

Moonee Parklands Trust



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



P1002663JR07V01
March 2013

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Contents

1 OVERVIEW.....	5
1.1 Study Overview	5
1.2 Project Scope	5
1.3 Proposed Development	6
1.4 Policy and Objectives	7
1.5 Site OSD Requirements	9
2 SITE DESCRIPTION	11
2.1 Location and Site Description	11
2.2 Field Investigations	12
2.3 Topography and Drainage	12
2.4 Site Soil Profile and Geology	12
3 STORMWATER MANAGEMENT	13
3.1 Stormwater Management and Performance Objectives	13
3.2 Proposed Stormwater Management System – Overview	14
3.3 Study Methodology and Assumptions	14
3.4 Hydrological Modelling	17
3.5 Site Stormwater Quality	20
3.6 Minimum Basin Requirements – Site Flooding	25
3.7 Construction Phase Sediment and Erosion Control	26
4 SUMMARY	28
5 REFERENCES	29
6 ATTACHMENT A – SITE AND SOIL AND WATER MANAGEMENT PLANS.....	30

1 Overview

1.1 Study Overview

This report has been prepared on behalf of Moonee Parklands Trust ("The Client") to support an application to sub-divide and develop new residential allotments at existing Lot 1 DP1097743 and Lot 6 DP 252223, Pacific Highway, 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 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 considers only the proposed development on Lot 1 DP 1097743 as a proposed layout for the future development on Lot 6 DP 252223 was not available at the time of reporting.

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 101 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. Construction of stormwater Basin 2.
 - b. 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 planned 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.

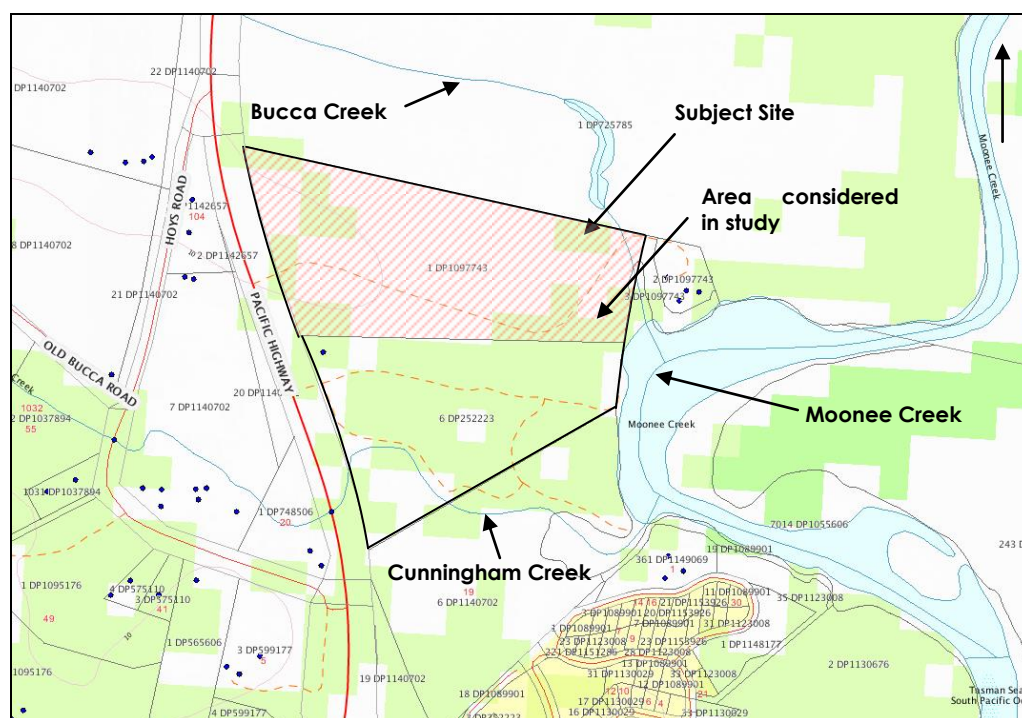


Figure 1: Location of the subject site within its local context.

Lot 6 has an area of 10.073 ha while Lot 1 is 12.93 ha in area, giving the site a total area of approximately 23 ha. 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. There is a caravan and detachable house in the eastern portion and a caravan and stables in the north-west corner of Lot 6 and unsealed access roads on both properties. Otherwise, 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 basins.

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 basins positioned to capture surface and piped stormwater flows from the site and upslope catchments for treatment and possible re-use. These 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 P1002663JR08V01, March 2013) 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 site bioremediation basins 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 basins, which are not modelled as having a specific OSD function.

- Lot, roof, road and open parkland site areas have assumed pervious / impervious areas as summarised in . "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 basins are assumed to be completely empty at the commencement of storm events. As these basins are designed to be "dry basins" for the purposes of water quality management, this assumption is acceptable.
- Bioremediation basins include 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 and proposed gross pollutant traps 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).
- All stormwater runoff from lots and roads was assumed to go to proposed stormwater bioremediation basins with no bypass flows.

- Exfiltration rates for all sedimentation dams were set at 0 mm/hr as dams are 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.
- Proposed gross pollutant traps upslope of site bioremediation basins used available data for the "Stormceptor" gross pollutant device including treatment and system bypass rates and pollutant retention rates.

3.3.3 RAFTS Model Assumptions

Assumptions used in RAFTS modelling are given in the flooding assessment report (MA reference P1002663JR08V01, March 2013).

3.3.4 TufLOW Model

Assumptions used in TUFLOW modelling are given in the flooding assessment report (MA reference P1002663JR08V01, March 2013).

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 outlets 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	0.81	5.5	18.6	2.1	94.5	190.1	2.1	0.0	-	-
Bypass 2	0.91	5.0	89.2	4.0	95.0	89.2	4.0	0.0	-	-
Driveway	0.07	90.0	67.9	1.3	10.0	67.9	1.3	0.0	-	-
Basin 1	0.69	49.8	128.1	1.2	44.8	107.3	1.4	5.4	107.3	1.4
Basin 2	0.16	5.0	49.4	2.0	95.0	49.4	2.0	0.0	-	-
Cat 1/1	1.03	43.4	151.0	0.5	48.8	58.8	1.7	7.8	58.8	1.7
Cat 2/1	0.41	56.8	119.8	2.6	37.6	47.2	7.8	5.5	47.2	7.8
Cat 3/1	0.52	48.0	111.5	2.8	45.0	128.0	6.3	7.0	128.0	6.3
Cat 4/1	0.33	45.8	106.8	6.3	54.1	92.2	7.6	0.0	-	-
Cat 1/2	0.05	89.5	37.2	1.3	10.5	37.2	1.3	0.0	-	-
Cat 1/3	0.76	55.4	164.5	0.6	38.8	50.8	1.0	5.8	50.8	1.0
Cat 2/3	0.56	49.9	91.6	0.5	43.4	91.0	0.8	6.7	91.0	0.8
Cat 3/3	0.67	52.5	92.7	2.2	41.2	87.0	7.7	6.3	87.0	7.7
Cat 4/3	0.27	56.3	77.6	4.8	38.2	29.5	12.9	5.5	29.5	12.9
Cat 5/3	0.36	42.6	108.9	5.7	57.4	91.2	8.8	0.0	-	-
Cat 1/4	0.47	36.6	47.8	1.3	54.5	36.8	1.6	8.9	36.8	1.6
Cat 2/4	0.86	35.1	43.6	3.4	55.8	39.3	12.0	9.1	39.3	12.0
Cat 3/4	0.23	27.4	63.7	10.0	72.6	81.8	11.0	0.0	-	-
Cat 1/5	0.89	40.1	105.2	0.6	51.6	130.4	1.2	8.3	130.4	1.2
Cat 1/6	0.60	40.0	78.1	1.0	51.6	137.0	5.4	8.4	137.0	5.4
Cat 1/7	0.59	45.9	112.0	4.1	46.7	42.6	5.9	7.4	42.6	5.9
Cat 1/8	0.80	30.2	42.9	11.2	60.0	42.9	11.2	9.8	42.9	11.2
Cat 2/8	0.34	32.7	81.7	6.1	67.3	44.0	11.1	0.0	-	-
Cat 1/9	0.44	42.2	72.5	7.9	49.8	105.2	4.7	8.0	105.2	4.7
Treatment 1 ²	0.11	0.0	-	-	100.0	-	-	0.0	-	-
Total	12.93	-	-	-	-	-	-	-	-	-

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

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 1	1.55	90	10	Roads
	Roofs to Basin 1	1.27	100	0	Roofs
	Lots to Basin 1	2.96	14	86	Urban Residential
	Park to Basin 1	0.35	5	95	Urban Residential
	Roads to Basin 2	1.31	90	10	Roads
	Roofs to Basin 2	0.88	100	0	Roofs
	Lots to Basin 2	2.06	14	86	Urban Residential
	Park to Basin 2	0.32	5	95	Urban Residential
	Bypassing	1.72	5	95	Forest
	Driveway	0.07	90	10	Roads
	Basin 1	0.11	0	100	Urban Residential
	Basin 2	0.11	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 (common)	Low Flow Bypass – 0 m ³ /s
	High Flow Bypass – 1 m ³ /s
	Extended Detention Depth – 0.5 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
Bioremediation Basin 1	Surface Area – 856.2 m ²
	Filter Area – 599.1 m ²
	Unlined Filter Media Perimeter – 95.6 m
Bioremediation Basin 2	Surface Area – 828.3 m ²
	Filter Area – 599.1 m ²
	Unlined Filter Media Perimeter – 97.7 m
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
Gross Pollutant Trap (SPEL "Stormceptor")	Low Flow Bypass – 0 m ³ /s
	High Flow Bypass – 0.102 m ³ /s
	Total Suspended Solids Removal – 97%
	Total Phosphorus Removal – 30%
	Total Nitrogen Removal – 30%
	Gross Pollutant Removal – 100%
Buffer	Percentage upstream area buffered – 100%
	Buffer area (% of upstream impervious area) – 50%
	Exfiltration rate – 3.6 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 basins 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)	Gross Pollutants (kg/year)
Existing Conditions	16,300	17.2	140	102
Post-development Conditions	3,430	15.3	104	72.7
Reduction (%)	79.0	11.0	25.7	28.7

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	23,300	44.6	240	2,190
Post-development – discharged	3,430	15.3	104	72.7
Retention rate (%)	85.3	65.7	56.7	96.7

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 P1002663JR08V01, March 2013) 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 basins are therefore designed with base surface levels at 2.50 mAHD, spillway and surface pipe outlet levels at 3.00 mAHD and top embankment levels of 3.50 mAHD. This will ensure that

the basins have no adverse impacts (e.g. backwater effects) on the proposed trunk drainage network and will flood-proof the basins 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 m³/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 basins to be configured as sedimentation basins during the initial earthworks phase.
- Proposed bioremediation basins are to be configured as sedimentation basins 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 basins a minimum volume of 600 m³ each, allowing for 2.4 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.
- 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 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/

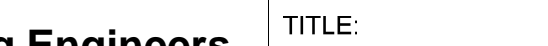
6 Attachment A – Site and Soil and Water Management Plans

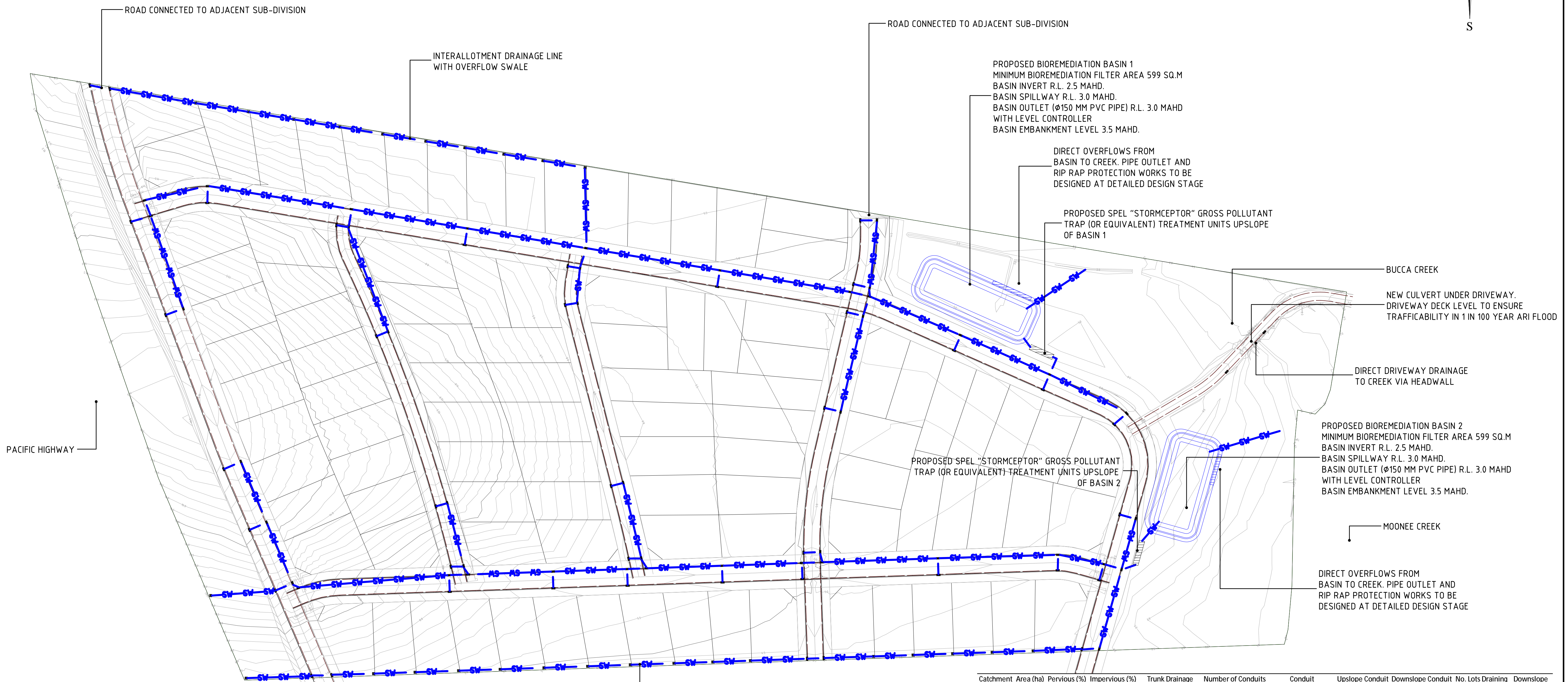
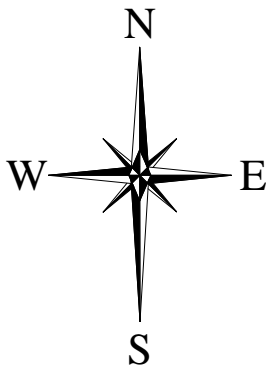
JW PLANNING PTY LTD

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	BAR SCALE	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT JW PLANNING PTY LTD MOONEE BEACH	<div><div>Consulting Engineers <i>Environment Water Geotechnical Civil</i></div></div> 6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au	TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET COVER SHEET			DRAWING ID: SK122
A	ATTACHMENT A	13.03.05	DMM		REVIEWED: GT	HORIZONTAL RATIO: 1:1000						
B	ATTACHMENT A	13.03.06	DMM									
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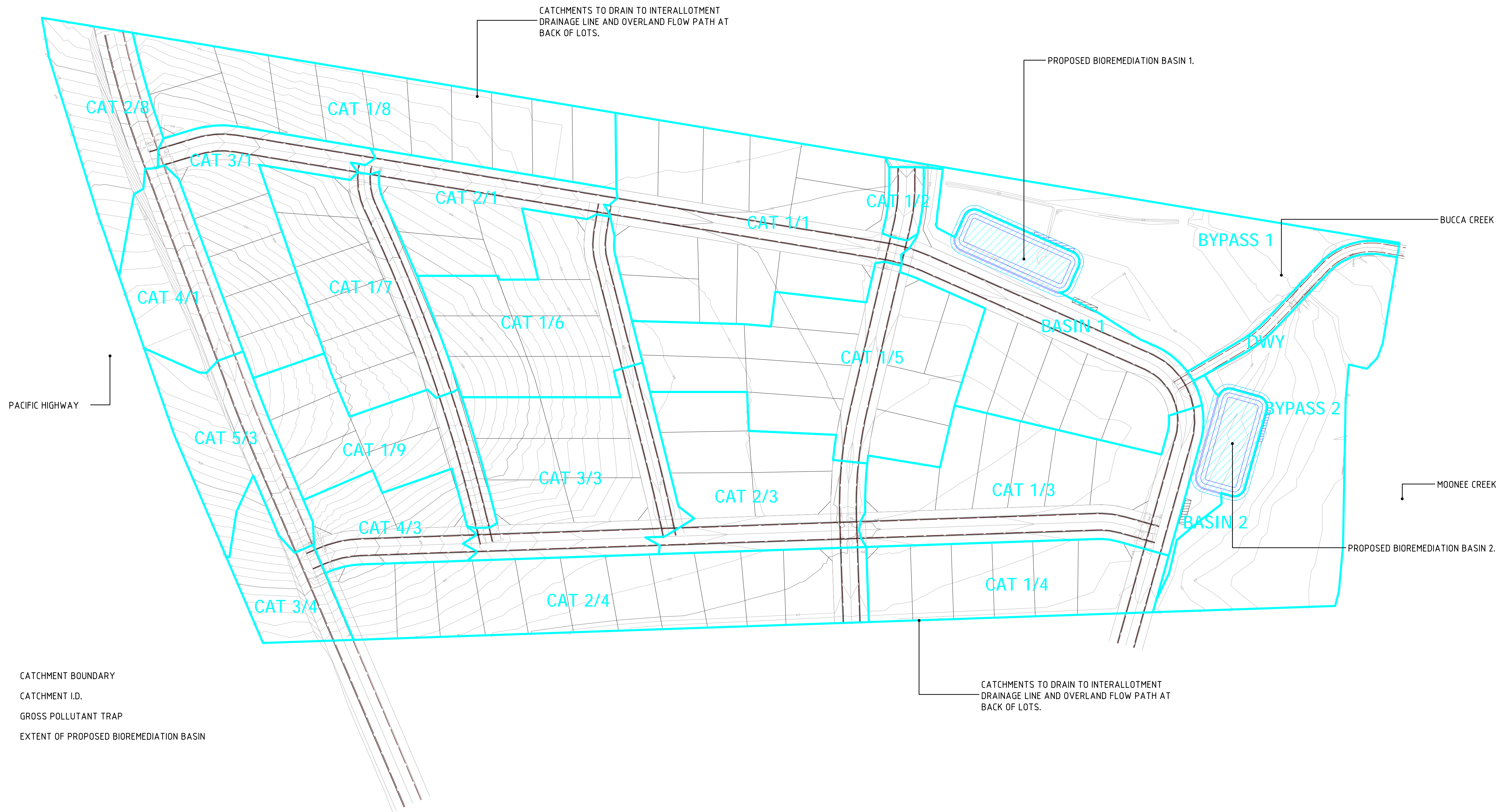
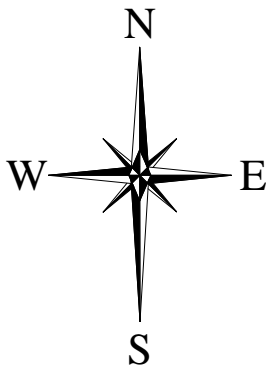
KEY

- STORMWATER PIT
- SW — STORMWATER PIPE

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.

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	0.810	94.50%	5.50%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck
Bypass 2	0.905	95.00%	5.00%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck
Dwy	0.070	10.00%	90.00%	Ø375	1	3.5	2.7	1.7	0	Moonee Ck
Basin 1	0.690	44.80%	55.20%	1800 W x 750 H	1	31.1	2.85	2.5	5	BASIN 1 Out
Basin 1 Out	0.000	N/A	N/A	Ø600	2	23	2.85	1.5	0	Moonee Ck
Basin 2	0.160	95.00%	5.00%	Ø600	2	20	2.9	1.5	0	Moonee Ck
Cat 1/1	1.032	48.84%	51.16%	1800 W x 750 H	1	92.39	3.5	2.85	11	Basin 1
Cat 2/1	0.405	37.61%	62.39%	Ø675	2	136.15	4.52	3.5	3	Cat 1/1
Cat 3/1	0.517	44.99%	55.01%	Ø450	2	112.37	7	4.52	5	Cat 2/1
Cat 4/1	0.329	54.12%	45.88%	Ø450	1	99.19	10	7	0	Cat 3/1
Cat 1/2	0.053	10.50%	89.50%	Ø450	1	3	3.53	3	0	Cat 1/1
Cat 1/3	0.757	38.87%	61.13%	Ø750	2	30.8	2.85	2.5	6	Basin 2
Cat 2/3	0.557	43.41%	56.59%	Ø600	2	143.2	3.8	2.85	5	Cat 1/3
Cat 3/3	0.673	41.23%	58.77%	Ø525	2	82.65	4.62	3.8	6	Cat 2/3
Cat 4/3	0.273	38.18%	61.82%	Ø375	2	92.99	6	4.62	2	Cat 3/3
Cat 5/3	0.360	57.40%	42.60%	Ø375	1	74.34	10.5	6	0	Cat 4/3
Cat 1/4	0.469	54.53%	45.47%	1200 W x 450 H	1	37.77	3.2	2.85	6	Cat 1/3
Cat 2/4	0.861	55.74%	44.26%	1200 W x 450 H	1	131.58	3.6	3.2	11	Cat 1/4
Cat 3/4	0.232	72.62%	27.38%	Ø375	1	235.49	6	3.6	0	Cat 2/4
Cat 1/5	0.894	51.55%	48.45%	Ø450	2	8.45	3.59	3.5	10	Cat 1/1
Cat 1/6	0.604	51.66%	48.34%	Ø450	1	8.77	4.61	4.52	7	Cat 2/1
Cat 1/7	0.587	46.70%	53.30%	Ø450	1	7.4	7.08	7	6	Cat 3/1
Cat 1/8	0.798	60.00%	40.00%	Ø450	2	37.6	4.9	4.52	11	Cat 2/1
Cat 2/8	0.339	67.32%	32.68%	Ø450	1	230.2	6.05	4.9	0	Cat 1/8
Cat 1/9	0.442	49.78%	50.22%	Ø375	1	3.2	6.04	6	5	Cat 4/3
Treatment	0.222	100.00%	0.00%	N/A	N/A	N/A	N/A	N/A	0	Moonee Ck

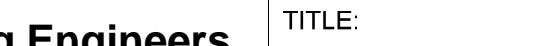

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B	ATTACHMENT A	13.03.06	DMM	 UNITS - METRES SCALE - 1:1000 @ A1 1:2000 @ A3	PAPER SIZE: A1	VERTICAL RATIO: 1:1000	THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY All measurements in mm unless otherwise specified					
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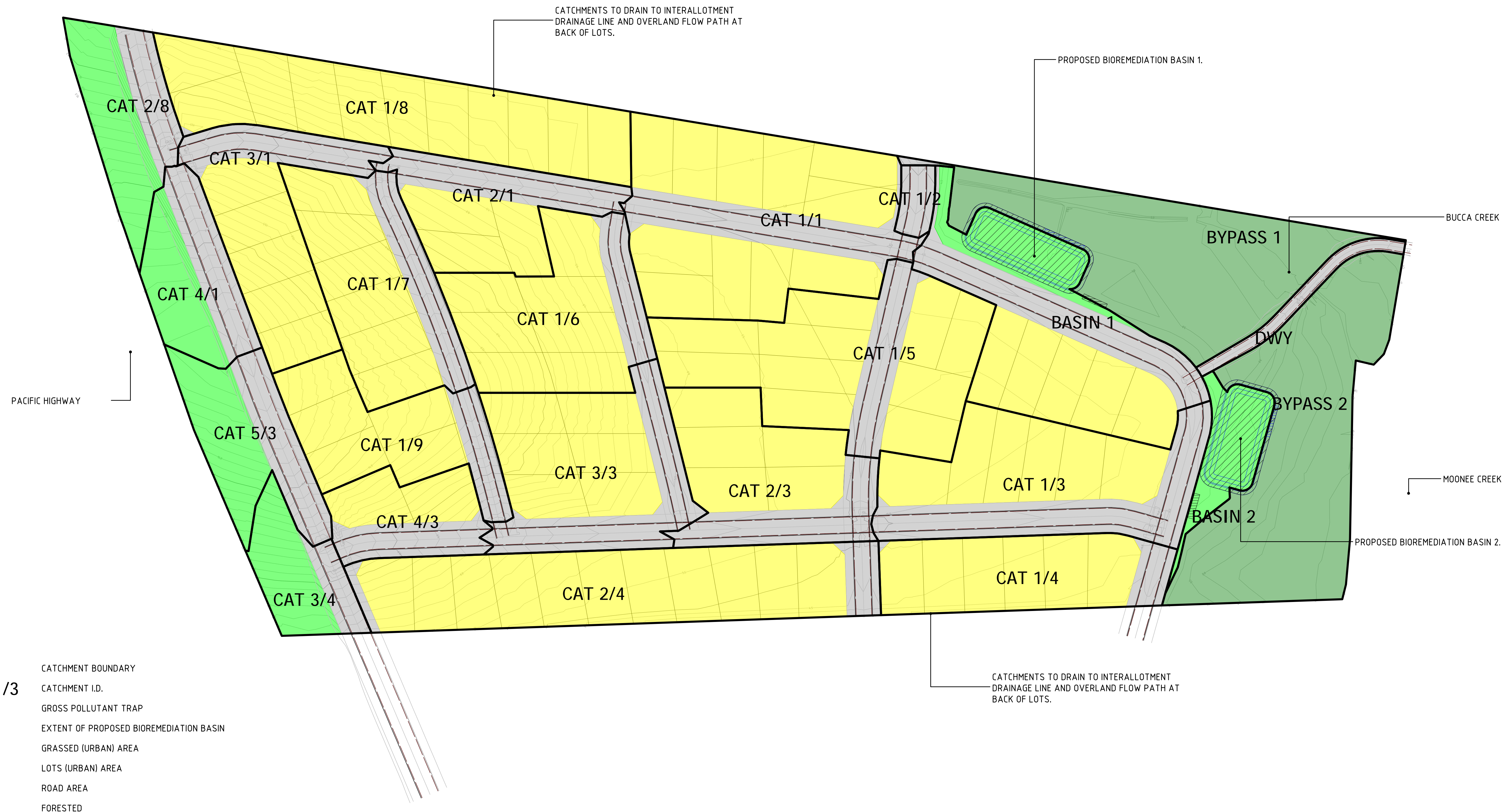
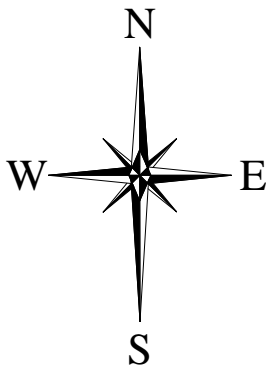


KEY



- CATCHMENT BOUNDARY
- CATCHMENT I.D.
- GROSS POLLUTANT TRAP
- EXTENT OF PROPOSED BIOREMEDIATION BASIN

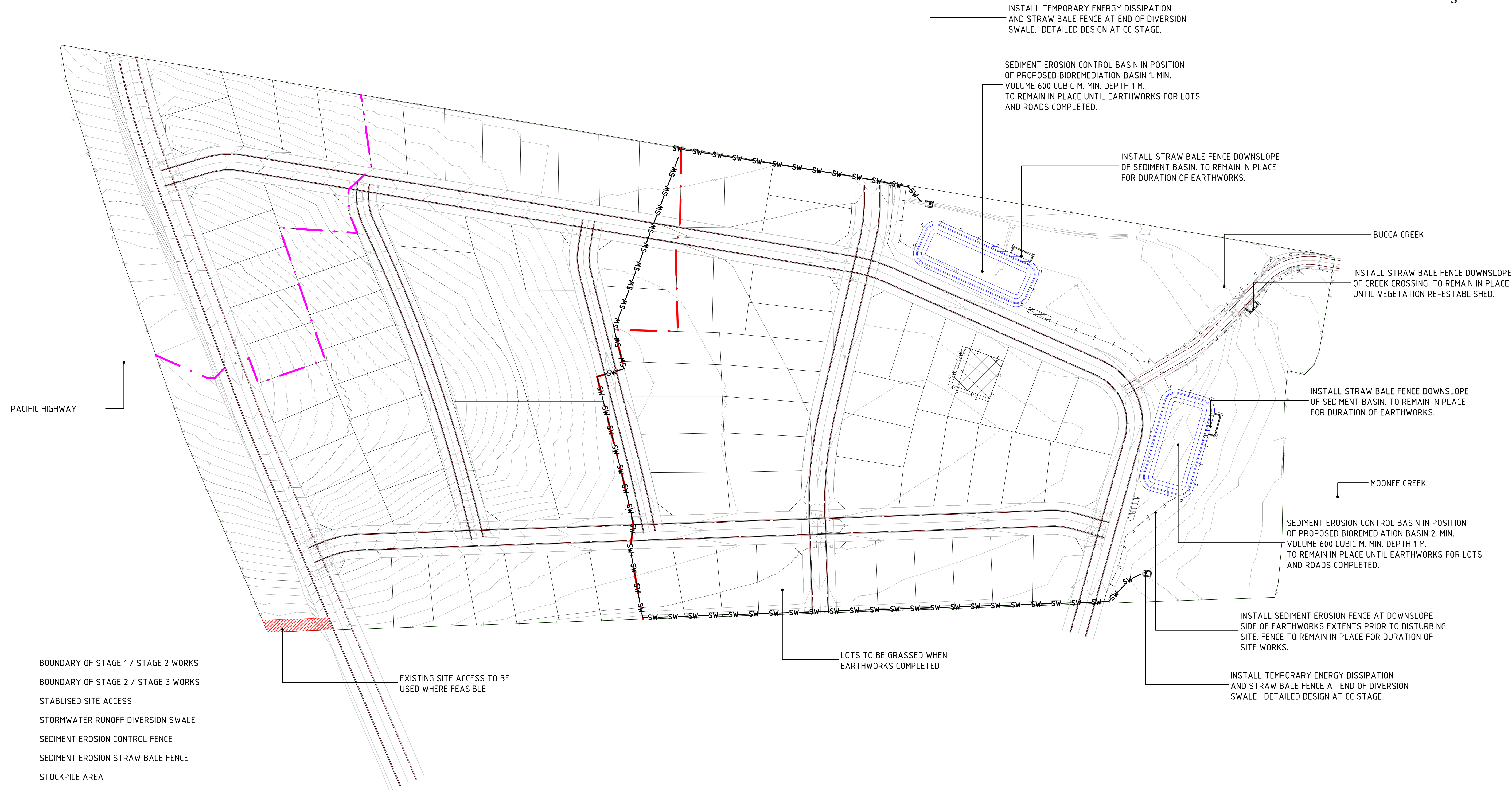
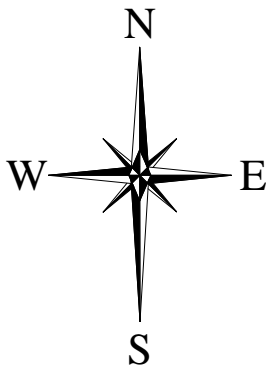
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2. BIOREMEDIATION BASINS SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT
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A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM	PAGE BAR SCALE  UNITS - METRES SCALE - 1:1000 @ A1 1:2000 @ A3 <small>(C) Copyright Martens & Associates Pty Ltd This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd</small>	REVIEWED: GT	HORIZONTAL RATIO: 1:1000	JW PLANNING PTY LTD MOONEE BEACH		PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A
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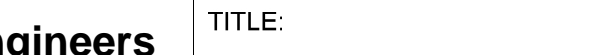

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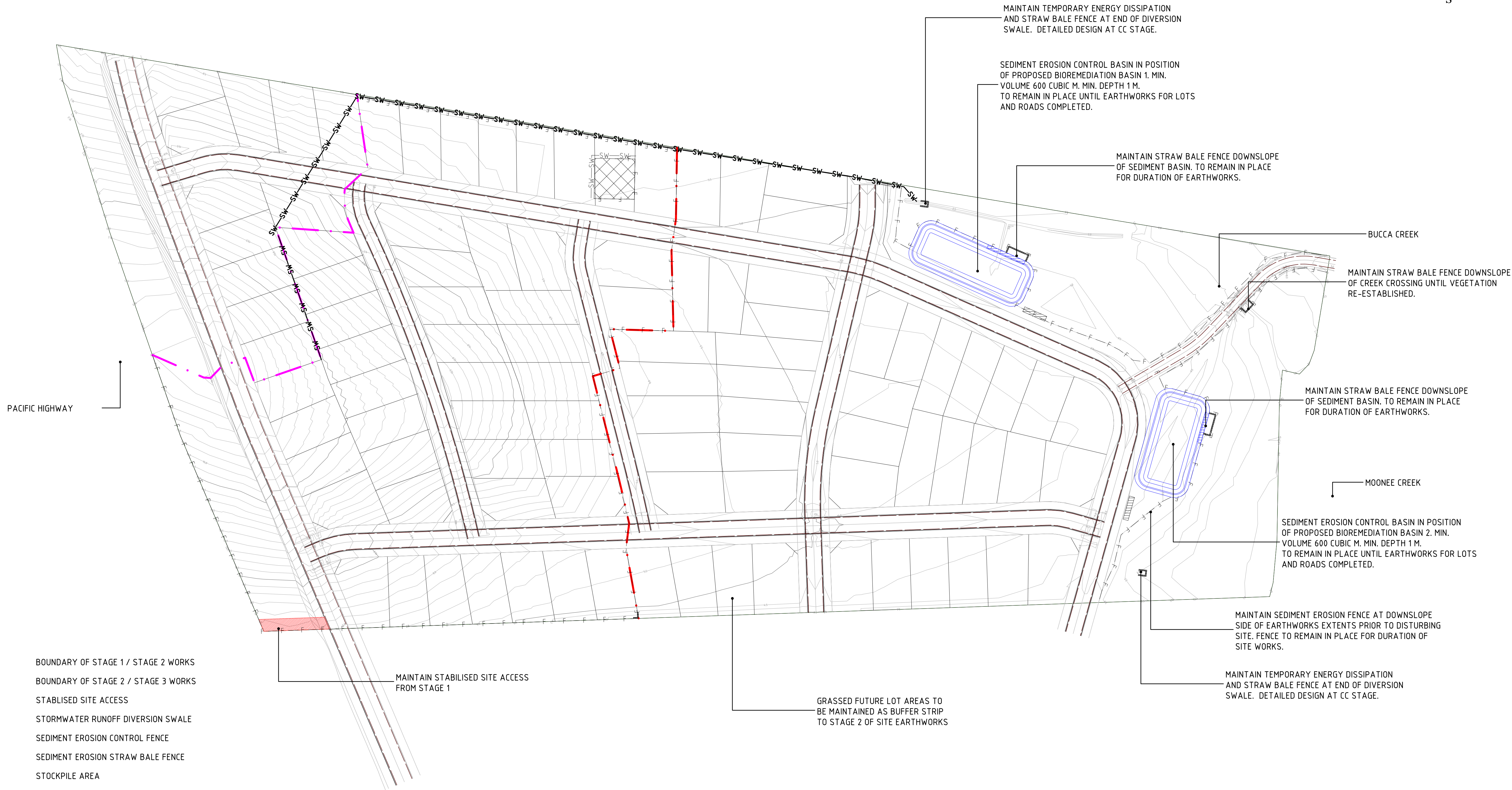
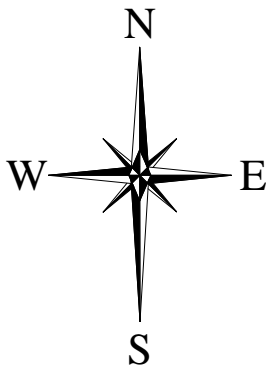


KEY

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

NOTES: 1. CATCHMENTS TO SEDIMENT BASINS 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 BASINS SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

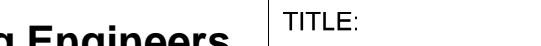

REV.	DESCRIPTION	DATE	ISSUED	BAR SCALE	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT	<div><div><div>Consulting Engineers Environment Water Geotechnical Civil</div></div><div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div></div>	TITLE:	DRAWING ID:		
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM	<div>PAGE BAR SCALE</div> <div></div> <div>UNITS - METRES</div> <div>SCALE - 1:1000 @ A1 1:2000 @ A3</div> <div>(C) Copyright Martens & Associates Pty Ltd</div> <div>This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd</div>	REVIEWED: GT	HORIZONTAL RATIO: 1:1000	JW PLANNING PTY LTD MOONEE BEACH		CONCEPT STORMWATER MANAGEMENT PLAN SET SOIL AND WATER MANAGEMENT - STAGE 1 EARTHWORKS	SK125		
B	ATTACHMENT A	13.03.06	DMM		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		PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A

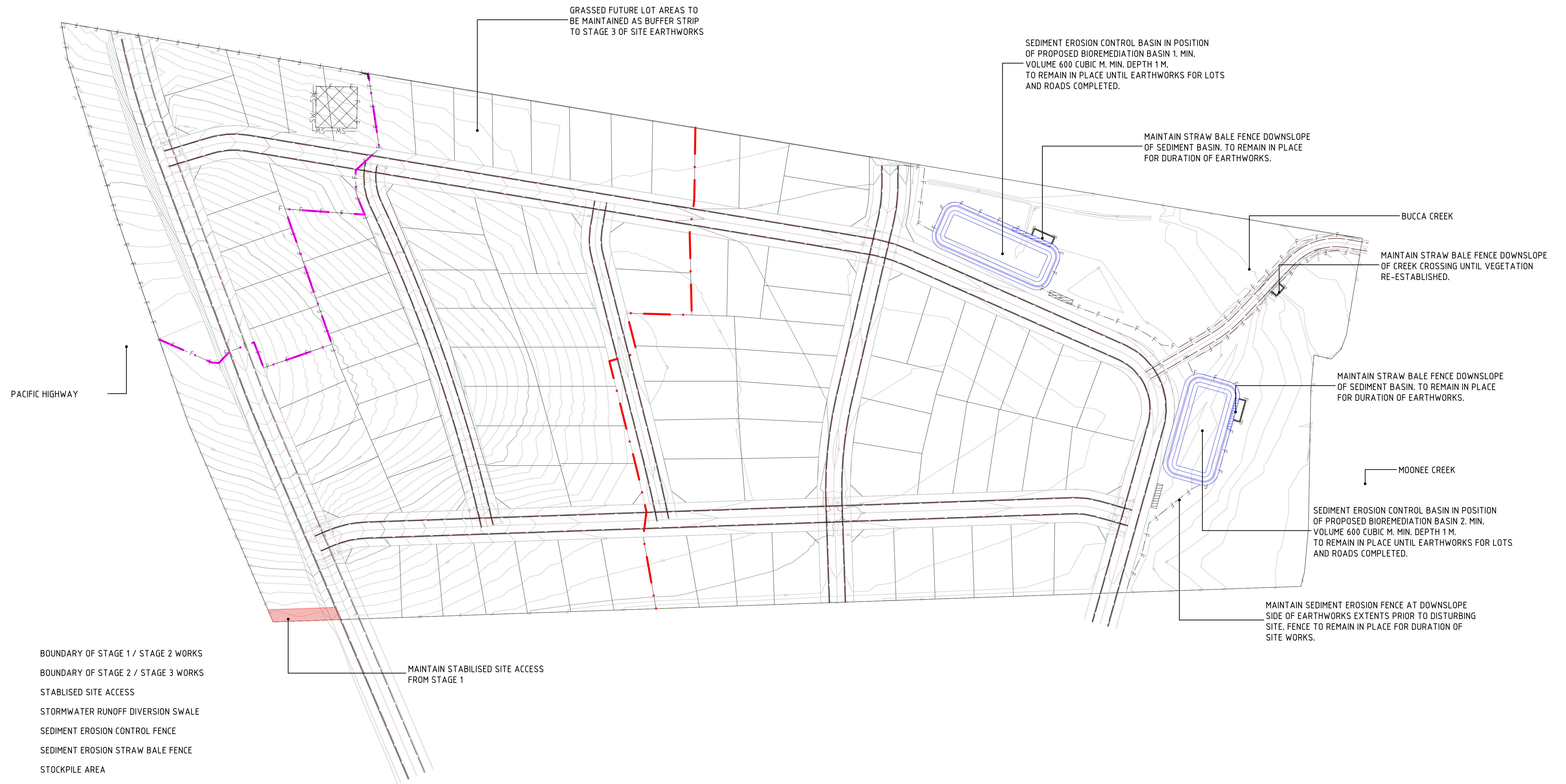
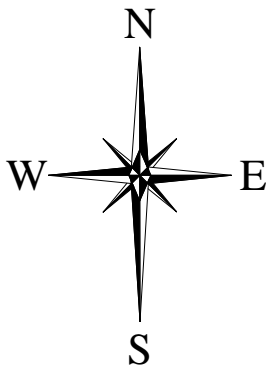


KEY

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

NOTES: 1. CATCHMENTS TO SEDIMENT BASINS 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 BASINS SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.



REV.	DESCRIPTION	DATE	ISSUED	BAR SCALE	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT	<div><div>Consulting Engineers <i>Environment Water Geotechnical Civil</i></div><div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div></div>	TITLE:	DRAWING ID:		
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM	<div>PAGE BAR SCALE</div> <div></div> <div>UNITS - METRES</div> <div>SCALE - 1:1000 @ A1 1:2000 @ A3</div> <div>(C) Copyright Martens & Associates Pty Ltd</div> <div>This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd</div>			JW PLANNING PTY LTD MOONEE BEACH		CONCEPT STORMWATER MANAGEMENT PLAN SET SOIL AND WATER MANAGEMENT - STAGE 2 EARTHWORKS	SK126		
B	ATTACHMENT A	13.03.06	DMM		REVIEWED: GT	HORIZONTAL RATIO: 1:1000						
					PAPER SIZE: A1	VERTICAL RATIO: 1:1000						
									PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A



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. CATCHMENTS TO SEDIMENT BASINS 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 BASINS SHOWN INDICATIVE ONLY. FINAL CONFIGURATION AND ALIGNMENT SUBJECT TO DETAILED DESIGN AT CONSTRUCTION CERTIFICATE STAGE.

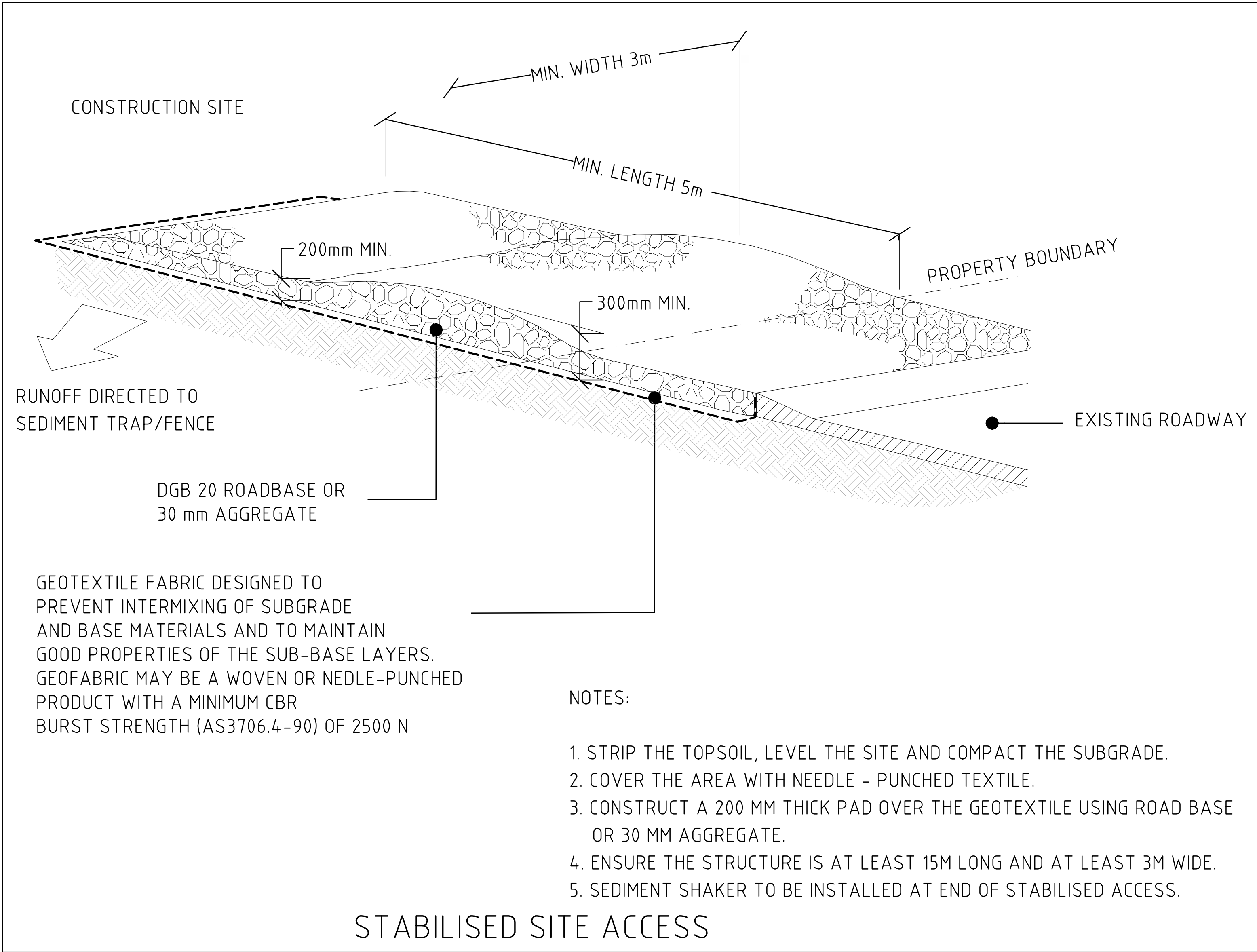
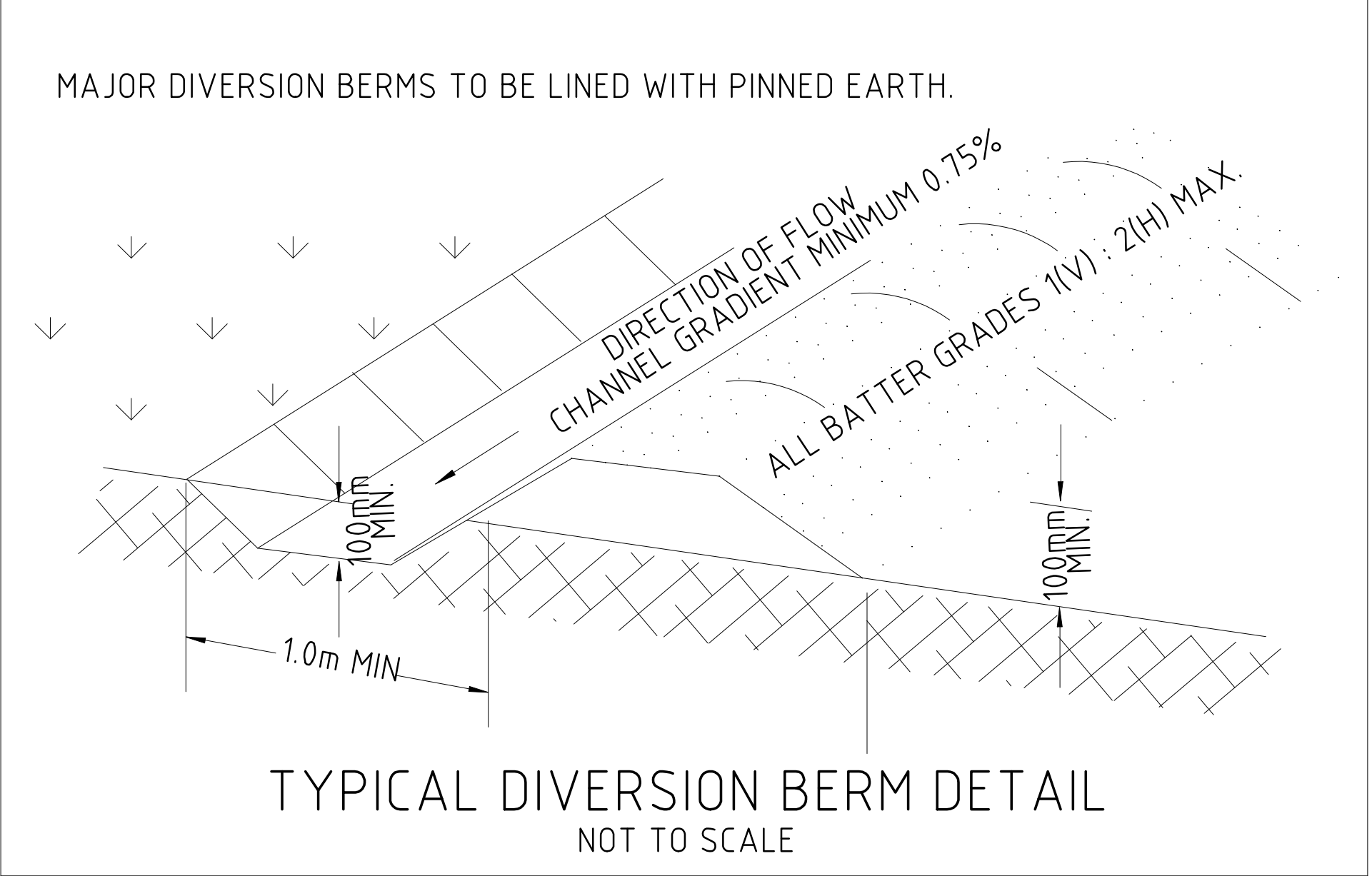
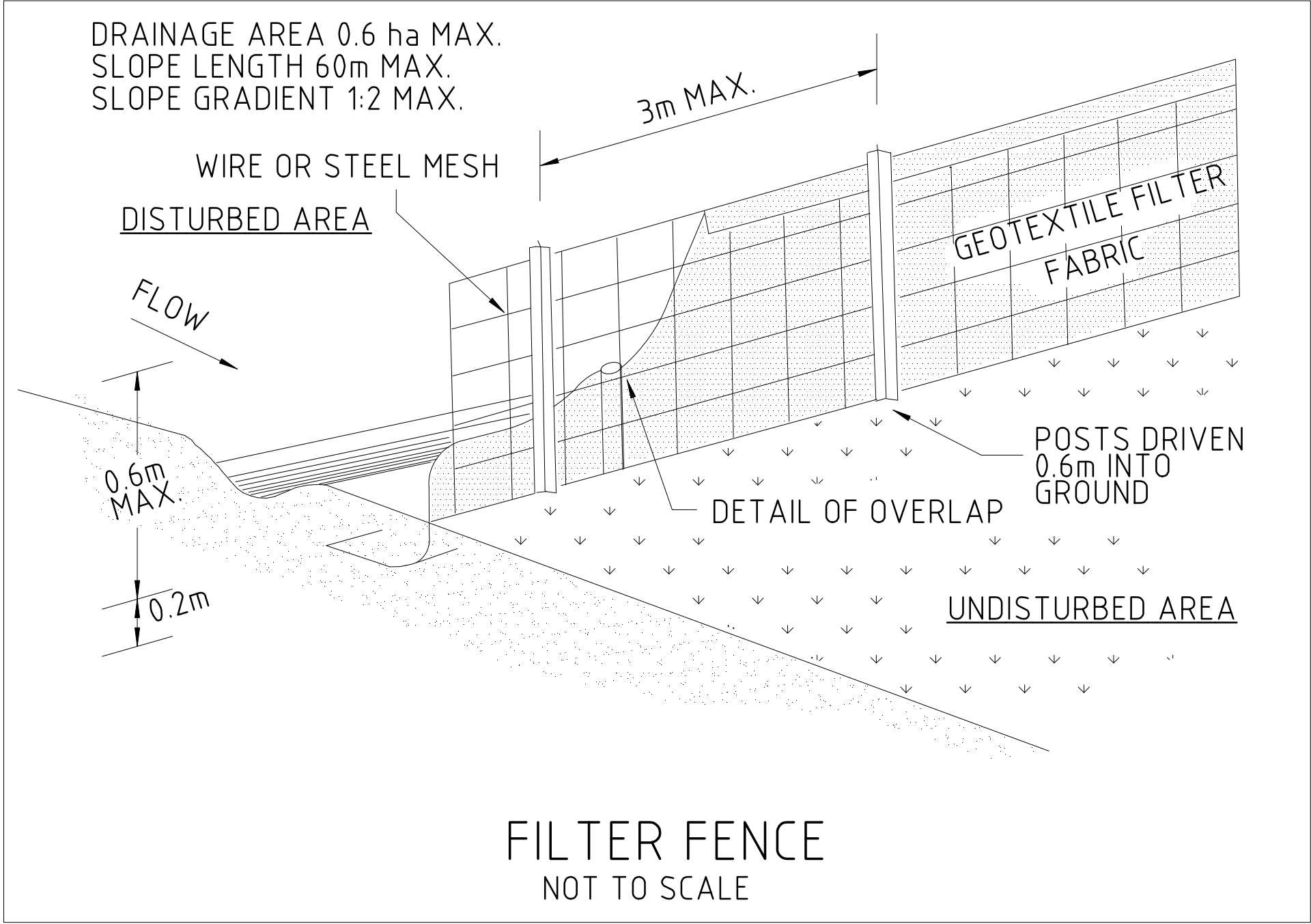
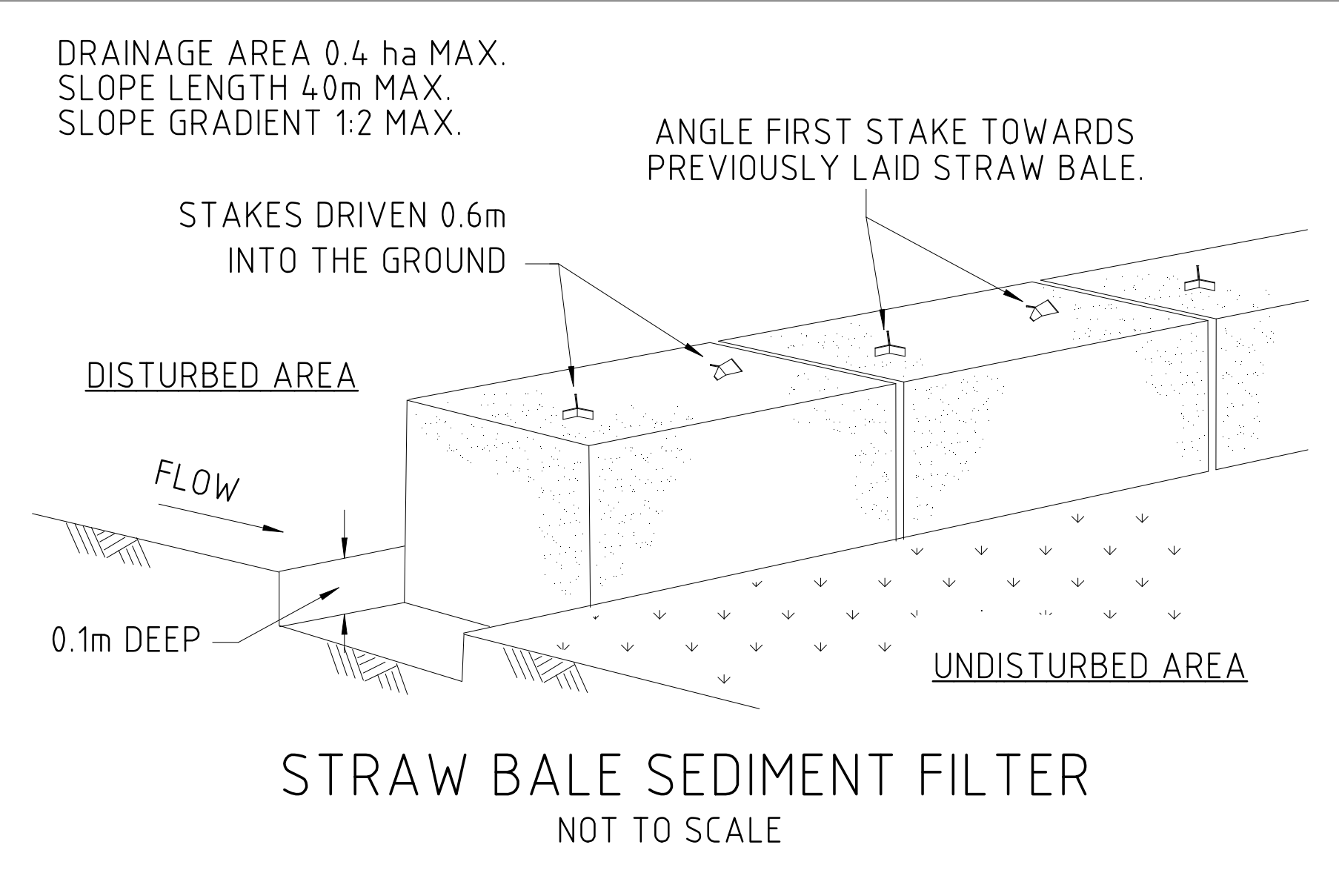
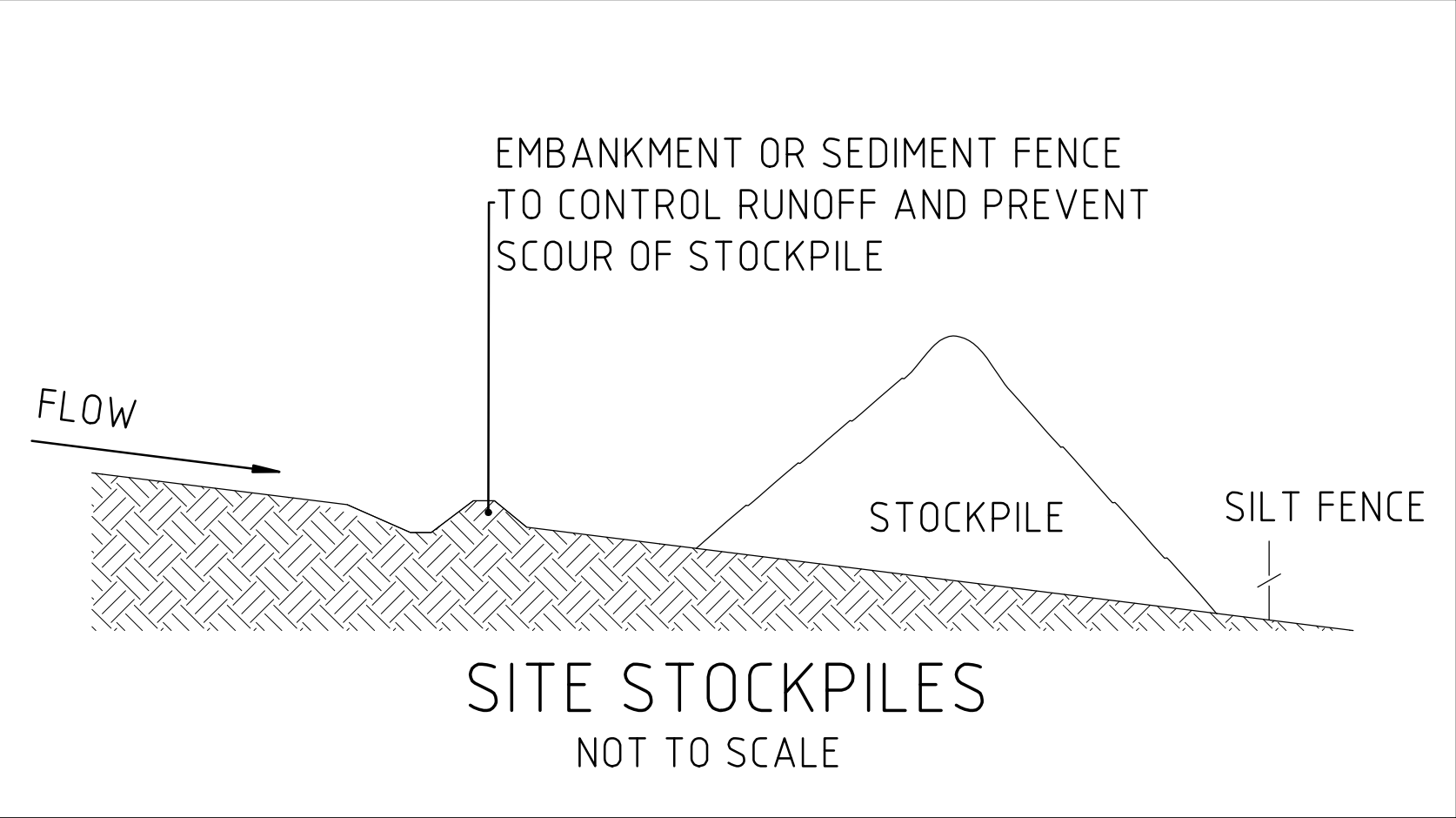
REV.	DESCRIPTION	DATE	ISSUED	<div>BAR SCALE</div> <div>PAGE BAR SCALE</div> <div></div> <div>UNITS - METRES</div> <div>SCALE - 1:1000 @ A1 1:2000 @ A3</div> <div>(C) Copyright Martens & Associates Pty Ltd</div> <div>This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd</div>	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT JW PLANNING PTY LTD MOONEE BEACH	<div></div> <div>Consulting Engineers</div> <div>Environment Water Geotechnical Civil</div> <div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div>	TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET SOIL AND WATER MANAGEMENT - STAGE 3 EARTHWORKS			DRAWING ID: SK127
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM		REVIEWED: GT	HORIZONTAL RATIO: 1:1000			PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	
B	ATTACHMENT A	13.03.06	DMM		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							


GENERAL NOTES

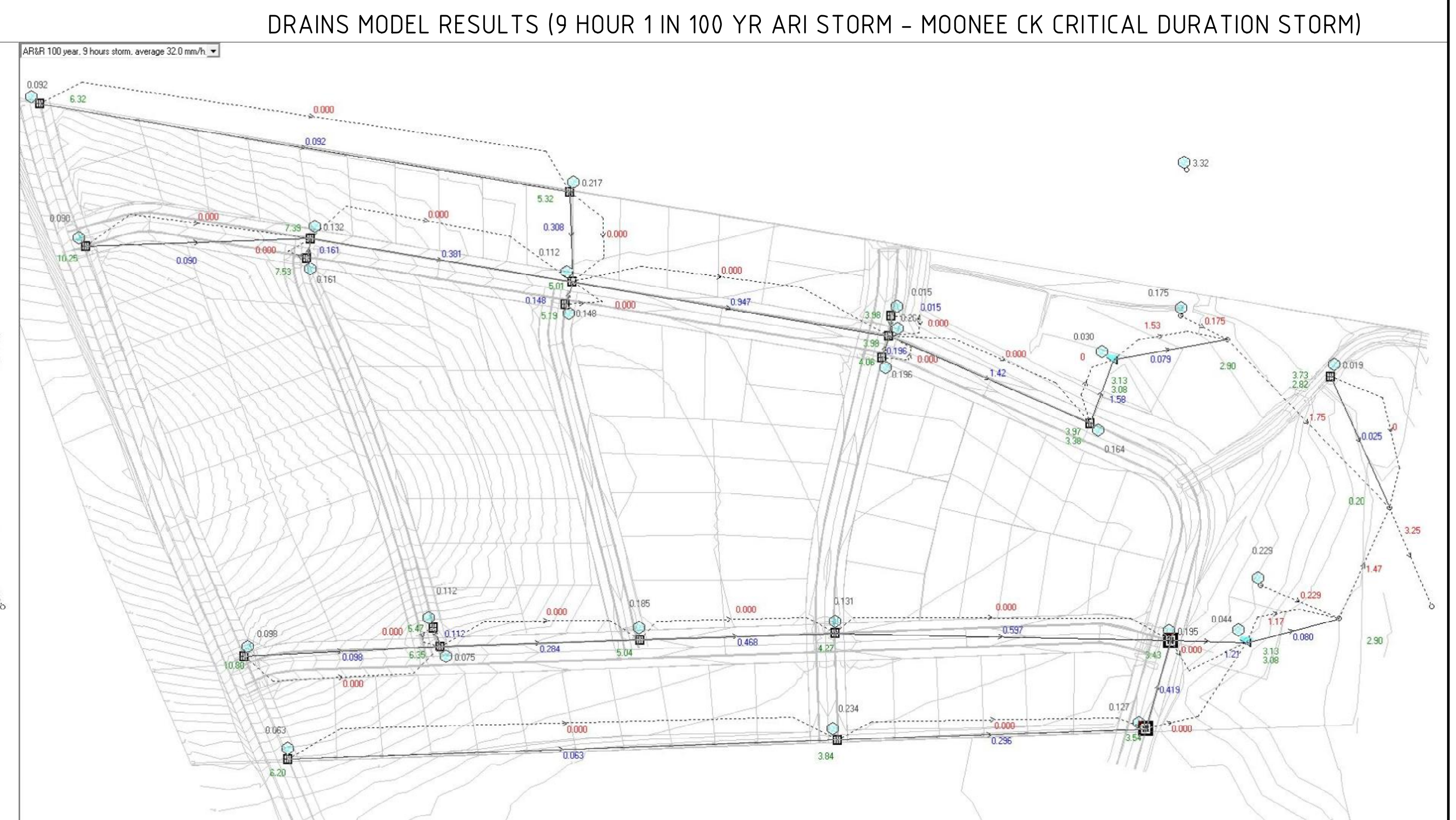
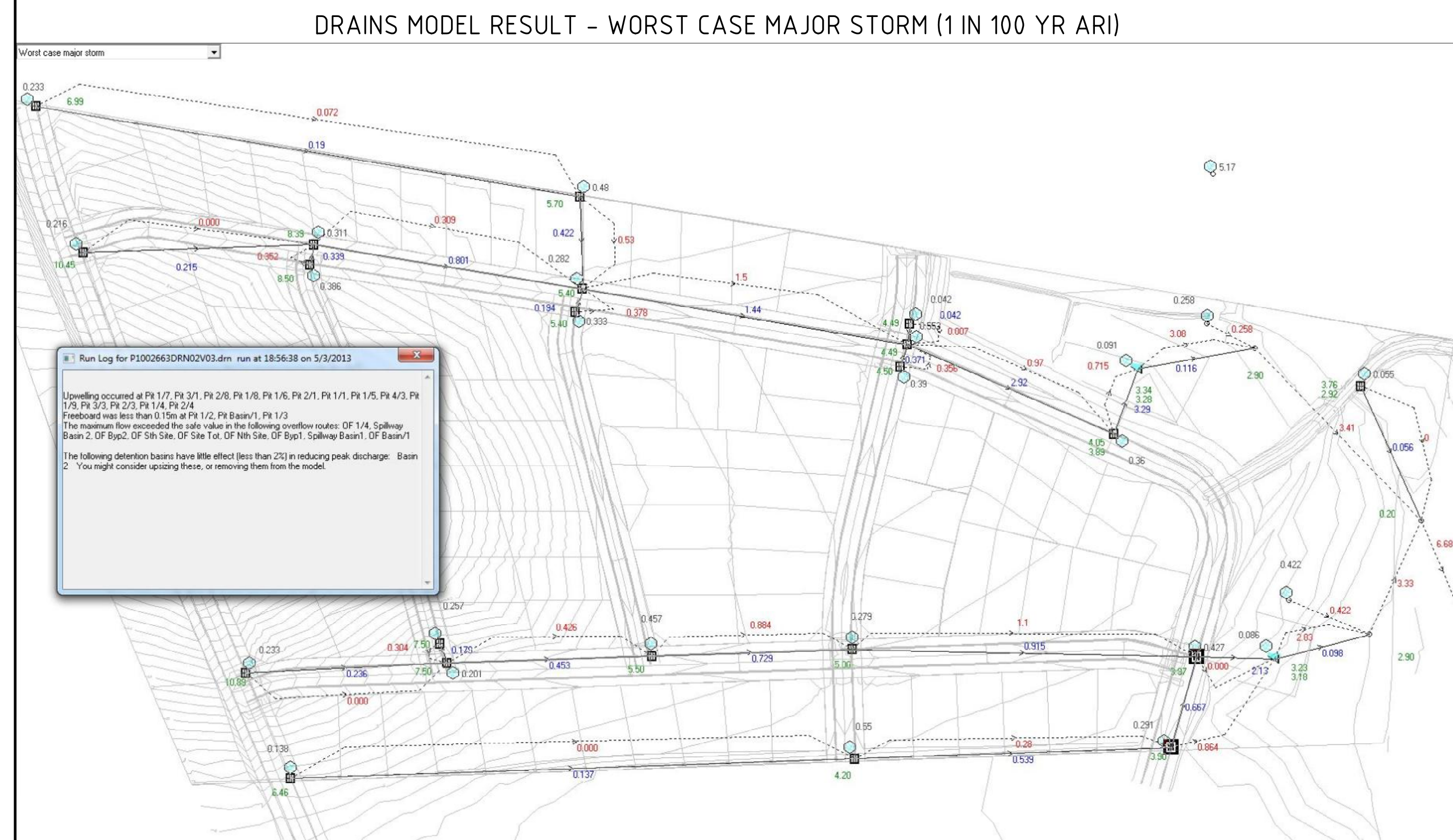
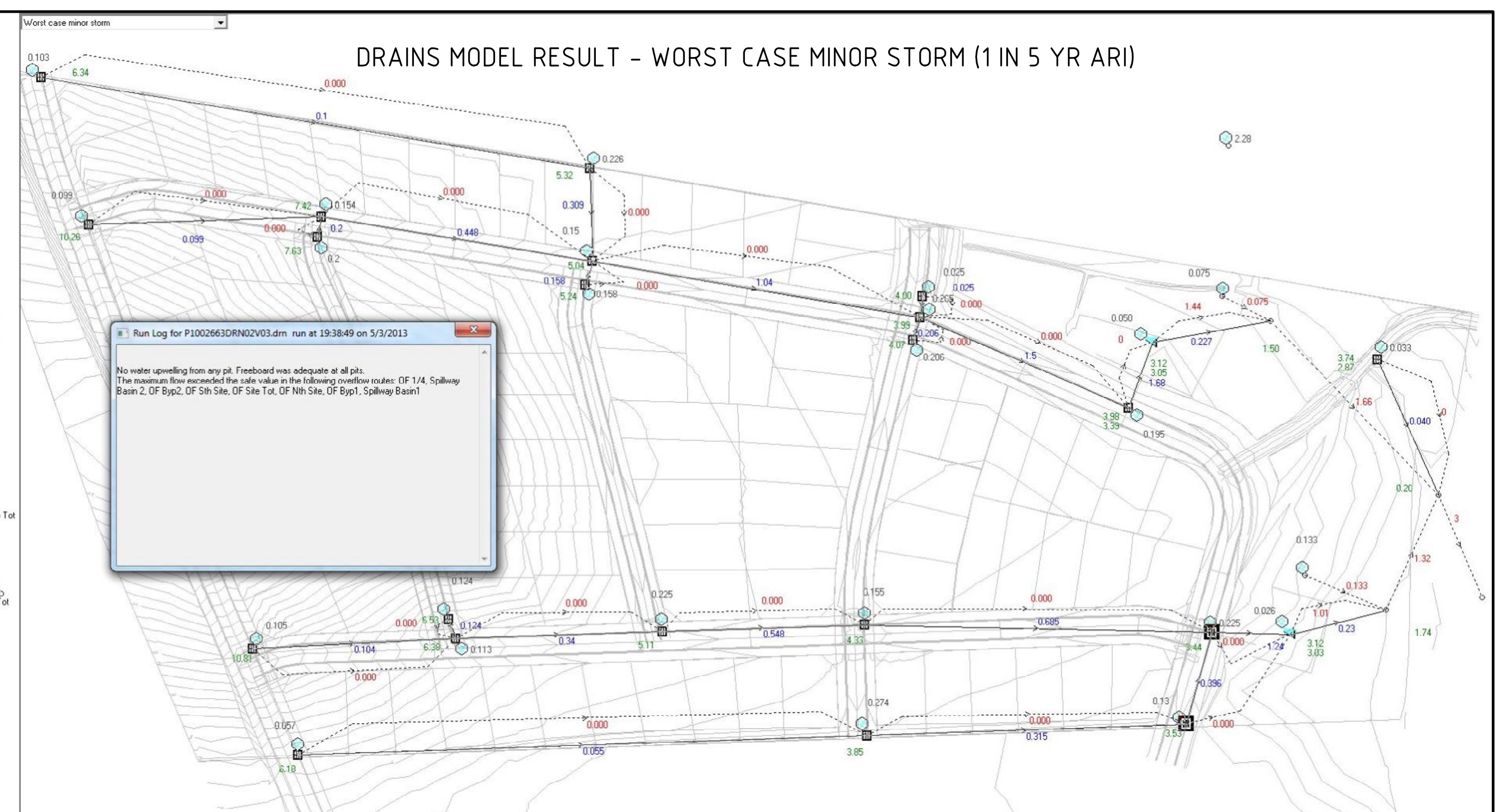
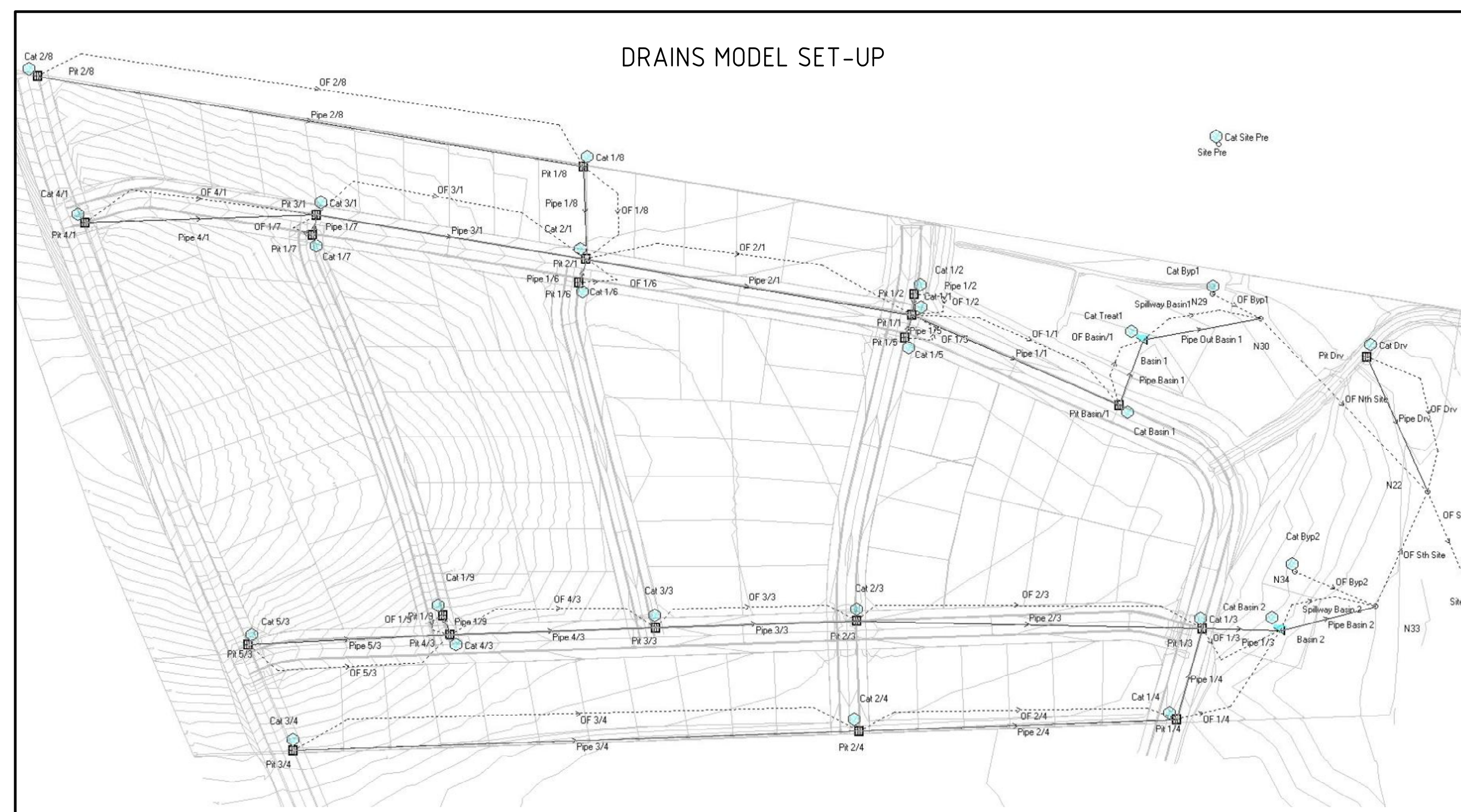
- 1. ALL SEDIMENT AND EROSION CONTROL MEASURES TO BE IN ACCORDANCE WITH NSW LANDCOM (2004).
- 2. CONTRACTOR TO KEEP DISTURBED AREAS TO A MINIMUM WHERE FEASIBLE AND TO RE-ESTABLISH VEGETATION COVER IMMEDIATELY FOLLOWING COMPLETION OF WORKS.
- 3. SEDIMENT AND EROSION CONTROL MEASURES REFERRED TO ON THIS 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

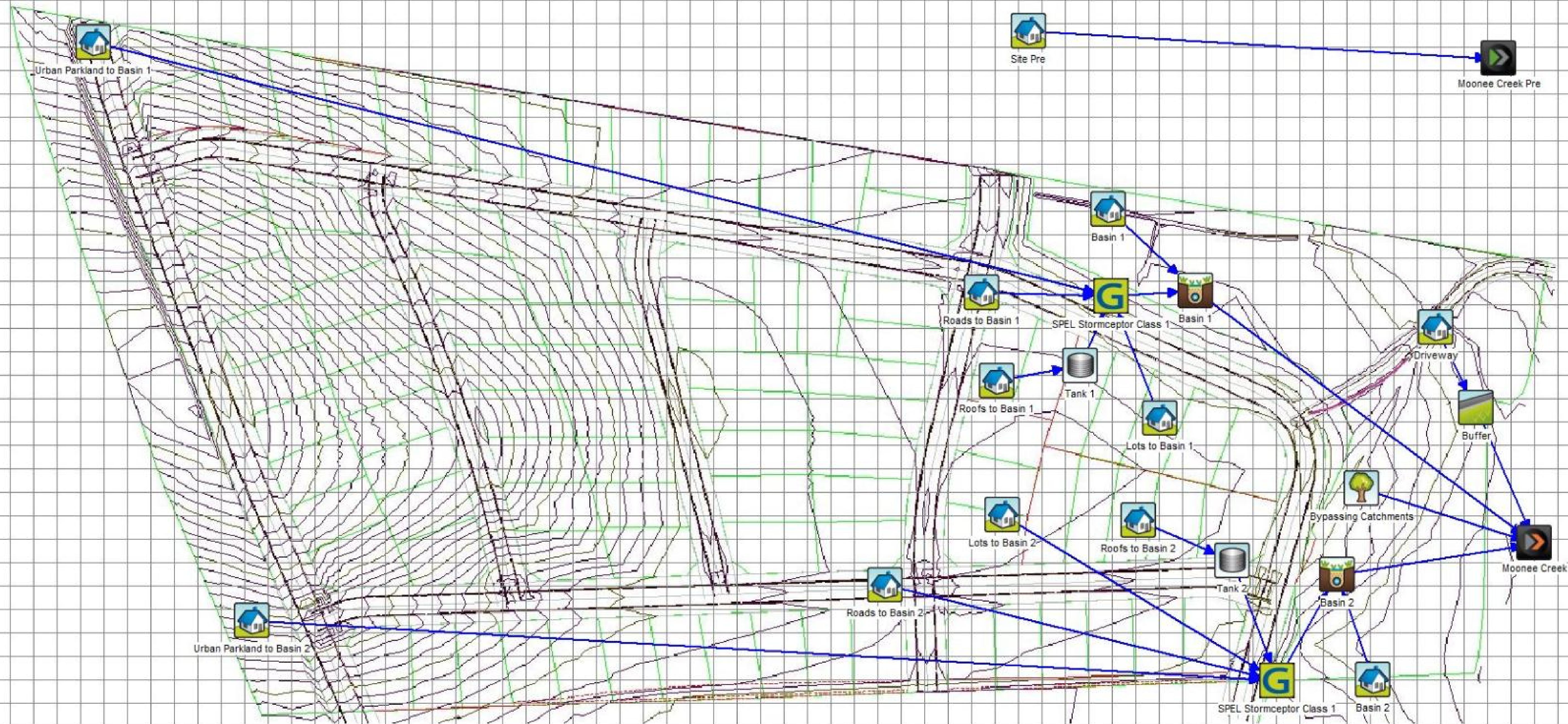
- 1. CONSTRUCT STABILISED SITE ACCESSSES.
- 2. ESTABLISH SEDIMENT FENCES AT DOWNSLOPE END OF SITE.
- 3. INSTALL SURFACE FLOW DIVERSION BUNDS.
- 4. INSTALL STRAW BALE FENCES.
- 5. CONSTRUCT TEMPORARY SEDIMENT BASINS.
- 6. REMOVAL OF ALL SEDIMENT AND EROSION CONTROL MEASURES ONCE VEGETATION IS ESTABLISHED.




REV.		DESCRIPTION	DATE	ISSUED	BAR SCALE	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT JW PLANNING PTY LTD MOONEE BEACH	<div><div>Consulting Engineers <i>Environment Water Geotechnical Civil</i></div></div> <div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div>	TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET SOIL AND WATER MANAGEMENT - TYPICAL DETAIL			DRAWING ID: SK128
A	DRAFT PLAN FOR CLIENT REVIEW		13.03.05	DMM		REVIEWED: GT	HORIZONTAL RATIO: NTS						
B	ATTACHMENT A		13.03.06	DMM									
						(C) Copyright Martens & Associates Pty Ltd This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd				PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A



REV.	DESCRIPTION	DATE	ISSUED	BAR SCALE	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT	<div><div>Consulting Engineers <i>Environment Water Geotechnical Civil</i></div></div> <div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div>	TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET DRAINS MODEL LAYOUT AND SUMMARY OF RESULTS			DRAWING ID: SK129
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM		REVIEWED: GT	HORIZONTAL RATIO: NTS	JW PLANNING PTY LTD MOONEE BEACH		PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A
B	ATTACHMENT A	13.03.06	DMM		PAPER SIZE: A1	VERTICAL RATIO: NTS						
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REV.	DESCRIPTION	DATE	ISSUED	BAR SCALE <div>(C) Copyright Martens & Associates Pty Ltd This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd</div>	DESIGNED: MGD	DATUM: mAHD	CLIENT / PROJECT JW PLANNING PTY LTD MOONEE BEACH	<div><div><div>Consulting Engineers</div><div>Environment Water Geotechnical Civil</div></div><div>6/37 Leighton Place, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: http://www.martens.com.au</div></div>	TITLE: CONCEPT STORMWATER MANAGEMENT PLAN SET MUSIC MODEL LAYOUT			DRAWING ID: SK130
A	DRAFT PLAN FOR CLIENT REVIEW	13.03.05	DMM		REVIEWED: GT	HORIZONTAL RATIO: NTS	THIS PLAN MUST NOT BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED BY PRINCIPAL CERTIFYING AUTHORITY All measurements in mm unless otherwise specified		PROJECT MANAGER: G. TAYLOR	PROJECT NO.: P1002663	FILE: JD11V01	REVISION: A
B	ATTACHMENT A	13.03.06	DMM									