

# Murwillumbah CBD Levee & Drainage Study

Final Report

Volume 2 of 2: Figures

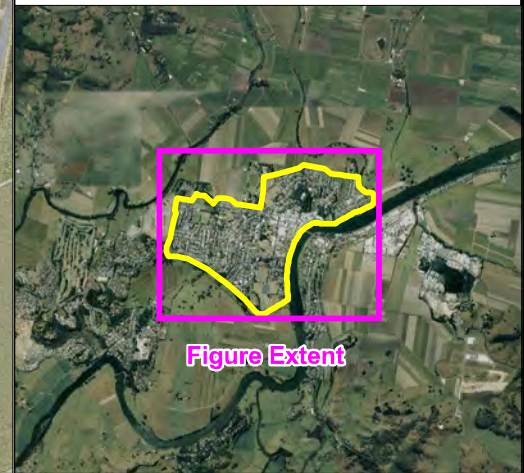
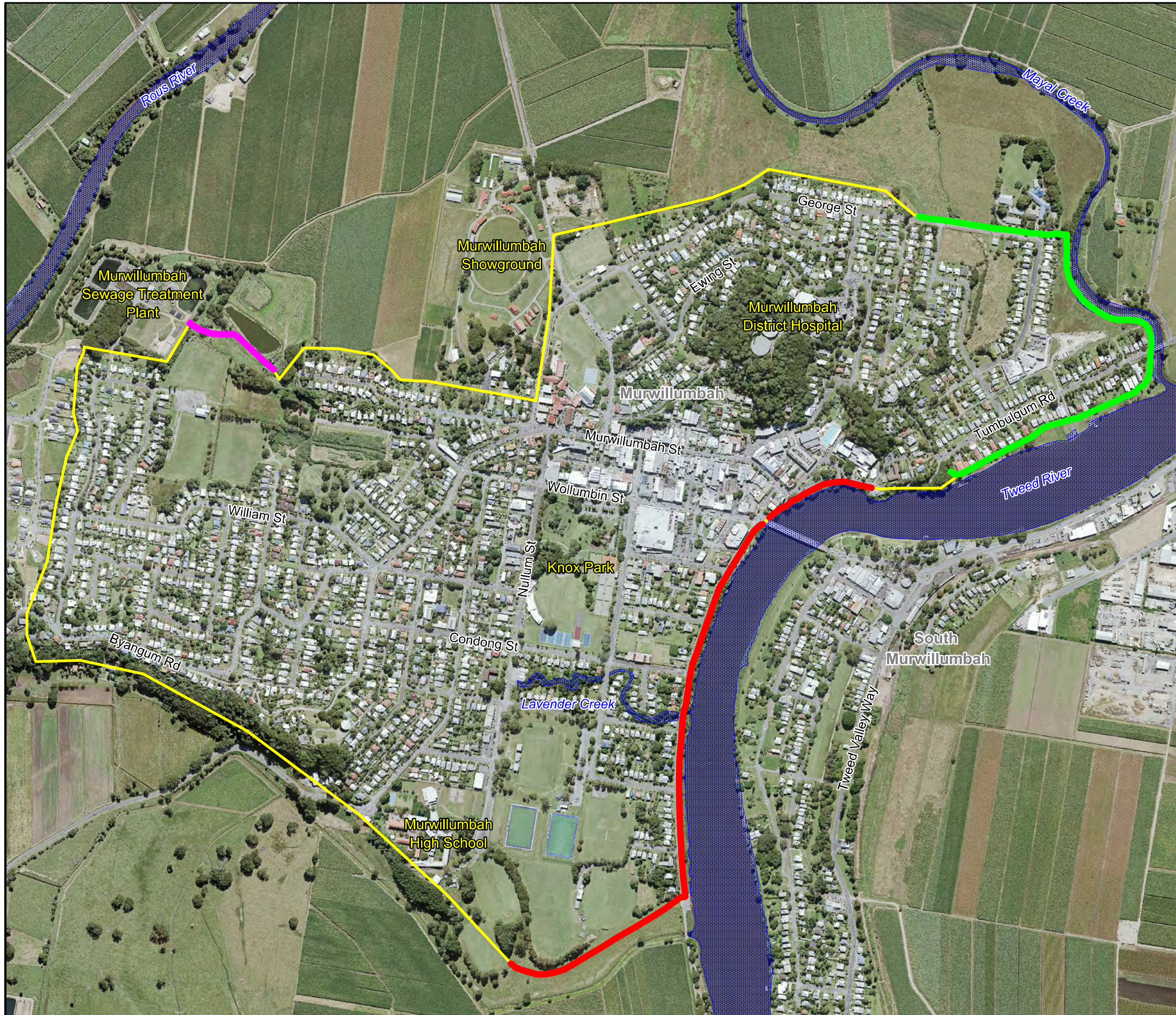


## ▶ FIGURES





- Figure 1: Murwillumbah CBD Study Area
- Figure 2: Extent of Available Information
- Figure 3: Digital Elevation Model
- Figure 4: Details of Existing Levees and Drainage System
- Figure 5: Remote Sensing Land Use Map
- Figure 6: TUFLOW Model Layout
- Figure 7: Isohyet Map for 2017 Storm
- Figure 8: Simulated Floodwater Depths & Levels for 2017 Flood
- Figure 9: Recorded and Simulated Stage Hydrographs for the 2017 Flood
- Figure 10: Isohyet Map for 2012 Storm
- Figure 11: Simulated Floodwater Depths & Levels for 2012 Flood
- Figure 12: Recorded and Simulated Stage Hydrographs for the 2012 Flood
- Figure 13: Isohyet Map for 2016 Storm
- Figure 14: Simulated Floodwater Depths & Levels for 2016 Flood
- Figure 15: Recorded and Simulated Stage Hydrographs for the 2016 Flood
- Figure 16: Design Flow Hydrographs
- Figure 17: Floodwater Depths for the 20% AEP Flood
- Figure 18: Floodwater Depths for the 5%AEP Flood
- Figure 19: Floodwater Depths for the 1%AEP Flood
- Figure 20: Floodwater Depths for the 0.2% AEP Flood
- Figure 21: Floodwater Levels for the 20% AEP Flood
- Figure 22: Floodwater Levels for the 5% AEP Flood
- Figure 23: Floodwater Levels for the 1%AEP Flood
- Figure 24: Floodwater Levels for the 0.2% AEP Flood
- Figure 25: Floodwater Velocities for the 20% AEP Flood
- Figure 26: Floodwater Velocities for the 5% AEP Flood
- Figure 27: Floodwater Velocities for the 1% AEP Flood
- Figure 28: Floodwater Velocities for the 0.2% AEP Flood
- Figure 29: Levee and Floodwater Surface Profiles
- Figure 30: Stormwater Capacity Maps
- Figure 31: Hazard Categories for the 1% AEP Flood
- Figure 32: Hazard Categories for the 0.2% AEP Flood
- Figure 33: Hydraulic Categories for the 1% AEP Flood
- Figure 34: Hydraulic Categories for the 0.2% AEP Flood
- Figure 35: Emergency Response Precinct Classifications for the 1% AEP Flood
- Figure 36: Emergency Response Precinct Classifications for the 0.2% AEP Flood
- Figure 37: High Flow Map for the 1% AEP Flood
- Figure 38: Flood Planning Category Constraint Mapping



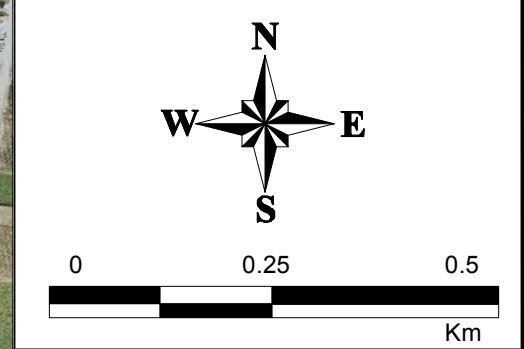





**LEGEND**

-  Murwillumbah CBD Levee Study Area
-  Levee 1 - Commerical Road
-  Levee 2 - East Murwillumbah
-  Levee 3 - Dorothy Street

Notes:  
Aerial photograph date: 2015

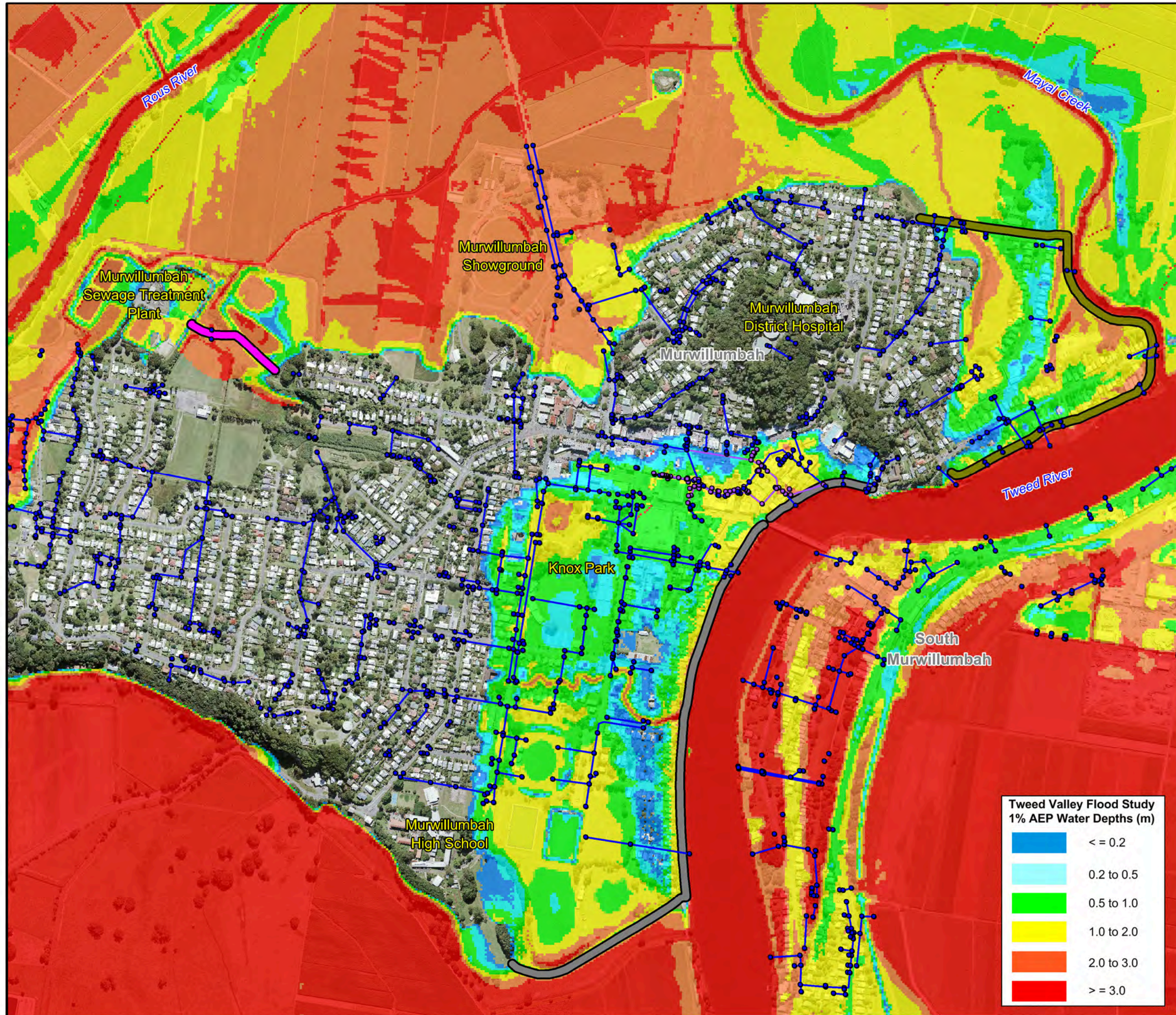


**Figure 1:  
Murwillumbah CBD  
Study Area**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig1 - Murwillumbah CBD Levee Study Area.wor

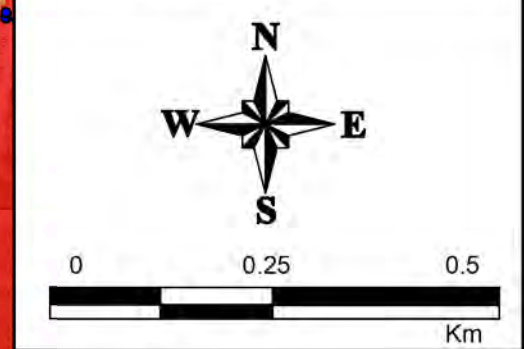




**LEGEND**

- Stormwater Pit from GIS
  - Stormwater Pipe from GIS
  - Stormwater Pit from Plans
  - Stormwater Pipe from Plans
- Levee Plans**
- Levee 1 - Commercial Road
  - Levee 2 - East Murwillumbah
  - Levee 3 - Dorothy Street


Notes:  
Aerial photograph date: 2015



**Tweed Valley Flood Study  
1% AEP Water Depths (m)**

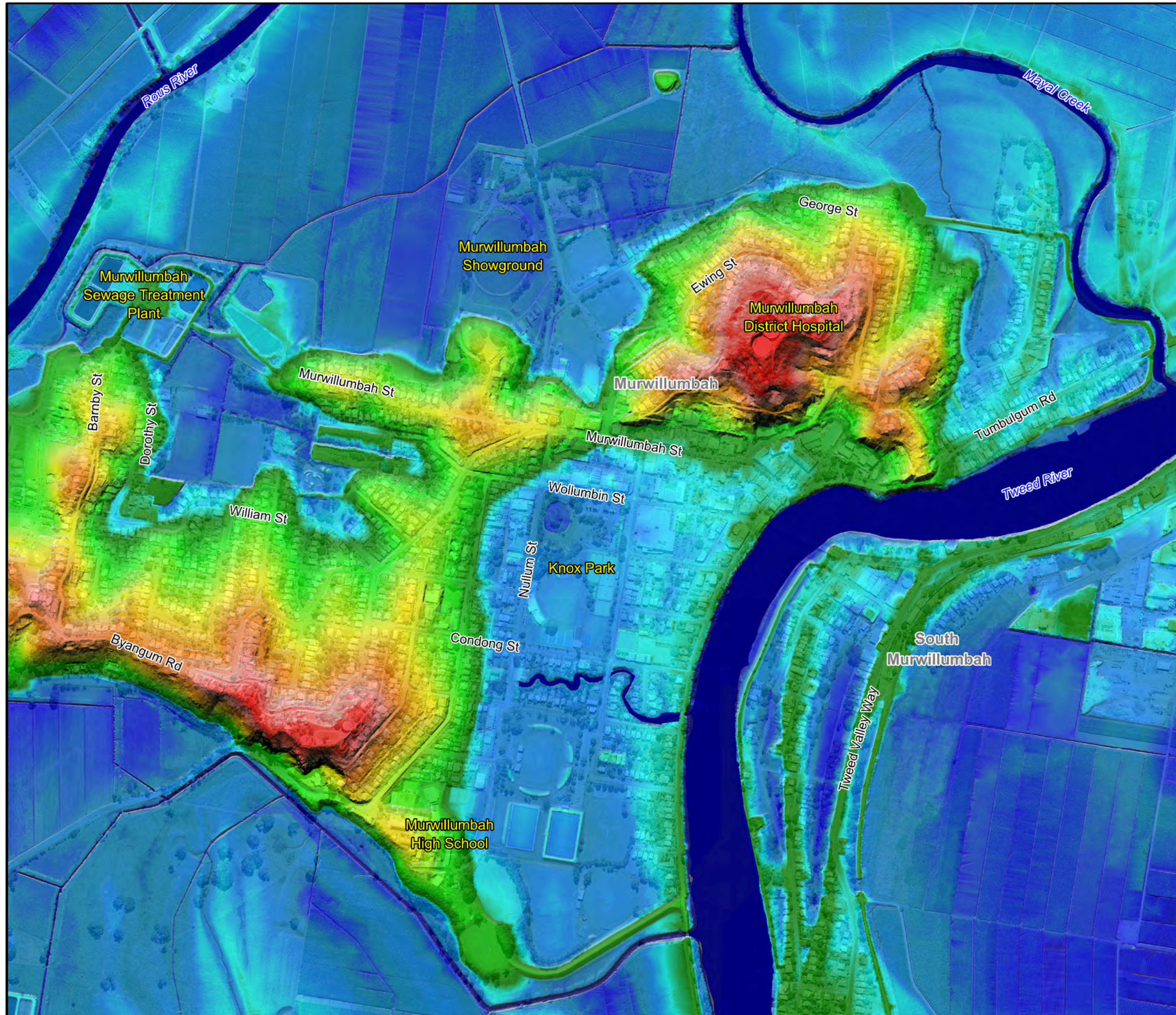
	<= 0.2
	0.2 to 0.5
	0.5 to 1.0
	1.0 to 2.0
	2.0 to 3.0
	>= 3.0

**Figure 2:  
Extent of Available  
Information**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig2 - Extent of Available Information.wor




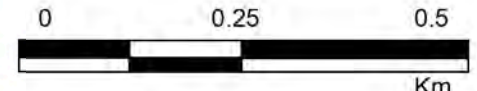


**LEGEND**


DEM (mAHD)

Dark Blue	<= 0	Light Green	10
Blue	1	Yellow	20
Light Blue	2	Orange	30
Cyan	3	Red	40
Light Cyan	4	Dark Red	>= 50
Green	5		

Notes:  
Aerial photograph date: 2015

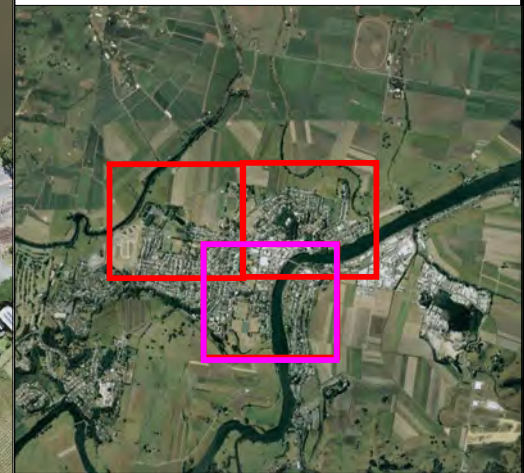



**Figure 3:  
Digital Elevation  
Model**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George St  
 Sydney, NSW 2000

File Name: Fig3 - Digital Elevation Model.wor





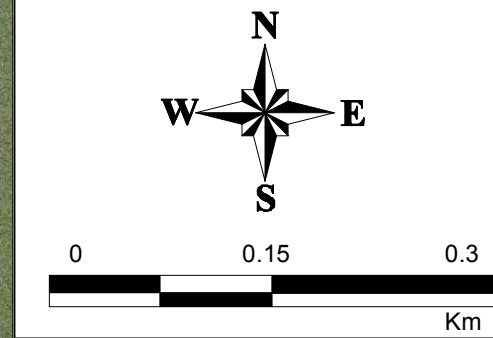
**LEGEND**

- Levee Alignment
- Levee Crest Elevation (mAHD)
- Culvert
- Stormwater Pit
- Pump Station
- Flood Gate

Pipe Diameter (m)

- ≤ 0.3
- 0.375
- 0.45
- 0.525
- 0.6
- ≥ 0.675

**Notes:**  
Aerial photograph date: 2015

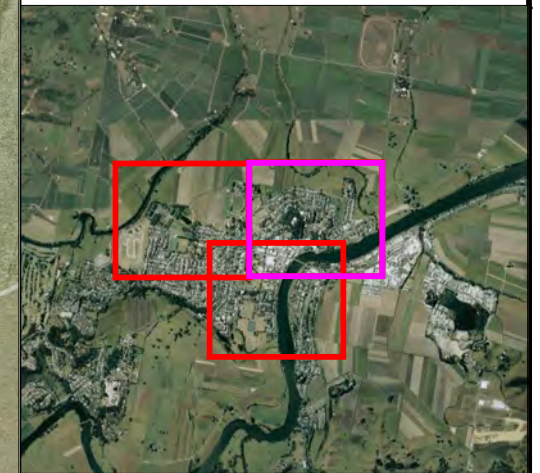


**Figure 4.1:  
Commercial Road  
Levee and  
Drainage System**













Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig4.1 - Details of Existing Levee and Drainage System.wor



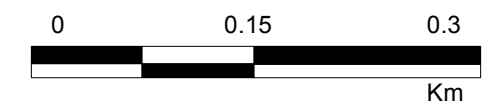
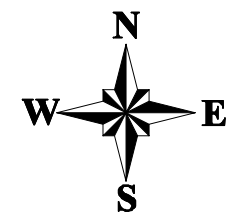


**LEGEND**

-  Levee Alignment
  -  Levee Crest Elevation (mAHD)
  -  Culvert
  -  Stormwater Pit
  -  Pump Station
  -  Flood Gate
- Pipe Diameter (m)
-  ≤ 0.3
  -  0.375
  -  0.45
  -  0.525
  -  0.6
  -  ≥ 0.675


Notes:

Aerial photograph date: 2015



**Figure 4.2:  
East Murwillumbah  
Levee and Drainage  
System**

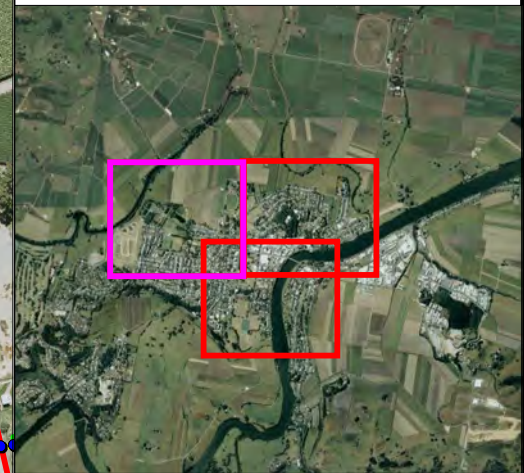
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000













File Name: Fig4.2 - Details of Existing Levee and Drainage System.wor





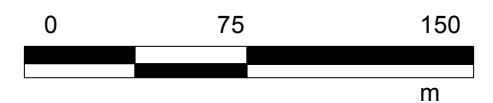
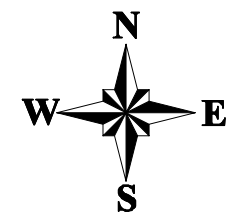


**LEGEND**

-  Levee Alignment
  -  Levee Crest Elevation (mAHD)
  -  Culvert
  -  Stormwater Pit
  -  Pump Station
  -  Flood Gate
- Pipe Diameter (m)
-  ≤ 0.3
  -  0.375
  -  0.45
  -  0.525
  -  0.6
  -  ≥ 0.675


Notes:

Aerial photograph date: 2015



**Figure 4.3:  
Dorothy Street  
Levee and Drainage  
System**

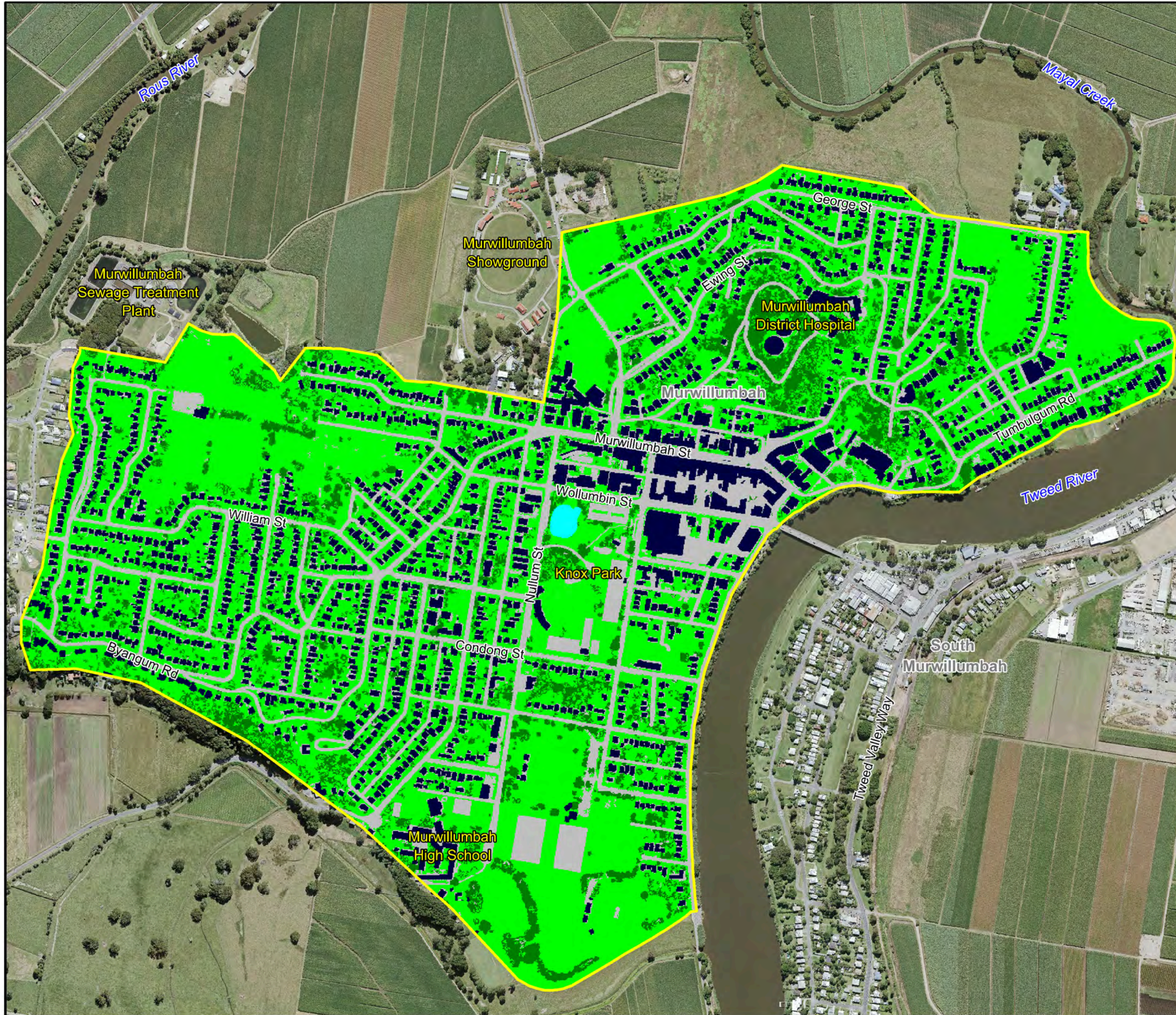
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig4.3 - Details of Existing Levee and Drainage System.wor



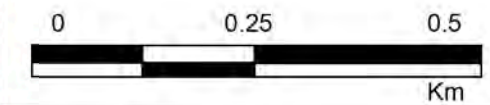





**LEGEND**

- Material
-  Building
  -  Water
  -  Trees
  -  Grass
  -  Impervious

Notes:  
Aerial photograph date: 2015

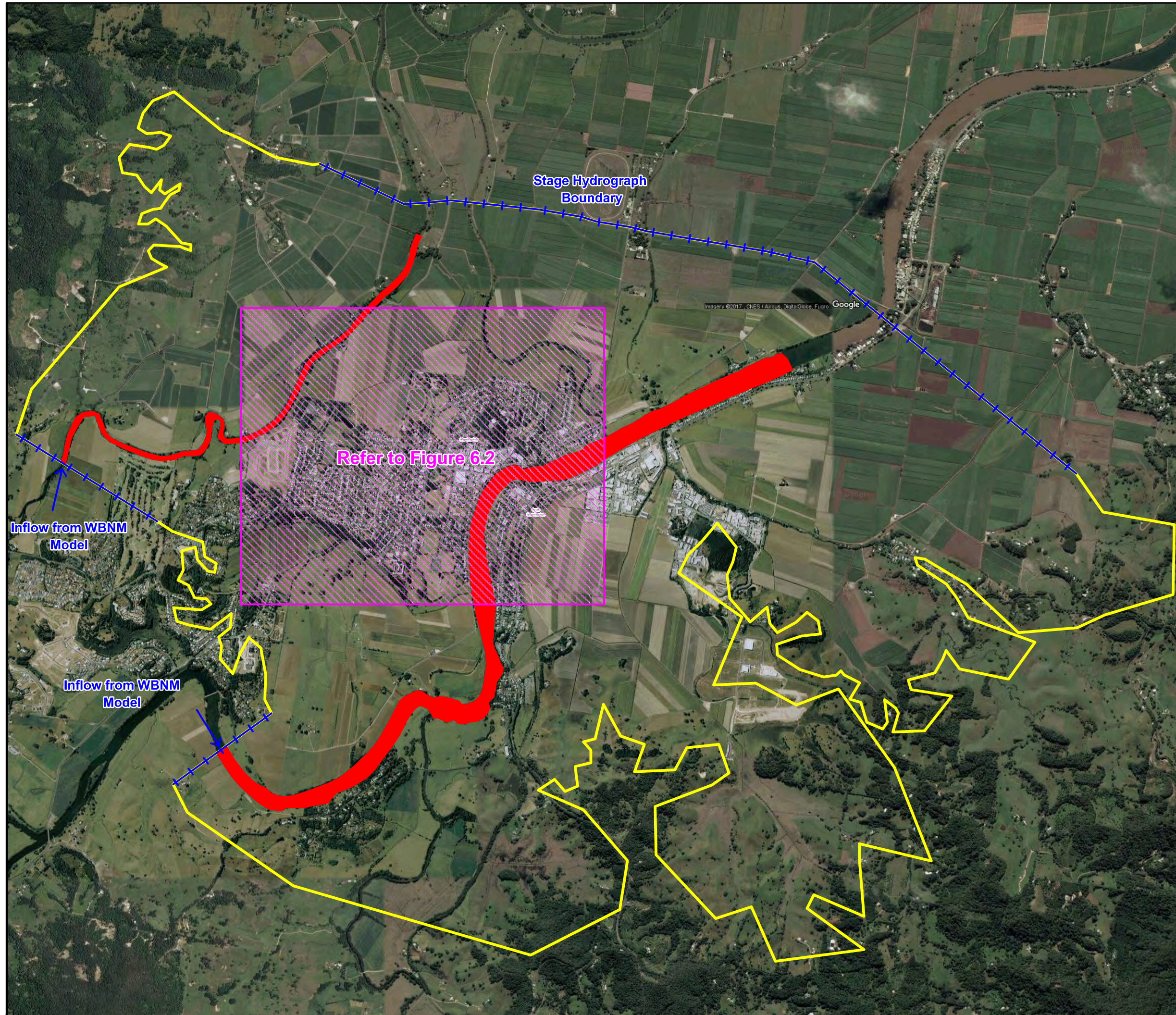


**Figure 5:  
Remote Sensing  
Land Use Map**




Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig5 - Remote Sensing Land Use Map.wor

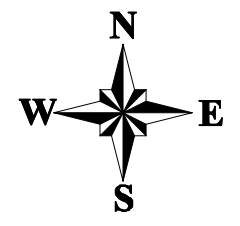
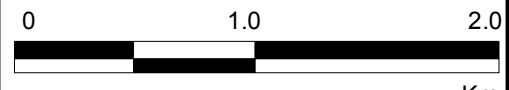




**LEGEND**


-  2D Domain
-  1D Domain
-  Boundary Condition

**Notes:**  
Aerial photograph date: 2015

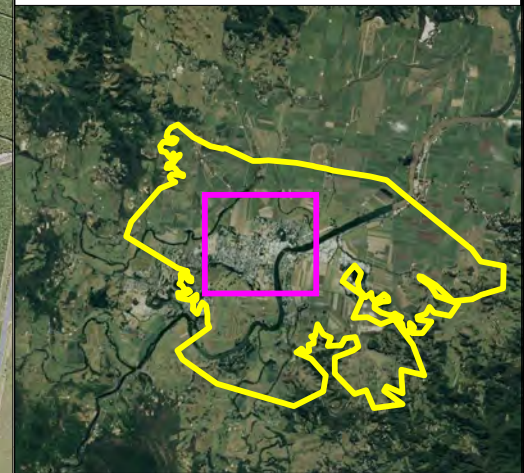
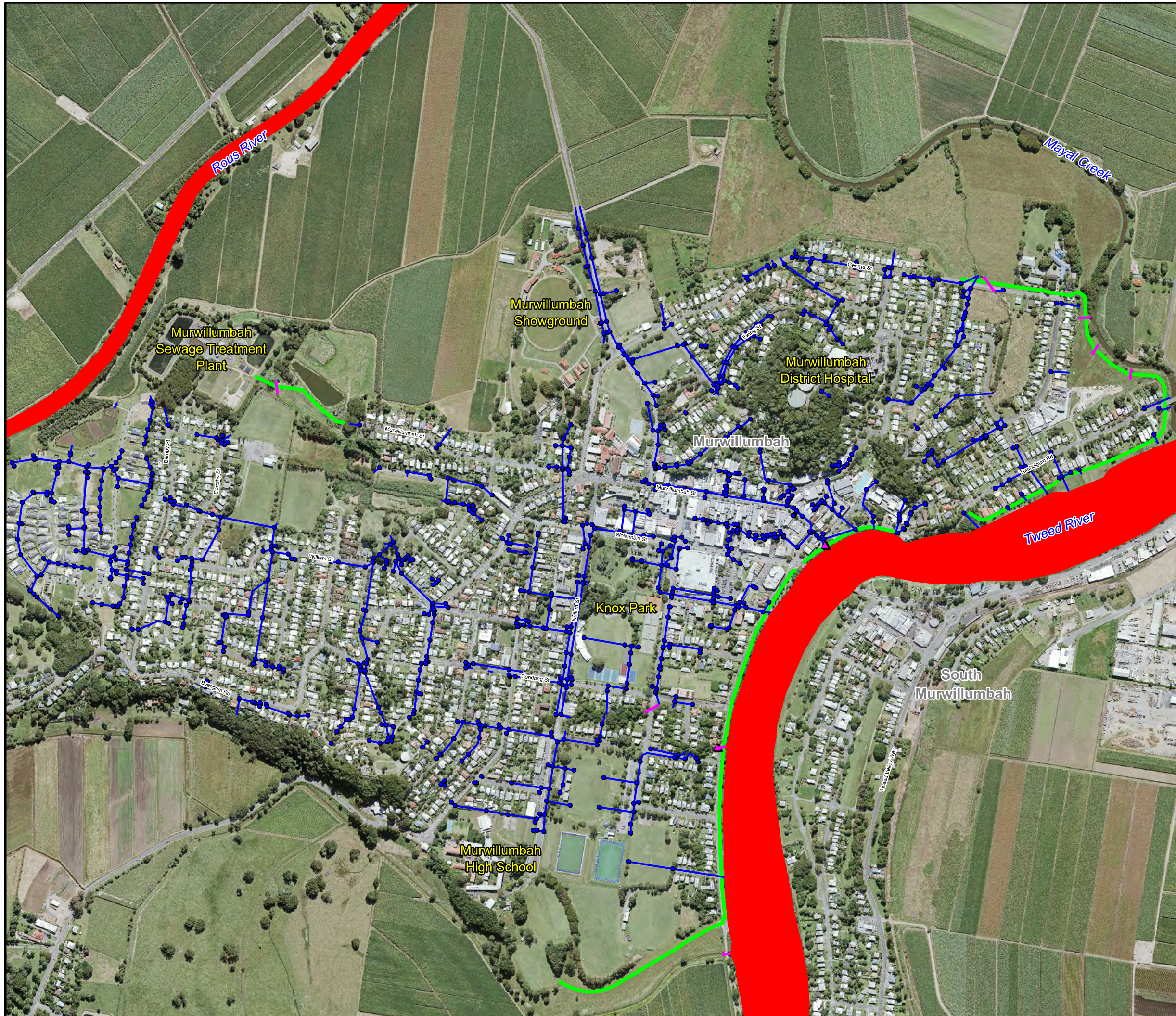
0 1.0 2.0  
Km

**Figure 6.1:**  
**TUFLOW Model**  
**Layout**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George St  
 Sydney, NSW 2000

File Name: Fig6.1 - TUFLOW Model  
Layout.wor

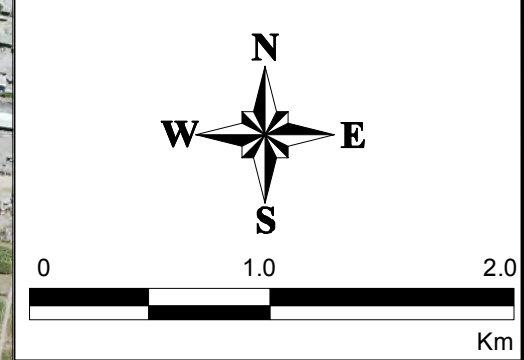





**LEGEND**

- █ 1D Domain
- █ Bridge
- █ Culvert
- █ Stormwater Pipe
- Stormwater Pit
- ▲ Stormwater Pump
- █ Levee Z Shape

Notes:  
Aerial photograph date: 2015



**Figure 6.2:**  
**TUFLOW Model**  
**Layout**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig6.2 - TUFLOW Model  
Layout.wor



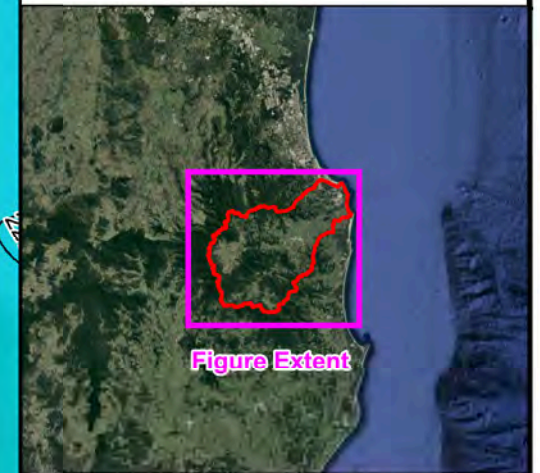


Figure Extent

**LEGEND**

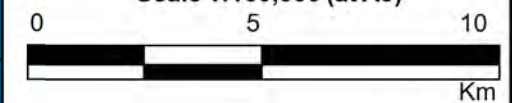
- Catchment Boundary
  - Study Area
  - Gauge Number - Rainfall (mm)
  - Rainfall Isohyet (mm)
- Rainfall Depth (mm)**
- 0
  - 200
  - 400
  - 600
  - 800
  - 1000

Notes:

Isohyets are calculated based on total rainfall for the entire duration of the storm.  
Aerial photograph date: 2015.



Scale 1:160,000 (at A3)

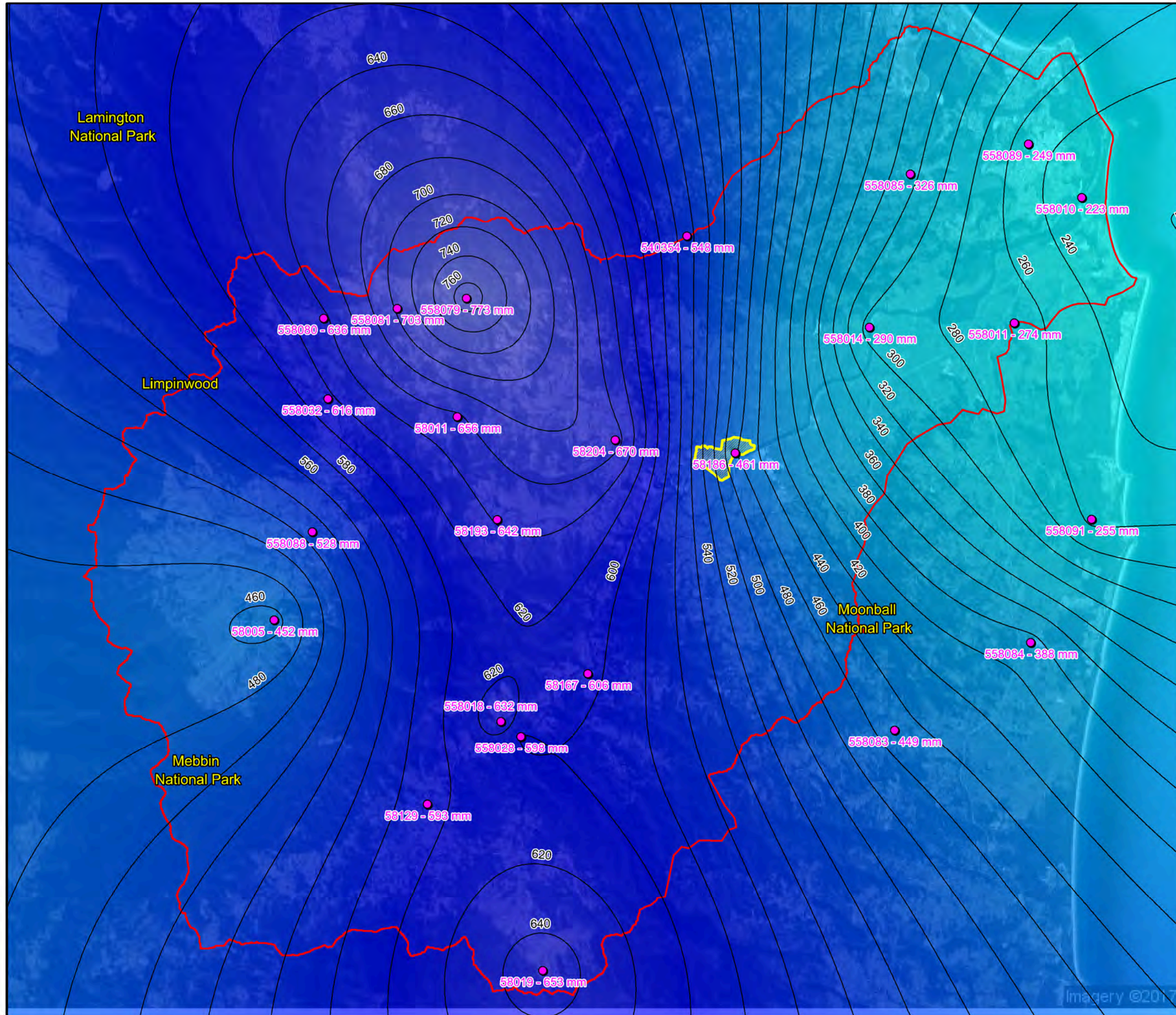


**Figure 7:  
Isohyet Map for  
2017 Storm**

Prepared By:

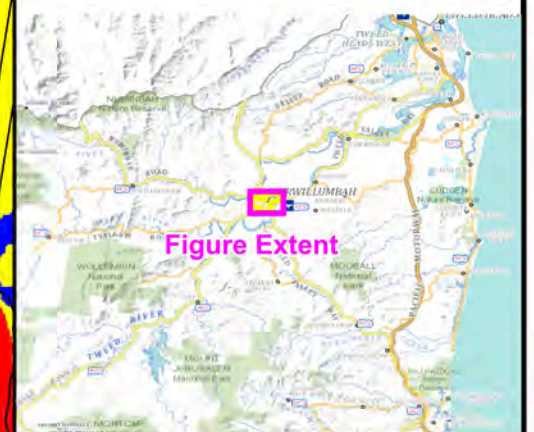
**Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig 7 Isohyet Map for 2017 Storm.wor



Imagery ©2017

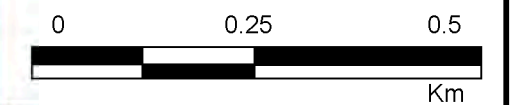
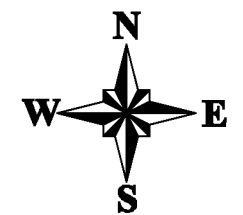





**LEGEND**

- Survey Flood Mark Elevation (mAHD)
  - Simulated Water Level (mAHD)
- Depths (m)
- 0.15 - 0.3
  - 0.3 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - >= 2.0

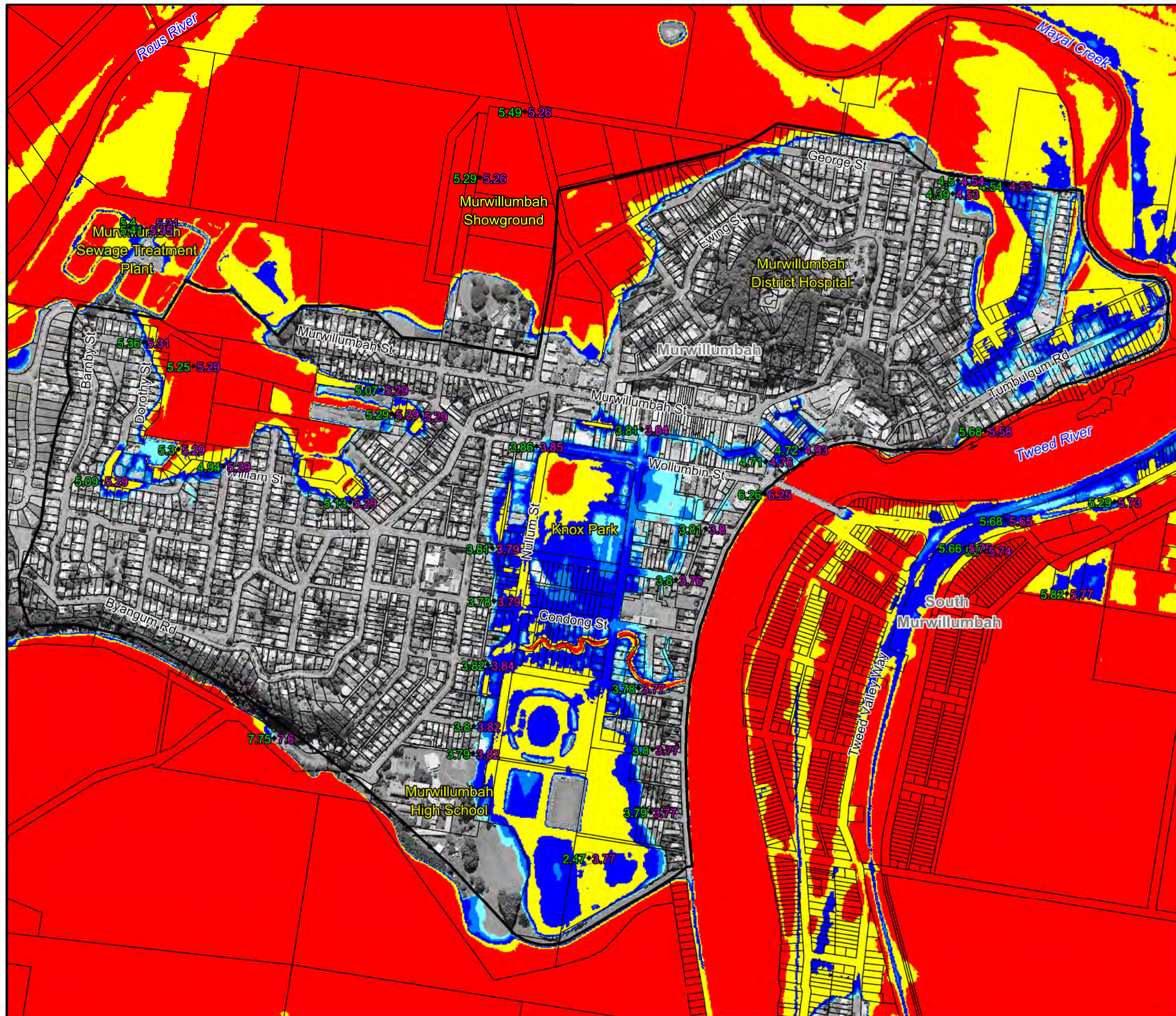
Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 8:  
Simulated Floodwater  
Depths & Levels  
for 2017 Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

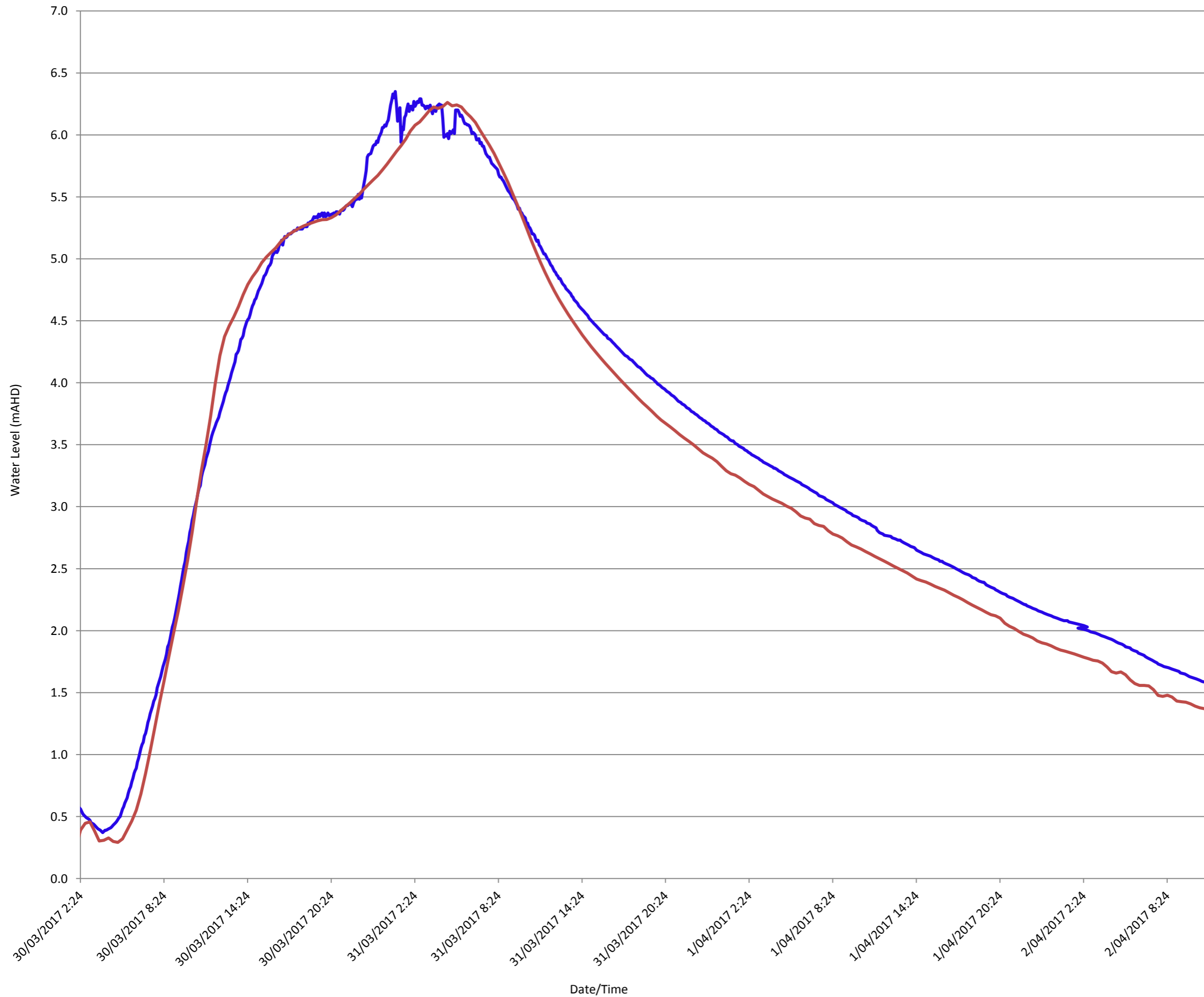
File Name: Fig8 - Flood Depths & Level  
for 2017 Flood.wor






**LEGEND:**

- Recorded Stage Hydrograph
- Simulated Stage Hydrograph



Notes:

**Figure 9.1:  
Recorded and  
Simulated Stage  
Hydrographs for Tweed  
River at Murwillumbah  
Gauge for 2017 Flood**

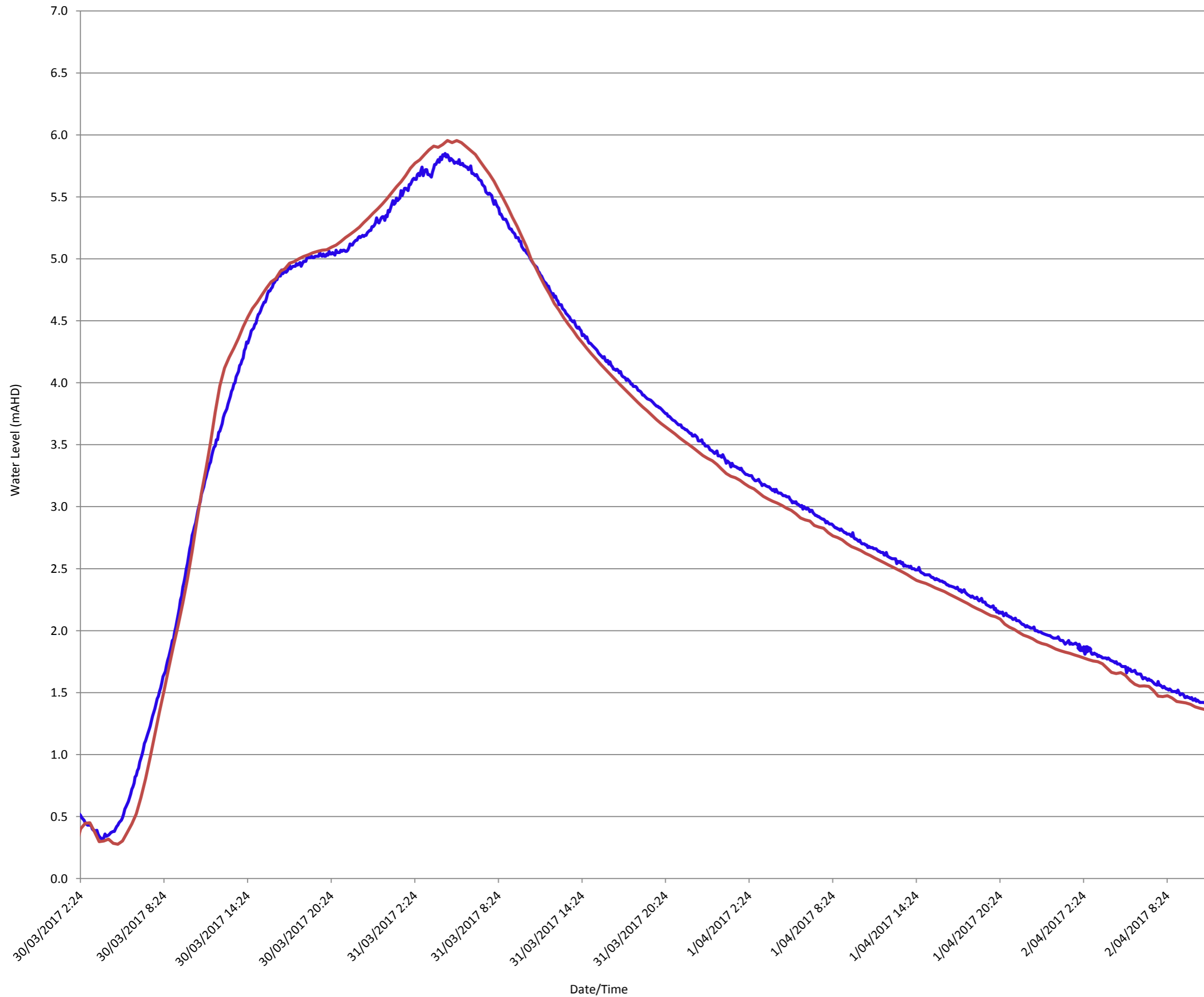
Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: .xls




**LEGEND:**

- Recorded Stage Hydrograph
- Simulated Stage Hydrograph



Notes:

**Figure 9.2:  
Recorded and  
Simulated Stage  
Hydrographs for Tweed  
River at Murwillumbah  
Bridge Gauge for 2017  
Flood**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: .xls



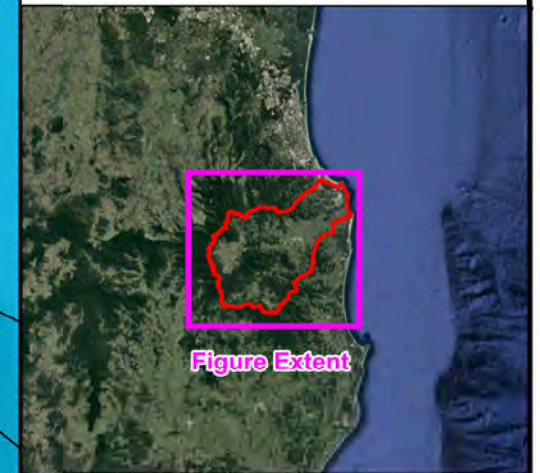


Figure Extent

**LEGEND**

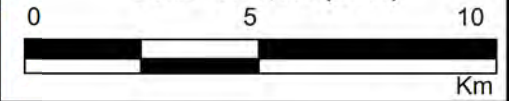
- Catchment Boundary
  - Study Area
  - Gauge Number - Rainfall (mm)
  - Rainfall Isohyet (mm)
- Rainfall Depth (mm)**
- 0
  - 200
  - 400
  - 600
  - 800
  - 1000

Notes:

Isohyets are calculated based on total rainfall for the entire duration of the storm.  
Aerial photograph date: 2015.



Scale 1:160,000 (at A3)

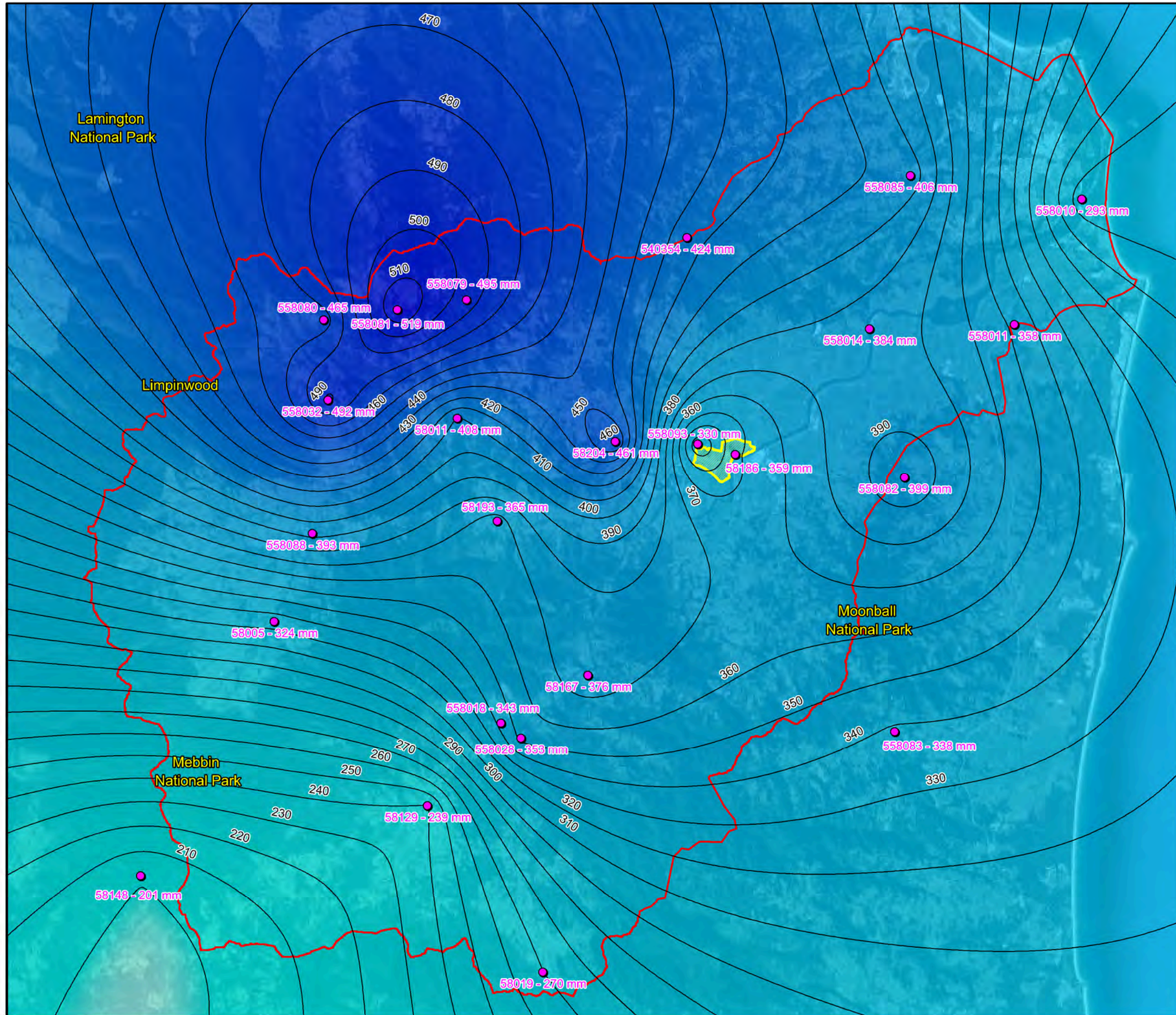


**Figure 10:  
Isohyet Map  
for 2012 Storm**

Prepared By:

**Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig 10 Isohyet Map for 2012 Storm.wor



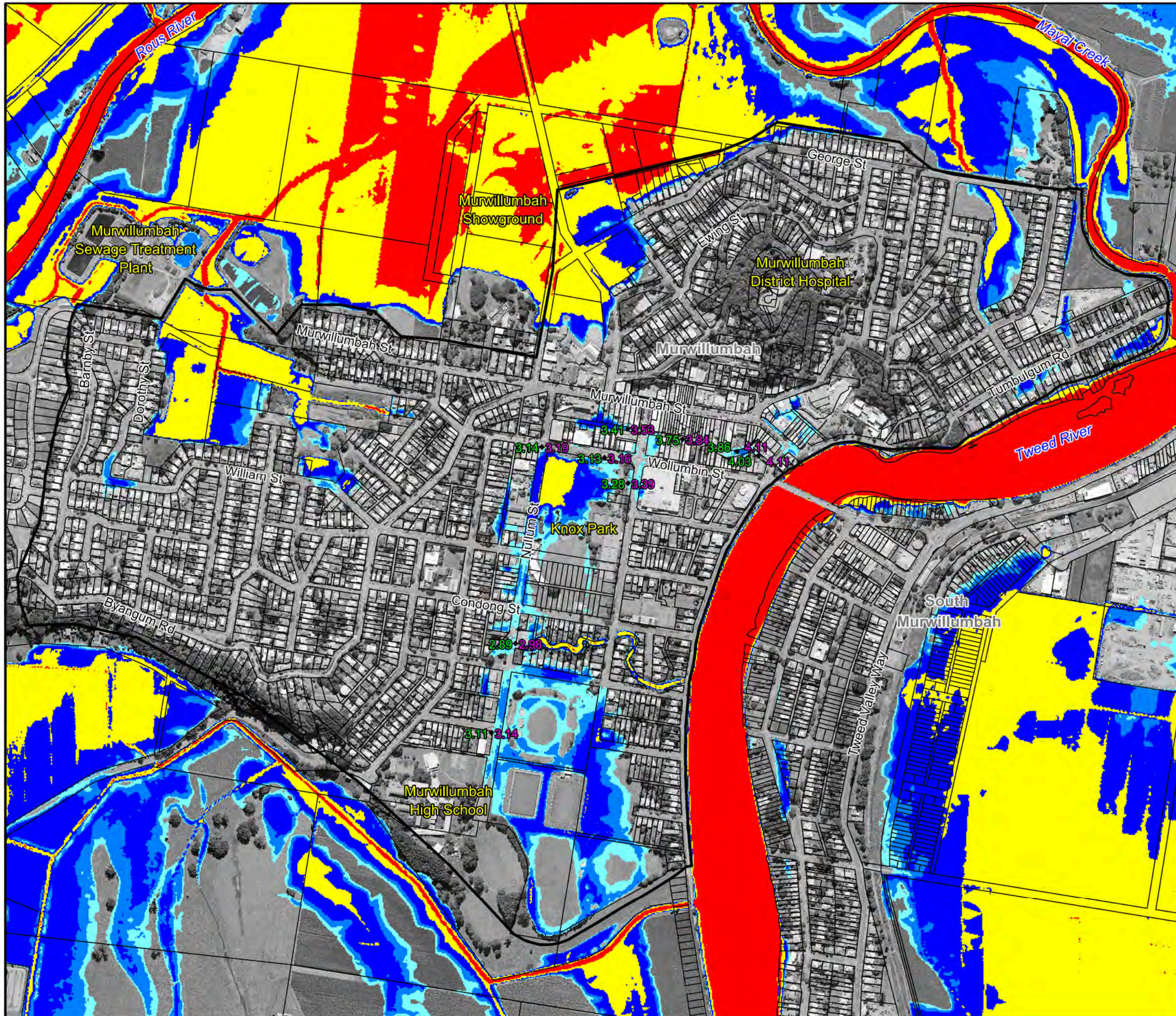
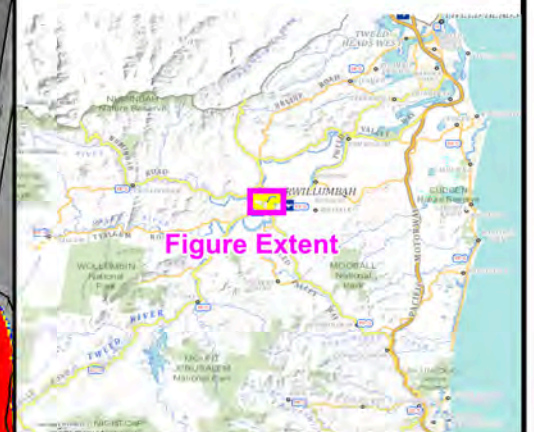
Lamington National Park

Limpinwood

Mebbin National Park

Moonball National Park

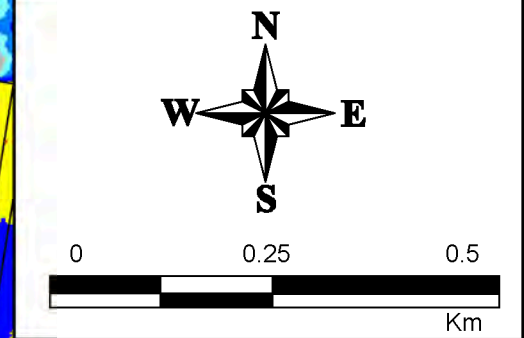





**LEGEND**

- Survey Flood Mark Elevation (mAHD)
  - Simulated Water Level (mAHD)
- Depths (m)
- 0.15 - 0.3
  - 0.3 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - >= 2.0

Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 11:  
Simulated Floodwater  
Depths & Levels  
for 2012 Flood**

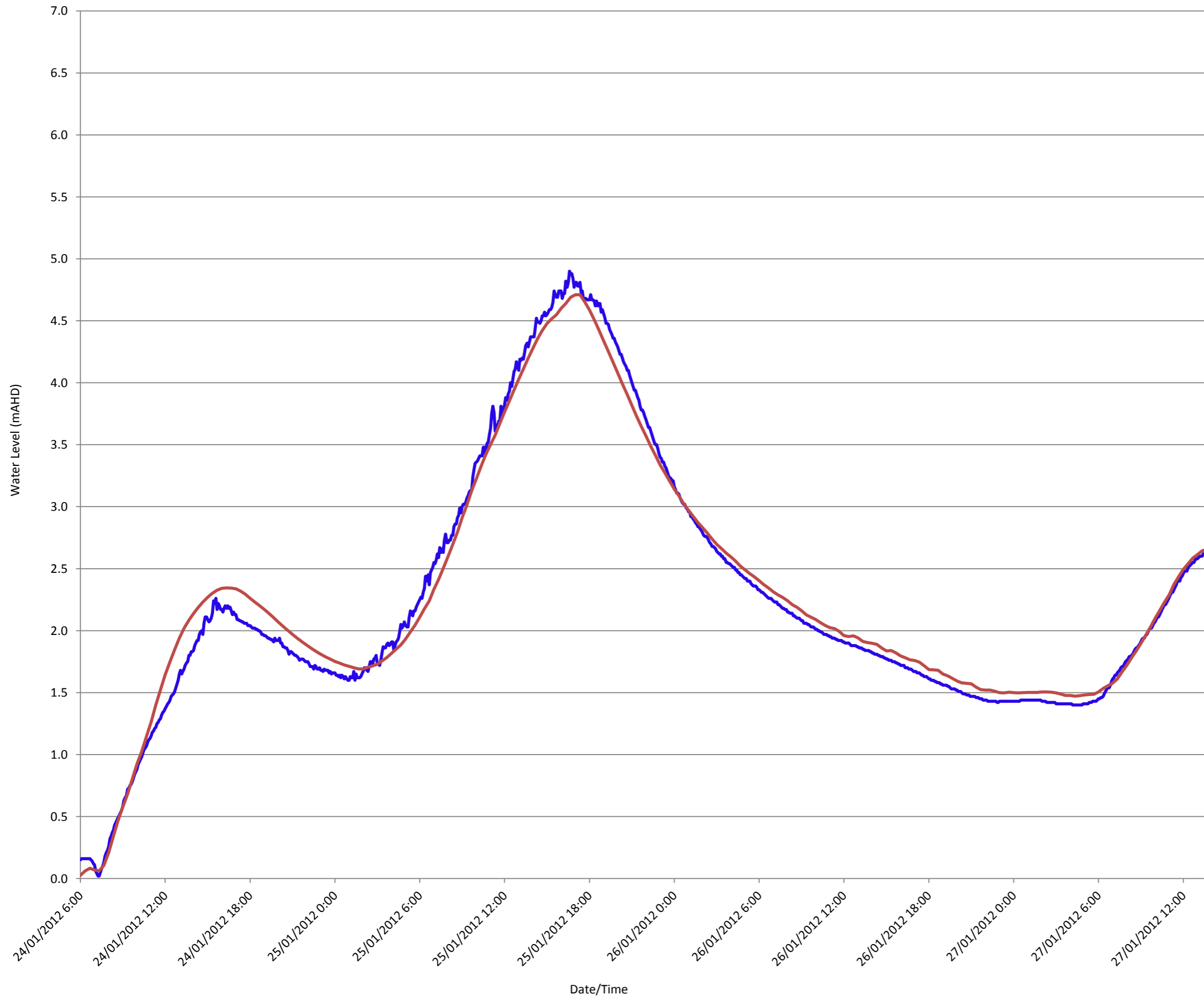
Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig11 - Flood Depths & Level for 2012 Flood.wor




**LEGEND:**

- Recorded Stage Hydrograph
- Simulated Stage Hydrograph



Notes:

**Figure 12.1:  
Recorded and  
Simulated Stage  
Hydrographs for Tweed  
River at Murwillumbah  
Gauge for 2012 Flood**

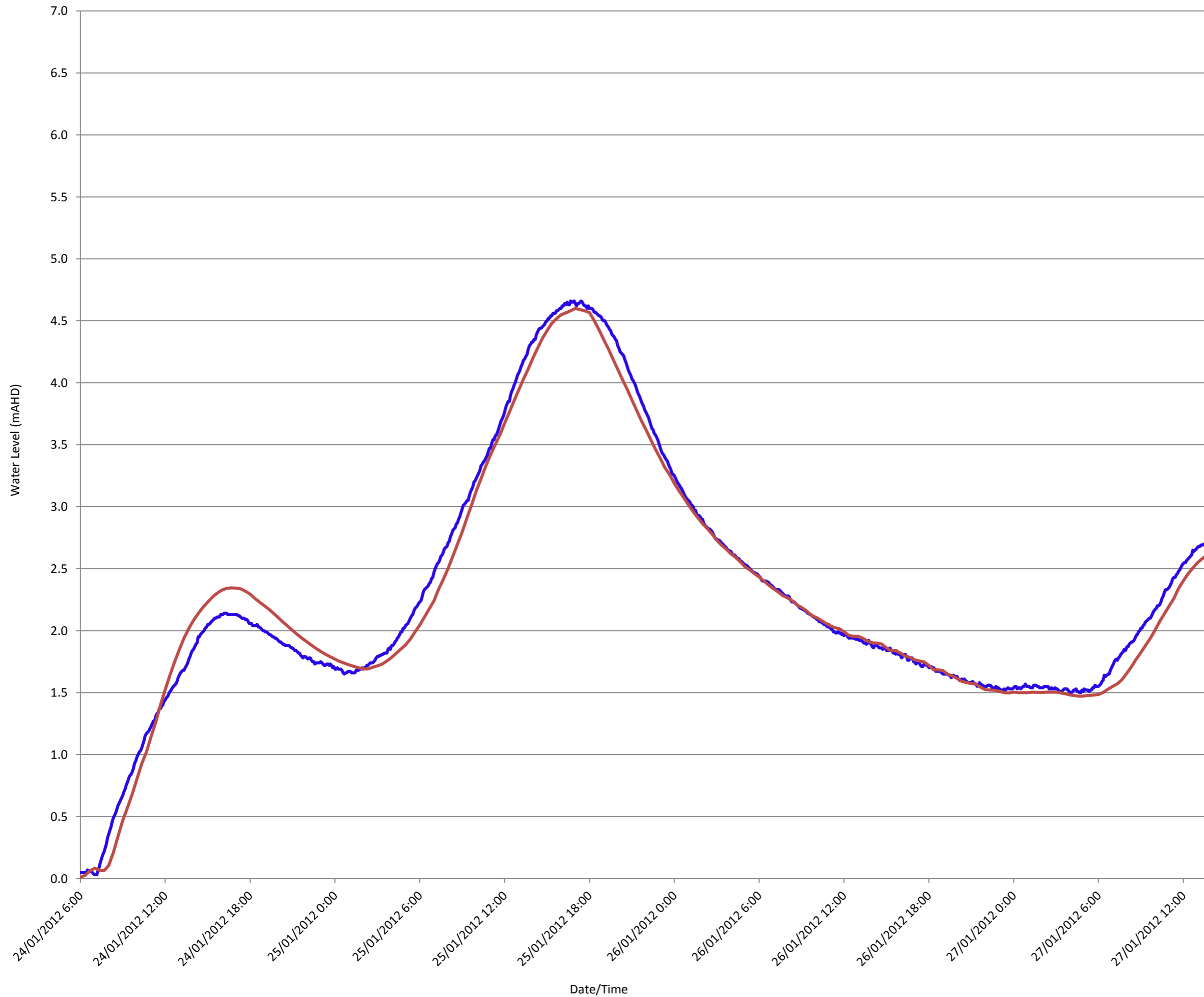
Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: .xls




**LEGEND:**

- Recorded Stage Hydrograph
- Simulated Stage Hydrograph



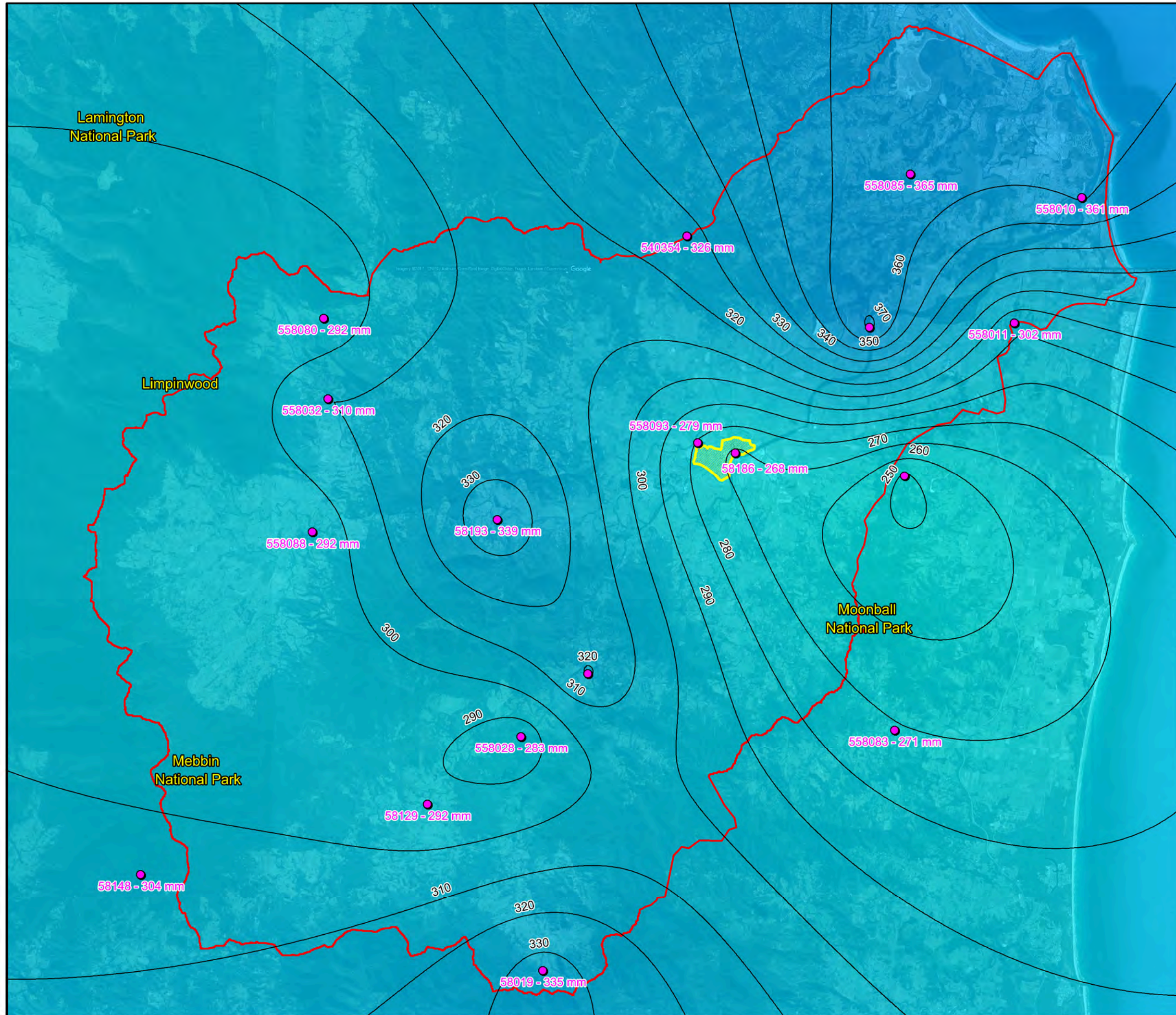
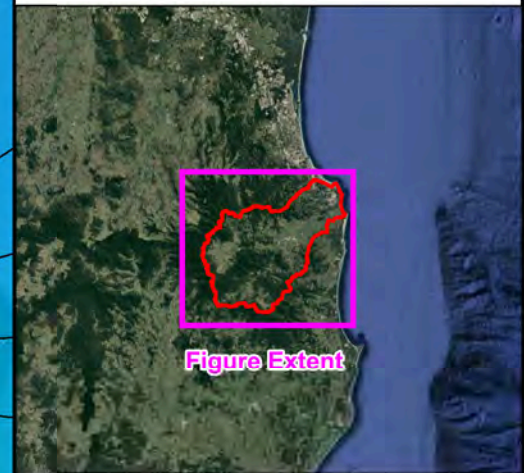
Notes:

**Figure 12.2:  
Recorded and  
Simulated Stage  
Hydrographs for Tweed  
River at Murwillumbah  
Bridge Gauge for 2012  
Flood**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: .xls





**LEGEND**

- Catchment Boundary
- Study Area
- Gauge Number - Rainfall (mm)
- Rainfall Isohyet (mm)

**Rainfall Depth (mm)**

	0
	200
	400
	600
	800
	1000

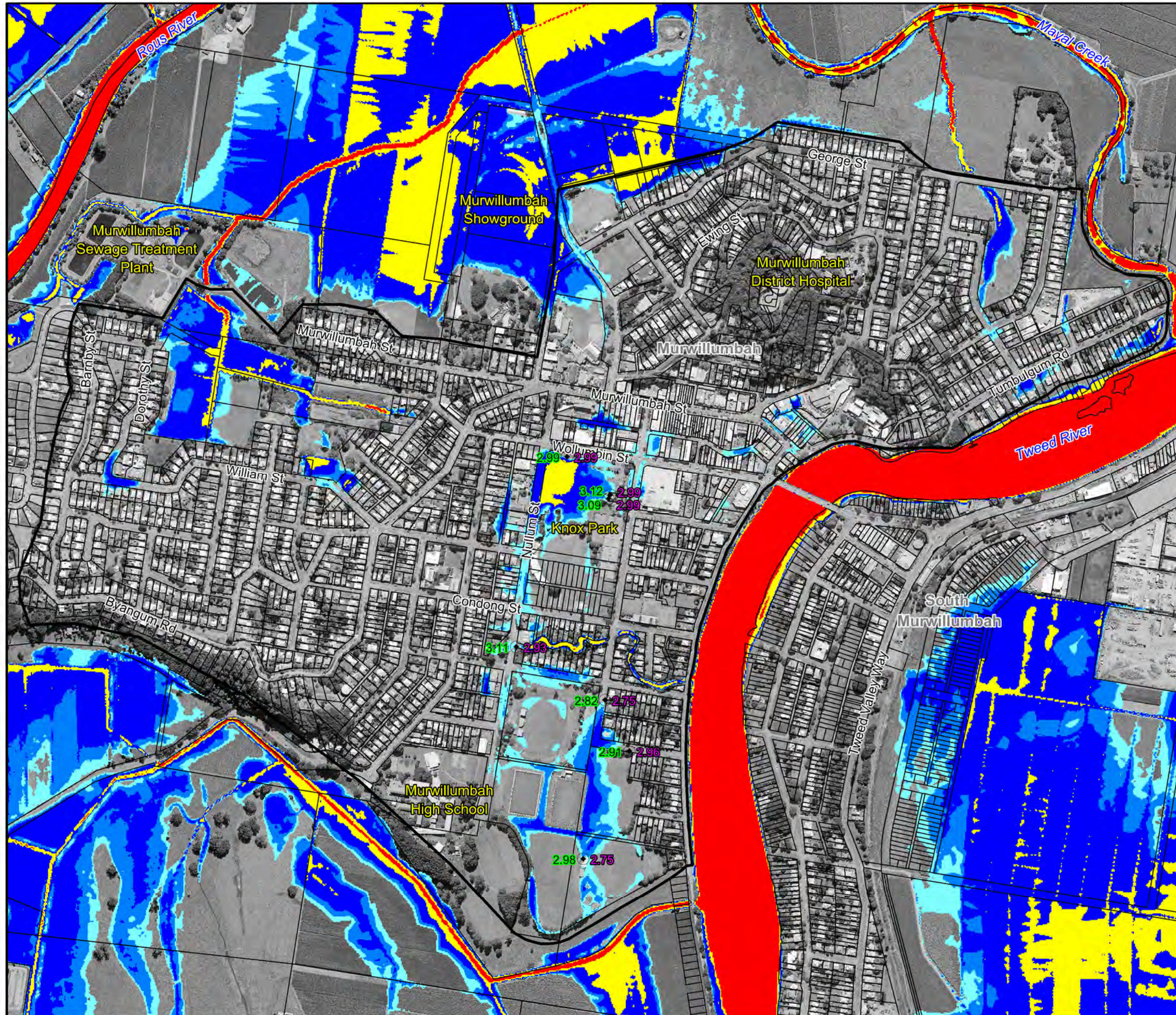
Notes:  
Isohyets are calculated based on total rainfall for the entire duration of the storm.  
Aerial photograph date: 2015.

Scale 1:160,000 (at A3)

0 5 10  
Km

**Figure 13:  
Isohyet Map for  
2016 Storm**

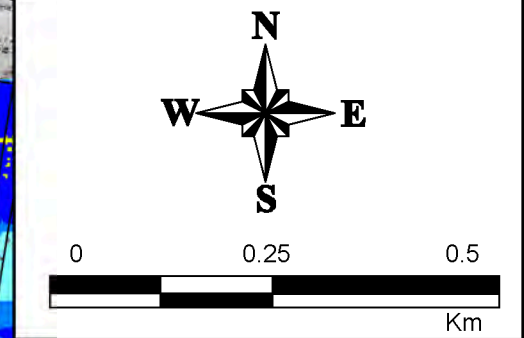




**LEGEND**

- Survey Flood Mark Elevation (mAHD)
  - Simulated Water Level (mAHD)
- Depths (m)
- 0.15 - 0.3
  - 0.3 - 0.5
  - 0.5 - 1.0
  - 1.0 - 2.0
  - >= 2.0

Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 14:  
Simulated Floodwater  
Depths & Levels  
for 2016 Flood**

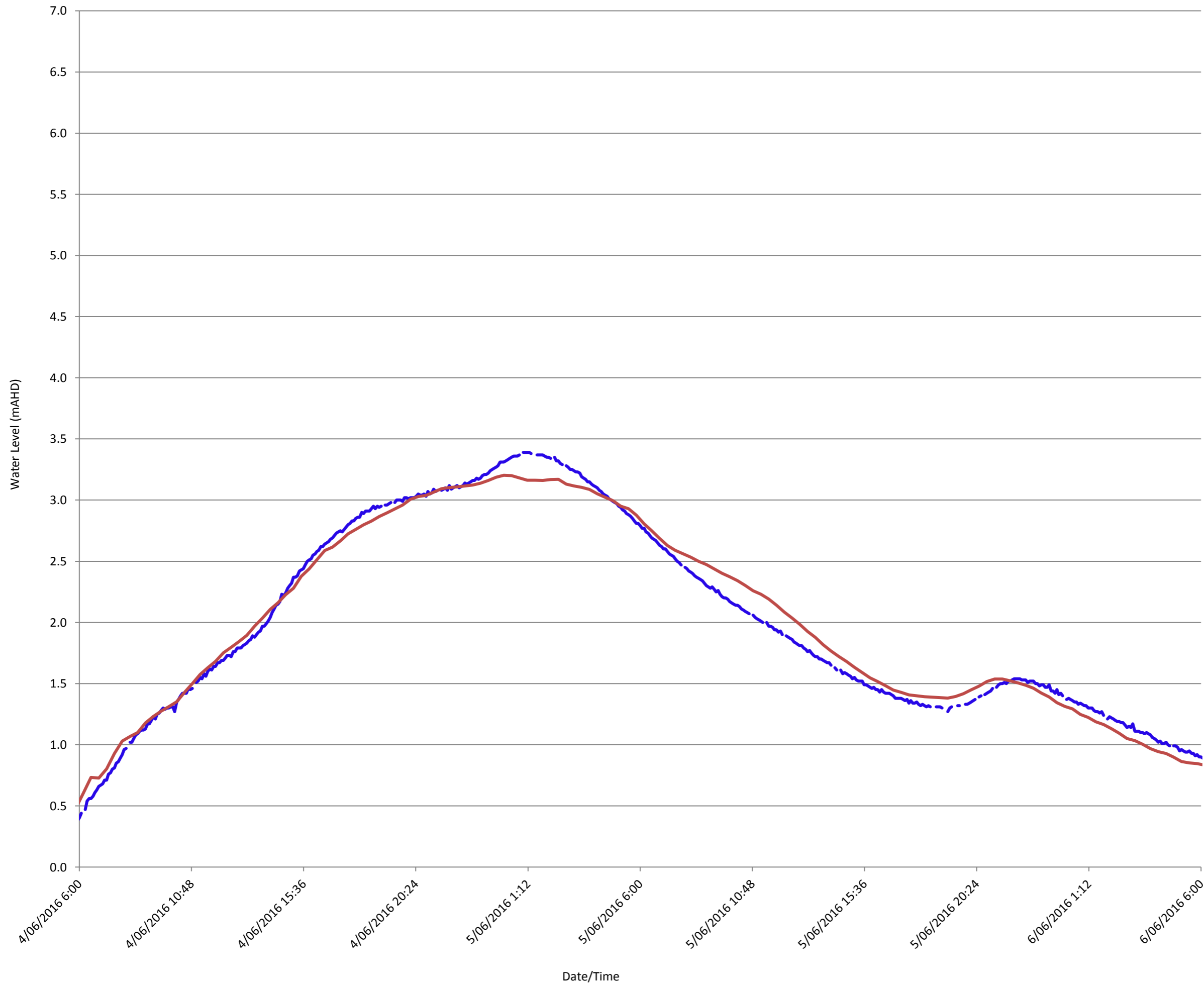
Prepared By:  
**Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig14 - Flood Depths & Level  
for 2016 Flood.wor



**LEGEND:**


- Recorded Stage Hydrograph
- Simulated Stage Hydrograph



Notes:

**Figure 15.1:  
Recorded and  
Simulated Stage  
Hydrographs for Tweed  
River at Murwillumbah  
Bridge Gauge for 2016  
Flood**

Prepared By:

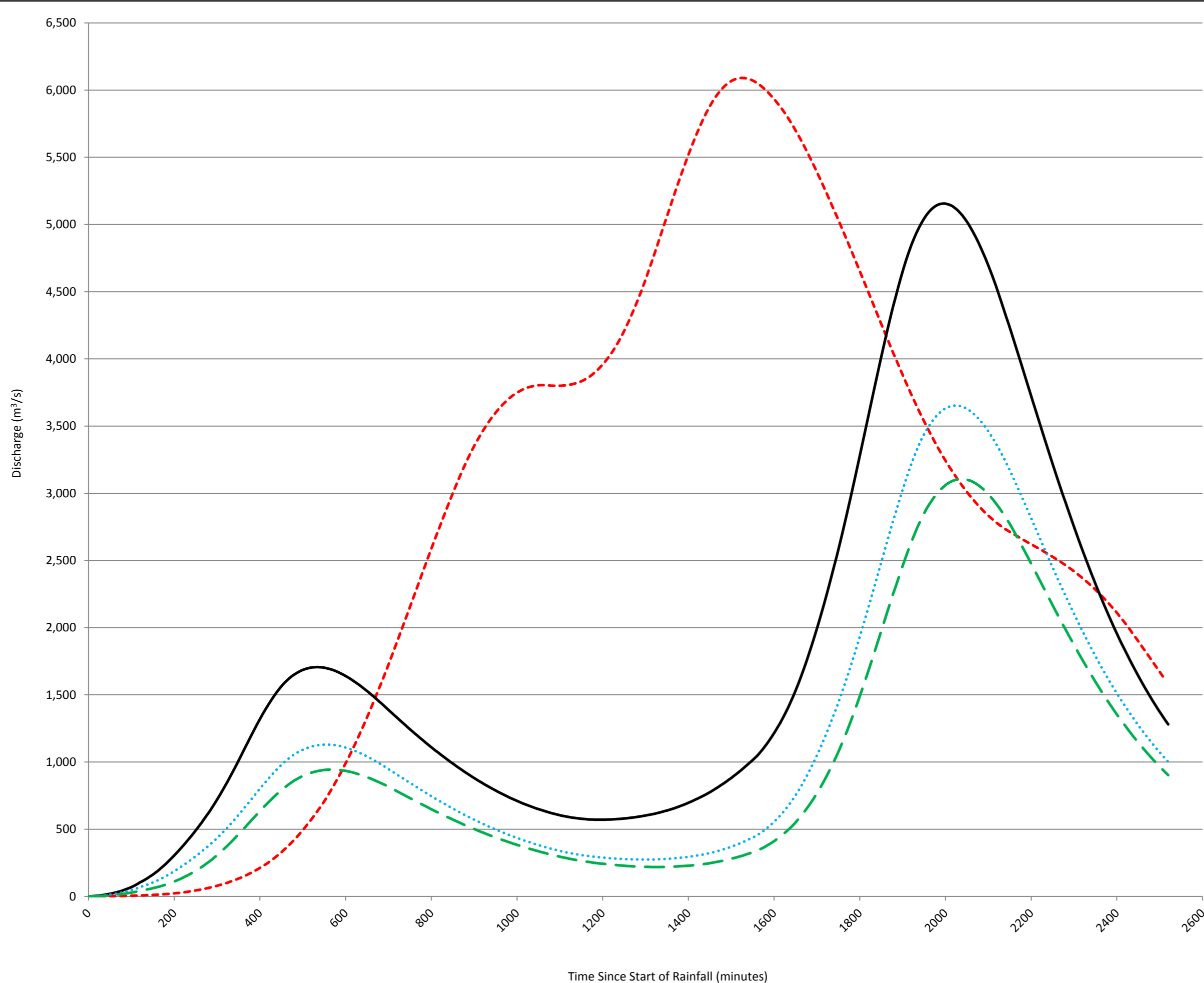
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George Street  
Sydney, NSW, 2000

File Name: .xls




**LEGEND:**

- - - 0.2% AEP Discharge Hydrograph
- 1% AEP Discharge Hydrograph
- . . . 5% AEP Discharge Hydrograph
- - - 20% AEP Discharge Hydrograph



Notes:

**Figure 16.1:  
Design Flow  
Hydrographs:  
Tweed River at  
Murwillumbah**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: Murwillumbah Design Flow Hydrographs.xls




**LEGEND:**

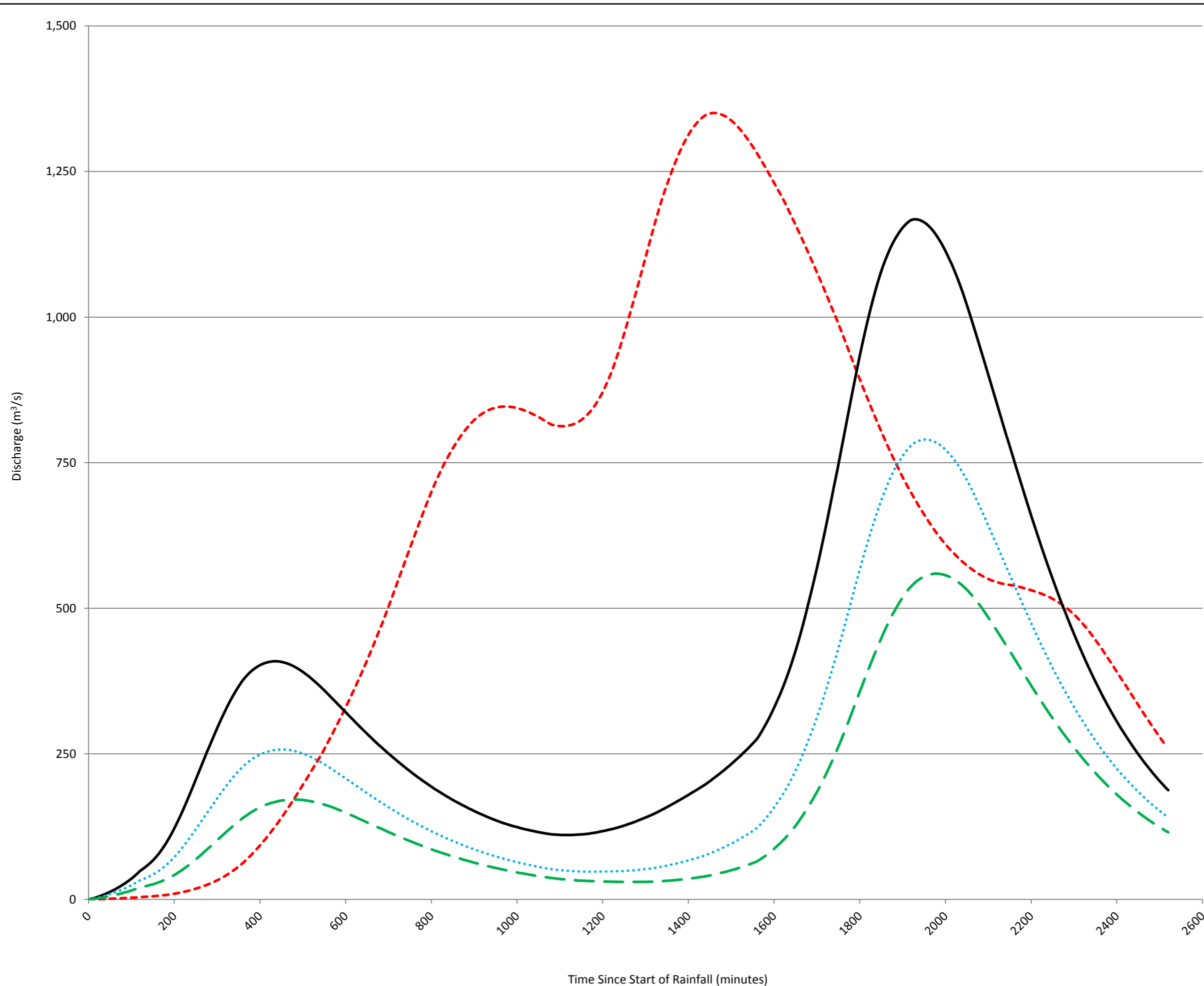
- - - 0.2% AEP Discharge Hydrograph
- 1% AEP Discharge Hydrograph
- · · 5% AEP Discharge Hydrograph
- - - 20% AEP Discharge Hydrograph

Notes:

**Figure 16.2:  
Design Flow  
Hydrographs:  
Rous River at  
Murwillumbah**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: Murwillumbah Design Flow  
Hydrographs.xls







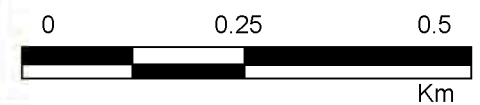
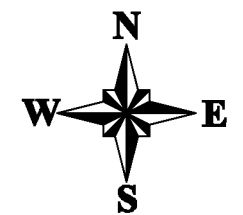
**LEGEND**

Depths (m)

0.15 - 0.3
0.3 - 0.5
0.5 - 1.0
1.0 - 2.0
>= 2.0


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

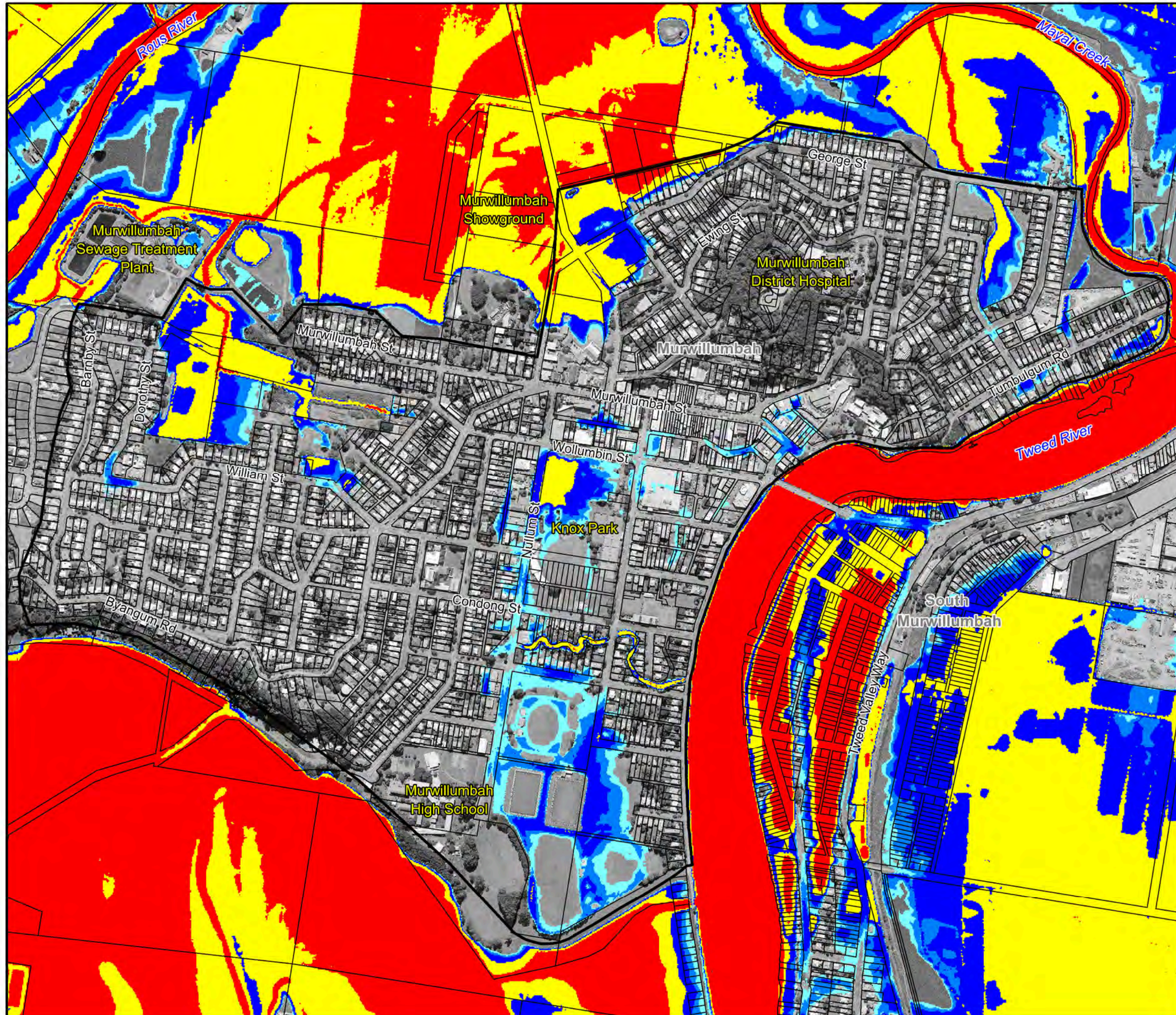


**Figure 17:**  
**Floodwater Depths**  
**for the 20% AEP Flood**

Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig17 - Flood Depths 20AEP.wor







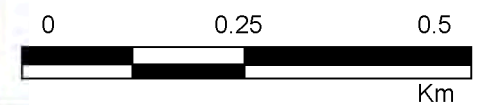
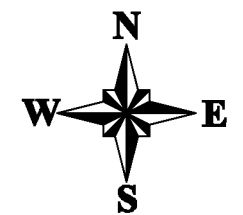
**LEGEND**

Depths (m)

0.15 - 0.3
0.3 - 0.5
0.5 - 1.0
1.0 - 2.0
>= 2.0


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

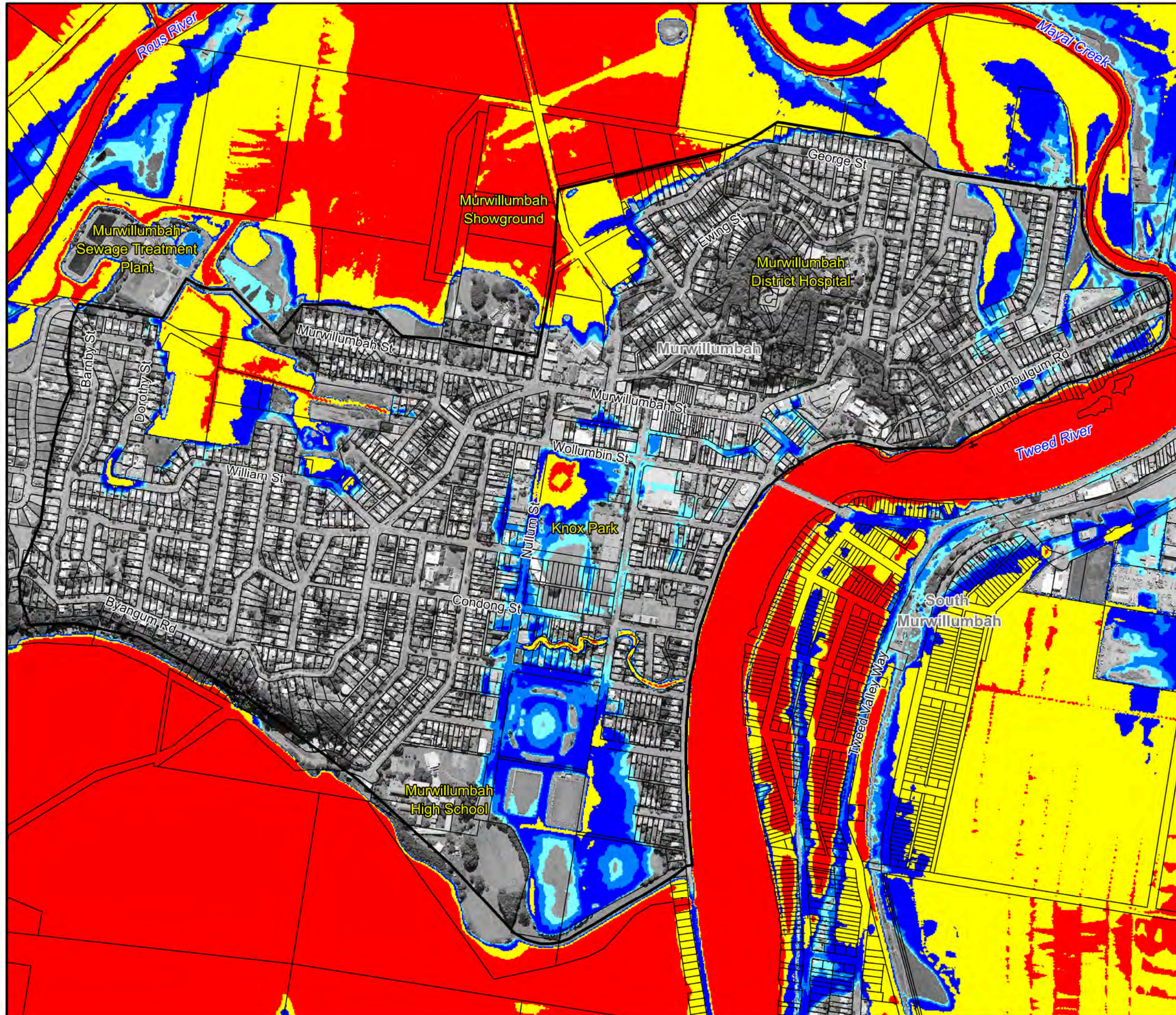


**Figure 18:  
Floodwater Depths  
for the 5% AEP Flood**

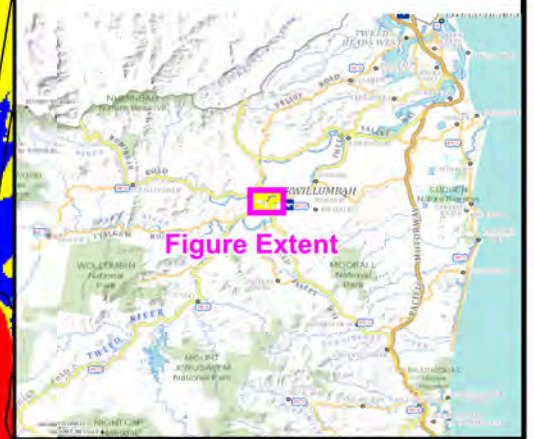
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig18 - Flood Depths 5AEP.wor





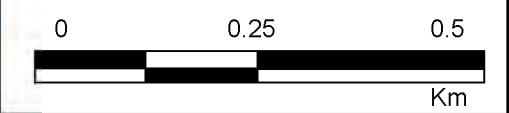
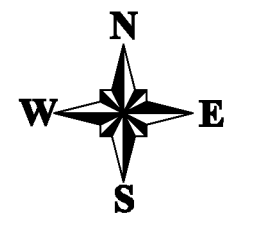


**LEGEND**


Depths (m)

0.15 - 0.3
0.3 - 0.5
0.5 - 1.0
1.0 - 2.0
>= 2.0

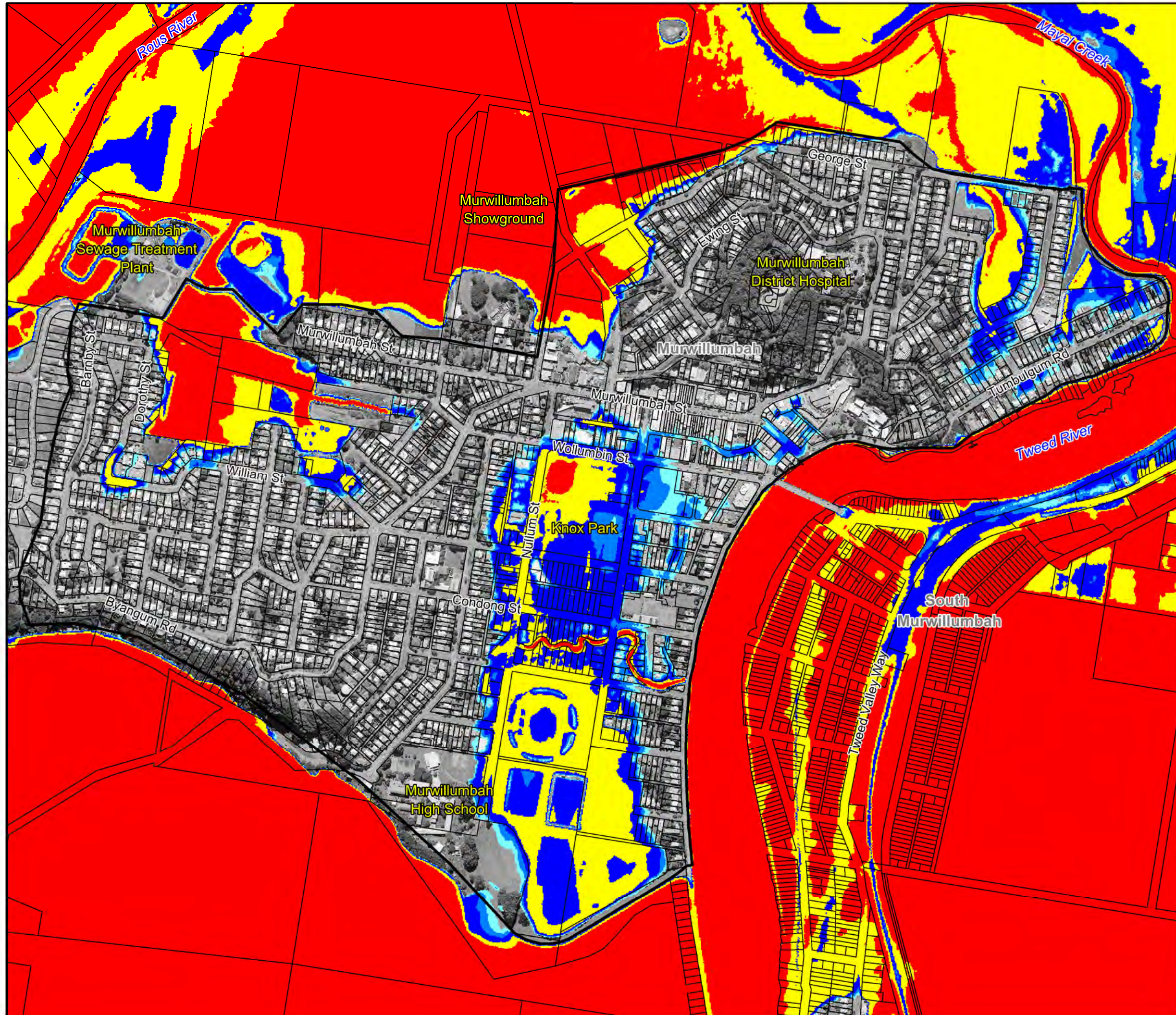
Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 19:  
Floodwater Depths  
for the 1% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig19 - Flood Depths 1AEP.wor





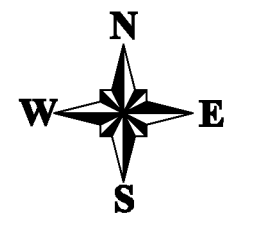


**LEGEND**


Depths (m)

0.15 - 0.3
0.3 - 0.5
0.5 - 1.0
1.0 - 2.0
>= 2.0

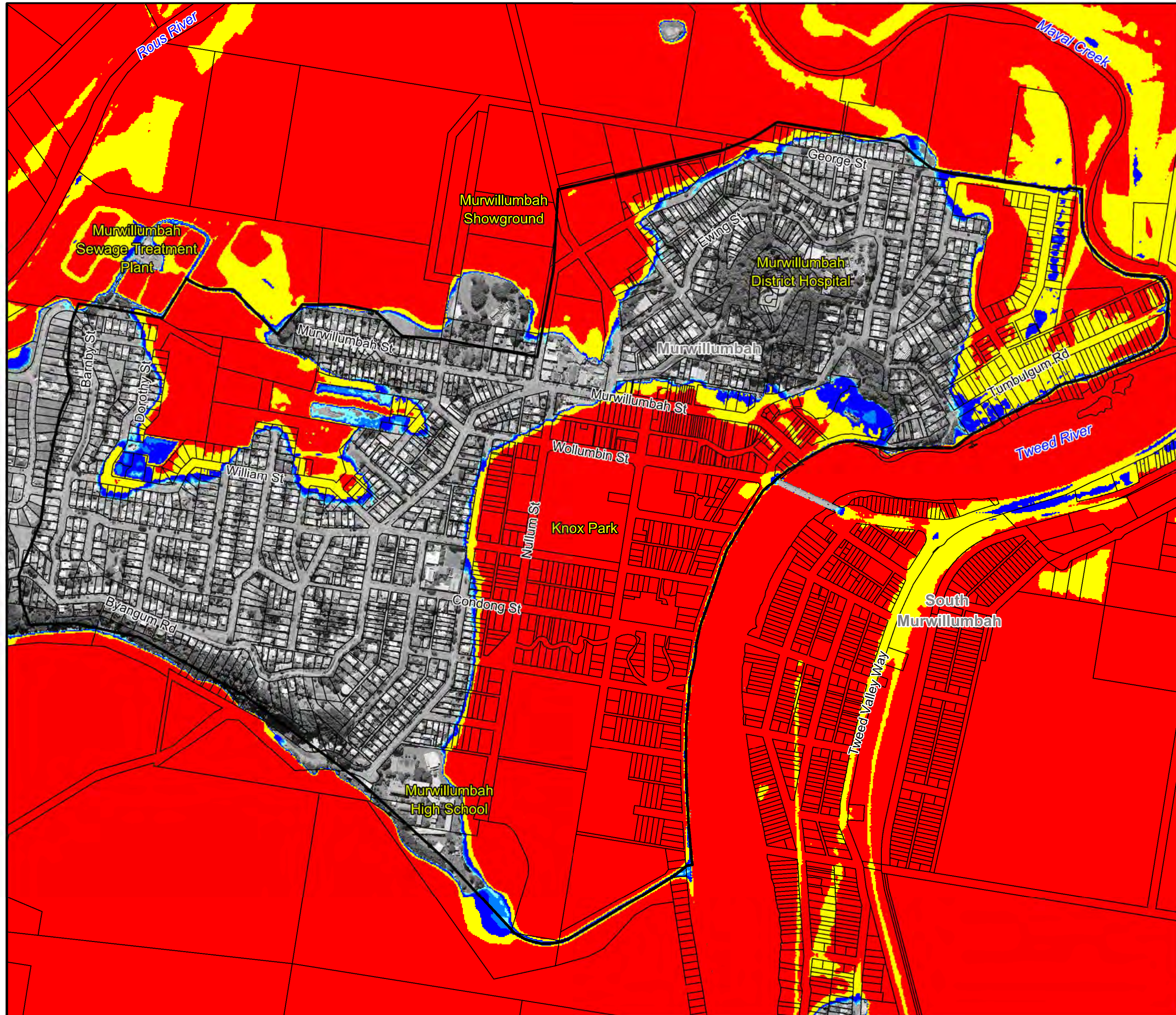
Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 20:**  
**Floodwater Depths**  
**for the 0.2% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

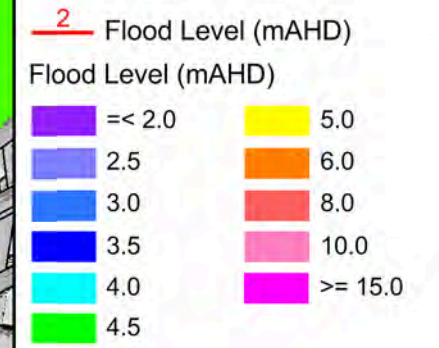
File Name: Fig20 - Flood Depths 02AEP.wor



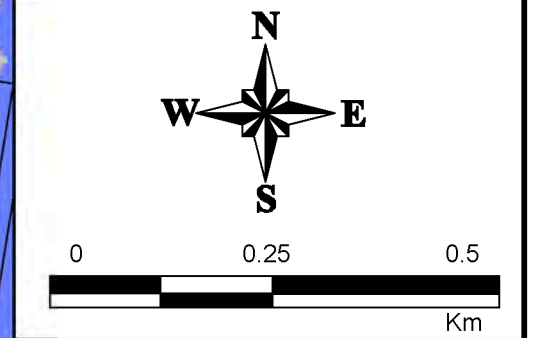




**LEGEND**

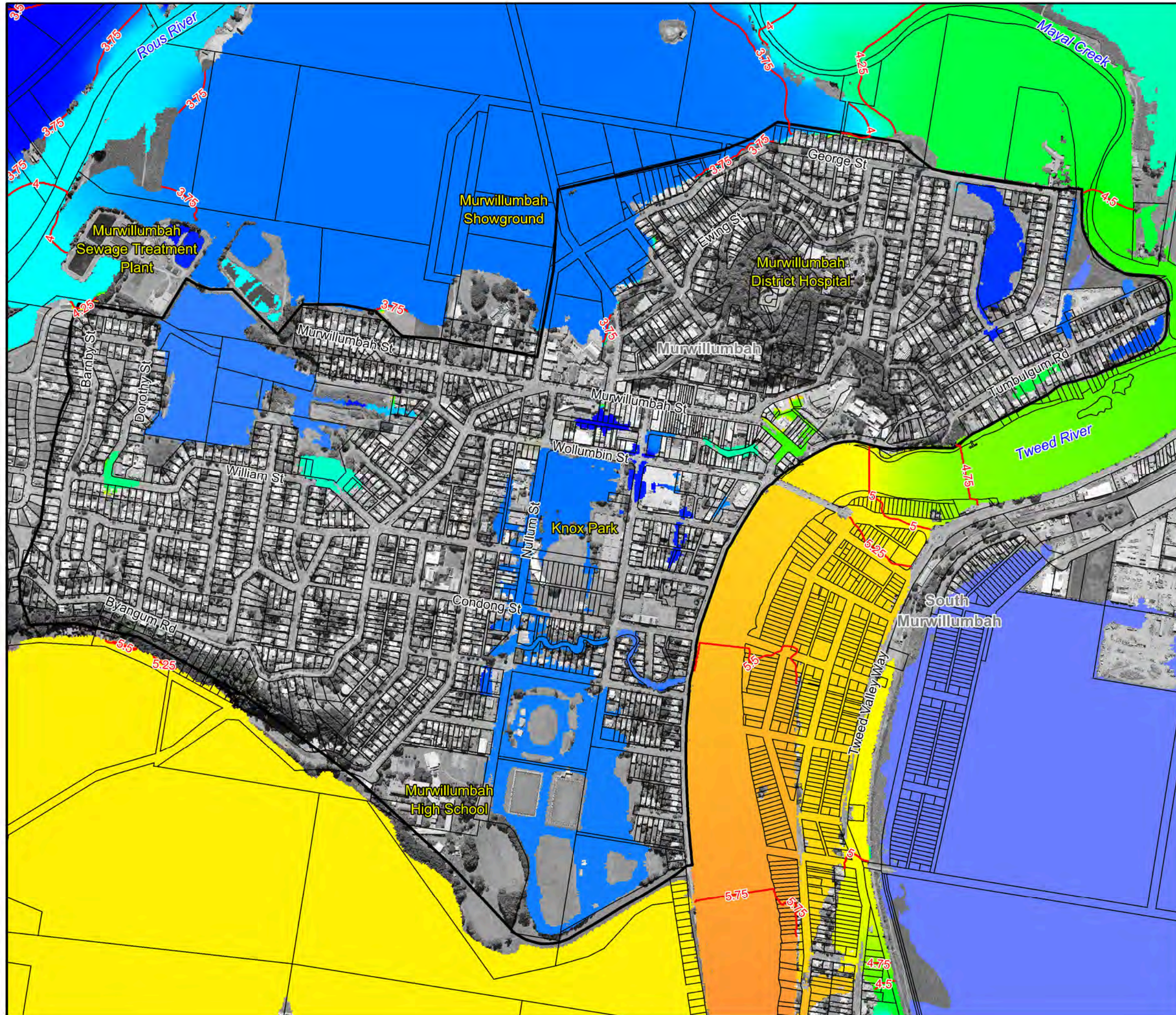


Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 21:  
Floodwater Levels  
for the 20% AEP Flood**

Prepared By:  
**Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000  
File Name: Fig21 - Flood Levels 20AEP.wor







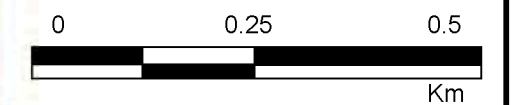
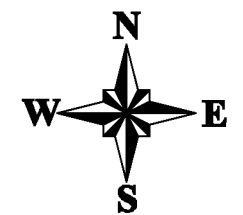
**LEGEND**

2 Flood Level (mAHD)


Flood Level (mAHD)

≤ 2.0	5.0
2.5	6.0
3.0	8.0
3.5	10.0
4.0	≥ 15.0
4.5	

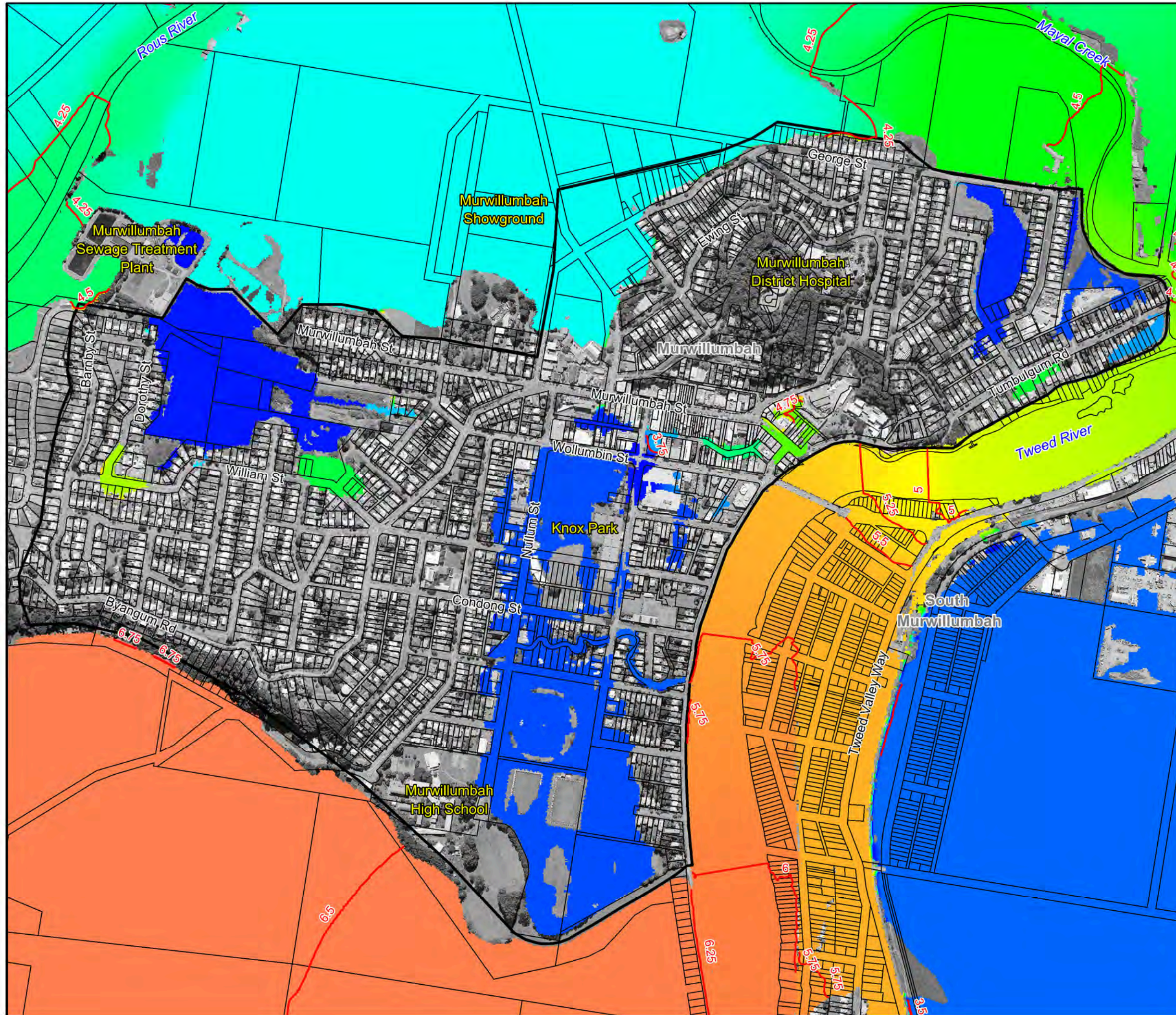
Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 22:**  
**Floodwater Levels**  
**for the 5% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig22 - Flood Levels 5AEP.wor







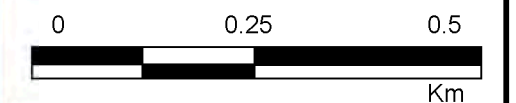
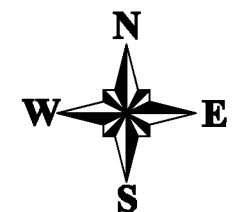
**LEGEND**

**2** Flood Level (mAHD)


Flood Level (mAHD)

≤ 2.0	5.0
2.5	6.0
3.0	8.0
3.5	10.0
4.0	≥ 15.0
4.5	

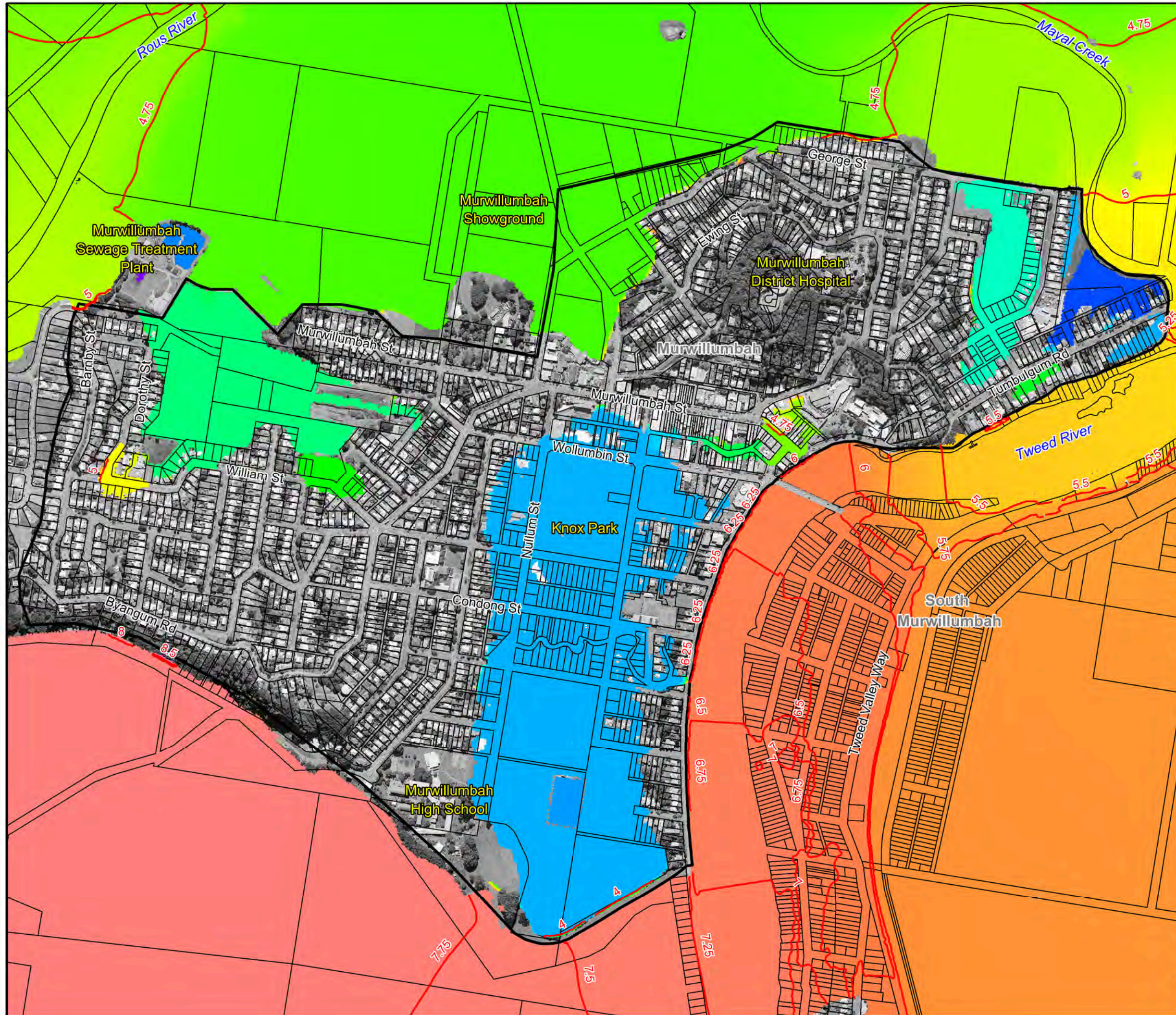
Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 23:**  
**Floodwater Levels**  
**for the 1%AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig23 - Flood Levels 1AEP.wor







**LEGEND**

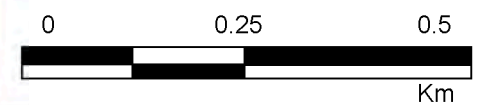
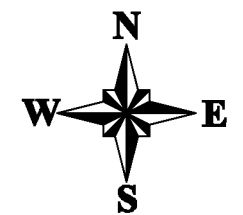
**2** Flood Level (mAHD)

Flood Level (mAHD)

≤ 2.0	5.0
2.5	6.0
3.0	8.0
3.5	10.0
4.0	≥ 15.0
4.5	


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

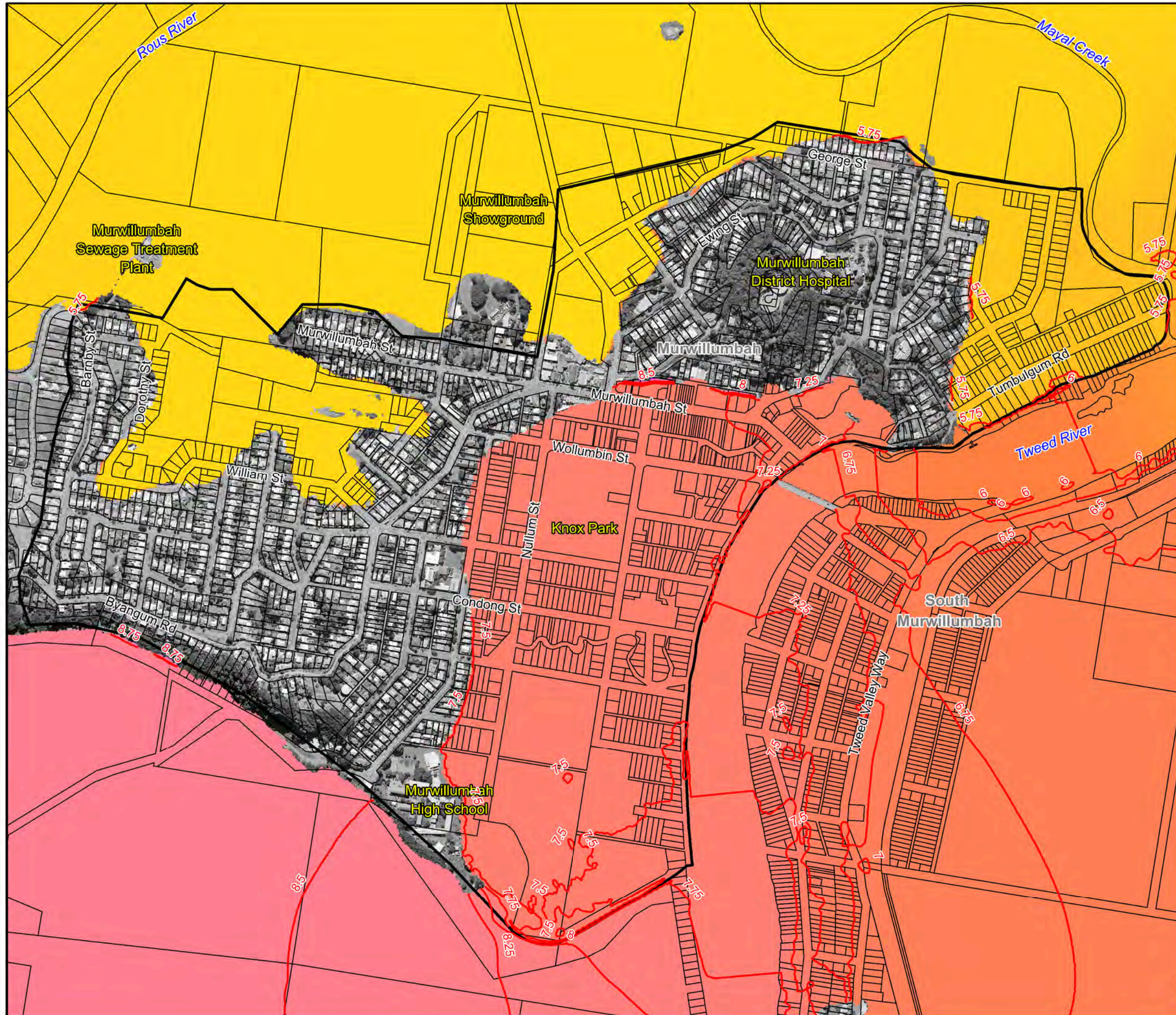


**Figure 24:**  
**Floodwater Levels**  
**for the 0.2% AEP Flood**

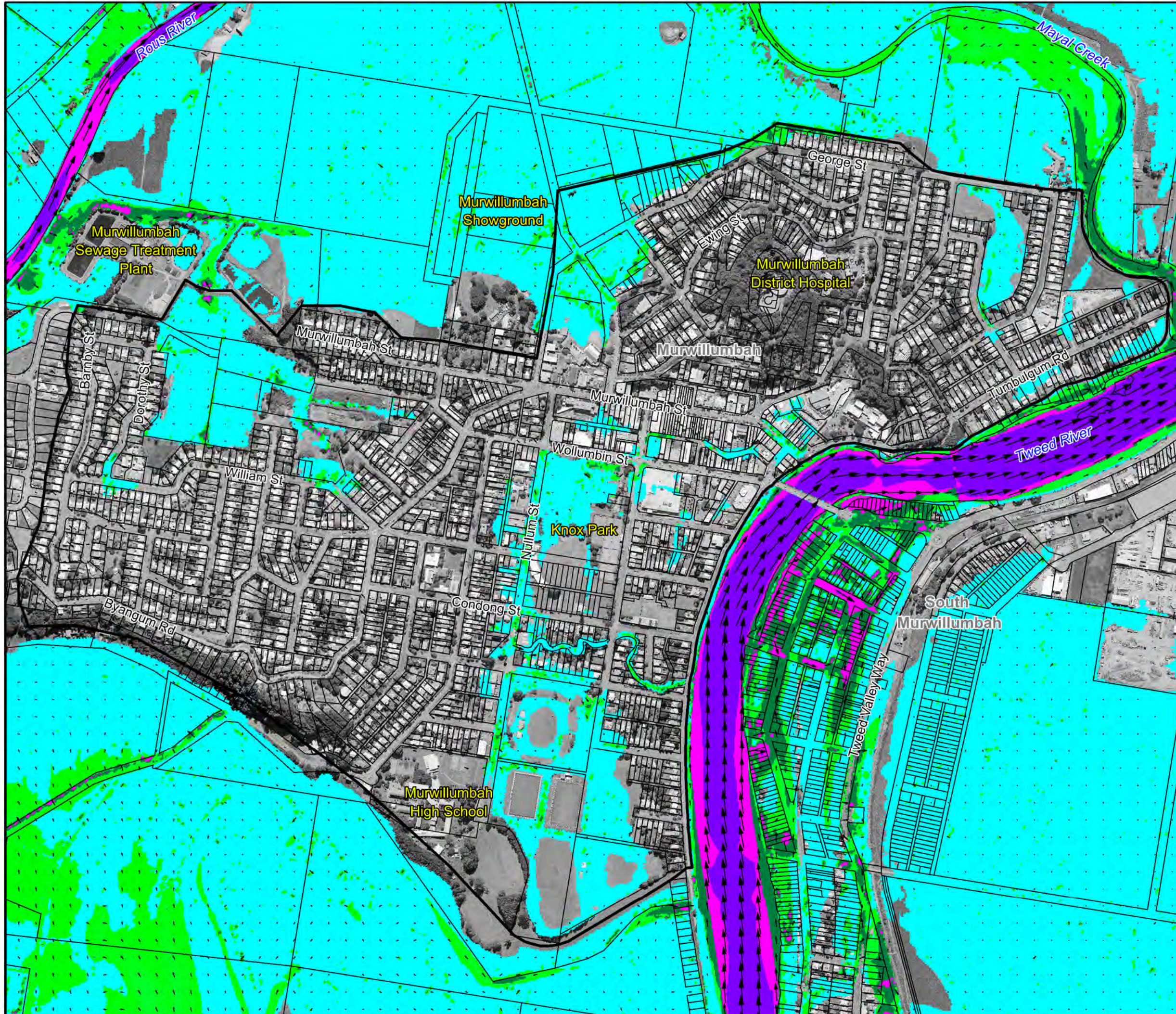
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

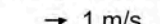
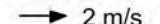
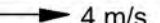
File Name: Fig24 - Flood Levels 02AEP.wor



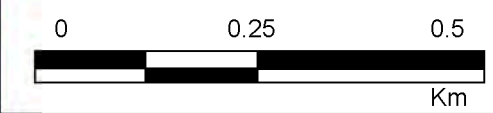
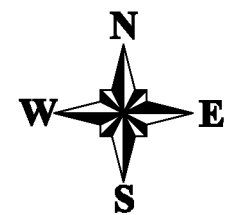





**LEGEND**

Velocity (m/s)	Velocity Vectors
<span style="color: cyan;">■</span> 0.0 - 0.25	 1 m/s
<span style="color: green;">■</span> 0.25 - 0.5	 2 m/s
<span style="color: darkgreen;">■</span> 0.5 - 1.0	 4 m/s
<span style="color: magenta;">■</span> 1.0 - 2.0	
<span style="color: purple;">■</span> ≥ 2.0	

Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

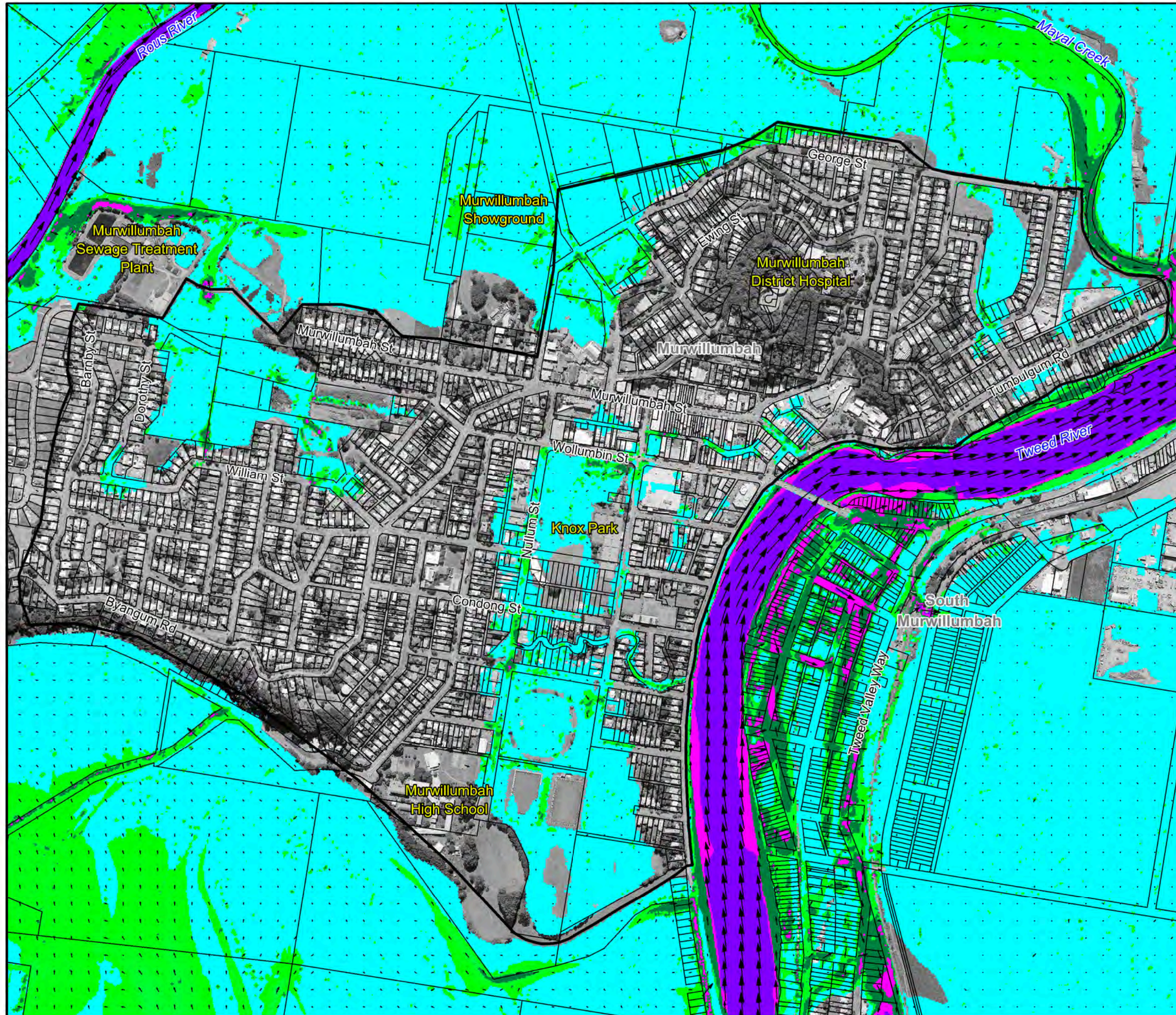


**Figure 25:**  
**Floodwater Velocities**  
**for the 20% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig25 - Flood Vel 20AEP.wor



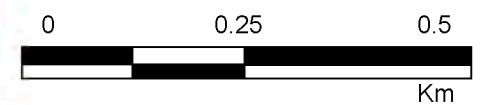
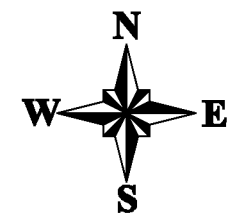


**LEGEND**

Velocity (m/s)	Velocity Vectors
0.0 - 0.25	→ 1 m/s
0.25 - 0.5	→ 2 m/s
0.5 - 1.0	→ 4 m/s
1.0 - 2.0	
≥ 2.0	


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



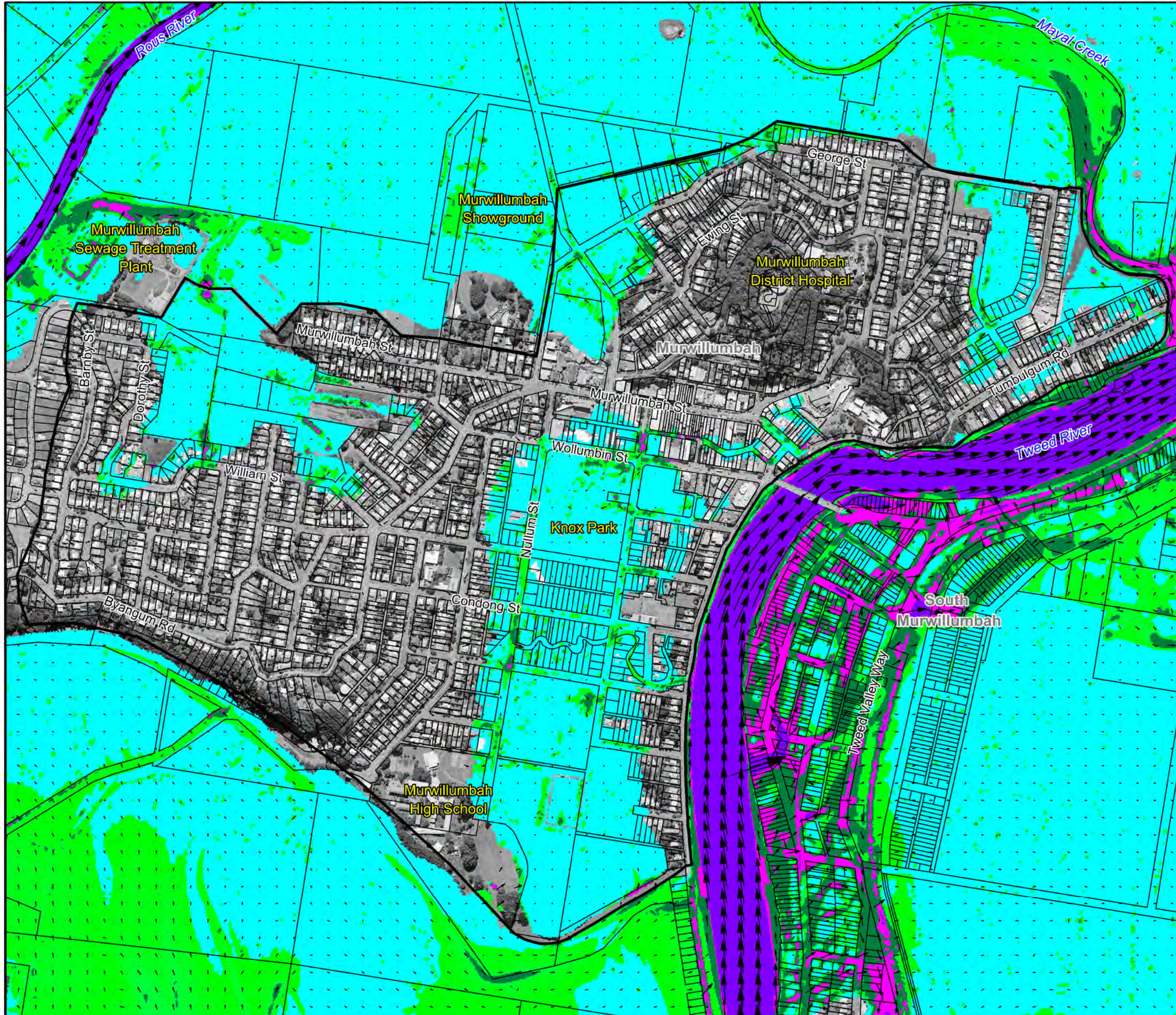
**Figure 26:**  
**Floodwater Velocities**  
**for the 5% AEP Flood**

Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig26 - Flood Vel for 5AEP.wor

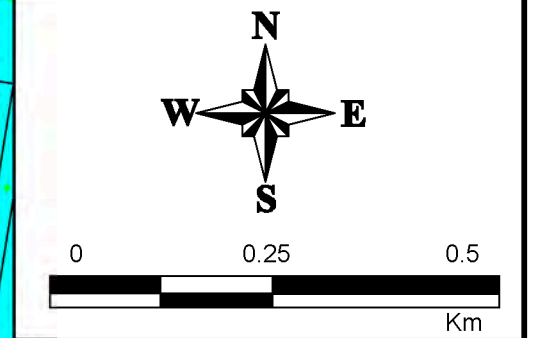





**LEGEND**

Velocity (m/s)	Velocity Vectors
0.0 - 0.25	→ 1 m/s
0.25 - 0.5	→ 2 m/s
0.5 - 1.0	→ 4 m/s
1.0 - 2.0	
>= 2.0	

Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

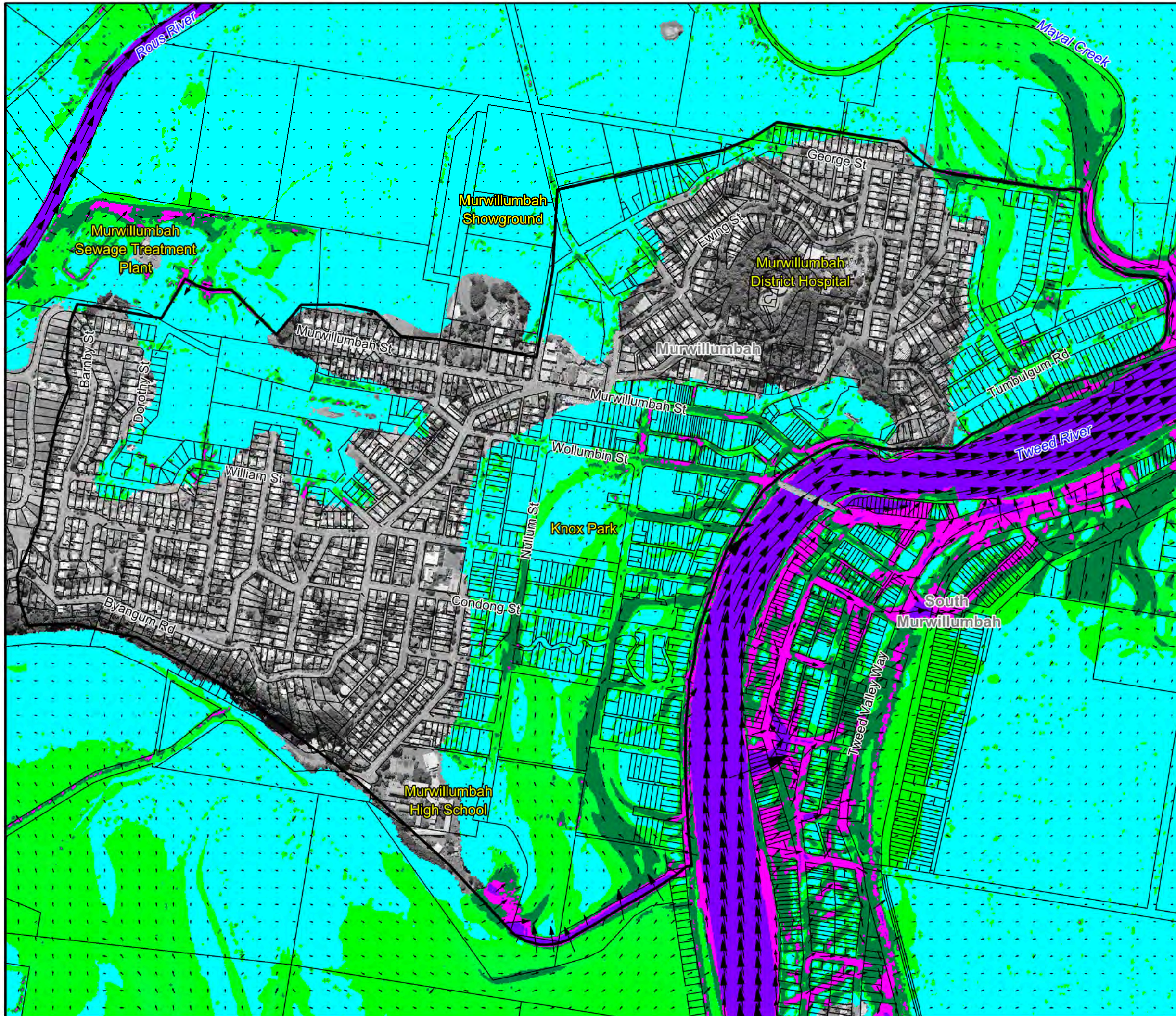


**Figure 27:**  
**Floodwater Velocities**  
**for the 1% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig27 - Flood Vel 1AEP.wor



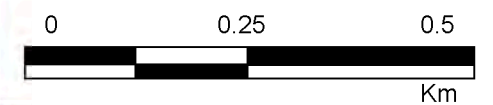
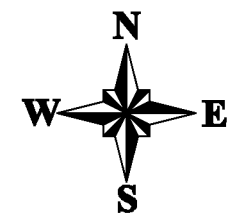


**LEGEND**

Velocity (m/s)	Velocity Vectors
0.0 - 0.25	→ 1 m/s
0.25 - 0.5	→ 2 m/s
0.5 - 1.0	→ 4 m/s
1.0 - 2.0	
>= 2.0	


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 28:**  
**Floodwater Velocities**  
**for the 0.2% AEP Flood**

Prepared By:

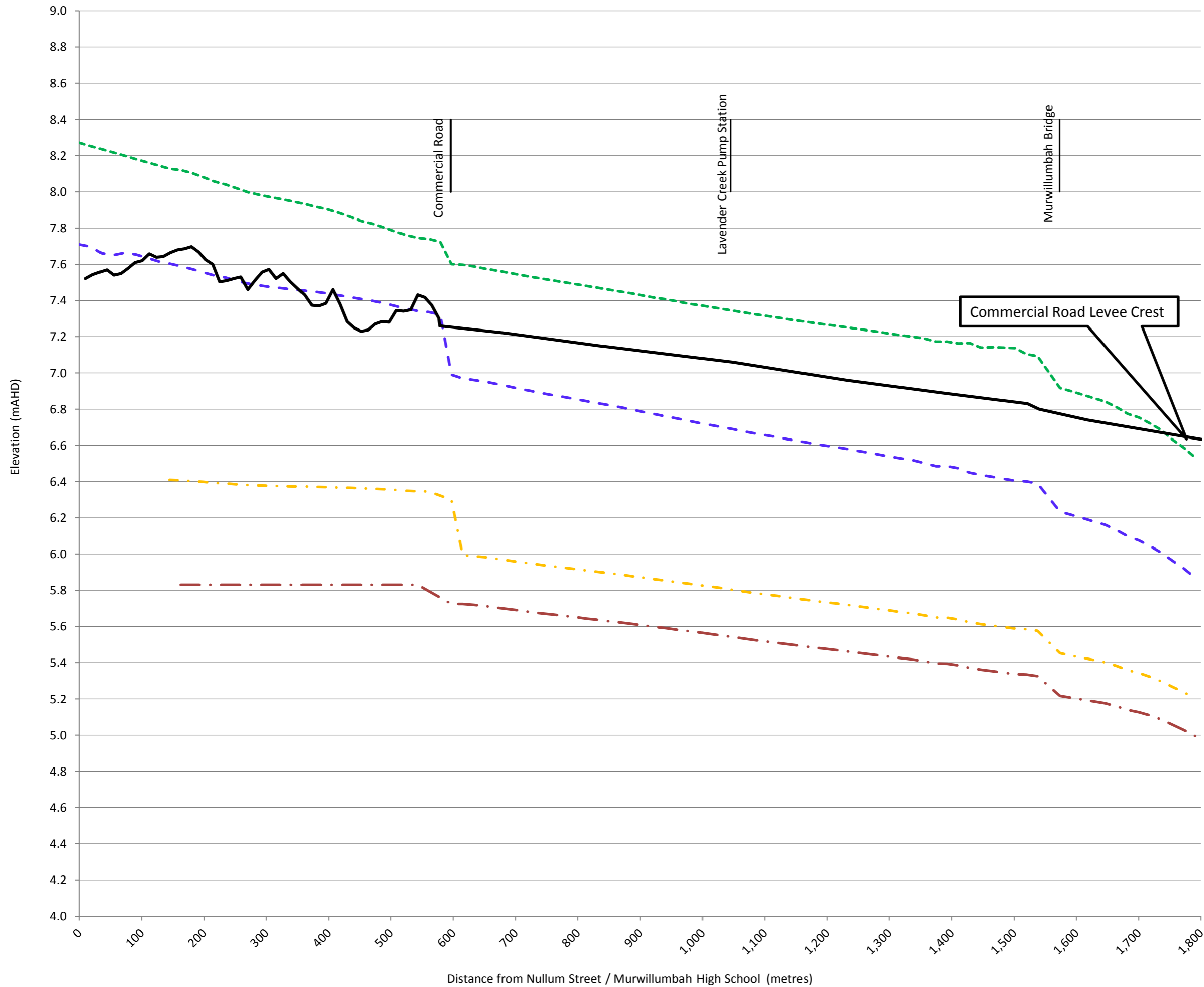
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig28 - Flood Vel 02AEP.wor




**LEGEND:**

- - - 0.2% AEP Water Surface Profile
- - - 1% AEP Water Surface Profile
- . - 5% AEP Water Surface Profile
- . - 20% AEP Water Surface Profile



Notes:

**Figure 29.1:  
Design Water Surface  
Profiles for Commercial  
Road Levee**

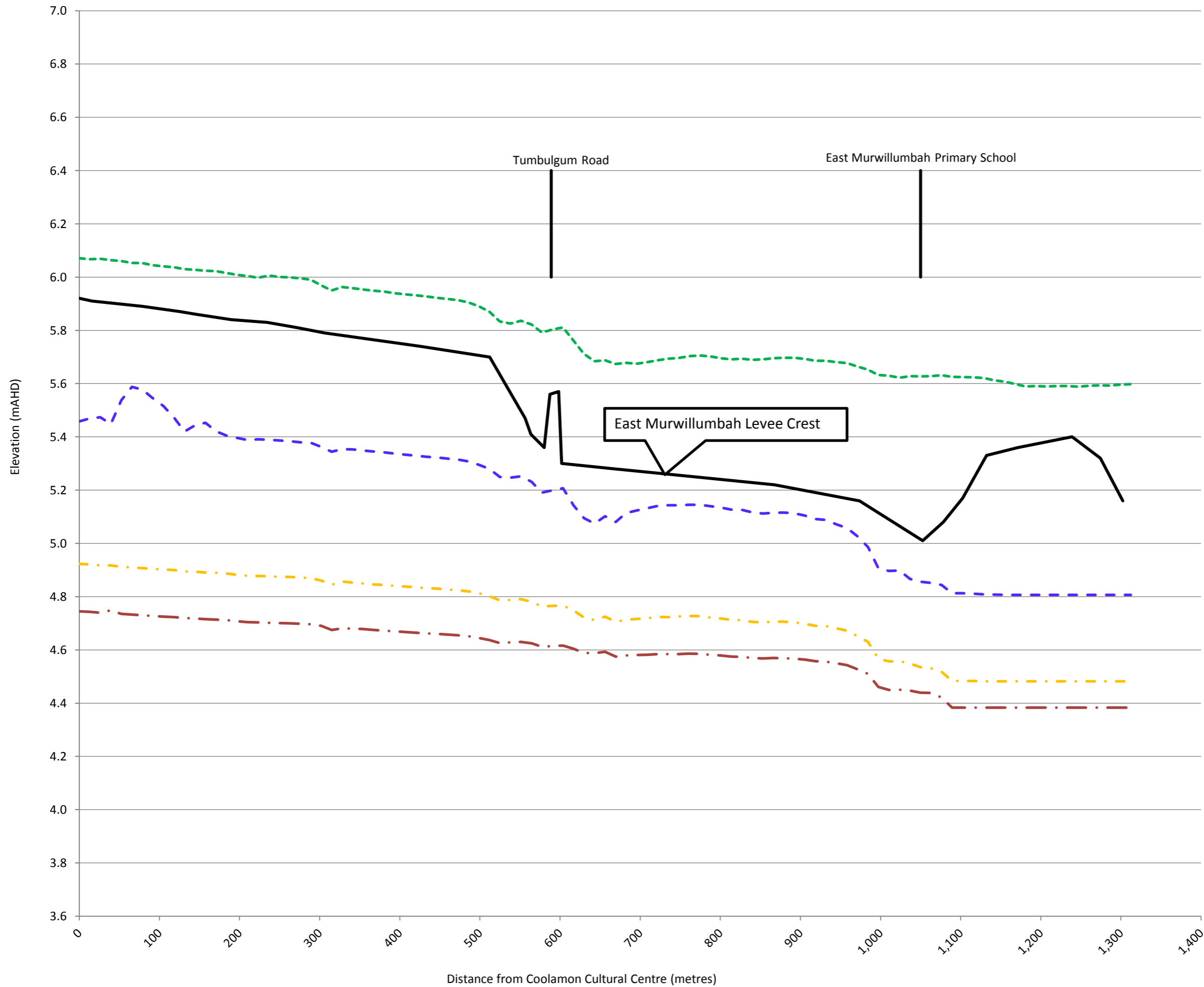
Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: Murwillumbah Levee & WSP.xls




**LEGEND:**

- - - 0.2% AEP Water Surface Profile
- - - 1% AEP Water Surface Profile
- - - 5% AEP Water Surface Profile
- . - . 20% AEP Water Surface Profile



Notes:

**Figure 29.2:  
Design Water Surface  
Profiles for East  
Murwillumbah Levee**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: Murwillumbah Levee & WSP.xls




**LEGEND:**

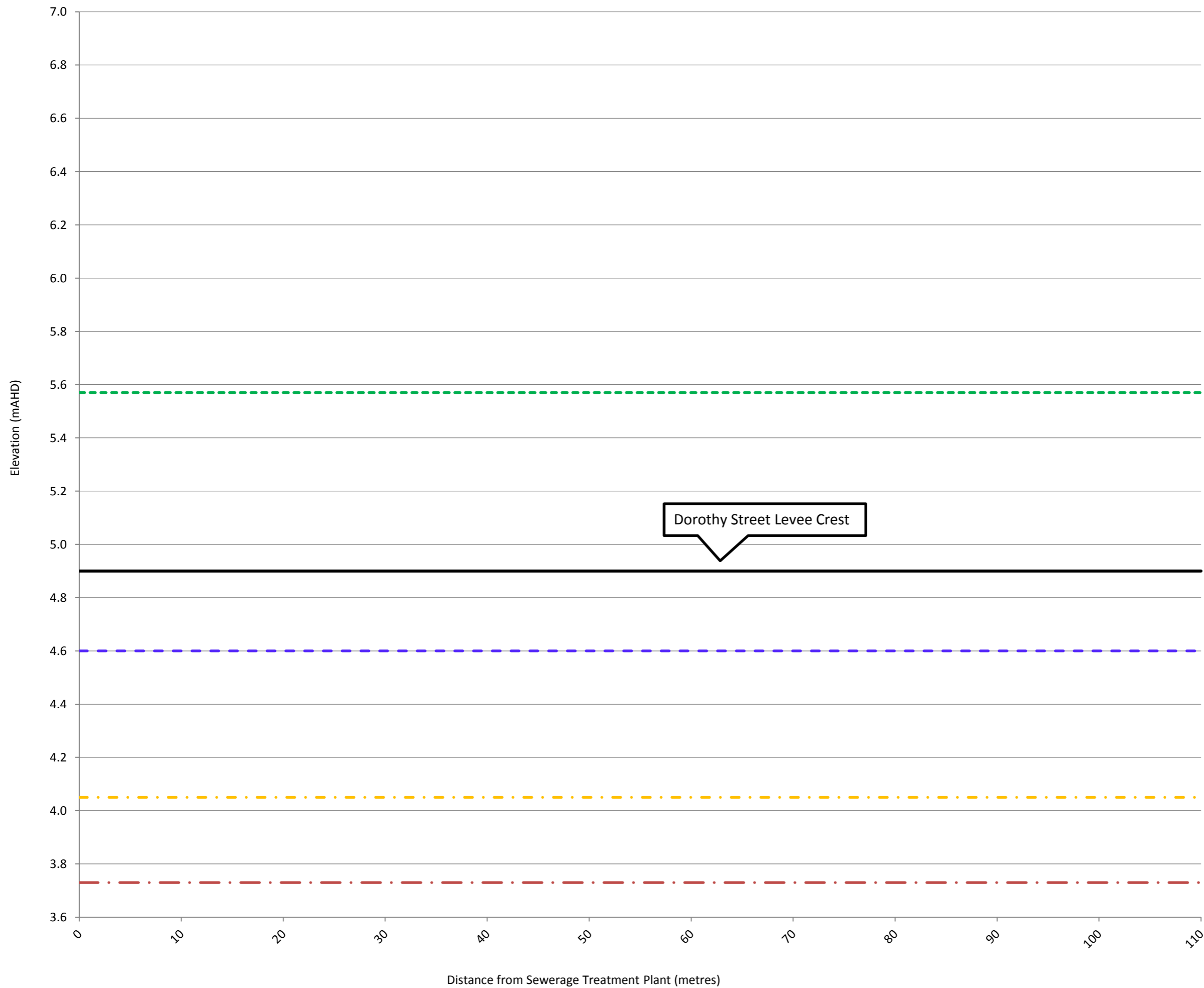
- - - 0.2% AEP Water Surface Profile
- - - 1% AEP Water Surface Profile
- . - . 5% AEP Water Surface Profile
- . - . 20% AEP Water Surface Profile

Notes:

**Figure 29.3:  
Design Water Surface  
Profiles for Dorothy  
Stree Levee**

Prepared By:  

**Catchment Simulation Solutions**  
 Suite 2.01, 210 George Street  
 Sydney, NSW, 2000

File Name: Murwillumbah Levee &  
WSP.xls



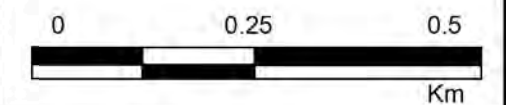





**LEGEND**

Failure AEP	Pit Failure Type
<span style="color: red;">█</span> >= 20% AEP	● No Failure
<span style="color: orange;">█</span> 5% AEP	▲ Surcharge
<span style="color: yellow;">█</span> 1% AEP	◆ Ponding
<span style="color: blue;">█</span> <= 0.2% AEP	

Notes:  
Aerial photograph date: 2015



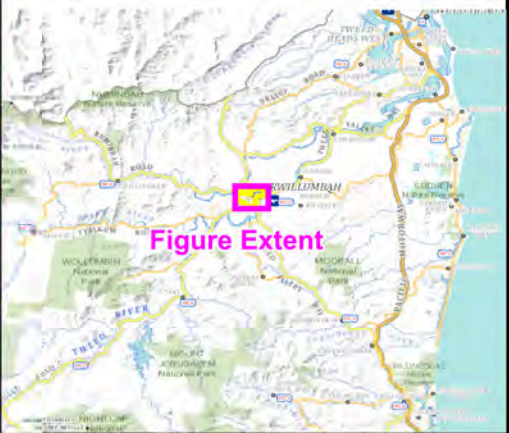
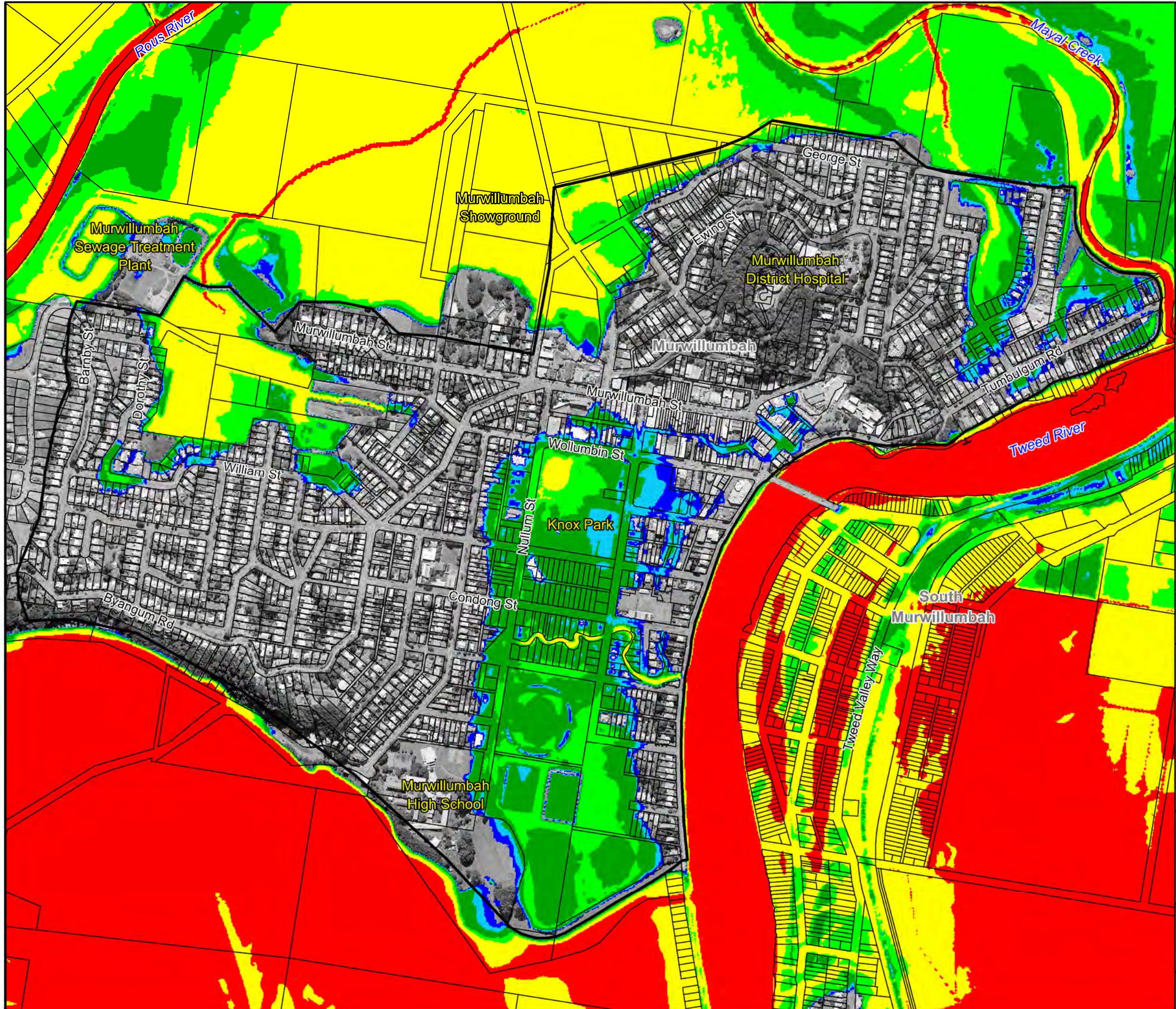
**Figure 30:  
Stormwater Capacity  
Maps**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig30 - Stormwater Capacity  
Maps.wor



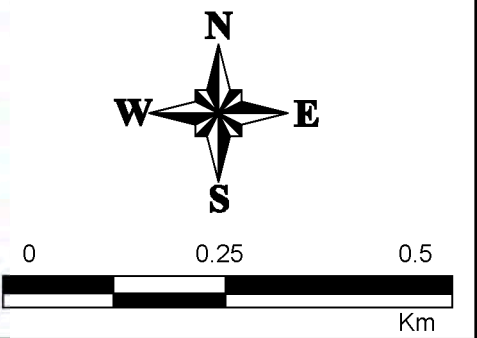




**LEGEND**

- Hazard Categories
- H1
  - H2
  - H3
  - H4
  - H5
  - H6

Notes:  
Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 31:  
Hazard Categories for  
the 1% AEP Flood**

Prepared By:  
 Catchment Simulation Solutions  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig31 - Hazard Categories for 1AEP.wor





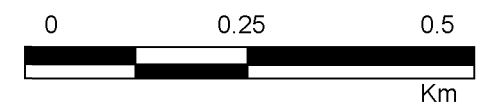
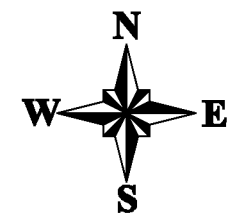
**LEGEND**

Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

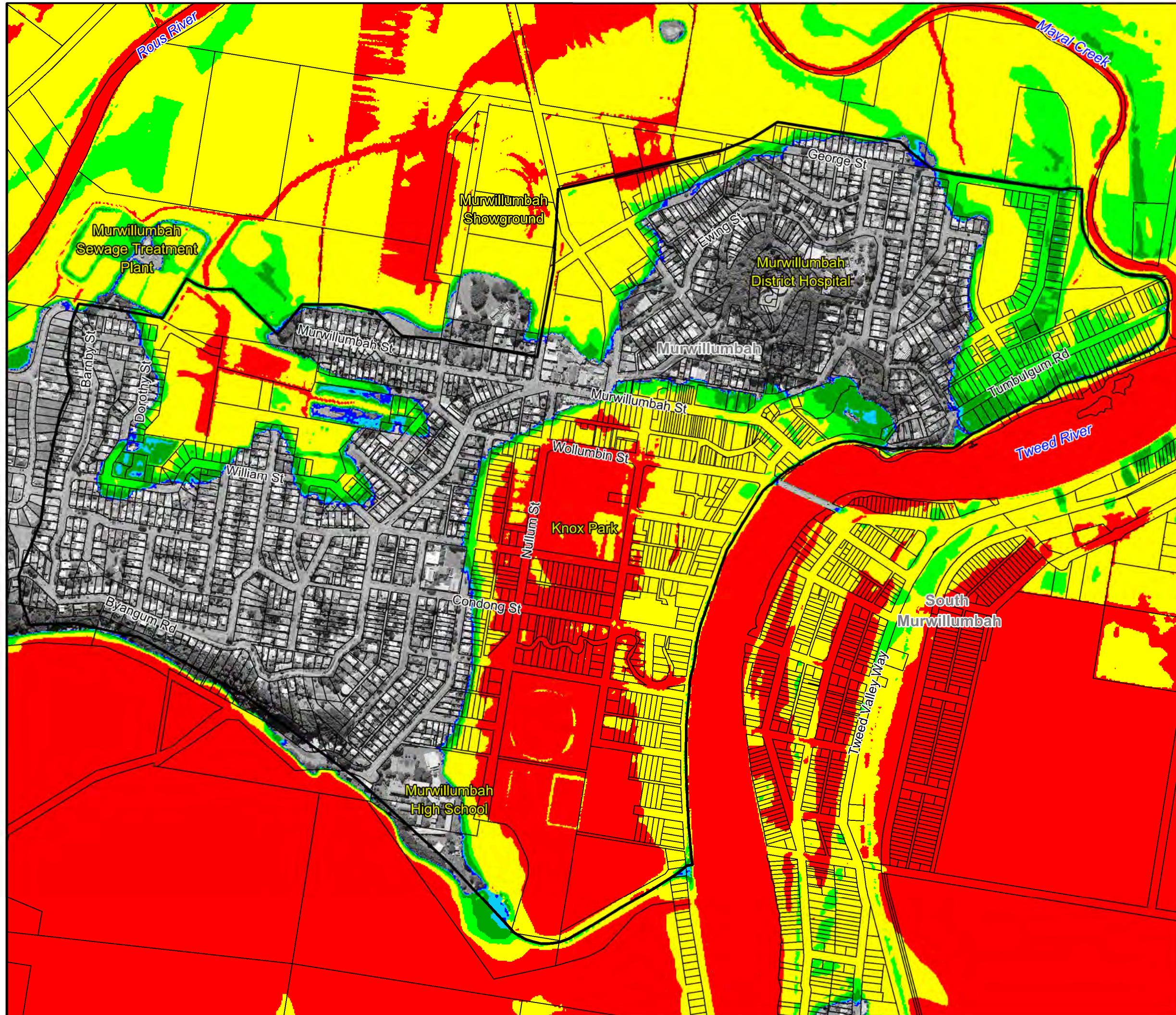


**Figure 32:  
Hazard Categories for  
the 0.2% AEP Flood**

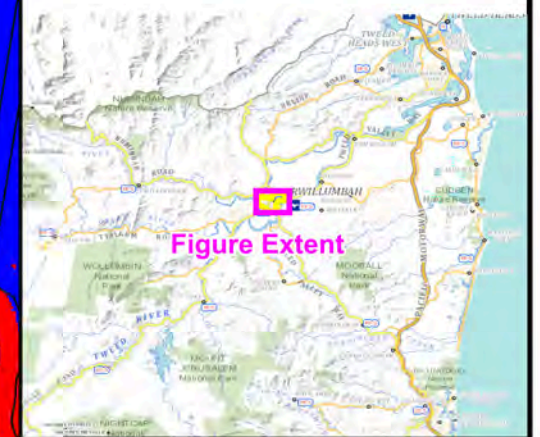
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig32 - Hazard Categories for 0.2AEP.wor





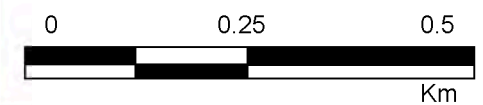


**LEGEND**

- Hydraulic Categories
- Flood Fringe
  - Flood Storage
  - Floodway


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

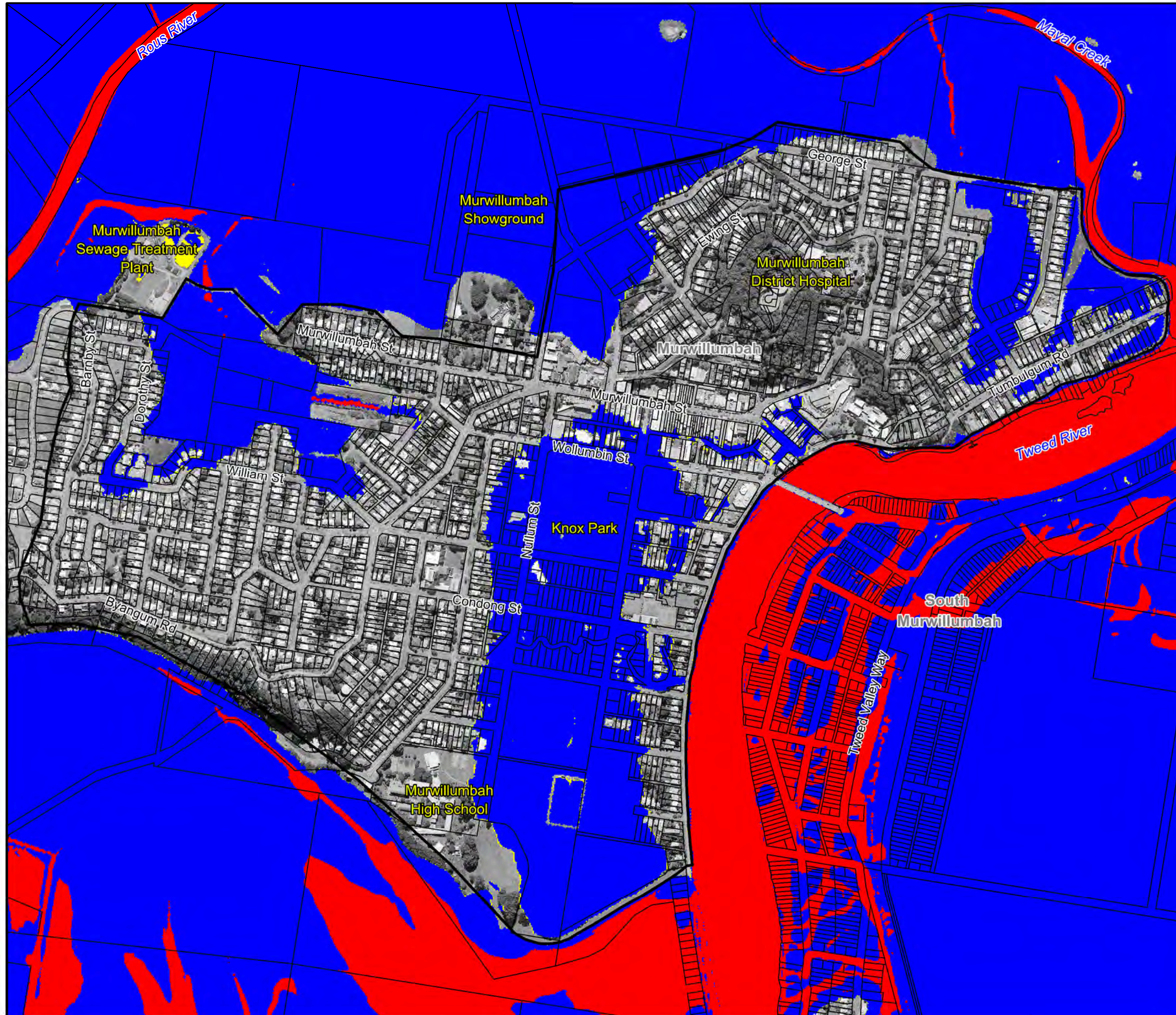


**Figure 33:**  
**Hydraulic Categories for**  
**the 1% AEP Flood**

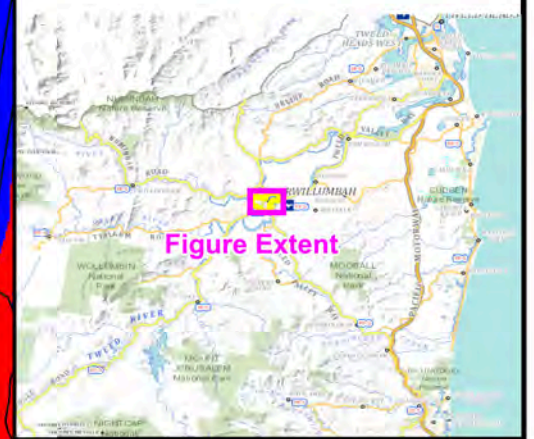
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig33 - Hydraulic Categories for the 1% AEP Flood.wor





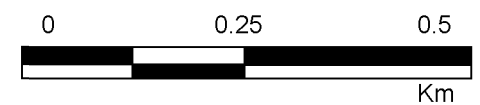
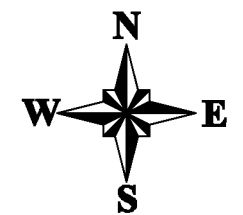


**LEGEND**

- Hydraulic Categories
- Flood Fringe
  - Flood Storage
  - Floodway


Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m

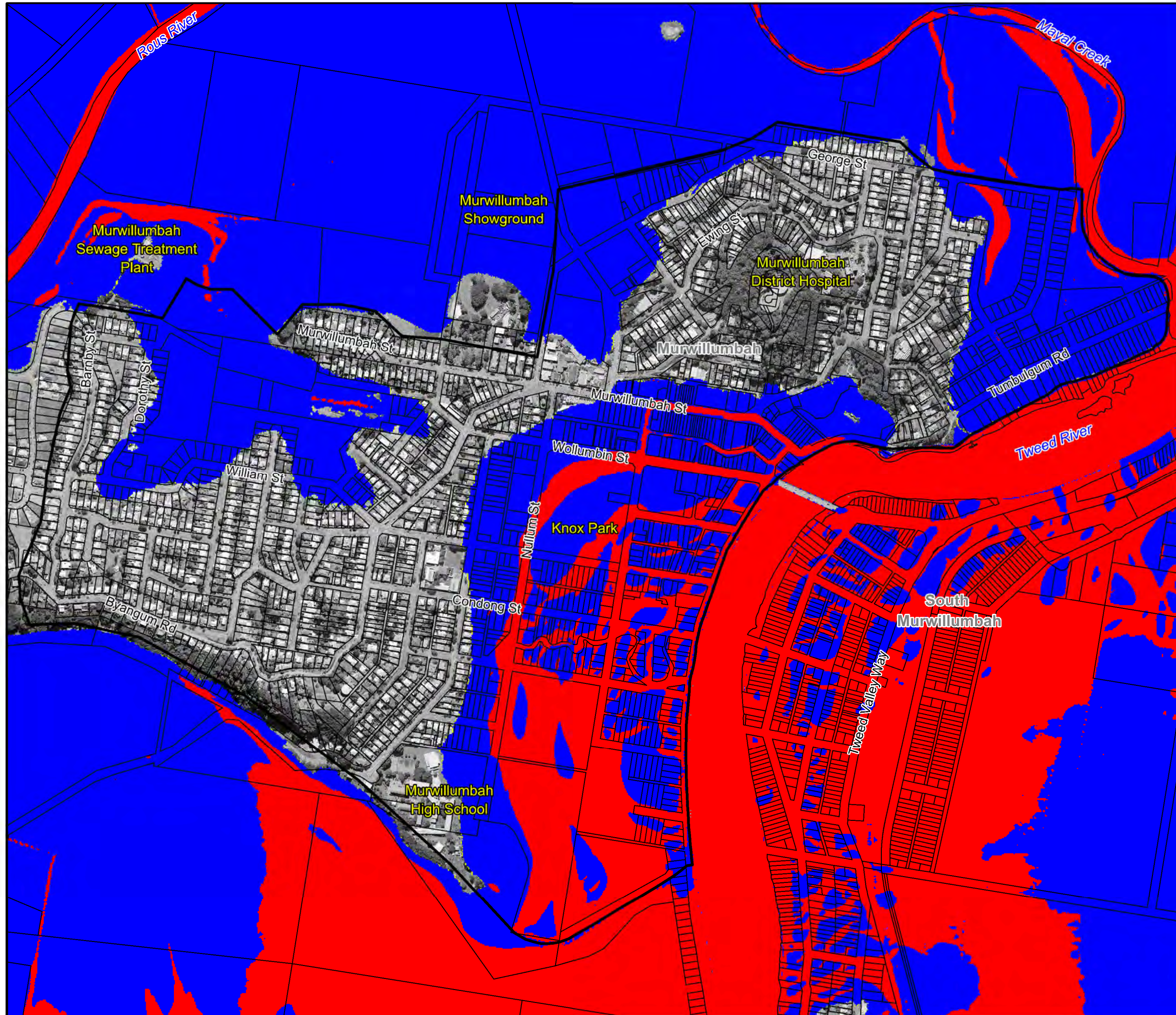


**Figure 34:**  
**Hydraulic Categories for**  
**the 0.2% AEP Flood**

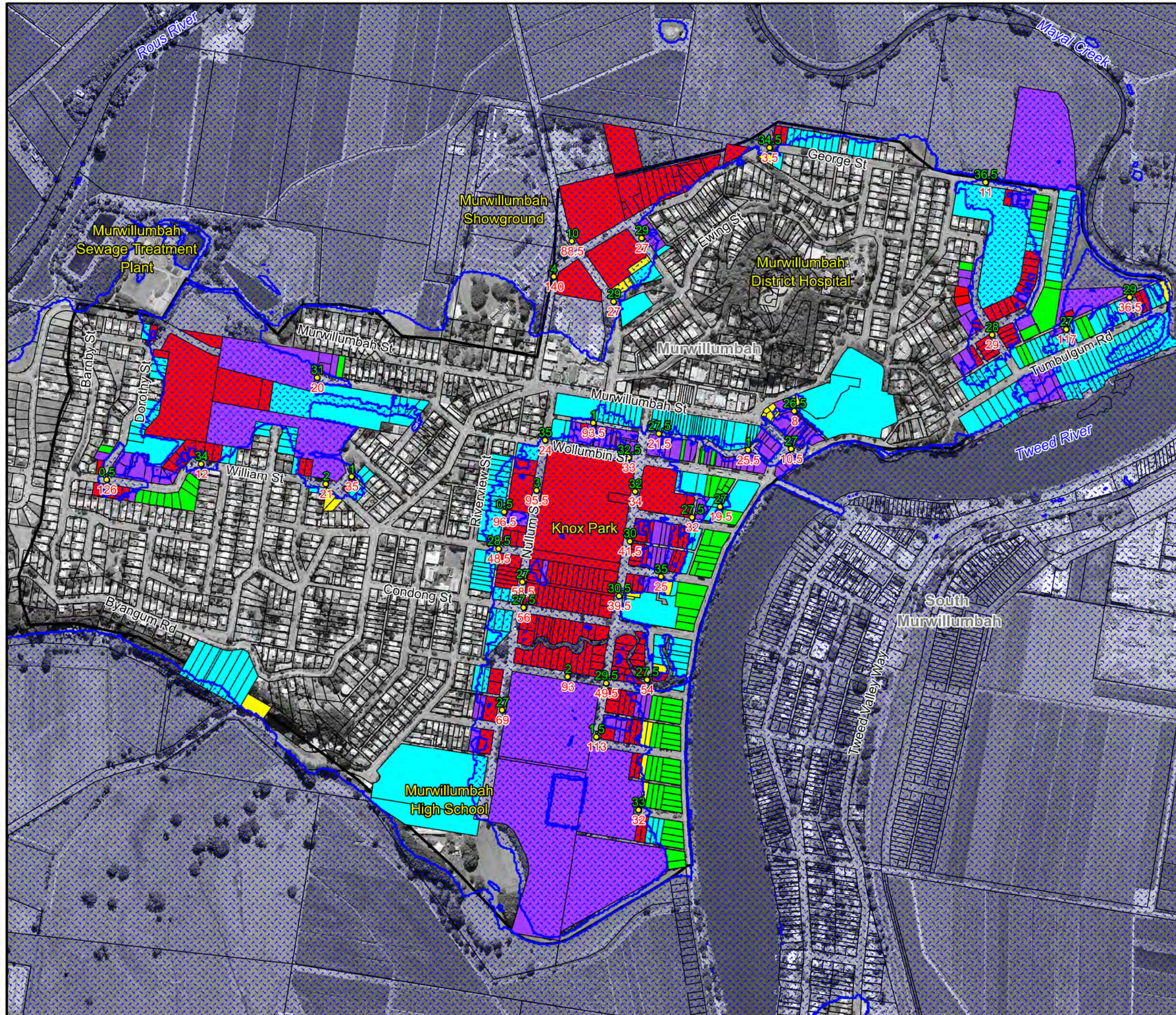
Prepared By:

 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig34 - Hydraulic Categories for  
0.2% AEP Flood.wor



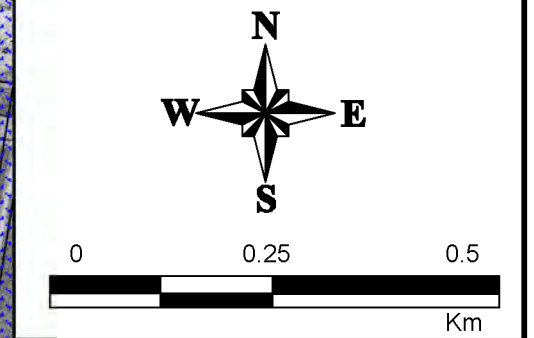





**LEGEND**

- Flooded Isolated Submerged
  - Flooded Isolated Elevated
  - Flooded Exit Route Overland Escape Route
  - Flooded Exit Rising Road Egress
  - Indirect Consequences
  - No Flood Impacts
- Road Overtopping Location**
- 15 Time of road first cut (hours)
  - 0.5 Duration of inundation (hours)
  - Flood Extent

Notes:  
Aerial photograph date: 2015

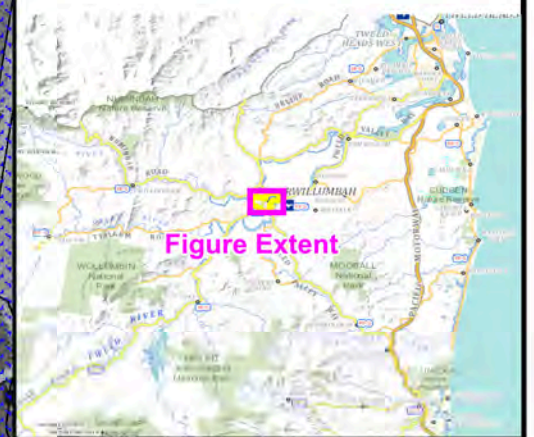


**Figure 35:  
Preliminary Emergency  
Response Classifications  
for the 1% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig35 - ERC 1%AEP Flood .wor

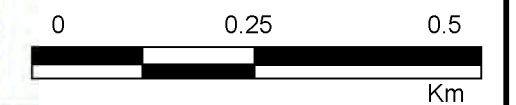
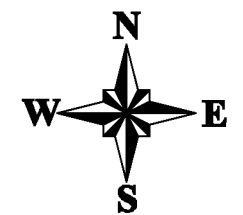





**LEGEND**

- Flooded Isolated Submerged
  - Flooded Isolated Elevated
  - Flooded Exit Route Overland Escape Route
  - Flooded Exit Rising Road Egress
  - Indirect Consequences
  - No Flood Impacts
- Road Overtopping Location**
- 15 Time of road first cut (hours)
  - 0.5 Duration of inundation (hours)
  - Flood Extent

Notes:  
Aerial photograph date: 2015



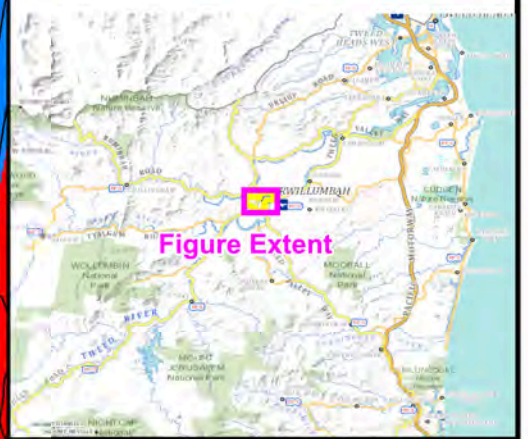
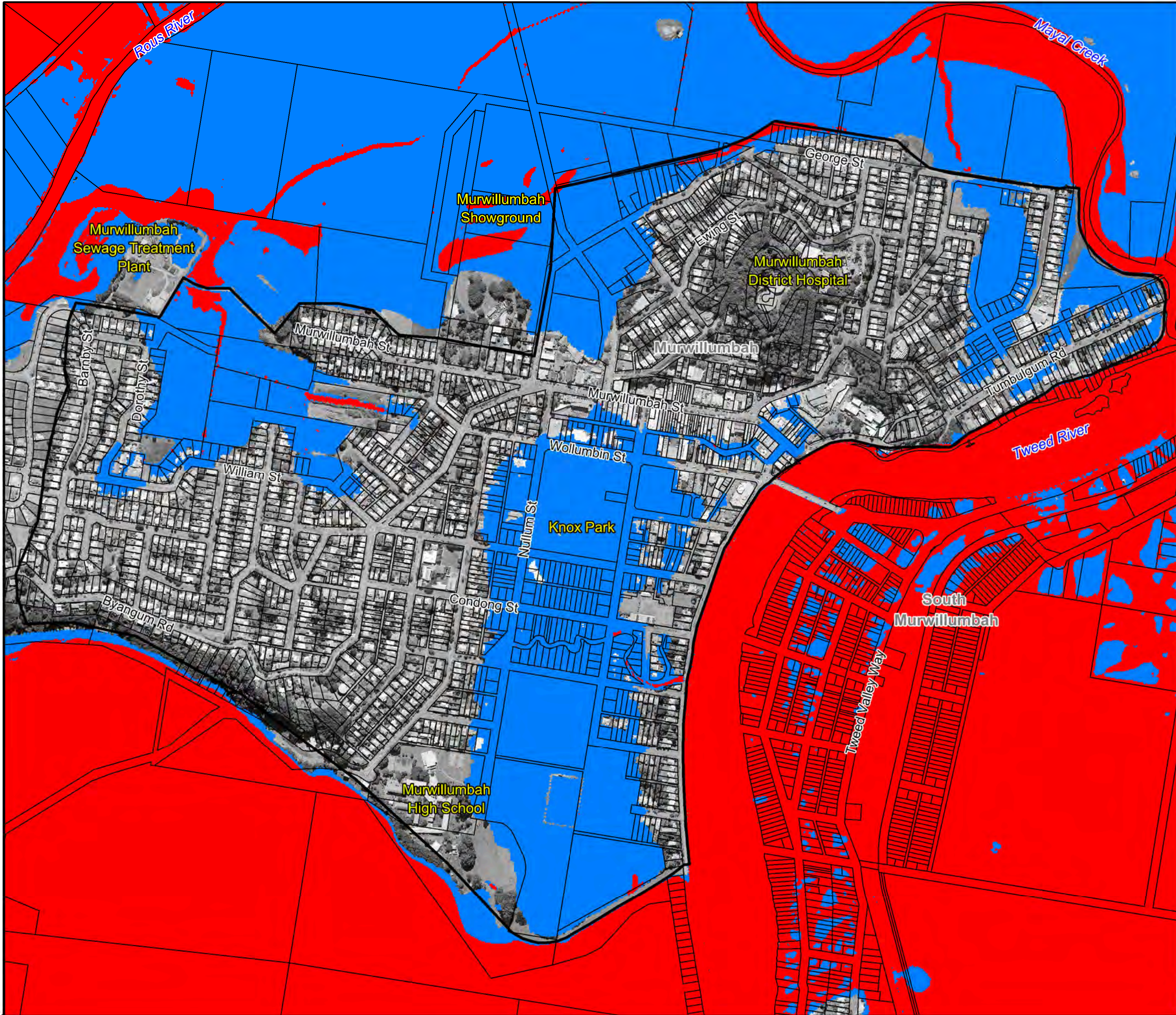
**Figure 36:  
Preliminary Emergency  
Response Classifications  
for the 0.2% AEP Flood**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig36 - ERC 50.2% AEP Flood .wor



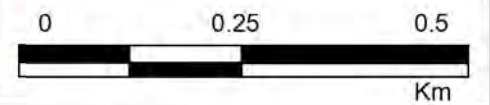




**LEGEND**

Velocity Depth Product (m2/s)  
■  $\leq 0.3$  "Low Flow Area"  
■  $> 0.3$  "High Flow Area"

Notes:  
 Aerial photograph date: 2015



**Figure 37:  
 High Flow Map  
 for the 1% AEP Flood**












Prepared By:  
 Catchment Simulation Solutions  
 Suite 2.01, 210 George St  
 Sydney, NSW 2000

File Name: Fig37 - High Flow Map.wor



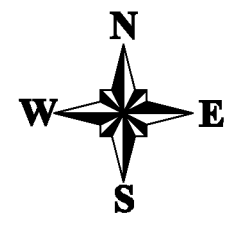


**LEGEND**


-  R3 Zone
  -  Existing Increased Density Area
  -  Additional Increased Density Area
- Flood Planning Constraint Category
- |                                                                                          |                                                                                         |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|  1a   |  2d  |
|  1b  |  2e |
|  2a |  3 |
|  2b |  4 |
|  2c |                                                                                         |

Notes:

Aerial photograph date: 2015  
Results only shown where depths are above 0.15m



**Figure 38:  
Flood Planning  
Constraint Map**

Prepared By:  
 **Catchment Simulation Solutions**  
Suite 2.01, 210 George St  
Sydney, NSW 2000

File Name: Fig38 - Flood Planning Constraint Map.wor

