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# STORMWATER MANAGEMENT PLAN

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## Lithgow Mountain Bike Park

### DEVELOPMENT ADDRESS

**3A State Mine Gully Road  
State Mine Gully, NSW 2790**

### LEGAL DESCRIPTION

**LOTS 10 & 11 DP1240259, LOTS 1, 2 & 3 DP1110346,  
LOT 1 DP965231 (Part Reserve 751655), LOT 2  
DP787403, LOT 2 DP876025**

**FOR**

**Central Tablelands Mountain Bike Club**

**ORIGINAL REPORT DATE  
May 2025**

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**CALARE PROJECT REF:  
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**Client:** Central Tablelands Mountain Bike Club

**Document Name:** STORMWATER MANAGEMENT PLAN

**Site Address:** LOTS 10 & 11 DP1240259, LOTS 1, 2 & 3 DP1110346, LOT 1 DP965231 (Part Reserve 751655), LOT 2 DP787403, LOT 2 DP876025  
3A State Mine Gully Road  
State Mine Gully, NSW 2790

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**Author:** CALARE CIVIL PTY LTD

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# CONTENTS

<b>1.</b>	<b>INTRODUCTION.....</b>	<b>4</b>
<b>2.</b>	<b>SITE DESCRIPTION.....</b>	<b>5</b>
2.1.	TOPOGRAPHY & EXISTING CONDITIONS .....	5
2.2.	SOILS.....	7
2.3.	WATERCOURSES .....	7
<b>3.</b>	<b>DATA.....</b>	<b>8</b>
3.1.	RELATED STUDIES .....	8
3.2.	EXISTING STORMWATER INFRASTRUCTURE .....	8
3.3.	STORMWATER MANAGEMENT PLANS .....	8
3.4.	HYDROLOGIC & HYDRAULIC NEEDS/WANTS .....	8
3.5.	WATER QUALITY/STREAM HEALTH .....	8
<b>4.</b>	<b>OPPORTUNITIES AND CONSTRAINTS.....</b>	<b>9</b>
4.1.	OPPORTUNITIES .....	9
4.2.	CONSTRAINTS .....	9
<b>5.</b>	<b>FLOODING.....</b>	<b>9</b>
<b>6.</b>	<b>STORMWATER MANAGEMENT .....</b>	<b>9</b>
<b>7.</b>	<b>STORMWATER QUALITY.....</b>	<b>10</b>
7.1.	EXISTING CONDITIONS .....	10
7.2.	RECEIVING WATERS .....	11
7.3.	OBJECTIVES .....	11
7.4.	PROPOSED WATER QUALITY MANAGEMENT STRATEGIES .....	11
7.5.	METHODOLOGY .....	11
7.6.	EFFECTIVENESS OF THE PROPOSED STORMWATER QUALITY CONTROLS.....	14
<b>8.</b>	<b>CONCLUSION.....</b>	<b>14</b>
8.1.	FLOOD IMPACTS & RISK .....	14
8.2.	WATER QUALITY .....	14
8.3.	RECOMMENDATIONS .....	14
<b>9.</b>	<b>LIFECYCLE COST ASSESSMENT .....</b>	<b>15</b>
<b>10.</b>	<b>ASSET HANDOVER.....</b>	<b>15</b>
<b>11.</b>	<b>REFERENCES.....</b>	<b>15</b>

## APPENDIX A

### HYDRAULIC CATEGORISATION OF FLOODPLAIN (100 YEAR ARI)

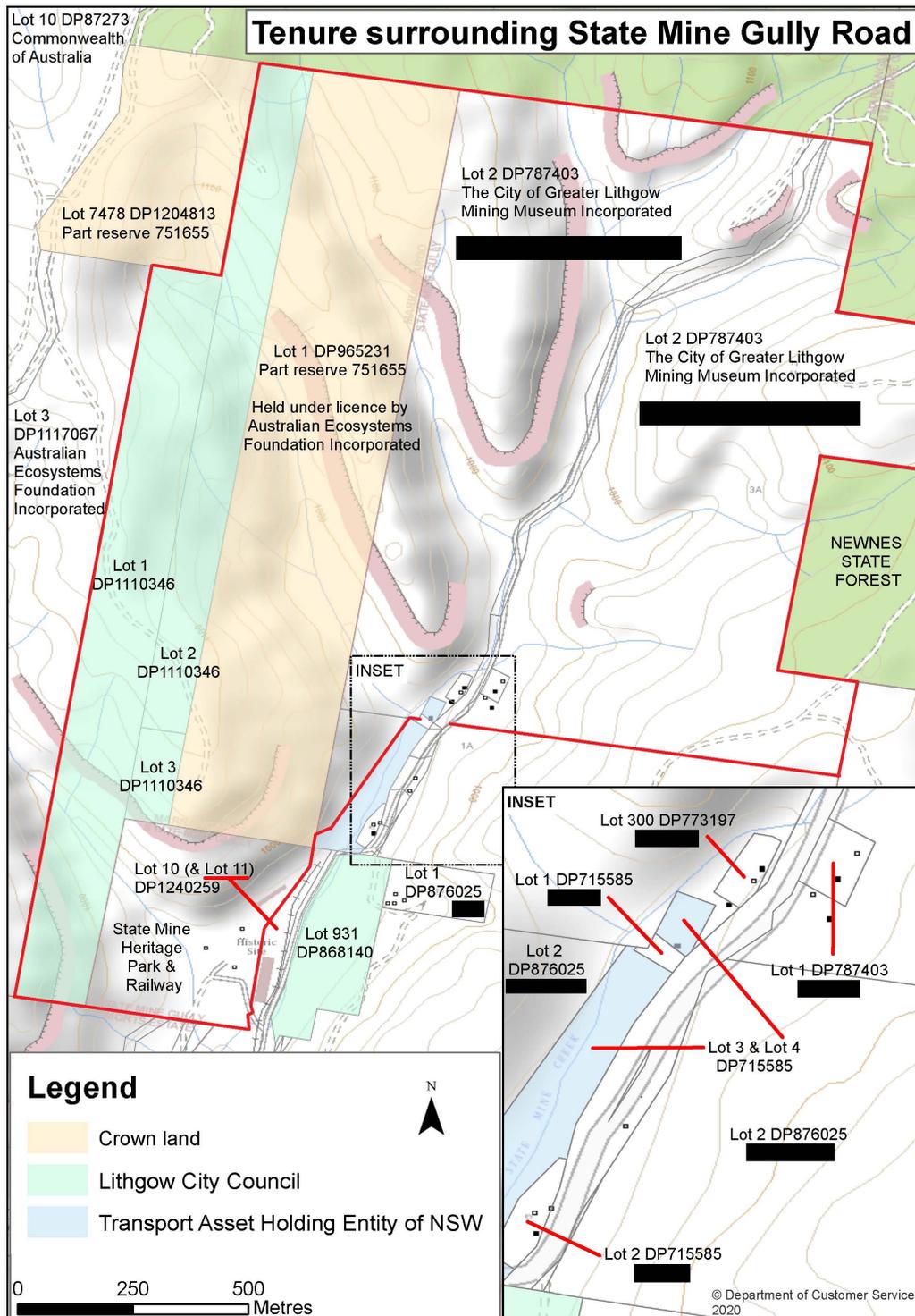
## 1. INTRODUCTION

<b>Developer</b>	Central Tablelands Mountain Bike Club
<b>Address</b>	3A State Mine Gully Road, State Mine Gully, NSW 2790
<b>Local Authority</b>	Lithgow City Council
<b>Property Description</b>	LOTS 10 & 11 DP1240259, LOTS 1, 2 & 3 DP1110346, LOT 1 DP965231 (Part Reserve 751655), LOT 2 DP787403, LOT 2 DP876025
<b>Size of Development</b>	Tenure Area: 216.61ha Disturbed Area: 2.28ha (including tracks)
<b>Type of Development</b>	Lithgow Mountain Bike Park
<b>Time to Undertake Works</b>	6 Months
<b>Existing Land Use &amp; Zone</b>	The proposed carpark is located on vacant re-vegetated land used as an informal parking area for the Lithgow State Mine Heritage Park. The proposed trails are located within the existing eucalypt forest. Zone C3 – Environmental Management.
<b>Adjacent Land Use &amp; Zone</b>	General Residential (R1), Environmental Management (C3) and RU3 Forestry
<b>Engineering Consultant</b>	Calare Civil
<b>Report Written By</b>	Harrison Oakley
<b>Qualifications</b>	B.E (Hons) Civil / B.E (Hons) Environmental
<b>Experience</b>	7+ years' experience across disciplines including civil design and project management, construction supervision, water quality analysis, hydrologic and hydraulic investigation, modelling and design.
<b>Report Checked By</b>	Garth Dean Director
<b>Qualifications</b>	B.E. GDSTT FIEAust CPEng NER APEC Engineer IntPE (Aus) RBP (Vic/NT)
<b>Experience</b>	30+ Years Civil Engineering Experience
<b>Purpose of Report</b>	To assess the impacts of the proposed development on the quality of the stormwater runoff and to provide water quality improvement measures as appropriate to satisfy Water NSW's NorBE requirements.

## 2. SITE DESCRIPTION

### 2.1. Topography & Existing Conditions

The proposed development consists of the construction of 24.54km of mountain bike trails and ancillary facilities including a carpark, toilets/amenities, and picnic site. The site, as shown in **Figure 2-1**, is located across 8 lots (Lots 10 & 11 DP1240259, Lots 1, 2 & 3 DP1110346, Lot 1 DP965231 (Part Reserve 751655), Lot 2 DP787403 and Lot 2 DP876025).

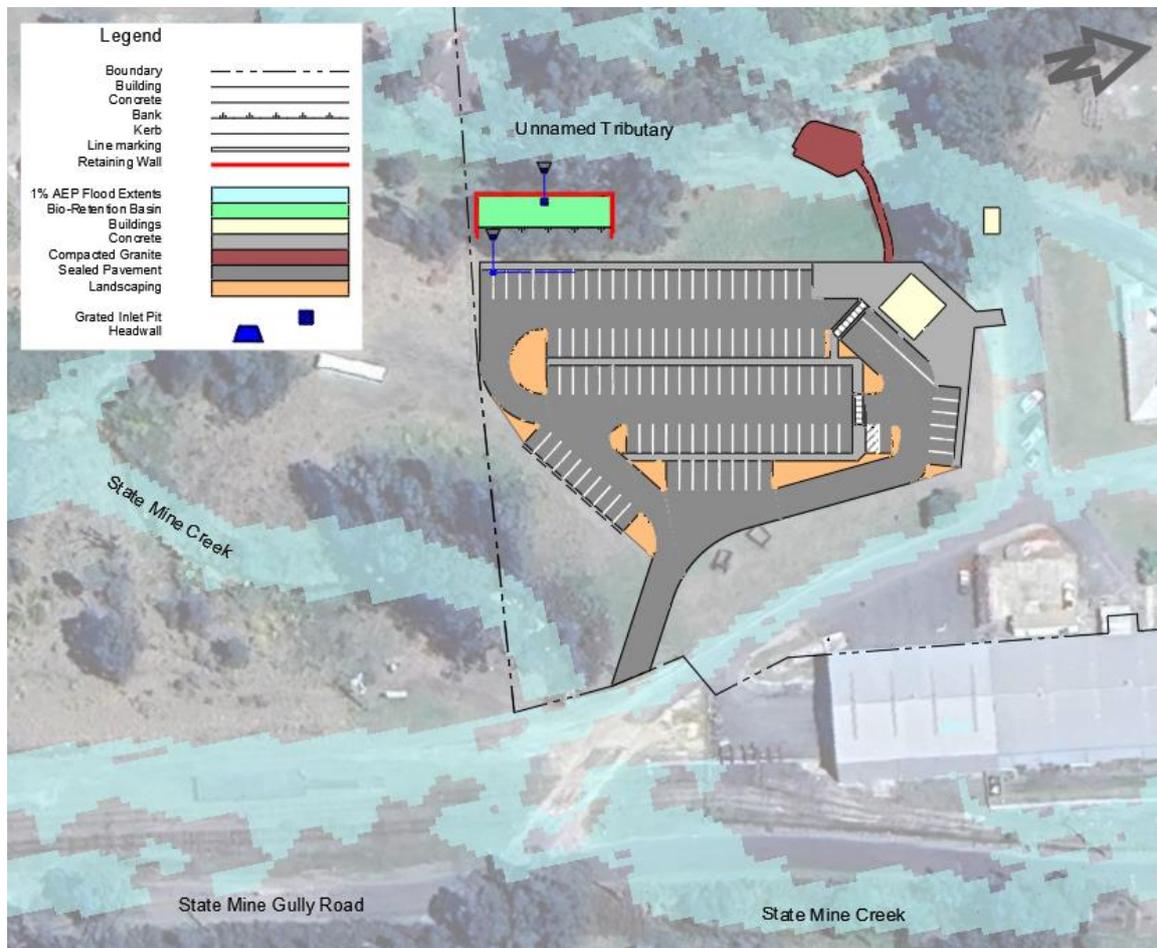


**Figure 2-1:** Tenure Map for the Proposed Development

The trails will be located in the hills and forest surrounding State Mine Gully whereas the trail head facilities will be located in the southeast corner of Lot 11 DP 1240259, 3A State Mine Gully Road. Through liaison with WaterNSW, it has been confirmed that a stormwater management plan and water quality impact assessment, the subject of this report, is not required for the mountain bike trails themselves as no trees are being cleared nor is any canopy being removed in their development. Furthermore, no sealed pavements will be provided, as such there will be no change to the volume or quality of runoff generated. Water NSW have also confirmed that the only area that requires a stormwater management plan and water quality impact assessment is that associated with the development of the trail head facilities and carpark, this is therefore the primary focus of this report.

The trailhead facilities as noted above are situated at the base of the valley with State Mine Creek to the east and the channel of a minor unnamed tributary to the west; the confluence of the two is to the south. The valley floor generally forms the floodplain for State Mine Creek; however, the proposed trail head facilities are to be situated on top of a capped and re-vegetated chitter heap from the previous State Mine workings. Due to being a chitter heap, the site has been filled up approximately 1.5-3.0m above the natural valley floor, and as such is not impacted by flood flows, with all flows being diverted around.

The site for the trail head facilities is gently graded with a 2.5% fall to the southwest, however it is bounded by 1V:4H batters back to natural on all sides. Existing pad elevations range from 948.8m AHD (northeast corner) to 946.8m AHD (southwest corner). Minor earthworks in the form of approximately 300mm of fill to the existing surface level are proposed to facilitate the development of a free draining carpark. All runoff is to be directed to the proposed bio-retention basin in southwest corner where the grading and drainage design shall be verified during detailed design. Note, there will no net impact on the overall behaviour of stormwater runoff or flood flows around the site. For reference, a general locality plan is provided in **Figure 2-2** below.



**Figure 2-2:** Locality Plan for the Proposed Development

## 2.2. Soils

The trail head facilities are to be constructed on a capped chitter heap. It is noted that the capping material consists of a minimum 300mm thick layer of densely compacted clay blended with road base material (DGB20). For the basis of defining the soil storage capacity and infiltration parameters for the existing conditions runoff assessment, this capping material has been taken as the equivalent of a medium-heavy clay as per the parameters defined in **Tables 4.4** and **4.5** of Water NSW's *Using MUSIC in Sydney's Drinking Water Catchment* (February 2023).

The adopted parameters assuming a 0.5m root zone are as follows:

Parameter	Soil Description: Medium Clay
<b>Soil Properties</b>	
Soil Storage Capacity (mm)	94
Field Capacity (mm)	70
Initial Storage (% of Capacity)	25
Infiltration Capacity Coefficient – a (mm/d)	135
Infiltration Capacity Exponent – b	4.0
<b>Ground Water Properties</b>	
Initial Depth (mm)	10
Daily Recharge Rate (%)	10
Daily Baseflow Rate (%)	10
Daily Deep Seepage Rate (%)	0

## 2.3. Watercourses

There are no defined watercourses from an upstream catchment running through the proposed development. All watercourse, i.e. State Mine Creek or the unnamed tributary run around the site and given the elevated nature of the site, it is not impacted by any out of channel flows or flooding.

## **3. Data**

### **3.1. Related Studies**

In 2017 Lyall & Associates presented the Lithgow Flood Study Review (LFSR) of which has since been adopted by Council. The Water Cycle Management Plan presented here considers the above document and all recommendations made here have been made with the LFSR in mind.

### **3.2. Existing Stormwater Infrastructure**

There is no existing piped stormwater drainage infrastructure on the proposed site, currently all stormwater runoff is discharged as sheet flow to the unnamed tributary of State Mine Creek to the west.

At the toe of the northeastern batter, there is a swale that collects runoff from the museum's driveway and parking area. The only alterations to this swale proposed as part of these works include a crossing for the proposed driveway and another for the stairs connecting the trail head amenities to the museum's parking area.

### **3.3. Stormwater Management Plans**

The Water Cycle Management Plan presented herein is in accordance with the following guidelines:

- Developments in the Sydney Drinking Water Catchment – Water Quality Information Requirements, Water NSW (February 2023).
- Using MUSIC in Sydney's Drinking Water Catchment, Water NSW (February 2023).
- Neutral or Beneficial Effect on Water Quality Assessment Guideline, Water NSW (October 2022).
- Flood Hazard: Flood Risk Management Guideline FB03, NSW Department of Planning and Environment (June 2023).

### **3.4. Hydrologic & Hydraulic needs/wants**

The site for the trailhead facilities are within the flood plain for State Mine Creek however due to its elevation (by virtue of being located on top of the existing chitter heap) it is not impacted by flood waters.

### **3.5. Water Quality/Stream Health**

No study has been undertaken to determine the water quality of the recipient waterway and does not form a part of this document.

## 4. OPPORTUNITIES AND CONSTRAINTS

### 4.1. Opportunities

Through the proposed development and formalising the site drainage, the potential for rill erosion on the batters that form the existing chitter heap and cap will be minimised. This will reduce the risk of potential environmental contamination that may result from the exposing of the chitter through erosion of the embankments.

### 4.2. Constraints

The primary constraint for the proposed development is to ensure that the chitter heap cap is not compromised nor its integrity threatened through the operation of the site. During design and construction this means that any top soil stripping shall be sufficiently shallow so that the cap will not be impacted, noting earthworks will generally compromise of fill to level the site. Any backfill must be suitably compacted and comprising of a material with a similar clay content.

For the operational phase, erosion of the cap must be prevented thus any trafficable areas must be sealed and all batters suitably vegetated such that during droughts, bare earth is not exposed.

## 5. FLOODING

As noted above, the site is situated within the floodplain of State Mine Creek, however due to being situated on top of a chitter heap the site is immune from flood impacts in all events up to and including the 0.2% AEP Event (500yr ARI). The local 1% AEP flood extents are presented above in **Figure 2-2** and are also shown on sheet SW01 of the DA plans (rev P3).

Access along Council's State Mine Gully Road is compromised in much more frequent events as the road becomes inundated, approximately 200m downstream of the site, during events greater than and including the 10% AEP Event (10yr ARI).

For a depiction of the State Mine Creek floodplain, flood storage and flood fringe areas during the 1% AEP Event, please refer to Figures 6.10 (sheet 1) of the LFSR Volume 2 – Figures. For reference, this sheet has been extracted and provided in **Appendix A**.

## 6. STORMWATER MANAGEMENT

The trailhead site (0.456ha) is currently assessed as being 0% impervious noting it is currently a managed grassland being used as an informal parking area. The proposed development will increase the level of imperviousness to 91.3%, as such the volume of stormwater runoff will be increased and if no mitigation measures are provided, the quality of this stormwater runoff will also be decreased. A decrease in discharged water quality is not an acceptable outcome and due to being within the Sydney Drinking Water Catchment, a Neutral or Beneficial Effect (NorBE) on water quality must be achieved.

Section 7 of this report outlines Calare Civil's assessment of the discharged water quality and provides recommendations on what mitigation measures are required to ensure a NorBE on water quality is achieved.

## 7. STORMWATER QUALITY

Through liaison with WaterNSW, it was confirmed that a water quality impact assessment is not required for the mountain bike trails themselves as no canopy is being cleared in their development. Furthermore, no sealed pavements will be provided, and as such there will be no change to the volume or quality of the runoff generated. The only area that requires a water quality impact assessment is that associated with the development of the trail head facilities and carpark, this is therefore the subject of this section.

Due to the size and location of the proposed trail head facilities, a MUSIC model has been prepared to demonstrate that the proposed development and treatment train results in a Neutral or Beneficial Effect (NorBE) on Water Quality within the Sydney Drinking Water Catchment. The level of assessment and the subsequent information provided herein is commensurate with the information requirements for a Module 5 development as set out in **Table A1** of *Neutral or Beneficial Effect on Water Quality Assessment Guideline*, Water NSW (October 2022).

The development has been classified as falling under Module 5, and subsequently assessed using a MUSIC Model for the following reasons:

- The proposed additional impervious area exceeds 2,500m<sup>2</sup>
- The total developable / disturbed area associated with the trail head facilities is 4,562m<sup>2</sup> and the proposed development will result in 91.3% or 4,167m<sup>2</sup>, of this area becoming impervious, noting the pre-developed site is entirely pervious.
- The site is situated in a sensitive area i.e. within the State Mine Creek floodplain between the main channel and a minor tributary.

Based on the above and in accordance with the listed information requirements in **Table A3** of *Neutral or Beneficial Effect on Water Quality Assessment Guideline*, the following has been provided as part of this assessment:

- Conceptual Soil and Water Management Plan, refer sheets ES01 – ES04 of the DA plans (rev P3, provided separately)
- MUSIC Modelling and Assessment Report, refer below.
- Flood Study, refer **Section 5** above.
- Stormwater Drainage Plan, refer to sheets SW01 and SW02 of the DA plans (rev P3, provided separately)

### 7.1. Existing Conditions

As noted previously the site is a rehabilitated chitter heap consisting of managed grasslands, being used as an informal parking area. As per **Section 2.2**, there is limited opportunity for rainwater infiltration due to the presence of a 300mm thick layer of densely compacted clay blended with road base material provided to form the impermeable cap / containment cell for the chitter heap. Therefore, the only soil storage capacity is within the topsoil layer provided to stabilise the surface.

There are no formal stormwater quality improvement devices (SQIDs) or water sensitive urban design (WSUD) measures in place and all run off from the site will fall to the southwest. There is the potential for rill erosion of the batters particularly during droughts when the vegetation has died off.

## 7.2. Receiving Waters

The site discharges to the State Mine Creek which is understood to be a modified environment consisting primarily of a natural bottom, although it has limited ecological benefits or available habitat due to the urbanisation of its overbank areas.

State Mine Creek then flows down to Farmers Creek which is a highly modified environment with sections of concrete lining and natural bottom. At the confluence of State Mine Creek, Farmers Creek has a natural bed however within 750m, the bed transitions into concrete lining that then extends a further 2.5 km downstream, to the Geordie St causeway. Similarly to State Mine Creek, very little to no ecological benefit or available habitat is provided in this reach of Farmers Creek. From the Geordie St causeway natural bottom resumes however this portion of this creek is subject to a constant discharge from the Lithgow Sewerage Treatment Plant (STP) which results in Farmers Creek developing a perennial flow regime.

With the nutrient loading and perennial flow regime as a result of discharges from the STP, Farmers Creek has a modified ecosystem where invasive and non-native species have been able to establish themselves within the riparian corridor. Due to the nature of this development, the current site conditions, and the condition of State Mine Creek and Farmers Creek, it is expected that there will be no detrimental impacts of these proposed works on the receiving environment.

## 7.3. Objectives

To provide recommendations around the provision of suitable SQIDs or WSUD measures on a site that currently has none. The provision of any SQID or WSUD measures will subsequently improve the quality of any runoff and thus satisfy the NorBE conditions which call for an overall 10% reduction in Total Suspended Solids, Total Nitrogen and Total Phosphorus

## 7.4. Proposed Water Quality Management Strategies

This Stormwater Management Plan has assessed the implementation of the following water quality improvement devices / strategies. The proposed treatment train has been modelled in MUSIC to assess its effectiveness in satisfying the objectives noted in **Section 7.3**

- Provision of a formalised stormwater drainage network to limit the volume of uncontrolled runoff from the site. This will minimise any potential risk of exposing the chitter through rill erosion of the batters and cap which may occur under the existing conditions. Furthermore, a formalised drainage network enables the total capture and conveyance of site runoff to the proposed Bio-Retention Basin.
- Provision of a Bio-Retention Basin to provide an opportunity for stormwater filtration and nutrient uptake through specialised planting.
- Provision of a formalised outlet structure / stabilised discharge location, again this will further minimise the potential for erosion and scour that may exist under the existing conditions.

## 7.5. Methodology

Stormwater quality modelling was undertaken to estimate the load of common stormwater pollutants including Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN) generated by the proposed development. MUSIC modelling was undertaken to estimate continuous hydrology and runoff water quality for the proposed development.

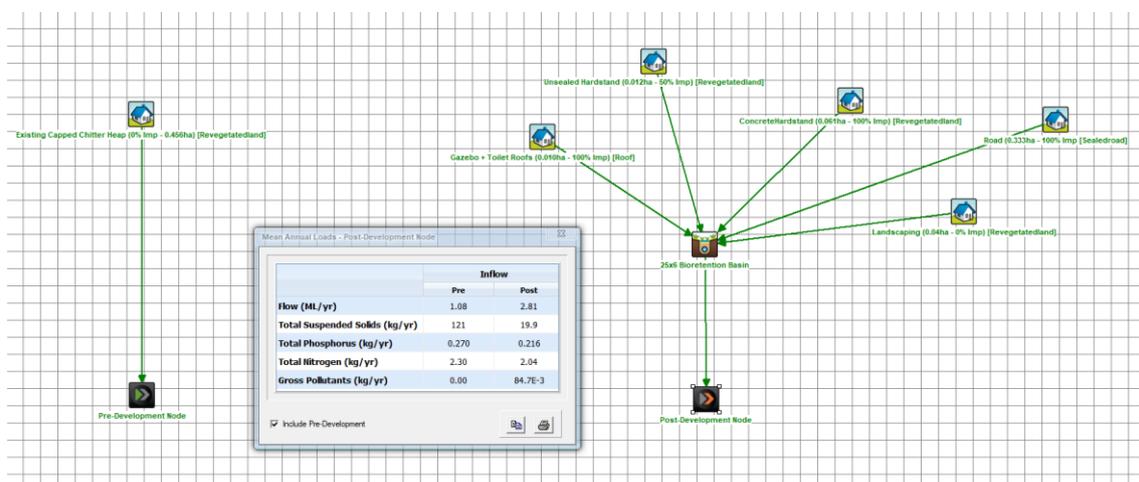
MUSIC includes algorithms to evaluate the hydrology and concentrations / loads from urban catchments, and estimate the performance of stormwater management measures at capturing these pollutants. MUSIC was designed to continuously simulate urban stormwater systems over a range of temporal and spatial scales utilising historically representative rainfall data. MUSIC is considered within the industry to be an appropriate conceptual design tool for the analysis of runoff water quality in the urban environment.

The hydrologic algorithms in MUSIC represents the rainfall runoff processes and requires input of the following variables to perform the hydrological assessment:

- Rainfall data (time steps varying from 6 minutes to 1 day)
- Areal Potential Evapo-Transpiration (PET) rates
- Catchment parameters (area, % impervious and % pervious)
- Impervious and pervious area parameters (rainfall threshold, soil and groundwater parameters)
- Storm event and base flow stormwater (event mean) pollutant concentrations for differing land uses.

MUSIC can be applied for comparison of alternative scenarios that adopt the same base inputs. Although the magnitude of the estimates may not be equivalent to actual site conditions (due to limitations in available data for a particular site), the relative differences between scenarios is expected to be appropriate for decision making.

An overview of the MUSIC model developed as part of this study is shown in **Figure 7-1**.



**Figure 7-1:** MUSIC Model for the subject site (includes the pre and post development scenarios)

### Delineation of Surface Types, Areas and Parameters

The surface types, areas and proportion effective impervious areas for the catchment nodes in both the existing and developed scenario were estimated using a combination of aerial imagery and the concept design drawings prepared by both Calare Civil and World Trail. A high-level summary of the catchment parameters is provided in the following table.

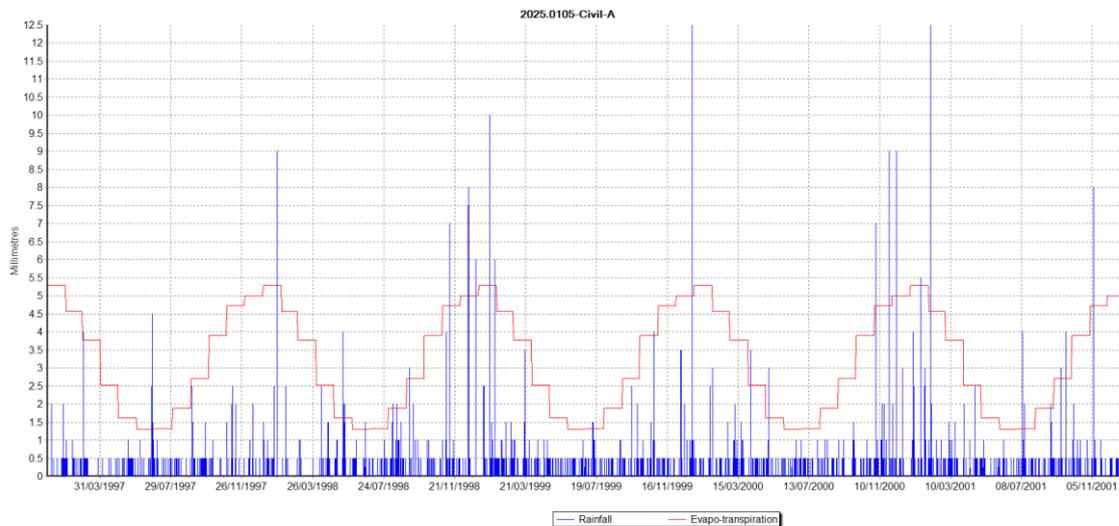
**Table 7-1:** Catchment Area and Land Use Summary

Catchment Name	Usage	MUSIC Land Use	Catchment Area (ha)	Effective Impervious Area (%)
<b>Existing</b>				
Ex Cat	Grassland & Informal Parking	Re-vegetated Land	0.456	0
<b>Developed</b>				
Roof	Roof	Roof	0.010	100
Concrete Hardstand	Footpath & Gathering Area	Revegetated Land	0.061	100
Unsealed Hardstand	Footpath & Picnic Space	Revegetated Land	0.012	50
Landscape	Landscape	Revegetated Land	0.040	0
Road	Carpark	Sealed Road	0.333	100

## Rainfall and Evaporation

To simulate the performance of stormwater quality treatment measures, MUSIC requires the input of data from a representative continuously recording rainfall station (pluviograph). Daily rainfall data was input into the model sourced from Water NSW using the Zone 4 data; a five-year, six-minute time step was used between 01 January 1997 to 31 December 2001. Evapotranspiration data was also sourced from the Bureau of Meteorology.

The 5-year input data period shown in **Figure 7-2** was selected to include both periods of high and low rainfall which best represents a range of scenarios. It is from this data that the flows and stormwater runoff volumes could be analysed for the site.



**Figure 7-2: MUSIC Hydrological Input Data**

## Model Timestep

A 6-minute time-step was adopted to simulate rainfall-runoff processes, water quality and characterise pollutant loads across the site.

## Runoff Quality Parameters

The MUSIC stormwater constituent pollutant concentrations were adopted in accordance with the default MUSIC pollutant node values and values presented in **Tables 5-6** and **5-7** of the NSW MUSIC modelling guidelines (BMT WBM, 2015).

## Summary of Treatment Node Parameters

Proposed 25x6 Bio-Retention Basin:

- Extended Detention Depth = 0.3m
- Base / Filter Area = 150m<sup>2</sup>
- Filter Depth = 0.4m
- Saturated Hydraulic Conductivity of Filter Media = 150mm/hr
- TN Content of Filter Media = 400mg/kg
- Orthophosphate Content of Filter Media = 40mg/kg
- Drainage Layer = 100mm
- Within the drainage layer, provide perforated sub-soil drainage lines, laid at a minimum of 0.5% at a max spacing of 1m reporting to a 900x900 Grated Inlet Pit
- High flow spillway, width = 2,000mm and depth = 200mm

## 7.6. Effectiveness of the Proposed Stormwater Quality Controls.

The conceptual WSUD strategy for the site as proposed in **Section 7.4** was assessed using the MUSIC model which estimates the treatment effectiveness of water quality controls. The mean annual pollutant loads and treatment train effectiveness for the subject site are shown in **Table 7-2** which clearly demonstrates that the proposed Bio-Retention basin is able to reduce the sites pollutant loads by more than the targeted value of 10%.

**Table 7-2:** Mean Annual Pollutant Load Reductions

Parameter	Mean Annual Load and Treatment Effectiveness						NorBE Load Reduction (%)
	Source		Residual		% Reduction		
	Pre	Post	Pre	Post	Pre	Post	
Flow (ML/yr)	1.08	3.09	1.08	2.81	0	9.06	n/a
Total Suspended Solids (kg/yr)	121	908	121	19.9	0	97.8	83.6
Total Phosphorus (kg/yr)	0.27	1.59	0.27	0.216	0	86.4	20.0
Total Nitrogen (kg/yr)	2.3	7.33	2.3	2.04	0	72.2	11.3
Gross Pollutants (ky/yr)	0	76.3	0	0.0847	0	99.9	n/a

## 8. CONCLUSION

### 8.1. Flood Impacts & Risk

This development is not subject to flood flows and so there is no flood risk. The proposed works will also have no impact on flood behaviour.

Access to the site is impacted by flood waters in events greater than and including the 10% AEP Event however this is on an existing section of Council's State Mine Gully Road and separate to this development.

### 8.2. Water Quality

The site is currently a rehabilitated and re-vegetated chitter heap being used as an informal parking area. There are no SQID's or WSUD measures and all runoff generated is discharged directly to the State Mine Creek as sheet flow.

The implementation of the proposed SQID & WSUD measures will improve the quality of any discharge and thus satisfy the NorBE requirements for all development within the Sydney Drinking Water Catchment.

### 8.3. Recommendations

During the detailed design of this development, Calare Civil recommend that the following be implemented to ensure effective stormwater management and water quality improvement.

- Provision of a formalised stormwater drainage networks to limit the volume of uncontrolled runoff from the site. This will minimise any potential risk of exposing the chitter through rill erosion of the batters and cap. Furthermore, it enables total capture and conveyance of site runoff to the proposed Bio-Retention Basin.
- Provision of a Bio-Retention Basin to provide an opportunity for stormwater filtration and nutrient uptake through specialised planting.
- Stabilised site discharge minimising the potential for erosion and scour

## 9. LIFECYCLE COST ASSESSMENT

As this is a private development no assets are to be handed over to Council and so a cost assessment has not been undertaken.

## 10. ASSET HANDOVER

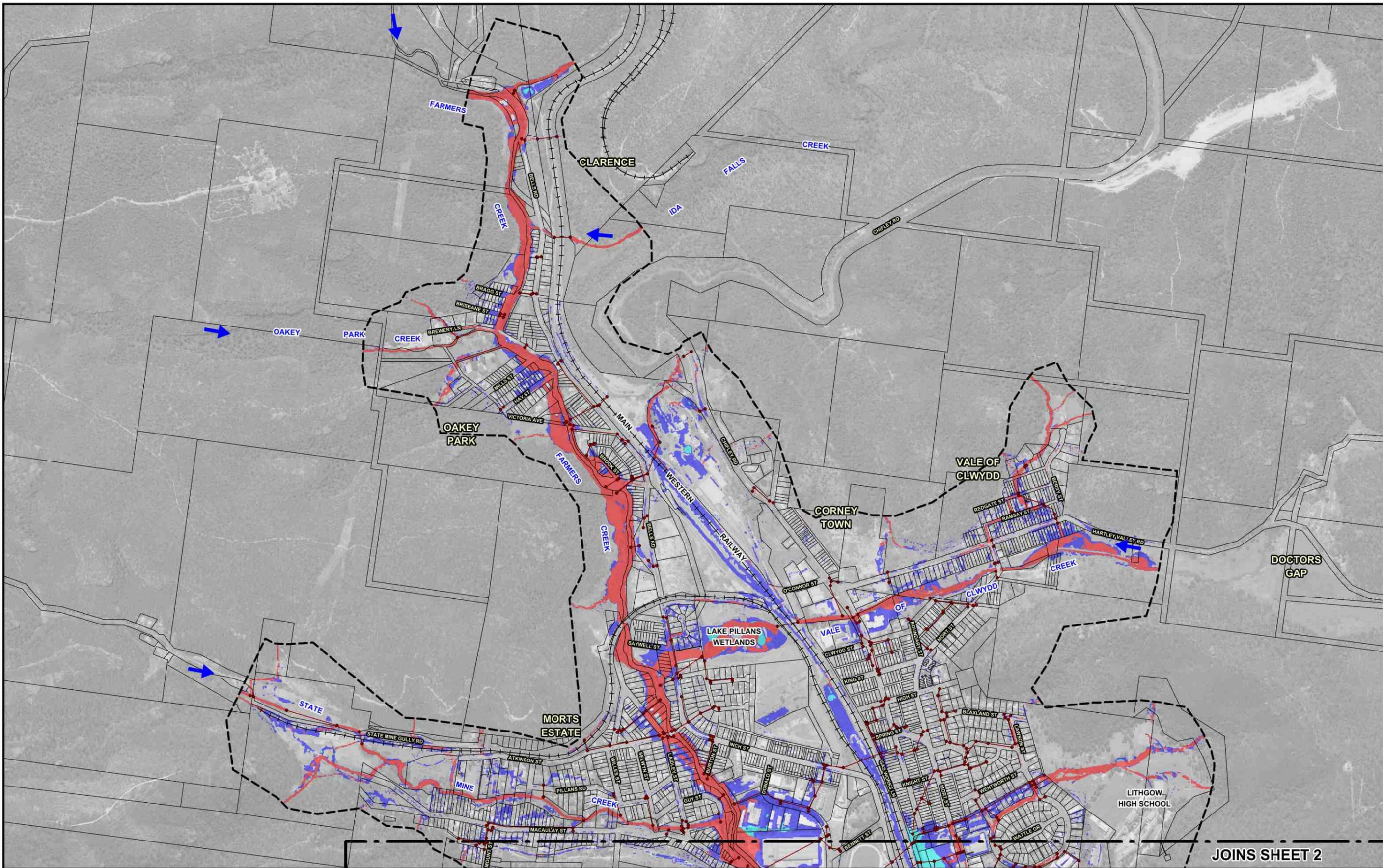
There are no assets to hand over to Council.

## 11. REFERENCES

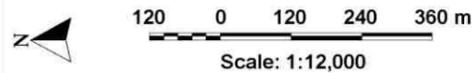
1. Australian Rainfall & Runoff (AR&R) 2019:
  - Regional Flood Frequency Estimation Modelling
  - AR&R Data Hub
  - FFA-Reconciled Losses Map
  - WMA Water Review of AR&R Design Inputs for NSW - Appendix C
2. Bureau of Meteorology:
  - Design Rainfall Data System
3. NSW Water Management (General) Regulation 2018 Hydroline Spatial Data 1.0
4. Lyall & Associates
  - Lithgow Flood Study Review May 2017 Rev. 1.4 Volume 1 - Report
  - Lithgow Flood Study Review May 2017 Rev. 1.4 Volume 2 – Figures
5. Water NSW
  - Developments in the Sydney Drinking Water Catchment – Water Quality Information Requirements, Water NSW (February 2023).
  - Using MUSIC in Sydney’s Drinking Water Catchment, Water NSW (February 2023).
  - Neutral or Beneficial Effect on Water Quality Assessment Guideline, Water NSW (October 2022).
6. NSW Department of Planning and Environment:
  - Flood Hazard: Flood Risk Management Guideline FB03, (June 2023).

## **APPENDIX A**

### **Hydraulic Categorisation of Floodplain (100 year ARI)**



JOINS SHEET 2



Scale: 1:12,000

**NOTE:**  
 The ground surface model incorporated in TUFLOW is based on LiDAR survey which has been sampled on a 3m grid and does not necessarily incorporate localised features which can influence flooding behaviour in individual allotments.  
 Flood depths are therefore approximate only and require interpretation by a suitably qualified engineer to determine flooding behaviour in individual allotments. Any assessment of flooding in individual allotments may also require a site survey.

LEGEND	
	Two-Dimensional Model Boundary
	Modelled Stormwater Network
	Floodway
	Flood Storage
	Flood Fringe

LITHGOW FLOOD STUDY REVIEW