

WATER QUALITY REPORT

for

Proposed Stormwater Diversion Channel

Kings Hill Urban Release Area

at

North Raymond Terrace, New South Wales

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Date:	06/10/2017	
	BY	DATE
Prepared	BC	06/10/2017
Checked	LG	06/10/2017
Admin	BM	06/10/2017



Level 1, 215 Pacific Highway Charlestown NSW 2290

PO Box 180 Charlestown NSW 2290

T (02) 4943 1777 F (02) 4943 1577

E newcastle@northrop.com.au

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1.1 Background

As part of the assessment of the channel, Northrop Consulting Engineers have been engaged to undertake stormwater water quality modelling of runoff leaving the URA, being conveyed by the channel and ultimately entering the downstream wetland. The purpose of this report is to summarise the extent of modelling, modelling methodology, results and estimated implications of stormwater being diverted from the URA to the downstream wetland.

- A description of the locality and subject catchment;
- A summary of authority requirements and design constraints with respect to the proposed development of the URA and channel;
- An outline of water quality modelling undertaken to determine estimated pollutant loads from future development and existing land uses;
- The results of modelling undertaken; and
- A discussion around the impacts of the proposal as well as design and ongoing maintenance implications.

2.1 Locality Description

Grahamstown Dam is located to the east, with a portion of the site currently draining to the dam. To the South East of the site, a spillway from the dam releases water to the Irrawang Swamp. A secondary disused spillway is located to the North of the current spillway. Irrawang Wetland drains to the Williams River, just upstream of the confluence point with the Hunter River.

The major features in the vicinity are shown in the attached Figure A1.

The contributing catchment from URA to the proposed channel is approximately 148ha in size. It is currently undeveloped with the lower portions used for agricultural purposes.

Topography is steep with grades in excess of 25 percent on the Western portion of the catchment and levels up to 100m AHD. In the East, grades are more accessible and are in the range of one to ten percent. Levels in the lower reaches are in the order of 13m AHD and act as storage volume for the Grahamstown Dam.

The subject catchment, including elevations and piped outlet locations is shown in the attached Figure A2.

Several hundred residential lots are proposed within the URA catchment. As mentioned earlier, Hunter Water requires water to be collected and conveyed around the dam. In order to satisfy this design requirement, a channel is proposed along the length of the site on the eastern side of the highway to the existing disused spillway to the south. From here the diverted water will enter the existing tributary creek line that drains to the Irrawang Swamp. The proposed channel is approximately 3.3km in total length. Preliminary designs show it having a 5m base width and typically 1 in 5 side slopes. It is expected that the channel will be revegetated with endemic grasses on its side slopes with macrophytes encouraged to establish in its base.

The total post developed catchment draining to the Irrawang Spillway is shown in the attached Figure A3 with the alignment of the proposed channel also shown.

3 Relevant Legislation and Guidelines

Port Stephens Local Environmental Plan (Kings Hill, North Raymond Terrace) 2010

The Port Stephens Local Environmental Plan (LEP) for the URA outlines the permitted or prohibited development. More specifically the Kings Hill LEP outlines the land zoning in the area and the type of development that is permitted with or without consent. As such the LEP has been used to map future development in the URA.

Stormwater Management within the URA will be designed in accordance with Port Stephens Council (PSC) Development Control Plan (DCP) for Kings Hill. At a subdivision scale the requirements / objectives as outlined in this DCP which will be incorporated in the urban development of the URA include:

- Stormwater Quality Devices designed to meet the DCP targets (see Table 1 below); and
- Provision of retention storage equal to 15mm/m² of new impervious area on site.

It is noted that the full design of these devices will be required at subdivision Development Application and Construction Certificate stage.

Australian Rainfall and Runoff 1987

The Australian Rainfall and Runoff guidelines provide guidance for best practice stormwater design and flood mitigation in Australia.

Australian Runoff Quality

Australian Runoff Quality is a guideline that was published by the Institution of Engineers, Australia (IEAust). The document provides information regarding the current best practice when considering Water Sensitive Urban Design (WSUD) measures for developments. Included within the document is guidance on modelling stormwater quality and current water treatment options.

Landcom's 'Water Sensitive Urban Design' Policy

As the channel is proposed to be drain into the SEPP14 wetland, HWC have noted that additional criteria over and above that noted by PSC should be considered. HWC have stated that developments fringing the wetland have in the past applied the 'Stretch Targets' for pollutant removal from urban development as defined in the Landcom's 'Water Sensitive Urban Design' publication. Table 1 below outlines these targets as they would relate to the URA draining to the channel.

Table 1 – Comparison of Pollutant removal targets

Pollutant	PSC DCP Removal Target (%)	Landcom Standard Removal Target (%)	Landcom Stretch Removal Target (%)
TSS	85	85	90
TP	65	65	85
TN	50	45	65

Landcom notes the following regarding the stretch targets:

'The stretch targets reflect the stormwater outcomes considered necessary to protect the receiving environment from the impact of urban development (achieve sustainable development that maintain environmental values). They are included to demonstrate the gap between environmental objectives and the extent to which those objectives can be met by 'best practice' WSUD, and encourage the attainment of outcomes beyond the standard targets, where practicable.'

The Water Management Act 2000

3.1 Available Data

- \\incl-fp\job_files1\YEAR 2012 Jobs\NL120526\E\E11_East Channel WQ
Report\NL120526 E11 ECWQ [A] 171006.docx

The following:

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5.1 Catchment Boundaries

- Pacific Highway approximately 19ha; and
- Area east of the highway draining to the channel / spillway including the channel itself 52ha

The minor sub catchments have then also divided into a series of land uses based on the zoning and information provided in the masterplan. The land use types include:

- A typical impervious percentage of 70% and 50% has been assumed for the Residential and Road catchments respectively.

5.2 MUSIC setup

A Mean Annual Rainfall (MAR) that is greater than 1000mm/yr. has been determined for the site. On this basis, rainfall runoff parameters have been adopted from the *Draft NSW MUSIC Modelling Guidelines* where appropriate.

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Buffer strips and Bioretention basins in combination with Gross Pollutant Traps (GPTs) have been considered the most feasible stormwater treatment devices for the development of the URA. Buffer strips have been used to simulate the effects of non-connected impervious areas from the developed areas. Downstream of buffers, end of line Humegard GPT nodes and Bioretention basins have been provided for each catchment.

- They can be placed offline therefore satisfying the requirements outlined by DPI – Water;
- They have minimal standing water within the basin, typically emptied shortly following precipitation events, therefore reducing environments that are susceptible to pest species such as mosquitoes and algae;
- They are typically used as an end of line treatment device and therefore are ideal for the proposed development due to steep grades in upstream reaches of the development;
- They have a greater treatment efficiency per square meter when compared to wetlands and are therefore highly effective at removing suspended solids, nutrients and gross pollutants from stormwater;
- They have the ability to satisfy both water quality and quantity requirements for the development due to retention capacity within the basins; and
- They can be aesthetically pleasing if properly designed with the potential to be easily integrated into the development masterplan within parks and surrounding residential zones.

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Figure 1 – Photo of a bio retention basin. Source Water By Design.

The filter media installed into the basins are highly susceptible to scour and erosion, therefore it is expected that flows from the minor events are to enter the basins and flows from the major event will bypass. During construction, it is important to ensure that the majority of the upstream catchment is stabilized prior to installing the filter media to ensure the filter media does not become inundated by sediment.

Typical modelling parameters have been adopted from the *Draft NSW MUSIC Modelling Guidelines* and data sheets for filtration media locally available and are outlined in Table 2 below.

Table 2 – Bio-filtration basin parameters (Typical)

Filter depth (m)	0.8
Saturated hydraulic conductivity (mm/hr)	50
Total nitrogen content in filter (mg/kg)	600
Orthophosphate content in filter (mg/kg)	9
Base lined?	No
Underdrain?	Yes
Vegetated with effective nutrient removal plants?	Yes
Submerged Carbon Zone Present?	No

5.4 Treatment Devices for Pacific Highway and Channel

Further to the stormwater treatment devices used to model pollutant reduction from the developed URA a number of devices were also used to estimate the treatment received from existing vegetated table drains beside the Highway and the channel itself.

- Buffer strips to filter runoff from impervious areas of the Pacific Highway road reserve; and
- A Biofiltration swale used to model the vegetated channel.

Results of the MUSIC model have been reviewed in a number of critical locations / scenarios. The following provides a brief explanation of these areas and their relevance.

- Developed URA Catchment – These results are from the urbanised catchment within the URA only. They do not include flow from forested areas within the URA or flow down creek lines from undevelopable areas on site. The results from the MUSIC model (see Table 4) show that the GPT's, buffers and biofiltration devices proposed within the site boundaries can be utilised to meet the Landcom's stretch reduction targets.
- Forest, Highway and Biofiltration swale / Channel - These results have been taken at the outlet of the channel at the old Irrawang Spillway excluding any flow from the Developed URA Catchment. Results of the modelling (see Table 5) show the impact of the channel as a biofiltration swale. Reduction targets are quite low for TP and TN, compared to that from the urbanised catchment. This is due to the fact that pollutant generation is very low to start with as the contributing catchment is largely forested/natural catchments.
- Combination of URA, Forest and Highway – These results have been taken at the outlet of the channel at the old spillway and include all the contributing catchment. Reduction targets at this point appear to be largely the same as that of the swale only scenario. Pollutant load reduction appears to have peaked and increased reductions through typical devices is hard to achieve. The resultant loads are very small for the size of the contributing catchment. It is important to note that the modelling has only assumed very small infiltration and transpiration rates for flows within the channel and thus the results could be considered conservative.

	Source	Residual Load	% Reduction
Flow (ML/yr)	717	644	10.1
Total Suspended Solids (kg/yr)	125,000	7,830	93.7
Total Phosphorus (kg/yr)	205	31	84.8
Total Nitrogen (kg/yr)	1,540	526	65.7
Gross Pollutants (kg/yr)	18,500	106	99.4

Table 4 – Forest & Highway and Biofiltration Swale (MUSIC Model)

	Source	Residual Load	% Reduction
Flow (ML/yr)	450	272	39.7
Total Suspended Solids (kg/yr)	62,800	5,800	90.8
Total Phosphorus (kg/yr)	107	35	67.0
Total Nitrogen (kg/yr)	645	372	42.3
Gross Pollutants (kg/yr)	3,690	0	100.0

Table 5 – Combining URA, Forest and Highway (MUSIC Model)

	Source	Residual Load	% Reduction
Flow (ML/yr)	1,110	818	26.2
Total Suspended Solids (kg/yr)	184,000	16,700	90.9
Total Phosphorus (kg/yr)	301	106	64.6
Total Nitrogen (kg/yr)	2,080	1,110	47.1
Gross Pollutants (kg/yr)	22,100	0	100.0

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The introduction of the channel will direct additional catchment to an existing tributary of the SEPP14 Irrawang wetland. An assessment of the impacts of this additional flow from a water quality and wetting and drying has been completed and detailed in this report. Based on the assessment undertaken it was concluded that:

- The introduction of urban development within the URA will require the construction of stormwater treatment devices in accordance with PSC DCP. Preliminary MUSIC modelling completed for the site shows that stormwater devices such as Biofiltration basins can be used within the development to achieve both PSC pollutant removal targets and the stretch targets recommended by Landcom's guidelines. These devices will minimise pollutants leaving the developed catchment and entering the channel.
- Furthermore, the channel itself will have an impact in the removal of pollutants such that by the time the runoff enters the tributary for the wetland only small quantities of pollutants remain.
- Significant increases in wetting and drying of the wetland due to increases flows in the tributary are not expected due to:
 - The relative size of the existing catchment and flows contributing to the tributary; and
 - the requirement for retention storage as part of the development will limit the impact of impervious surfaces constructed as part of the development of the URA.

Prepared by:

Ger Claas

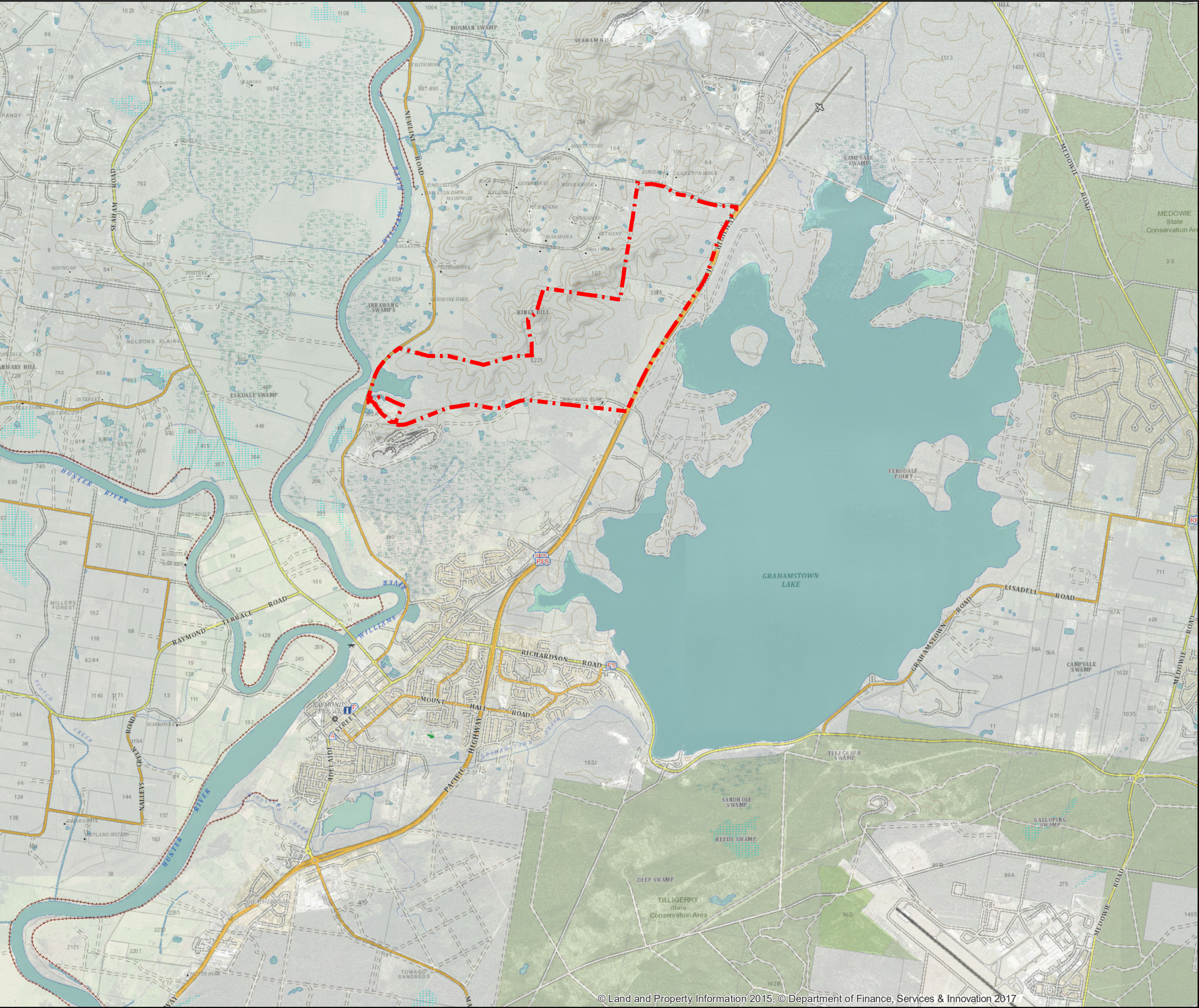
Ben Clark

Principal | Civil Engineer

BEng (Civil) CPEng NER RPEQ



APPENDIX A

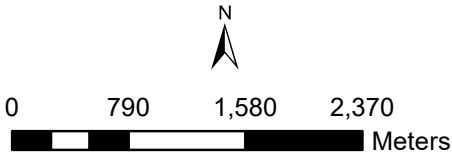


Legend

Site Boundary

Figure A1
Locality

Date	06 October 2017
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Job Number	NL120526 Rev A




Newcastle

Level 1, 215 Pacific Hwy, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
P.O Box 180, Charlestown NSW 2290
email newcastle@northrop.com.au ABN 81 094 433 100



Legend

Catchment Outlets

URA Catchment

Cadastral

Elevation (mAHD)

	0.0 - 2.5
	2.6 - 5
	5.1 - 7.5
	7.6 - 10
	10.1 - 15
	15.1 - 20
	20.1 - 25
	25.1 - 30
	30.1 - 40
	40.1 - 50
	50.1 - 60
	60.1 - 70
	70.1 - 80
	80.1 - 90
	90.1 - 100
	100.1 - 110
	110.1 - 120
	120.1 - 130
	130.1 - 138.4

Figure A2
Urban Release Area
Catchment (Pre-Developed)

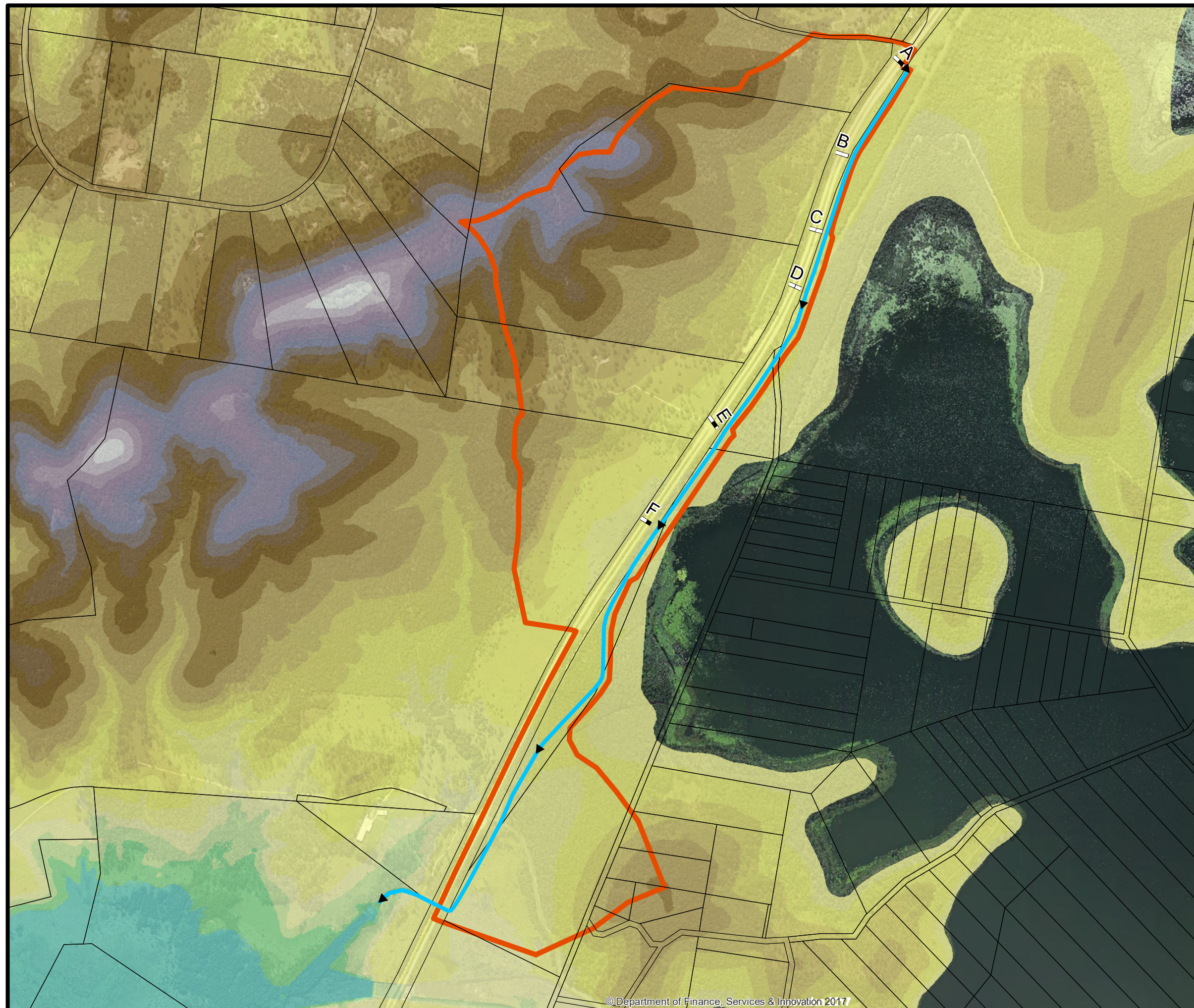
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Newcastle

Level 1, 215 Pacific Hwy, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
P.O Box 180, Charlestown NSW 2290
email newcastle@northrop.com.au ABN 81 094 433 100



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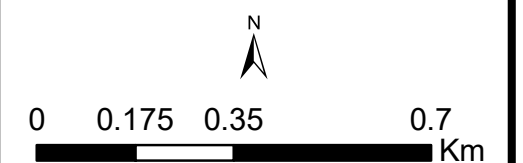
- Catchment Outlets
- Diversion Channel
- Cadastre
- Post Developed Catchment
- Elevation (mAHD)
 - Post Developed Catchment
 - 0.0 - 2.5
 - 2.6 - 5
 - 5.1 - 7.5
 - 7.6 - 10
 - 10.1 - 15
 - 15.1 - 20
 - 20.1 - 25
 - 25.1 - 30
 - 30.1 - 40
 - 40.1 - 50
 - 50.1 - 60
 - 60.1 - 70
 - 70.1 - 80
 - 80.1 - 90
 - 90.1 - 100
 - 100.1 - 110
 - 110.1 - 120
 - 120.1 - 130
 - 130.1 - 138.4

Figure A3
Developed Catchment

Date 06 October 2017

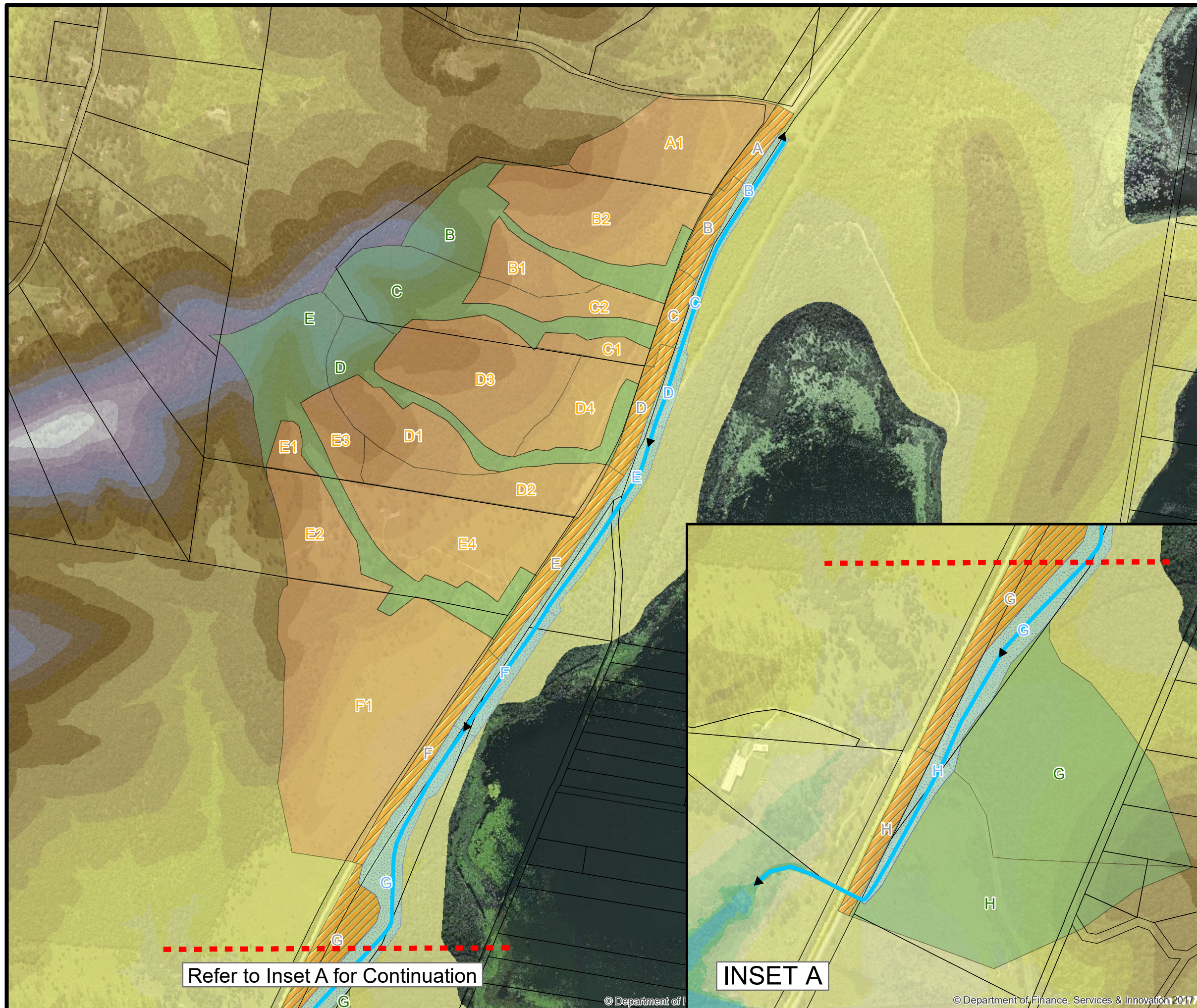
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Newcastle

Level 1, 215 Pacific Hwy, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
P.O Box 180, Charlestown NSW 2290
email newcastle@northrop.com.au ABN 81 094 433 100



Legend

- Swale Catchments
- Road Catchments
- Residential Catchments
- Forest and Creeks Catchments
- Channel Alignment
- Cadastre

Elevation (mAHD)

- 0.0 - 2.5
- 2.6 - 5
- 5.1 - 7.5
- 7.6 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 40
- 40.1 - 50
- 50.1 - 60
- 60.1 - 70
- 70.1 - 80
- 80.1 - 90
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- 120.1 - 130
- 130.1 - 138.4

Figure A4

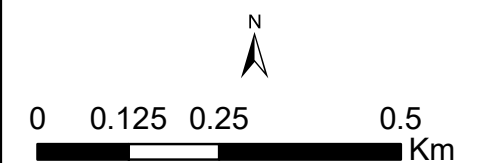
MUSIC Catchments

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Newcastle

Level 1, 215 Pacific Hwy, Charlestown NSW 2290
Ph (02) 4943 1777 Fax (02) 4943 1577
P.O. Box 180, Charlestown NSW 2290
email newcastle@northrop.com.au ABN 81 094 433 100

Refer to Inset A for Continuation

INSET A

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