Moonee Parklands Trust
C/- JW Planning Pty Ltd

Concept Stormwater Management Plan:
Proposed Sub-Division, Lot 1 DP1097743 and Lot 6 DP252223, Pacific Highway, Moonee Beach, NSW.

ENVIRONMENTAL

WATER

WASTEWATER

GEOTECHNICAL

CIVIL

PROJECT MANAGEMENT

P1002663JR07V02
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All enquiries regarding this project are to be directed to the Project Manager.

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1 Overview

1.1 Study Overview

Martens and Associates have prepared this revised stormwater management plan for Moonee Parklands Trust C/- JW Planning Pty Ltd for a proposed residential sub-division yielding up to 104 lots at Lot 1 DP 1097743, Pacific Hwy, Moonee Beach, NSW. This report addresses the requirements of Coffs Harbour Council's DCP (2012) and WSUD (2009) guidelines and the Director General Requirement's (DGRs) issued by the NSW Department of Planning and Infrastructure (DPI) with respect to stormwater management.

This report addresses comments made by BMT WBM in their review for the Department of Planning and Environment (January 2014).

This report details an environmentally sustainable strategy for the management of stormwater generated from the site and from upslope urban areas as well as detailing likely impacts resulting from the proposed development. The solutions and conceptual designs presented in this report draw from field inspections, modelling, relevant planning and engineering controls, policy objectives and guiding principles and represent a model for best practice management techniques for stormwater management. The report incorporates subsequent modelling conducted following a review of the initial report by BMT WBM (2014).

1.2 Project Scope

The report addresses the following issues:

- Assessment of minimum site drainage infrastructure requirements (including trunk drainage, overland flow paths and discharge control components) for conveyance of stormwater flows from the site to Moonee Creek.
- Assessment of likely impacts on catchment wide flood characteristics resulting from development of the site.
- Assessment of likely changes to stormwater quality as a result of the proposed development.
- Preliminary design of stormwater quality treatment measures to ensure post-development site stormwater discharge quality complies with minimum Council requirements.

- Integration of site stormwater control measures with site groundwater conditions.
- Soil and water management plan for the proposed development.

1.3 Proposed Development

The development proposal involves the sub-division of land zoned predominantly for residential purposes and part conservation purposes.

The implementation of the concept subdivision is proposed to occur in 4 construction stages beginning in the north west corner. The construction stages will be divided further in into 10 sales stages which may be adjusted in size at the time of release to suit marketing requirements. Preliminary staged works are as follows:

1. Stage 1:
   a. Bulk earthworks for the entire 104 lots to reduce costs and impact on adjoining residents.
   b. The court approved collector road running along the western edge of Moonee Parklands links the approved Glades development to the north with Moonee Beach Village to the south and will be constructed prior to development and release of lots in the Glades development.
   c. Connections to power, water and telecommunication infrastructure to be located within the collector road.
   d. Construction of vehicular access to the proposed sewer pump station as well as to stormwater treatment and detention Basin 1.
   e. Services extended as required and access to the existing residence maintained.
2. Stage 2:
   a. Extension of Roads 4, 5 and 6 with associated services.
3. Stage 3:
   a. Extension of Road 3 & 6 and the partial construction of Road 2 with associated services.
4. Stage 4:
   a. Connection of Road 1 and Road 2 as well as complete Roads 4 & 5 and associated services.

The proposed staging plan aims to provide a cost effective construction sequence that seeks to minimise the impact on any local residents. Whilst subject to possible variation via more detailed construction certificate investigation, design and market considerations as well as land owner circumstances, the proposed staging is practical and logical.

1.4 Policy and Objectives

A number of planning controls and principles have been considered and implemented in the development of site stormwater management solutions and assessment. The objectives of these are summarised below:

1.4.1 Coffs Harbour City Council Development Control Plan (2012) – Parts B1 (Sub-division), C8 (Integrated (Natural) Water Cycle Management), D1 (Erosion and Sediment Control for Development) and E6 (Moonee)

This document addresses minimum requirements for stormwater runoff quantity and quality management and minimum flood management and mitigation measures for development sites to ensure no adverse impacts to upstream and downstream properties and infrastructure.

Specific objectives of Council's DCP (2013) Parts B1 and C8 considered pertinent to this study include:

- Drainage from sites should reflect the pre-existing or natural situation in terms of location, quantity, quality and velocity of water.
- That stormwater drainage shall be designed and provided in accordance with Council's Development Design and Construction Specification (2008) and Council's WSUD (2009) policy.
- To harvest rainwater and urban stormwater run-off for re-use.
- To safeguard the environment by improving the quality of stormwater runoff.
- To ensure that minimum buffers between developments and local creeks are incorporated into any designs.
- To minimise the potential for sediment and erosion associated with the development of land and ensure that the quality of stormwater discharged from a development does not impact on the environment and receiving waters in terms of sedimentation, water pollution and other impacts.

1.4.2 Coffs Harbour City Council Engineering Design Specification – 0074 Stormwater Drainage (2009)

This document summarises the technical specifications for developments to comply with Council's DCP 2013 with respect to stormwater management. Specific objectives and specifications considered to be pertinent to this study include the following:

- To ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below prescribed velocity / depth limits.

- To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within the prescribed limits.

- Retain within each catchment as much incident rainfall and runoff as possible and appropriate for the panned use and the characteristics of the catchment.

- Design recurrence intervals for piped systems for residential developments and overland flow paths are the 5 year ARI and 1 in 100 year ARI respectively.

- Other hydrological models (as opposed to Rational Method) may be used as long as the requirements of AR&R are satisfied.

- Installation of Stormwater Detention is required on redevelopment sites within the Council area where under capacity drainage systems exist.

1.4.3 Coffs Harbour City Council Water Sensitive Urban Design (2009) Policy

These guidelines provide details of water quality objectives, typical treatment devices and input parameters to be used in MUSIC water quality modelling for sites within the Council area.

These guidelines refer to the Gold Coast City Council (2006) Music modelling guidelines with respect to pollutant generation rates and suggested modelling parameters.

1.4.4 Department of Planning and Infrastructure – Director General's Requirements (2010)

This document details minimum environmental assessment requirements from the NSW DPI specifically for the site. Specific objectives and specifications considered to be pertinent to this study include the following:

- Stormwater – Address stormwater quality and quantity, including lawful points of discharge. A comprehensive stormwater management plan should be provided that allows for the appropriate management of stormwater and ensures there are no adverse environmental impacts as a result of the proposal. The plan must also include a conceptual design layout for the

preferred stormwater treatment train showing location, size and key functional elements of each part of the system and identify the anticipated effect of each element.

- Address and outline measures for Integrated Water Cycle Management based on Water Sensitive Urban Design principles which addresses impacts on the surrounding environment, drainage and water quality and quantity controls for the catchment, so that there is no water pollution resulting from the development.

- Surface water – In accordance with the correspondence from the NSW Office of Water and DECCW, provide an assessment of any impacts on surface water (particularly Cunningham Creek and Moonee Creek) as a result of the development, including any impacts on quantity, quality and the functioning of the hydrological regime.

- Provide an assessment of measures to ensure the following water quality objectives for the proposal are met:

  - There is no pollution of waters during the construction and operational phases;

  - There is no inconsistency with any Statement of Joint Intent established by the Healthy Rivers Commission; and

  - Ensure the proposal is not inconsistent with the relevant River Flow Objectives and Water Quality Objectives for the area.

1.5 Site OSD Requirements

OSD is not considered necessary for the development for the following reasons:

1. Council's (2009) Engineering design specifications state that installation of Stormwater Detention is required on redevelopment sites within the Council area where under capacity drainage systems exist. As the site drains directly to Moonee Creek and is downslope of the Pacific Highway, no existing Council drainage infrastructure will be impacted by the development.

2. Post-development peak site discharge is slightly reduced for the critical duration (9 hours) 1 in 100 year ARI Moonee Creek catchment flood event. Increases noted in other storm events modelled are minimal when compared with total discharge rates for the overall Moonee Creek catchment.

3. The site's location near to the catchment outlet suggests that site peak discharges occur on the rising limb of the hydrograph for the overall Moonee Creek catchment and that detention of flows from the site may adversely impact on the peak catchment flows by releasing water closer to the peak which would otherwise have been released earlier in the flood event.

It is also reasonable to anticipate that the proposed rainwater tanks, as required by BASIX for individual dwellings, will have an attenuating effect on site peak stormwater discharges and are likely to reduce flood runoff volumes for short duration storm events, depending on antecedent storage levels.

The above has been confirmed via email from Council (J. Park, 21/2/2013).

2 Site Description

2.1 Location and Site Description

The subject site is located between Pacific Highway and Moonee Creek at Moonee Beach, approximately 12 km north of Coffs Harbour and is within the Coffs Harbour City Council Local Government Area (Figure 1).

Bucca Creek, a tributary of the Moonee Creek, is located at the northern side of the subject site. Cunningham Creek dissects the lot adjacent to the southern site boundary and joins Moonee Creek approximately 300m south of the south-eastern corner of the site.

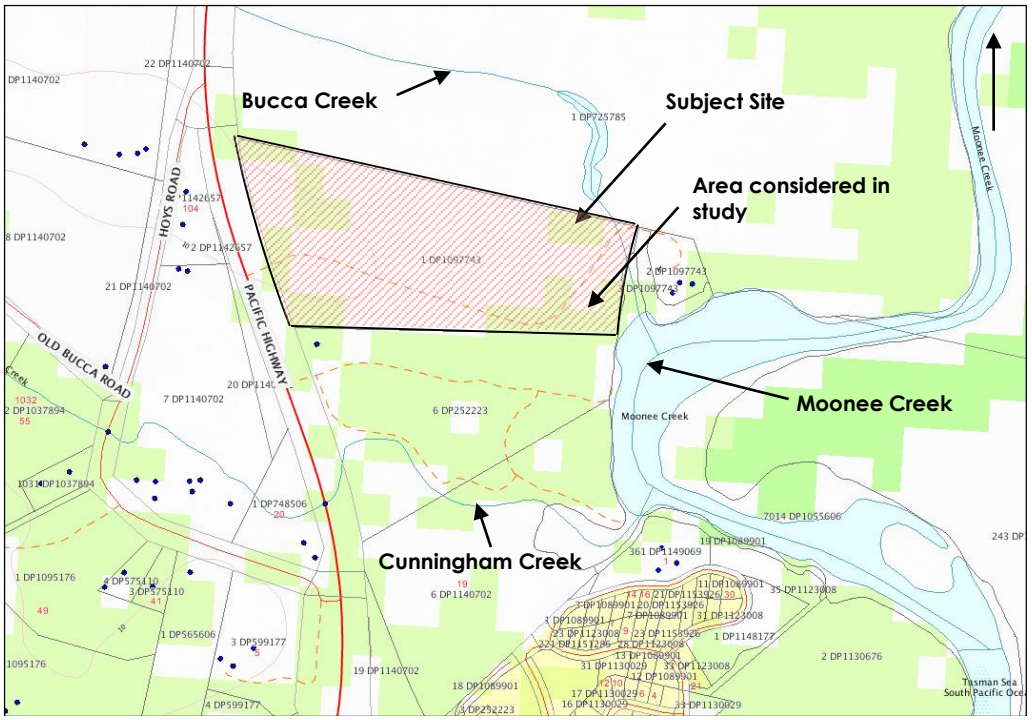

Figure 1: Location of the subject site within its local context.

Lot 1 is 12.93 ha in area. The site is in an area of low density rural development approximately 500 m north of a commercial area and existing residential areas of Moonee Beach. The site is partly cleared with stands of remnant trees remaining. The site is undeveloped.

2.2 Field Investigations

Site investigations were undertaken 26 – 28 July 2010 for a range of engineering services, including a walkover inspection of the site to assess existing site conditions, surface waters on the site and inspection of the surrounding creeks.

2.3 Topography and Drainage

The site is located in an area of gently to moderately undulating hills and flatter low-lying alluvial plains associated with Moonee Creek. Site elevation ranges between approximately 18 mAHD in the west of Lot 1 and 2 mAHD along the banks of Moonee Creek in the east with slopes of up to 8 degrees in the west and relatively flat (generally less than 5%) across low-lying areas in the east.

Bucca Creek flows through the site near to the north-eastern corner of Lot 1 DP 1097743. Moonee Creek forms the eastern site boundary. Cunningham's Creek lies to the south of Lot 6 DP 252223. The site contains a constructed drainage feature adjacent to the northern boundary. No other drainage features were noted on the site.

2.4 Site Soil Profile and Geology

Borehole investigations indicate that the site soil profile generally consists of stiff – very stiff, moderately plastic grey clays with up to 1.5 m of sand overlying clays in some parts of the site. Data shows that sandy deposits are thicker at lower elevations and absent on the lower slopes in the north-west of the site (above approximately 5 mAHD). Further details of sub-surface conditions are provided in the site geotechnical assessment report (MA reference P1002663JR02V03).

3 Stormwater Management

3.1 Stormwater Management and Performance Objectives

Stormwater management objectives are broadly outlined as follows:

- Provide comment and recommendation for likely on-site stormwater quantity management requirements for the proposed development and likely effects of site development on catchment flood behaviour.
- Provide preliminary recommendations for on-site stormwater quality measures to ensure development compliance with identified performance objectives.
- Provide preliminary details of stormwater infrastructure to transfer site stormwater to proposed stormwater quality basin.

Performance objectives are specified to generally comply with Coffs Harbour City Council's DCP (2012), Coffs Harbour Water Sensitive Urban Design (WSUD) (2009) guidelines and the principles of Ecologically Sustainable Development (ESD) as follows:

- Post-development stormwater to be directed to Moonee Creek via a suitably designed pit and pipe network to ensure pedestrian and vehicle safety and prevent unnecessary flooding of property.
- Post-development site stormwater quality is to be of equal or better quality than existing site stormwater quality and pollution retention rates are to comply with Council requirements as given in Table 1.

Table 1: Stormwater pollutant retention targets (Coffs Harbour City Council, 2009).

Pollutant	Retention Target (%)
Total Suspended Solids	85
Total Phosphorus	65
Total Nitrogen	45
Gross Pollutants	90

3.2 Proposed Stormwater Management System – Overview

The proposed stormwater management system for the site is designed to include the following stormwater quantity and quality control measures:

- Stormwater drainage network including pits, pipes, culverts and headwalls (where necessary) and associated outlet energy dissipation and erosion protection works.

- Stormwater bioremediation basin positioned to capture surface and piped stormwater flows from the site and upslope catchments for treatment and possible re-use. The basin shall be located as shown on the attached site plans.

- Rainwater tanks consisting of 5 KL (minimum) rainwater tank(s) per allotment to reduce stormwater runoff and provide non-potable re-use for landscaping, *etc*.

- Site earthworks and landscaping designed specifically to minimise the concentration of runoff, minimise flood hazard, direct runoff to proposed stormwater bioremediation basins and to minimise potential erosion from site surface flows and overflows from stormwater bioremediation basins.

Preliminary sizing of the above stormwater management measures is achieved through iterative hydrological, hydraulic and water quality modelling detailed in the following sections.

3.3 Study Methodology and Assumptions

The study used the following computer models to determine preliminary recommendations for site stormwater quantity and quality control measures:

- DRAINS hydrological and hydraulic modelling package to determine existing and post-development peak flow rates to size minor (pit and pipe) and major (overland flow path) stormwater system components for the critical duration 1 in 5 and 1 in 100 year ARI storms respectively. Design rainfall data used in the model were sourced from Council and are considered to be consistent with Council's (2009) Engineering Design Specifications.

- MUSIC 5.00.11 water quality modelling package to determine effects of proposed stormwater harvesting dams on site post-development water quality. Design pollutant generation rates are consistent with Council's WSUD (2009) guidelines and rainfall and evapotranspiration data were sourced from eWater (2013) and Bureau of Meteorology (2001) respectively.

The report and modelling also draws on findings from the site flooding assessment (MA reference P1002663JR08V02, July 2015) with respect to flood levels and behaviour in the Moonee Creek, Cunninghams Creek and Bucca Creek catchments. This data was used to set levels for the

site bioremediation basin and for designing site drainage infrastructure. The flooding assessment utilised the following models:

- RAFTS hydrological modelling package to determine peak flow rates from sub-catchments within the Moonee Creek catchment for the 1 in 20 year ARI, 1 in 100 year ARI, Probable Maximum Flood (PMF) and 1 in 100 year ARI with climate change events. Design rainfall data used in the model were sourced from Council and are considered to be consistent with Council's (2008) Engineering Specifications.

- Tuflow 11.0.10 1D / 2D hydraulic modelling package to determine existing and post-development flood characteristics and potential effects of proposed development on adjacent properties and infrastructure.

Models used a conceptual design layout and surveyed site levels provided by the Client as well as LiDAR data and drainage information provided by Council. Plans showing the concept layout and existing and proposed site contours are provided in Attachment A. Key assumptions used in the modelling included the following:

3.3.1 DRAINS Model

- Modelling time-step adopted for existing and proposed conditions was 0.01 minutes.

- The RAFTS component within DRAINS was used for existing conditions model as suggested in the DRAINS modelling guidelines.

- Post-development sub-catchments are based on proposed site contours and lot layout, noting that drainage easements for specific lots have not been nominated at this stage of the development. Road pit and pipe sub-catchments were combined for brevity.

- All runoff from site roofs, roads, developed and hardstand areas directed to site bioremediation basin, which is not modelled as having a specific OSD function.

- Lot, roof, road and open parkland site areas have assumed pervious / impervious areas as summarised in Table 2. "Urban" areas are taken to be lot areas minus 30% for assumed roof area.

- Initial and continuing losses and soil type used in the modelling are conservative and are considered to be consistent with Council guidelines (see Table 3).

- Proposed bioremediation basin is assumed to be completely empty at the commencement of storm events. As the basin is designed to be a "dry basin" for the purposes of water quality management, this assumption is acceptable.

- Bioremediation basin includes an outlet pipe (with water level controller) for flows as well as a spillway and sub-surface outlet pipe for collecting treated stormwater. The outlet pipe is modelled as running from an outlet pit with surface level equal to the spillway to simulate the water level controller.

- Individual rainwater tanks on each lot were not included in the model.

- Lag times and flow path lengths are based on measured lengths from site plans.

3.3.2 MUSIC Model

- MUSIC model used 6 minute pluviograph data from Coffs Harbour climate station available on the MUSIC website (www.toolkit.net.au/specials/). Data was for the period 1960 – 2010. Average monthly evapotranspiration rates for Coffs Harbour were obtained from BOM (2001) guidelines and used in the modelling.

- Sub-catchments used the stochastic pollutant generation method for determining pollutant loads as specified by Gold Coast City Council (2006) guidelines.

- Model used combined catchments based on sub-catchments calculated for the DRAINS hydrological model.

- Pollutant generation rates used in the model are from Gold Coast City Council (2006).

- Stormwater runoff from most lots and roads was assumed to go to proposed stormwater bioremediation basin with no bypass flows.

- Stormwater runoff from some roads, reserves and lots in the west and south of the site were assumed to drain via grassed swales and buffer strips to Moonee Creek.

- Exfiltration rates for bioremediation basin was set at 0 mm/hr as the basin is to be lined.

- Re-use from rainwater tanks on each lot was set at 85 kL/lot/year. This assumes a water demand of 170 kL/lot/year for external usage

(Coffs Harbour Water, 2013) and 50% of total external household demand being supplied by rainwater tanks for non-potable uses such as car washing and irrigation of landscaped areas.

3.3.3 RAFTS Model Assumptions

Assumptions used in RAFTS modelling are given in the flooding assessment report (MA reference P1002663JR08V02, July 2015).

3.3.4 Tuflow Model

Assumptions used in TUFLOW modelling are given in the flooding assessment report (MA reference P1002663JR08V02, July 2015).

3.4 Hydrological Modelling

DRAINS modelling conducted for this study used sub-catchment data and modelling input parameters as summarised in Table 2 and Table 3. Catchment plans and details of trunk drainage pit and pipe requirements are provided in Attachment A. Results (in terms of total peak flow discharged from the site) are summarised in Table 4 and compliance with Council trunk drainage and overland flow path design parameters shown in Attachment A. General comments about the hydrological modelling are as follows:

- The proposed site minor drainage system (trunk pit and pipe network) adequately conveys the peak runoff arising from the 1 in 5 year ARI critical duration storm event.
- The proposed site major drainage system (overland flow paths) adequately convey the peak runoff arising from the 1 in 100 year ARI critical duration storm event.
- Site peak runoff for the Moonee Creek catchment critical duration 9 hour storm in the 1 in 100 year ARI event is reduced compared with existing conditions.
- The critical storm duration for the site varies but is generally the 90 minute storm event for the 1 in 1 year ARI – 1 in 10 year ARI and 1 in 50 year ARI, and the 2 hour event for the 1 in 20 and 1 in 100 year ARI events.
- Site bioremediation basin outlet and proposed pit and pipe network and overland flow paths are not affected by flood backwater from Moonee Creek, Bucca Creek or Cunninghams Creek.

Table 2: Summary of sub-catchments used in DRAINS hydrological modelling.

Sub-Catchment	Area (ha)	Impervious Area			Pervious Area			Supplementary Area		
		Area (% of Total)	Length (m)	Slope (%)	Area (% of Total)	Length (m)	Slope (%)	Area (% of Total)	Length (m)	Slope (%)
Pre-development[1]	12.93	98.2	-	-	1.8	-	-	0.0	-	-
Bypass 1	0.54	5.0	11.6	1.0	95.0	190.1	2.1	0.0	-	-
Bypass 2	1.03	5.0	87.2	4.6	95.0	87.2	4.6	0.0	-	-
Driveway	0.11	70.1	55.8	1.0	29.9	55.8	1.0	0.0	-	-
Basin[2]	0.34	5.8	116.8	0.9	94.1	116.8	0.9	0.1	116.8	0.9
Cat 1/1	1.00	47.2	117.9	1.3	46.6	39.0	1.0	6.2	39.0	1.0
Cat 2/1	0.46	46.0	146.9	5.4	47.5	90.0	6.9	6.4	90.0	6.9
Cat 3/1	0.53	45.1	109.7	4.1	48.1	111.6	7.3	6.8	111.6	7.3
Cat 4/1	0.38	32.1	110.2	7.0	67.9	87.5	8.6	0.0	-	-
Cat 1/2	0.05	75.0	32.9	1.5	25.0	6.0	6.7	0.0	-	-
Cat 1/3	0.42	30.0	39.5	0.5	60.0	39.5	0.5	10.0	39.5	0.5
Cat 1/4	0.69	42.6	140.8	1.1	50.2	55.9	1.3	7.2	55.9	1.3
Cat 2/4	0.14	75.2	93.1	0.6	24.8	93.1	0.6	0.0	-	-
Cat 3/4	0.43	45.7	88.8	2.0	47.7	56.1	6.2	6.5	56.1	6.2
Cat 4/4	0.45	39.1	55.0	4.5	52.9	111.4	7.6	8.0	111.4	7.6
Cat 5/4	0.18	65.7	109.7	6.4	34.3	10.6	9.4	0.0	-	-
Cat 1/5	0.63	30.0	36.0	1.4	60.0	36.0	1.4	10.0	36.0	1.4
Cat 1/6	0.45	38.4	108.7	4.1	53.7	40.1	10.0	8.0	40.1	10.0
Cat 2/6	0.32	45.2	108.6	1.3	48.4	40.2	6.2	6.4	40.2	6.2
Cat 1/7	0.58	40.4	134.6	5.2	52.2	43.2	4.6	7.4	43.2	4.6
Cat 1/8	0.76	30.0	39.2	8.9	60.0	39.2	8.9	10.0	39.2	8.9
Cat 1/9	0.23	45.5	58.1	10.3	48.3	42.6	3.5	6.3	42.6	3.5
Cat 1/10	0.48	75.5	266.1	0.8	24.5	4.0	0.5	0.0	-	-
Cat 2/10	0.66	30.0	47.7	1.0	60.0	47.7	1.0	10.0	47.7	1.0
Cat 1/11	0.48	30.0	51.2	1.2	60.0	51.2	1.2	10.0	51.2	1.2
Cat 2/11	0.85	30.0	45.0	8.9	60.0	45.0	8.9	10.0	45.0	8.9
Cat NW	0.28	24.3	52.3	7.6	75.7	51.8	11.8	0.0	-	-
Cat SW	0.45	16.3	50.0	11.0	83.7	63.8	12.5	0.0	-	-
Total	12.93	-	-	-	-	-	-	-	-	-

Notes: [1.] Existing conditions catchment used RAFTS PERN of 0.05 and catchment slope of 3.8%. [2.] Catchment Basin is direct rainfall to Bioremediation Basin.

Table 3: Summary of additional parameters used in DRAINS hydrological and hydraulic modelling.

Parameter	Value	Unit
Paved Area Depression Storage	1.0	mm
Supplementary Area Depression Storage	1.0	mm
Grassed Area Depression Storage	10.0	mm
Soil Type (Ilsax)	3.0	-
Pervious Initial Loss (RAFTS)	15.0	mm
Pervious Continuing Loss (RAFTS)	2.0	mm/hr
Pervious Initial Loss (RAFTS)	1.0	mm
Pervious Continuing Loss (RAFTS)	0.0	mm/hr
Calculation Time Step	0.01	minutes

Table 4: Summary of results of DRAINS hydrological modelling (total peak site discharge) for 1 in 100 year ARI storms.

Duration (minutes)	Existing Peak Discharge (m^3/s)	Post-Development Peak Discharge (m^3/s)	Change in Peak Discharge (m^3/s)
540 (9 hour critical duration for creek)	3.32	3.25	-0.07
720	3.49	3.35	-0.14
1080	2.50	2.41	-0.09
1440	2.42	2.35	-0.07

3.5 Site Stormwater Quality

3.5.1 MUSIC Model Set-up

MUSIC model was set-up with sub-catchments and treatment nodes as detailed in the following tables and assumptions outlined in Section 3.3.2. Sub-catchments were assigned event mean and baseflow pollutant generation rates based on the catchment usage and soil parameters based on the site sub-surface investigations. Details of pollutant generation rates used are given in Table 6, soil parameters in Table 7. Rates and parameters adopted are based on Coffs Harbour City Council WSUD (2009), Gold Coast City Council (2006) MUSIC modelling guidelines and Sydney Metropolitan Catchment Management Authority (SMCMA, 2010) guidelines.

Table 5: Catchments used in MUSIC water quality modelling.

Scenario	Model Catchment	Catchment Area (ha)	Impervious Area (% of Total Area)	Pervious Area (% of Total Area)	Adopted Catchment Usage
Existing Conditions	Site Pre	12.93	2	98	Rural Residential
Developed Conditions	Roads to Basin	2.53	76	24	Roads
	Roofs to Basin	1.81	100	0	Roofs
	Lots to Basin	4.23	14	86	Urban Residential
	Park to Basin	0.29	5	95	Urban Residential
	Roads Bypass	0.13	86	14	Roads
	Roofs bypass	0.40	100	0	Roofs
	Lots bypass	0.93	14	86	Urban Residential
	Park bypass	0.60	5	95	Urban Residential
	Park adjacent to Creek	1.58	5	95	Forest
	Driveway	0.11	90	10	Roads
	Basin	0.33	0	100	Urban Residential

Table 6: Event mean and baseflow concentration of pollutants used in MUSIC modelling (GCCC, 2006).

Land-use	Guideline Adopted	Parameter	Storm Flow (SF) (mg/L)	Standard Deviation (log_{10})	Base Flow (BF) (mg/L)	Standard Deviation (log_{10})
Rural Residential	GCCC (2006)	Total suspended solids (mg/L)	182.00	0.51	3.39	0.24
		Total phosphorus (mg/L)	0.275	0.28	0.029	0.38
		Total nitrogen (mg/L)	2.09	0.30	0.30	0.39
Urban Residential	GCCC (2006)	Total suspended solids (mg/L)	151.00	0.39	10.00	0.34
		Total phosphorus (mg/L)	0.339	0.31	0.107	0.31
		Total nitrogen (mg/L)	1.82	0.23	1.58	0.20
Roads	GCCC (2006) – Storm flow SMCMA (2010) – Base flows	Total suspended solids (mg/L)	270.00	0.32	15.80	0.17
		Total phosphorus (mg/L)	0.500	0.25	0.141	0.19
		Total nitrogen (mg/L)	1.82	0.19	1.29	0.12
Roofs	GCCC (2006)	Total suspended solids (mg/L)	20.00	0.32	20.00[1]	0.32[1]
		Total phosphorus (mg/L)	0.129	0.25	0.129[1]	0.25[1]
		Total nitrogen (mg/L)	1.82	0.23	1.82[1]	0.23[1]
Forest	GCCC (2006)	Total suspended solids (mg/L)	79.40	0.51	3.24	0.51
		Total phosphorus (mg/L)	0.079	0.22	0.016	0.28
		Total nitrogen (mg/L)	0.84	0.24	0.26	0.22

Notes: [1]. Base flow for roof areas not given in guidelines due to lack of base flow from roofs. Storm flow values adopted for model.

Table 7: Soil parameters used in MUSIC modelling.

Modelling Parameter	Value Adopted for Forest and Rural Residential	Value Adopted for Urban Residential, Roofs and Roads
Rainfall Threshold (mm/day)	1	1
Soil Storage Capacity (mm)	120	400
Initial Storage (% of Capacity)	25	10
Field Capacity (mm)	80	200
Infiltration Capacity Coefficient - a	200	50
Infiltration Capacity Coefficient - b	1	1
Initial Depth – Groundwater (mm)	50	50
Daily Recharge Rate – Groundwater (%)	25	25
Daily Baseflow Rate – Groundwater (%)	5	5
Daily Deep Seepage Rate – Groundwater (%)	0	0

Table 8: Parameters used in treatment node for post-development conditions.

Treatment Node	Parameters Adopted for MUSIC model
Bioremediation Basin	Low Flow Bypass – 0 m^3/s
	High Flow Bypass – 10 m^3/s
	Extended Detention Depth – 0.9 m
	Saturated Hydraulic Conductivity – 100 mm/hr (lined)
	TN Content of Filter Media – 500 mg/kg
	Orthophosphate Content of Filter Media – 50 mg/kg
	Base Lined and underdrain present
	Exfiltration rate – 0 mm/hr
	Surface Area – 2282 m^2
	Filter Area – 1741 m^2
	Unlined Filter Media Perimeter – 0.0 m
Swale	Low Flow Bypass – 0 m^3/s
	Length – 184 m
	Bed slope – 1%
	Base width – 1 m
	Top width – 3 m
	Depth – 0.25 m
	Vegetation height – 0.1 m
	Exfiltration rate – 0 mm/hr
Rainwater Tank	Low Flow Bypass – 0 m^3/s
	High Flow Bypass – 0.5 m^3/s
	Overflow pipe diameter – 300 mm
	Depth above overflow – 0.2 m
	Potential Evapotranspiration – 0 mm/day
	Annual Demand[1] – 75 kL/lot/year
	Surface Area – 1 m^2/lot
	Volume below overflow – 10 kL/lot
	Lots included in catchment – Tank 1 – 58, Tank 2 – 41
Buffer	Percentage upstream area buffered – 100%
	Buffer area (% of upstream impervious area) – 50%
	Exfiltration rate – 0 mm/hr

Notes: [1.] Annual demand assumes no usage during May – August period of year. Remainder split into approximately 45% summer, 27.5 % spring and autumn usage.

3.5.2 MUSIC Model Results

Results of the MUSIC model are summarised in Table 9 and Table 10. Results indicate that post-development water quality objectives will be met by the proposed treatment train (i.e. an improvement in stormwater quality of discharges from the site and minimum pollutant retention targets). The model suggests that a significant amount of sediment and gross pollutants will be captured by the stormwater bioremediation basin and shall need to be periodically removed to maintain basin aesthetics and preserve treatment efficiency.

Table 9: Summary of MUSIC modelling results – NorBE (total residual loads).

Model	Total Suspended Solids (kg/year)	Total Phosphorus (kg/year)	Total Nitrogen (kg/year)
Existing Conditions	17,000	17.2	140
Post-development Conditions	2,530	13.9	102
Reduction (%)	85.1	19.2	27.1

Table 10: Summary of MUSIC modelling results – Pollution retention rates.

Model	Total Suspended Solids (kg/year)	Total Phosphorus (kg/year)	Total Nitrogen (kg/year)	Gross Pollutants (kg/year)
Post-development – generated	21,000	41.0	247	2,130
Post-development – discharged	2,530	13.9	102	137
Retention rate (%)	87.9	66.1	58.9	93.6

3.6 Minimum Basin Requirements – Site Flooding

Consultation with Council officers has established that the proposed site bioremediation basins should be flood-proofed to the 1 in 20 year ARI peak flood level for Moonee and Bucca Creeks adjacent to the site.

The Tuflow model established as part of the site flood assessment (MA reference P1002663JR08V02, July 2015) was re-run to determine the 1 in 20 year ARI peak flood height adjacent to the site. The model was re-run with a downstream boundary condition of 1.8 mAHD (1 in 5 year ocean level). The peak 1 in 20 year ARI flood level adjacent to the site was modelled to be 2.43 – 2.50 mAHD depending on site position.

Site bioremediation basin is therefore designed with base (and outlet pipe) surface levels at 2.60 mAHD, spillway outlet level at 3.50 mAHD and top embankment levels of 4.00 mAHD. This will ensure that the basin has no adverse impacts (e.g. backwater effects) on the proposed trunk drainage network and will flood-proof the basin to at least the 1 in 20

year ARI level. Additionally, these levels ensure that there is sufficient hydraulic pressure head to continue to push some flows through treatment media even in high flow events.

3.7 Construction Phase Sediment and Erosion Control

Council's DCP (2013) and sediment and erosion control policy (2009) requires that a Soil and Water Management Plan be prepared for the construction phase of works at the site. Council's (2009) policy requires that sediment basins be provided with a minimum volume of 250 m^3/ha of disturbed area with upslope diversion bunds / swales in place to divert surface flows around the works area.

A detailed Stormwater Management Plan is provided in Attachment A of this document with the following proposed measures:

- Proposed site clearance and bulk earthworks are to be undertaken in three stages as shown on the plans. This is to allow for a maximum of 4.8 ha to be disturbed at any given time and for proposed bioremediation basin to be configured as a sedimentation basin during the initial earthworks phase.

- Proposed bioremediation basin is to be configured as sedimentation basin during site earthworks. Proposed spillway and embankment levels are to be set 0.5 m higher than eventual design level with internal and external batters steepened to 1:3 internal and 1:2 external respectively. This shall give the basin a minimum volume of 1200 m^3, allowing for 4.8 ha of disturbed area to be treated during each stage.

- Diversion bunds / swales are to be constructed as shown on the plans to direct surface flows around disturbed site areas.

- Temporary pipe is required to direct flows from the southern boundary to the sedimentation basin, until areas draining to new swale on southern boundary are revegetated.

- Where areas adjacent to the southern site boundary cannot drain to the sedimentation basin, runoff from these areas is to be directed to a straw bale outlet as shown on plans. This outlet is to be maintained regularly (i.e. after all site rainfall events) to remove accumulated sediments until such time as the disturbed areas draining to the outlet are revegetated.

- Sediment fencing is to be used at the downslope end of the site for the duration of all earthworks. Where concentrated surface flows are expected (such as at downslope end of diversion swales, basin outlets and at the driveway crossing over Bucca Creek) and

straw bales supported by 1.0 m star pickets driven a minimum of 0.6 m into the ground are to be included and remain in place until vegetation is established.

- All site stockpile areas are to include diversion bunds upslope and sediment fencing downslope of them.
- Stabilised site access is to be used at all times during construction phase. The existing site access is to be used where feasible.

4 Summary

The following recommendations and conclusions are made based on the hydrological, hydraulic and water quality assessments:

- The proposed site minor drainage system (trunk pit and pipe network) adequately conveys the peak runoff arising from the 1 in 5 year ARI critical duration storm event.
- The proposed site major drainage system (overland flow paths) adequately convey the peak runoff arising from the 1 in 100 year ARI critical duration storm event.
- Site peak runoff for the Moonee Creek catchment critical duration 9 hour storm in the 1 in 100 year ARI event is reduced compared with existing conditions.
- OSD is not required for the site for the reasons given in Section 1.5.
- The proposed stormwater management system shall have a beneficial effect on water quality of site stormwater discharges through the capture and removal of sediments, nutrients and gross pollutants. Proposed measures achieve water quality targets in accordance with Council WSUD (2009) policy.
- A concept Soil and Water Management Plan for the site is provided in Attachment A and satisfies the requirements of Council's DCP (2013) and Sediment and Erosion Control (2009) guidelines.

5 References

Bureau of Meteorology (2001) *Climatic Atlas of Australia – Evapotranspiration.*

Coffs Harbour City Council (2012) *Development Control Plan – Part B1 Sub-division*.

Coffs Harbour City Council (2012) *Development Control Plan – Part C8 Integrated (Natural) Water Cycle Management.*

Coffs Harbour City Council (2012) *Development Control Plan – D1 Erosion and Sediment Control for Development*.

Coffs Harbour City Council (2012) *Development Control Plan – E6 Moonee.*

Coffs Harbour City Council (2009) *Engineering Design Specification – 0074 Stormwater Drainage (Design)*

Coffs Harbour City Council (2009) *Engineering Design Specification – 0075 Control of erosion and stormwater management.*

Coffs Harbour City Council (2009) *Water Sensitive Urban Design (WSUD) Policy*

Gold Coast City Council (2006) *MUSIC Modelling Guidelines 2006.*

Institute of Engineer's Australia (1987) *Australian Rainfall and Runoff.*

Sydney Metropolitan Catchment Management Authority (2010) *Draft MUSIC Modelling Guidelines.*

www.toolkit.net.au/specials/

www.coffsharbour.nsw.gov.au/

6 Attachment A – Site and Soil and Water Management Plans

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CONCEPT STORMWATER MANAGEMENT PLAN FOR PROPOSED SUB-DIVISION

LOT 1 DP 1097743, PACIFIC HIGHWAY, MOONEE BEACH, NSW

DRAWING	DRAWING TITLE
SK122	COVER SHEET
SK101	CONCEPT SITE STORMWATER MANAGEMENT LAYOUT
SK123	CONCEPT SITE STORMWATER CATCHMENTS - DRAINS MODEL
SK124	CONCEPT SITE STORMWATER CATCHMENTS - MUSIC MODEL
SK125	SOIL AND WATER MANAGEMENT PLAN - STAGE 1 EARTHWORKS
SK126	SOIL AND WATER MANAGEMENT PLAN - STAGE 2 EARTHWORKS
SK127	SOIL AND WATER MANAGEMENT PLAN - STAGE 3 EARTHWORKS
SK128	SOIL AND WATER MANAGEMENT PLAN - TYPICAL DETAIL
SK129	DRAINS MODEL LAYOUT AND SUMMARY OF RESULTS
SK130	MUSIC MODEL LAYOUT

REV.	DESCRIPTION	DATE	ISSUED
A	ATTACHMENT A	13.03.05	DMM
B	ATTACHMENT A	13.03.06	DMM
C	REVISED	15.07.30	DMM

BAR SCALE

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DATUM: mAHD
REVIEWED: GT
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PAPER SIZE: A1
VERTICAL RATIO: NTS

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MOONEE BEACH

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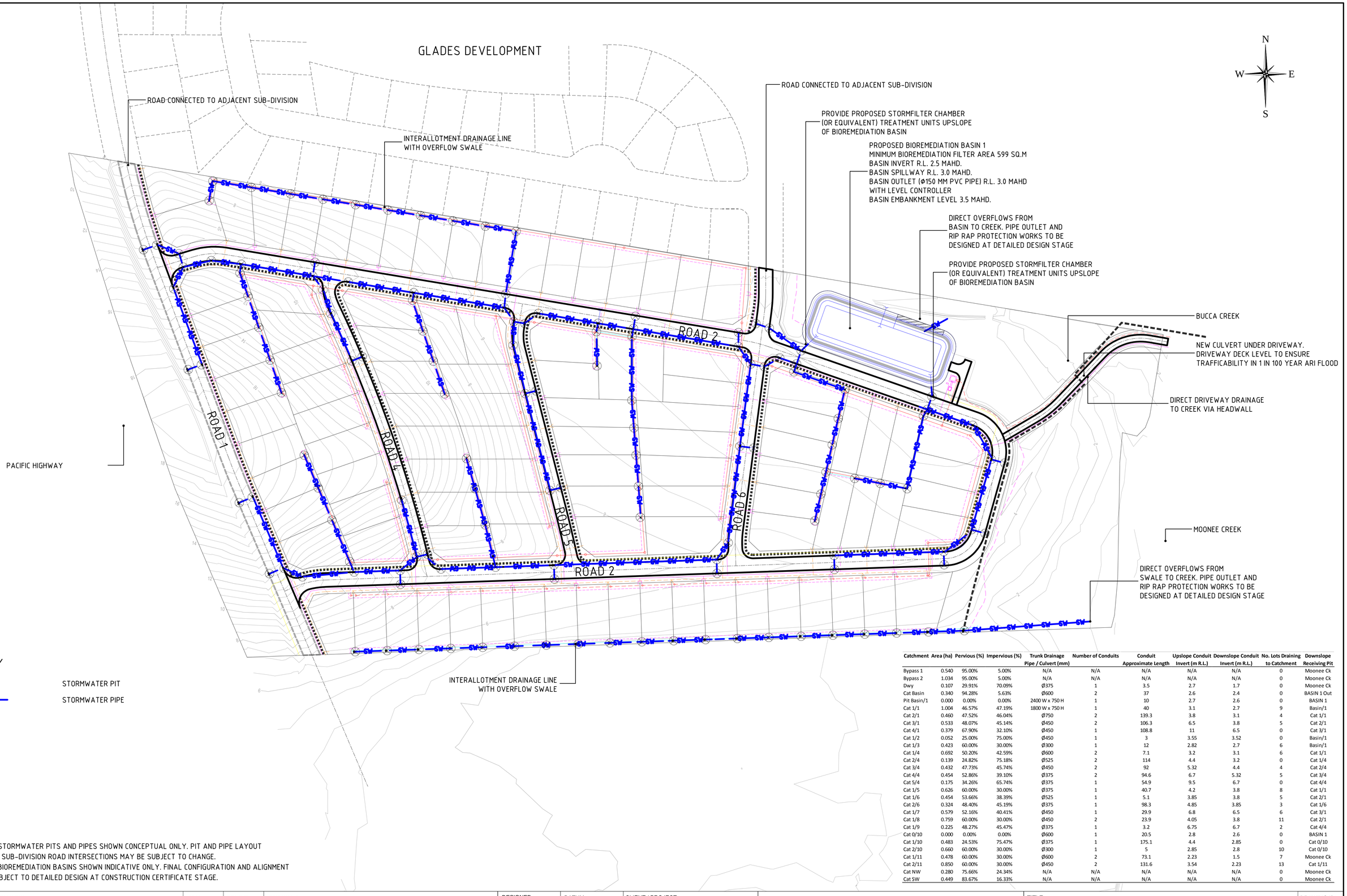
TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET
COVER SHEET

DRAWING ID: **SK122**

PROJECT MANAGER: G. TAYLOR
PROJECT NO.: P1002663
FILE: JD12V04
REVISION: C



KEY

STORMWATER PIT

STORMWATER PIPE

Catchment	Area (ha)	Pervious (%)	Impervious (%)	Trunk Drainage Pipe / Culvert (mm)	Number of Conduits	Conduit Approximate Length	Upslope Conduit Invert (m R.L.)	Downslope Conduit Invert (m R.L.)	No. Lots Draining to Catchment	Downslope Receiving Pit
Bypass 1	0.540	95.00%	5.00%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck
Bypass 2	1.034	95.00%	5.00%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck
Dwy	0.107	29.91%	70.09%	Ø375	1	3.5	2.7	1.7	0	Moonee Ck
Cat Basin	0.340	94.28%	5.63%	Ø600	2	37	2.6	2.4	0	BASIN 1 Out
Pit Basin/1	0.000	0.00%	0.00%	2400 W x 750 H	1	10	2.7	2.6	0	BASIN 1
Cat 1/1	1.004	46.57%	47.19%	1800 W x 750 H	1	40	3.1	2.7	9	Basin/1
Cat 2/1	0.460	47.52%	46.04%	Ø750	2	139.3	3.8	3.1	4	Cat 1/1
Cat 3/1	0.533	48.07%	45.14%	Ø450	2	106.3	6.5	3.8	5	Cat 2/1
Cat 4/1	0.379	67.90%	32.10%	Ø450	1	108.8	11	6.5	0	Cat 3/1
Cat 1/2	0.052	25.00%	75.00%	Ø450	1	3	3.55	3.52	0	Basin/1
Cat 1/3	0.423	60.00%	30.00%	Ø300	1	12	2.82	2.7	6	Basin/1
Cat 1/4	0.692	50.20%	42.59%	Ø600	2	7.1	3.2	3.1	6	Cat 1/1
Cat 2/4	0.139	24.82%	75.18%	Ø525	2	114	4.4	3.2	0	Cat 1/4
Cat 3/4	0.432	47.73%	45.74%	Ø450	2	92	5.32	4.4	4	Cat 2/4
Cat 4/4	0.454	52.86%	39.10%	Ø375	2	94.6	6.7	5.32	5	Cat 3/4
Cat 5/4	0.175	34.26%	65.74%	Ø375	1	54.9	9.5	6.7	0	Cat 4/4
Cat 1/5	0.626	60.00%	30.00%	Ø375	1	40.7	4.2	3.8	8	Cat 1/1
Cat 1/6	0.454	53.66%	38.39%	Ø525	1	5.1	3.85	3.8	5	Cat 2/1
Cat 2/6	0.324	48.40%	45.19%	Ø375	1	98.3	4.85	3.85	3	Cat 1/6
Cat 1/7	0.579	52.16%	40.41%	Ø450	1	29.9	6.8	6.5	6	Cat 3/1
Cat 1/8	0.759	60.00%	30.00%	Ø450	2	23.9	4.05	3.8	11	Cat 2/1
Cat 1/9	0.225	48.27%	45.47%	Ø375	1	3.2	6.75	6.7	2	Cat 4/4
Cat 0/10	0.000	0.00%	0.00%	Ø600	1	20.5	2.8	2.6	0	BASIN 1
Cat 1/10	0.483	24.53%	75.47%	Ø375	1	175.1	4.4	2.85	0	Cat 0/10
Cat 2/10	0.660	60.00%	30.00%	Ø300	1	5	2.85	2.8	10	Cat 0/10
Cat 1/11	0.478	60.00%	30.00%	Ø600	2	73.1	2.23	1.5	7	Moonee Ck
Cat 2/11	0.850	60.00%	30.00%	Ø450	2	131.6	3.54	2.23	13	Cat 1/11
Cat NW	0.280	75.66%	24.34%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck
Cat SW	0.449	83.67%	16.33%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck

NOTE: 1. STORMWATER PITS AND PIPES SHOWN CONCEPTUAL ONLY. PIT AND PIPE LAYOUT AT SUB-DIVISION ROAD INTERSECTIONS MAY BE SUBJECT TO CHANGE.
2. BIOREMEDIATION BASINS SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

REV.	DESCRIPTION	DATE	ISSUED
A	DRAFT PLAN FOR CLIENT REVIEW	12.11.15	DMM
B	ATTACHMENT A	13.03.06	DMM
C	AMENDED LAYOUT	15.07.22	DMM

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TITLE:

CONCEPT STORMWATER MANAGEMENT

PLAN SET - STORMWATER MANAGEMENT LAYOUT

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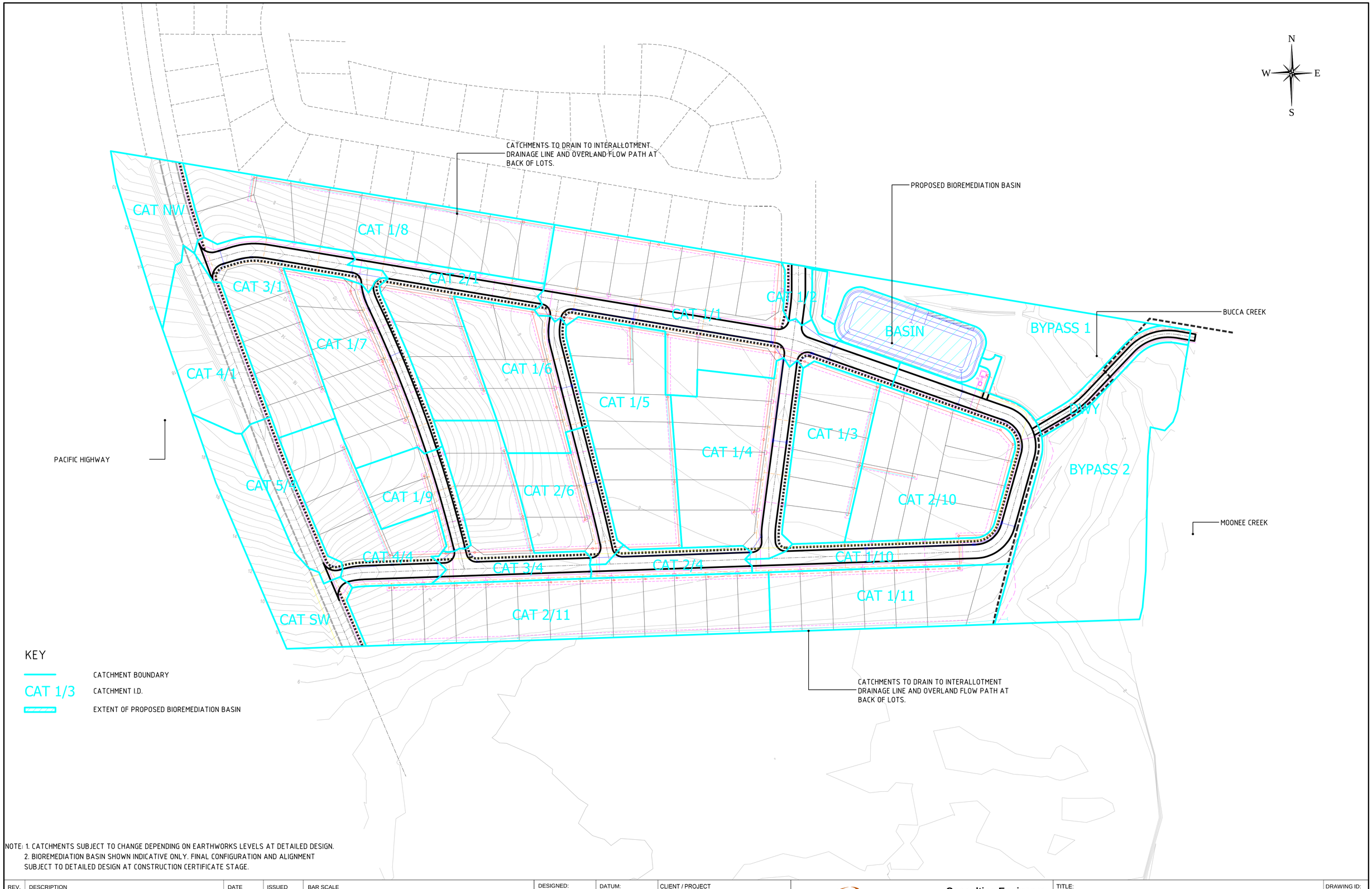
PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C



NOTE: 1. CATCHMENTS SUBJECT TO CHANGE DEPENDING ON EARTHWORKS LEVELS AT DETAILED DESIGN.
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A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM
B	ATTACHMENT A	13.03.06	DMM
C	REVISED LAYOUT	15.07.30	DMM

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CONCEPT STORMWATER MANAGEMENT PLAN SET

CONCEPT STORMWATER CATCHMENTS - DRAINS MODEL

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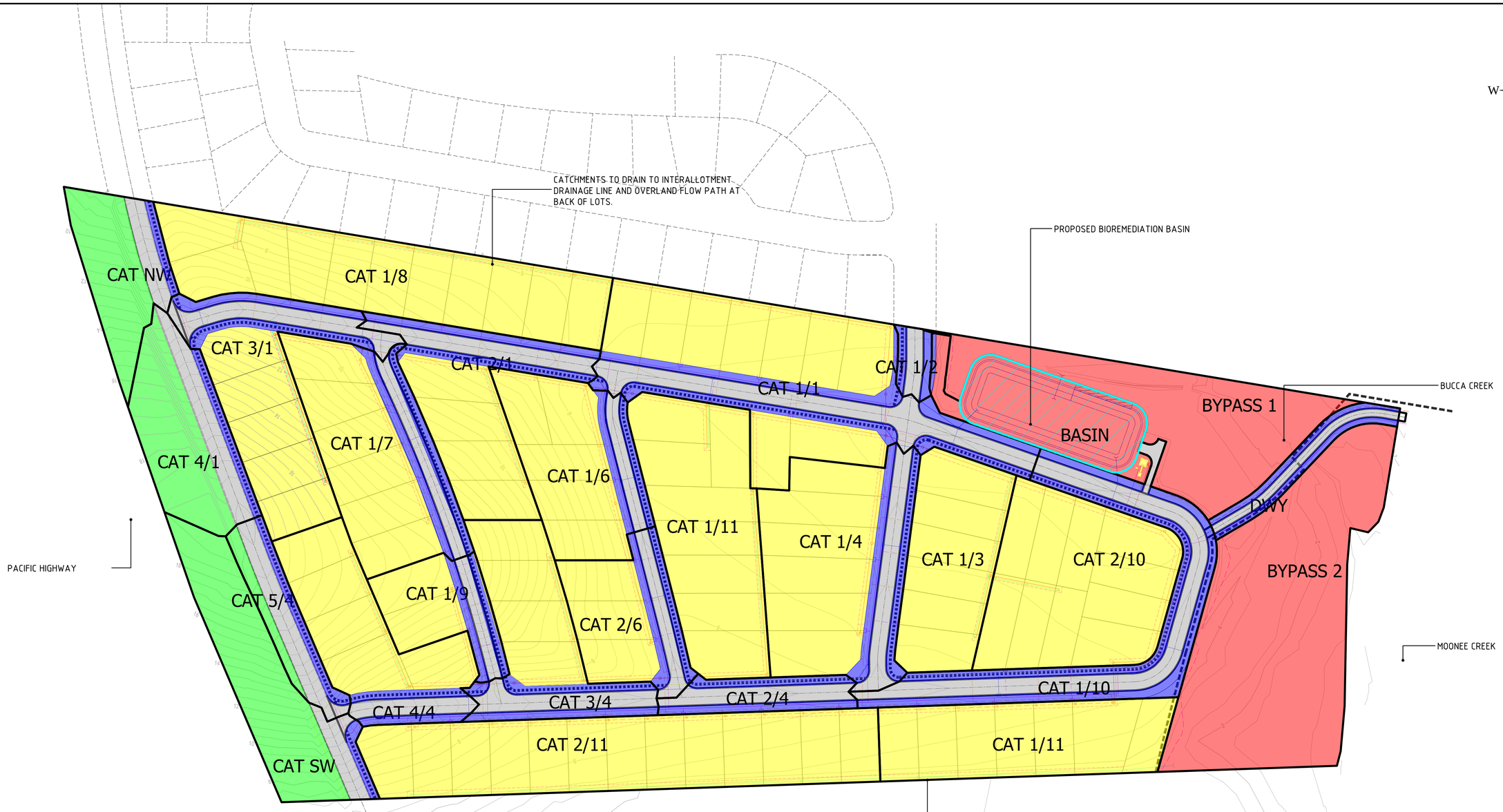

KEY

- CATCHMENT BOUNDARY
- CAT 1/3 — CATCHMENT I.D.
- EXTENT OF PROPOSED BIOREMEDIATION BASIN
- GRASSED (URBAN) AREA
- LOTS (URBAN) AREA
- ROAD AREA (PAVED)
- ROAD AREA (VERGE)
- FORESTED

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REV.	DESCRIPTION	DATE	ISSUED
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B	ATTACHMENT A	13.03.06	DMM
C	REVISED LAYOUT	15.07.30	DMM

BAR SCALE

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CONCEPT STORMWATER MANAGEMENT PLAN SET
CONCEPT STORMWATER CATCHMENTS - MUSIC MODEL

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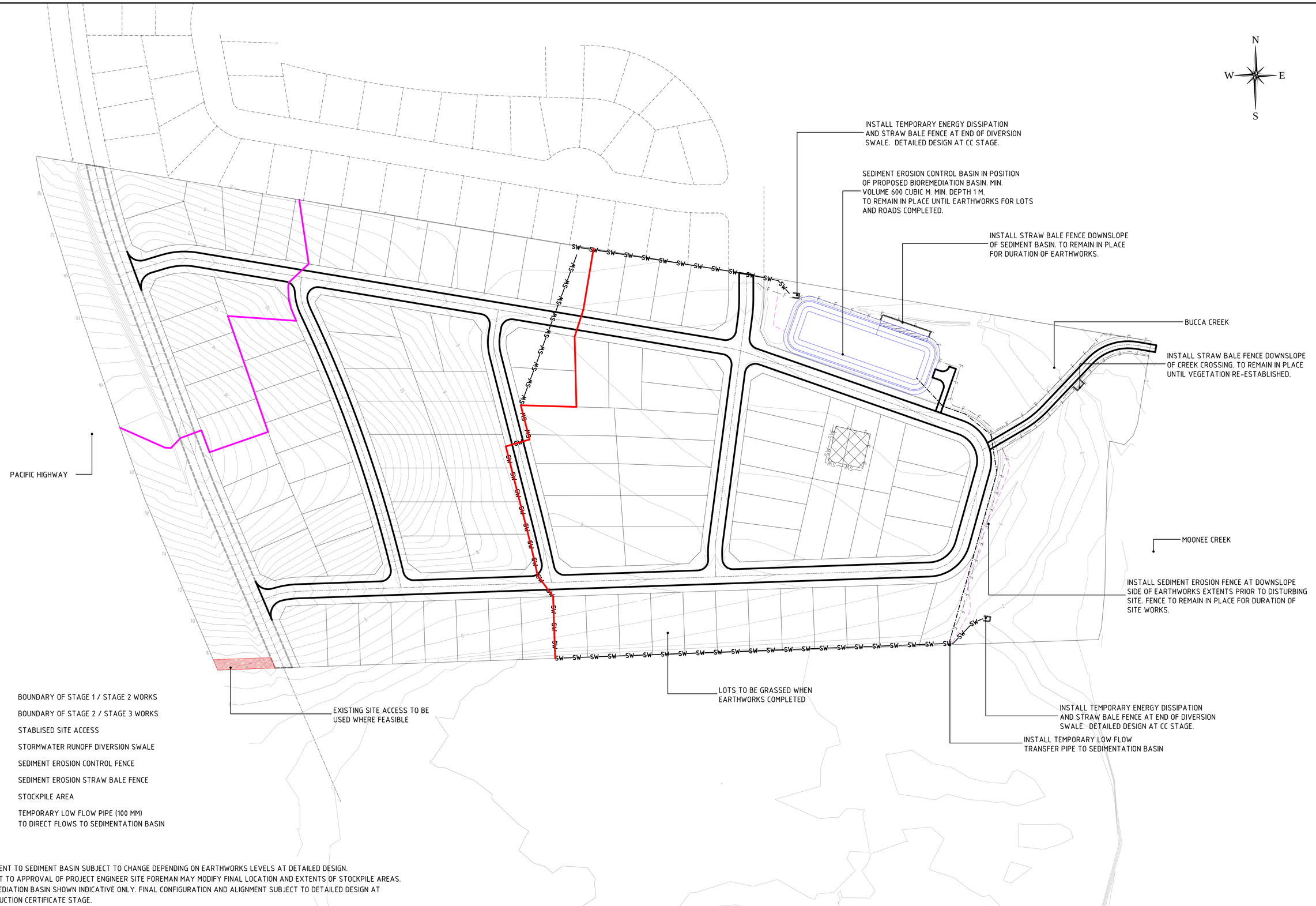

KEY

- BOUNDARY OF STAGE 1 / STAGE 2 WORKS
- BOUNDARY OF STAGE 2 / STAGE 3 WORKS
- STABLISED SITE ACCESS
- —SW— STORMWATER RUNOFF DIVERSION SWALE
- — F — SEDIMENT EROSION CONTROL FENCE
- SEDIMENT EROSION STRAW BALE FENCE
- STOCKPILE AREA
- TEMPORARY LOW FLOW PIPE (100 MM) TO DIRECT FLOWS TO SEDIMENTATION BASIN

NOTES: 1. CATCHMENT TO SEDIMENT BASIN SUBJECT TO CHANGE DEPENDING ON EARTHWORKS LEVELS AT DETAILED DESIGN.
2. SUBJECT TO APPROVAL OF PROJECT ENGINEER SITE FOREMAN MAY MODIFY FINAL LOCATION AND EXTENTS OF STOCKPILE AREAS.
3. BIOREMEDIATION BASIN SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

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CONCEPT STORMWATER MANAGEMENT PLAN SET

SOIL AND WATER MANAGEMENT - STAGE 1 EARTHWORKS

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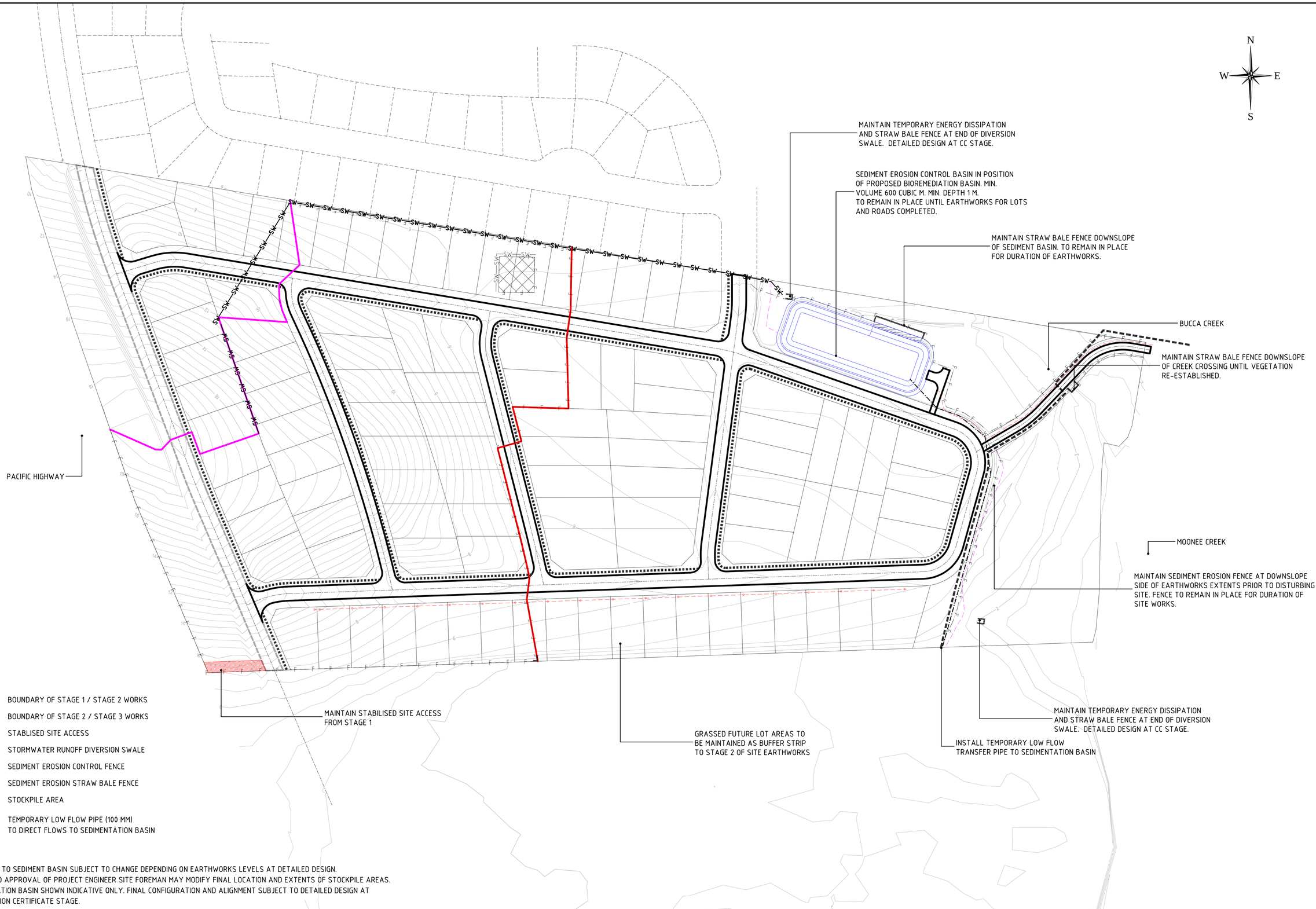

KEY

- BOUNDARY OF STAGE 1 / STAGE 2 WORKS
- BOUNDARY OF STAGE 2 / STAGE 3 WORKS
- STABLISED SITE ACCESS
- —SW— STORMWATER RUNOFF DIVERSION SWALE
- — F — SEDIMENT EROSION CONTROL FENCE
- SEDIMENT EROSION STRAW BALE FENCE
- STOCKPILE AREA
- TEMPORARY LOW FLOW PIPE (100 MM) TO DIRECT FLOWS TO SEDIMENTATION BASIN

NOTES: 1. CATCHMENT TO SEDIMENT BASIN SUBJECT TO CHANGE DEPENDING ON EARTHWORKS LEVELS AT DETAILED DESIGN.
2. SUBJECT TO APPROVAL OF PROJECT ENGINEER SITE FOREMAN MAY MODIFY FINAL LOCATION AND EXTENTS OF STOCKPILE AREAS.
3. BIOREMEDIATION BASIN SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

REV.	DESCRIPTION	DATE	ISSUED
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM
B	ATTACHMENT A	13.03.06	DMM
C	REVISED LAYOUT	15.07.30	DMM

BAR SCALE

PAGE BAR SCALE

0 20 40 60 80 100

UNITS – METRES

SCALE – 1:1000 @ A1 1:2000 @ A3

DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT: JW PLANNING PTY LTD MOONEE BEACH	
REVIEWED: GT	HORIZONTAL RATIO: 1:1000		
PAPER SIZE: A1	VERTICAL RATIO: 1:1000	THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY. All measurements in mm unless otherwise specified	

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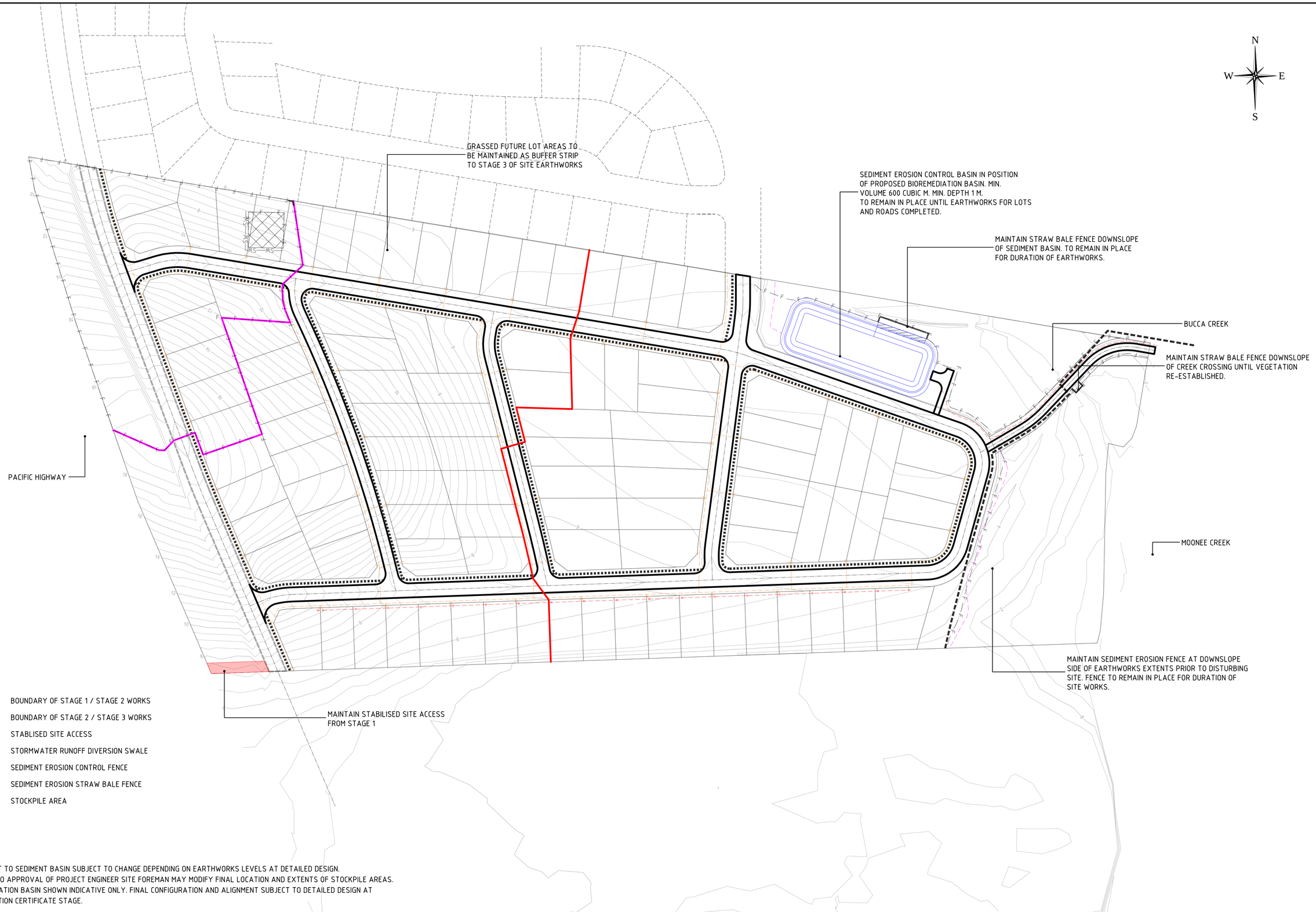
TITLE:
CONCEPT STORMWATER MANAGEMENT PLAN SET
SOIL AND WATER MANAGEMENT - STAGE 2 EARTHWORKS

DRAWING ID: **SK126**

PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C



KEY

- BOUNDARY OF STAGE 1 / STAGE 2 WORKS
- BOUNDARY OF STAGE 2 / STAGE 3 WORKS
- STABLISED SITE ACCESS
- SW — STORMWATER RUNOFF DIVERSION SWALE
- F — SEDIMENT EROSION CONTROL FENCE
- SEDIMENT EROSION STRAW BALE FENCE
- STOCKPILE AREA

NOTES: 1. CATCHMENT TO SEDIMENT BASIN SUBJECT TO CHANGE DEPENDING ON EARTHWORKS LEVELS AT DETAILED DESIGN.
2. SUBJECT TO APPROVAL OF PROJECT ENGINEER SITE FOREMAN MAY MODIFY FINAL LOCATION AND EXTENTS OF STOCKPILE AREAS.
3. BIOREMEDIATION BASIN SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

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DESIGNED:	DATUM:
MGD	mAHD
REVIEWED:	HORIZONTAL RATIO:
GT	1:1000
PAPER SIZE:	VERTICAL RATIO:
A1	1:1000

CLIENT / PROJECT

JW PLANNING PTY LTD

MOONEE BEACH

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TITLE:

CONCEPT STORMWATER MANAGEMENT PLAN SET

SOIL AND WATER MANAGEMENT - STAGE 3 EARTHWORKS

DRAWING ID: **SK127**

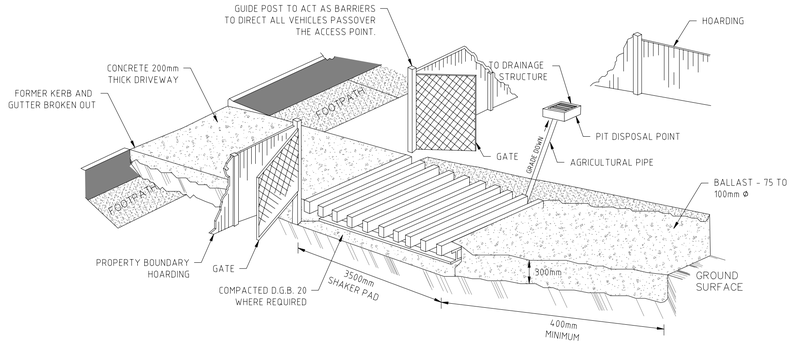
PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C

STABILISED ACCESS POINT

TYPE II SAP

THE TYPE II SAP DESIGN IS MORE DEFINED IN THAT IT REQUIRES AN AREA OF BALLAST WITHIN THE SITE COMBINED WITH A SHAKER PAD; ADJACENT THE SHAKER PAD AND IN THE PUBLIC WAY IS A TEMPORARY (CONCRETE) VEHICULAR CROSSING. (SEE DIAGRAM)

STABILISED ACCESS POINT - TYPE 2



IN BOTH TYPE I AND TYPE II SAP'S, THE TEMPORARY VEHICULAR CROSSING MUST:
- CONNECT TO AN EXISTING GUTTER LAYBACK (WHERE THE KERB AND GUTTER EXIST) . IF A GUTTER LAYBACK DOES NOT EXIST THEN THE CONNECTION MUST BE MADE TO THE GUTTER BY REMOVING THE ADJCENT KERB SECTION ONLY.
- CONNECT TO A DISH CROSSING (WHERE KERB AND GUTTER DOES NOT EXIST). IF A DISH CROSSING DOES NOT EXIST, THEN IT MUST BE CONSTRUCTED IN ACCORDANCE WITH DETAILS CONTAINED IN COUNCIL'S ISSUED FOOTPATH CROSSING LEVELS.

IT SHOULD BE NOTED THAT THESE TYPES OF SAPS ARE CONSIDERED TO BE APPLICABLE FOR THE MAJORITY OF ACTIVITIES HOWEVER SOME SITES MAY REQUIRE SPECIAL CONSIDERATION.

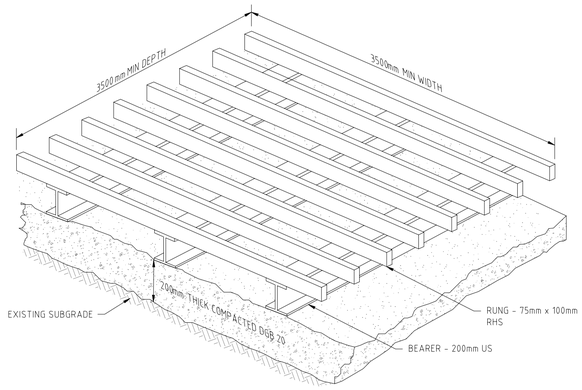
SHAKER PAD (CATTLE GRID)

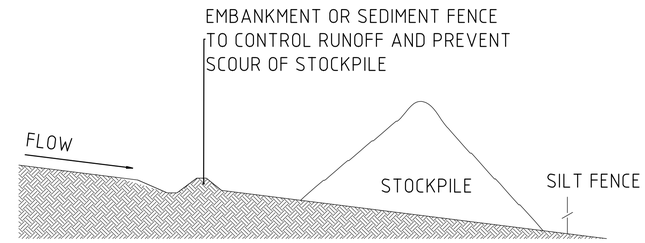
A CORRECTLY DESIGNED AND INSTALLED SHAKER PAD WILL ASSIST IN PREVENTING SEDIMENT TRANSFERE FROM A SITE. ANY STABILISED ACCESS POINT (SAP) CAN BE DESIGNED WITH A SHAKER PAD (COMPULSOPRY IN TYPE II SAP'S)

SHAKER PADS CAN BE DESIGNED AND CONSTRUCTED TO ENABLE RE-USE ON FUTURE PROJECTS.

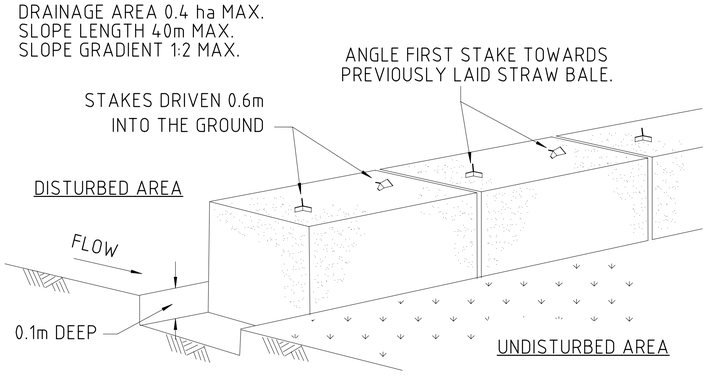
THE SHAKER PAD:
- MUST BE DESIGNED AND CERTIFIED BY A PRACTICING STRUCTURAL ENGINEER. THE CERTIFIED DESIGN SHOULD BE SUBMITTED WITH THE RELEVENT APPLICATION.
- CAN BE CONSTRUCTED FROM ANY SUITABLE MATERIAL.
- MUST BE LOCATED ON A SUITABLY PREPARED AND COMPACTED SUB-GRADE/BASE MATERIAL.
- MUST BE SITUATED SUCH THAT THE RUNGS OF THE SHAKER PAD ARE LEVEL WITH THE ADJOINING NATURAL SURFACE.
- MUST BE A MINIMUM OF 3.5m IN LENGTH.
- MUST BE A MINIMUM OF 3.5m IN WIDTH.
- MUST HAVE CLEAR SPACING BETWEEN RUNGS OF 200 - 250mm.
- RUNGS MUST HAVE A MAXIMUM WIDTH (BEARING AREA) OF 75mm.
- MUST HAVE A MINIMUM CLEAR DEPTH OF 300mm IE FORM THE ROP OF THE RUNG TO THE FINISHED SUB-GRADE/BASE LEVEL.

THE SHAKER PAD MUST BE PROVIDED WITH SUITABLE BARRIERS AT THE SIDES TO ENSURE THAT ALL TYERS OF VEHICLES LEAVING THE SITE TRAVERSE THE DEVICE.

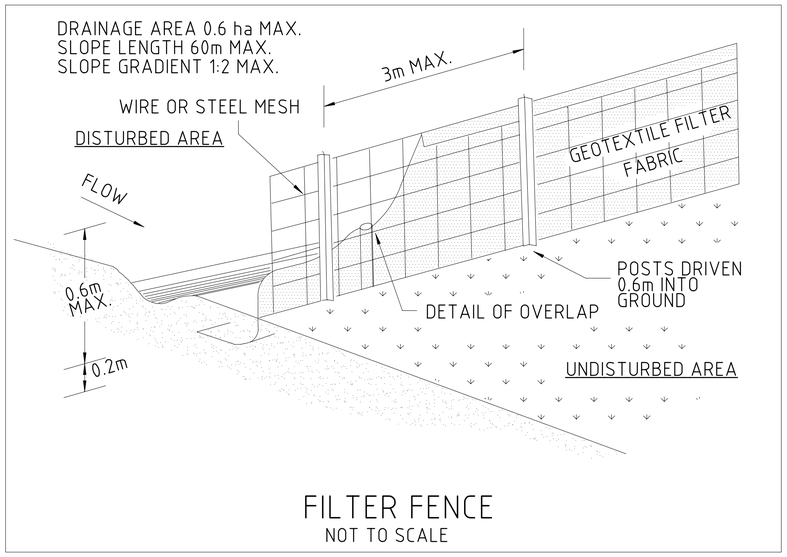




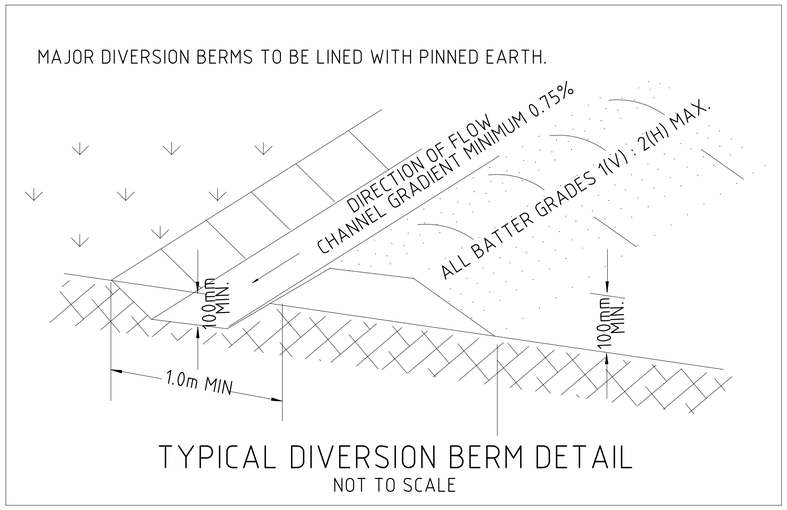
SITE STOCKPILES
NOT TO SCALE



STRAW BALE SEDIMENT FILTER
NOT TO SCALE



FILTER FENCE
NOT TO SCALE



TYPICAL DIVERSION BERM DETAIL
NOT TO SCALE

GENERAL NOTES

1. ALL SEDIMENT AND EROSION CONTROL MEASURES TO BE IN ACCORDANCE WITH NSW LANDCOM (2004).
2. CONTRACTOR TO KEEP DISTURBED AREAS TO A MINIMUM WHERE FEASIBLE AND TO RE-ESTABLISH VEGETATION COVER IMMEDIATELY FOLLOWING COMPLETION OF WORKS.
3. SEDIMENT AND EROSION CONTROL MEASURES REFERRED TO ON THIS PLAN ARE TO BE CONFIRMED BY CONTRACTOR PRIOR TO COMMENCEMENT OF WORKS. CONTRACTOR RETAINS RESPONSIBILITY TO PLAN AND IMPLEMENT ENVIRONMENTAL PROTECTION MEASURES REQUIRED BY LAW, COUNCIL AND CONTRACT THROUGHOUT THE WORKS.
4. SEDIMENT AND EROSION CONTROL MEASURES CONFIRMED BY CONTRACTOR ARE TO BE STAGED ACCORDING TO THIS PLAN.
5. DUST CONTROL TO BE UNDERTAKEN PERIODICALLY DURING BULK EARTHWORKS AND PRIOR TO ESTABLISHMENT OF VEGETATION.

SCHEDULE OF SEDIMENT AND EROSION CONTROL WORKS

1. CONSTRUCT STABILISED SITE ACCESSES.
2. ESTABLISH SEDIMENT FENCES AT DOWNSLOPE END OF SITE.
3. INSTALL SURFACE FLOW DIVERSION BUNDS.
4. INSTALL STRAW BALE FENCES.
5. CONSTRUCT TEMPORARY SEDIMENT BASIN.
6. REMOVAL OF ALL SEDIMENT AND EROSION CONTROL MEASURES ONCE VEGETATION IS ESTABLISHED.

REV.	DESCRIPTION	DATE	ISSUED
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM
B	ATTACHMENT A	13.03.06	DMM
C	REVISED LAYOUT	15.07.22	DMM

BAR SCALE

DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT: JW PLANNING PTY LTD MOONEE BEACH
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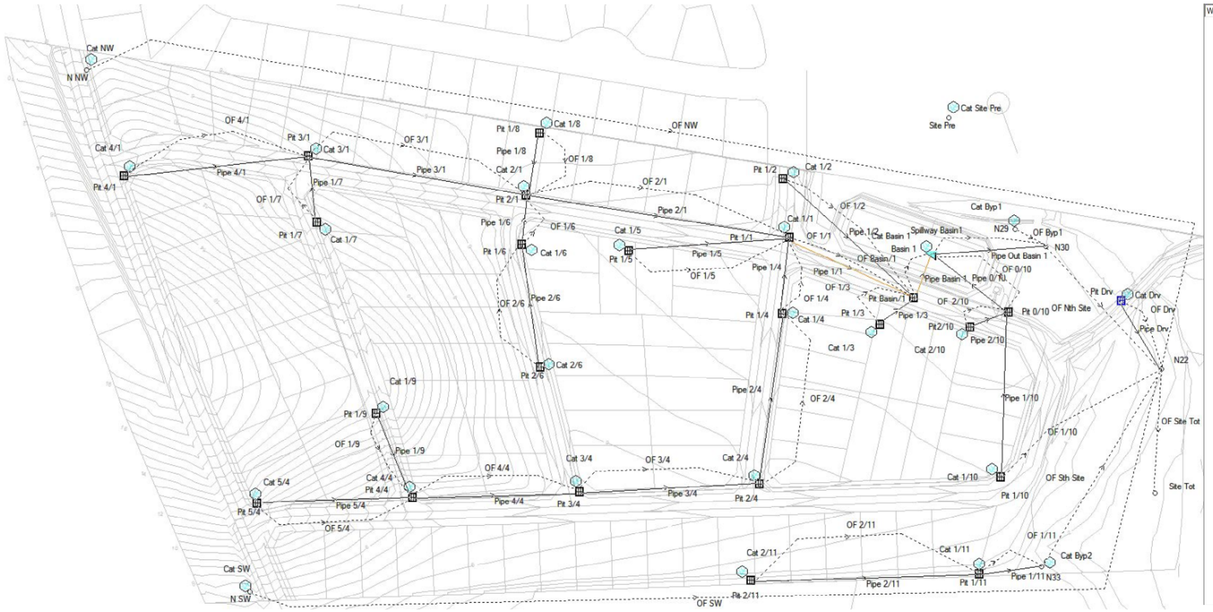
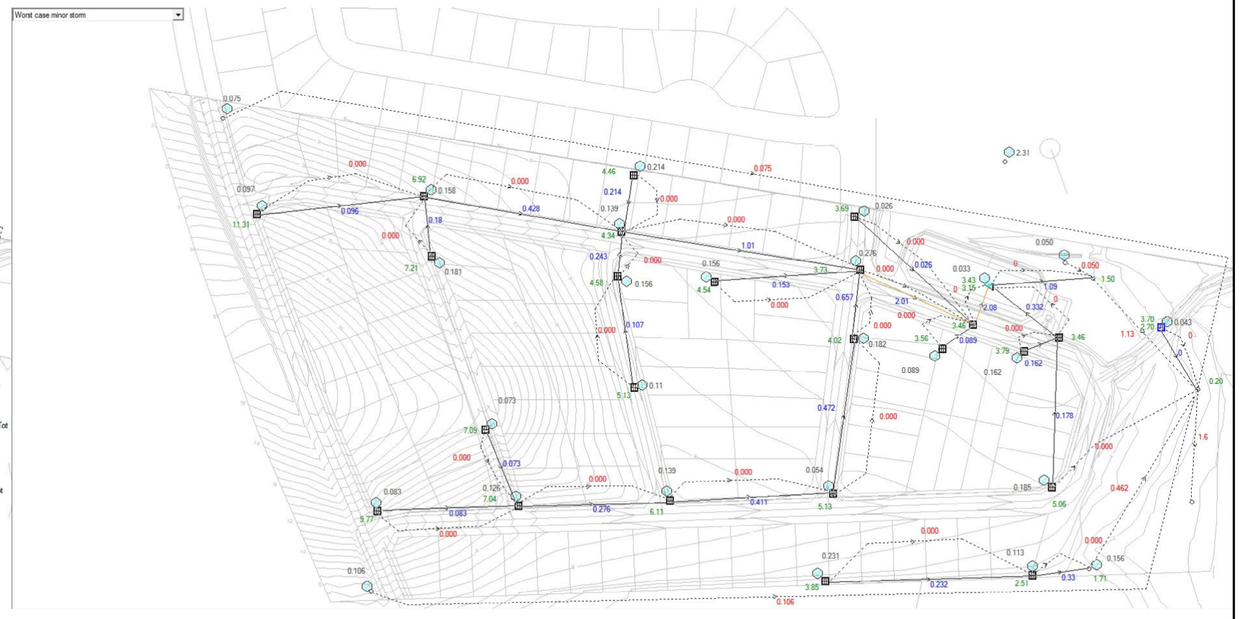
TITLE:	DRAWING ID:
CONCEPT STORMWATER MANAGEMENT PLAN SET SOIL AND WATER MANAGEMENT - TYPICAL DETAIL	SK128

PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C

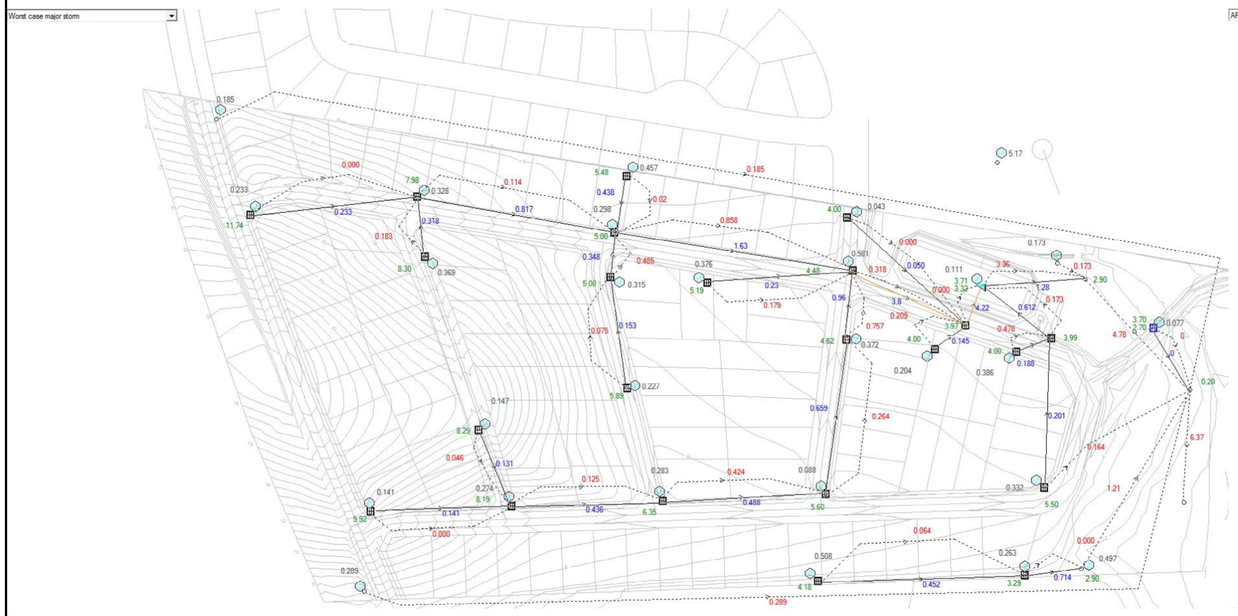
DRAINS MODEL SET-UP



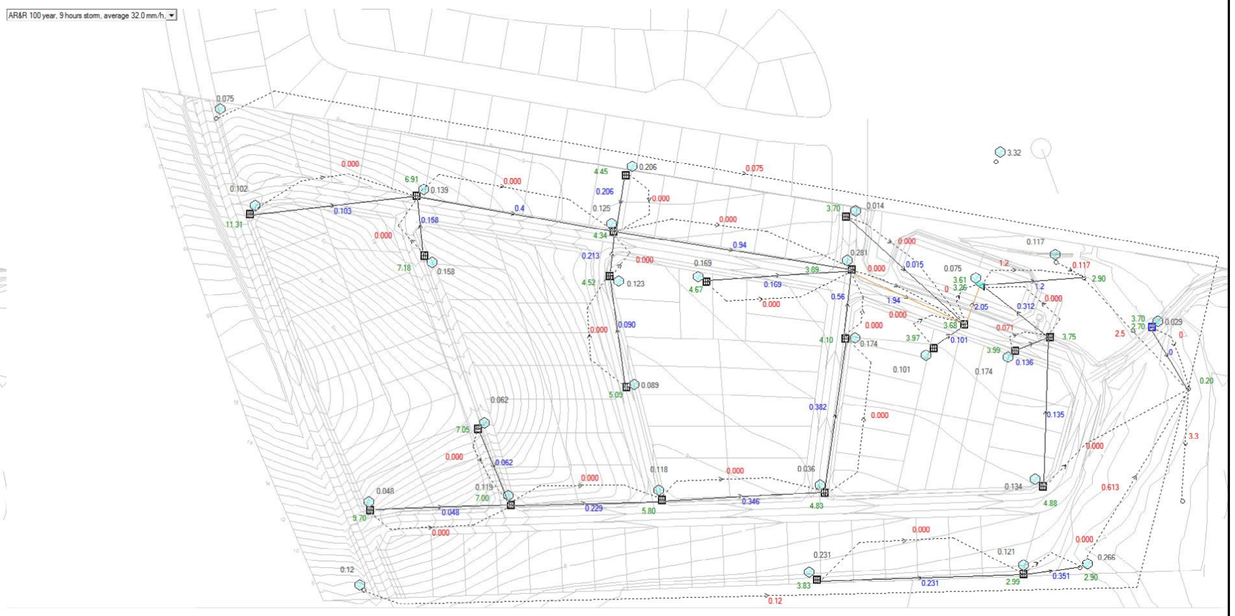
DRAINS MODEL RESULT - WORST CASE MINOR STORM (1 IN 5 YR ARI)



DRAINS MODEL RESULT - WORST CASE MAJOR STORM (1 IN 100 YR ARI)



DRAINS MODEL RESULTS (9 HOUR 1 IN 100 YR ARI STORM - MOONEE CK CRITICAL DURATION STORM)



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DESIGNED:	DATUM:
MGD	mAHD
REVIEWED:	HORIZONTAL RATIO:
GT	NTS
PAPER SIZE:	VERTICAL RATIO:
A1	NTS

CLIENT / PROJECT

JW PLANNING PTY LTD

MOONEE BEACH

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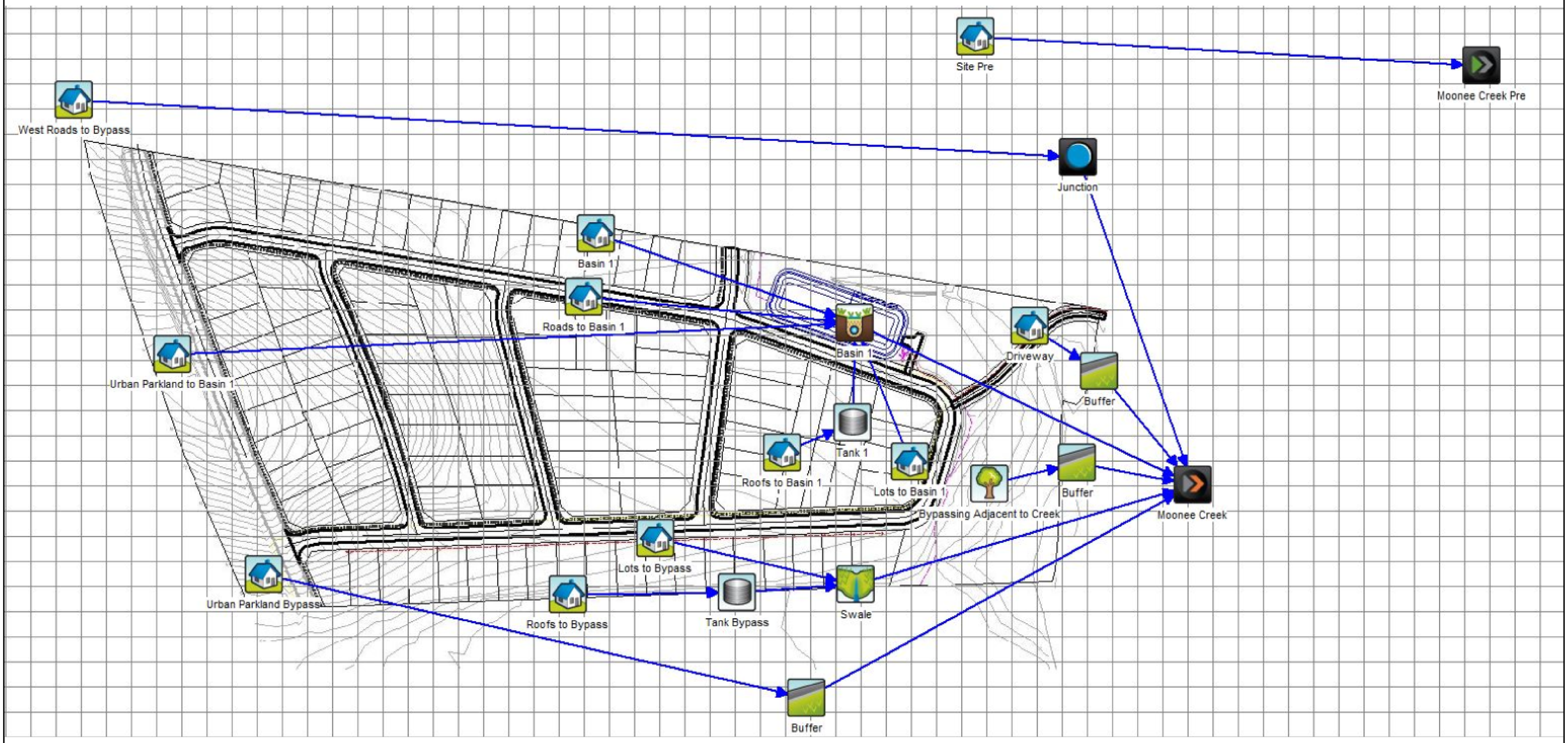
TITLE:

CONCEPT STORMWATER MANAGEMENT PLAN SET
DRAINS MODEL LAYOUT AND SUMMARY OF RESULTS

DRAWING ID: **SK129**

PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C



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CLIENT / PROJECT

JW PLANNING PTY LTD

MOONEE BEACH

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TITLE:

CONCEPT STORMWATER MANAGEMENT PLAN SET

MUSIC MODEL LAYOUT

DRAWING ID: **SK130**

PROJECT MANAGER:	PROJECT NO.:	FILE:	REVISION:
G. TAYLOR	P1002663	JD12V04	C