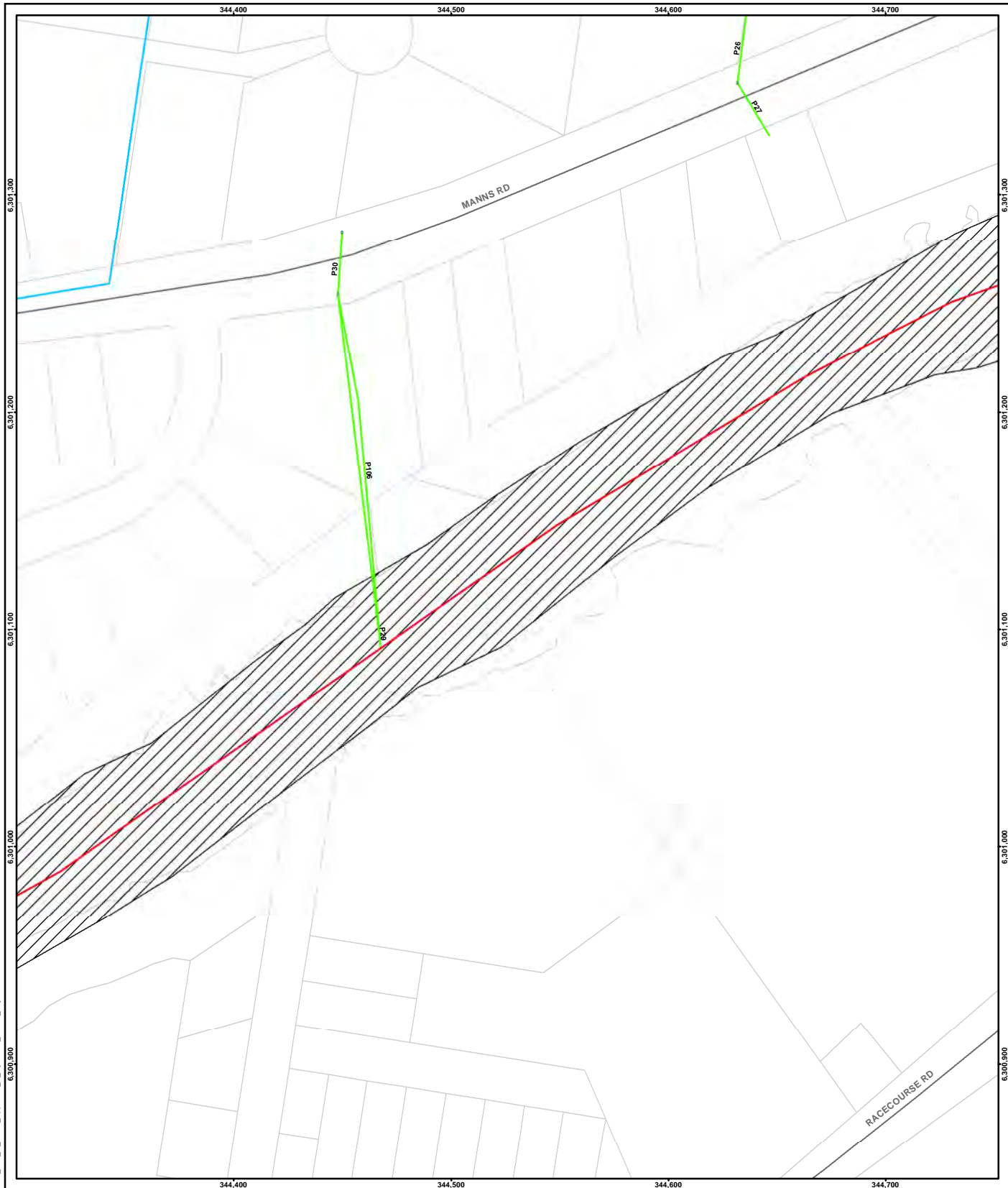
PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-40

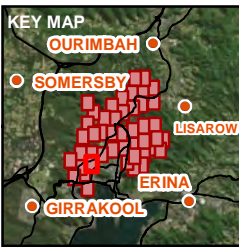


PATH: R:\01 Client\Gosford City Council\097620608\PROJECTS\Updated\_Mapping\_Mar18\097620608\_006\_R\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:20:05 AM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

**PROJECT**

**NARARA CREEK FLOOD STUDY**

**TITLE**

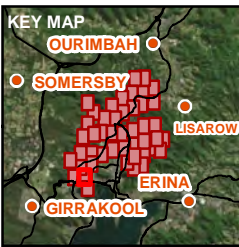
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097620608	006	G	Appendix E-41



**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- ▨ 1D Extent within 2D Model
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-42

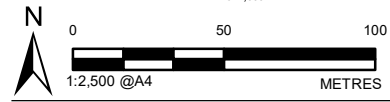
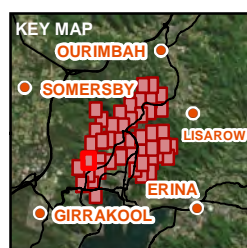
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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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	DESIGNED	HB
	PREPARED	BG
	REVIEWED	NM
	APPROVED	NM



PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-43

PATH: R:\01 Client\Gosford City Council\097626068\PROJECTS\Updates\Mapping\_Mar18\097626068\_006\_F\_RevG\_Appendix\_E\_Hydraulic\_Model\_Layout.mxd PRINTED ON: 2018-04-03 AT: 11:20:10 AM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4

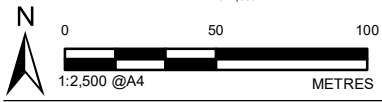
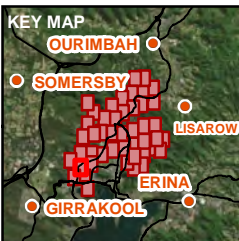


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6.300,800  
6.300,700  
6.300,600  
6.300,500  
6.300,400  
6.300,300  
6.300,200  
6.300,100

**Legend**

- Localities
- Unserved Pit
- Structures
- Main Roads
- Surveyed Structures
- Unserved Pipe
- Weir
- Open Channel
- ▨ 1D Extent within 2D Model
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



**NOTE(S)**  
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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-44

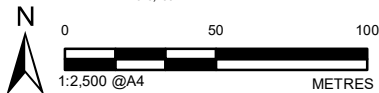
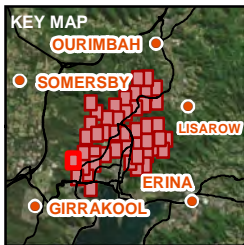
25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



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**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**REFERENCE(S)**

**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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DD/MM/YYYY      3/04/2018

DESIGNED          HB

PREPARED        BG

REVIEWED        NM

APPROVED        NM

PROJECT

**NARARA CREEK FLOOD STUDY**

TITLE

**HYDRAULIC MODEL LAYOUT**

PROJECT NO.  
 097626068

CONTROL  
 006

REV.  
 G

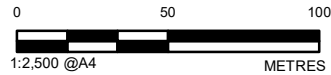
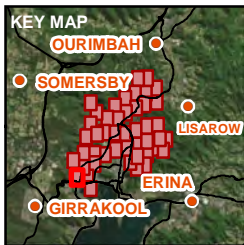
FIGURE  
**Appendix E-45**

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Unsurveyed Pit
- Structures
- Main Roads
- Surveyed Structures
- Unsurveyed Pipe
- Weir
- Open Channel
- 1D Extent within 2D Model
- Drainage Sub-Catchment
- Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**

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**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

**PROJECT**

**NARARA CREEK FLOOD STUDY**

**TITLE**

**HYDRAULIC MODEL LAYOUT**

PROJECT NO. 097626068 CONTROL 006

REV. G FIGURE Appendix E-46

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**CENTRAL COAST COUNCIL**

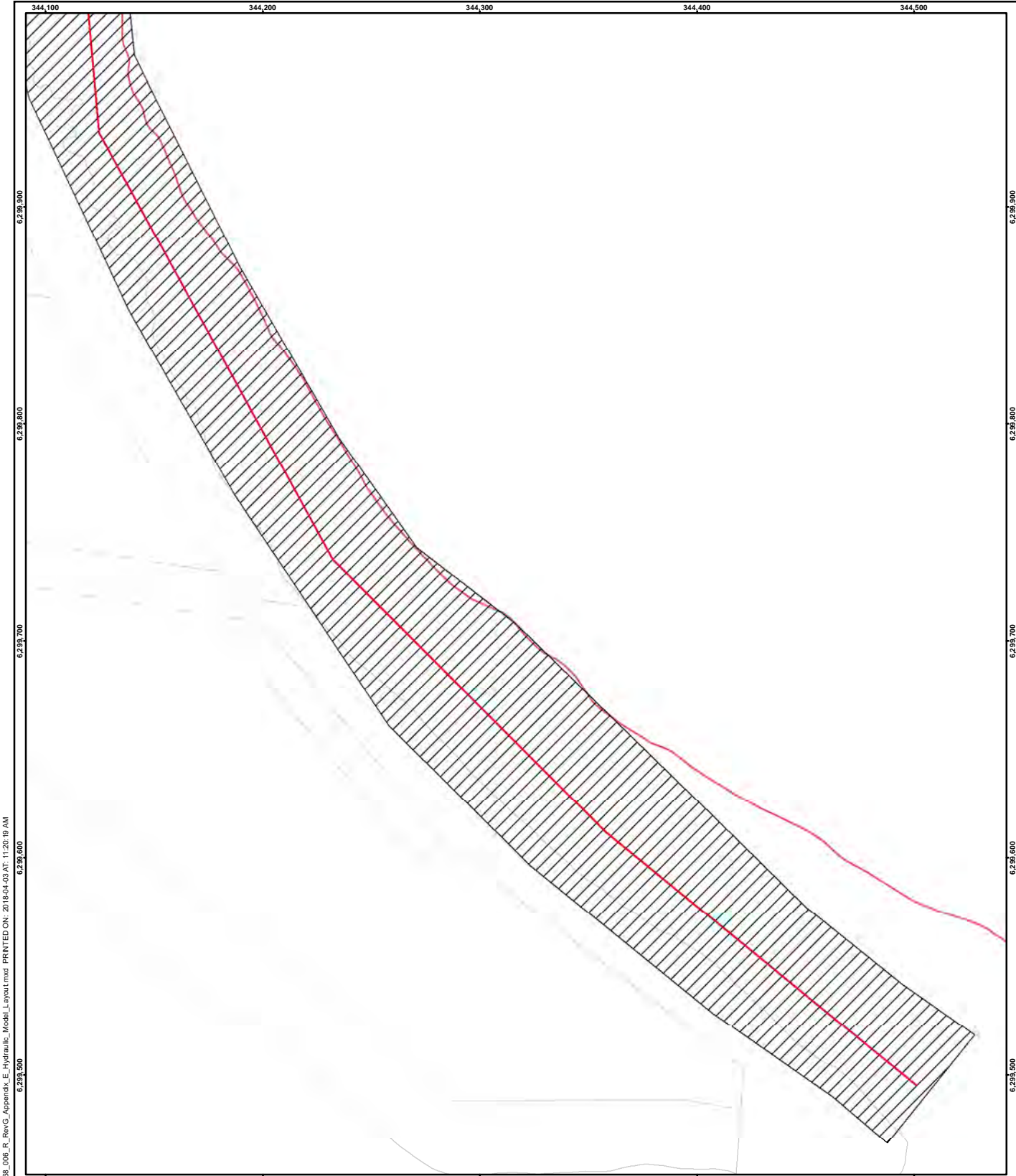
CONSULTANT



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DESIGNED	HB
PREPARED	BG
REVIEWED	NM
APPROVED	NM

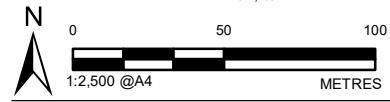
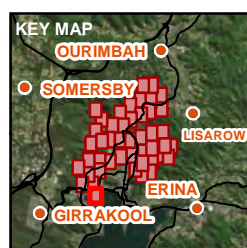
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- Legend**
- Localities
  - Unserved Pit
  - Structures
  - Main Roads
  - Surveyed Structures
  - Unserved Pipe
  - Weir
  - Open Channel
  - ▨ 1D Extent within 2D Model
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Drainage Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**



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PREPARED	BG
REVIEWED	NM
APPROVED	NM

PROJECT  
**NARARA CREEK FLOODED STUDY**

TITLE  
**HYDRAULIC MODEL LAYOUT**

PROJECT NO.	CONTROL	REV.	FIGURE
097626068	006	G	Appendix E-47

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ISO A4





























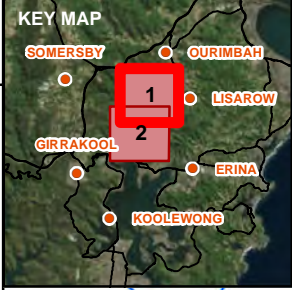
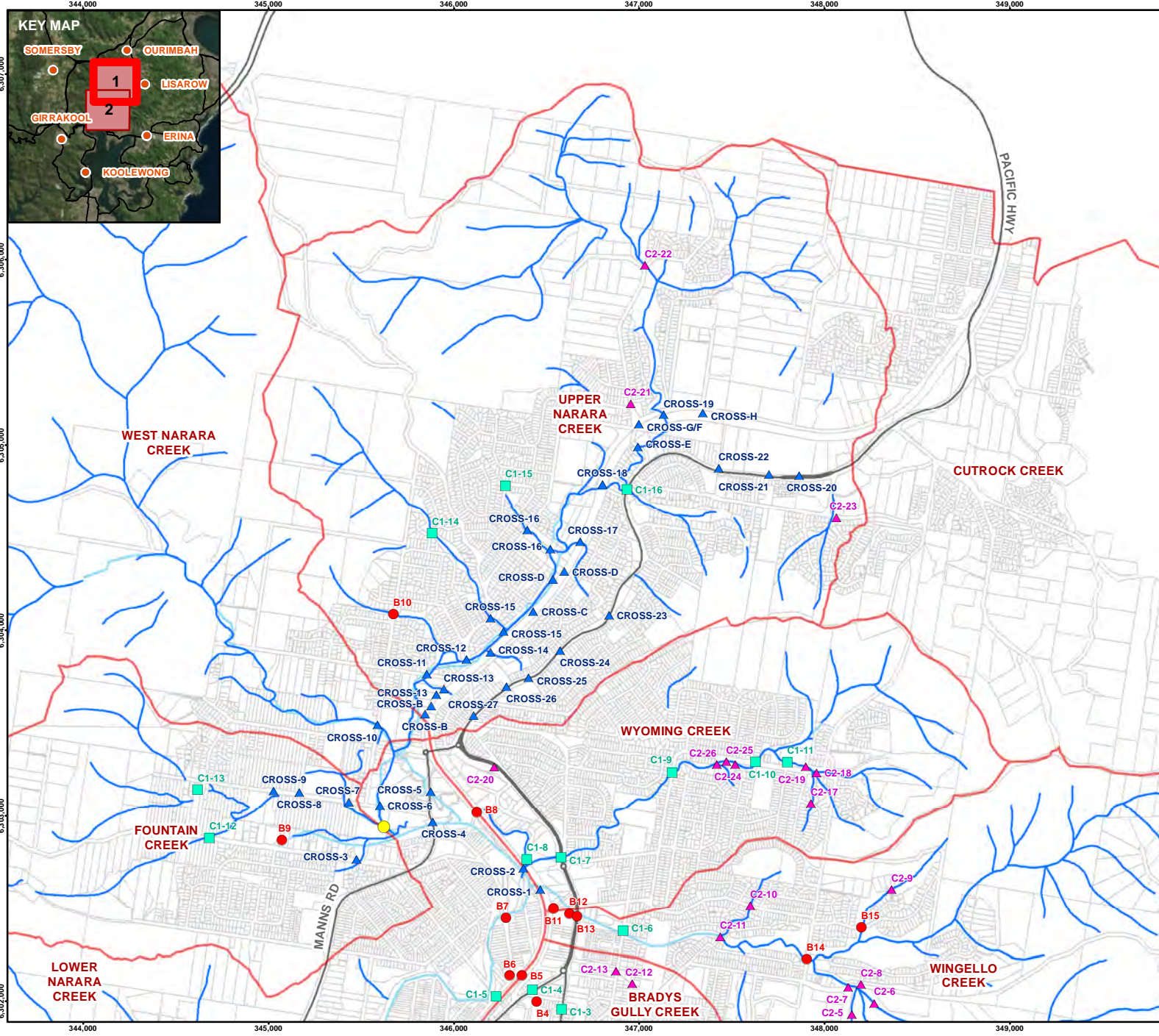




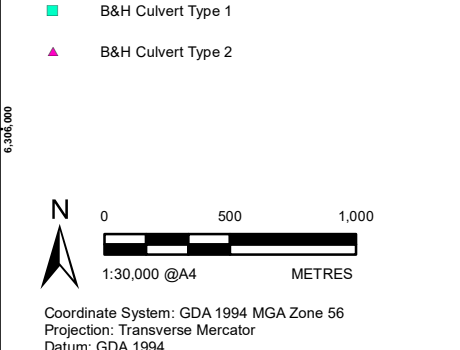
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S028	C	F	V	15.513	0.017	0.233	6.204	1.7	0	0	0	1.047	0	1	1	1	0.5	1	0	3	0.3	S081	Node	F	1.87	1.5X	2.4	0	0	0	1	
S031	C	F	V	18.859	0.017	0.201	6.158	0	0	0	0	1.051	0	1	1	1	0.5	1	0	3	0.3	S082	MH	F	0.74	0	0	0	0	0	1	
S034	C	F	V	8.652	0.017	0.233	6.231	1.7	0	0	0	1.057	0	1	1	1	0.5	1	0	3	0.3	S082	MH	F	0.63	0	0	0	0	0	1	
S035	D	F	N	0.001	0.017	2.392	2.392	0	0	0	0	1	0	0	0	0	0	0	0	0	0	S082	MH	F	0.54	0	0	0	0	0	1	
S037	D	F	N	0.001	0.017	10.071	10.071	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	S082	MH	F	2.2	0	0	0	0	0	1
S038	C	F	V	44.713	0.017	2.4	1.64	1.4	0	0	0	1.35	0	1	1	1	0.5	1	0	3	1.2	S090	MH	F	0.44	0.5	0	0	0	0	1	
S039	D	F	N	0.001	0.017	5.444	5.444	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	S090	MH	F	2.23	1.5X	2.4	0	0	0	1
S040	C	F	V	11.362	0.017	18.299	18.217	2.2	0	0	0	0.523	0	1	1	1	0.5	1	0	4	0.7	S091	MH	F	0.53	0	0	0	0	0	1	
S0401a	C	F	V	12.848	0.017	18.238	18.125	0	0	0	0	0.523	0	1	1	1	0.5	1	0	4	0.7	S091	Node	F	0.16	0	0	0	0	0	1	
S0402	C	F	V	13.613	0.017	18.36	18.3	0	0	0	0	0.45	0	1	1	1	0.5	1	0	4	0.5	S092	MH	F	0.45	0	0	0	0	0	1	
S0403	C	F	V	13.924	0.017	18.4	18.3	0	0	0	0	0.45	0	1	1	1	0.5	1	0	4	0.7	S092	MH	F	0.37	0	0	0	0	0	1	
S0404	C	F	V	13.924	0.017	18.3	18.3	0	0	0	0	0.449	0	1	1	1	0.5	1	0	4	0.7	S092	MH	F	0.33	0	0	0	0	0	1	
S0405	C	F	V	21.832	0.017	24.6	24.4	0	0	0	0	1.8	0.8	1	1	1	0.5	0.9	0.5	1	0	4	S092	MH	F	0.25	0	0	0	0	0	1
S0406	C	F	V	26.147	0.017	34.8	34.4	0	0	0	0	1.2	0.8	2	1	1	1	0.5	1	0	4	5.4	S092	MH	F	0.2	0	0	0	0	0	1
S0407	C	F	V	15.423	0.017	15.423	15.423	0	0	0	0	0.28	0	1	1	1	0.5	1	0	3	1.2	S093	MH	F	0.26	0.3	0	0	0	0	1	
S0408	C	F	V	28	0.017	0.2	0.24	0	0	0	0	0.5	0	1	1	1	0.5	1	0	3	1.2	S093	Node	F	2.35	1.5X	2.4	0	0	0	1	
S0409	C	F	V	26.381	0.017	2.7	0.5	0	0	0	0	0.5	0	1	1	1	0.5	1	0	4	8.3	S096	MH	F	0.25	0.5	0	0	0	0	1	
S_Bank01	C	F	V	4.229	0.017	8.17	10.74	0	0	0	0	0.375	0	1	1	1	0.5	1	0	3	22.8	S095	Node	F	2.44	1.5X	2.4	0	0	0	1	
S_Jam01	C	F	V	9.503	0.017	10.85	9.403	0	0	0	0	0.4	0	1	1	1	0.5	1	0	3	13.1	S097	MH	F	8.35	0.5	0	0	0	0	1	
T0401	C	F	V	7.999	0.017	14.927	14.537	1.4	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	S097	Node	F	10.07	1.5X	2.4	0	0	0	1	
T0402	C	F	V	17.394	0.017	14.531	14.328	1.7	0	0	0	0.45	0	1	1	1	0.5	1	0	4	1.2	S098	MH	F	3.95	0.5	0	0	0	0	1	
T0402a	C	F	V	15.419	0.017	14.333	14.151	1.4	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	S098	Node	F	5.44	1.5X	2.4	0	0	0	1	
T0403	C	F	V	18.275	0.017	14.151	13.91	1.4	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	S098	MH	F	3.23	0	0	0	0	0	1	
T0403a	C	F	V	16.639	0.017	13.811	13.561	1.4	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	S098	Node	F	24.73	0	0	0	0	0	1	
W1	W	F	V	27	0	81.5	31.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0102	Node	F	24.73	0	0	0	0	0	1	
W10	W	F	V	29	0	29.97	29.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0102	Node	F	24.6	0	0	0	0	0	1
W11	W	F	V	30	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0102	Node	F	24.6	0	0	0	0	0	1
W12	W	F	V	30	0	16.44	16.44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	34.8	0	0	0	0	0	1
W17	W	F	V	33.1	0	18.961	18.961	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	33.4	0	0	0	0	0	1
W18	W	F	V	32	0	15.657	15.657	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	0.65	0	0	0	0	0	1
W19	W	F	V	31	0	10.667	10.667	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	2.7	0	0	0	0	0	1
W20	W	F	V	34	0	14.5	14.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	0.5	0	0	0	0	0	1
W3	W	F	V	38	0	13.855	13.855	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S0103	Node	F	11.7	0	0	0	0	0	1
W4	W	F	V	35.068	0.017	15.068	15.068	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	S_Bank01	Node	F	10.65	0	0	0	0	0	1
W5	W	F	V	37	0	46.027	46.027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	T0402	MH	F	14.33	0	0	0	0	0	1
W6	W	F	V	37.5	0	16.49	16.49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	T0402	MH	F	13.81	0	0	0	0	0	1
W0401	C	F	V	17.934	0.017	18.023	17.733	1.4	0	0	0	0.375	0	1	1	1	0.5	1	0	4	1.2	W0401.2	MH	F	3.73	0	0	0	0	0	1	
W0402	C	F	V	16.432	0.017	17.78	17.467	0	0	0	0	0.453	0	1	1	1	0.5	1	0	4	1.6	W0401a.2	MH	F	17.46	0	0	0	0	0	1	
W0402b	C	F	V	7.999	0.017	17.467	17.249	0	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	W0402	MH	F	16.75	0	0	0	0	0	1	
W0403	C	F	V	11.377	0.017	17.249	17.14	0	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	W0402	MH	F	11.95	0	0	0	0	0	1	
W0403a	C	F	V	12.588	0.017	16.753	16.2	0	0	0	0	0.449	0	1	1	1	0.5	1	0	4	1.2	W0403	MH	F	15.29	0	0	0	0	0	1	
W0403b	C	F	V	14.277	0.017	16.198	15.85	1.4	0	0	0	0.602	0	1	1	1	0.5	1	0	4	1.2	W0403	MH	F	6.08	0	0	0	0	0	1	
W0403a	C	F	V	10.569	0.017	15.951	15.729	0	0	0	0	0.602	0	1	1	1	0.5	1	0	4	0.7	W0403b.2	Node	F	14.7	0	0	0	0	0	1	
W0404	C	F	V	23.898	0.017	15.729	15.295	1.4	0	0	0	0.75	0	1	1	1	0.5	1	0	4	1.6	W04.1	Node	F	4.38	0	0	0	0	0	1	
W0404a	C	F	V	19.811	0.017	15.237	14.937	0	0	0	0	0.75	0	1	1	1	0.5	1	0	4	1.6	W04.2	Node	F	6.57	0	0	0	0	0	1	
W0404b	C	F	V	13.069	0.017	14.939	14.702	0	0	0	0	0.75	0	1	1	1	0.5	1	0	4	1.6	W04.10	Node	F	5.48	0	0	0	0	0	1	
W0405	C	F	V	16.649	0.017	14.702	14.48	0	0	0	0	0.75	0	1	1	1	0.5	1	0	4	1.6	W04.11	Node	F	5.43	0	0	0	0	0	1	
W0405	C	F	V	9.398	0.017	9.324	9.112	0	0	0	0	0.375	0	1	1	1	0.5	1	0	4	1.2	W04.12	Node	F	5.43	0	0	0	0	0	1	
W0405	C	F	V	11.087	0.017	9.113	8.981	0	0	0	0	0.453	0	1	1	1	0.5	1	0	4	1.2	W04.12	Node	F	5.58	0	0	0	0	0	1	
W0406	C	F	V	8.863	0.017	8.868	8.876	0	0	0	0	0.453	0	1	1	1	0.5	1	0	4	1.2	W04.11	Node	F	5.58	0	0	0	0	0	1	
W0406	C	F	V	14.511	0.017	8.875	8.609	0	0	0	0	0.523	0	1	1	1	0.5	1	0	4	1.2	W04.12	Node	F	5.58	0	0	0	0	0	1	
W0407a	C	F	V	22.31	0.017	8.611	8.202	0	0	0	0	0.523	0	1	1	1	0.5	1	0	4	1.6	W04.11	Node	F	6.14	0	0	0	0	0	1	
W0407b	C	F	V	5.325	0.017	8.3	8.263	0	0	0	0	0.523	0	1	1	1	0.5	1	0	4	1.6	W04.12	Node	F	6.08	0	0	0	0	0	1	
W0408	C	F	V	9.35	0.017	8.262	8.199	0	0																							

APPENDIX F

Topographic and Hydrographic  
Survey



- Legend**
- Localities
  - Tidal Limit
  - B&H Bridge
  - ▲ Degotardi Bridge/Culvert
  - B&H Culvert Type 1
  - ▲ B&H Culvert Type 2
  - Main Roads
  - Narara Creek and Tributaries
  - ▭ Drainage Sub-Catchment
  - ▭ Cadastral Boundary



**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community  
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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Creek Lines, Sub-Catchment:** Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

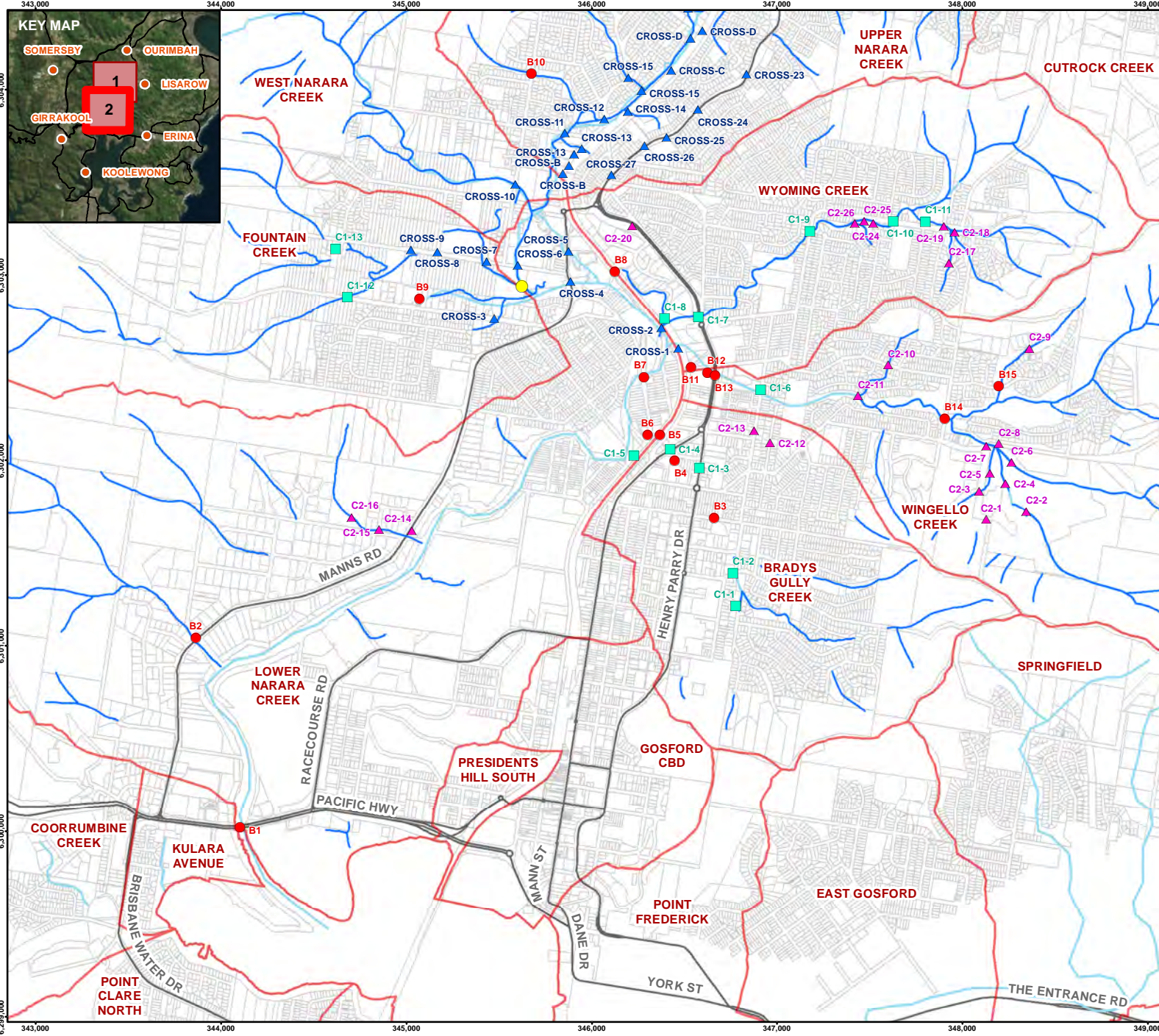
TITLE  
**INDEX OF SURVEYED HYDRAULIC STRUCTURES**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

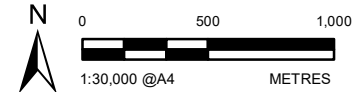
PROJECT NO. 097626068 CONTROL REV. 006 FIGURE G Appendix F - A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4



**Legend**

- Localities
- Tidal Limit
- B&H Bridge
- ▲ Degotardi Bridge/Culvert
- B&H Culvert Type 1
- ▲ B&H Culvert Type 2
- Main Roads
- Narara Creek and Tributaries
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary



Coordinate System: GDA 1994 MGA Zone 56  
 Projection: Transverse Mercator  
 Datum: GDA 1994

**NOTE(S)**  
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**Cadastral, Creek Lines, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**INDEX OF SURVEYED HYDRAULIC STRUCTURES**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM ISO A4

**APPENDIX G**

# Tabulated Model Output



1D Flows (m3/s)

ID	2	5	10	20	50	100	200	500	PMP
CROSS4	133.6	142.3	142.9	143.0	143.3	141.5	142.5	142.6	144.4
CROSS4.W	0.0	8.3	13.8	19.9	26.6	34.6	41.4	46.5	64.0
CH158	111.7	150.5	171.8	199.6	229.7	243.2	275.5	300.8	638.4
CH1259A	20.9	23.5	24.4	24.7	26.3	28.0	32.9	36.6	70.5
WN 5	26.1	31.1	33.6	37.2	40.2	42.2	46.3	50.0	107.0
WN 21	39.5	48.2	52.2	58.1	62.4	65.0	70.5	75.9	178.5
CH145	51.3	57.4	63.3	72.8	81.9	89.8	99.2	110.8	601.9
CH118	101.5	108.9	114.5	124.0	133.5	139.2	150.0	160.8	529.8
CH1006	129.5	161.8	178.5	203.0	226.2	249.7	275.4	312.7	858.3
CH35	152.7	214.7	251.1	303.4	352.1	377.1	399.3	423.6	943.5
CH98	147.4	207.2	240.7	289.9	339.9	375.6	418.8	478.5	1367.3
CH1236	154.9	218.9	254.7	292.9	341.7	387.3	431.1	482.7	757.6
CH404	8.8	13.0	15.1	18.2	21.5	26.9	30.0	34.9	118.0
S126	14.1	15.0	15.3	15.6	15.8	15.9	16.1	16.1	17.3
CH421	4.8	6.6	7.5	8.5	10.1	12.1	13.9	16.3	78.3
P4c	2.0	2.1	2.1	2.1	2.2	2.2	2.2	2.3	2.6
P11gg	0.1	0.4	0.6	0.6	1.0	0.7	0.7	0.7	0.3
P12b3	1.2	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.1
P12yy	0.4	0.4	0.4	0.4	0.6	0.5	0.5	0.5	0.3
CH394	16.3	25.2	29.9	35.1	39.9	46.7	52.4	60.4	142.0
CH407	14.5	22.2	25.9	30.0	33.2	40.7	45.8	53.7	169.3
CH1039	18.5	24.2	27.3	31.1	43.2	57.3	71.4	86.1	137.2
CH1032	17.6	21.8	23.8	26.1	32.3	36.3	40.3	46.2	139.7
CH1057	3.4	4.9	5.5	6.4	7.1	7.9	8.8	10.0	20.9
CH1049	16.6	21.4	23.6	27.7	39.9	52.4	62.9	74.9	256.5
CH1075	13.7	16.2	17.7	23.1	32.6	43.3	53.2	67.4	283.9
P1	7.6	8.5	9.0	9.4	9.4	9.5	9.6	9.6	9.6
CH1106	2.6	3.4	3.9	4.5	5.2	5.6	6.2	7.1	17.3
CH1126	19.4	25.1	25.3	28.3	30.4	34.4	39.0	45.1	158.3
CH1114B	2.8	4.4	5.3	6.7	8.1	9.2	10.2	11.4	43.0
CH1095	13.9	16.3	18.1	23.1	32.0	41.9	50.7	62.5	240.7
CROSS1	19.3	24.9	28.7	35.7	42.8	49.2	55.6	60.2	182.7
CROSS1.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.6
C8	2.5	2.9	3.1	3.5	4.2	4.5	4.9	5.0	4.8
CROSS2	20.2	26.0	29.8	37.0	44.3	52.4	60.8	73.8	180.3
CROSS2.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.7
S17	21.0	28.3	33.8	40.3	49.4	58.8	79.4	80.0	92.1
S17.W	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.7	38.6
CH214	16.5	22.6	26.5	34.6	43.0	50.7	58.5	69.3	225.7
CH1280	19.9	26.7	30.7	38.6	48.0	57.0	65.7	77.5	205.7
CH1283	9.9	13.9	16.9	21.0	24.8	28.0	31.9	39.4	130.1
C1-11	4.4	9.1	11.7	14.7	17.3	19.9	22.4	26.3	61.8
CH247	5.0	7.3	8.7	10.9	14.6	18.2	22.1	27.3	86.2
CH311	15.7	22.2	26.0	31.1	36.5	42.1	47.7	55.5	214.0
CHF 09	15.9	22.5	26.3	31.4	36.8	42.5	48.2	56.2	215.9
CH361	2.7	4.9	6.3	8.1	9.9	11.5	13.1	15.2	39.8
CHF 12a	16.4	19.7	21.0	22.6	23.8	25.0	26.2	28.0	46.4
CS10W	1.5	7.4	10.7	16.2	21.1	26.3	31.1	37.8	108.9
S43	10.8	11.7	11.9	12.2	12.4	12.5	12.5	12.6	13.7
CS15W	15.2	21.7	25.5	30.7	36.2	41.8	47.5	55.4	210.0
S38	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
CH373	5.3	6.5	7.9	8.8	9.6	10.0	11.2	12.7	34.7
CH371	3.4	5.5	6.8	8.0	7.4	8.0	8.8	9.9	25.8
CH165	129.8	174.1	195.4	223.1	253.1	267.4	302.6	333.7	777.1
WN 32	21.9	25.9	28.4	32.0	35.7	38.2	43.6	48.5	119.4
CH259	43.0	47.3	48.9	51.4	53.4	56.8	59.0	63.9	116.9
CH519	3.3	5.3	6.4	7.7	8.7	9.8	10.9	12.3	28.7
CH704	45.2	58.8	66.0	75.7	84.5	93.1	102.5	112.4	281.9
CH1271	49.5	60.8	66.9	77.1	87.7	98.6	109.2	123.0	350.2
CROSS14	3.9	4.3	4.8	5.3	5.5	5.7	5.8	6.0	6.5
CROSSC	2.3	2.6	2.7	2.7	2.8	2.9	3.0	3.0	3.1
S21	3.5	5.1	5.6	6.3	6.6	7.2	7.6	8.0	9.1
CROSS17	3.2	3.8	4.0	4.2	4.4	4.5	4.6	4.7	5.5
CROSS18	37.3	51.9	61.7	74.8	88.1	100.3	113.8	132.5	270.1
CROSS18.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.3
CH549	34.3	43.6	49.8	57.5	64.4	70.2	76.1	83.4	176.0
CH488A	4.1	5.5	7.5	10.1	12.1	13.8	15.4	17.3	39.8
C1-16	5.5	6.8	7.1	7.2	7.2	7.2	7.2	7.2	7.3
W4	0.0	0.0	1.2	4.3	6.7	9.1	11.2	13.9	41.3
CH871	3.9	5.8	6.4	7.2	8.1	9.4	10.4	12.3	25.9
CROSSF	3.5	4.9	5.0	5.0	5.0	5.0	5.0	5.1	5.1
CH576	34.8	48.8	57.3	69.7	82.7	94.4	107.3	127.2	339.9
CH589	32.6	46.7	54.7	66.3	77.6	88.3	101.2	120.6	371.2
CH876	12.0	15.5	17.4	23.7	30.4	39.0	47.8	59.2	198.9
CH906	13.8	20.7	24.1	28.4	31.9	36.1	40.2	46.0	112.3
CH911	11.6	17.2	20.0	23.6	26.3	29.5	32.7	37.3	88.8
CH891	18.4	24.5	27.7	34.6	41.7	50.3	60.7	75.7	279.6
CROSS19A	19.2	25.3	28.7	35.9	43.1	51.7	60.1	63.9	63.5
CROSS19A.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	78.0
CH665	5.9	8.4	9.8	11.8	13.1	14.7	16.2	18.3	39.9
CH685	1.9	2.7	3.1	3.6	3.9	4.3	4.6	5.1	13.9
CH676	1.9	2.9	3.4	4.0	4.4	4.9	5.4	6.1	12.7
S24	2.5	3.6	4.2	5.0	5.6	6.2	6.7	7.6	17.9
CH634	3.3	5.2	6.8	8.9	10.8	12.5	14.0	16.0	35.6
CH649	9.3	12.2	13.4	14.3	15.0	15.6	16.0	16.5	28.1
CH639	8.5	14.9	18.4	23.6	28.4	32.8	38.0	44.8	141.8
CH644	9.8	10.8	11.4	11.9	12.3	12.7	13.2	13.7	18.7
CH630	2.8	3.5	3.7	3.9	4.1	4.2	4.3	4.7	25.9
CH655	2.3	3.1	3.5	4.1	4.8	6.1	7.3	8.8	25.0
P702b	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.8	1.1
CH594A	18.9	26.2	30.1	35.7	41.0	45.6	50.1	55.8	129.8
CH691	43.7	59.0	68.5	82.6	94.5	102.2	107.6	114.3	265.5
CH117	147.6	200.7	229.3	269.9	308.5	346.2	384.2	435.8	1165.9
CH113	141.8	183.9	208.2	240.1	269.8	297.9	328.4	371.0	802.9
CH112	144.6	200.2	229.8	270.0	309.9	339.9	374.5	421.1	1066.2
CH62	16.1	22.6	27.3	34.8	42.1	48.7	54.7	63.4	182.0
S25	155.4	220.6	257.3	297.0	344.9	381.8	416.8	460.1	619.0
CH60	15.8	22.5	28.1	35.8	43.8	51.3	58.7	66.4	176.2
CH58	14.3	19.6	22.7	26.5	30.7	34.5	38.3	43.8	124.3
S19	41.7	41.5	42.1	42.2	42.2	42.5	42.3	42.4	43.6
S19.W	3.4	8.3	10.3	12.6	15.1	17.3	19.4	22.4	77.0
CH263	108.8	131.2	140.9	154.2	164.6	170.0	181.6	191.9	300.7
S20	38.4	43.8	46.7	49.4	51.9	53.6	55.3	57.3	62.7
S20.W	13.8	25.2	30.5	37.9	46.3	53.5	60.4	68.3	167.5

## 1D Velocity (m/s)

ID	2	5	10	20	50	100	200	500	PMP
CROSS4	2.3	2.5	2.5	2.5	2.5	2.4	2.5	2.5	2.5
CROSS4.W	0.1	1.1	1.3	1.5	1.6	1.6	1.7	1.7	1.8
CH158	1.3	1.5	1.6	1.8	1.9	1.9	2.0	2.1	2.5
CH1259A	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.3
WN 5	1.2	1.2	1.3	1.3	1.4	1.4	1.4	1.5	1.7
WN 21	1.2	1.4	1.4	1.5	1.5	1.5	1.6	1.6	2.2
CH145	0.9	1.0	1.0	1.0	1.0	1.0	1.1	1.1	3.4
CH118	1.0	1.1	1.0	1.1	1.1	1.1	1.2	1.2	2.0
CH1006	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.7	3.1
CH35	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.4
CH98	0.9	1.2	1.3	1.5	1.6	1.7	1.8	2.0	3.9
CH1236	1.0	1.3	1.5	1.6	1.8	2.0	2.1	2.2	2.7
CH404	0.9	0.9	0.9	1.0	1.0	1.1	1.1	1.3	3.4
S126	2.7	2.8	2.9	2.9	3.0	3.0	3.0	3.0	3.3
CH421	0.8	1.0	1.0	1.1	1.1	1.2	1.3	1.4	2.3
P4c	1.8	1.8	1.9	1.9	1.9	1.9	2.0	2.0	2.3
P11gg	0.3	0.3	0.3	0.4	0.6	0.4	0.4	0.4	0.1
P12b3	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1
P12yy	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4	0.3
CH394	2.1	2.4	2.3	2.4	2.4	2.4	2.5	2.6	3.3
CH407	1.7	1.9	2.0	2.1	2.2	2.4	2.5	2.7	4.5
CH1039	1.2	1.3	1.4	1.5	1.6	1.8	2.0	2.2	2.5
CH1032	1.1	1.2	1.3	1.3	1.4	1.4	1.4	1.4	1.9
CH1057	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.4
CH1049	1.9	2.0	2.1	2.2	2.2	2.2	2.2	2.2	2.9
CH1075	0.9	0.9	1.0	1.0	1.2	1.3	1.5	1.6	3.4
P1	3.3	3.8	4.0	4.1	4.2	4.2	4.2	4.2	4.3
CH1106	0.4	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.9
CH1126	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	1.1
CH1114B	1.6	1.8	1.9	2.0	2.1	2.2	2.3	2.4	3.6
CH1095	1.0	1.1	1.1	1.3	1.5	1.7	1.9	2.1	4.2
CROSS1	1.5	1.7	1.8	2.0	2.4	2.8	2.8	3.1	9.0
CROSS1.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2
C8	1.3	1.5	1.6	1.8	2.2	2.4	2.5	2.6	2.5
CROSS2	1.5	1.7	1.8	1.9	2.0	2.1	2.3	2.4	4.7
CROSS2.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
S17	2.0	2.6	3.2	3.6	3.9	4.0	7.4	7.4	8.5
S17.W	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.8	1.8
CH214	1.9	2.0	2.1	2.3	2.5	2.7	2.9	3.2	5.7
CH1280	1.6	1.7	1.6	1.8	1.8	1.8	1.9	2.0	2.9
CH1283	1.5	1.7	1.8	1.9	1.9	2.0	2.1	2.2	3.3
C1-11	0.9	1.0	1.0	1.1	1.2	1.3	1.4	1.5	2.1
CH247	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.8	1.2
CH311	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.9
CHF 09	0.6	0.6	0.7	0.6	0.7	0.7	0.7	0.8	1.2
CH361	0.7	0.7	0.7	0.8	0.8	0.7	0.8	0.8	1.2
CHF 12a	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7
CS10W	0.7	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.3
S43	1.6	1.8	1.8	1.9	1.9	1.9	1.9	1.9	2.1
CS15W	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
S38	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
CH373	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.4
CH371	1.0	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.8
CH165	1.6	1.8	1.9	2.1	2.2	2.3	2.4	2.6	3.9
WN 32	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.2	1.9
CH259	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	1.0
CH519	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.7
CH704	1.4	1.6	1.7	1.8	1.8	1.9	1.9	2.0	3.0
CH1271	1.5	1.5	1.5	1.5	1.6	1.6	1.7	1.8	3.0
CROSS14	3.4	3.8	4.3	4.7	4.9	5.0	5.1	5.3	5.7
CROSSC	3.7	4.1	4.2	4.2	4.4	4.6	4.7	4.7	4.9
S21	3.1	3.3	3.4	3.6	3.8	4.1	4.3	4.5	5.2
CROSS17	2.9	3.4	3.6	3.8	3.9	4.0	4.1	4.2	4.8
CROSS18	0.9	0.8	0.9	1.0	1.1	1.2	1.3	1.5	3.1
CROSS18.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
CH549	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.1	2.7
CH488A	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.4	1.9
C1-16	3.9	4.7	4.9	5.0	5.0	5.1	5.1	5.1	5.1
W4	0.0	0.0	0.7	0.9	1.0	1.0	1.1	1.2	1.6
CH871	1.1	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.4
CROSSF	2.8	3.9	3.9	3.9	3.9	3.9	4.0	4.0	4.0
CH576	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	2.5
CH589	1.3	1.3	1.3	1.4	1.5	1.5	1.6	1.7	2.9
CH876	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	2.1
CH906	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.3	1.7
CH911	1.3	1.4	1.5	1.6	1.6	1.7	1.7	1.8	2.3
CH891	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.9
CROSS19A	1.1	1.2	1.4	1.7	2.0	2.4	2.7	2.9	2.9
CROSS19A.W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.9
CH665	1.0	1.1	1.2	1.2	1.3	1.3	1.3	1.4	1.7
CH685	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.3	1.6
CH676	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.3
S24	1.7	1.9	2.0	2.2	2.2	2.3	2.4	2.5	6.8
CH634	0.6	0.6	0.7	0.9	1.0	1.0	1.1	1.1	1.5
CH649	0.9	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.6
CH639	0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.4
CH644	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.3
CH630	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1.6
CH655	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.8	1.4
P702b	2.1	2.1	2.1	2.0	2.1	2.1	2.1	2.1	2.0
CH594A	1.7	1.8	1.9	2.0	2.0	2.0	2.1	2.1	2.3
CH691	1.6	1.8	1.9	2.1	2.2	2.3	2.3	2.4	2.8
CH117	1.3	1.6	1.8	1.9	2.1	2.2	2.4	2.6	4.6
CH113	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	3.0
CH112	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	3.0
CH62	1.0	1.3	1.5	1.8	2.0	2.1	2.3	2.4	3.8
S25	0.9	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.4
CH60	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.6	2.5
CH58	0.9	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.6
S19	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.1
S19.W	0.9	1.3	1.4	1.5	1.6	1.6	1.7	1.8	2.4
CH263	2.3	2.6	2.7	2.9	2.9	3.0	3.1	3.2	3.7
S20	2.0	2.3	2.4	2.5	2.7	2.8	2.8	2.9	3.2
S20.W	1.3	1.6	1.7	1.8	1.9	2.0	2.1	2.1	2.7

1D\_Height (mAHd)

ID	2	5	10	20	50	100	200	500	PMP
CH156.1	3.2	3.7	3.9	4.2	4.4	4.6	4.8	5.1	7.9
CH156.1	3.2	3.7	3.9	4.2	4.4	4.6	4.8	5.1	7.9
CH158.2	2.7	3.1	3.3	3.6	3.8	4.0	4.2	4.5	7.4
CH1259A.2	4.1	4.4	4.5	4.7	4.9	5.0	5.2	5.4	8.2
WN 5.2	6.7	6.8	6.9	7.0	7.1	7.1	7.2	7.3	8.9
WN 21.2	8.4	8.6	8.6	8.8	8.9	9.0	9.1	9.2	10.9
CH145.2	2.5	2.9	3.1	3.4	3.7	3.9	4.1	4.4	7.2
CH118.2	2.3	2.8	3.0	3.3	3.6	3.8	4.0	4.3	7.1
CH1005.1	2.0	2.4	2.6	2.9	3.1	3.3	3.5	3.7	6.1
CH34.1	1.2	1.5	1.7	1.8	2.0	2.2	2.3	2.5	4.5
CH38.1	1.4	1.8	2.0	2.2	2.4	2.6	2.7	2.9	4.9
CH1236.2	1.0	1.2	1.3	1.4	1.5	1.6	1.8	1.9	3.9
CH404.2	10.0	10.4	10.6	10.9	11.2	11.3	11.3	11.4	11.8
P2.1	6.3	6.4	6.4	6.5	6.5	6.6	6.7	6.8	7.8
GH421.2	12.4	12.5	12.5	12.6	12.6	12.7	12.7	12.7	13.8
P4c.2	16.4	16.5	16.5	16.5	16.6	16.6	16.6	16.7	17.4
P11gg.2	2.4	2.9	3.1	3.4	3.7	3.9	4.2	4.6	7.1
P12b3.2	2.5	2.9	3.2	3.4	3.7	4.0	4.2	4.6	7.1
P12yy.2	2.4	2.9	3.1	3.4	3.7	3.9	4.2	4.6	7.1
CH394.2	3.4	3.9	4.2	4.5	4.6	4.7	4.8	5.1	7.1
CH407.2	8.0	8.2	8.3	8.4	8.5	8.6	8.7	8.9	9.8
CH1039.2	3.0	3.2	3.4	3.7	4.1	4.4	4.7	5.0	7.1
CH1032.2	5.8	5.9	6.0	6.1	6.4	6.7	6.9	7.2	9.0
CH1050.1	8.8	8.9	8.9	8.9	9.0	9.0	9.0	9.1	10.4
CH1046.1	6.8	7.0	7.1	7.2	7.4	7.7	7.9	8.2	10.3
CH1075.2	8.2	8.3	8.4	8.5	8.8	9.0	9.1	9.3	11.0
P1.2	10.3	10.4	10.4	10.7	10.8	10.9	10.9	11.1	12.6
CH1106.2	12.7	13.4	13.8	14.3	14.5	14.6	14.7	14.8	15.6
CH1126.2	12.9	13.4	13.8	14.3	14.5	14.6	14.7	14.8	15.6
CH11148.2	13.8	13.9	13.9	14.3	14.5	14.7	14.8	14.9	15.7
CH1091.1	8.9	9.0	9.0	9.2	9.4	9.5	9.7	9.9	11.6
CH150.1	2.6	3.0	3.2	3.5	3.7	3.9	4.1	4.4	7.4
CH150.1	2.6	3.0	3.2	3.5	3.7	3.9	4.1	4.4	7.4
C8.2	2.6	3.0	3.2	3.5	3.8	4.0	4.4	4.7	7.3
CH160.1	2.6	3.0	3.2	3.5	3.8	4.0	4.2	4.5	7.3
CH160.1	2.6	3.0	3.2	3.5	3.8	4.0	4.2	4.5	7.3
CH170.1	2.6	3.0	3.2	3.5	3.8	4.0	4.4	4.7	7.3
CH170.1	2.6	3.0	3.2	3.5	3.8	4.0	4.4	4.7	7.3
CH214.2	8.1	8.2	8.2	8.4	8.5	8.5	8.6	8.7	9.5
CH1279.1	4.6	4.8	5.0	5.2	5.3	5.5	5.6	5.8	7.3
CH1283.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	11.0	12.2
C1-11.2	14.0	14.2	14.3	14.3	14.4	14.5	14.5	14.6	15.5
CH231.1	13.0	13.2	13.3	13.4	13.5	13.7	13.9	14.1	15.4
GH311.2	9.5	9.7	9.8	9.9	10.0	10.1	10.2	10.3	11.6
CHF 09.2	7.9	8.1	8.2	8.3	8.3	8.4	8.5	8.6	9.9
CH361.2	11.8	12.2	12.4	12.5	12.6	12.7	12.7	12.8	13.3
CHF 12a.2	7.1	7.2	7.3	7.4	7.4	7.5	7.5	7.6	8.6
CH347.1	10.2	10.4	10.4	10.6	10.7	10.8	10.8	11.0	11.8
CH347.1	10.2	10.4	10.4	10.6	10.7	10.8	10.8	11.0	11.8
CH1309.1	9.2	9.4	9.5	9.6	9.6	9.7	9.8	9.9	11.2
CH1309.1	9.2	9.4	9.5	9.6	9.6	9.7	9.8	9.9	11.2
CH373.2	6.0	6.0	6.0	6.1	6.1	6.1	6.1	6.1	8.3
CH371.2	6.0	6.2	6.4	6.5	6.6	6.7	6.7	6.8	8.2
CH153.1	3.0	3.4	3.6	3.9	4.2	4.4	4.6	4.8	7.7
WN 31.1	9.5	9.7	9.7	9.9	10.0	10.1	10.2	10.3	11.9
CH259.2	5.6	5.8	5.9	6.0	6.1	6.2	6.3	6.4	8.4
CH519.2	8.2	8.3	8.3	8.4	8.4	8.4	8.5	8.6	10.1
CH704.2	8.8	9.1	9.2	9.4	9.6	9.8	9.9	10.1	11.8
CH1271.2	8.4	8.8	8.9	9.1	9.2	9.4	9.5	9.7	11.3
CH1272.2	8.4	8.7	8.9	9.0	9.2	9.4	9.5	9.6	11.2
CH694.2	9.1	9.4	9.5	9.7	9.9	10.0	10.2	10.3	12.1
S21.2	9.9	10.2	10.4	10.6	10.8	10.9	11.0	11.2	13.0
CROSS17.2	10.5	10.8	10.9	11.1	11.3	11.4	11.5	11.6	13.3
CH559.1	12.6	12.8	13.0	13.2	13.3	13.5	13.6	13.7	14.9
CH559.1	12.6	12.8	13.0	13.2	13.3	13.5	13.6	13.7	14.9
CH549.2	11.5	11.7	11.8	11.9	12.0	12.1	12.2	12.3	13.6
CH488A.2	14.4	14.5	14.7	14.8	14.9	15.0	15.1	15.2	15.8
C1-16.2	13.6	13.7	13.8	14.0	14.1	14.2	14.3	14.4	16.0
C1-16.2	13.6	13.7	13.8	14.0	14.1	14.2	14.3	14.4	16.0
CH871.2	17.1	17.2	17.3	17.3	17.3	17.3	17.4	17.4	17.7
CROSSF.2	14.2	14.6	14.7	14.9	15.1	15.2	15.3	15.6	17.2
CH576.2	13.5	13.8	14.0	14.2	14.4	14.6	14.7	15.0	16.6
CH589.2	14.3	14.7	14.9	15.1	15.2	15.4	15.5	15.8	17.5
CH876.2	19.5	19.8	19.9	20.1	20.4	20.7	20.9	21.2	23.5
CH906.2	18.6	18.9	19.0	19.2	19.3	19.4	19.5	19.7	21.4
CH911.2	22.3	22.6	22.7	22.8	22.9	23.0	23.1	23.3	24.4
CH891.2	17.3	17.5	17.6	17.8	18.0	18.2	18.4	18.7	20.8
CH22.1	14.8	15.1	15.2	15.5	15.7	15.9	16.5	16.9	18.1
CH22.1	14.8	15.1	15.2	15.5	15.7	15.9	16.5	16.9	18.1
CH665.2	16.9	17.0	17.1	17.2	17.3	17.3	17.4	17.5	18.0
CH685.2	27.1	27.1	27.2	27.2	27.2	27.2	27.2	27.3	27.6
CH676.2	29.0	29.2	29.3	29.3	29.4	29.4	29.4	29.4	29.7
CH617.1	32.2	32.3	32.3	32.4	32.4	32.4	32.5	32.5	32.9
CH634.2	20.1	20.1	20.2	20.2	20.2	20.2	20.2	20.3	20.9
CH649.2	20.9	21.0	21.0	21.0	21.1	21.1	21.1	21.1	21.3
CH639.2	16.4	16.6	16.8	16.9	17.0	17.1	17.2	17.3	18.6
CH644.2	17.4	17.5	17.5	17.5	17.5	17.5	17.6	17.6	18.3
CH630.2	22.3	22.3	22.4	22.4	22.5	22.5	22.6	22.6	23.4
CH655.2	22.8	22.9	23.0	23.0	23.1	23.2	23.2	23.2	23.5
P702b.2	32.7	32.7	32.7	32.7	32.8	32.8	32.8	32.8	33.2
CH594A.2	15.0	15.3	15.4	15.6	15.8	15.9	16.0	16.2	18.0
CH691.2	9.4	9.8	9.9	10.1	10.3	10.4	10.5	10.7	12.5
CH117.2	2.2	2.6	2.8	3.1	3.4	3.6	3.8	4.0	6.6
CH113.2	1.8	2.2	2.5	2.7	2.9	3.1	3.3	3.5	5.9
CH111.1	1.6	2.0	2.2	2.4	2.6	2.8	3.0	3.2	5.5
CH62.2	1.4	1.7	1.9	2.1	2.3	2.5	2.6	2.8	4.9
CH27.1	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2	4.0
CH60.2	1.8	2.1	2.2	2.5	2.6	2.8	2.9	3.1	4.9
CH58.2	2.5	2.7	2.8	3.0	3.2	3.3	3.4	3.6	5.0
CH493.1	6.7	7.0	7.1	7.2	7.3	7.3	7.4	7.5	8.6
CH493.1	6.7	7.0	7.1	7.2	7.3	7.3	7.4	7.5	8.6
CH263.2	5.0	5.1	5.2	5.3	5.4	5.4	5.5	5.7	8.1
CH508.1	8.0	8.2	8.3	8.5	8.6	8.7	8.8	8.9	10.3
CH508.1	7.9808	8.2408	8.3362	8.4504	8.5782	8.6902	8.7896	8.8976	10.2651

ID	Height (m/ft)	All outputs	ID	2	5	10	20	50	100	200	500	PMP	ID	2	5	10	20	50	100	200	500	PMP	
B10-1	15.7	15.9	16.0	16.0	16.1	16.1	16.2	16.3	16.3	16.7	16.7	16.7	PH881-1	37.4147	37.4866	37.5002	37.5135	37.5289	37.5403	37.5504	37.5623	37.8921	37.8921
B10-2	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	15.7	PH881-2	37.4147	37.4866	37.5002	37.5135	37.5289	37.5403	37.5504	37.5623	37.8921	37.8921
B4-1	3.1	3.7	4.1	4.4	4.4	4.5	4.6	4.6	4.6	5.0	5.0	5.0	PH882-1	32.6389	32.6842	32.7092	32.7327	32.7418	32.7549	32.7674	32.7863	33.1208	33.1208
B4-2	3.1	3.7	4.1	4.4	4.4	4.5	4.6	4.6	4.6	4.7	4.7	4.7	PH882-2	30.9637	31.0012	31.0354	31.0714	31.0924	31.1155	31.1376	31.1665	31.5898	31.5898
B6-1	2.4	2.8	3.1	3.4	3.6	3.8	4.0	4.3	4.3	4.7	4.7	4.7	PH882-3	30.9029	30.9662	30.9939	31.0263	31.0452	31.0655	31.0849	31.1103	31.4712	31.4712
B6-2	2.4	2.8	3.1	3.4	3.6	3.8	4.0	4.3	4.3	4.7	4.7	4.7	PH882-4	27.0651	27.1239	27.1724	27.1858	27.2049	27.2244	27.2419	27.267	27.8888	27.8888
Bar003-2	13.7	13.9	13.9	13.9	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	PH882-5	22.6642	22.6974	22.738	22.8105	22.8552	22.8993	22.9401	22.9928	23.539	23.539
Bar03a-2	13.7	13.8	13.9	13.9	14.0	14.0	14.0	14.0	14.1	14.3	14.3	14.3	PH889-2	21.7289	21.8115	21.8509	21.8938	21.9174	21.9416	21.9639	21.9941	22.4192	22.4192
Bar04-2	13.7	13.8	13.9	13.9	14.0	14.0	14.0	14.0	14.1	14.4	14.4	14.4	PH891-1	9.4057	9.8899	10.0020	10.2734	10.4444	10.5745	10.6917	10.832	12.6178	12.6178
Beam0-2	21.2	21.2	21.2	21.2	21.2	21.2	21.3	21.3	21.3	21.3	21.3	21.3	PH891-2	9.4057	9.7906	9.9034	10.1185	10.2823	10.4163	10.5422	10.6861	12.4879	12.4879
Blanch-1	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.3	14.3	14.3	14.3	PH892-1	9.0766	9.5083	9.6428	9.844	10.0010	10.1554	10.2939	10.4466	12.2518	12.2518
Blanch-1.1	12.9	14.0	14.1	14.2	14.3	14.4	14.4	14.4	14.5	14.5	14.5	14.5	PH894-2	1.9799	1.9385	1.9233	1.9139	1.9881	1.0391	1.0391	1.0391	1.0391	1.0391
Blanch-1.2	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.4	14.4	14.4	14.4	14.4	PH895-1	9.8417	10.1774	10.3475	10.5859	10.7609	10.8103	10.8863	11.117	12.9154	12.9154
Blanch-1.3	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH895-2	9.6286	10.0044	10.2228	10.4441	10.6191	10.745	10.8566	10.9888	12.784	12.784
Blanch-1.4	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH895-3	10.0278	10.4277	10.5715	10.8258	11.0249	11.11	11.2426	13.0913	13.0913	
Blanch-1.4a	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH896-1	9.1377	9.5908	9.5319	9.5404	9.5464	9.5468	9.5468	9.5468	9.5468	9.5468
Blanch-1.4a.1	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH897-1	1.7341	1.7541	1.8802	2.0894	2.2788	2.4504	2.6035	2.7738	4.8324	4.8324
Blanch-1.4a.2	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH897-2	1.7341	1.7541	1.8802	2.0894	2.2788	2.4504	2.6035	2.7738	4.8324	4.8324
Blanch-1.4a.3	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH897-3	1.7341	1.7541	1.8802	2.0894	2.2788	2.4504	2.6035	2.7738	4.8324	4.8324
Blanch-1.4a.4	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH897-4	1.7341	1.7541	1.8802	2.0894	2.2788	2.4504	2.6035	2.7738	4.8324	4.8324
Blanch-1.5	12.9	14.0	14.1	14.2	14.3	14.3	14.3	14.3	14.4	14.4	14.4	14.4	PH897-5	1.7341	1.7541	1.8802	2.0894	2.2788	2.4504	2.6035	2.7738	4.8324	4.8324
Blanch10a-2	16.0	16.1	16.1	16.1	16.1	16.1	16.2	16.2	16.3	16.3	16.3	16.3	PH900-1	8.8155	9.1118	9.2446	9.4207	9.5964	9.7599	9.9081	10.0693	11.8298	11.8298
Blanch10b-2	15.2	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.4	15.5	15.5	15.5	PH900-2	8.2724	8.0249	8.1548	8.3281	8.4988	8.6647	8.8104	9.0704	11.6984	11.6984
Blanch10c-2	12.9	14.0	14.1	14.2	14.3	14.4	14.4	14.4	14.5	14.5	14.5	14.5	PH900-3	8.6792	8.9813	9.1419	9.287	9.4634	9.6205	9.7639	9.9214	11.6111	11.6111
Blanch13a-2	14.3	14.8	14.9	14.9	14.9	15.0	15.1	15.2	15.6	15.6	15.6	15.6	PH900-4	8.9789	9.2888	9.3919	9.3882	9.6515	9.5145	9.6524	9.8100	11.4933	11.4933
Blanch13b-2	14.3	14.8	14.9	14.9	14.9	15.0	15.1	15.2	15.6	15.6	15.6	15.6	PH900-5	14.6371	14.6699	14.6862	14.7071	14.8251	14.7387	14.7418	14.7543	15.4297	15.4297
Blanch114b-2	11.9	12.2	12.2	12.3	12.3	12.4	12.4	12.4	12.7	12.7	12.7	12.7	PH900-6	11.4519	11.6043	11.6773	11.7733	11.8611	11.9544	12.0483	12.1398	13.3439	13.3439
Blanch115a-2	11.5	11.7	11.7	11.7	11.7	11.7	11.7	11.8	11.9	11.9	11.9	11.9	PH900-7	10.4637	10.6699	10.8226	10.9914	11.2251	11.3798	11.4953	11.6098	13.2924	13.2924
Blanch115b-2	11.0	11.2	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	11.3	PH900-8	13.889	13.9621	13.9999	14.0532	14.1171	14.1879	14.2767	14.4269	15.5459	15.5459
Blanch15c-2	10.6	10.8	10.8	10.8	10.8	10.9	10.9	10.9	11.2	11.2	11.2	11.2	PH900-9	11.585	11.9378	12.1799	12.3787	12.8763	13.9862	14.1124	14.5141	15.809	15.809
Blanch16-2	10.0	10.1	10.2	10.2	10.2	10.2	10.2	10.2	10.9	10.9	10.9	10.9	PH900-10	10.1052	10.1052	10.1052	10.1052	10.1052	10.1052	10.1052	10.1052	10.1052	10.1052
Blanch17-2	8.6	8.9	9.0	9.1	9.2	9.3	9.4	9.6	10.7	10.7	10.7	10.7	PH900-11	12.8281	13.048	13.1276	13.2873	13.4488	13.6444	13.827	14.146	15.0811	15.0811
Blanch118a-1	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-12	10.4586	10.6197	10.6986	10.8079	10.9229	11.0427	11.174	11.289	12.5791	12.5791
Blanch18a-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-13	12.845	12.999	13.1157	13.2139	13.4703	13.6281	13.821	14.0996	15.0357	15.0357
Blanch18b-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-14	11.3099	11.4674	11.5458	11.6471	11.7372	11.8266	11.9254	12.0299	13.9298	13.9298
Blanch18c-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-15	10.4674	10.6197	10.6986	10.8079	10.9229	11.0427	11.174	11.289	12.5791	12.5791
Blanch19a-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-16	11.627	11.9297	12.141	11.5153	11.5975	11.6771	11.744	11.8245	12.8279	12.8279
Blanch19b-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-17	10.4586	10.6197	10.6986	10.8079	10.9229	11.0427	11.174	11.289	12.5791	12.5791
Blanch19c-2	13.8	15.1	15.3	15.5	15.6	15.7	15.8	15.9	16.8	16.8	16.8	16.8	PH900-18	9.9843	10.1616	10.2478	10.3645	10.4999	10.6081	10.7211	10.8699	12.3089	12.3089
Blanch20-2	14.3	15.7	15.8	15.8	16.0	16.1	16.2	16.3	16.8	16.8	16.8	16.8	PH900-19	8.6831	9.2177	9.3934	9.5158	9.6963	9.8513	10.0664	10.3668	11.9003	11.9003
Blanch21-2	15.9	16.0	16.1	16.1	16.1	16.1	16.1	16.1	16.8	16.8	16.8	16.8	PH900-20	9.7636	9.9155	9.9319	9.9536	9.9839	9.9839	9.9839	9.9839	9.9839	9.9839
Blanch21a-2	15.9	16.0	16.1	16.1	16.1	16.1	16.1	16.1	16.8	16.8	16.8	16.8	PH900-21	10.706	10.967	11.0622	11.1463	11.2401	11.3315	11.4192	11.5253	12.6894	12.6894
Blanch21b-2	14.1	15.5	15.7	15.8	15.9	16.0	16.1	16.2	16.9	16.9	16.9	16.9	PH900-22	9.1148	9.3288	9.4615	9.6578	10.0083	10.0284	11.1163	10.2425	11.9355	11.9355
Blanch20c-2	13.8	15.7	15.8	15.8	16.0	16.1	16.2	16.3	16.8	16.8	16.8	16.8	PH900-23	8.9799	9.2799	9.3734	9.6015	9.8393	9.9857	10.0664	10		

CH104.2	1.7305	2.1414	2.3471	2.6001	2.8286	3.0132	3.1946	3.4039	3.5702	P674.1	20.3804	20.4056	20.4260	20.4488	20.4640	20.4854	20.5122	20.5403	20.5702	20.6049
CH104.0	6.7226	6.8678	6.9355	7.0037	7.2239	7.4238	7.6235	7.8747	8.144	P675.7	18.7486	18.773	18.8188	18.843	18.8607	18.8818	18.8965	18.9116	18.9277	18.9477
CH104.2	6.6793	6.8178	6.8811	6.9466	7.1767	7.3604	7.5325	7.7974	8.101	P676.1	19.5641	19.5884	19.6101	19.6153	19.6256	19.6402	19.6537	19.6678	19.6799	19.7899
CH104.2	6.7395	6.9344	6.9934	7.0682	7.3142	7.5425	7.7567	8.0176	8.2582	P676.2	19.3915	19.4155	19.4375	19.4427	19.4529	19.4675	19.4802	19.4925	19.5048	19.6255
CH104.1	6.8145	6.9219	7.0566	7.1368	7.4066	7.6507	7.8764	8.1411	10.158	P676.1	18.9485	19.0007	19.0388	19.0607	19.0844	19.1024	19.1207	19.1462	19.5805	
CH104.2	6.7935	6.9574	7.0304	7.1086	7.3699	7.6106	7.8291	8.1007	10.151	P677.1	18.9453	19.0072	19.0307	19.0566	19.0758	19.0989	19.1136	19.1377	19.5894	
CH104.1	6.8394	7.0076	7.0888	7.171	7.4459	7.6953	7.9349	8.1833	10.160	P678.1	20.7913	20.8042	20.8104	20.8174	20.8259	20.8271	20.8316	20.8375	20.8792	
CH104.2	6.7926	6.9584	7.0398	7.1237	7.3986	7.6481	7.8676	8.1173	10.162	P679.1	18.9455	19.0076	19.0311	19.057	19.0762	19.0993	19.114	19.1381	19.5797	
CH104.1	6.8787	7.0477	7.123	7.2108	7.4911	7.7441	7.9632	8.23	10.370	P676.1	18.9485	19.0007	19.0388	19.0607	19.0844	19.1024	19.1207	19.1462	19.5805	
CH104.2	6.8549	7.0272	7.1039	7.1904	7.4692	7.7206	7.9399	8.2071	10.376	P679.1	20.4333	20.0925	21.124	21.1415	21.1433	21.1461	21.1478	21.1504	21.5718	
CH105.0	8.8059	8.9272	8.899	8.9368	9.0001	8.9914	9.0232	9.0645	10.399	P680.1	18.0495	18.0653	18.07424	18.0816	18.0867	18.0919	18.0929	18.0945	11.1286	
CH105.2	7.9315	8.0466	8.089	8.1458	8.2849	8.2769	8.2763	8.3331	10.388	P681.2	10.1381	12.1852	12.1874	12.1536	12.1569	12.1569	12.1569	12.1736	12.1865	
CH105.1	7.987	8.0968	8.098	8.087	8.2348	8.2167	8.2167	8.2735	10.400	P682.1	10.1381	12.1852	12.1874	12.1536	12.1569	12.1569	12.1569	12.1736	12.1865	
CH105.2	7.1542	7.2589	7.2975	7.3429	7.4964	7.7524	7.9729	8.2391	10.382	P680.2	22.6803	22.7254	22.75	22.7662	22.7658	22.7677	22.7691	22.7712	23.4373	
CH105.1	6.828	6.9509	7.127	7.2123	7.4952	7.7519	7.9727	8.2392	10.386	P687.4	10.1826	10.4826	10.5191	10.5191	10.5191	10.5191	10.5191	10.5191	10.5191	
CH105.2	6.8802	7.0487	7.1221	7.221	7.4984	7.7517	7.9729	8.2393	10.393	CH107.1	43.2368	43.4368	43.6368	43.837	44.0372	44.2376	44.438	44.638		
CH105.1	15.338	15.3678	15.3678	15.3678	15.3678	15.3678	15.3678	15.3678	15.3678	CH107.2	24.4027	24.6027	24.8027	24.8027	24.8027	24.8027	24.8027	24.8027	24.8027	
CH105.2	12.7993	12.8277	12.8477	12.874	12.984	12.9945	12.9945	12.9945	12.9945	CH107.1	37.8121	37.8121	37.8121	37.8121	37.8121	37.8121	37.8121	37.8121	37.8121	
CH105.1	10.589	11.1877	11.5566	11.5775	11.5775	11.6083	11.6229	11.6371	11.6549	CH107.2	14.871	14.745	1.836	2.0246	2.256	2.441	2.6416	2.8508	2.9914	5.1747
CH105.2	1.6028	1.9398	2.1944	2.4229	2.6653	2.8488	3.0286	3.2382	3.5274	CH108.1	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	
CH106.2	11.0487	11.1129	11.1384	11.1424	11.2381	11.2325	11.2381	11.2614	11.2514	CH108.2	26.0477	26.1389	26.2402	26.316	26.3778	26.4494	26.521	26.5928	27.1588	
CH106.1	11.0487	11.1129	11.1384	11.1424	11.2381	11.2325	11.2381	11.2614	11.2514	CH109.1	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	23.0077	
CH106.2	7.4075	7.542	7.6056	7.7481	8.0208	8.2513	8.4186	8.6073	10.481	CH109.2	24.1073	24.1073	24.1073	24.1073	24.1073	24.1073	24.1073	24.1073	24.1073	
CH106.1	7.064	7.2062	7.2737	7.3888	7.6368	7.8687	8.07	8.3161	10.429	CH109.1	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.2	6.9241	7.0834	7.1578	7.2502	7.5229	7.7707	7.9868	8.2507	10.398	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.1	6.1497	6.3003	6.4183	6.498	6.8041	8.0065	8.7888	9.5940	10.540	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.2	6.1497	6.3003	6.4183	6.498	6.8041	8.0065	8.7888	9.5940	10.540	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.1	31.3488	31.3763	31.3876	31.4041	31.4145	31.428	31.4409	31.4572	31.5791	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.2	32.7523	32.7663	32.7689	32.8131	32.8229	32.8495	32.8689	32.894	33.0494	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH106.2	21.3335	21.3794	21.4019	21.4231	21.4495	21.4737	21.4968	21.5263	21.7458	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.2	16.9618	16.9753	16.9753	16.9954	17.0349	17.0349	17.0349	17.0349	17.0349	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.1	16.4317	16.4317	16.4317	16.4317	16.4317	16.4317	16.4317	16.4317	16.4317	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.2	15.6477	15.741	15.9472	15.7843	15.811	15.845	15.8776	15.9192	16.2225	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.1	14.3158	14.7474	14.7474	15.0715	15.1241	15.1573	15.1879	15.2242	15.6252	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.2	14.3042	14.7244	14.9332	15.0626	15.1422	15.1422	15.1573	15.2066	15.6252	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.1	8.289	8.3788	8.4384	8.498	8.5977	8.6573	8.7169	8.7765	10.1828	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.2	8.289	8.3788	8.4384	8.498	8.5977	8.6573	8.7169	8.7765	10.1828	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.1	7.9872	8.0937	8.1475	8.2011	8.5698	8.7277	8.9335	9.1177	10.8441	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.2	7.817	7.9407	8.0001	8.169	8.4191	8.6299	8.7888	8.9739	10.6226	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH107.1	7.674	7.7875	7.8489	8.016	8.2851	8.5097	8.679	8.8736	10.6229	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.2	8.767	8.867	8.967	9.067	9.167	9.267	9.367	9.467	10.623	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.1	8.6851	8.789	8.8209	8.9634	9.184	9.3572	9.5053	9.6864	11.4195	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.2	6.8851	6.799	8.2088	8.9628	9.1656	9.3489	9.4963	9.6746	11.3951	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.1	8.583	8.6591	8.7001	8.8341	9.0375	9.1916	9.34	9.5246	11.2723	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.2	8.4216	8.4216	8.4216	8.4216	8.4216	8.4216	8.4216	8.4216	8.4216	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.1	11.7591	11.8211	11.8211	11.8485	11.8668	11.8668	11.8668	11.8668	11.8668	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.2	9.1979	9.5431	9.657	9.863	9.9669	10.0121	10.021	10.048	11.3276	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.1	8.872	8.884	8.9164	8.955	9.186	9.2664	9.2664	9.5009	11.3793	CH109.2	6.3976	6.4888	6.5901	6.6914	6.7927	6.894	6.9953	7.0966	7.1979	
CH108.2	8.465	8.533	8.5547	8.6109	8.8815	9.126	9.2601	9.5004	11.3035	CH109.2	6.3976	6.4888	6.5901	6.69						



Table with columns for time (CH152.2 to CH35.1) and various numerical values representing model results.

Table with columns for time (P134 to P330) and various numerical values representing model results.

Table with columns for time (PH12a to PH35.1) and various numerical values representing model results.

CH350.1	9.9029	9.2542	9.3321	9.4464	9.5364	9.6192	9.6916	9.7602	9.8201	9.8744	9.9244	9.9704	10.0144	10.0564	10.0964	10.1344	10.1704	10.2064	10.2424	10.2784	10.3144	10.3504	10.3864	10.4224	10.4584	10.4944	10.5304	10.5664	10.6024	10.6384	10.6744	10.7104	10.7464	10.7824	10.8184	10.8544	10.8904	10.9264	10.9624	10.9984	11.0344	11.0704	11.1064	11.1424	11.1784	11.2144	11.2504	11.2864	11.3224	11.3584	11.3944	11.4304	11.4664	11.5024	11.5384	11.5744	11.6104	11.6464	11.6824	11.7184	11.7544	11.7904	11.8264	11.8624	11.8984	11.9344	11.9704	12.0064	12.0424	12.0784	12.1144	12.1504	12.1864	12.2224	12.2584	12.2944	12.3304	12.3664	12.4024	12.4384	12.4744	12.5104	12.5464	12.5824	12.6184	12.6544	12.6904	12.7264	12.7624	12.7984	12.8344	12.8704	12.9064	12.9424	12.9784	13.0144	13.0504	13.0864	13.1224	13.1584	13.1944	13.2304	13.2664	13.3024	13.3384	13.3744	13.4104	13.4464	13.4824	13.5184	13.5544	13.5904	13.6264	13.6624	13.6984	13.7344	13.7704	13.8064	13.8424	13.8784	13.9144	13.9504	13.9864	14.0224	14.0584	14.0944	14.1304	14.1664	14.2024	14.2384	14.2744	14.3104	14.3464	14.3824	14.4184	14.4544	14.4904	14.5264	14.5624	14.5984	14.6344	14.6704	14.7064	14.7424	14.7784	14.8144	14.8504	14.8864	14.9224	14.9584	14.9944	15.0304	15.0664	15.1024	15.1384	15.1744	15.2104	15.2464	15.2824	15.3184	15.3544	15.3904	15.4264	15.4624	15.4984	15.5344	15.5704	15.6064	15.6424	15.6784	15.7144	15.7504	15.7864	15.8224	15.8584	15.8944	15.9304	15.9664	16.0024	16.0384	16.0744	16.1104	16.1464	16.1824	16.2184	16.2544	16.2904	16.3264	16.3624	16.3984	16.4344	16.4704	16.5064	16.5424	16.5784	16.6144	16.6504	16.6864	16.7224	16.7584	16.7944	16.8304	16.8664	16.9024	16.9384	16.9744	17.0104	17.0464	17.0824	17.1184	17.1544	17.1904	17.2264	17.2624	17.2984	17.3344	17.3704	17.4064	17.4424	17.4784	17.5144	17.5504	17.5864	17.6224	17.6584	17.6944	17.7304	17.7664	17.8024	17.8384	17.8744	17.9104	17.9464	17.9824	18.0184	18.0544	18.0904	18.1264	18.1624	18.1984	18.2344	18.2704	18.3064	18.3424	18.3784	18.4144	18.4504	18.4864	18.5224	18.5584	18.5944	18.6304	18.6664	18.7024	18.7384	18.7744	18.8104	18.8464	18.8824	18.9184	18.9544	18.9904	19.0264	19.0624	19.0984	19.1344	19.1704	19.2064	19.2424	19.2784	19.3144	19.3504	19.3864	19.4224	19.4584	19.4944	19.5304	19.5664	19.6024	19.6384	19.6744	19.7104	19.7464	19.7824	19.8184	19.8544	19.8904	19.9264	19.9624	20.0024	20.0384	20.0744	20.1104	20.1464	20.1824	20.2184	20.2544	20.2904	20.3264	20.3624	20.3984	20.4344	20.4704	20.5064	20.5424	20.5784	20.6144	20.6504	20.6864	20.7224	20.7584	20.7944	20.8304	20.8664	20.9024	20.9384	20.9744	21.0104	21.0464	21.0824	21.1184	21.1544	21.1904	21.2264	21.2624	21.2984	21.3344	21.3704	21.4064	21.4424	21.4784	21.5144	21.5504	21.5864	21.6224	21.6584	21.6944	21.7304	21.7664	21.8024	21.8384	21.8744	21.9104	21.9464	21.9824	22.0184	22.0544	22.0904	22.1264	22.1624	22.1984	22.2344	22.2704	22.3064	22.3424	22.3784	22.4144	22.4504	22.4864	22.5224	22.5584	22.5944	22.6304	22.6664	22.7024	22.7384	22.7744	22.8104	22.8464	22.8824	22.9184	22.9544	22.9904	23.0264	23.0624	23.0984	23.1344	23.1704	23.2064	23.2424	23.2784	23.3144	23.3504	23.3864	23.4224	23.4584	23.4944	23.5304	23.5664	23.6024	23.6384	23.6744	23.7104	23.7464	23.7824	23.8184	23.8544	23.8904	23.9264	23.9624	24.0024	24.0384	24.0744	24.1104	24.1464	24.1824	24.2184	24.2544	24.2904	24.3264	24.3624	24.3984	24.4344	24.4704	24.5064	24.5424	24.5784	24.6144	24.6504	24.6864	24.7224	24.7584	24.7944	24.8304	24.8664	24.9024	24.9384	24.9744	25.0104	25.0464	25.0824	25.1184	25.1544	25.1904	25.2264	25.2624	25.2984	25.3344	25.3704	25.4064	25.4424	25.4784	25.5144	25.5504	25.5864	25.6224	25.6584	25.6944	25.7304	25.7664	25.8024	25.8384	25.8744	25.9104	25.9464	25.9824	26.0184	26.0544	26.0904	26.1264	26.1624	26.1984	26.2344	26.2704	26.3064	26.3424	26.3784	26.4144	26.4504	26.4864	26.5224	26.5584	26.5944	26.6304	26.6664	26.7024	26.7384	26.7744	26.8104	26.8464	26.8824	26.9184	26.9544	26.9904	27.0264	27.0624	27.0984	27.1344	27.1704	27.2064	27.2424	27.2784	27.3144	27.3504	27.3864	27.4224	27.4584	27.4944	27.5304	27.5664	27.6024	27.6384	27.6744	27.7104	27.7464	27.7824	27.8184	27.8544	27.8904	27.9264	27.9624	28.0024	28.0384	28.0744	28.1104	28.1464	28.1824	28.2184	28.2544	28.2904	28.3264	28.3624	28.3984	28.4344	28.4704	28.5064	28.5424	28.5784	28.6144	28.6504	28.6864	28.7224	28.7584	28.7944	28.8304	28.8664	28.9024	28.9384	28.9744	29.0104	29.0464	29.0824	29.1184	29.1544	29.1904	29.2264	29.2624	29.2984	29.3344	29.3704	29.4064	29.4424	29.4784	29.5144	29.5504	29.5864	29.6224	29.6584	29.6944	29.7304	29.7664	29.8024	29.8384	29.8744	29.9104	29.9464	29.9824	30.0184	30.0544	30.0904	30.1264	30.1624	30.1984	30.2344	30.2704	30.3064	30.3424	30.3784	30.4144	30.4504	30.4864	30.5224	30.5584	30.5944	30.6304	30.6664	30.7024	30.7384	30.7744	30.8104	30.8464	30.8824	30.9184	30.9544	30.9904	31.0264	31.0624	31.0984	31.1344	31.1704	31.2064	31.2424	31.2784	31.3144	31.3504	31.3864	31.4224	31.4584	31.4944	31.5304	31.5664	31.6024	31.6384	31.6744	31.7104	31.7464	31.7824	31.8184	31.8544	31.8904	31.9264	31.9624	32.0024	32.0384	32.0744	32.1104	32.1464	32.1824	32.2184	32.2544	32.2904	32.3264	32.3624	32.3984	32.4344	32.4704	32.5064	32.5424	32.5784	32.6144	32.6504	32.6864	32.7224	32.7584	32.7944	32.8304	32.8664	32.9024	32.9384	32.9744	33.0104	33.0464	33.0824	33.1184	33.1544	33.1904	33.2264	33.2624	33.2984	33.3344	33.3704	33.4064	33.4424	33.4784	33.5144	33.5504	33.5864	33.6224	33.6584	33.6944	33.7304	33.7664	33.8024	33.8384	33.8744	33.9104	33.9464	33.9824	34.0184	34.0544	34.0904	34.1264	34.1624	34.1984	34.2344	34.2704	34.3064	34.3424	34.3784	34.4144	34.4504	34.4864	34.5224	34.5584	34.5944	34.6304	34.6664	34.7024	34.7384	34.7744	34.8104	34.8464	34.8824	34.9184	34.9544	34.9904	35.0264	35.0624	35.0984	35.1344	35.1704	35.2064	35.2424	35.2784	35.3144	35.3504	35.3864	35.4224	35.4584	35.4944	35.5304	35.5664	35.6024	35.6384	35.6744	35.7104	35.7464	35.7824	35.8184	35.8544	35.8904	35.9264	35.9624	36.0024	36.0384	36.0744	36.1104	36.1464	36.1824	36.2184	36.2544	36.2904	36.3264	36.3624	36.3984	36.4344	36.4704	36.5064	36.5424	36.5784	36.6144	36.6504	36.6864	36.7224	36.7584	36.7944	36.8304	36.8664	36.9024	36.9384	36.9744	37.0104	37.0464	37.0824	37.1184	37.1544	37.1904	37.2264	37.2624	37.2984	37.3344	37.3704	37.4064	37.4424	37.4784	37.5144	37.5504	37.5864	37.6224	37.6584	37.6944	37.7304	37.7664	37.8024	37.8384	37.8744	37.9104	37.9464	37.9824	38.0184	38.0544	38.0904	38.1264	38.1624	38.1984	38.2344	38.2704	38.3064	38.3424	38.3784	38.4144	38.4504	38.4864	38.5224	38.5584	38.5944	38.6304	38.6664	38.7024	38.7384	38.7744	38.8104	38.8464	38.8824	38.9184	38.9544	38.9904	39.0264	39.0624	39.0984	39.1344	39.1704	39.2064	39.2424	39.2784	39.3144	39.3504	39.3864	39.4224	39.4584	39.4944	39.5304	39.5664	39.6024	39.6384	39.6744	39.7104	39.7464	39.7824	39.8184	39.8544	39.8904	39.9264	39.9624	40.0024	40.0384	40.0744	40.1104	40.1464	40.1824	40.2184	40.2544	40.2904	40.3264	40.3624	40.3984	40.4344	40.4704	40.5064	40.5424	40.5784	40.6144	40.6504	40.6864	40.7224	40.7584	40.7944	40.8304	40.8664	40.9024	40.9384	40.9744	41.0104	41.0464	41.0824	41.1184	41.1544	41.1904	41.2264	41.2624	41.2984	41.3344	41.3704	41.4064	41.4424	41.4784	41.5144	41.5504	41.5864	41.6224	41.6584	41.6944	41.7304	41.7664	41.8024	41.8384	41.8744	41.9104	41.9464	41.9824	42.0184	42.0544	42.0904	42.1264	42.1624	42.1984	42.2344	42.2704	42.3064	42.3424	42.3784	42.4144	42.4504	42.4864	42.5224	42.5584	42.5944	42.6304	42.6664	42.7024	42.7384	42.7744	42.8104	42.8464	42.8824	42.9184	42.9544	42.9904	43.0264	43.0624	43.0984	43.1344	43.1704	43.2064	43.2424	43.2784	43.3144	43.3504	43.3864	43.4224	43.4584	43.4944	43.5304	43.5664	43.6024	43.6384	43
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Table with columns for time (Year, Month, Day) and various pollutant concentrations (e.g., PM10, PM2.5, SO2, NO2, CO, O3, etc.). The table contains multiple rows of data for each time step, representing different model runs or scenarios.

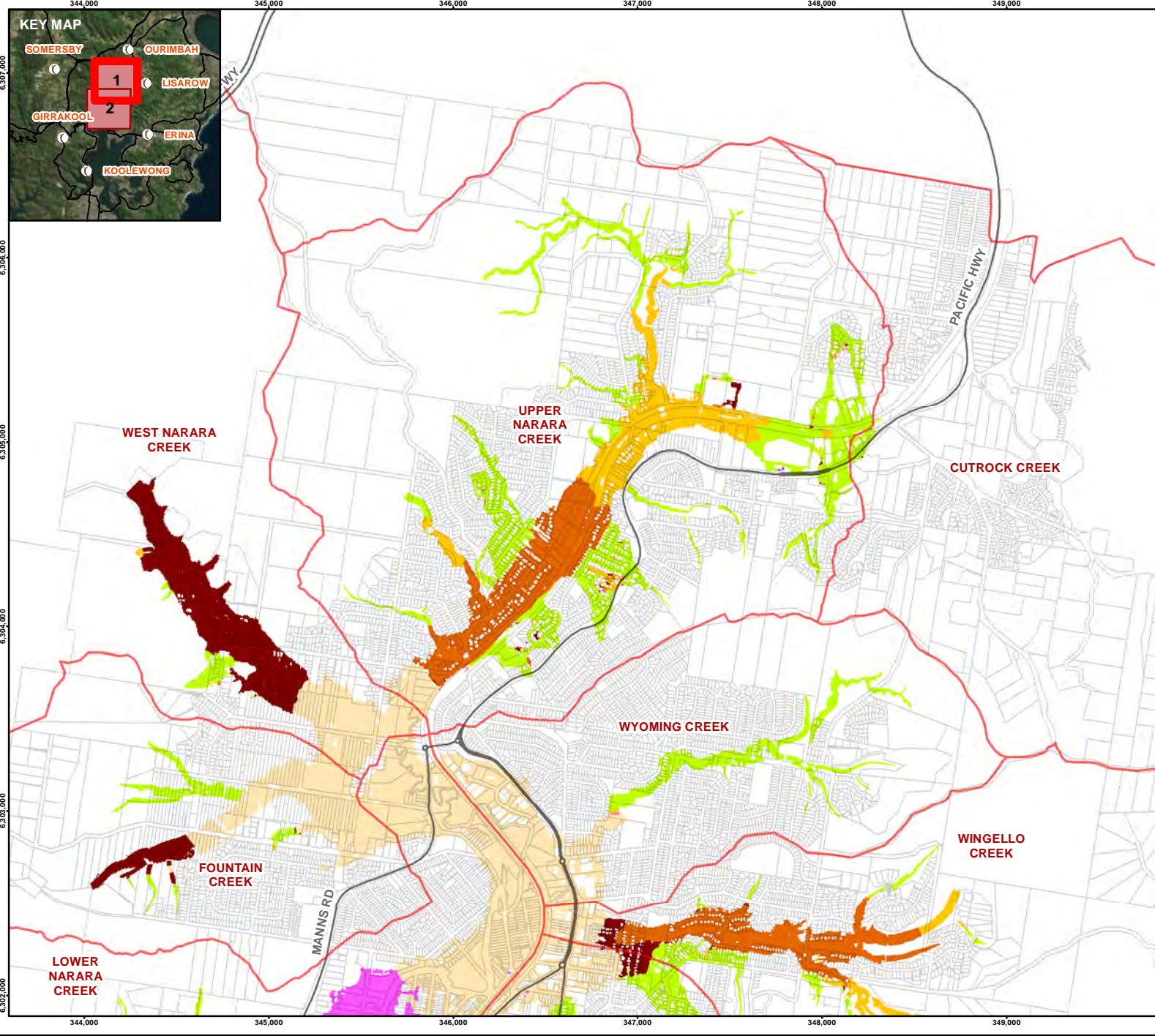
CH658.1	23.5516	23.5712	23.5806	23.5925	23.6	23.6099	23.6393	23.631	23.7194
CH658.2	20.5209	20.5442	20.5556	20.5688	20.5788	20.5909	20.6024	20.6167	20.7208
CH66.2	1.482	1.7474	1.9047	2.1209	2.2441	2.4986	2.6584	2.8389	4.9221
CH660.1	19.4469	19.5632	19.6248	19.7005	19.7511	19.8061	19.8569	19.9242	20.2736
CH660.2	18.2476	18.4038	18.4832	18.5738	18.6329	18.6958	18.7533	18.8267	19.4325
CH661.1	25.094	25.1766	25.2105	25.248	25.2726	25.3019	25.3293	25.3636	25.611
CH661.2	22.08	22.1321	22.1699	22.1977	22.2158	22.2479	22.278	22.3166	22.5929
CH663.2	18.0222	18.1706	18.2405	18.3261	18.383	18.4437	18.4989	18.5694	19.1486
CH665.2	16.8902	17.0417	17.1172	17.2059	17.2615	17.3197	17.3766	17.4503	18.0442
CH666.2	16.4967	16.6639	16.7442	16.8342	16.8717	16.9209	16.9718	17.0381	17.6088
CH667.2	15.892	15.9643	15.9797	16.0644	16.1527	16.2356	16.2985	16.3688	16.9567
CH668.2	14.8993	15.1104	15.2786	15.5016	15.6745	16.0356	16.091	16.1496	16.6594
CH669A.2	14.8024	15.4987	15.7701	15.8885	15.9587	16.0168	16.068	16.1234	16.6025
CH67.2	1.3959	1.725	1.8991	2.1141	2.3174	2.4914	2.6506	2.8287	4.9204
CH670.1	18.9216	19.0042	19.0532	19.1223	19.1667	19.2101	19.2508	19.305	19.8945
CH671.1	46.5296	46.5708	46.5848	46.6012	46.6116	46.6251	46.6379	46.6542	46.7701
CH671.2	40.2407	40.2903	40.3083	40.3289	40.3421	40.3593	40.3756	40.3962	40.5396
CH672.2	36.6952	36.7615	36.785	36.8122	36.8289	36.8507	36.8716	36.8981	37.0846
CH673.2	31.7634	31.9033	31.9489	31.9843	32.0197	32.0514	32.0811	32.1197	32.3811
CH674.2	30.0773	30.1112	30.1387	30.1838	30.2155	30.2557	30.2932	30.3417	30.6823
CH675.2	29.1174	29.3343	29.3862	29.4409	29.4761	29.5184	29.5579	29.6086	29.9741
CH676.2	29.0262	29.2498	29.2901	29.3297	29.3535	29.3832	29.4106	29.4459	29.7075
CH677.1	51.9219	51.9604	51.9752	51.991	52.0007	52.0132	52.0251	52.0409	52.1429
CH677.2	48.4589	48.5136	48.533	48.5529	48.5648	48.5794	48.5934	48.6111	48.7407
CH678.2	45.2429	45.3148	45.3405	45.3686	45.3849	45.4052	45.4249	45.45	45.6294
CH679.2	42.2065	42.5334	42.7207	42.9815	43.2169	43.4555	43.6883	43.9864	45.3672
CH68.2	1.2854	1.5869	1.7469	1.9313	2.1071	2.2643	2.4103	2.5803	4.6404
CH680.2	42.1743	42.5146	42.7101	42.9762	43.2137	43.4535	43.6867	43.9857	45.365

P567.1	21.1282	21.1354	21.139	21.1438	21.147	21.1511	21.1552	21.1604	21.2035
P568	19.0903	19.1656	19.2149	19.2963	19.3685	19.4951	19.6524	19.8329	20.6721
P568.1	20.4955	20.5297	20.5462	20.5675	20.5761	20.592	20.6079	20.6284	20.8688
P569	25.3845	25.4333	25.4576	25.4889	25.5103	25.537	25.5612	25.5924	25.7841
P569.1	26.5744	26.5861	26.59	26.6004	26.6076	26.6171	26.6257	26.6369	26.7345
P570	26.1581	26.1916	26.2079	26.2283	26.2422	26.2598	26.2778	26.2983	26.4144
P570.1	27.6699	27.6826	27.6888	27.6979	27.7032	27.7103	27.7187	27.7274	27.8035
P571	28.2056	28.2201	28.2269	28.2358	28.2421	28.2501	28.2574	28.2665	28.3384
P571.1	29.3637	29.3716	29.3756	29.381	29.3844	29.3889	29.3933	29.3989	29.4449
P572	26.534	26.591	26.6178	26.6509	26.6735	26.7027	26.7317	26.7658	26.9945
P572.1	27.8685	27.8816	27.8882	27.8968	27.9023	27.9095	27.9182	27.9267	27.989
P573	26.9789	27.0327	27.0576	27.0885	27.1099	27.1357	27.1613	27.1907	27.3853
P573.1	28.3668	28.3716	28.374	28.3771	28.3791	28.3818	28.3843	28.3878	28.4156
P574	27.4608	27.5129	27.5367	27.5668	27.5889	27.6164	27.6415	27.6694	27.852
P574.1	28.6558	28.6696	28.6763	28.686	28.6925	28.7016	28.7109	28.7233	28.8351
P575	28.2548	28.3023	28.3231	28.3511	28.3711	28.3956	28.4168	28.4389	28.5593
P575.1	29.32	29.3471	29.3568	29.369	29.3769	29.3895	29.4003	29.414	29.5879
P576	35.5487	35.5709	35.583	35.5981	35.6075	35.6193	35.629	35.64	35.7056
P576.1	38.7298	38.7515	38.7621	38.7753	38.7839	38.7955	38.8073	38.8222	38.9401
P577	37.8708	37.8849	37.8888	37.8976	37.903	37.9097	37.9157	37.9234	37.9845
P577.1	39.0199	39.0335	39.0372	39.0457	39.0513	39.0582	39.0649	39.0731	39.1417
P578	28.9396	28.9723	28.9895	29.0119	29.0268	29.0467	29.0646	29.0839	29.1678
P578.1	30.1376	30.1574	30.1674	30.1809	30.1899	30.2017	30.2128	30.2278	30.3406
P579.2	23.8369	23.8458	23.8498	24.0013	24.0589	25.1533	25.1681	25.2151	25.3788
P579a.2	22.3818	22.6092	22.6572	22.725	22.7752	24.8351	24.8471	24.92	25.1184
P58	7.5488	7.5953	7.6327	7.6992	8.2463	8.4076	8.5127	8.6246	8.9716
P58.1	8.7913	8.8106	8.8368	8.8808	8.9062	8.9337	8.9583	8.9573	8.9985
P580.2	20.8851	20.9941	21.0169	21.0596	21.1028	24.8183	24.8613	24.5452	24.7935

WN.26.2	9.0349	9.1969	9.2778	9.3969	9.497	9.5619	9.6993	9.8209	11.488
WN.28.1	9.3351	9.5183	9.6079	9.7395	9.8492	9.9173	10.0529	10.1678	11.6836
WN.28.2	9.225	9.3984	9.4842	9.6107	9.7171	9.7847	9.9227	10.0415	11.5985
WN.29.2	9.1438	9.2955	9.3714	9.4837	9.5793	9.6412	9.7721	9.8873	11.4802
WN.31.1	9.4506	9.653	9.7493	9.8879	10.0053	10.078	10.2425	10.3482	11.8934
WN.32.1	9.5283	9.7307	9.8295	9.9706	10.0912	10.1664	10.318	10.4455	12.0149
WN.33.1	9.8526	10.0661	10.1721	10.3272	10.4574	10.5379	10.7036	10.8469	12.6131
WN.33.2	9.6749	9.8625	9.9844	10.1355	10.2638	10.3438	10.5079	10.6484	12.3125
WN.34.2	9.6012	9.8119	9.9147	10.0632	10.1899	10.2691	10.43	10.5663	12.1885
WN.36.1	10.2217	10.461	10.5799	10.745	10.8817	10.9589	11.1056	11.2288	12.8741
WN.36.2	9.975	10.1885	10.2944	10.4475	10.5781	10.6561	10.8152	10.9537	12.7303
WN.38.1	10.4402	10.7094	10.8399	11.0229	11.187	11.2764	11.4509	11.5975	13.2349
WN.38.2	10.3814	10.655	10.7854	10.9691	11.1331	11.2209	11.3922	11.5354	13.1402
WN.4.1	7.2744	7.442	7.5219	7.6319	7.705	7.776	7.8933	7.9988	9.4683
WN.4.2	6.9348	7.0696	7.1341	7.2332	7.2974	7.3439	7.4474	7.5414	9.0298
WN.40.1	10.4698	10.7367	10.867	11.0497	11.2137	11.3038	11.4792	11.6271	13.2811
WN.5.2	6.7013	6.8292	6.8927	6.9833	7.0614	7.1096	7.2207	7.3218	8.9114
WN.6.2	6.5686	6.6989	6.7649	6.8606	6.9441	6.995	7.1123	7.219	8.8602
WN.7.2	6.4301	6.5661	6.6365	6.7354	6.8217	6.8733	6.9921	7.1095	8.7604
Woon04.2	9.0726	9.2925	9.4206	9.5815	9.7593	9.9219	10.0712	10.2309	12.0291
Woon04.3	9.2962	9.4642	9.5638	9.6871	9.8684	10.0282	10.1736	10.3288	12.1251
Woon04.4	9.2175	9.4026	9.5134	9.6503	9.8303	9.9912	10.138	10.2947	12.0919

APPENDIX H

Design Flood Modelling - Critical Durations



**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

Value	Color
30 min	Light Green
45 min	Yellow
60 min	Orange
90 min	Dark Orange
2 hr	Red
3 hr	Pink
6 hr	Purple

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
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Cadastre, Sub-Catchment: Provided by Central Coast Council February 2018

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**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

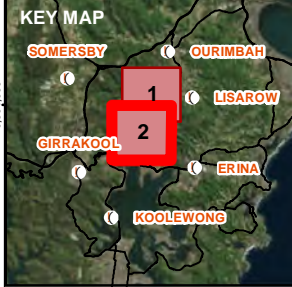
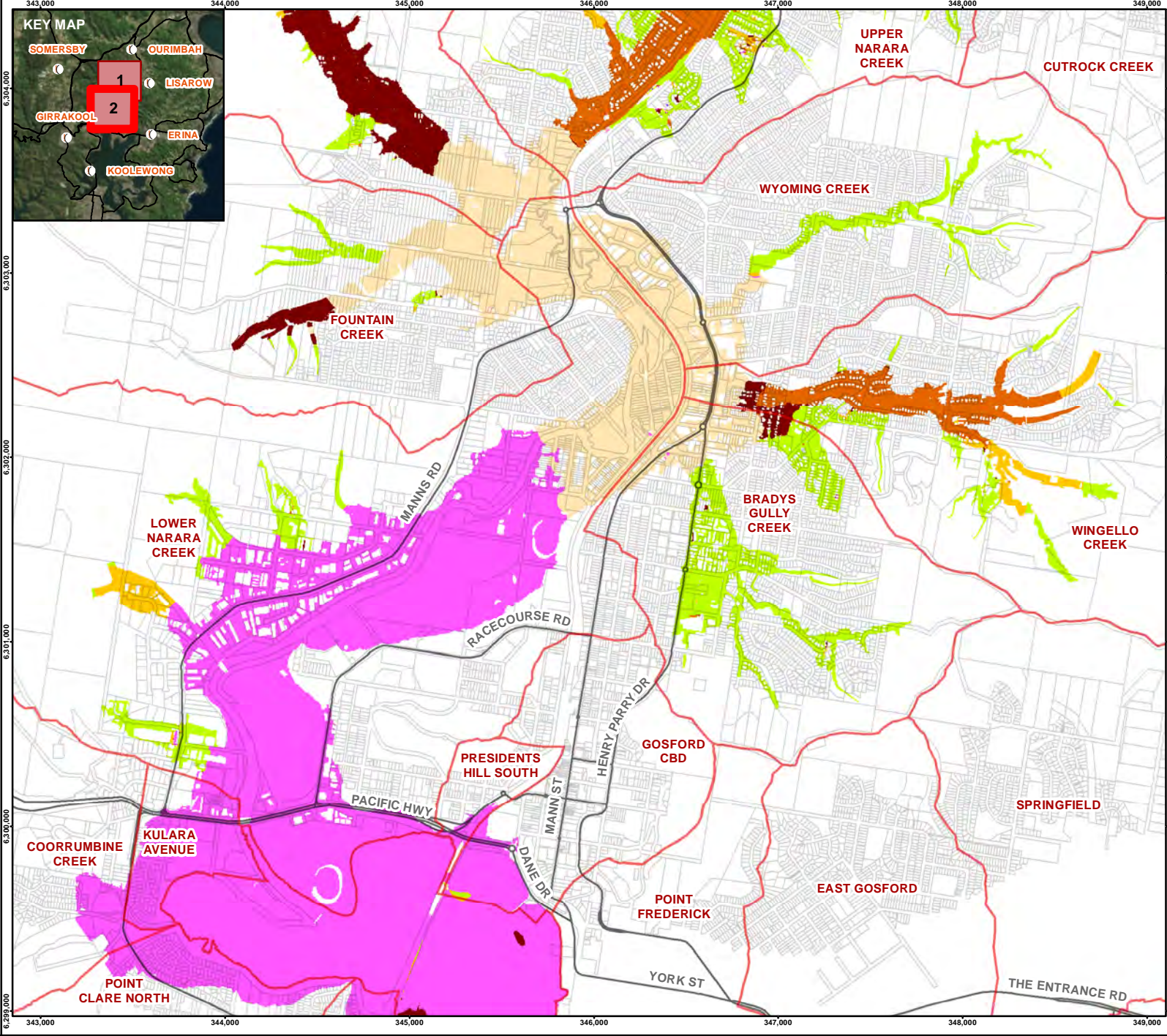
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CONSULTANT

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DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

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097626068 006 G Appendix H - 1A

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**Legend**

- ( ) Localities
- Main Roads
- ▭ Drainage Sub-Catchment
- ▭ Cadastral Boundary

Value	Color
30 min	Light Green
45 min	Yellow
60 min	Orange
90 min	Dark Orange
2 hr	Red
3 hr	Magenta
6 hr	Purple

0 500 1,000  
1:30,000 @A4 METRES

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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PROJECT  
**NARARA CREEK FLOOD STUDY**

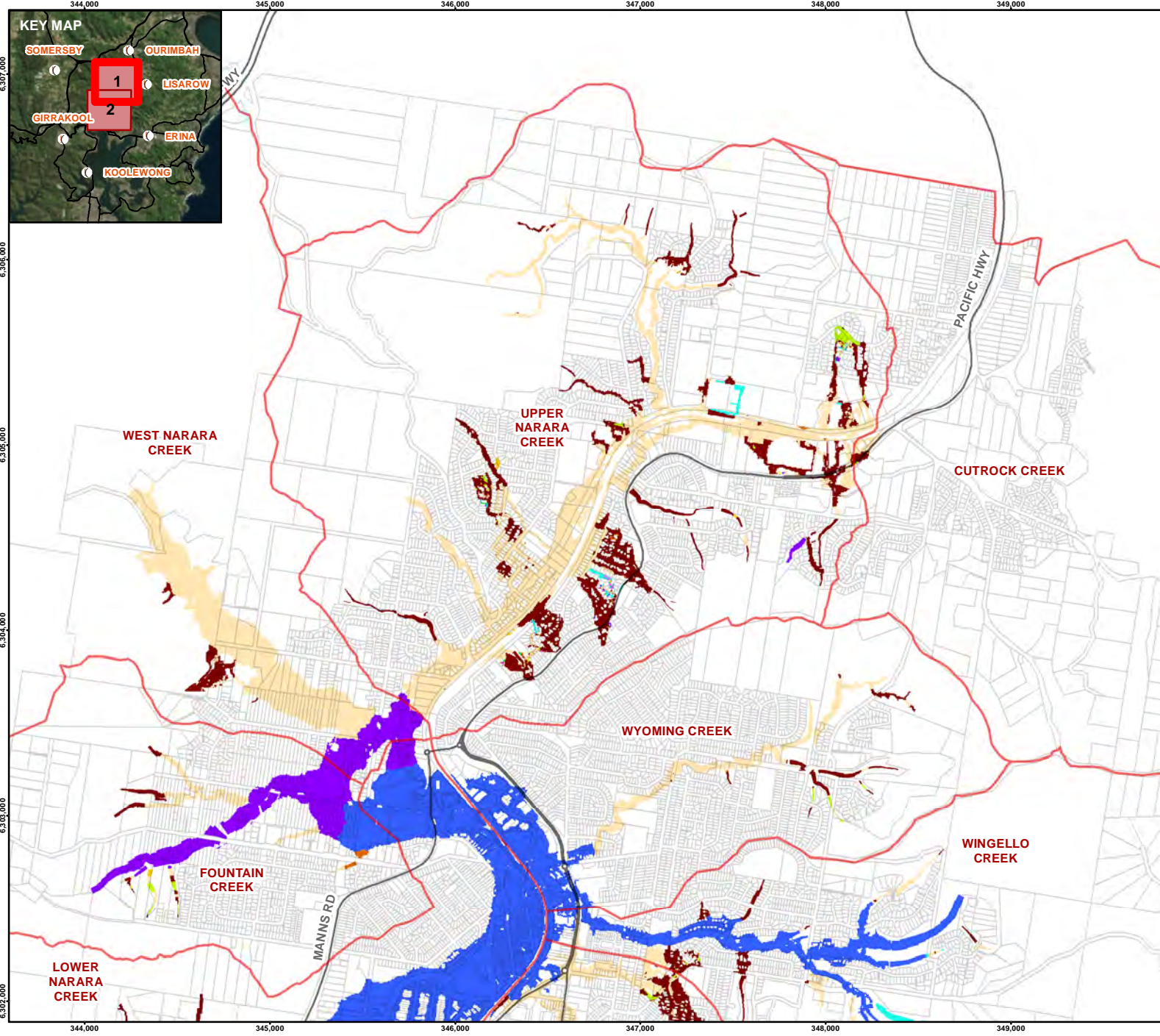
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CONSULTANT

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 097626068 006 G Appendix H - 1B

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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Cadastral, Sub-Catchment: Provided by Central Coast Council February 2018

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**NARARA CREEK FLOOD STUDY**

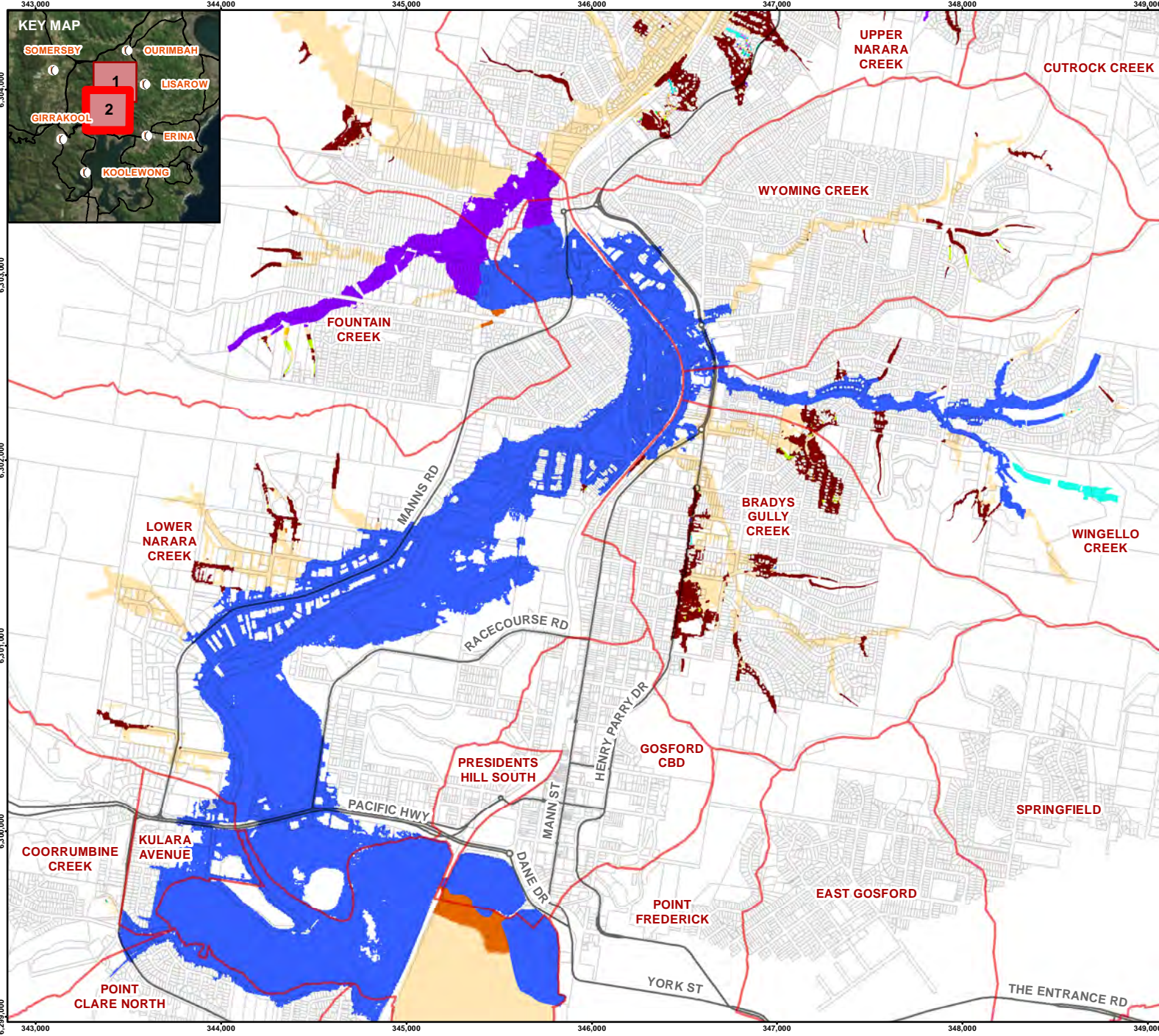
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**Golder Associates**

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APPROVED	NM

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097626068 006 G Appendix H-2A

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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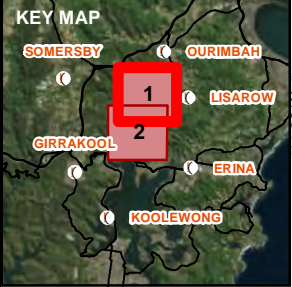
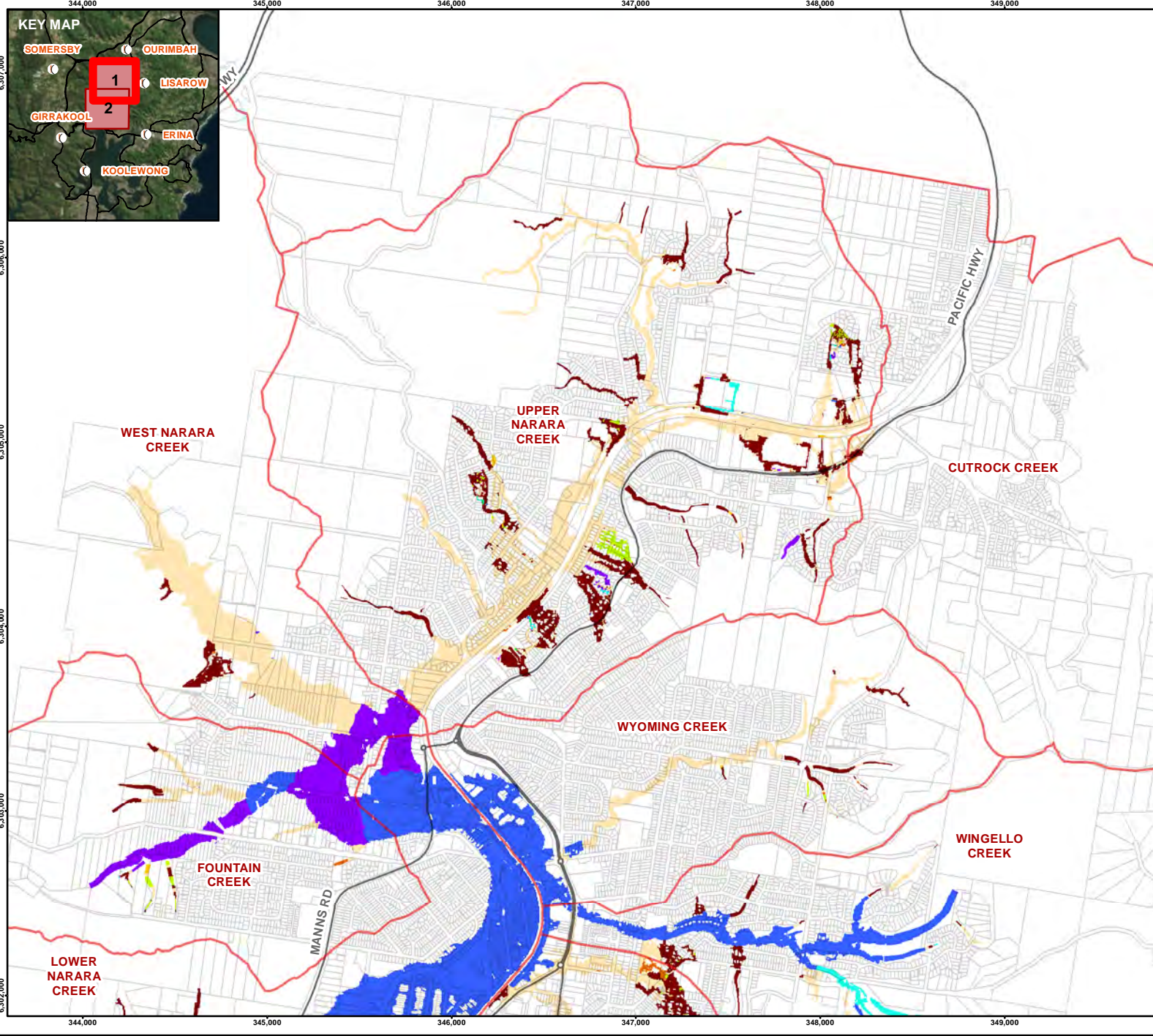
PROJECT  
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TITLE  
**CRITICAL DURATION 0.2% AEP EVENT**

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PREPARED	DC
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APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 0.5% AEP EVENT**

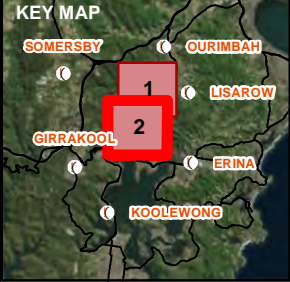
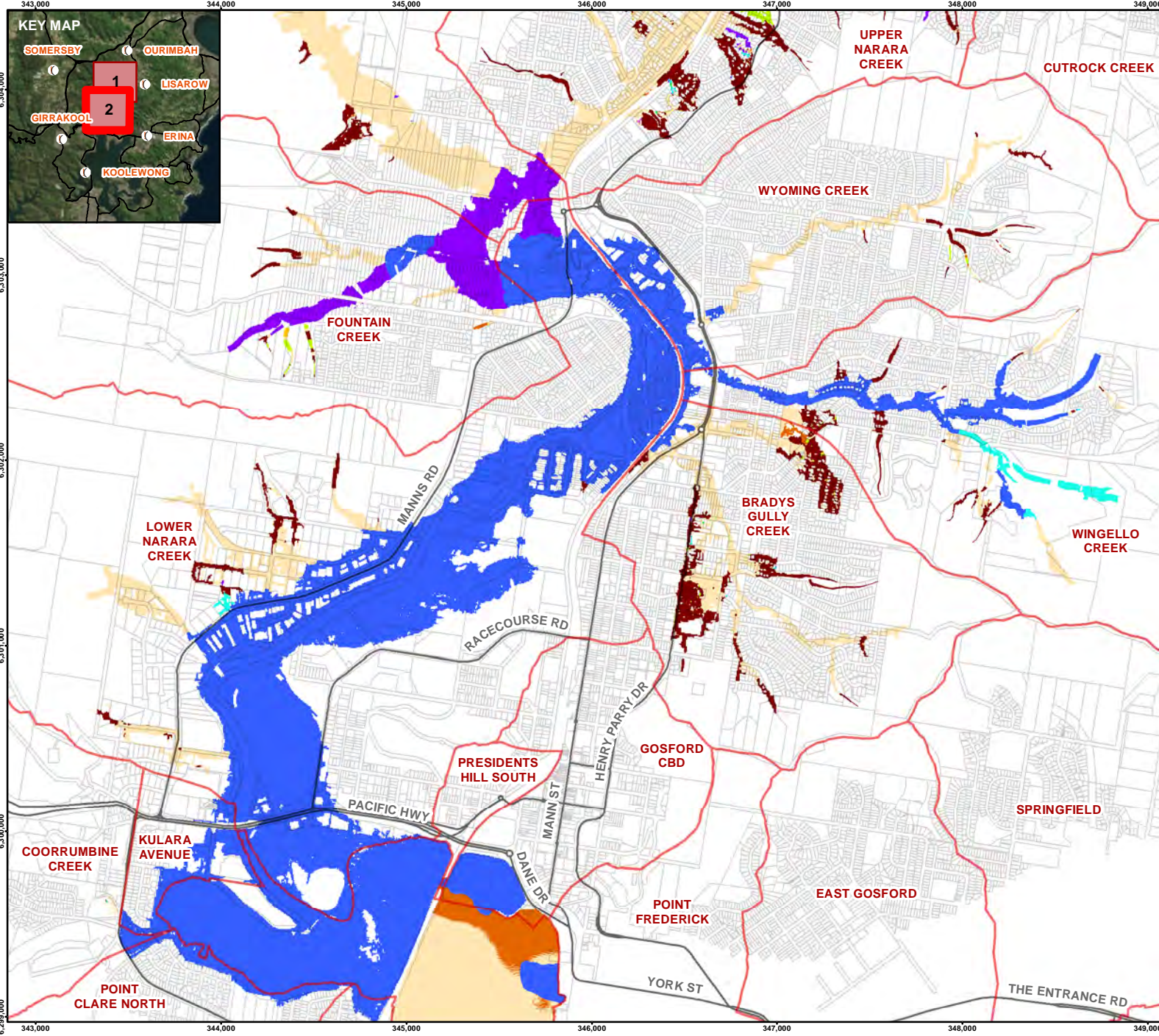
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APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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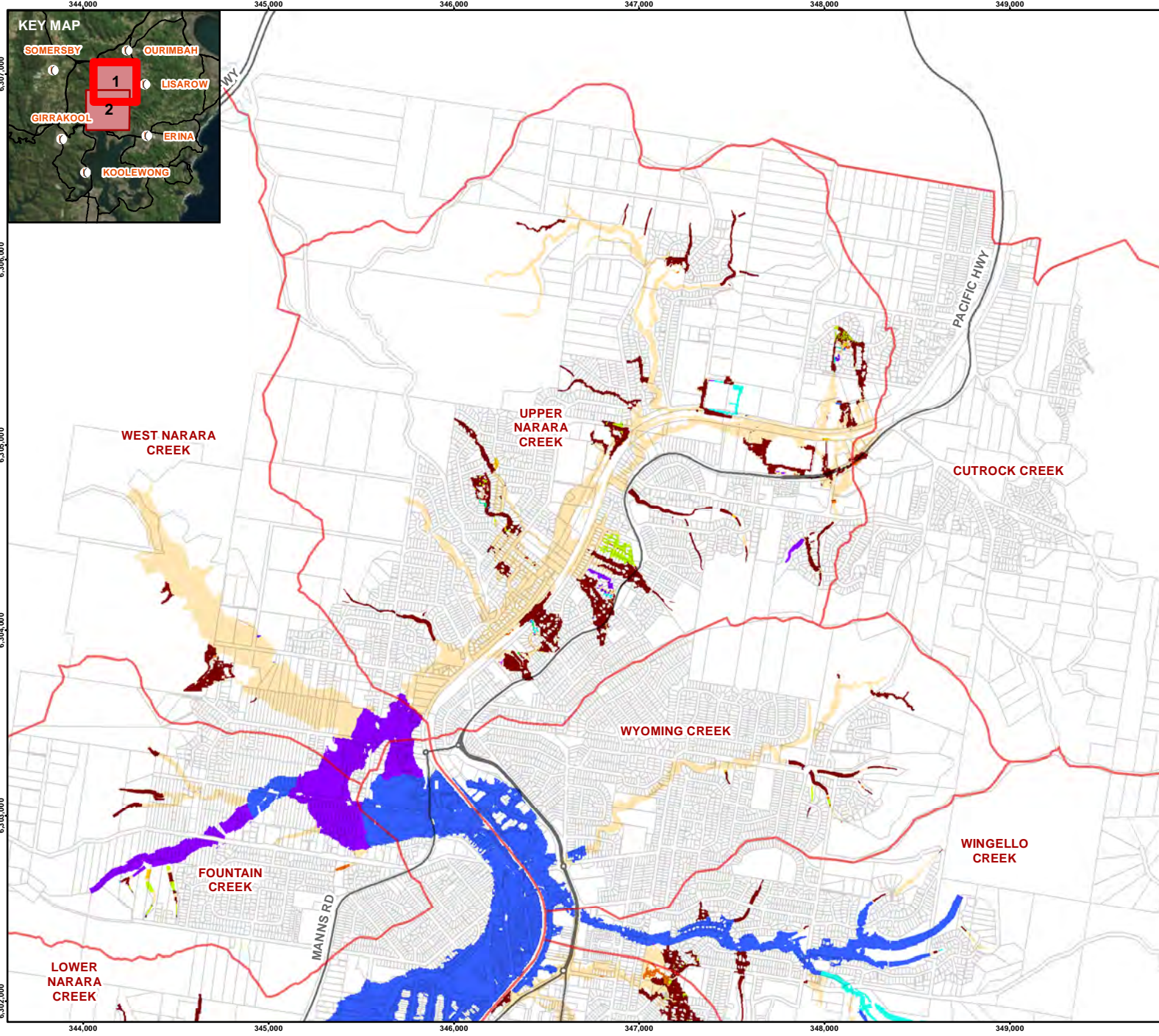
PROJECT  
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TITLE  
**CRITICAL DURATION 0.5% AEP EVENT**



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APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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**NARARA CREEK FLOOD STUDY**

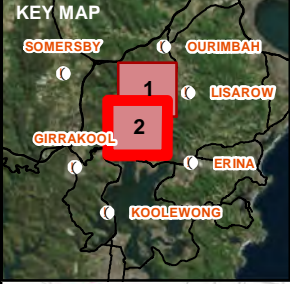
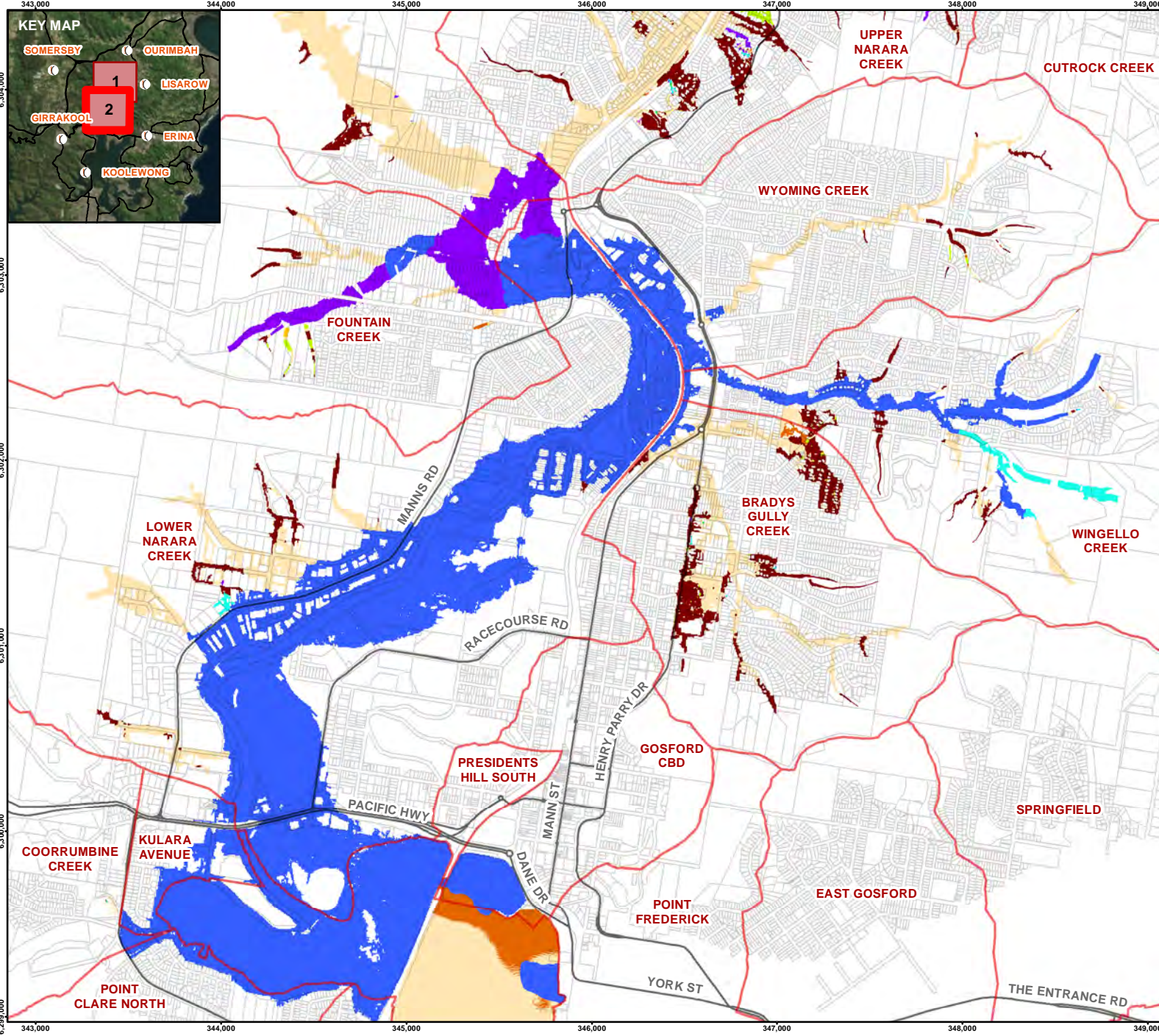
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**Legend**

- Localities
- Main Roads
- Drainage Sub-catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
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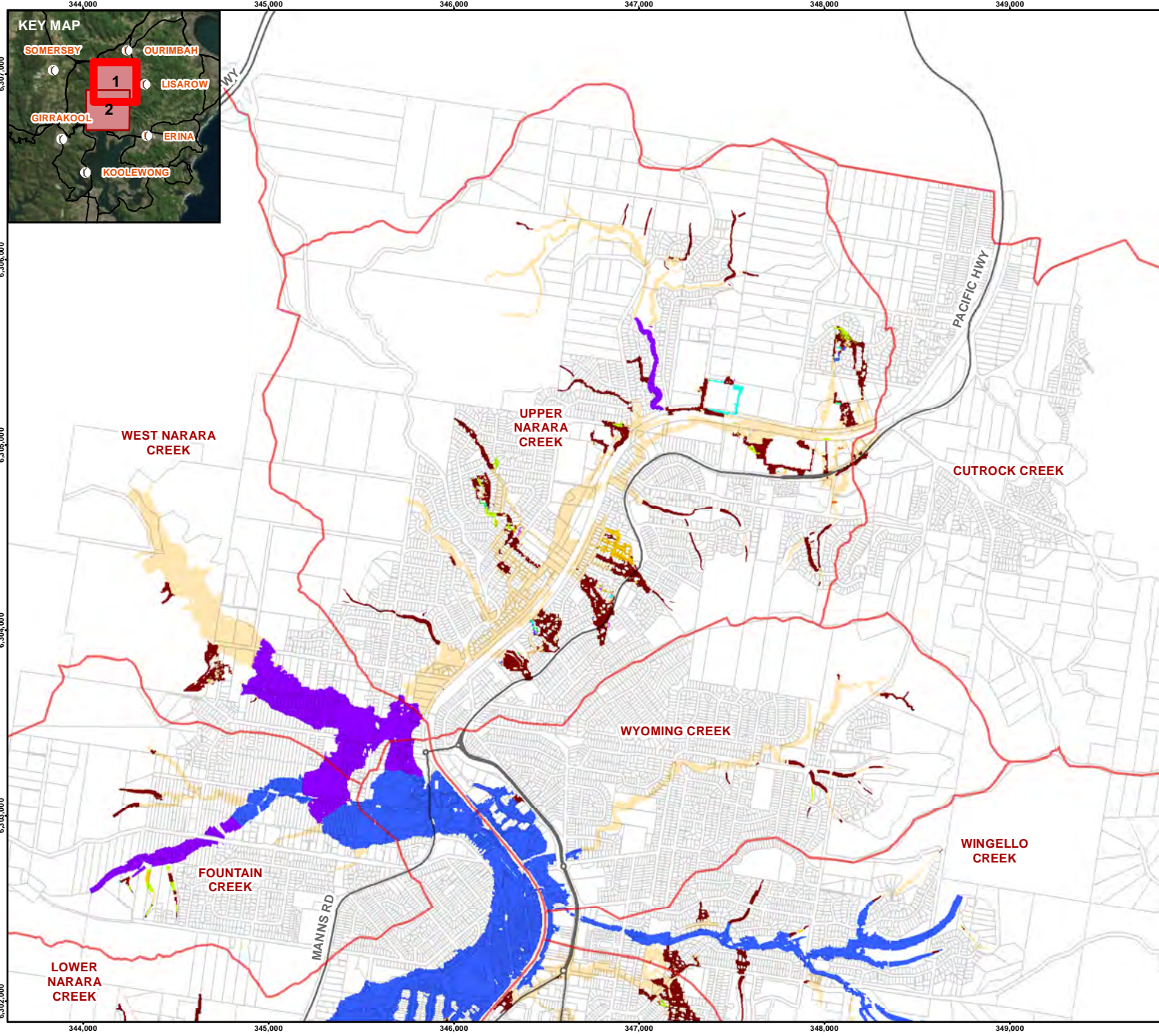
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 1% AEP EVENT**

CONSULTANT

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DESIGNED	SL
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REVIEWED	NM
APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
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**NARARA CREEK FLOOD STUDY**

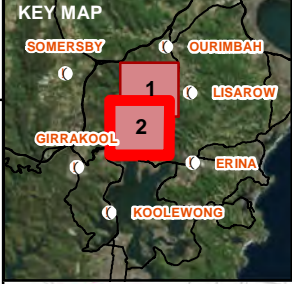
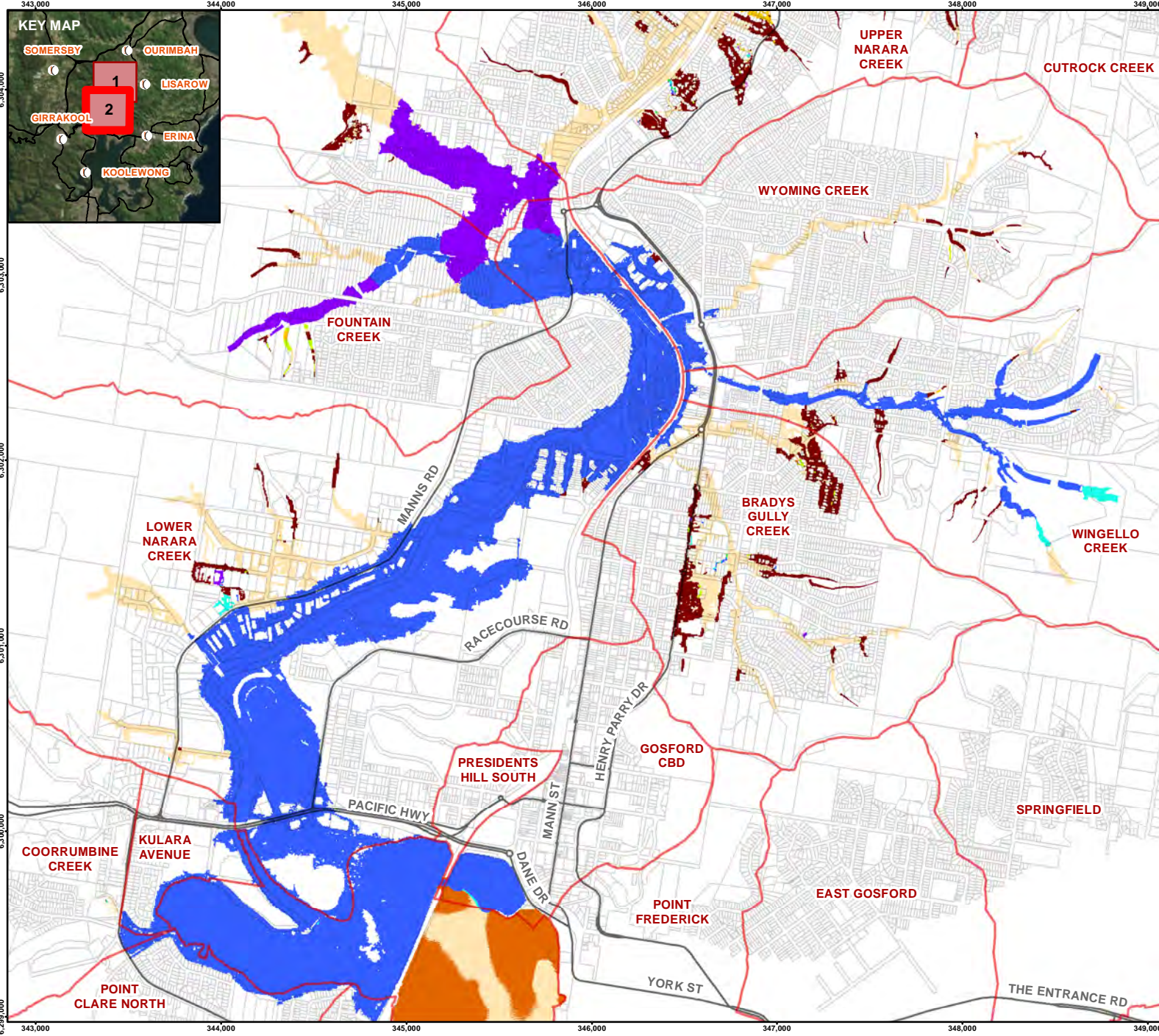
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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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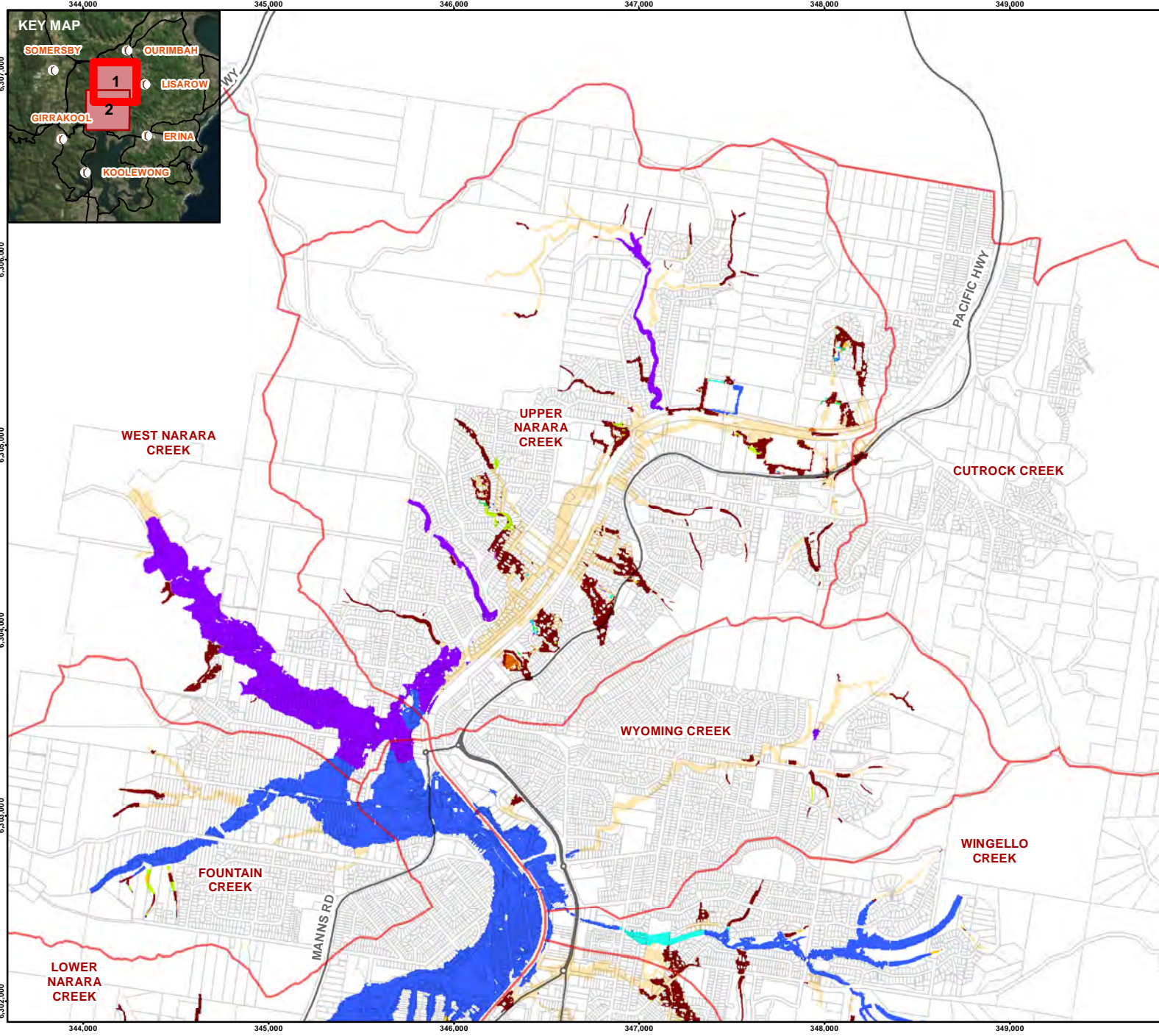
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 2% AEP EVENT**

CONSULTANT  
**Golder Associates**

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES  
1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

**NOTE(S)**  
**Service Layer Credits:** Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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**REFERENCE(S)**  
**Main Roads, Localities:** Provided by MapInfo StreetPro.  
**Cadastral, Sub-Catchment:** Provided by Central Coast Council February 2018

CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

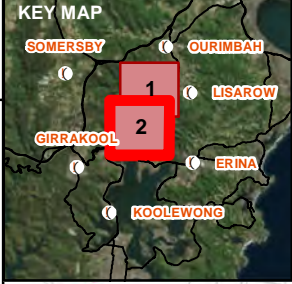
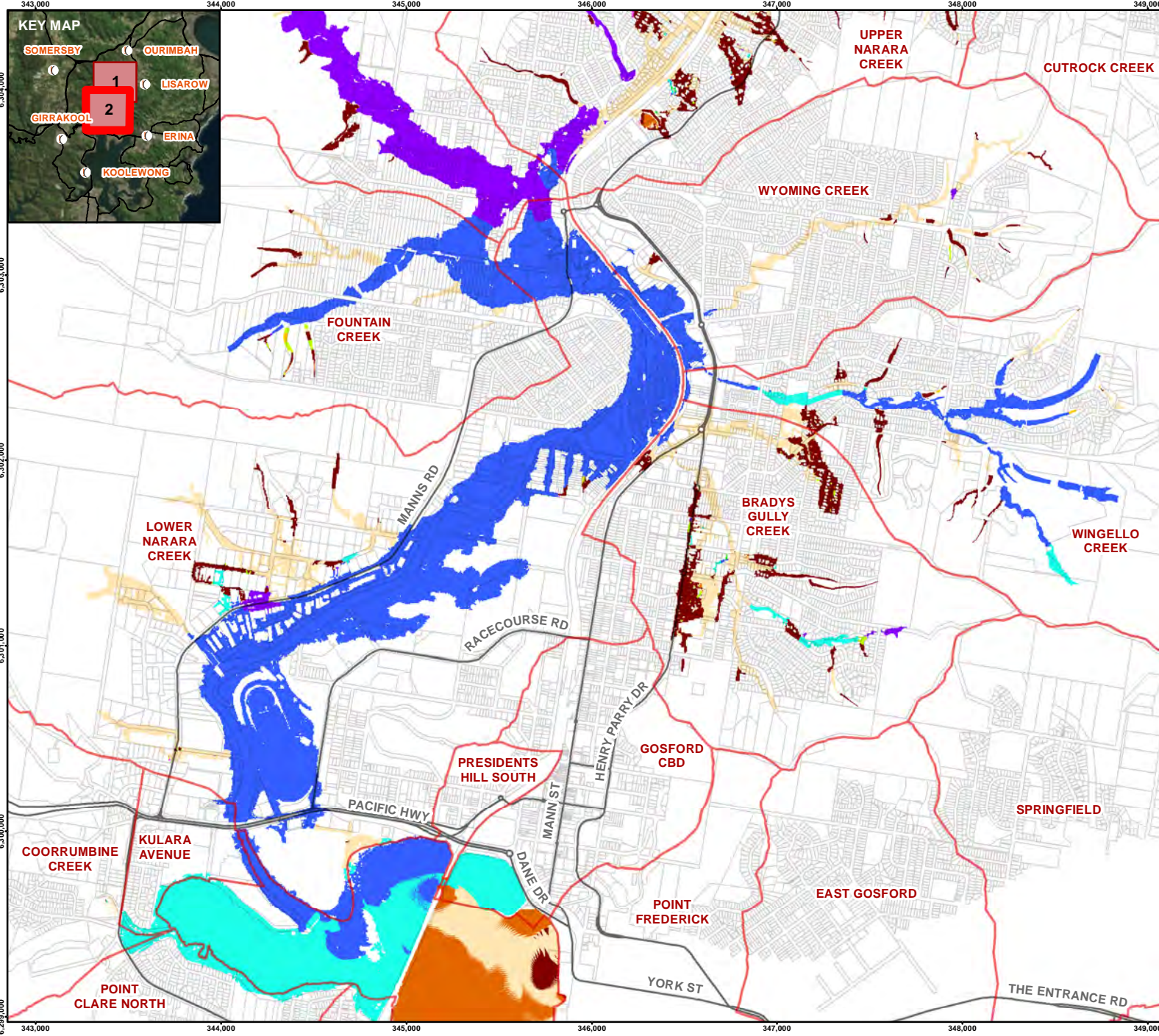
TITLE  
**CRITICAL DURATION 5% AEP EVENT**

CONSULTANT



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

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Datum: GDA 1994

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CLIENT  
**CENTRAL COAST COUNCIL**

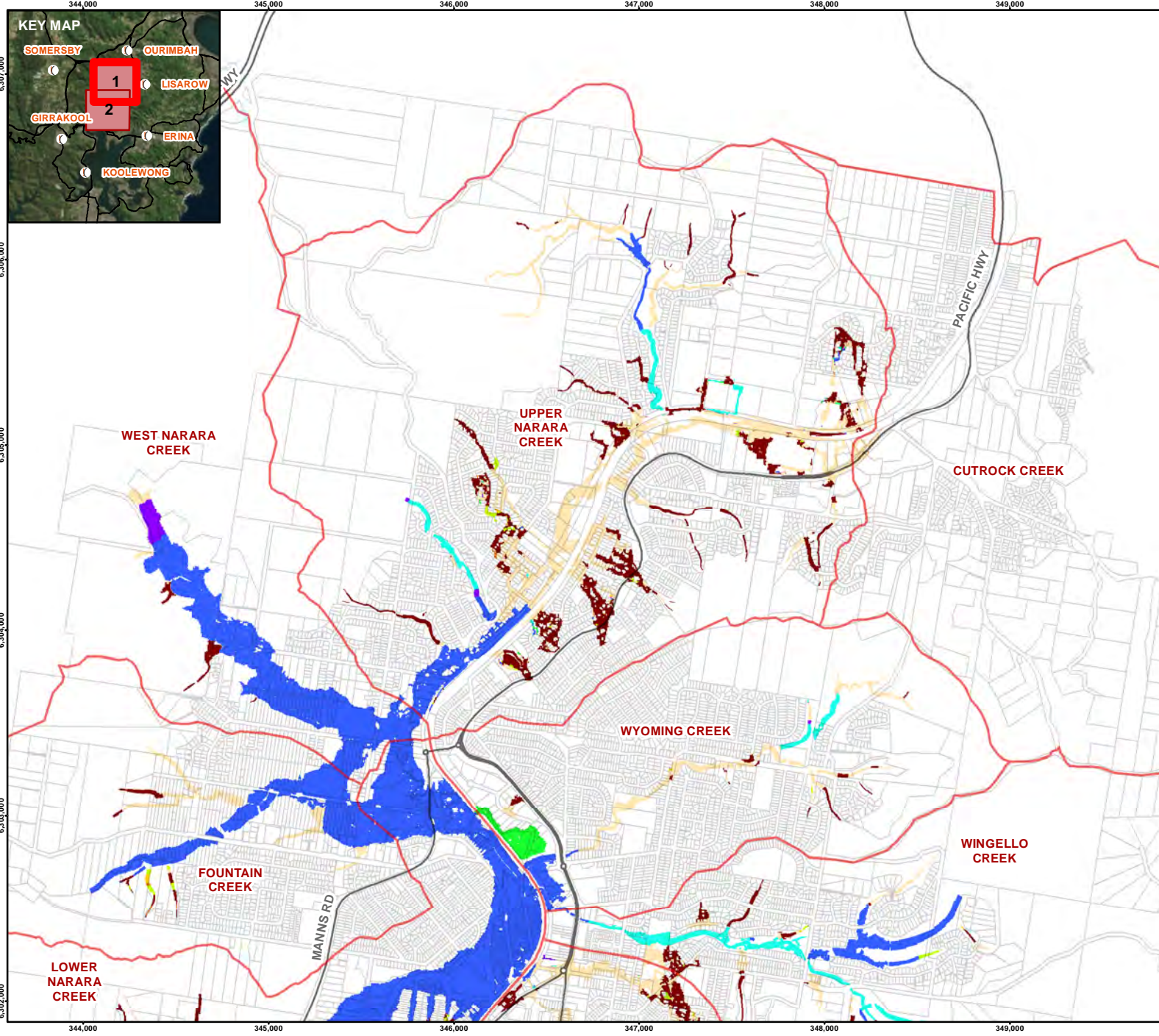
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 5% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
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REVIEWED	NM
APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 10% AEP EVENT**

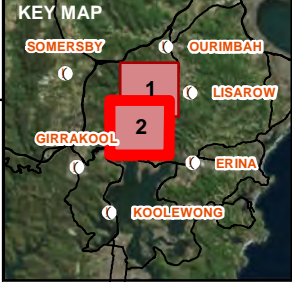
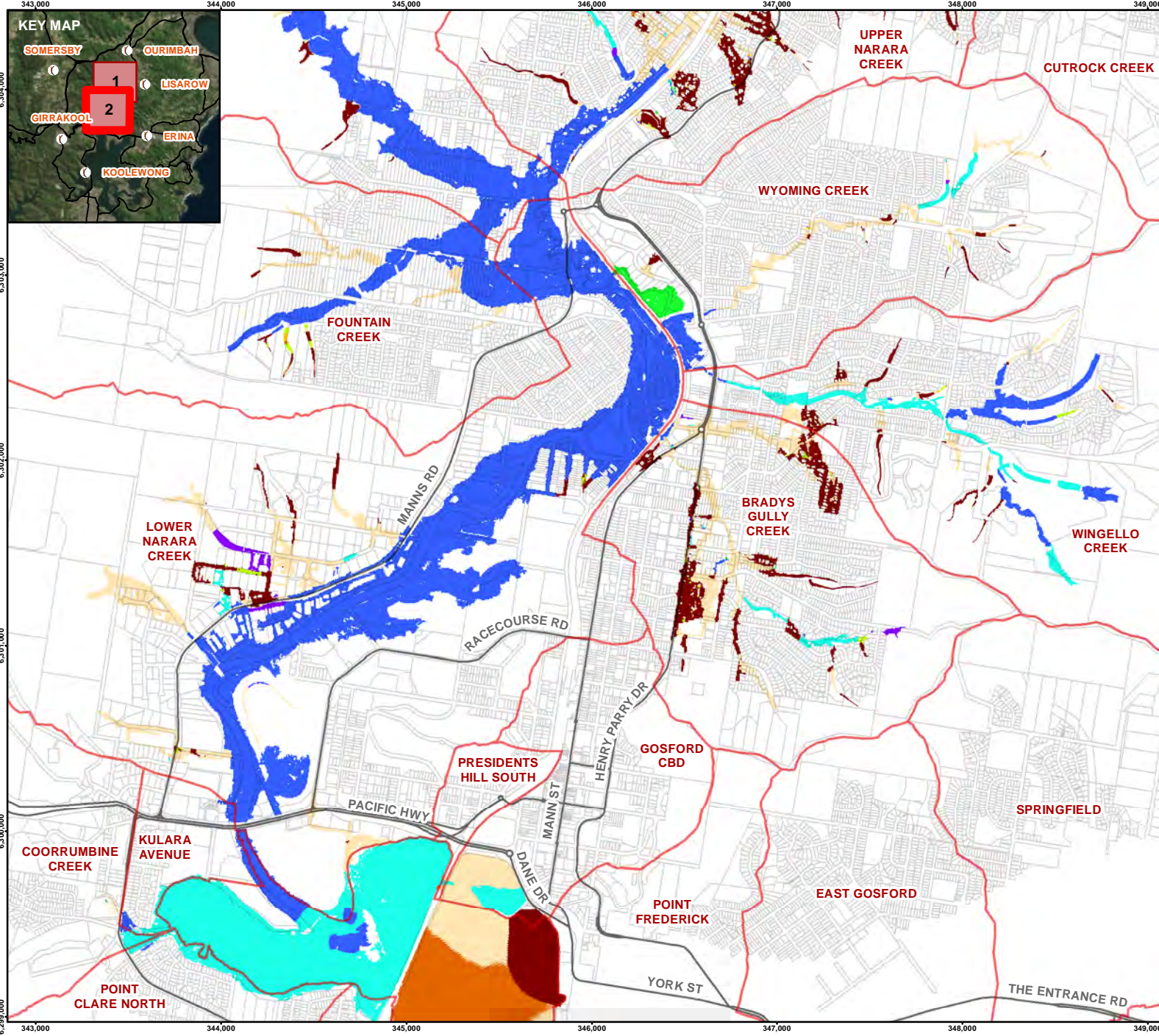
CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
 097626068 006 G Appendix H-7A

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
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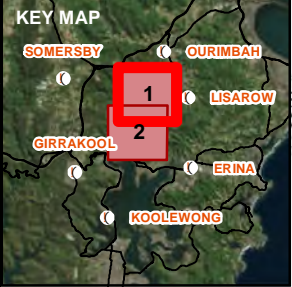
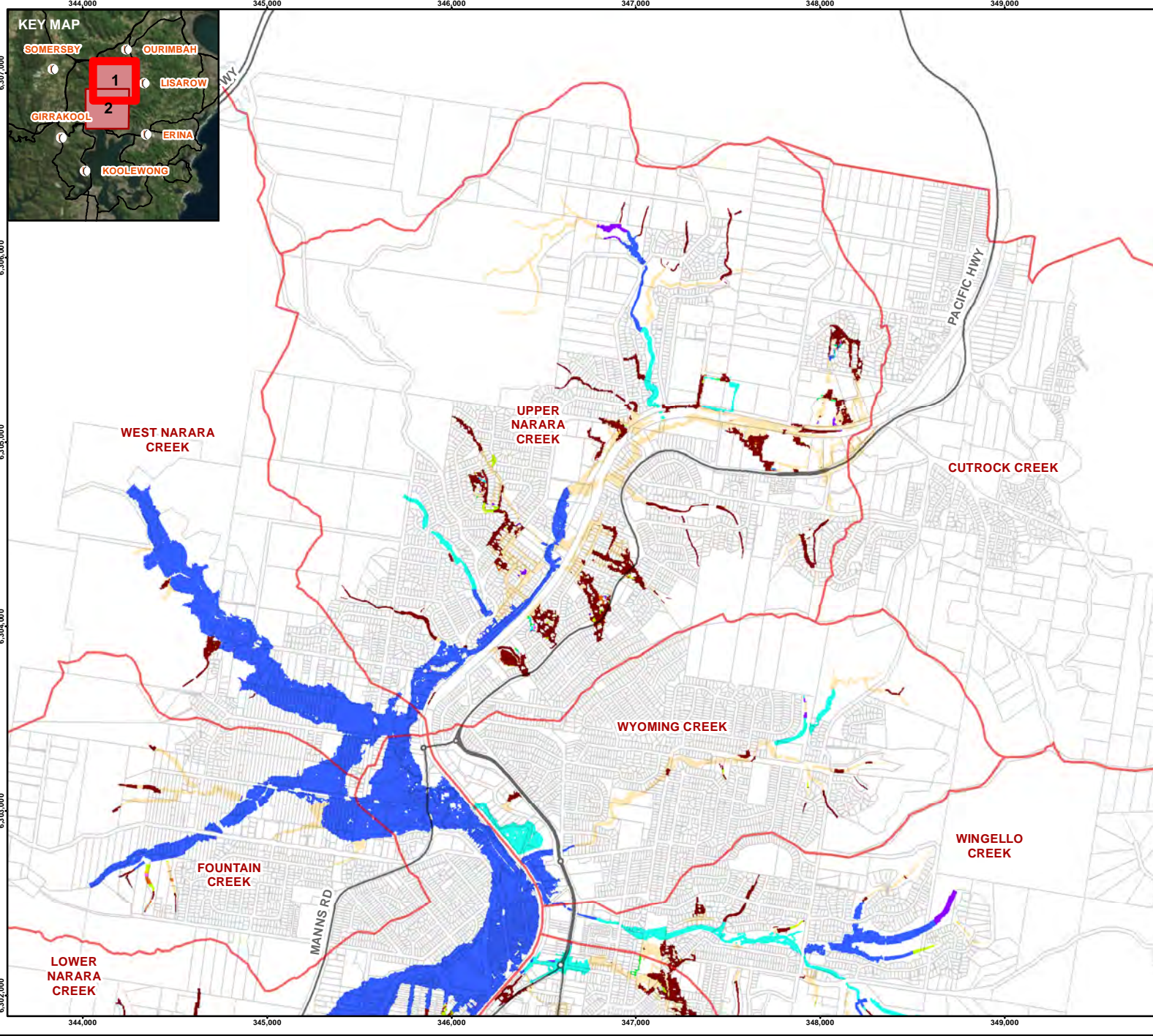
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 10% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
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- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000  
METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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PROJECT  
**NARARA CREEK FLOOD STUDY**

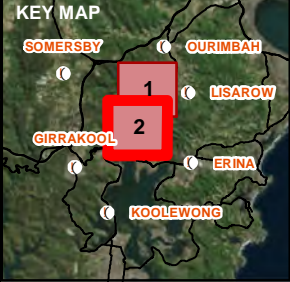
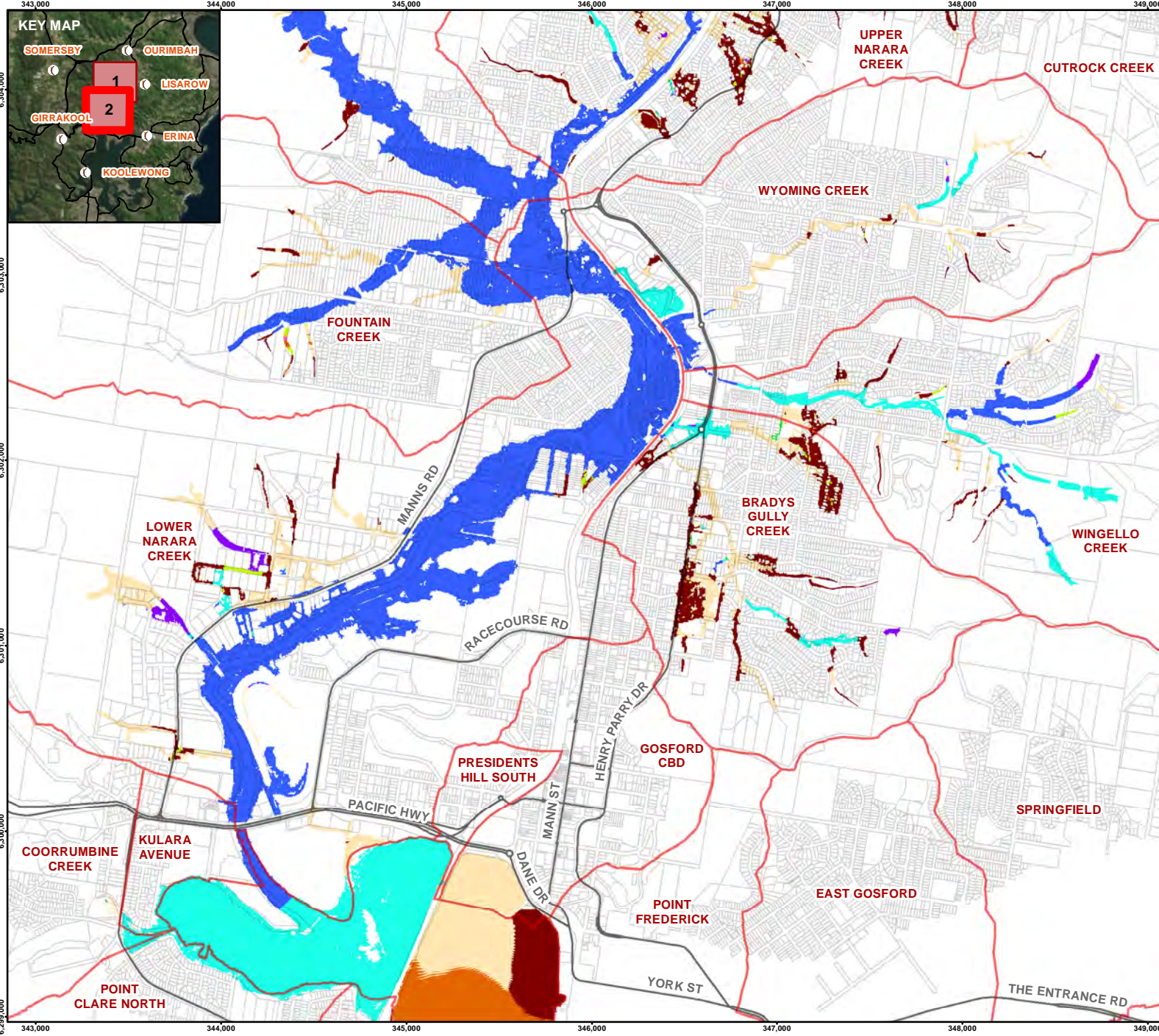
TITLE  
**CRITICAL DURATION 20% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
 097626068 006 G Appendix H-8A

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**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
- 6 hr
- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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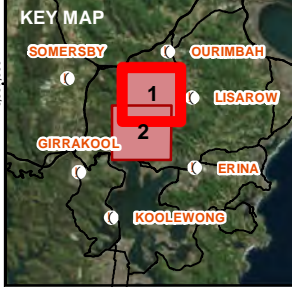
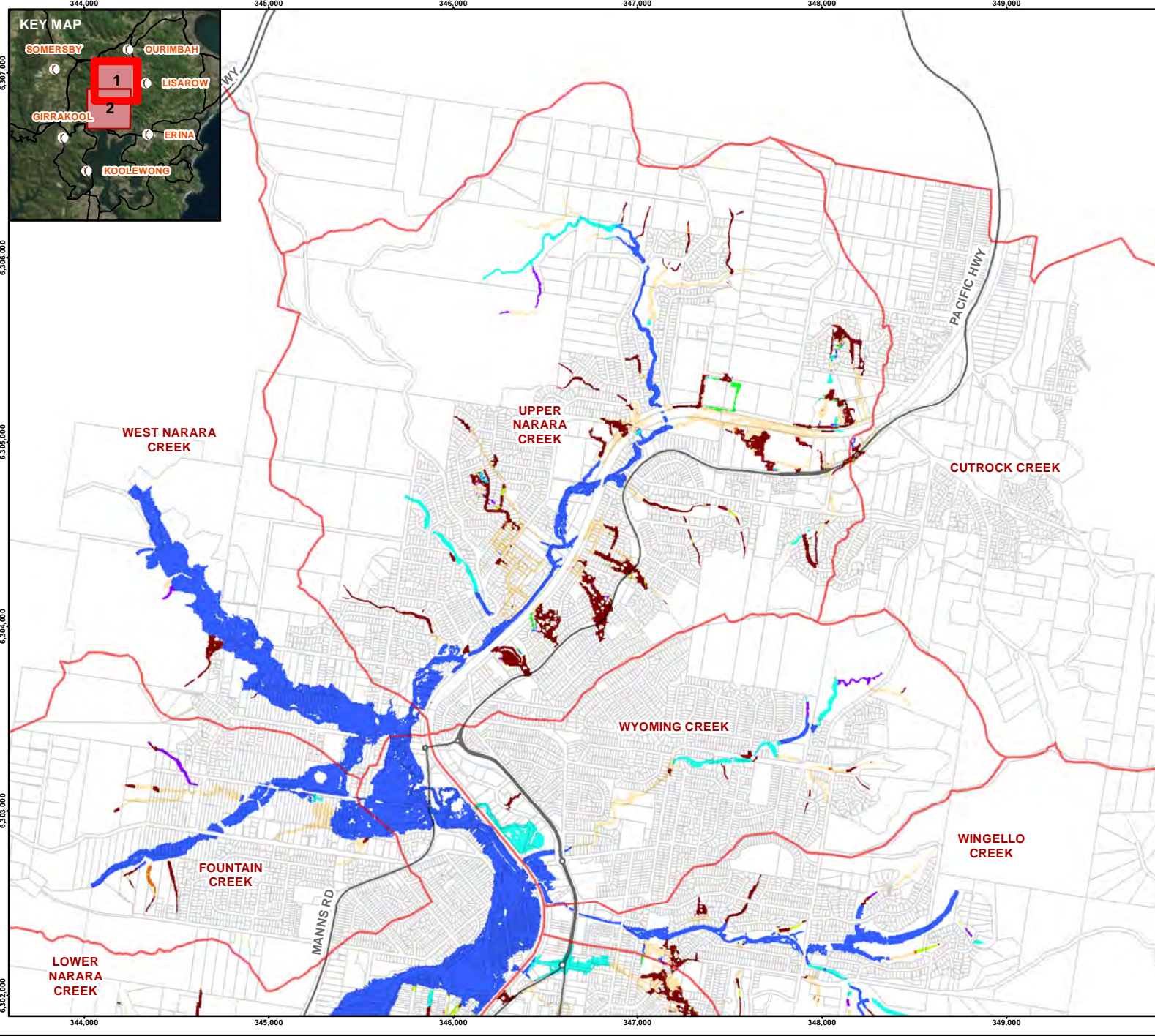
PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 20% AEP EVENT**



DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4 25mm



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
- Cadastral Boundary

**Critical Duration**

- 30 min
- 45 min
- 60 min
- 90 min
- 2 hr
- 3 hr
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- 9 hr
- 12 hr
- 18 hr

0 500 1,000 METRES  
1:30,000 @A4

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PROJECT  
**NARARA CREEK FLOOD STUDY**

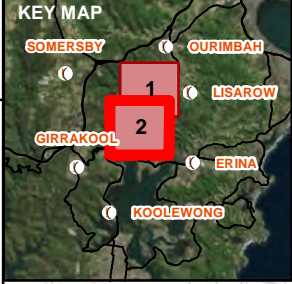
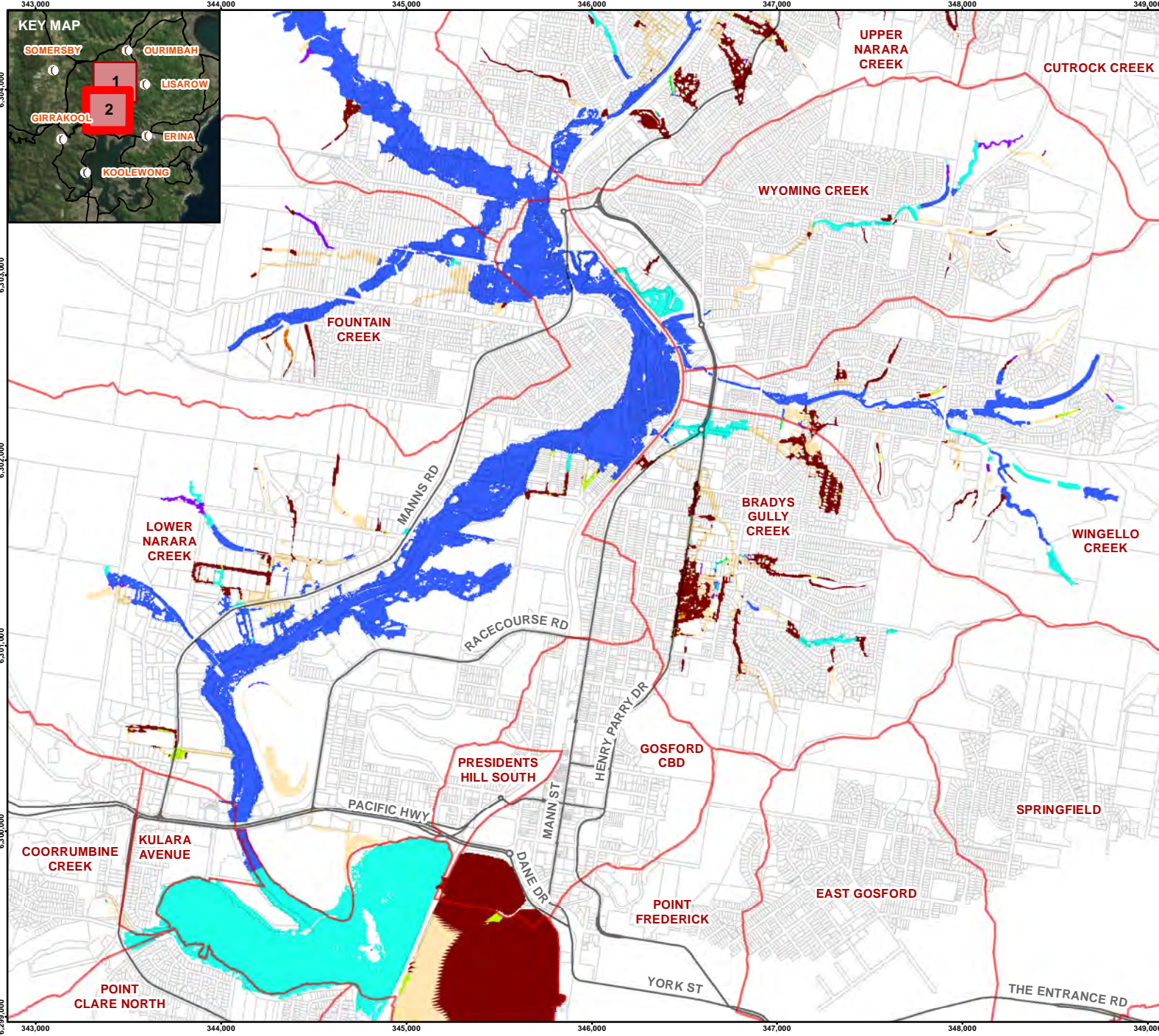
TITLE  
**CRITICAL DURATION 50% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
 097626068 006 G Appendix H-9A

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET HAS BEEN MODIFIED FROM: ISO A4



**Legend**

- Localities
- Main Roads
- Drainage Sub-Catchment
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- 12 hr
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0 500 1,000 METRES

1:30,000 @A4

Coordinate System: GDA 1994 MGA Zone 56  
Projection: Transverse Mercator  
Datum: GDA 1994

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CLIENT  
**CENTRAL COAST COUNCIL**

PROJECT  
**NARARA CREEK FLOOD STUDY**

TITLE  
**CRITICAL DURATION 50% AEP EVENT**

CONSULTANT

DD/MM/YYYY	3/04/2018
DESIGNED	SL
PREPARED	DC
REVIEWED	NM
APPROVED	NM

PROJECT NO. CONTROL REV. FIGURE  
 097626068 006 G Appendix H-9B

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APPENDIX I

Limitations

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

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This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

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