

PROJECT
**STORMWATER
MANAGEMENT PLAN
KINGS FOREST STAGE 1
PROJECT APPLICATION
KINGS FOREST
NEW SOUTH WALES**

PREPARED FOR
PROJECT 28 PTY LTD

DATE
JUNE 2011

**+GILBERT
SUTHERLAND**

DOCUMENT CONTROL

DOCUMENT 10468_SWMP_RAG2F.docx

TITLE Stormwater Management Plan, Kings Forest Stage 1 Project Application, Kings Forest, New South Wales

PROJECT MANAGER N. Sutherland

AUTHOR(S) N. Gifford

CLIENT Project 28 Pty Ltd

CLIENT CONTACT Reg van Rij

CLIENT REFERENCE –

SYNOPSIS This management plan supports an Integrated Water Cycle Management Strategy for the Kings Forest Stage 1 Project Application area, with a particular focus on the Precinct 5 detailed development. It establishes responsibilities and procedures for the management of erosion, sediment and stormwater during the construction, on-maintenance and operational phases of the project.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY
1	12/09	A. Genn	N. Zurig & N. Sutherland
2	2/11	N. Gifford	N. Zurig & N. Sutherland
3	6/11	M. Hancock	N. Zurig & N. Sutherland

DISTRIBUTION

	REVISION NUMBER									
Distribution	1	2	3	4	5	6	7	8	9	10
Project 28 Pty Ltd	3	1	1							
JBA Planning	-	1	1							
G&S file	1	1	1							

BRISBANE

CAIRNS

KAWANA

ROBINA

5/232 Robina Town Centre Dr.
PO Box 4115
Robina Q4230

Phone 07 5578 9944

Fax 07 5578 9945

robina@access.gs

Gilbert and Sutherland Pty Ltd
ABN 56 077 310 840

www.access.gs

SUMMARY

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare an Integrated Water Cycle Management Strategy and Stormwater Management Plan (SWMP) for the Stage 1 Project Application for the proposed development of the Kings Forest site at Kings Forest, New South Wales.

Presently, preliminary bulk earthworks design, site grading and drainage design have been prepared for the entirety of the Stage 1 area. Detailed road and allotment layouts have also been completed for Precinct 5. This SWMP will therefore focus on Precinct 5 and additional plans will be required at the detailed design phase for each Precinct.

This Stormwater Management Plan provides procedures aimed at achieving site-specific stormwater quality objectives during the construction, on-maintenance and operational phases. Ideally it should be included in the contract documents for the earthworks, roadworks and drainage construction works in this project.

This report addresses the issues raised in the New South Wales Department of Planning Director-General's Environmental Assessment Requirements (DGRs) dated December 23, 2010 in relation to Stormwater Management (DGR No. 7.3A):

'A Stormwater Management Plan is to be provided which includes a detailed design layout plan for the preferred stormwater treatment train showing location, size and key functional elements of each part of the system must be submitted with each development application for subdivision. MUSIC modelling must be undertaken to demonstrate appropriate water quality objectives are being achieved. The Plan is to demonstrate, through the provision of monitoring and adaptive management plans and commitments, that any proposed surface water/stormwater pollution reduction devices will be monitored to determine their pollutant removal efficiencies and the need for further treatment of drainage to ensure the preservation of water quality in Cudgen Creek and Blacks Creek.'

CONTENTS

1	SWMP structure	5
1.1	Objectives	5
1.2	Implementation.....	5
1.3	SWMP structure	5
1.4	Site-specific objectives.....	5
1.5	General commitments	7
1.6	Definitions	7
1.7	Contact details	7
2	Bulk earthworks and civil construction phases	9
2.1	Dust management.....	10
2.2	Sediment and erosion controls.....	12
2.3	Surface water monitoring on site.....	15
2.4	Surface water monitoring – permanent treatment measures	17
2.5	Contractor management	20
3	Management of potential impacts – on maintenance phase	21
3.1	Intent	21
3.2	Implementation.....	21
3.3	Sediment and erosion controls.....	22
3.4	Surface water monitoring	23
3.5	Maintenance of treatment measures.....	27
4	Management of potential impacts – operational phase ..	29
4.1	Intent	29
4.2	Implementation.....	29
4.3	Surface water monitoring	30
4.4	Maintenance of treatment measures.....	32
5	Administration of the SWMP	34
5.1	Amendment of the SWMP.....	34
5.2	Incident management.....	34

1 SWMP structure

1.1 Objectives

The principal objective of this SWMP is to provide mitigation measures to minimise the potential impacts of the development.

Additionally, the SWMP provides information on specific site management issues relating to potential environmental impacts from the development during the construction and operational phases.

The control measures detailed in this SWMP have been developed to minimise impacts on the environment and achieve the following objectives:

- appropriate stewardship of natural resources;
- protection of downstream flora and fauna habitats,;
- confirmation of the success of impact control measures by the means of monitoring during the construction of each stage;
- compliance with statutory requirements; and
- preservation of the existing groundwater conditions.

1.2 Implementation

The management plan requires the Proponent to mitigate the potential environmental impacts associated with the construction of the subdivision works.

It is intended that the SWMP will provide a set of performance criteria and guiding principles with which the engineering designs for the development will comply. The plans and specifications forming part of the construction contract for each stage should also include these performance criteria.

1.3 SWMP structure

This SWMP acknowledges the environmental impacts associated with the development and details strategies to mitigate them.

Each control strategy is based upon proven environmental management methods and is presented as a commitment. The commitments made within this document will form the basis of future assessments, which will be made available to the Tweed Shire Council for review.

1.4 Site-specific objectives

The stormwater quality objectives and environmental management strategies detailed in this SWMP are designed to comply with relevant laws and regulations while acknowledging the specific characteristics and localised environmental context of the site. The application of relevant legislation, guidelines and standards may necessitate specific consideration of unique or unusual natural and/or human factors in the local environment. Where necessary, variations to the relevant guidelines may be sought and, where approved, included in this SWMP.

This SWMP includes tables detailing objectives and management strategies for the construction, on-maintenance and the operational phases of the Kings Forest Stage 1 development. The party responsible for the implementation of the measures detailed is written on the table itself. The tables then detail the issue, the performance criteria, the implementation strategy, monitoring, auditing,

reporting, failure identification and the corrective action. The detachable pages within each section detail the provisions of the SWMP. The format is presented below for reference purposes.

Title

Applies to	The relevant construction stages to which the issue detailed on this page applies.
Person responsible	This is the person or party who has accepted the responsibility of implementing the SWMP provisions detailed on this page.

Issue	The issue with which the table deals.
Operational policy	The operational policy or management objective that applies to the element.
Performance criteria	Performance criteria (outcomes) for each element of the operation.
Implementation strategy	The strategies or tasks (to nominated operational design standards) that will be implemented to achieve the performance criteria.
Monitoring	The monitoring requirements which will measure actual performance (i.e. specified limits to pre-selected indicators of change).
Auditing	The auditing requirements, which will verify implementation of, agreed construction and operation phase environmental management strategies and compliance with agreed performance criteria.
Reporting	Content, timing and responsibility for reporting and auditing of monitoring results.
Identification of incident or failure	The circumstances under which the agreed performance criteria are unlikely to be met and environmental harm is likely to result.
Corrective action	The action to be implemented in case a performance requirement is not reached and the company(s) responsible for action.

Commitment

What the management has committed the company to.

An objective of the tabular format is to allow for change and allow the SWMP to be a working document. If items need altering, changes may be made to the individual tables after appropriate consultation with the statutory authorities.

1.5 General commitments

Commitment 1

The Proponent undertakes to comply with the environmental implementation strategy as contained within the approved Stormwater Management Plan (SWMP) on a stage-by-stage basis

Commitment 2

The Proponent undertakes to fulfil all commitments made in this SWMP and to carry out their activities at the project site in accordance with relevant current statutory requirements and approved amendments.

Compliance with the provisions of this SWMP requires the objectives and management strategies contained herein to be both reasonable and achievable within the context of the approval(s) to which they relate. Incidents and/or failures that involve factors beyond the control of the responsible party(s) and the response and/or corrective actions taken by the responsible party(s) should be considered in assessing compliance with this SWMP.

1.6 Definitions

In this SWMP these terms have the following meanings;

- SWMP means the approved Stormwater Management Plan and includes any amendments that may be approved from time to time.
- Development means the development of the site in accordance with the Kings Forest Stage 1 Project Application.
- TSC means Tweed Shire Council.
- Proponent means the person undertaking the construction of the proposed Kings Forest Stage 1 and includes the person nominated by the Proponent as having the responsibility for implementing the provisions of the SWMP.
- DECCW means the Department of Environment, Climate Change and Water.

1.7 Contact details

The following persons are responsible for the implementation of the management measures described in the individual tables of the SWMP.

Contractor's Site Manager

The name and address of the Contractor and its representative will be notified to Council by the Consulting Engineer prior to the commencement of each contract/stage of the project.

Consulting Engineer

Unless advised otherwise the Consulting Engineer is:

Company: Mortons Urban Solutions
 Address: PO Box 2484
 Southport Qld 4211
 Contact Details: Mr Warren Morton
 Phone: 55711099
 Facsimile: 55711088

Environmental Consultant

Unless advised otherwise the Environmental Consultant is:

Company	Gilbert & Sutherland Pty Ltd
Address:	Eastside 5/232 Robina Town Centre Drive
	PO Box 4115
	Robina Q 4230
Contact Details:	Mr Neil Sutherland
Phone:	55789944
Facsimile:	55789945

2 Bulk earthworks and civil construction phases

The SWMP requires the Proponent to mitigate the potential environmental impacts associated with the construction of the subdivision works.

Prior to commencement of construction in any stage, detailed erosion and sediment control plans will be prepared, based on the requirements of this SWMP and the NSW Landcom, *Managing Urban Stormwater Soils and Construction*,¹ and submitted to and approved by Council.

The development should be built in stages to minimise the potential for soil erosion and water pollution. This would enable the site to be progressively rehabilitated as the development proceeds.

As soon as is practicable after the completion of the earthworks, the disturbed areas will be reseeded to establish a fast-growing cover crop which will minimise erosion and movement of sediment across and off the site. On steeper slopes and the road cuttings, it is likely that hydromulching and/or placing of hoop pine mulch will be required.

Wherever possible the site will remain grassed and otherwise undisturbed until construction commences.

Although no MUSIC modelling has been completed for the construction phase, it is evident that temporary sedimentation ponds and other sediment control measures should be installed during this phase.

Prior to commencement of earthworks in any stage, temporary sedimentation ponds should be installed. The exact number, location and size will be determined at the detailed design stage concurrently with the development of the staging plan. All runoff from disturbed areas is to be collected by means of surface drains and diverted to a sedimentation pond. Where practicable, runoff from undisturbed areas should be diverted around disturbed areas and away from the sedimentation pond. The temporary sedimentation ponds may be removed when the site has been revegetated, after completion of the bulk earthworks.

Other control measures such as (but not limited to) temporary sedimentation basins, silt fences and contour drains should be installed and maintained in accordance with recommendations contained in the NSW Landcom, *Managing Urban Stormwater Soils and Construction*.

Erosion and sediment control measures must be installed in disturbed areas during the building construction phase in accordance with the requirements of Council's *Sediment and Erosion and Control Guidelines for Builders and Developers*. These measures should be maintained until landscaping has been completed and becomes established.

The soils identified on the site are assessed as low to very low fertility soils. Nevertheless, it is considered that nutrient transport from the site during the construction phase should be minimised by implementation of appropriate control measures.

The following detachable pages detail the provisions of this SWMP for the construction phase.

¹ Landcom, 2004, 'Managing Urban Stormwater, Soils and Construction' 4th Edition, March 2004.

2.1 Dust management

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractors site manager.

Issue	Minimisation of movement of dust offsite.
Operational policy	To achieve acceptable air quality standards through the control of the movement of dust offsite from site works.
Performance criteria	The target level for complaints by nearby residents is no more than one in any seven day period. Ambient air quality should not deteriorate by more than 30% over a period of seven consecutive days. Dust deposition at any nearby residence should not exceed 100µg/m ² /day.
Implementation strategy	The minimisation of the movement of dust offsite will be achieved through the following onsite practices: • Construction works shall be staged where appropriate to limit the areas exposed at any one time. • All permanent bunds and reshaped areas will be revegetated within 10 days after completion of earthworks (including excavation and backfilling of services trenches). • Stockpiling onsite will be minimised where possible. • Ground surfaces will be kept damp (not wet). • Surfaces shall be left in a rough cloddy condition to increase roughness and slow surface wind speed. • An on-site water cart will be available at all times. • All work to cease if wind speed exceeds 10m/sec. • Contractors staff to be trained to implement dust minimisation measures. • Protective ground covers shall be provided, including mulches, vegetation, organic binders or dust retardants. • Traffic movement on any disturbed areas shall be minimised.
Monitoring	Daily inspections will be carried out to verify that dust mitigation measures are being implemented. Dust monitoring will be conducted upon receipt of complaints by residents. If dust monitoring is to take place, the following will occur: • temporary dust deposition gauges will monitor the movement of dust offsite at the nearest residences adjacent to the proposed stages and within the predominant wind directions; and • monitoring will be undertaken in accordance with AS 3580.10.1(1991).
Auditing	Management to examine the complaints register weekly and review corrective action taken.

Reporting	• The contractor to notify DECCW of a possible environmental nuisance on receipt of 3 or more dust complaints in any 24 hour period. • Receipts will be provided to TSC upon request. • Complaints by residents are to be recorded in a Complaints Register and notified to TSC.
Identification of incident or failure	Any dust-related complaints by residents will indicate a failure of the dust control measures.
Corrective action	Locate the source of the dust and implement the following measures: • Apply water sprays to vegetation. • Cover or water exposed areas. • If dust persists, cease the dust creating activities. • All dust complaints to be addressed in consultation with council officers.

Commitment 3

Dust generated during the construction of the subdivision works will be managed to ensure that dust movement offsite is controlled.

2.2 Sediment and erosion controls

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractors site manager.

Issue	Sediment and Erosion Controls.
Operational policy	To prevent the displacement of sediment and soil across and offsite.
Performance criteria	No visual indication of erosion on stages under construction, including evidence of rilling (an indicator of sheet erosion).
Implementation strategy	Erosion and sediment control devices shall be installed prior to commencement of work in Stage 1 in accordance with the approved engineering plans and to the reasonable satisfaction of TSC. No site disturbance shall commence until the appropriate approvals have been obtained. Where possible, the construction program shall be scheduled to minimise the potential for soil loss to occur. Where construction activities cannot be altered, additional controls shall be implemented in the areas of high erosion potential. Runoff and erosion controls shall be installed prior to clearing and include: • Diversion of upslope runoff around cleared and/or disturbed areas in a way that minimises erosion, minimises the upslope catchment and diverts waters to a legal point of discharge. • Sediment control fences or other measures shall be installed at the downslope perimeter of cleared and/or disturbed areas. • Maintenance of all erosion control measures at operational capacity until land is effectively rehabilitated. Temporary erosion measures (e.g. hay bales, straw fences) are to be employed onsite during construction where reasonably deemed necessary by TSC from an assessment of slope and soil type. Such measures shall be maintained at, or above their design capacity. Such measures should be in accordance with the recommendations in Council's 'Code of Practice for Soil and Water Management on Construction Works – Annexure A of Development Design Specification D7 – Stormwater Quality' and "Managing Urban Stormwater: Soils and Construction" March 2004 by Landcom, Australia. In areas where more than 1000m² are to be disturbed, runoff controls are also to include measures such as, but not limited to: • The use of barrier fencing, • The utilisation of exclusions zones, and • Minimising slope lengths of disturbed, uncontrolled areas. Stripped topsoil shall be separated from subsoil materials and shall only be stripped from the areas designated on the appropriate plans.

	Stockpiled soil should be stored taking into account the following considerations: • They are not to be located on public footpaths, nature strips, roads, road shoulders or any other public land. • They are to be located at least 2m away from any hazard areas. • They are to be protected from upslope surface flows, and • They are to be provided with sediment filters downslope. Fill batters shall be located to avoid established trees. Unless otherwise specified, trenches must be backfilled and compacted to 95% standard compaction and capped with topsoil. Excess spoil may be retained onsite provided the stockpile area is prepared by stripping topsoil from beneath the fill site for further use in revegetation. Outside the construction area of Stage 1, existing surface water conditions should be maintained wherever possible. All stockpiles, including preload, should be seeded within a fortnight of final forming with an appropriate mix. Sediment detention basins and clean-water diversion channels shall be constructed prior to earthworks in accordance with the drawings detailed in the ESCP. Sediment shall be cleaned out of sediment basins when accumulated sediment volume reaches 70%. Removed materials must be disposed of in a manner that does not cause pollution. Sediment basins shall be dosed with gypsum at a rate of 32kg/100m³ of water when required to ensure that discharge water quality meets required limits. Level markers shall be installed within all sediment ponds. All weather access tracks shall be constructed to all internal water bodies, trash racks and gross pollutant traps. Sediment controls are required outside the construction site in the following cases: • Where increased stormwater runoff is likely to accelerate erosion of any downstream watercourse, the necessary remedial work shall be undertaken. All immediate downstream drainage inlets shall have appropriate controls installed. Outside the construction area of Stage 1 existing surface water conditions should be maintained wherever possible.
Monitoring	• Carry out visual inspections weekly and after rainfall events to ensure that erosion measures are in place and operational to suit the activities taking place at the time. • Surface water quality to be monitored monthly (refer to the Section titled 'Surface Water Monitoring' which details monitoring of surface water and stormwater quality).

Auditing	Regular self audits shall be carried out in accordance with the above monitoring requirements. Additional visual inspections to be carried out monthly and after rainfall events to verify that control measures are in place and properly maintained.
Reporting	Signed, completed self audits, original test results, rainfall-event and other result sheets shall be kept on site and made available on request to Council officers and other relevant statutory authorities.
Identification of incident or failure	• Signs of erosion on site. • Damaged or failed erosion control devices. • Falling stormwater quality as identified by Environmental Contractor. • Build-up of sediment.
Corrective action	Apply remedial measures to improve sediment and erosion measures, for example: silt fences, shake down areas.

Commitment 4

Best management practices will be implemented into work practices throughout the construction of the subdivision works to minimise erosion and sediment transport offsite.

2.3 Surface water monitoring on site

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractor's Site Manager, Environmental Consultant

Issue	Surface water controls																														
Operational policy	To maintain the water quality conditions of the receiving waters during the construction phase of the development.																														
Performance criteria	All water discharged from the controlled discharge points will comply with the following criteria: <table><tr><th>Water Quality Parameter</th><th>Release Criteria</th><th>Criteria Type</th></tr><tr><td>pH*</td><td>As developed from background monitoring</td><td>Range</td></tr><tr><td>Electrical conductivity</td><td><1.5mS/cm</td><td>Maximum</td></tr><tr><td>Suspended solids</td><td><50mg L⁻¹</td><td>Maximum</td></tr><tr><td>Turbidity</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Dissolved oxygen</td><td>60-105% saturation</td><td>Minimum</td></tr><tr><td>Total and dissolved Iron</td><td><0.3mg L⁻¹</td><td>Maximum</td></tr><tr><td>Filtered Aluminium</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Litter and gross pollutants</td><td>No man made material >5mm in any dimension</td><td>--</td></tr><tr><td>Oil and grease</td><td>No visible film, no detectable odour</td><td>--</td></tr></table> *Note that pH will be consistent with receiving water quality. If receiving waters are estuarine, pH should be 6.5 – 8.5; if receiving waters are acidic, pH should be 4.2 – 6.7 in accordance with the <i>Threatened Species Management Plan</i> (JWA 2011) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).	Water Quality Parameter	Release Criteria	Criteria Type	pH*	As developed from background monitoring	Range	Electrical conductivity	<1.5mS/cm	Maximum	Suspended solids	<50mg L ⁻¹	Maximum	Turbidity	As developed from background monitoring	Maximum	Dissolved oxygen	60-105% saturation	Minimum	Total and dissolved Iron	<0.3mg L ⁻¹	Maximum	Filtered Aluminium	As developed from background monitoring	Maximum	Litter and gross pollutants	No man made material >5mm in any dimension	--	Oil and grease	No visible film, no detectable odour	--
Water Quality Parameter	Release Criteria	Criteria Type																													
pH*	As developed from background monitoring	Range																													
Electrical conductivity	<1.5mS/cm	Maximum																													
Suspended solids	<50mg L ⁻¹	Maximum																													
Turbidity	As developed from background monitoring	Maximum																													
Dissolved oxygen	60-105% saturation	Minimum																													
Total and dissolved Iron	<0.3mg L ⁻¹	Maximum																													
Filtered Aluminium	As developed from background monitoring	Maximum																													
Litter and gross pollutants	No man made material >5mm in any dimension	--																													
Oil and grease	No visible film, no detectable odour	--																													
Implementation strategy	Sediment detention basins and clean-water diversion channels will be constructed prior to the commencement of earthworks Stormwater control will be achieved by directing as much runoff from disturbed areas as practicable to the sediment detention basins. Clean water diversion channels will be used to divert clean water from upstream of the proposed haul road/potential disturbance and direct it via culverts beneath and downstream of the proposed road, thus minimising the volume of water traversing the site and the potential for sediment																														

	entrainment. Monitoring of the sediment detention basins for compliance with background conditions will take place prior to any discharge of stormwater (controlled or uncontrolled) from the site. Where water quality fails to meet the established criteria, corrective measures will be undertaken (e.g. if sediment problems are identified, settling in the sediment detention ponds shall be aided by dosing with flocculation agents) to achieve compliance with the water quality release criteria. Treated water is to be re-tested prior to release to establish the effectiveness of treatment measures.
Monitoring	Surface water monitoring will be conducted monthly and following the first monthly rainfall event (defined as >25mm in 24 hours) for pH, EC, Turbidity, Total and Soluble Nitrogen and Phosphorus, Suspended Solids, Dissolved Oxygen and Oil & Grease.
Auditing	Environmental Consultant to audit water quality results to ensure all discharges comply with the performance criteria.
Reporting	Result sheets to be compiled and reported monthly to TSC.
Identification of incident or failure	Degradation of surface water quality within the temporary sediment basins or failure to meet the discharging surface water targets.
Corrective action	If the pH of surface water does not comply with the release criteria range, then such waters will be contained, and the pH adjusted to within the appropriate range prior to release. If total suspended solids exceed the water quality criteria for this parameter, then water will be contained on site for a period sufficient to allow suspended solids to settle out prior to release, or treated with a flocculant. Erosion control devices will be immediately inspected and cleaned if necessary. Additional devices will be installed if necessary to prevent future breaches of the suspended solids criteria. The placement of stockpiles and management of disturbed areas will be reviewed with regard to sediment and erosion control.

Commitment 5

The Proponent will take all reasonable steps to ensure that all waters discharged from the site during the construction phase meet the performance criteria set out above.

2.4 Surface water monitoring – permanent treatment measures

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractor's Site Manager, Consulting Engineer, Environmental Consultant

Issue	Surface water controls, permanent treatment measures.																																				
Operational policy	To maintain water quality condition of receiving waters during the construction phase.																																				
Performance criteria	All water discharged from the permanent treatment measures during the construction phase should comply with the following criteria: <table><tr><th>Water Quality Parameter</th><th>Release Criteria</th><th>Criteria Type</th></tr><tr><td>pH*</td><td>As developed from background monitoring</td><td>Range</td></tr><tr><td>Electrical conductivity</td><td><1.5mS/cm</td><td>Maximum</td></tr><tr><td>Suspended solids</td><td><50mg L⁻¹</td><td>Maximum</td></tr><tr><td>Turbidity</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Dissolved oxygen</td><td>60-105% saturation</td><td>Minimum</td></tr><tr><td>Total and dissolved Iron</td><td><0.3mg L⁻¹</td><td>Maximum</td></tr><tr><td>Total and dissolved N</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Total and dissolved P</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Filtered Aluminium</td><td>As developed from background monitoring</td><td>Maximum</td></tr><tr><td>Litter and gross pollutants</td><td>No man made material >5mm in any dimension</td><td>--</td></tr><tr><td>Oil and grease</td><td>No visible film, no detectable odour</td><td>--</td></tr></table> *Note that pH will be consistent with receiving water quality. If receiving waters are estuarine, pH should be 6.5 – 8.5; if receiving waters are acidic, pH should be 4.2 – 6.7 in accordance with the <i>Threatened Species Management Plan</i> (JWA 2011) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).	Water Quality Parameter	Release Criteria	Criteria Type	pH*	As developed from background monitoring	Range	Electrical conductivity	<1.5mS/cm	Maximum	Suspended solids	<50mg L ⁻¹	Maximum	Turbidity	As developed from background monitoring	Maximum	Dissolved oxygen	60-105% saturation	Minimum	Total and dissolved Iron	<0.3mg L ⁻¹	Maximum	Total and dissolved N	As developed from background monitoring	Maximum	Total and dissolved P	As developed from background monitoring	Maximum	Filtered Aluminium	As developed from background monitoring	Maximum	Litter and gross pollutants	No man made material >5mm in any dimension	--	Oil and grease	No visible film, no detectable odour	--
Water Quality Parameter	Release Criteria	Criteria Type																																			
pH*	As developed from background monitoring	Range																																			
Electrical conductivity	<1.5mS/cm	Maximum																																			
Suspended solids	<50mg L ⁻¹	Maximum																																			
Turbidity	As developed from background monitoring	Maximum																																			
Dissolved oxygen	60-105% saturation	Minimum																																			
Total and dissolved Iron	<0.3mg L ⁻¹	Maximum																																			
Total and dissolved N	As developed from background monitoring	Maximum																																			
Total and dissolved P	As developed from background monitoring	Maximum																																			
Filtered Aluminium	As developed from background monitoring	Maximum																																			
Litter and gross pollutants	No man made material >5mm in any dimension	--																																			
Oil and grease	No visible film, no detectable odour	--																																			
Implementation strategy	- Surface water samples to be collected during the first rainfall event (>25mm in 24 hours) each month from the monitoring points and analysed at a NATA registered laboratory. - Monitoring results should be reviewed after 6 months and sampling frequency revised in consultation with Council Officers.																																				

Monitoring	Stormwater control should be achieved by directing as much runoff as practicable from disturbed areas to the temporary control measures. 'Clean' runoff from undisturbed areas should be diverted around disturbed areas if possible.
	- Surface water monitoring during construction should be conducted at the monitoring points for the parameters shown above. Flow rates are to be estimated and recorded at the time of sampling. - Sampling frequency is to be after the first rainfall event (>25mm in 24hours) each month. - Daily visual surveillance of water bodies for changes in conditions.
	The consulting engineer to audit stormwater quality results to verify all discharges comply with the performance criteria.
Auditing	
Reporting	- Results sheets to be compiled for monitoring results relating to water quality of water bodies. All results to be kept on site for inspection by local and state government officers at all times. - Monthly reports to TSC including raw data, a results summary and a discussion comparing results with baseline values and ANZECC guidelines.
Identification of incident or failure	Degradation of surface water quality at the monitoring points to below the levels specified in 'Performance Criteria' above prior to discharge. Apparent visual changes in water body conditions.
Corrective action	Locate the source of the contaminant. Take all possible actions to contain and control the contaminant. Investigate the cause of the contamination and take action to prevent a recurrence. If the test result for any parameter fails to meet the performance criteria, then weekly monitoring shall commence and continue until the recorded value/s meets the performance criteria. For example: - If total suspended solids exceed the stormwater quality criteria for this parameter, then water may need to be contained on site for a period sufficient to allow suspended solids to settle out prior to release, or settling shall be aided by dosing with flocculation agents at the rate recommended by the manufacturer. Erosion control devices should be immediately inspected and cleaned if necessary. Additional devices should be installed if a need is detected to prevent future breaches of the suspended solids criteria. - If Total N levels are high, check upstream stormwater quality. Check fertiliser application rates on landscaping work and adjust as required. - If Total P levels are high, check effluent disposal practices upstream. Check fertiliser rates on landscaping work on site and adjust as required. - If Oil and Grease levels are high, locate the source of the contamination and clean up source and contaminated waters in consultation with Council officers.

Commitment 6

Surface water quality should be maintained during the construction of the subdivision works in accordance with the criteria detailed above.

2.5 Contractor management

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Consulting Engineer

Issue	Contractor management.
Operational policy	To ensure the proponent's duty of care is met by ensuring the Contractor is aware of his responsibilities under the terms of the SWMP and the DECCW.
Performance criteria	Contractor is fully aware of their responsibilities under the terms of the SWMP.
Implementation strategy	• Review of the SWMP and the construction phase contracts by the proponent. • Periodic checks to be made by an independent Environmental Consultant. • Training for construction staff in implementation of SWMP provisions.
Monitoring	Weekly site inspections to be carried out.
Auditing	Inspections will be carried out monthly during the construction phase by an Environmental Consultant for every stage of development.
Reporting	Full details to be available to the contractor together with suggested corrective actions if required.
Corrective action	To be detailed at the time.

Commitment 7

A proactive program of contractor management will be implemented.

3 Management of potential impacts – on maintenance phase

3.1 Intent

This part of the SWMP specifies those matters which must be complied with by the Proponent during the 6 months 'on-maintenance period', being the period after construction but before Tweed Shire Council assumes responsibility for the subdivision works. The Proponents' obligations in this Section of the SWMP conclude at the end of the maintenance period for each stage.

3.2 Implementation

At the completion of the construction of the development's civil works, the GPT's (if any have been installed) should be cleaned out to become part of the permanent stormwater quality control treatment train.

3.3 Sediment and erosion controls

Applies to	On-maintenance phase.
Person responsible	Contractor's site manager, consulting engineer.

Issue	Sediment and erosion controls.
Operational policy	To prevent the displacement of sediment and soil across and offsite.
Performance criteria	Offsite discharges to comply with requirements for suspended sediments as detailed in Section 3.4 of the SWMP.
Implementation strategy	Temporary erosion and sediment control devices shall be maintained in an operational state during the maintenance period.
Monitoring	Temporary erosion control measures are to be inspected monthly and after rainfall events. Permanent stormwater quality control structures (GPT's, basins etc.) are to be inspected monthly and after rainfall events.
Auditing	Quarterly inspections to be carried out by an independent Environmental Consultant.
Reporting	Reporting only required in the event of failure of the sediment and erosion control measures.
Identification of incident or failure	• Signs of erosion on site. • Build up of sediment. • Falling stormwater quality.
Corrective action	Repair temporary sediment and erosion control measures. Check permanent measures for build up of sediment and clean out as necessary.

Commitment 8

Erosion and sediment control devices will be maintained during the on-maintenance period until the risk of soil erosion and sediment transport is considered negligible.

3.4 Surface water monitoring

Applies to	On-maintenance phase.
Person responsible	Contractor's Site Manager, Environmental Consultant.

Issue	Surface water monitoring in new permanent water bodies.																																	
Operational policy	To establish stable surface water conditions and verify that development management is appropriate.																																	
Performance criteria	All water discharged from the controlled discharge points will comply with the following criteria: <table><tr><th>Water Quality Parameter</th><th>Release Criteria</th><th>Criteria Type</th></tr><tr><td>pH</td><td>As determined by background monitoring</td><td>Range</td></tr><tr><td>Electrical conductivity</td><td><1.5mS/cm</td><td>Maximum</td></tr><tr><td>Suspended solids</td><td><50mg/L</td><td>Maximum</td></tr><tr><td>Turbidity</td><td>As determined by background monitoring</td><td>Maximum</td></tr><tr><td>Dissolved oxygen</td><td>60-105% saturation</td><td>Minimum</td></tr><tr><td>Total N</td><td>As determined by background monitoring</td><td>Maximum</td></tr><tr><td>Total P</td><td>As determined by background monitoring</td><td>Maximum</td></tr><tr><td>Total algae numbers</td><td><50,000cells/mL</td><td>Maximum</td></tr><tr><td>Litter and gross pollutants</td><td>No man made material >5mm in any dimension</td><td>--</td></tr><tr><td>Oil and grease</td><td>No visible film, no detectable odour</td><td>--</td></tr></table> *Note that pH will be consistent with receiving water quality. If receiving waters are estuarine, pH should be 6.5 – 8.5; if receiving waters are acidic, pH should be 4.2 – 6.7 in accordance with the Threatened Species Management Plan (JWA 2011) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).	Water Quality Parameter	Release Criteria	Criteria Type	pH	As determined by background monitoring	Range	Electrical conductivity	<1.5mS/cm	Maximum	Suspended solids	<50mg/L	Maximum	Turbidity	As determined by background monitoring	Maximum	Dissolved oxygen	60-105% saturation	Minimum	Total N	As determined by background monitoring	Maximum	Total P	As determined by background monitoring	Maximum	Total algae numbers	<50,000cells/mL	Maximum	Litter and gross pollutants	No man made material >5mm in any dimension	--	Oil and grease	No visible film, no detectable odour	--
Water Quality Parameter	Release Criteria	Criteria Type																																
pH	As determined by background monitoring	Range																																
Electrical conductivity	<1.5mS/cm	Maximum																																
Suspended solids	<50mg/L	Maximum																																
Turbidity	As determined by background monitoring	Maximum																																
Dissolved oxygen	60-105% saturation	Minimum																																
Total N	As determined by background monitoring	Maximum																																
Total P	As determined by background monitoring	Maximum																																
Total algae numbers	<50,000cells/mL	Maximum																																
Litter and gross pollutants	No man made material >5mm in any dimension	--																																
Oil and grease	No visible film, no detectable odour	--																																
Implementation strategy	Maintenance of internal bioretention and filter basins, waterbodies, swales and vegetated filter strips as specified at detailed design and approved by TSC. Samples are to be collected monthly and during rainfall events (defined as >25mm in any 24 hour period) at the upstream and downstream sampling locations and water quality control pond discharge point and analysed for the above parameters.																																	

Monitoring	Where water quality fails to meet the established criteria, corrective measures will be undertaken to achieve compliance with the water quality release criteria. Treated water is to be re-tested prior to release to establish the effectiveness of treatment measures. Only appropriate herbicides and fertilisers are to be used in accordance with TSC specifications. Clean-up of GPT's on a quarterly basis or after significant rainfall events.
	Monitoring for pH, electrical conductivity, suspended solids, turbidity, dissolved oxygen, total N, total P, litter and gross pollutants and oil and grease will be conducted monthly and during rainfall events. Analysis for total algae numbers will also be conducted monthly and during rainfall events once any waterbody(ies) specified by the erosion and sediment control plan have made operational. Monitoring for aluminium and total and dissolved iron will occur on a monthly basis at water holding locations prior to discharge off site. If iron floc, sediments or iron staining are observed at the discharge points, samples should also be taken for laboratory analysis and discharge halted until water has been treated to adequate levels. Iron indicator strips will be used if practicable. Sample recovery and in-situ analysis will be performed by trained onsite staff and, when required, samples will be forwarded to a NATA accredited laboratory. Sediment and erosion control measures will be inspected daily by the site manager during periods of rainfall.
	Environmental consultant to audit water quality results to ensure all discharges comply with the performance criteria.
Reporting of monitoring results	Result sheets to be compiled for monitoring results relating to water quality of water bodies. These results to be kept onsite for inspection by local and state government officers. Biannual report to be submitted to TSC. These reports will be submitted to TSC within 30 working days upon receipt of the laboratory results. The water quality reports will be prepared by a suitably qualified and experienced Environmental Consultant. These reports will detail: • The results for each of the environmental indicators monitored. • An assessment of the monitoring results against the release criteria. • An evaluation, if applicable, of the environmental conditions if monitoring results fall outside the limits of the release criteria. • Recommendations that are relevant to ensuring a high level of water quality is maintained. Each report will include previous water quality results in tabular format for comparative purposes and trend graphs will be provided. Laboratory certificates will be provided.

Identification of incident or failure	The results of the water quality monitoring indicating concentrations exceeding the release limits specified in the “performance criteria” for a single water quality parameter.
Corrective action	All development activities taking place at the time of incident/failure shall be reviewed to verify compliance with the SWMP provisions and, if necessary, construction methods and procedures shall be adjusted. Specific strategies to be implemented are as follows: pH In the event that the pH of waters falls outside of the critical limits, such waters will be contained and the pH adjusted to within the target range prior to release. Monitoring of the pH level shall be carried out immediately prior to release. Low pH waters (i.e. $\text{pH} < 6.5$) that need to be amended to be consistent with receiving environment waters of $\text{pH} > 6.5$ may be ameliorated in-situ by the use of hydrated lime or crushed ag-lime to achieve a $\text{pH} > 6.5$ and < 9.0 prior to release. In using hydrated lime, all care shall be undertaken to ensure pH is not above 9.0. Low pH waters consistent with receiving environment waters of $\text{pH} 4.2\text{--}6.7$ and that contain dissolved iron above 0.3mg/L will require treatment to reduce dissolved iron to acceptable levels prior to discharge. Electrical conductivity If electrical conductivity exceeds 1.5 dS m^{-1}, the waters will be contained onsite until adequate EC levels are reached. Further monitoring of upstream waters will be conducted to assess the impact of the development on the absolute change to water quality. Rainfall data will also be assessed at such times to determine the impact that rainfall has had on the water quality of the site and discharging waters. Suspended solids and turbidity If total suspended solids exceed 30mg L^{-1} the waters will be contained onsite for a period sufficient to allow suspended solids to settle out prior to release, or treated with a flocculent. After gypsum has been applied, the stored waters will be retested immediately prior to discharge. Erosion control devices will be immediately inspected and cleaned if necessary. Additional devices will be installed if a need is detected to prevent future breaches of the suspended solids criteria. The placement of stockpiles and management of disturbed areas will be reviewed with regard to the site’s Erosion and Sediment Control Plan. Dissolved oxygen In the event that dissolved oxygen levels drop below 6.5mg L^{-1}, the waters will not be released until visual inspections for algae has been carried out. If algae are present, further laboratory tests will be carried out to determine

the type of algae in the waters.

A general investigation will be carried out of the flow conditions of the affected waters, to assess the flow rates and volume of water passing through the monitoring locations.

Litter and gross pollutants

In the event that litter and gross pollutants with a dimension greater than 5mm are observed, this material will be clean up and appropriately disposed of as soon as practicable. The contractor shall inform staff of the appropriate waste disposal procedures and reiterate the importance and sensitivity of the surrounding ecosystems.

Oil and grease

In the event that oil and grease are visible and/or an odour is detected within a waterbody, management strategies will be implemented. Specifically, the waters shall be contained and the oil and grease isolated through the use of booms, containments bunds or other appropriate measures. Remediation works shall be implemented in consultation with the environmental consultant and DECCW.

Commitment 9

Subdivision works will be maintained during the maintenance period to ensure surface water quality complies with the water quality criteria detailed above.

3.5 Maintenance of treatment measures

Applies to	On-maintenance phase.
Person responsible	Contractor's Site Manager, Consulting Engineer.

Issue	Maintenance of stormwater quality treatment devices.
Operational policy	To ensure that the stormwater quality treatment devices are maintained at an appropriate operational standard.
Performance criteria	No significant change in the physical characteristics of treatment devices. No significant change in the physicochemical and/or biological characteristics of the treatment devices.
Implementation strategy	Routine visual inspections and monitoring and maintenance.
Monitoring	Routine monthly visual inspection of treatment trains and vegetated open space for: • litter; • erosion; • excessive sediment deposition; • clogging (bioretention); • vegetation damage (e.g. die off, weed growth); and • damaged or failed treatment devices. Change in physical characteristics: • water level; and • area, depth or bed profile of any bioretention basin, waterway and wetland system.
Auditing	Audit inspections are to be carried out on a quarterly basis to verify that the stormwater quality control structures are properly maintained by the contractor.
Reporting of monitoring results	A checklist is to be completed which assesses the strategies listed above and includes the following: • A record of inspection details and; • A record of details of all maintenance activities (including volume of silt removed from each GPT or other control structure). Results to be made available to TSC at all times. A summary of the inspection checklist findings shall be included in the annual water quality monitoring report.

Identification of incident or failure	Non compliance with the criteria will be identified by: • Blockage of stormwater system. • Build up of sediment & litter or re-entrainment of trapped sediments. • Excessive erosion. • Vegetation damage. • Poorly maintained, damaged or failed control devices. • A change in the physical characteristics. • A change in the physicochemical and/or biological characteristics. • Impeded drainage of bioretention and filter basins. • Deterioration of water quality downstream of the control structure/s.
Corrective action	Bioretention and filter basin maintenance • Regular harvesting to ensure vegetation is maintained at acceptable levels. • Removal of a portion of vegetation to maintain nutrient and biomass balance. • Removed vegetation to be composted and reused on landscaping in other parts of development site. • Soil renovation (as required) to maintain permeability. • Removal of litter. Gross pollutant traps • Removal of trapped material in accordance with manufacturer's specifications. Vegetated buffer • Regular mowing and maintenance of buffer filter characteristic by mulching organic matter back into buffer soil profile • ensure vegetation is maintained at acceptable levels (minimum 85% foliage protective cover). • Removal of litter within the swale. Waterway and wetland system will be as per weed management program.

Commitment 10

Stormwater quality control structures will be adequately maintained during the maintenance period to ensure continued performance.

4 Management of potential impacts – operational phase

4.1 Intent

This part of the SWMP specifies those matters that must be complied with by TSC after it assumes responsibility for the subdivision works.

4.2 Implementation

Permanent stormwater quality control structures are to be monitored and maintained as detailed in the following tables.

4.3 Surface water monitoring

Applies to	Operational phase.
Person responsible	Tweed Shire Council

Issue	Surface water monitoring.
Operational policy	Any waters discharged from the site should meet the specified water quality objectives (WQOs). Water quality in the waterway and wetland system should remain at an acceptable level.
Performance criteria	The quality of discharge from the site should achieve the following long term WQOs. The WQOs will reflect the mean background level $\pm$ 2 standard deviations for: • pH; • dissolved oxygen; • total phosphorous; • total nitrogen; • turbidity; • suspended solids; • chlorophyll 'a'; • faecal coliforms; • total algae numbers; • litter and gross pollutants; and • oil and grease.
Implementation strategy	Surface water entering and exiting the development shall be monitored at the environmental monitoring points during the operational phase of the development. Monitoring will also be undertaken during flood events where practicable. This monitoring will allow water quality comparisons to be made.
Monitoring	Frequency: Routine biannual monitoring for two years following the completion of the on-maintenance period, with biannual rainfall event (>25mm/24hrs) monitoring campaigns. Parameters: temperature, dissolved oxygen, pH, conductivity, salinity, turbidity, suspended solids, total nitrogen, total phosphorous, faecal coliforms, chlorophyll 'a' and algae identification and count. Vertical Profiling: Routine biannual monitoring of temperature, dissolved oxygen, pH, conductivity, salinity and turbidity at 0.5m depths of all off-stream deep water bodies. Sample recovery and in-situ analysis will be performed by a NATA

Auditing	accredited sampler and, when required, samples will be forwarded to a NATA accredited laboratory.
	Reviews are to be carried out on a 6 monthly basis to assess the implementation strategy. A checklist is to be completed which assesses the strategies listed above.
Reporting of monitoring results	Annual Water quality report to be held by Tweed Shire Council.
Identification of incident or failure	Surface water quality parameter monitoring identifying exceedance of WQOs.
Corrective action	If exceedance of WQOs continues to occur, inspect all treatment techniques, revise designs or review different alternatives and install if necessary.

4.4 Maintenance of treatment measures

Applies to	Operational phase.
Person responsible	Tweed Shire Council.

Issue	Maintenance of stormwater quality treatment devices.
Operational policy	To ensure that the stormwater quality treatment devices are maintained at an appropriate operational standard.
Performance criteria	No significant change in the physical characteristics of treatment devices. No significant change in the physicochemical and/or biological characteristics of the treatment devices.
Implementation strategy	Routine visual inspections and monitoring and maintenance.
Monitoring	Routine quarterly visual inspection of treatment trains and vegetated open space for: • Litter. • Erosion. • Excessive sediment deposition. • Clogging (bioretention). • Vegetation damage (e.g. die off, weed growth). • Damaged or failed treatment devices: ◦ Change in physical characteristics. ◦ Water level. • Area, depth or bed profile of any bioretention basin, waterway and wetland system.
Auditing	Audits are to be carried out on an annual basis to assess the implementation strategy.
Reporting of monitoring results	A checklist is to be completed which assesses the strategies listed above.
Identification of incident or failure	Non compliance with the criteria will be identified by: • Blockage of stormwater system. • Build up of sediment & litter or re-entrainment of trapped sediments. • Excessive erosion. • Vegetation damage. • Poorly maintained, damaged or failed control devices. • A change in the physical characteristics. • A change in the physicochemical and/or biological characteristics. • Impeded drainage of bioretention and filter basins.

Corrective action	• Deterioration of water quality downstream of the control structure/s.
	Bioretention and filter basin maintenance • Regular harvesting to ensure vegetation maintained at acceptable levels. • Removal of a portion of vegetation to maintain nutrient and biomass balance. • Removed vegetation to be composted and reused on landscaping in other parts of development site. • Soil renovation (as required) to maintain permeability. • Removal of litter. Gross pollutant traps • Removal of trapped material in accordance with manufacturer's specifications. Vegetated buffer • Regular mowing and maintenance of buffer filter characteristic by mulching organic matter back into buffer soil profile. • ensure vegetation is maintained at acceptable levels (minimum 85% foliage protective cover). • Removal of litter within the swale. Waterway and wetland system • As per weed management program Sediment/sludge removal Sludge and sediments are expected to settle in the inlet zones of the bioretention systems and other water bodies. In the operational state this is expected to be minor and de-silting will only be required on an infrequent basis. Prior to works the recommended best practice method of sediment/sludge removal of the time will be used.

5 Administration of the SWMP

5.1 Amendment of the SWMP

The proponent may make application to TSC to amend the provisions of this SWMP. The application shall:

- be in writing;
- specify the provisions of the SWMP to which the application relates; and
- state how the proposed amendment(s) achieve the objectives of the provisions to which the amendment(s) relate.

TSC shall approve the amendment(s) where TSC is satisfied acting reasonably that the proposed amendment(s) achieve the objective of the provisions to which the amendment(s) relates.

5.2 Incident management

The Proponent and any person appointed by the Proponent as having responsibility for a control strategy set out in this SWMP have clearly defined responsibilities under the Environmental Planning and Assessment Act 1979 to report any incidents likely to cause material or serious environmental harm.