

PART 3 - KINGS FOREST STAGE 1 MANAGEMENT PLAN

KINGS FOREST STAGE 1 – MP 08_0194 SUBDIVISION AND BULK EARTHWORKS

PREPARED FOR:

PROJECT 28 PTY LTD

COMPILED BY:

DARRYL ANDERSON CONSULTING PTY LTD

IN CONJUNCTION WITH:

Mortons Urban Solutions
Bushfire Safe (Aust) Pty Ltd
James Warren & Associates Pty Ltd
Gilbert & Sutherland Pty Ltd



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SUTHERLAND**

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12.0 STORMWATER MANAGEMENT PLAN – GILBERT & SUTHERLAND

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AUTHOR(S) M. Foster
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

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DISTRIBUTION

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JBA Planning	-	1	1	-						
Darryl Anderson Consulting Pty Ltd	-	-	-	1						
G&S file	1	1	1	1						

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.

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised):

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

This revised report addresses the amendments to the project and the key issues raised in the submissions.

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.'

Response to Submissions

Submitter: NSW EPA; Tweed Shire Council

Issue: Impact of stormwater discharges on Blacks Creek, SEPP 14 Wetlands, EECs and the Cudgen Nature Reserve demonstrating that the treatment system will deliver an appropriate level of protection.

Response: This has been addressed in the *Integrated Water Cycle Management Plan* (G&S, July 2012).

LIST OF DRAWINGS

DRAWING NO.	DESCRIPTION
10927.1.1	Surface water monitoring locations

Kings Forest, Stage 1 - Summary and Implementation Table, Stormwater Management Plan

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Bulk earthworks and civil construction phases								
SWMP 1	Dust management	Stage 1	To achieve acceptable air quality standards through the control of the movement of dust offsite from site works	Daily inspections to verify that dust mitigation measures are being implemented Dust monitoring will be conducted upon receipt of complaints by residents	Contractor's site manager	No more than one complaint by nearby residents 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	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	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 - monitoring will be undertaken in accordance with AS 3580.10.1(1991)
SWMP 2	Sediment and erosion controls	Stage 1	To prevent the displacement of sediment and soil across and offsite	Weekly visual inspections and following rainfall events to ensure that erosion measures are in place and operational Surface water quality to be monitored in accordance with Table 12.2.3	Contractor's site manager	No visual indication of erosion on stages under construction, including evidence of rilling (an indicator of sheet erosion)	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	Table 12.2.2

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
SWMP 3	Surface water monitoring on site	Drawing No. 10927.1.1	To maintain the water quality conditions of the receiving waters during the construction phase of the development	Surface water monitoring will be conducted monthly and following the first monthly rainfall event (defined as >25mm in 24 hours) Sediment detention basins will be monitored prior to any discharge of stormwater (controlled or uncontrolled)	Contractor's Site Manager; Environmental Consultant	All water discharged from the controlled discharge points will comply with the parameters in Table 12.2.3	Result sheets to be compiled and reported monthly to TSC	Table 12.2.3
SWMP 4	Surface water monitoring – permanent treatment measures	Drawing No. 10927.1.1	To maintain water quality condition of receiving waters during the construction phase	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	Contractor's Site Manager; Consulting Engineer; Environmental Consultant	All water discharged from the permanent treatment measures during the construction phase should comply with the parameters in Table 12.2.4	Results sheets to be compiled for water quality monitoring of water bodies and 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 of results	Table 12.2.4
SWMP 5	Contractor management	Stage 1	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 POEO Act.	Weekly site inspections to be carried out	Consulting Engineer	Contractor is fully aware of their responsibilities under the terms of the SWMP	Full details to be available to the contractor together with suggested corrective actions if required	Table 12.2.5

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Management of potential impacts – On maintenance phase								
SWMP 6	Sediment and erosion controls	Stage 1	To prevent the displacement of sediment and soil across and offsite	Temporary erosion control measures and permanent stormwater quality control structures (GPT's, basins etc.) are to be inspected monthly and after rainfall events	Contractor's site manager; Consulting Engineer	Offsite discharges to comply with requirements for suspended sediments as detailed in Section 12.2.3 of the SWMP	Reporting only required in the event of failure of the sediment and erosion control measures	Table 12.3.3
SWMP 7	Surface water monitoring	Drawing No. 10927.1.1	To establish stable surface water conditions and verify that development management is appropriate	Monitoring will be conducted monthly and during rainfall events	Contractor's Site Manager; Environmental Consultant	All water discharged from the controlled discharge points will comply with water quality criteria set by pre-construction background monitoring as referred to in Table 12.2.3 of this SWMP	Result sheets relating to water quality of water bodies to be kept onsite for inspection by local and state government officers Biannual reports to be submitted to TSC	Table 12.3.4
SWMP 8	Maintenance of treatment measures	Stage 1	To ensure that the stormwater quality treatment devices are maintained at an appropriate operational standard	Routine monthly visual inspection of treatment trains and vegetated open space	Contractor's site manager; Consulting Engineer	No significant change in the physical characteristics of treatment devices. No significant change in the physicochemical and/or biological characteristics of the treatment devices.	A checklist is to be completed which includes details of all maintenance activities (including volume of silt removed from each GPT or other control structures) 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	Table 12.3.5

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Management of potential impacts –Operational phase								
SWMP 9	Surface water monitoring	Drawing No. 10927.1.1	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.	Routine biannual monitoring for two years following the completion of the on-maintenance period (including vertical profile monitoring), with biannual rainfall event (>25mm/24hrs) monitoring campaigns	Tweed Shire Council	All water discharged from the controlled discharge points will comply with water quality criteria set by pre-construction background monitoring as referred to in Table 12.2.3 of this SWMP	Annual Water quality report to be held by TSC	Table 12.4.3
SWMP 10	Maintenance of treatment measures	Stage 1	To ensure that the stormwater quality treatment devices are maintained at an appropriate operational standard	Routine quarterly visual inspection of treatment trains and vegetated open space	Tweed Shire Council	No significant change in the physical characteristics of treatment devices No significant change in the physicochemical and/or biological characteristics of the treatment devices	A checklist is to be completed which assesses the strategies listed above	Table 12.4.4

12.1 SWMP structure

12.1.1 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.

12.1.2 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.

12.1.3 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 (TSC) for review.

12.1.4 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.

12.1.5 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.

12.1.6 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.
- POEO Act means the NSW *Protection of the Environment Operations Act 1997*.
- DECCW means the Department of Environment, Climate Change and Water.

12.1.7 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

12.2 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.

12.2.1 Dust management

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractor's 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.

12.2.2 Sediment and erosion controls

Applies to	Bulk earthworks and civil construction phases.
Person responsible	Contractor's 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. sterile straw 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. 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.

12.2.3 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	The performance criteria shall be set by background monitoring of pre-construction water quality conditions. The following parameters shall be monitored for a minimum of 12 months to capture the range of seasonal variation: • pH (field measurement); • electrical conductivity (EC) (field measurement); • turbidity (field measurement); • dissolved oxygen (DO) (field measurement); • temperature (field measurement); • Redox potential (mV) • suspended solids (SS) (mg L^{-1}); • total nitrogen (TN), soluble nitrogen, nitrogen oxide (NO_x), total kjeldahl nitrogen (TKN), nitrite (NO_2) & nitrate (NO_3) (mg L^{-1}); • total phosphorus (TP) & soluble phosphorous (mg L^{-1}); • oil and grease (visual inspection); • calcium (Ca); • magnesium (Mg); • sodium (Na); • potassium bicarbonate (K/HCO_3); • bicarbonate (HCO_3); • carbonate (CO_3); • total & dissolved iron (Fe); • total & dissolved aluminium (Al); • dissolved manganese (Mn); • chloride (Cl); • sulfate (SO_4); • ammonium (NH_4); • colour; • total acidity (titratable); • total alkalinity; • arsenic (As);

- cadmium (Cd);
- copper (Cu)
- lead (Pb)
- nickel (Ni)
- zinc (Zn)
- chlorophyll-a;
- faecal coliforms;
- total algal cell count; and
- blue green algae.

All water discharged from the controlled discharge points will comply with the following interim criteria (based on data collected by TSC):

Parameter	Interim criteria
pH	5.5 - 7.5
Turbidity	<10NTU
Suspended solids	<10mg L ⁻¹
Dissolved oxygen	>5mg L ⁻¹
Chlorophyll-a	<6µg L ⁻¹
Total Aluminium	<0.9mg L ⁻¹
Total Iron	<1.7mg L ⁻¹
Total Nitrogen	<1.0mg L ⁻¹
Total Phosphorous	<0.06mg L ⁻¹
Salinity	<12ppt
Litter and gross pollutants	No man made material >5mm in any dimension
Oil and/or grease	No visible film, no detectable odour
*Note that pH will be consistent with receiving water quality. If receiving waters are estuarine, pH should be 6.5 – 7.5; if receiving waters are acidic, pH should be 4.2 – 6.7 in accordance with the <i>Threatened Species Management Plan</i> (JWA 2012) for habitat requirements for Wallum Froglet (<i>Crinia signifera</i>) and Olongburra Frog (<i>Litoria olongburensis</i>).	

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	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.
	Surface water monitoring will be conducted monthly and following the first monthly rainfall event (defined as >25mm in 24 hours) at the locations shown on Drawing No. 10927.1.1 for the parameters listed above.
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.

12.2.4 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 the water quality conditions of receiving waters during the construction phase.
Performance criteria	All water discharged from the permanent treatment measures during the construction phase should comply with water quality criteria set by pre-construction background monitoring as referred to in Table 12.2.3 of this SWMP. Interim performance criteria have been based on existing TSC water quality monitoring data.
Implementation strategy	• Surface water samples to be collected during the first rainfall event (>25mm in 24 hours) each month from the monitoring points shown in Drawing No. 10927.1.1 and analysed at a NATA-accredited laboratory. • Monitoring results should be reviewed after 6 months and sampling frequency revised in consultation with Council Officers. • 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.
Monitoring	• Surface water monitoring during construction should be conducted at the locations shown on Drawing No. 10927.1.1 for the parameters listed in Table 12.2.3. • Sampling frequency is to be after the first rainfall event (>25mm in 24-hours) each month. • Daily visual surveillance of water bodies for changes in conditions.
Auditing	The Consulting Engineer to audit stormwater quality results to verify all discharges comply with the performance criteria.
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.

12.2.5 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 POEO ACT.
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.

12.3 Management of potential impacts – on maintenance phase

12.3.1 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 TSC 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.

12.3.2 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.

12.3.3 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 12.3.4 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.

12.3.4 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 water quality criteria set by pre-construction background monitoring as referred to in Table 12.2.3 of this SWMP. Interim performance criteria have been based on existing TSC water quality monitoring data.
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 sampling locations shown on Drawing No. 10927.1.1 and water quality control pond discharge points. Samples will be analysed for the parameters listed in Table 12.2.3. 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	Monitoring will be conducted monthly and during rainfall events. Analysis for total algae numbers will commence 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.
Auditing	Environmental consultant to audit water quality results to ensure all

Reporting of monitoring results	discharges comply with the performance criteria. 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. pH<5.5) that need to be amended to be consistent with receiving environment waters of pH >5.5 may be ameliorated in situ by the use of hydrated lime or crushed ag-lime to achieve a pH>5.5 and <7.5 prior to release. In using hydrated lime, all care shall be undertaken to ensure pH is not above 7.5. Low pH waters consistent with receiving environment waters of pH 5.5-7.5 and that contain Total iron above 1.7mg L⁻¹ will require treatment to reduce dissolved iron to acceptable levels prior to discharge. Salinity If salinity exceeds 12ppt, the waters will be contained onsite until adequate salinity 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 SS exceed 10mg L^{-1} the waters will be contained onsite for a period sufficient to allow SS 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 SS 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 DO levels drop below 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.

12.3.5 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.

12.4 Management of potential impacts – operational phase

12.4.1 Intent

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

12.4.2 Implementation

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

12.4.3 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	All water discharged from the controlled discharge points will comply with water quality criteria set by pre-construction background monitoring as referred to in Table 12.2.3 of this SWMP. Interim performance criteria have been based on existing TSC water quality monitoring data.
Implementation strategy	Surface water entering and exiting the development shall be monitored at the environmental monitoring points shown in Drawing No. 10927.1.1 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: Listed in Table 12.2.3. Vertical Profiling: Routine biannual monitoring of temperature, DO, pH, EC, 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 accredited sampler and, when required, samples will be forwarded to a NATA accredited laboratory.
Auditing	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 TSC.
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.

12.4.4 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. • Deterioration of water quality downstream of the control structure/s.

Corrective action	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.
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12.5 Administration of the SWMP

12.5.1 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.

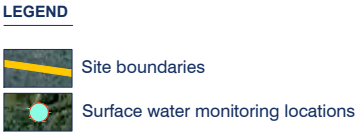
12.5.2 Incident management

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 *Protection of the Environment Operations Act 1997* to report any incidents likely to cause material or serious environmental harm.

12.6 Attachment 1 - Drawing

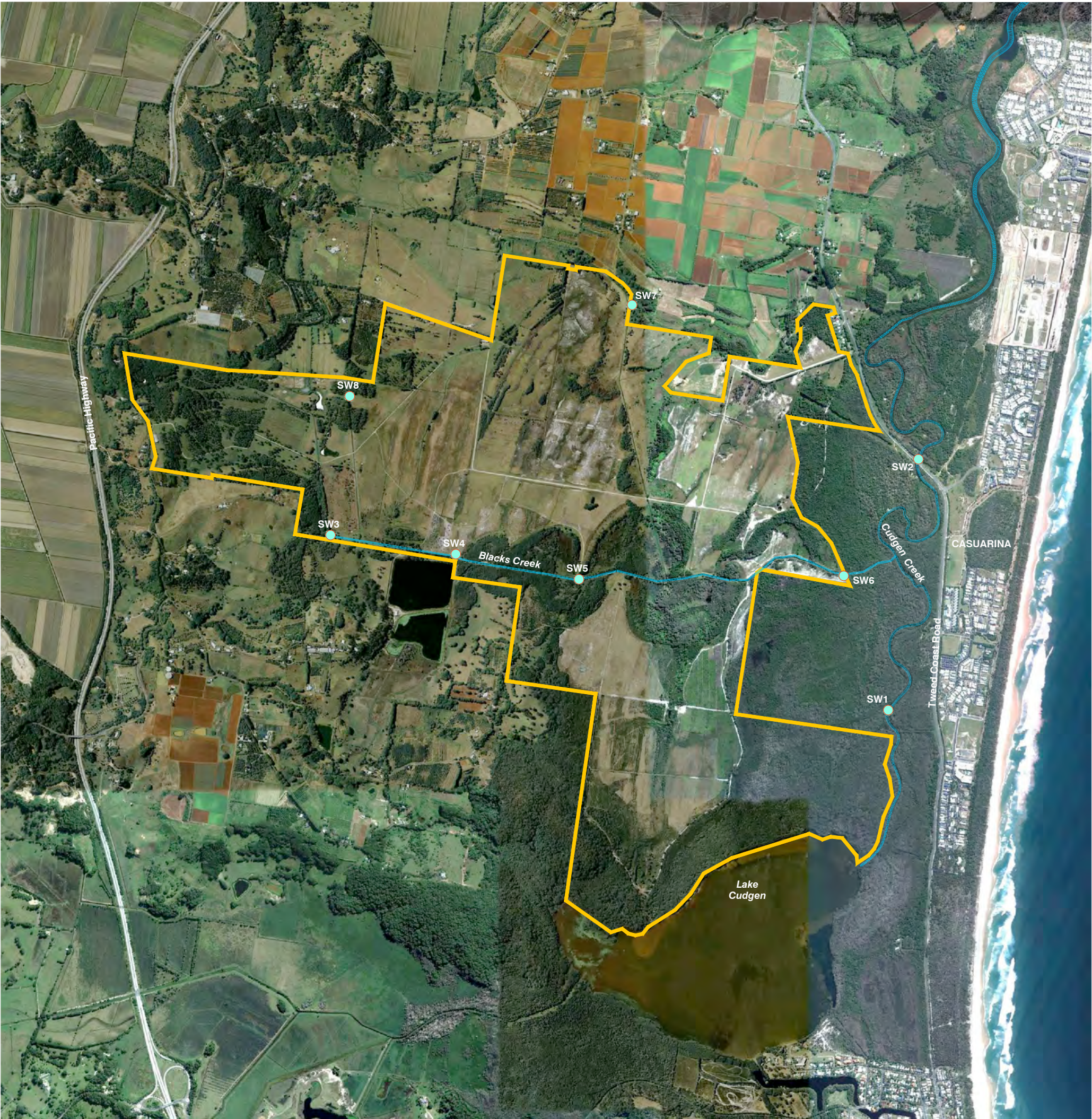


ORIENTATION
NORTH



SOURCES

Image base:
Google Earth Pro 2012, imagery date 13/05/2010



Brisbane Sydney Melbourne and regions

**+GILBERT
SUTHERLAND**

Agriculture. Water. Environment.

PROJECT
KINGS FOREST
STAGE 1
PROJECT APPLICATION

CLIENT
PROJECT 28
PTY LTD

DRAWING
SURFACE WATER
MONITORING
LOCATIONS

SCALE
1:25 000@A3

DRAWN
SPD

CHECKED
MLF

DATE
27/07/2012

PROJECT NO
10927

DRAWING NO
1.1

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13.0 EROSION AND SEDIMENTATION CONTROL PLAN – GILBERT & STERLAND

Darryl Anderson Consulting Pty Ltd

A.C.N. 093 157 165
Town Planning & Development Consultants

13-1

DOCUMENT CONTROL

DOCUMENT 10927 ESCP MLF1F.docx
TITLE Erosion & Sediment Control Plan, Kings Forest Stage 1 Project Application, Kings Forest, New South Wales
PROJECT MANAGER N. Sutherland
AUTHOR(S) M. Foster
CLIENT Project 28 Pty Ltd
CLIENT CONTACT Reg van Rij
CLIENT REFERENCE

SYNOPSIS This report provides an assessment of the erosion risk at the site and erosion and sediment control measures required to ensure that stormwater runoff from the proposed development meets the water quality standards of Tweed Shire Council.

REVISION HISTORY

REVISION #	DATE	EDITION BY	APPROVED BY	FILE NAME
1	12/10	J. Tobin	E. Holton /L. Varcoe	10468 ESCP RMF1F.docx
2	2/11	J. Tobin	N. Sutherland /L. Varcoe	10468 ESCP RMF2F.docx
3	4/11	M. Hancock	N. Sutherland /L. Varcoe	10468 ESCP RMF3F.docx
4	6/12	M. Foster	N. Sutherland /L. Varcoe	10927 ESCP MLF1F.docx

DISTRIBUTION

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

SUMMARY

Project 28 Pty Ltd commissioned Gilbert & Sutherland Pty Ltd (G&S) to prepare an Erosion and Sediment Control Plan (ESCP) in support of the Kings Forest Stage 1 Project Application at Kings Forest, Cudgen, New South Wales.

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised):

- Subdivision to create new lots for future development;
 - Bulk earthworks across the site;
 - Road works comprising:
 - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
 - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
 - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m² of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

The assessment involved a review of the amended Director General's Requirements (DGRs), Approved Concept Plan Conditions, the Project Report for the Concept Plan and a desktop study and assessment of the site. The ESCP is produced in general accordance with Tweed Shire Council's *'Code of Practice for Soil and Water Management on Construction Works – Annexure A of Development Design Specification D7 – Stormwater Quality'* and

the Landcom guideline '*Managing Urban Stormwater: Soils and Construction*', 4th Edition, March 2004.

This Erosion and Sediment Control Plan provides guidelines for the management of stormwater runoff discharging from the site during the bulk earthworks and civil construction phase, the landform stabilisation phase, the on maintenance phase and the operational phase of the proposed development of Stage 1, in accordance with the project application.

This revised report addresses the amendments to the project and the key issues raised in the submissions.

Response to Submissions

Submitter: Department of Planning and Infrastructure

Issue: Further detailed plans showing the sequence of earthworks and maximum exposed areas

Response: MUS plan set includes detailed plans of earth works sequencing.

Submitter: Department of Planning and Infrastructure

Issue: Further details of specific management measures for works within and adjacent to SEPP 14 wetlands

Response: Stockpiled soil should be stored at least 60m away from SEPP 14 wetlands (Table 13.3.3). Sediment fences should be installed up gradient of all vegetation to be retained (Drawing No. 10468.4.1). Where possible, tracks shall not be placed within retained vegetation. If this is not possible, the tracks shall be identified on the Vegetation Management Plan, paved in locations to minimise environmental impact and constructed so as to minimise erosion. These tracks shall be locked with keys available only to approved personnel (Table 13.3.4). Erosion and sediment controls will be installed in accordance with the set of standard details provided in Drawing No. 10468.4.2.

Submitter: Tweed Shire Council

Issue: Fish passage

Response: Waterway crossings will be designed in accordance with NSW Fisheries 'Why do Fish Need to Cross the Road?'¹ Further detail will be provided in the Construction Certificate Application.

Submitter: Tweed Shire Council

Issue: Water quality discharge criteria

Response: Interim water quality criteria have been based on data collected by TSC (Table 13.2.1). However, additional monitoring rounds will be required to obtain a comprehensive data set from which site-specific water quality targets may be created.

Submitter: NSW Office of Water

Issue: Detailed plans showing the layout of all drainage channels, sediment basins, artificial wetlands and associated discharge points.

Response: This will depend on the earthworks plan and preliminary grading. Further detail will be provided with the Construction Certificate Application.

Submitter: NSW Office of Water

Issue: Surface water quality monitoring parameters

Response: The water quality parameters in tables 13.2.1, 13.3.5, 13.5.5 have been expanded to include those listed by the NSW Office of Water.

The implementation table included in the front of this management plan details the actions, responsibilities and performance criteria upon which monitoring and auditing may be implemented.

¹ Fairfull, S. & Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla

LIST OF DRAWINGS / FIGURES

DRAWING NO.	DESCRIPTION
10468.4.1	Conceptual sediment basin plan
10468.4.2	Standard notes, drawings and details set
10927.1.1	Surface water monitoring locations

Kings Forest, Stage 1 - Summary and Implementation Table, Erosion and Sediment Control Plan

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Baseline data collection phase								
ESCP 1	Background surface water quality monitoring	Eight monitoring locations as shown on Drawing No. 10927.1.1	Establishing appropriate discharge criteria	A minimum of 12 months of background monthly monitoring	Nominated Environmental Consultant	Adequate rounds of data collected prior to commencement of bulk earthworks.	Background water quality report submitted to TSC prior to commencement of construction works	Water quality parameters are listed in Table 13.2.1
Management of potential impacts – Bulk earthworks and civil construction phase								
ESCP 2	Minimising soil disturbance	Vegetation to be retained is marked on Drawing No. 10468.4.1	Removal or disturbance of ground cover is to be kept to a minimum	Clearing shall be conducted progressively to minimise the area of disturbed soil at any time during the works	Contractor's Site Manager	No clearing of designated retained vegetation.	Weekly inspections, no reporting is necessary unless areas are inadvertently cleared outside approved stage boundaries.	Revegetate over cleared areas where necessary as per Table 13.3.1
ESCP 3	Dust management	Stage 1	Minimising the movement of dust offsite	Daily inspections and dust monitoring on receipt of complaints by residents	Contractor's Site Manager	No more than one complaint in any seven-day period (Table 13.3.2)	- Complaints register - DECCW notified upon receipt of three or more complaints in 24 hrs - Reports provided to TSC upon request	Dust generation minimised through onsite practices listed in Table 13.3.2
ESCP 4	Erosion control	Stage 1	To prevent the displacement of sediment and soil across and offsite during storm events	Site inspections to be carried out weekly, immediately following rainfall events and before site closure	Contractor's Site Manager, Environmental Consultant	- No signs of erosion on site - No decline in water quality	- DECCW to be notified immediately of breaches. - Self audits provided to TSC upon request	Erosion and sediment control devices installed in accordance with the approved engineering drawings and Table 13.3.3

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
ESCP 5	Sediment control	Stage 1	To prevent the displacement of sediment and soil across and offsite during storm events	Site inspections to be carried out weekly, immediately following rainfall events and before site closure	Contractor's Site Manager, Environmental Consultant	- No build-up of sediment - No decline in water quality	- DECCW to be notified immediately of breaches. - Self audits provided to TSC upon request	Sediment detention basins and clean-water diversion channels shall be constructed in accordance with Table 13.3.4 and Drawing No. 10468.4.1 and 10468.4.2
ESCP 6	Surface water quality monitoring	Drawing No. 10927.1.1	To maintain the water quality conditions of the receiving waters during the construction phase of the development	Monthly and following the first rainfall event of the month	Contractor's Site Manager, Environmental Consultant	All controlled water discharges from the site will comply with water quality criteria set by pre-construction background monitoring	- DECCW to be notified immediately of breaches. - Report results to TSC monthly	Water quality parameters are listed in Table 13.3.5
ESCP 7	Contractor management	Stage 1	Ensuring the Contractor is aware of his responsibilities under the terms of the ESCP and the <i>Protection of the Environment Operations Act</i> (1997)	Periodic checks to be made by an independent environmental consultant.	Proponent	Contractor is fully aware of his/her responsibilities under the terms of the ESCP	- Weekly site inspections - Full details to be available to the contractor together with suggested corrective actions if required.	Table 13.3.6
Management of potential impacts – Landform stabilisation phase								
ESCP 8	Rehabilitation and landscaping	Stage 1	To aid the treatment of surface water and minimise sediment transport	Progressive stabilisation with minimal delay (a period of 20 days) between final land shaping and permanent rehabilitation	Proponent	No sediment transport from completed areas	- Regular inspections - No reporting is necessary unless problems are identified	Table 13.4.1

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Management of potential impacts – On maintenance phase								
ESCP 9	Maintenance of treatment measures	Stage 1	To maintain the water quality control structures to ensure adequate performance during the operational period	Routine monthly visual inspection of treatment trains and vegetated open space	Proponent	The control measures are maintained and operational	- Record inspection details and maintenance activities (including volume of silt removed from each GPT or other control structure) - Results to be made available to TSC at all times	Table 13.5.3
ESCP 10	Erosion controls	Stage 1	To prevent the displacement of sediment across and offsite during storm events	Site inspections to be carried out weekly, immediately following rainfall events and before site closure	Proponent	- Off-site discharges to comply with surface water criteria set by background monitoring - No visual indication of erosion in completed areas	- DECCW to be notified immediately of breaches. - Self audits provided to TSC upon request	Erosion and sediment control devices shall be maintained in accordance with the approved engineering plans
ESCP 11	Surface water quality monitoring	Drawing No. 10927.1.1	To maintain the water quality conditions of receiving waters during the maintenance phase of the development	Monthly and following the first rainfall event of the month	Proponent	All controlled water discharges from the site will comply with water quality criteria set by pre-construction background monitoring	- DECCW to be notified immediately of breaches. - Report results to TSC biannually	Water quality parameters are listed in Table 13.5.5

Action No	ACTION	Location (reference to Map)	Purpose	TIMING and FREQUENCY	RESPONSIBILITY	PERFORMANCE MEASURE	MONITORING and reporting	Further Details
Management of potential impacts –Operational phase								
ESCP 12	Maintenance of treatment measures		To maintain the water quality control structures to ensure adequate performance during the operational period	Routine monthly visual inspection of treatment trains and vegetated open space	Tweed Shire Council	The control measures are maintained and operational	Record inspection details and maintenance activities (including volume of silt removed from each GPT or other control structure)	Table 13.6.3

13.1 ESCP structure

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

Each control strategy is based upon proven environmental management methods in general accordance with Tweed Shire Council's 'Code of Practice for Soil and Water Management on Construction Works – Annexure A of Development Design Specification D7 – Stormwater Quality' and the Landcom Soils and Construction Guidelines, 4th Edition, March 2004 with each strategy presented as a commitment following the respective management table. 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.

The ESCP is based on a series of tables and Drawings 10468.4.1 and 10468.4.2 (Attachment 1) for the bulk earthworks and civil construction, landform stabilisation, on-maintenance and operational phases of the Kings Forest Stage 1 development. The person responsible for the implementation of the measures detailed is written on the table itself. The tables then show 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 ESCP. The format is presented below for reference purposes.

Title

Person responsible	This is the person who has accepted the responsibility of implementing the ESCP 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 ESCP to be a working document. If items need altering, changes may be made to the individual tables after appropriate consultation with the statutory authorities.

13.1.1 General commitments

Commitment 1

The Proponent undertakes to comply with the environmental implementation strategy as contained within the approved Erosion and Sediment Control Plan (ESCP) on a stage-by-stage basis.

Commitment 2

The Proponent undertakes to fulfil all commitments made in this ESCP 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 ESCP 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 ESCP.

13.1.2 Definitions

In this ESCP these terms have the following meanings;

- ESCP means the approved Erosion and Sediment Control 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 ESCP.
- DECCW means the Department of Environment, Climate Change and Water.

13.2 Baseline data collection phase

13.2.1 Background water quality monitoring

Person responsible	Nominated Environmental Consultant
Issue	Establishing appropriate discharge criteria for the construction phase. Interim water quality criteria have been based on data collected by TSC. However, additional monitoring rounds will be required to obtain a comprehensive data set from which site-specific water quality targets may be created.
Operational policy	To determine existing surface water quality parameters downstream of the development of the proposed Kings Forest Stage 1, prior to construction.
Performance criteria	The performance criteria shall be set by background monitoring of pre-construction water quality conditions. The following parameters shall be monitored for a minimum of 12 months to capture the range of seasonal variation: • pH (field measurement); • electrical conductivity (EC) (field measurement); • turbidity (field measurement); • dissolved oxygen (DO) (field measurement); • temperature (field measurement); • suspended solids (SS) (mg L^{-1}); • total nitrogen (TN), soluble nitrogen, nitrogen oxide (NO_x), total kjeldahl nitrogen (TKN), nitrite (NO_2) & nitrate (NO_3) (mg L^{-1}); • total phosphorus (TP) & soluble phosphorous (mg L^{-1}); • oil and grease (visual inspection); • calcium (Ca); • magnesium (Mg); • sodium (Na); • potassium bicarbonate (K/HCO_3); • bicarbonate (HCO_3); • carbonate (CO_3); • total & dissolved iron (Fe); • total & dissolved aluminium (Al); • dissolved manganese (Mn); • chloride (Cl); • sulfate (SO_4); • ammonium (NH_4);

- colour;
- total acidity (titratable);
- total alkalinity;
- arsenic (As);
- cadmium (Cd);
- copper (Cu)
- lead (Pb)
- nickel (Ni)
- zinc (Zn)
- chlorophyll-a;
- faecal coliforms;
- total algal cell count; and
- blue green algae.

Interim water quality criteria (based on data collected by TSC)

Parameter	Interim criteria
pH	5.5 - 7.5
Turbidity	<10NTU
Suspended solids	<10mg/L
Dissolved oxygen	>5mg/L
Chlorophyll-a	<6µg/L
Total Aluminium	<0.9mg/L
Total Iron	<1.7mg/L
Total Nitrogen	<1.0mg/L
Total Phosphorous	<0.06mg/L
Salinity	<12ppt
Litter and gross pollutants	No man made material >5mm in any dimension
Oil and/or grease	No visible film, no detectable odour

Implementation strategy

Surface water quality and groundwater level and quality monitoring on a monthly basis from established monitoring locations prior to commencement of bulk earthworks.

Following the completion of background monitoring, a water quality report, including results and interpretation would be prepared and submitted to TSC for review.

Monitoring	Background monitoring shall be conducted by a qualified Environmental Scientist for the parameters listed above to allow the interpretation of data for statistical analysis and groundwater modelling purposes.
Auditing	The consultant will audit the results and submit a background groundwater quality report to TSC prior to the commencement of construction works.
Reporting	The consultant will audit the results and submit a background groundwater quality report to TSC prior to the commencement of construction works.
Identification of incident or failure	Failure to collect adequate rounds of data prior to commencement of bulk earthworks.
Corrective action	• Cease works until data is available. • Increase frequency of monitoring until sufficient data is available.

Commitment 3

Surface water quality at the discharge points will be monitored prior to the construction works to determine background water quality data and release criteria.

13.3 Management of potential impacts – Bulk earthworks and civil construction phase

13.3.1 Soil disturbance

Person responsible	Contractor's Site Manager
Issue	Removal or disturbance of ground cover is to be kept to a minimum.
Operational policy	To maintain existing vegetation as long as possible during construction works.
Performance criteria	No vegetation is to be removed prior to Council approval.
Implementation strategy	- No vegetation removal prior to receipt of Council approval shall be undertaken. - Clearing shall be conducted progressively in a manner that minimises the area of disturbed soil at any time during the works. - The area of disturbance shall be clearly delineated to keep vehicles, building materials and refuse away from areas to be protected. - Access points onto the site shall be minimised. - Vegetation buffer zones shall be maintained where possible. - Where practicable vegetative debris shall be salvaged as logs or woodchip. - Where possible, shakedown devices shall be utilised to minimise sediment transport onto public roads. - Newly completed hardstand areas shall be swept to prevent excess aggregate or gravel entering street drains.
Monitoring	Regular inspections shall be carried out to ensure that construction work areas are kept within the Kings Forest Stage 1 area.
Auditing	A weekly safety audit shall be conducted of the retained vegetation. Management is to examine the boundary of the works weekly.
Reporting	No reporting is necessary unless areas are inadvertently cleared outside approved stage boundaries.
Identification of incident or failure	Clearing of designated retained vegetation. Clearing outside of stage boundaries.
Corrective action	Reinstate and revegetate overcleared areas where necessary, unless the area is to be used for future stages, in which case temporary stabilisation, such as seeding, may be appropriate.

Commitment 4

Best management practices will be implemented throughout the bulk earthworks and civil construction phase to minimise erosion.

13.3.2 Dust management – Bulk earthworks and civil construction phase

Person Responsible	Contractor's Site Manager
Issue	Dust movement offsite is to be kept to a minimum.
Operational policy	Acceptable air quality standards will be achieved by minimising 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	Dust generation shall be minimised 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. • Contractor's 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. • Monitoring will be undertaken in accordance with AS 3580.10.1 (2003).
Auditing	Management is to examine the Complaints Register weekly and review corrective action taken.
Reporting	• The contractor to notify the DECCW of a possible environmental nuisance on receipt of three or more dust complaints in any 24-hour period.

Identification of incident or failure	• Reports will be provided to TSC upon request. • Complaints by residents are to be recorded in a Complaints Register.
	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, • cease the dust creating activities if dust persists. All dust complaints are to be addressed in consultation with the environmental consultant. Council shall be advised of the remedial measures taken to address dust complaints.

Commitment 5

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

13.3.3 Erosion controls – Bulk earthworks and civil construction phase

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Erosion Controls
Operational policy	To prevent the displacement of sediment and soil across and offsite during storm events.
Performance criteria	No visual indication of erosion during the construction phase in Stage 1, 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. sterile straw bales, straw fences) are to be employed onsite during construction where 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 (Landcom, Aust). 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 hazardous areas, at

	least 30m away from all retained native vegetation and at least 60m away from SEPP 14 wetlands (whichever is the greater). • 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.
Monitoring	A self auditing program shall be developed for the site. A site inspection and self audit and monitoring program shall include: • weekly site inspections, • inspections immediately following rainfall events that cause runoff, and • inspections immediately before site closure. Surface water quality to be monitored during rainfall events (refer to table titled 'Surface Water Quality – Construction Phase' which details monitoring of surface water and stormwater quality including during storm events).
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	• The contractor to notify the DECCW immediately of breaches with potential to cause harm to the environment. • 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. • Declining water quality as identified by Environmental Consultant.
Corrective action	Apply remedial measures to improve sediment and erosion measures, for example; • Sterile straw bales, sediment fences and flocculation of water quality sedimentation ponds. • Maintain or replace ineffective ESC devices. • Add further controls in consultation with environmental consultant or supervising engineer.

Commitment 6

Management will ensure, through inspection and in situ analysis, that no adverse impact on surface water quality results from development of the site.

13.3.4 Sediment control – Bulk earthworks and civil construction phase

Person responsible	Contractor's Site Manager, Environmental Consultant
Issue	Sediment Control
Operational policy	To prevent the displacement of sediment and soil across and offsite during storm events.
Performance criteria	Offsite discharges are to comply with surface water requirements set by background water quality monitoring. Interim performance criteria have been based on existing Council and G&S water quality monitoring data.
Implementation strategy	All sediment control measures and facilities must be installed and stabilised prior to the commencement of site construction activities. No site disturbance shall commence until the appropriate approvals have been obtained. Wherever possible, surface waters from undisturbed lands shall be diverted away from construction areas. Sediment detention basins and clean-water diversion channels shall be constructed prior to earthworks in accordance with Drawing No. 10468.4.1 and 10468.4.2 (Attachment 1). The location of these devices will depend on the earthworks plan and preliminary grading. 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. Temporary erosion measures (e.g. sterile straw bales, sediment fences) are to be employed onsite during construction where deemed necessary by TSC from an assessment of slope and soil type. Such measures should be in accordance with TSC'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. Sterile straw bales and sediment fences are to be replaced when damaged or permanently blocked. 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. Where possible, tracks shall not be placed within retained vegetation. If this is not possible, the tracks shall be identified on the Vegetation Management Plan, paved in locations to minimise environmental impact and constructed so as to minimise erosion. These tracks shall be locked with keys available only to approved personnel. Detailed design drawings of temporary culvert crossings, cross banks for slow speed tracks and erosion and sediment controls are provided in

Monitoring	Drawing No. 104683.4.2. 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.
	A self auditing program shall be developed for the site. A site inspection and self audit and monitoring program shall include: - weekly site inspections - inspections immediately following rainfall events that cause runoff, and - inspections immediately before site closure. Surface water quality to be monitored monthly and during rainfall events (refer to section 13.3.5 of the ESCP titled 'Surface Water Quality – Bulk earthworks and civil construction phase' which details monitoring of surface water and stormwater quality including during storm events).
	- 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.
	- The contractor to notify the DECCW immediately of breaches with potential to cause harm to the environment. - Signed, completed self audits, original test results, weekly and other result sheets shall be kept on site and made available on request to Council officers and other relevant statutory authorities.
	- Declining water quality as identified by Environmental Consultant. - Build-up of sediment.
	Apply remedial measures to improve sediment and erosion measures, for example; - Sterile straw bales, sediment fences and flocculation of water quality sedimentation ponds. - Maintain or replace ineffective ESC devices. - Add further controls in consultation with environmental consultant or supervising engineer.

Commitment 7

Best management practices will be implemented throughout the construction works to minimise sediment transport offsite.

13.3.5 Surface water quality – Bulk earthworks and civil construction phase

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 controlled water discharges from the site will comply with water quality criteria set by pre-construction background monitoring as referred to in Table 13.2.1 of this ESCP. Interim performance criteria have been based on existing TSC water quality monitoring data.
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. Waterway crossings will be designed in accordance with NSW Fisheries <i>'Why do Fish Need to Cross the Road?'</i>² Further detail will be provided in the Construction Certificate Application. 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) at the locations shown on Drawing No. 10927.1.1 for the parameters listed in Table 13.2.1 (Background water quality monitoring). Surface water and groundwater quality monitoring are to be conducted simultaneously to allow temporal comparisons between the systems.
Auditing	Environmental Consultant to audit water quality results to ensure all discharges comply with the performance criteria.

² Fairfull, S. & Witheridge, G. (2003) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings*. NSW Fisheries, Cronulla

Reporting	• The contractor to notify the DECCW immediately of breaches with potential to cause harm to the environment. • 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 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 8

Surface water quality at the discharge points will be maintained during the construction works in accordance with the criteria agreed with TSC based on the background data.

13.3.6 Contractor management – Bulk earthworks and civil construction phase

Person responsible	Proponent
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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 ESCP and the <i>Protection of the Environment Operations Act (1997)</i> .
Performance criteria	Contractor is fully aware of his/her responsibilities under the terms of the ESCP.
Implementation strategy	• Review of the ESCP and the bulk earthworks and civil construction phase contracts by the proponent. • Periodic checks to be made by an independent environmental consultant. • Training for construction staff in implementation of ESCP 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 Stage 1 of the development.
Reporting of monitoring results	Full details to be available to the contractor together with suggested corrective actions if required.
Corrective action	To be detailed at the time.

Commitment 9

A proactive program of contractor management will be implemented.

13.4 Management of potential impacts - Landform stabilisation phase

13.4.1 Rehabilitation and landscaping – Landform stabilisation phase

Person responsible	Proponent
Issue	Rehabilitation and landscaping
Operational policy	Landscaping, stabilisation and revegetation of completed areas to aid the treatment of surface water and minimise sediment transport.
Performance criteria	No sediment transport from completed areas.
Implementation strategy	• Progressive stabilisation and revegetation of completed areas. • The landscaping and rehabilitation program shall be programmed to ensure that minimal time delay occurs between final land shaping and permanent rehabilitation (a period of 20 days is to be provided). All temporary erosion and sediment control works are to be removed once works are complete and revegetation is successfully established in formerly disturbed areas.
Monitoring	Regular inspections shall be carried out on completed areas to assess success of revegetation works.
Auditing	No reporting is necessary unless problems are identified.
Reporting of monitoring results	Failure to rehabilitate completed works areas progressively.
Identification of incident or failure	Revegetate as soon as possible.
Corrective action	• Test topsoil if revegetation works have been unsuccessful to determine the possible problem. • Review procedures in consultation with landscape architect and/or horticulturalist.

Commitment 10

Best management practices will be implemented throughout the landform stabilisation phase to minimise sediment transport offsite.

13.5 Management of potential impacts – On Maintenance Phase

13.5.1 Intent

This part of the ESCP specifies requirements that must be met by the Proponent following completion of the construction of Stage 1. Areas where bulk earthworks have been completed will be monitored to ensure ongoing stability and soils and areas where civil works are complete will be monitored to ensure permanent surface water quality improvement devices function in accordance with their design specifications.

13.5.2 Implementation

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

13.5.3 Maintenance of treatment measures – On Maintenance Phase

Person responsible	Proponent
Issue	Operation and maintenance of the treatment measures.
Operational policy	To maintain the water quality control structures to ensure adequate performance during the operational period.
Performance criteria	The control measures are maintained and operational.
Implementation strategy	Water quality on site will continue to be maintained during the maintenance phase through utilisation of appropriate water sensitive urban design measures. Stormwater traversing the site in each catchment will be directed through a series of stormwater treatment devices in order to minimise flow velocities and allow the settling of entrained sediment/uptake of nutrients prior to discharge. Culverts and structures allowing the passage of clean water from the upper catchment areas during the construction phase will remain in place throughout the on maintenance phase, minimising the volume of water traversing exposed areas of the site. Regular maintenance of all stormwater control structures will be carried out to: • Ensure the structural integrity of the treatment measures. • Ensure inlets and outlets are not blocked. • Ensure that sediment, debris and litter accumulation does not impair operational efficiency.
Monitoring	Routine monthly visual inspection of treatment trains and vegetated open space for: • litter; • erosion; • excessive sediment deposition; • clogging (bio-retention);

Auditing	• 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 bio-retention basin, • waterway and wetland system.
	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 bio-retention and filter basins. • Deterioration of water quality downstream of the control structure/s.
Corrective action	Bio-retention 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 trap material in accordance with manufacturer's specifications.

Vegetated rough

- Regular mowing and maintenance of rough filter characteristic by mulching organic matter back into rough 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 11

Best management practices will be implemented throughout the maintenance phase to maintain permanent treatment measures.

13.5.4 Erosion controls – On Maintenance Phase

Person responsible	Proponent
Issue	Erosion Controls
Operational policy	To prevent the displacement of sediment across and offsite during storm events.
Performance criteria	Off-site discharges to comply with surface water criteria set by background monitoring. Interim performance criteria have been based on existing TSC water quality monitoring data. No visual indication of erosion in completed areas, including evidence of rilling (an indicator of sheet erosion).
Implementation strategy	Erosion and sediment control devices shall be maintained in accordance with the approved engineering plans and to the reasonable satisfaction of TSC. A program of monitoring stabilized areas where bulk earthworks have been completed and rehabilitated. Where damage from excess surface runoff has occurred, additional controls shall be implemented in the areas of high erosion potential. Maintenance of all erosion control measures at operational capacity until land is effectively rehabilitated. Erosion and sediment control measures shall be maintained at, or above their design capacity. Such measures should be in accordance with the recommendations of Tweed Shire Council's '<i>Code of Practice for Soil and Water Management on Construction Works – Annexure A of Development Design Specification D7 – Stormwater Quality</i>' and '<i>Managing Urban Stormwater: Soils and Construction</i>' March 2004 by Landcom, Australia. Outside Stage 1, existing surface water conditions should be maintained wherever possible.
Monitoring	A self auditing program shall be developed for the site. A site inspection and monitoring program shall include: • weekly site inspections, • inspections immediately following rainfall events that cause runoff, and • inspections immediately before site closure. Surface water quality to be monitored during rainfall events (refer to the section titled 'Surface Water Quality – On Maintenance Phase' which details monitoring of surface water and stormwater quality including during storm events).
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	• The contractor to notify the DECCW immediately of breaches with potential to cause harm to the environment. • 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 water quality as identified by Environmental Consultant.
Corrective action	• Apply remedial measures to improve sediment and erosion measures, for example; sterile straw bales, sediment fences and flocculation of water quality control ponds. • Repair or maintain existing controls. • Add further controls.

Commitment 12

Best management practices will be implemented throughout the on maintenance period to minimise erosion.

13.5.5 Surface water quality – On Maintenance Phase

Person responsible	Proponent
Issue	Surface water controls
Operational policy	To maintain the water quality conditions of receiving waters during the maintenance phase of the development.
Performance criteria	All controlled water discharges from the site will comply with water quality criteria set by pre-construction background monitoring. Interim performance criteria have been based on existing TSC water quality monitoring data.
Implementation strategy	Surface water runoff control will be achieved by maintaining temporary and permanent stormwater treatment devices throughout the development. Monitoring of stormwater treatment devices for compliance with the approved water quality criteria will take place monthly and following rainfall events (defined as >25mm in any 24 hour period) and prior to any discharge of stormwater (controlled or uncontrolled) from the site. Where water quality fails to meet the criteria, corrective measures will be undertaken to achieve compliance with the water quality release criteria.
Monitoring	Surface water monitoring will be conducted monthly (in conjunction with groundwater monitoring) and following the first monthly rainfall event (defined as >25mm in 24 hours) at the locations shown on Drawing No. 10927.1.1 for the parameters listed in Table 13.2.1 (Background water quality monitoring) in addition to: hydrocarbon (TPH); benzene, toluene, ethylbenzene and xylenes (BTEX); and enterococci. Surface water and groundwater quality monitoring are to be conducted simultaneously to allow temporal comparisons between the systems.
Auditing	Environmental Consultant to audit water quality results to ensure all discharges comply with the performance criteria.
Reporting	- The contractor to notify the DECCW immediately of breaches with potential to cause harm to the environment. - Result sheets are to be compiled and reported bi-annually to TSC.
Identification of incident or failure	Degradation of surface water quality or failure to meet the specified water quality criteria set by pre-construction background monitoring.
Corrective action	If 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. Remaining erosion control devices will be immediately inspected and cleaned if necessary. Additional devices will be installed if a need is identified to prevent future breaches of the suspended solids criteria.

Commitment 13

Surface water quality at the discharge points will be maintained during the on maintenance period in accordance with the criteria agreed with TSC based on the background data.

13.6 Management of potential impacts – Operational Phase

13.6.1 Intent

The following procedures are recommended to be undertaken by TSC upon assuming responsibility for works.

13.6.2 Implementation

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

13.6.3 Maintenance of treatment measures – Operational Phase

Person responsible	Tweed Shire Council
Issue	Operation and maintenance of the treatment measures.
Operational policy	To maintain the water quality control structures to ensure adequate performance during the operational period.
Performance criteria	The control measures are maintained and operational.
Implementation strategy	Water quality on site will continue to be maintained during the operational phase through utilisation of appropriate water sensitive urban design measures. Stormwater traversing the site in each catchment will be directed through a series of permanent stormwater treatment devices in order to slow flow velocities and allow the settling of entrained sediment/uptake of nutrients prior to discharge. Regular maintenance of all stormwater control structures will be carried out to: • Ensure the structural integrity of the treatment measures. • Ensure inlets and outlets are not blocked. • Ensure that sediment, debris and litter accumulation does not impair operational efficiency.
Monitoring	Routine monthly visual inspection of treatment trains and vegetated open space for: • litter; • erosion; • excessive sediment deposition; • clogging (bio-retention); • 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 bio-retention 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.
Corrective action	Bio-retention 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 trap material in accordance with manufacturer's specifications. Vegetated rough • Regular mowing and maintenance of rough filter characteristic by mulching organic matter back into rough 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 14

Best management practices will be implemented into work practices throughout the operational phase to minimise erosion.

13.7 Administration of the ESCP

13.7.1 Amendment of the ESCP

The Proponent may make an application to TSC to amend the provisions of this ESCP. The application shall:

- be in writing; and
- specify the provisions of the ESCP to which the application relates; and
- state how the proposed amendments achieve the objectives of the provisions to which the amendments relate.

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

13.7.2 Incident management

The Proponent and any person appointed by the Proponent as having responsibility for a control strategy set out in this ESCP have clearly defined responsibilities under the NSW *Protection of the Environment Operations Act* (1997) to report any incidents likely to cause material or serious environmental harm.

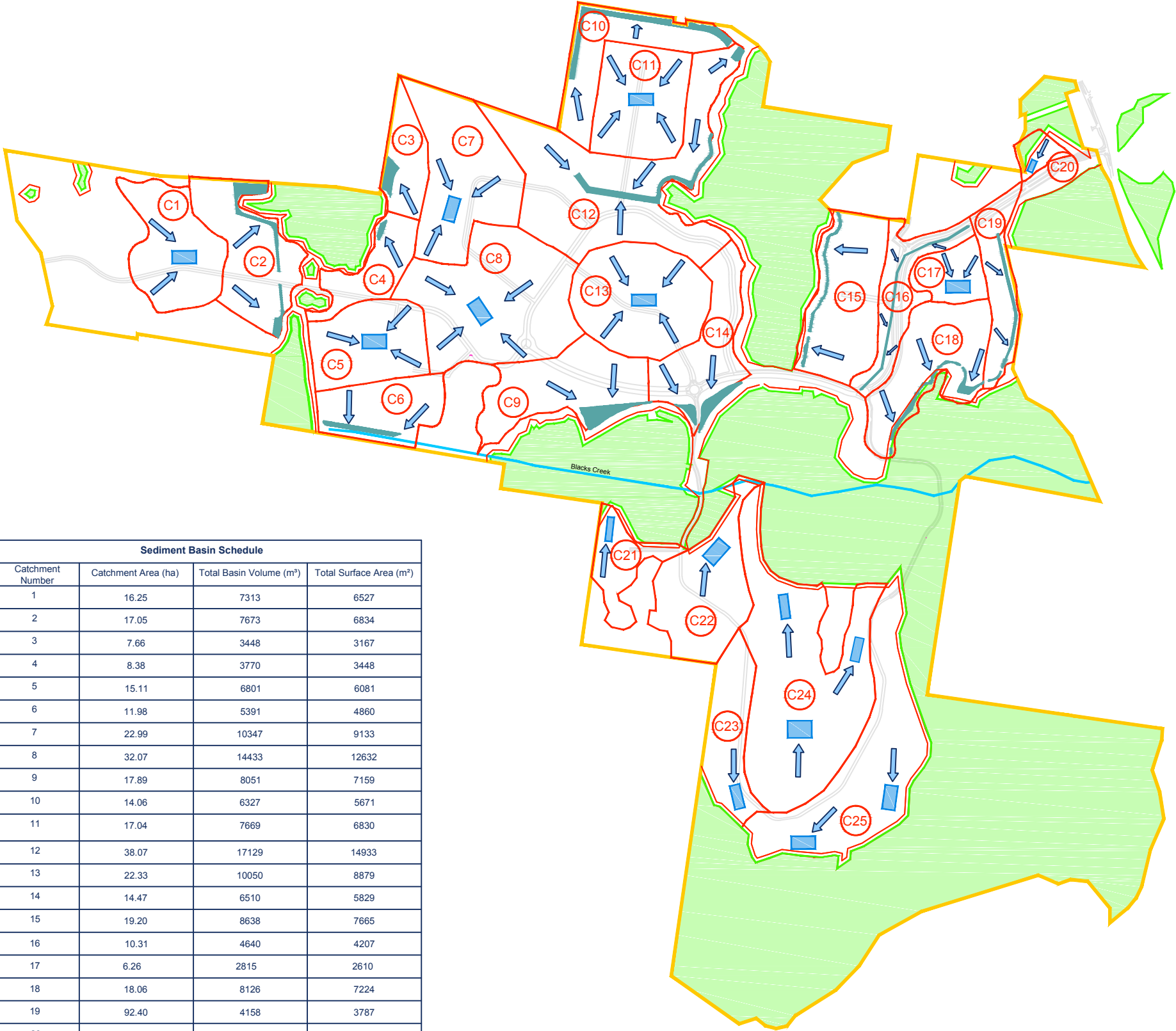
13.8 Attachment 1 – Drawings

LEGEND

- Site boundary
- Catchment area boundary
- Catchment area number
- Sediment basins
- Biofiltration basins (temporary sediment basins)
- Sediment flow direction
- Sediment fences
- Vegetation to be retained
- Main road network

SOURCES

Layout:
Mortons Urban Solutions Pty Ltd, 2012



Sediment Basin Schedule			
Catchment Number	Catchment Area (ha)	Total Basin Volume (m³)	Total Surface Area (m²)
1	16.25	7313	6527
2	17.05	7673	6834
3	7.66	3448	3167
4	8.38	3770	3448
5	15.11	6801	6081
6	11.98	5391	4860
7	22.99	10347	9133
8	32.07	14433	12632
9	17.89	8051	7159
10	14.06	6327	5671
11	17.04	7669	6830
12	38.07	17129	14933
13	22.33	10050	8879
14	14.47	6510	5829
15	19.20	8638	7665
16	10.31	4640	4207
17	6.26	2815	2610
18	18.06	8126	7224
19	92.40	4158	3787
20	25.40	1143	1119
21	7.52	3385	3111
22	18.07	8130	7227
23	12.10	5444	4906
24	42.79	19254	16743
25	28.23	12703	11152

NOTES:
1. All basins have a depth of 1.2m
2. All basins sized in accordance with the Landcom Guideline and Tweed Shire Council Development Design Specification D7 Stormwater Quality Guidelines

EROSION AND SEDIMENT CONTROL

Standard notes, drawings and details set

To be applied in conjunction with approved plans for location and extent

Brisbane Sydney Melbourne and regions

**+GILBERT
SUTHERLAND**
Agriculture. Water. Environment.

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PROJECT
**KINGS FOREST
STAGE 1**
PROJECT APPLICATION

CLIENT
**PROJECT 28
PTY LTD**

	DATE 27/07/2012	DRAWN SPD
PROJECT NO 10864	DRAWING NO 10864_4.2_01	CHECKED MLF

GENERAL

All erosion and sediment controls to be constructed in accordance with 'Soils and Construction Guidelines - Managing Urban Stormwater' 4th Edition, March 2004, Landcom, New South Wales.

SITE LAYOUT/CLEARING LIMITS

No site disturbance shall occur until appropriate approvals are obtained. Any trees or vegetation to be retained should be clearly marked. Perimeter fencing should be constructed to clearly delineate the extent of disturbance. Vegetation buffer zones shall be maintained where possible especially around high erosion risk areas. No onsite maintenance of earthmoving equipment shall occur unless appropriate controls are in place.

DUST MANAGEMENT

Ground surfaces will be kept damp (not wet). An on-site water cart will be available at all times. Surfaces shall be left in a rough cloddy condition to increase roughness and slow surface wind speed. Temporary access roads and parking areas shall be sealed with a gravel layer.

EROSION CONTROLS

Construction programme shall be scheduled to minimise the potential for soil loss. Sediment and erosion controls shall be installed prior to clearing and include:

1. Diversion of stormwater around disturbed areas.
2. Sediment control fences at the downslope perimeter of cleared and/or disturbed areas. These controls shall be functional prior to commencing upslope work.
3. Sediment fences should be constructed at the toe of all fill batters, downslope of all temporary soil stockpiles and around the existing freshwater dam.
4. Sedimentation basins shall be constructed in accordance with the design drawings, including adequate outlet protection. Stormwater runoff shall be directed away from construction entry/exit points.

Temporary erosion measures (sediment fences, sterile straw bales, catch drains, perimeter banks and diversion channels) are to be employed onsite during construction where reasonably deemed necessary. Access is to be provided for maintenance and sediment removal works.

Stockpiled soil should be stored taking into account the following considerations:

1. They are not to be located on public footpaths, nature strips, roads or any other public land.
2. Be located at least 2m away from any hazard areas, at least 30m away from all retained native vegetation and at least 60m away from SEPP 14 wetlands (whichever is the greater)
3. Be protected from upslope surface flows, and
4. Be provided with sediment filters downslope.

SEDIMENT CONTROL

Stormwater control will be achieved by directing all runoff from disturbed areas to a temporary sedimentation basin.

Where practicable, future bioretention basins to be used as temporary sediment basins during the construction phase. Basins to be constructed as required by the progression of the works.

Sediment is to be removed after each rainfall event and weirs are to be regularly maintained and cleaned. Sediment fences are to be constructed along the contour, but not across areas of concentrated flow, and replaced when damaged or permanently blocked.

Level markers shall be installed within all temporary sedimentation basins. Sediment basins shall be dosed with flocculating agents when required to ensure that discharge water quality meets required limits.

Bypass flows from sediment traps shall be directed to stable areas. Access is to be provided to sediment basins and sediment shall be cleaned out when accumulated sediment volume reaches 70% of storage capacity. Where possible, tracks shall not be placed within retained vegetation.

Additional protection should be provided on the site perimeters that

adjoin environmental protection areas. Controls in these areas should include:

1. Retaining existing vegetation as long as possible
2. No stockpiling of soil adjacent to environmental protection areas
3. Temporary application of mulch if areas are to be left cleared for long periods of time
4. Stabilisation of adjoining land within 14 days of completion of earthworks.

SURFACE WATER MONITORING

All surface water tested to conform with the following criteria (or as established by background monitoring):

Parameter	Release Criteria	Criteria type
PH	5.5 - 7.5	Range
Salinity	< 35ppt	Maximum
Turbidity	NTU < 25	Maximum
Dissolved oxygen (Field measured)	mg/L > 5.0	Minimum
Oil and grease	No visible film and/or no detectable odour	

Sampling and analysis of surface water should be undertaken prior to release of water from the temporary sedimentation basins.

POLLUTION CONTROL

Petroleum and other chemical products shall be prevented from contaminating surface water and soil. Any onsite fuel storage areas shall comply with Australian Standards. Adequate trade waste and litter bins shall be provided onsite and serviced regularly.

Concrete wastes and washouts shall not be deposited in any location where the wastes or washings can flow, or can be washed into any areas of retained vegetation or receiving waters.

REHABILITATION AND LANDSCAPING

Progressive stabilisation of areas where construction delays occur and revegetation of completed areas. All landscaping and rehabilitation shall be completed so that a duration of less than 20 working days will elapse from final land shaping to

permanent rehabilitation. All temporary erosion and sediment control works are to be removed once works are complete and revegetation is successfully established in formerly disturbed areas. Drainage channels are to be stabilised immediately after construction.

CONTRACTOR MANAGEMENT

Review of the ESCP 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 ESCP provisions. Contractors staff to be trained to implement dust minimisation measures.

MATERIALS

Fabric:

Polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140g/m². All fabric to contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).

Fabric reinforcement:

Wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.

Support posts/stakes:

1500mm² (min.) hardwood, 2500mm² (min.) softwood or 1.5kg/m (min.) steel star pickets suitable for attaching fabric

INSTALLATION

1. Refer to approved plans for location and installation details. If there are questions or problems with the location, extent or method of installation contact the engineer or responsible on-site officer for assistance.

2. To the maximum degree practical and where the plans allow, ensure the fence is located:

- Totally within the property boundaries.
- Along a line of constant elevation wherever practical

- At least 2m from the toe of any filling operations that may result in shifting soil/fill damaging the fence

3. Install returns within the fence at maximum 20m intervals if the fence is installed along the contour or 5 to 10m maximum spacing (depending on the slope) if the fence is installed at an angle on the contour. The 'returns' shall consist of either:

- V-shape section extending at least 1.5m up-slope, or
- Sandbags or rock/aggregates check dam minimum $\frac{1}{3}$ and minimum $\frac{1}{2}$ fence height and extending at least 1.5m up the slope.

4. Ensure the extreme ends of the fence are turned up the slope at least 1.5m or as necessary to minimise water bypassing around the fence.

5. Ensure the sediment fence is installed in a manner that avoids the concentration of flow along the fence and the undesirable discharge of water around the ends of the fence.

6. If the sediment fence is to be installed along the edge of existing trees, ensure care is taken to protect the trees and their root systems during installation of the fence. Do not attach the fabric to the trees.

7. Unless otherwise directed by the responsible on-site officer, excavate a 200mm wide by 200mm deep trench along the proposed alignment of the filter fence, placing the excavated material up-slope of the trench.

8. Along the lower side of the trench appropriately secure the stakes into the ground spaced not greater than 3m if supported by a top wire or weir mesh backing, otherwise no greater than 2m.

9. If specified, securely attach the support wire or mesh to the up-slope side of the stakes with the mesh extending at least 200mm into the excavated trench. Ensure the mesh and fabric is attached to the up-slope side of the stakes even when directing a fence around a corner or sharp change in direction.

10. Wherever possible, construct the sediment fence from a continuous roll of fabric. To join fabric either:

- Attach each end to two overlapping stakes with the fabric folding around the associated stakes one turn and

with the two stakes tied together with wire

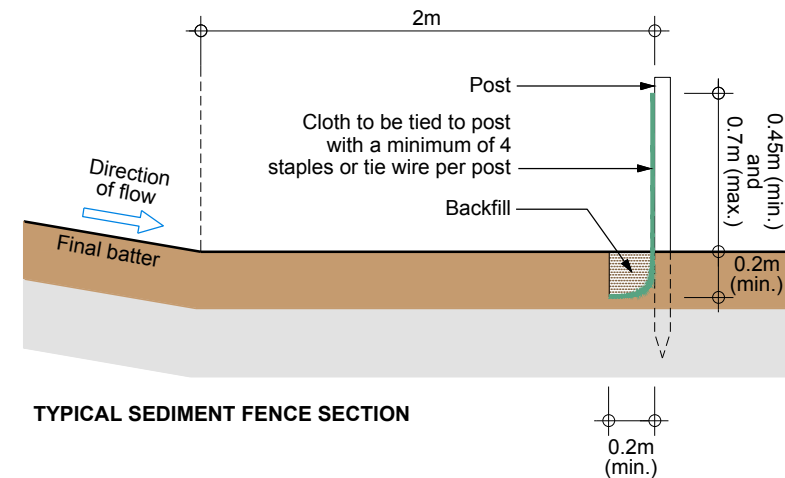
- Overlap the fabric to the next adjacent support post.

11. Securely attach the fabric to the supports posts using 25x12.5mm staples or tie wire at maximum 150mm spacing.

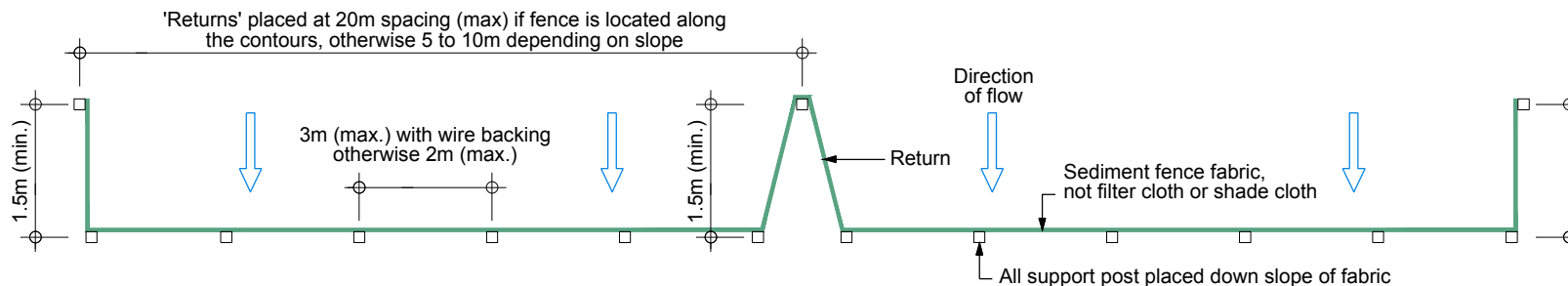
12. Securely attach the fabric to the support/mesh (if any) at a maximum spacing of 1m.

13. Ensure the completed sediment fence is at least 450mm but not more than 700mm high. If a spill-through weir is installed, ensure the crest of the weir is at least 300mm above ground level.

14. Backfill the trench and tamp the fill to firmly anchor the bottom of the fabric and mesh to prevent water from flowing under the fence.



TYPICAL SEDIMENT FENCE SECTION



TYPICAL SEDIMENT FENCE LAYOUT

ADDITIONAL REQUIREMENTS FOR THE INSTALLATION OF A SPILL-TROUGH WEIR

1. Locate the spill-through weir such that the weir crest will be lower than the ground level at each end of the fence.
2. Ensure the crest of the spill-through weir is at least 300mm above the ground elevation
3. Securely tie a horizontal cross member (weir) to the support posts/stakes each side of the fabric down the side of each post and fold the fabric over the cross member and appropriately secure the fabric.

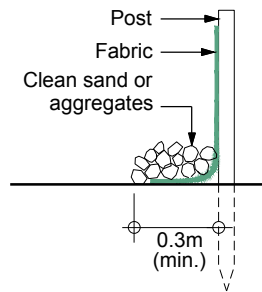
4. Install a suitable splash pad and/or chute immediately down-slope of the spill through weir to control soil erosion and appropriately discharge the concentrated flow passing over the weir.

MAINTENANCE

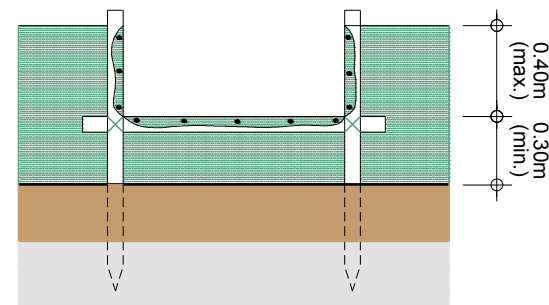
1. Inspect the sediment fence at least weekly and after any significant rain. Make necessary repairs immediately.
2. Repair any torn section with a continuous piece of fabric from post to post.
3. When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.
4. If the fence is sagging between stakes install additional support posts.
5. Remove accumulated sediment if the sediment deposit exceeds a depth of $\frac{1}{3}$ the height of the fence.
6. Dispose of sediment in a suitable manner that will not cause an erosion or pollution hazard.
7. Replace the fabric if the service life of the existing fabric exceeds 6 months.

REMOVAL

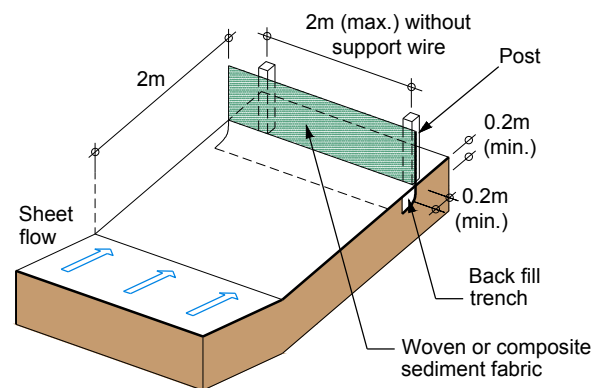
1. When disturbed areas up-slope of the sediment fence are sufficiently stabilised to restrain erosion, the fence must be removed.
2. Remove materials and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
3. Rehabilitate/revegetate the disturbed ground as necessary to minimise the erosion hazard



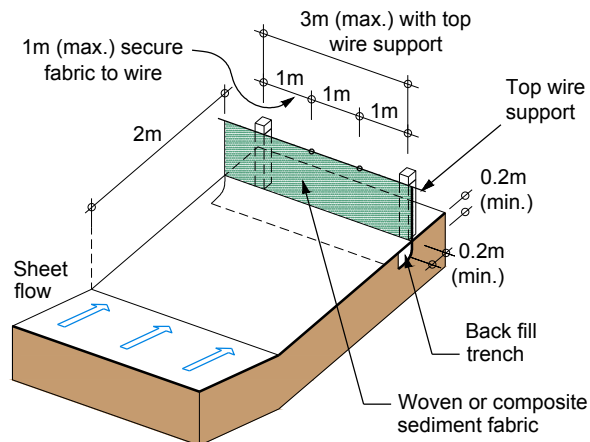
ALTERNATIVE FABRIC ANCHORING METHOD



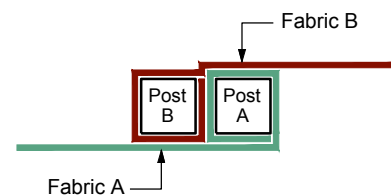
SPILL THROUGH WEIR ELEVATION



INSTALLATION WITHOUT BACKING SUPPORT

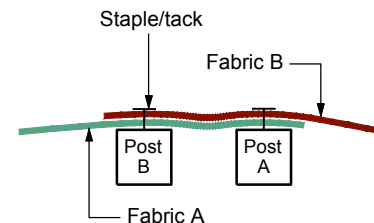


INSTALLATION WITH TOP WIRE SUPPORT



Fabric to be fold around each stake one full turn. Stake B to be drive tightly against stake A. The tops of both stakes to be secured with wire.

JOINING FABRIC - Method 1



JOINING FABRIC - Method 2

MATERIALS

Straw bales:

Straw bales containing minimum seed content. Hay or lucerne bales must not be used.

Support post/stakes:

1500mm² (min.) hardwood, 2500mm² (min.) softwood or 1.5kg/m (min.) steel star pickets.

Aggregate:

15 to 25 mm clean gravel or aggregate.

Filter cloth:

Heavy-duty non-woven, needle punched filter fabric, minimum 'bidim' A34 or equivalent

INSTALLATION

1. Refer to approved plans for location and construction details. If there are questions or problems with the location or method of installation, contact the engineer or responsible on-site officer for assistance

2. Suitably clear and prepare the surface where the bales will be installed.

3. Lay the filter fabric on the ground with the up-slope edge extending at least 200mm up-slope of the intended up-slope edge of the bales.

4. If more than one sheet of fabric is used, then overlap the fabric a minimum of 600mm at all joints.

5. Place the bales end to end (length-wise) on the fabric with the up-slope edge at least 200mm down-slope of the up-slope edge of the fabric.

6. Fold the remainder of the filter cloth over the bales such that the end of the fabric rests firmly on the ground and extends at least 200mm up-slope of the bales.

7. Securely anchor the bales with a minimum of one stake or picket driven through the centre line of each bale. If the bales are not wrapped in filter cloth (not recommended), then use at least two stakes per bale. The first stake being driven towards the adjoining bale at a 45 degree angle to force the bales together

MAINTENANCE

1. Replace the straw bale barrier if full or partial collapse of the bales occurs.

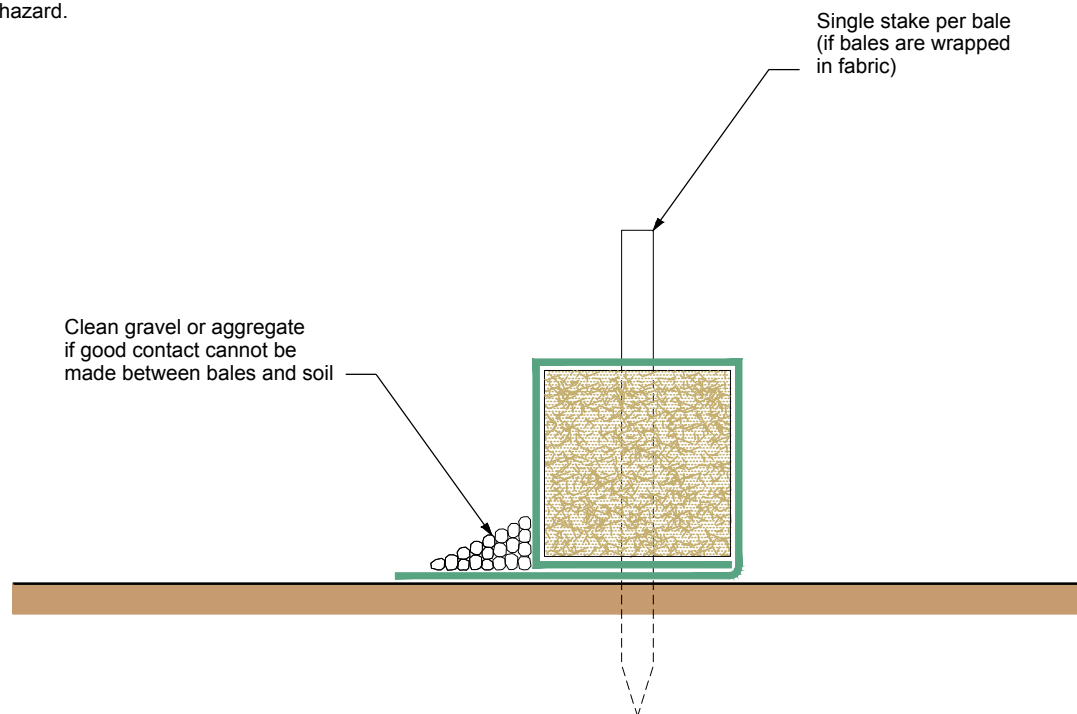
2. Remove and suitably dispose of accumulated sediment prior to replacing the bales.

3. Replace the filter fabric when it becomes blocked with sediment and/or the flow rate through the barrier becomes unacceptable.

REMOVAL

1. When work area up-slope of the straw bale barrier is sufficiently stabilised to restrain erosion, the barrier must be removed.

2. Remove all materials and deposited sediment and dispose of in a manner that will not cause an erosion or pollution hazard.



INSTALLATION OF STRAW BALE BARRIER

CATEGORY
SEDIMENT CONTROL
TECHNIQUES

SUB-CATEGORY
MINOR
CONCENTRATED
FLOW

DRAWING
STRAW BALE
BARRIER

SCALE
NTS

DRAWN
SPD

DRAWING NO
MCF.9

CHECKED
CMA

MATERIALS

Rock:

150 to 300mm nominal diameter, hard, erosion resistant rock. Smaller rock may be used if suitable large rock is not available.

Sandbags:

Geotextile bags (woven synthetic, or non-woven biodegradable) filled with clean coarse sand, clean aggregate, straw or compost.

INSTALLATION

1. Refer to approved plans for location and installation details. If there are questions or problems with the location or method of installation, contact the engineer or responsible on-site contractor for assistance.

2. Prior to placement of the check dams, ensure the type and size of each check dam will not cause a safety hazard or cause water to spill out of the drain.

3. Locate the first check dam at the downstream end of the section of channel being protected. Locate each successive check dam such that the crest of the immediate downstream dam is level with the toe of the check dam being installed.

4. Ensure the channel slope is no steeper than 10:1 (H:V), otherwise consider the use of a suitable channel liner instead of the check dams.

5. Construct the check dam to the dimensions and profile shown within the approved plan.

6. Where specified the check dams shall be constructed on a sheet of geotextile fabric used as a downstream splash pad.

7. Each check dam shall be extended up the channel bank (where practicable) to an elevation at least 150mm above the crest level of the dam.

MAINTENANCE

1. Inspect each check dam and the drainage channel at least weekly and after the runoff-producing rainfall.

2. Correct all damages immediately. If significant erosion occurs between any of the check dams, then check the spacing of dams, and where necessary install intermediate check dams or a suitable channel liner.

3. Check for displacement of the check dams.

4. Check for soil scour around the ends of each check dam. If such erosion is occurring, consider extending the width of the check dam to avoid such problems.

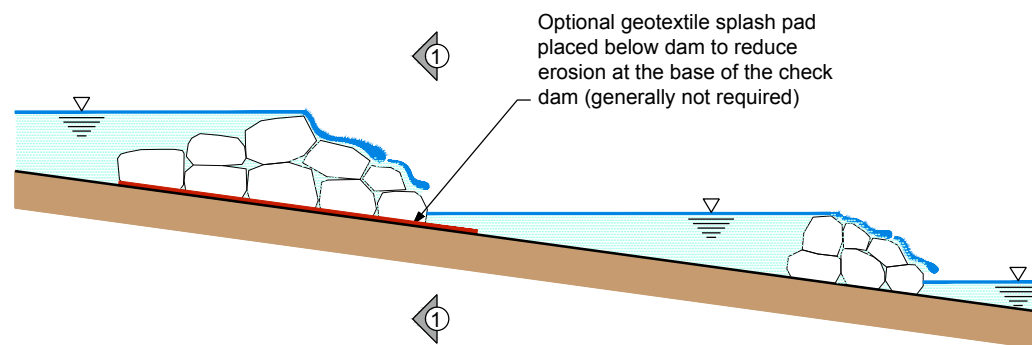
6. Remove any sediment accumulated by the check dams, unless it is intended that this sediment will remain within the channel.

7. Dispose of collected sediments in a suitable manner that will not cause an erosion or pollution hazard.

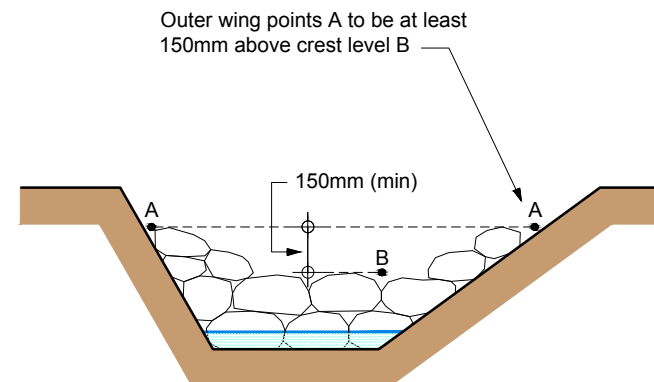
REMOVAL

1. When construction work within the drainage area above the check dams has been completed and the disturbed areas and the drainage channel are sufficiently stabilised to restrain erosion, all temporary check dams must be removed.

2. Remove the check dams and associated sediment and dispose of in suitable manner that will not cause an erosion or pollution hazard.



LONGITUDINAL AND CROSS SECTIONS 1-1 OF TYPICAL CHECK DAMS (ROCK CHECK DAMS SHOWN)



CROSS SECTION 1-1

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

DRAWING
CHECK DAMS

SCALE
NTS

DRAWN
SPD

DRAWING NO
ODS.1

CHECKED
CMA

INSTALLATION

1. Refer to approved plans for location and installation details. If there are questions or problems with the location, extent or method of installation contact the engineer or responsible on-site contractor for assistance.
2. Ensure all necessary soil testing (e.g. soil pH, nutrient levels) and analysis has been completed and required soil adjustment performed prior to planting.
3. Clear the location for the channel, clearing only what is needed to provide access for personnel and construction equipment.
4. Remove roots, stumps and other debris and dispose of them properly. Do not use debris to build any associated embankments.
5. Excavate the diversion channel to the specified shape, elevation and gradient. The sides of the channel should be no steeper than a 2:1 (H:V) if constructed in earth, unless specifically directed within the approved plans.

6. Stabilise the channel and banks immediately unless it will operate for less than 30 days. In either case, temporary erosion protection (matting, rock, etc.) will be required as specified within the approved plans or as directed.

7. Ensure the channel discharges to a stable area.

ADDITIONAL REQUIREMENTS FOR TURF PLACEMENT:

1. Turf should be used within 12 hours of delivery, otherwise ensure the turf is stored in conditions appropriate for the weather conditions (e.g. a shaded area).
2. Moistening the turf after it is unrolled will help maintain its viability.
3. Turf should be laid on a minimum 75mm bed of adequately fertilised topsoil. Rake soil surface to break the crust just before laying the turf.
4. During the warmer months, lightly irrigate the soil immediately before laying the turf.

5. Ensure the turf is not laid on gravel, heavily compacted soil, or soils that have been recently treated with herbicide.

6. Ensure the turf extends up the sides of the drain at least 100mm above the elevation of the channel invert, or at least to a sufficient elevation to fully contain expected channel flow.

7. On channel gradients of 3:1 (H:V) or steeper, or in situations where high flow velocities (i.e. velocity > 1.5m/s) are likely within the first 2 weeks following placement, secure the individual turf strips with wooden or plastic pegs.

8. Ensure that intimate contact is achieved and maintained between the turf and the soil such that seepage flow beneath the turf is avoided.

9. Water until the soil is wet 100mm below the turf. Thereafter watering should be sufficient to maintain and promote healthy growth.

MAINTENANCE

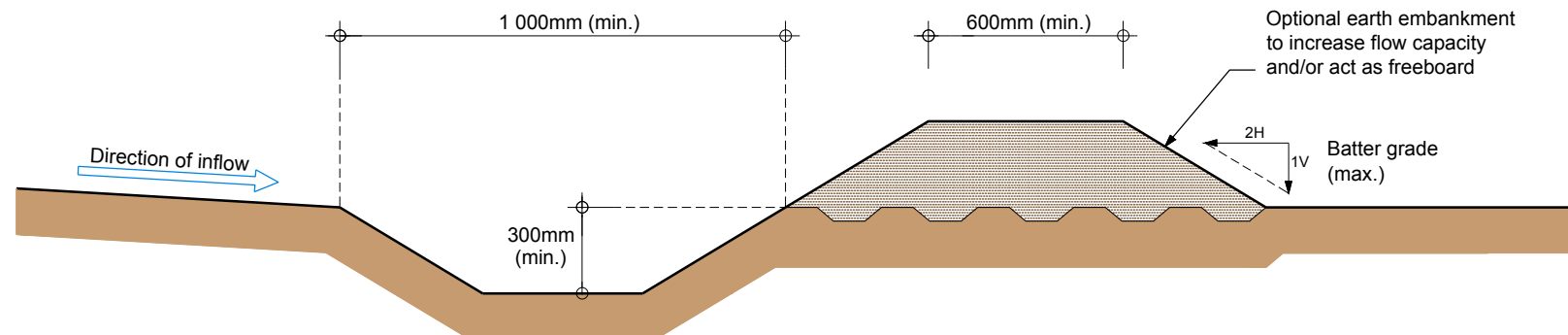
1. During the site's construction period, inspect the diversion channel weekly and after any increase in flow within the channel. Repair any slumps, wheel track damage or loss of freeboard.

2. Ensure fill material or sediment is not partially blocking the channel. Where necessary, remove any deposited material to allow free drainage.

3. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.

REMOVAL

1. When the construction work above the temporary diversion channel is finished and the area is stabilised, the area should be appropriately rehabilitated.
2. Dispose of any collected sediment or fill in a manner that will not create an erosion or pollution hazard.
3. Grade the area and smooth it out in preparation for stabilisation.
4. Stabilise the area as specified in the approved plan.



TYPICAL PROFILE OF DIVERSION CHANNEL WITH BANK

1. Refer to approved plans for location, extent and construction details. If there are questions or problems with the location, extent or method of installation, contact the engineer or responsible on-site contractor for assistance.

5. If earth is used, then ensure the sides of the bank are no steeper than a 2:1 (H:V) slope, and the completed bank must be at least 500mm high.

- CHECKED
CMA

MATERIALS

Rock:

Hard, angular, weather resistant rock and evenly graded with 50% by weight larger than the specified nominal rock size and sufficient small rock to fill the voids between the larger rock. The diameter of the largest rock size should be no larger than 1.5 times the nominal rock size. Specify gravity to be at least 2.5.

Geotextile fabric:

Heavy duty, needle-punched, non-woven filter cloth, minimum 'Bidim' A24 or equivalent.

INSTALLATION:

1. Refer to approved plans for location and dimensional details. If there are questions or problems with the location, dimensions or method of installation contact the engineer or responsible on-site contractor for assistance.

2. The dimension of the outlet structure must align with the dominant flow direction.

3. Excavate the outlet pad footprint to the specified dimension such that when the rock is placed in the excavated pit the top of the rocks will be level with the surrounding ground, unless otherwise directed.

4. If the excavated soils are dispersive, over-excavate the rock pad by at least 300mm and backfill with stable non-dispersive material.

5. Line the excavated pit with geotextile filter cloth, preferably using a single sheet. If joints are required, overlap the fabric at least 300mm.

6. Ensure the filter cloth is protected from punching or tearing during the installation of the fabric and the rock. Repair any damage by removing the rock and replacing with another piece of filter cloth over the damaged area overlapping the existing fabric a minimum of 300mm.

7. Ensure there are at least two layers of rock. Where necessary, reposition

the larger rock to ensure two layers of rocks are achieved without elevating the upper surface above the pipe invert.

8. Ensure the rock is placed in a manner that will allow water to discharge freely from the pipe.

9. Ensure the upper surface of the rock pad does not cause water to be deflected around the edge of the rock pad.

10. Immediately after construction appropriately stabilise all disturbed areas.

MAINTENANCE:

1. While construction works continue on the site, inspect the outlet structure prior to forecast rainfall, daily during extended periods of rainfall, after significant runoff producing rainfall and at least on a weekly basis.

2. Replace any displaced rock with rock of a significantly (minimum 110%) larger size than the displaced rock.

REMOVAL:

1. Temporary outlet structures should be completely removed or, where appropriate, rehabilitated so as not to cause ongoing environmental nuisance or harm.

2. Following removal of the device, the disturbed area must be appropriately rehabilitated so as not to cause ongoing environmental nuisance or harm.

3. Remove material and collected sediment and dispose of in a suitable manner that will not cause an erosion or pollution hazard.

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

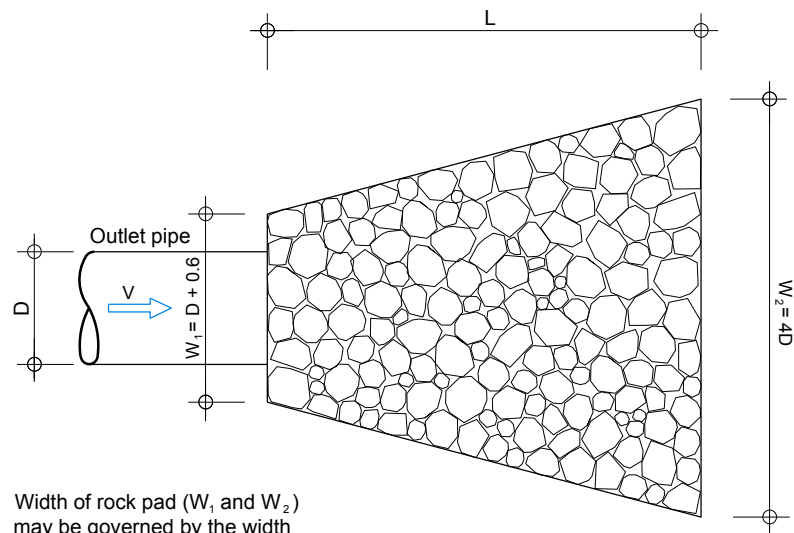
DRAWING
OUTLET STRUCTURES

SCALE
NTS

DRAWN
SPD

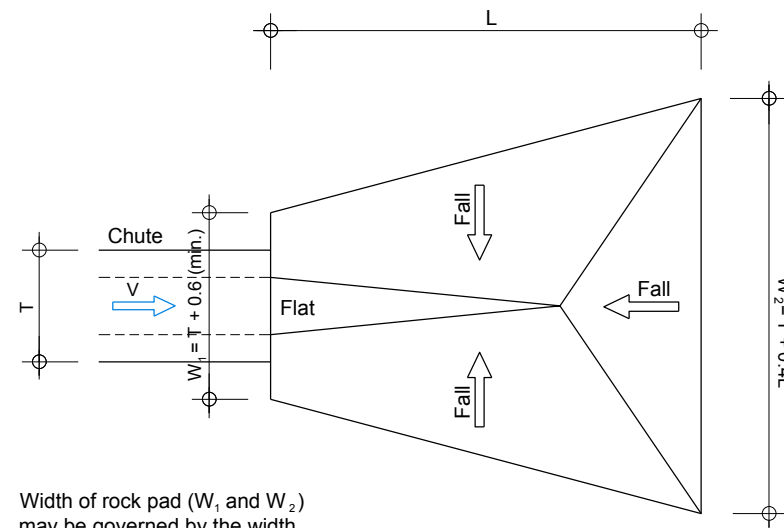
DRAWING NO
ODS.7.1

CHECKED
CMA



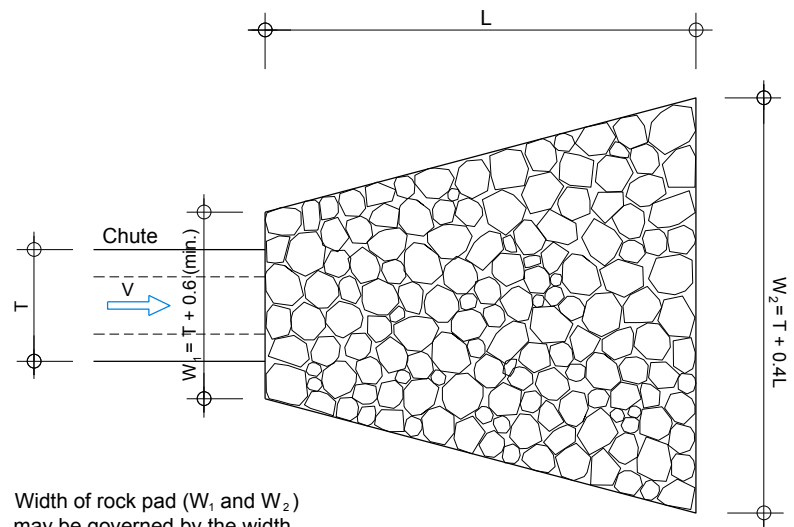
Width of rock pad (W_1 and W_2) may be governed by the width of the outlet channel.

TYPICAL LAYOUT OF A ROCK PAD OUTLET STRUCTURE FOR A PIPE OUTLET



Width of rock pad (W_1 and W_2) may be governed by the width of the outlet channel.

TYPICAL FORM OF A ROCK PAD OUTLET STRUCTURE FOR A DRAINAGE CHUTE



Width of rock pad (W_1 and W_2) may be governed by the width of the outlet channel.

TYPICAL LAYOUT OF A ROCK PAD OUTLET STRUCTURE FOR A DRAINAGE CHUTE

Notes:

1. Drawings applicable to temporary drainage chutes and slope drains.
2. Rock pad outlet structures for slope drains usually are not required to be recessed below natural ground level as is the case for chute outlets.

Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Picton NSW, Book 6

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

DRAWING
OUTLET STRUCTURES

SCALE
NTS

DRAWN
SPD

DRAWING NO
ODS.7.2

CHECKED
CMA

MATERIAL

Culvert:

Any commercial conduit that is suitable for the required traffic loading.

Rock:

Minimum 150mm nominal rock size.

Aggregate:

50-75mm clean aggregate.

Geotextile fabric:

Heavy duty, needle punched, non woven filter cloth (minimum bidim A34 or equivalent).

INSTALLATION:

1. Prior to commencing any works, obtain all necessary approvals and permits required to construct the temporary watercourse crossing including permit for the disturbance of bank vegetation, aquatic vegetation (e.g. mangroves) and any temporary instream flow diversion barrier or sediment control measures.

2. Refer to approved plans for location and installation details. If there are questions or problems with the location or method of installation, contact the engineer or responsible on-site contractor for assistance.

3. Ensure that the location of the crossing will not interfere with future construction works.

4. Prior to significant land clearing or construction of the approach ramps, establish all necessary sediment control measures and flow diversion works (instream and off-stream as required), clearing only those areas necessary for installation of these measures.

5. To the maximum degree practical, construction activities and equipment must not operate within open flowing waters.

6. Maintain clearing and excavation of the watercourse bed and banks to a minimum. Initially, clear only the area necessary to allow access for construction. Clear the remainder of the approach ramps only when adequate drainage and sediment controls are in place.

7. If flow diversion systems cannot be installed, conduct bank excavation by pulling the soil away from the channel.

8. Where practicable, construct the crossing perpendicular to the channel.

9. Where practicable, the approach ramps should be straight for at least 10 m and should be aligned with the crossing.

10. Where practicable, direct stormwater runoff from the approach ramps into stable drains, adjacent vegetation or appropriate sediment traps to minimise the release of sediment into the watercourse.

11. Shape the channel, if necessary, to receive the pipe(s).

12. If highly erosive soils are detected, then appropriately stabilise such soils as soon as practicable.

13. Cover the crossing footing with heavy duty filter cloth.

14. Cover the filter cloth with a minimum of 150mm of clean 50 to 75mm aggregate.

15. Place the specified size and number of culvert cells and align them with the direction of the downstream channel.

16. Ensure the pipes extend at least 300mm beyond the proposed extent of rock fill.

17. Fill between the pipe(s) with 75 to 100mm aggregate.

18. Cover pipe(s) with sufficient rock (minimum 300mm layer) to satisfy manufacturer's loading requirements to avoid damage to the pipe(s) resulting from the expected traffic load. Slope of rock face upstream and downstream of the culvert no steeper than 3:1 (H:V).

19. Form the shape of the road surface in accordance with the plans and/or standard drawings.

20. Apply a suitable cover of aggregate over the rock fill to form the trafficable road surface.

21. Finish construction and stabilisation of the approach road, including the approach ramps each side of the bridge crossing.

22. Take all reasonable measures to prevent excess rock, debris and construction material from entering the watercourse, especially any still or flowing water.

23. If it is not practicable to stabilise the access ramps against erosion, then install flow diversion banks across the width of each access ramp adjacent to the top of the channel bank and at regular intervals down the ramps (as required) to prevent or minimise sediment laden runoff flowing directly into the watercourse.

24. Appropriately stabilise any disturbed watercourse banks.

25. Stabilise all disturbed areas that are likely to be subjected to flowing water, including bypass and overflow areas, with rock or other suitable materials.

MAINTENANCE:

1. Temporary watercourse crossing should be inspected weekly and after rainfall events.

2. Debris trapped on or upstream of the crossing should be removed.

3. Repair any damage caused by construction traffic. If traffic has exposed bare soil, stabilise as appropriate. Maintain a minimum of 200mm cover over the culvert.

4. Check for erosion of the formed embankments, channel scour or rock displacement. Make all necessary repairs immediately.

5. Check the bypass floodway making sure the banks are stable.

6. Check for excessive erosion on the approach ramp.

7. Check the conditions of any flow diversion channels/banks and the operating conditions of associated sediment traps.

REMOVAL:

1. Temporary watercourse crossings should be removed as soon as possible after alternative access is achieved or the culvert is no longer needed.

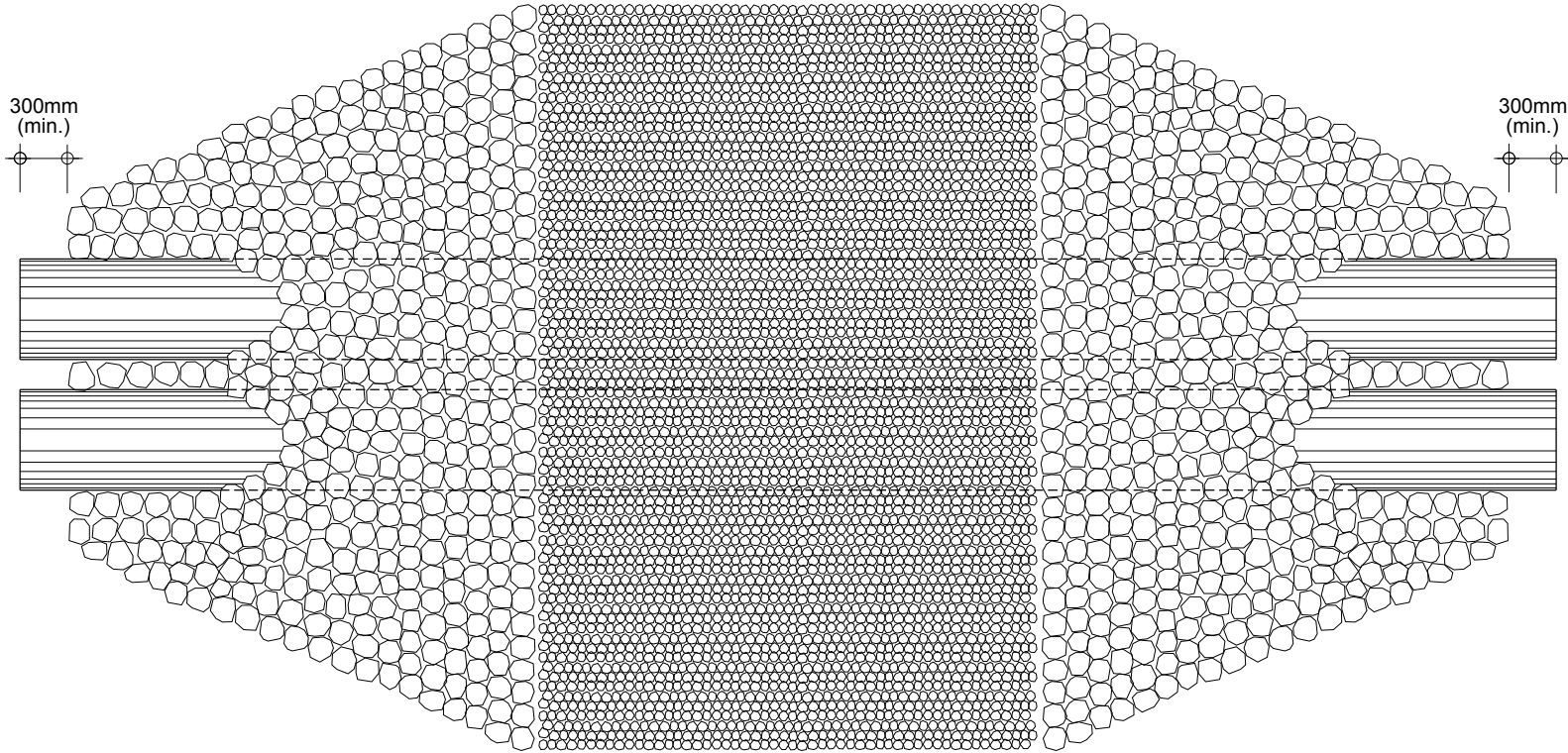
2. Remove all specified materials and dispose of in a suitable manner that will not cause an erosion or pollution hazard.

3. Restore the watercourse channel to its original cross-section and smooth and appropriately stabilise and/or revegetate all disturbed areas.

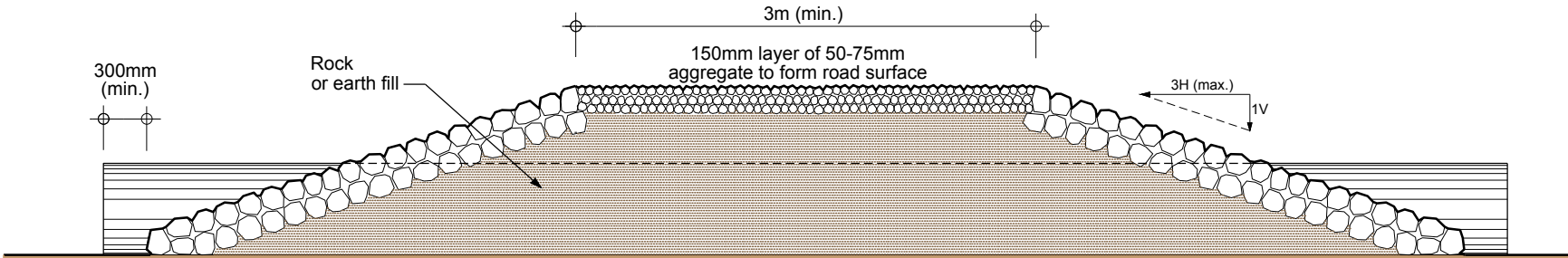
PREFERRED ARRANGEMENT FOR TEMPORARY CULVERT CROSSING

Source:

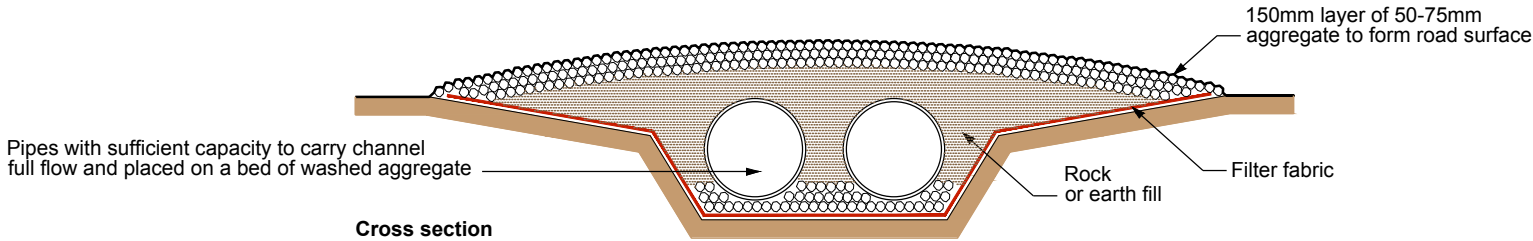
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Picton NSW, Book 6



Plan



Longitudinal section



Cross section

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

DRAWING
TEMPORARY
CULVERT CROSSING

SCALE
NTS

DRAWING NO
ODS.10.2

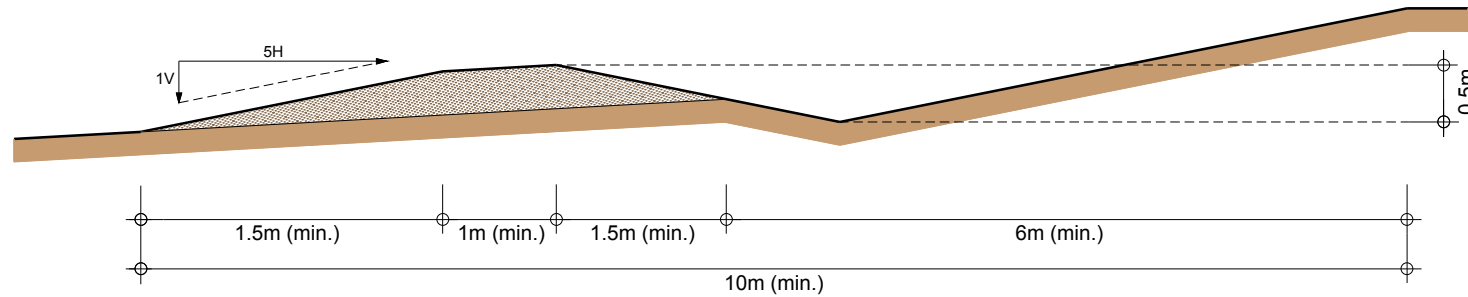
DRAWN
SPD

CHECKED
ELH

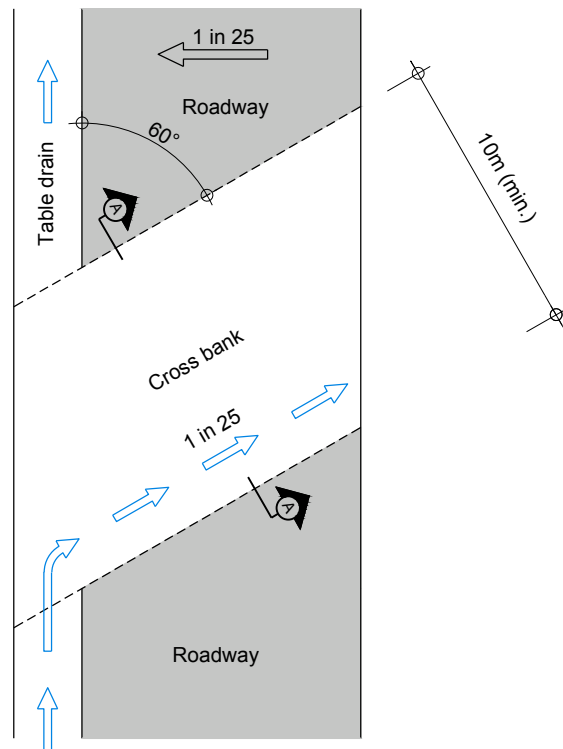
Source:

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CROSS BANK PROFILE A-A (IN SITU MATERIAL)



Stabilise table drain as required



INFALL CROSS BANK PLAN

NOTES

1. The cross bank is formed by excavating road material upslope of the bank, thus forming an up-slope drain. Alternatively the bank could be formed using imported material.
2. The table drain up-slope of the cross bank must be free draining.
3. Sediment deposited within the cross drain must be removed on a regular basis.

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

DRAWING
OUTFALL CROSS
BANK FOR
LOW SPEED TRACKS

SCALE
NTS

DRAWN
SPD

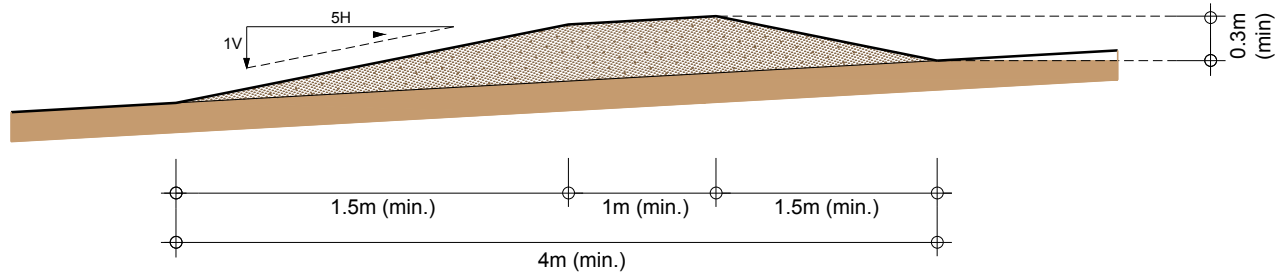
DRAWING NO
ODS.12

CHECKED
CMA

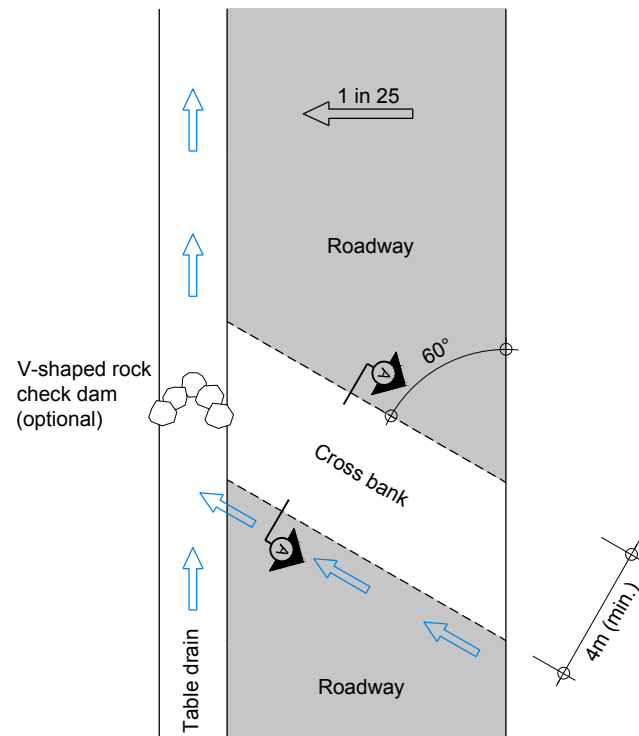
Source:

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CROSS BANK PROFILE A-A (IN SITU MATERIAL)



Stabilise table drain as required



OUTFALL CROSS BANK PLAN

NOTES

1. The cross bank is formed using imported material, and thus doesn't require any excavations into the road up-slope of the bank. Alternatively, the bank could be formed using in situ materials.
2. Rock check dams or other stabilisation measures placed in the table drain must not cause ponding on the road.

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
OTHER DRAINAGE
STRUCTURES

DRAWING
INFALL CROSS
BANK FOR
LOW SPEED TRACKS

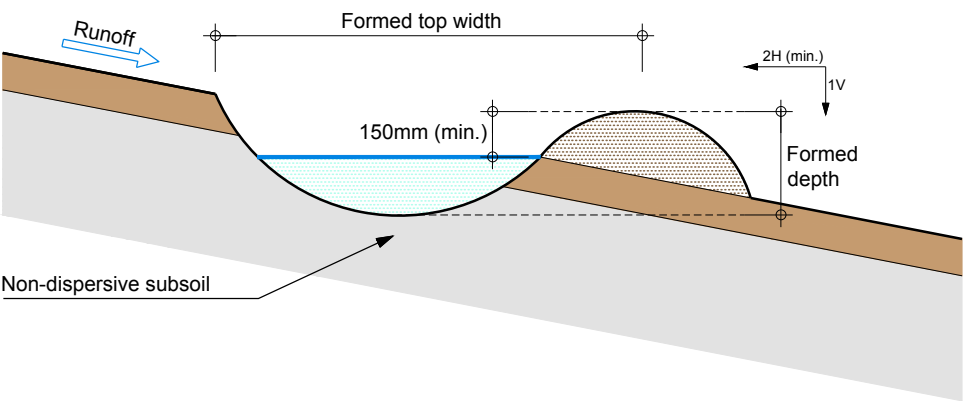
SCALE
NTS

DRAWN
SPD

DRAWING NO
ODS.13

CHECKED
CMA

PARABOLIC CATCH DRAIN WITH DOWN-SLOPE BANK



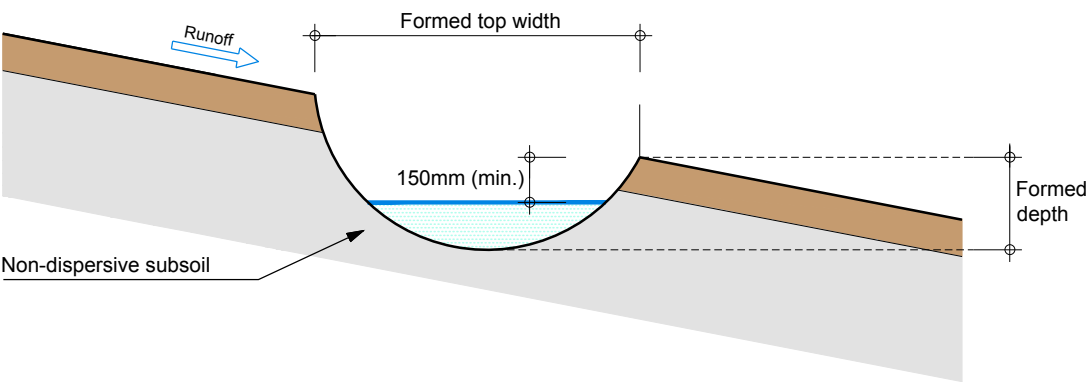
CONSTRUCTED DIMENSIONS OF PARABOLIC CATCH DRAINS

Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-A	1.60m	0.30m
Type-B	2.40m	0.45m
Type-C	3.60m	0.65m

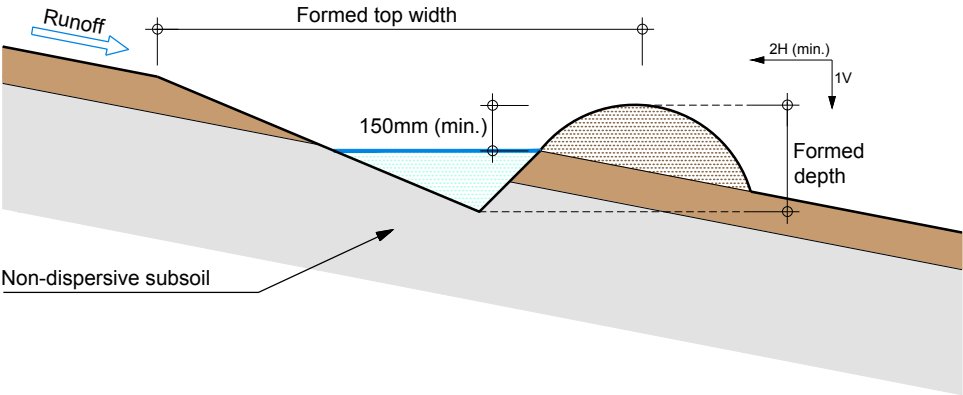
Source:

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PARABOLIC CATCH DRAIN WITHOUT BANK



TRIANGULAR V-DRAIN WITH DOWN-SLOPE BANK



CONSTRUCTED DIMENSIONS OF TRIANGULAR V- DRAINS

Drain type	Formed top width with or without bank	Formed depth with or without bank
Type-AV	2.00m	0.30m
Type-BV	2.70m	0.45m
Type-CV	3.90m	0.65m

CATEGORY
DRAINAGE CONTROL
TECHNIQUES

SUB-CATEGORY
CATCH DRAINS
AND CHUTES

DRAWING
CATCH DRAIN TYPES

SCALE
NTS
DRAWN
SPD
DRAWING NO
CDC.1
CHECKED
CMA

MATERIALS

Rock:

1. All rock must be hard, weather resistant and durable against disintegration under conditions to be met in handling, placement and operation.
2. All rock must have its greatest dimension not greater than 3 times its least dimensions.
3. The rock used in formation of the drain must be evenly graded with 50% by weight larger than the specified nominal rock size and have sufficient small rock to fill the void between the larger rock. Dirt, fines, and smaller rock not to exceed 5% by weight.
4. The diameter of the largest rock size should be no larger than 1.5 times the nominal rock size. Specific gravity to be at least 2.5.
5. The colour of the riprap must be approved by the engineer. Once approved the colour shall be kept consistent throughout the project.

Geotextile fabric:

Heavy-duty, needle-punched, non-woven filter cloth, minimum bidim A24 or equivalent.

INSTALLATION

1. Refer to approved plans for location, extent and construction details. If there are questions or problems with the location, extent or method of installation, contact the engineer or responsible on-site officer for assistance.
2. Prior to placement, all rocks must be visually checked for size, elongation, cracks, deterioration and other visible. The degree and thoroughness of such checking must be appropriate for the potential consequences associated with failure of the structure or purpose for which the material will be used.
3. Clear the location for the catch drain, clearing only what is needed to provide access for personnel and equipment for installation.

4. Remove roots, stumps and other debris and dispose of them properly. Do not use debris to build the bank.
5. Remove all soft, yielding material, replace with suitable on-site material and compact to smooth firm surface.
6. Excavate the drain to the lines and grades shown on the approved plans. Over-cut the drain to a depth equal to the specified depth of rock placement such that the finished top surface will be at the elevation of the surrounding land. Placement of the rock lining must not reduce the drain's top width and depth as specified within the approved plans.
7. Grade the drain to the specified slope and form the associated embankment with compacted fill. Note that the drain invert must fall 10cm every 10 m for each 1% of channel gradient.
8. Ensure the sides of the cut drain are not steeper than a 1.5:1 (H:V) slope and the embankment fill slopes no steeper than 2:1.
9. If the drain is cut into a dispersive (sodic) soil, then prior to placing filter cloth, the exposed dispersive soil must be covered with a minimum 200mm thick layer of non-dispersive soil prior to placement of filter cloth or rocks.
10. If a filter cloth underlay is specified, place the filter fabric directly on the prepared foundation. If more than one sheet of filter cloth is required to cover the area, overlap the edge of each sheet at least 300mm, and secure anchor pins at minimum 1m spacing along the overlap.
11. Ensure the filter cloth is protected from punching or tearing during installation of the fabric and the rock. Repair any damage by removing the rock and placing with another piece of filter cloth over the damaged area overlapping the existing fabric a minimum of 300mm
12. Placement of rocks should follow immediately after placement of the filter layer. Place rock so that it forms a dense, well graded mass of rock

with a minimum of void.

13. Place Rock lining to the extent and depth indicated within the approved plans.
14. Ensure the rock is placed in an appropriate manner to avoid displacing underlying materials or placing undue impact force on the bedding materials.
15. Ensure the rock is placed with a minimum thickness of 1.5 times the nominal rock size (D50).
16. Ensure material that are D50 and larger are not positioned flush with the top surface with faces and shapes matched to minimise voids.
17. Ensure projections above or depressions under the specified top surface are less than 20% of the rock layer thickness. The average surface plane of the finished rock is defined as the plane where 50% of the tops of rocks would contact.
18. Ensure the completed drain has sufficient depth (as specified for the type of drain) measured from the drain invert (average surface plane along channel invert) to the top of the embankment. The average surface plane of the finished rock is defined as the plane where 50% of the tops of rock would contact.
19. To the maximum degree practicable, the material between larger rock must not be loose or easily displaced by the expected flow.
20. After placement of the rock lining, ensure the drain has a constant fall in obstructions.
21. Ensure the drain discharges to a stable outlet such that soil erosion will be prevented from occurring. Ensure the drain does not discharge to an unstable fill slope.

MAINTENANCE

1. Inspect all catch drains at least weekly and after runoff-producing storm events and repair any slumps, bank damage, or loss of freeboard.
2. Closely inspect the outer edges of the rock protection. Ensure water entry into the rock-lined area is not causing erosion along the edges of the rock protection.
3. Carefully check the stability of the rock, looking for indications of piping, scour holes or bank failures.
4. Replace or reposition the surface rock such that the drain functions as required and the drain's required hydraulic capacity is not reduced.
5. Replace any displaced rock with rock of significantly (minimum 110%) larger size than the displaced rock.
6. Ensure fill material or sediment is not partially blocking the drain. Where necessary, remove any deposited material to allow free drainage.
7. Dispose of any sediment or fill in a manner that will not create an erosion or pollution hazard.

REMOVAL

1. When the soil disturbance above the catch drain is finished and the area is stabilised, the temporary drain and any associated banks should be removed, unless it is to remain as a permanent drainage feature.
2. Dispose of any sediment or earth in a manner that will not create and erosion or pollution hazard.
3. grade the area and smooth it out in preparation for stabilisation
4. Stabilise the area by grassing or as specified within the approved site rehabilitation plan.

MATERIALS

Earth fill:

Clean soil with Emerson class 2(1), 3, 4 or 5 and free of roots, woody vegetation, rocks and other unsuitable materials. Soil with Emerson class 4 and 5 may not be suitable depending on particle size distribution and degree of dispersion. Class 2(1) should only be used upon recommendation from a geotechnical specialist. This specification may be replaced by an equivalent standard based on the exchangeable sodium percentage.

Riser pipe:

Minimum 250mm diameter.

Spillway rock:

Hard, angular, durable weather resistant and evenly graded rock with 50% by weight larger than specified nominal (d50) rock size. Large rock should dominate, with sufficient small rock to fill the voids between the larger rock. The diameter of the largest rock size should be no longer than 1.5 times the nominal rock size. The specific gravity should be at least 2.5.

Geotextile fabric:

Needle-punched, non-woven filter cloth, minimum 'Bidim' A24 or equivalent.

CONSTRUCTION:

1. Notwithstanding any description contained within the approved plans or specifications, the contractor shall be responsible for satisfying themselves as to the nature and extent of the specified works and the physical and legal conditions under which the works will be carried out.

This shall include:

- Means of access
- Extent of clearing
- Nature of materials to be excavated
- Type and size of mechanical plants required
- Location and suitability of water supply for construction and testing

purposes

- Any other like matter affecting the construction of the works.

2. Refer to approved plans for location, dimensions and construction details. If there are questions or problems with the location, dimensions or method of installation, contact the engineer or responsible on-site officer for assistance.

3. Before starting any clearing or construction, ensure all the necessary materials and components are on the site to avoid delays in completing the pond once works begin.

4. Install required short-term sediment control measures downstream of the proposed earthwork to control sediment runoff during construction of the basin.

5. The area to be covered by the embankment, borrow pits and incidental works, together with an area extending beyond the limits of each for a distance not exceeding 5 metres all around must be cleared of all trees, scrub, stumps, roots, dead timber and rubbish and disposed of in a suitable manner. Delay clearing the main pond area until the embankment is complete.

6. Ensure all holes made by grubbing within the embankment footprint are filled with sound material, adequately compacted and finished flush with the cut-off trench.

7. Before construction of cut-off trench or any ancillary works within the embankment footprint, all grass growth and topsoil must be removed from the area to be occupied by the embankment and must be deposited clear of this area and reserved for topdressing the completed embankment.

8. Excavate a cut-off trench along the central line of the earth fill embankment. Cut the trench to stable soil material, but in no cases make it less than 600mm deep. The cut-off trench must extend into both abutments to at least the elevation of the riser pipe crest. Make the minimum

bottom width wide enough to permit operation of excavation and compaction equipment, but in no case less than 600mm. Make the slopes of the trench no steeper than 1:1 (H:V).

9. Ensure all water, loose soil and rock are removed from the trench before backfilling commences. The cut-off trench must be backfilled with selected earth-fill of the type specified for the embankment and this soil must have moisture content and degree of compaction the same as that specified for the selected core zone.

10. Material excavated from the cut-off trench may be used in construction of the embankment provided it is suitable and it is placed in the correct zone according to its classification.

EMBANKMENT:

11. Scarify areas on which fill is to be placed before placing the fill.

12. Ensure all fill material used to form the embankment meets the specifications certified by a soil scientist or geotechnical specialist.

13. The fill material must contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Place fill material in 150 to 250mm continuous layers over the entire length of the fill area and then compact before placement of further fill.

14. Place riser pipe outlet system, if specified, in appropriate sequence with the embankment filling. Refer to separate installation specifications.

15. Unless otherwise specified on the approved plans, compact the soil at about 1 to 2% wet of optimum and to 95% modified or 100% standard compaction.

16. Where both dispersive and non-dispersive classified earth fill materials are available, non-dispersive earth-fill must be used in the core zone. The remaining

classified earth-fill materials must only be used as directed.

17. Where specified, construct the embankment to an elevation 10% higher than the design height to allow for settling; or otherwise finished dimensions of the embankment after spreading of topsoil must conform to the drawing with a tolerance of 75mm from the specified dimensions.

18. Ensure debris and other unsuitable building waste is not placed within the earth embankment.

19. After completion of the embankment all loose uncompacted earth-fill material on the upstream and downstream batter must be removed prior to spreading of topsoil.

20. Topsoil and revegetate/stabilise all exposed earth as directed within the approved plans.

SPILLWAY CONSTRUCTION

21. The spillway must be excavated as shown on the plans and the excavated material, if classified as suitable, must be used in the embankment, and if not suitable it must be disposed of into spoil heaps.

22. Ensure excavated dimensions allow adequate boxing-out such that the specified elevations, grades, chute width and entrance and exit slopes for the emergency spillway will be achieved after placement of the rock or other scour protection measures as specified in the plans.

23. Place specified scour protection measures on the emergency spillway. Ensure the finished grade blends with the surrounding area to allow a smooth flow transition from spillway to downstream channel.

(continued on drawing No. TC.2.2)

**+GILBERT
SUTHERLAND**

Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Piction NSW, Book 6

CATEGORY
SEDIMENT CONTROL
TECHNIQUES

SUB-CATEGORY
TYPE 1 & 2
CONTROLS

DRAWING
SEDIMENT BASINS

SCALE
NTS
DRAWING NO
TC.2.1

DRAWN
SPD
CHECKED
CMA

Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Picton NSW, Book 6

24. If a synthetic filter fabric underlay is specified, place the filter fabric directly on the prepared foundation. If more than 1 sheet of filter fabric is required, overlap the edges by at least 300mm and place anchor pins at minimum 1m spacing along the overlap. Bury the upstream end of the fabric a minimum of 300mm below ground and, where necessary, bury the lower end of the fabric or overlap a minimum of 300mm over the next downstream section as required. Ensure the filter fabric extends at least 1m upstream of the spillway crest.

25. Take care not to damage the fabric during or after placement. If damage occurs, remove the rock and repair the sheet by adding another layer of fabric with a minimum overlap of 300mm around the damaged area. If extensive damage is suspected, remove and replace the entire sheet.

26. Where large rock is used, or machine placement is difficult, a minimum 100mm layer of fine gravel, aggregate or sand may be needed to protect the fabric.

27. Placement of rock should follow immediately after placement of the filter fabric. Place rock so that it forms a dense, well-graded mass of rock with a minimum of voids. The desired distribution of rock throughout the mass may be obtained by selective loading at the quarry and controlled dumping during final placement.

28. The finished slope should be free of pockets of small rock or clusters of large rocks. Hand placing may be necessary to achieve the proper distribution of rock size to produce a relatively smooth, uniform surface. The finished grade of the rock should blend with the surrounding area. No overfall or protrusion should be apparent.

29. Ensure that the final arrangement of the spillway crest will not promote excessive flow through the rock such that the water can be retained within the settling basin an elevation no less than 50mm above or below the nominated spillway crest elevation.

**ESTABLISHMENT OF THE
SETTLING POND:**

30. The area to be covered by the stored water outside the limits of the borrow pits must be cleared of all scrub and rubbish. Trees must be cut down stump high and removed from the immediate vicinity of the work.

31. Establish all required inflow chutes and inlet baffles, if specified, to enable water to discharge into the basin in a manner that will not cause soil erosion or the re-suspension of settled sediment.

32. Install a sediment storage level marker post with a cross member set just below the top of the sediment storage zone (as specified on the approved plans). Use at least 75mm wide post firmly set into the basin floor.

33. If specified, install internal settling pond baffles. Ensure the crest of these baffles is set level with, or just below, the elevation of the emergency spillway crest

34. Install all appropriate measures to minimise safety risk to on-site personnel and the public caused by the presence of the settling pond. Avoid steep, smooth internal slopes. Appropriately fence the settling pond and post warning signs if unsupervised public access is likely or there is considered to be unacceptable risk to the public.

MAINTENANCE:

1. Inspect the sediment basin during the following periods:

- During construction to determine whether machinery, falling trees or construction activity has damaged any components of the sediment basin. If damage has occurred, repair it

- After each runoff event inspect the erosion damage at flow entry and exit points. If damage has occurred, make the necessary repairs.

- At least weekly during the nominated wet season (if any) otherwise at least fortnightly.

- Prior to, and immediately after, periods of 'stop work' or site shutdown.

2. Clean out accumulated sediment when it reaches the marker board/post, and restore the original storage volume. Place sediment in a disposal area or, if appropriate, mix with dry soil on the site.

3. Do not dispose of sediment in a manner that will create an erosion or pollution hazard.

4. Check all visible pipe connections for leaks and repair as necessary

5. Check all embankments for excessive settlement, slumping of the slopes or piping between the conduit and the embankment; make all necessary repairs.

6. Remove all trash and other debris from the basin and riser.

7. Submerged inflow pipes must be inspected and de-silted (as required) after each inflow event.

REMOVAL:

1. When grading and construction in the drainage area above a temporary sedimentation basin is completed and the disturbed areas are adequately stabilised, the basin must be removed or otherwise incorporated into the permanent stormwater drainage system. In either case sediment should be cleared and properly disposed of and the basin area stabilised.

2. Before starting any maintenance work on the basin or spillway, install all necessary short-term sediment control measures downstream of the sediment basin.

3. All water and sediment must be removed from the basin prior to the dam's removal. Dispose of sediment and water in a manner that will not create an erosion or pollution hazard.

4. Bring the disturbed area to a proper grade, then smooth, compact and stabilise and/or revegetate as required to establish a stable land surface

**CATEGORY
SEDIMENT CONTROL
TECHNIQUES****SUB-CATEGORY
TYPE 1 & 2
CONTROLS****DRAWING
SEDIMENT BASINS**

SCALE
NTS

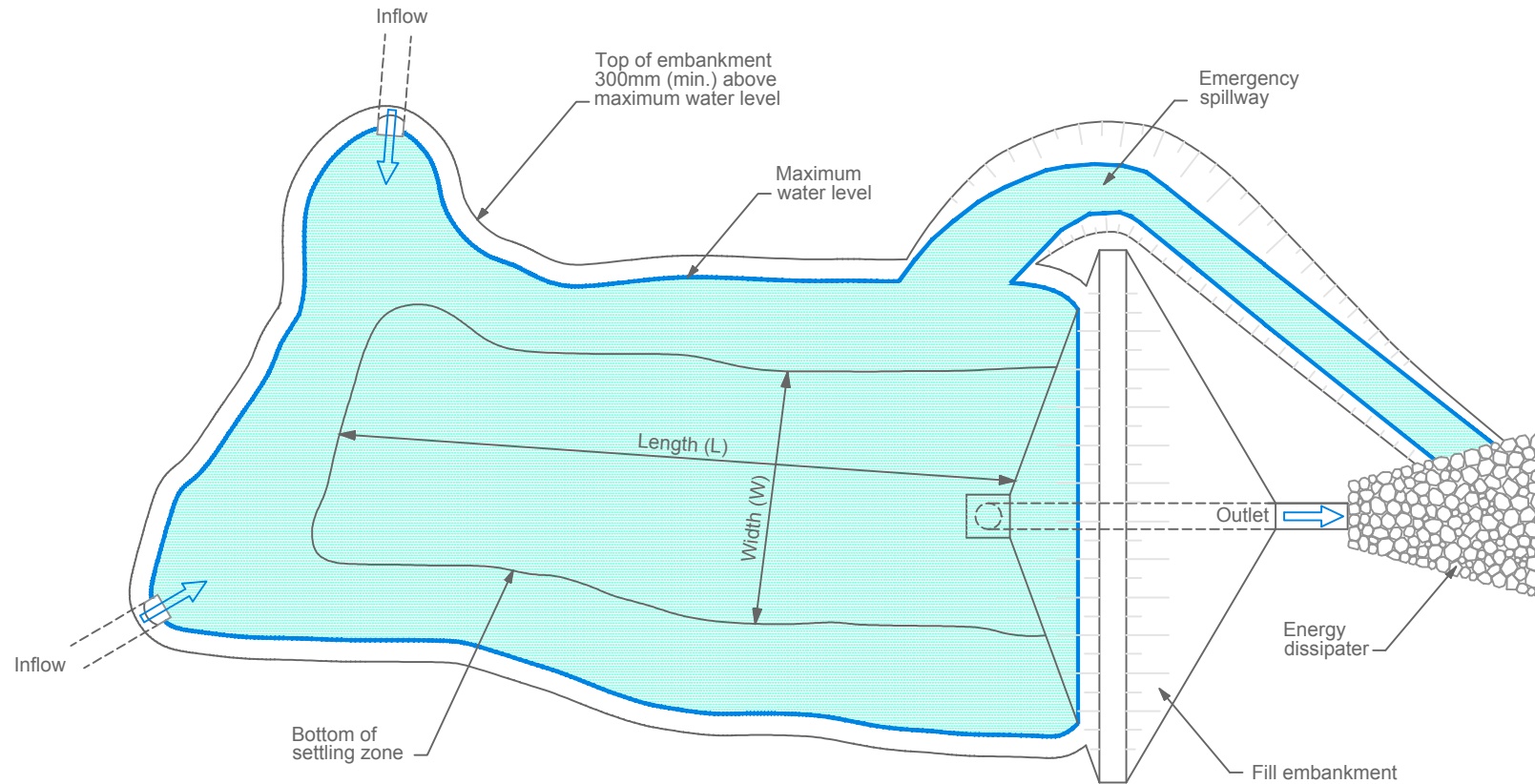
DRAWING NO
TC.2.2

DRAWN
SPD

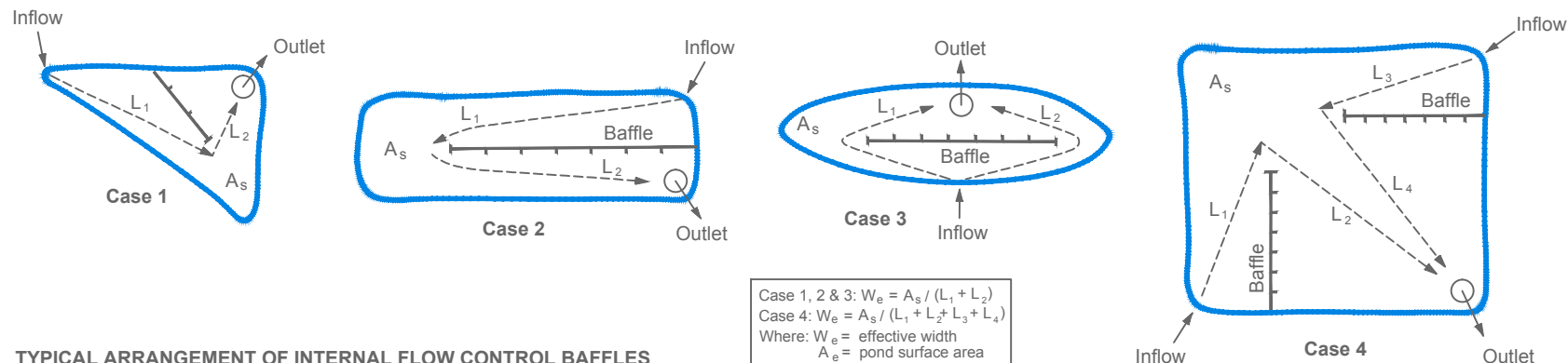
CHECKED
CMA

Source:

Base text and schematics reproduced from IECA 2008, Best Practice Erosion and Sediment Control, International Erosion Control Association (Australasia), Picton NSW, Book 6



TYPICAL PLAN OF A TYPE C (DRY) BASIN WITH RISER PIPE OUTLET SYSTEM



TYPICAL ARRANGEMENT OF INTERNAL FLOW CONTROL BAFFLES

CATEGORY
SEDIMENT CONTROL
TECHNIQUES

SUB-CATEGORY
TYPE 1 & 2
CONTROLS

DRAWING
SEDIMENT BASINS

SCALE
NTS

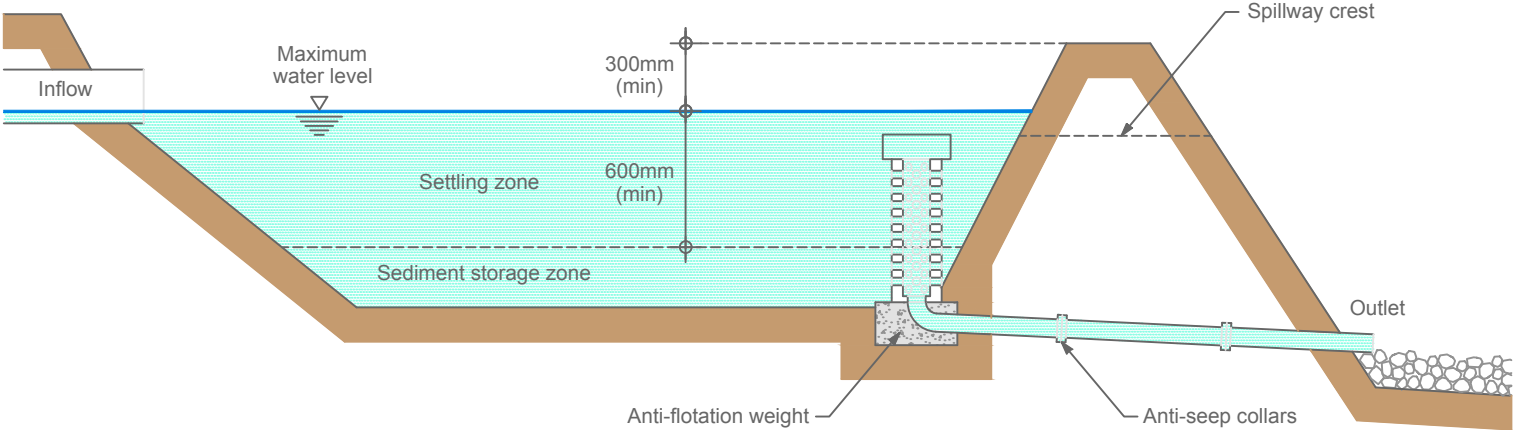
DRAWING NO
TC.2.3

DRAWN
SPD

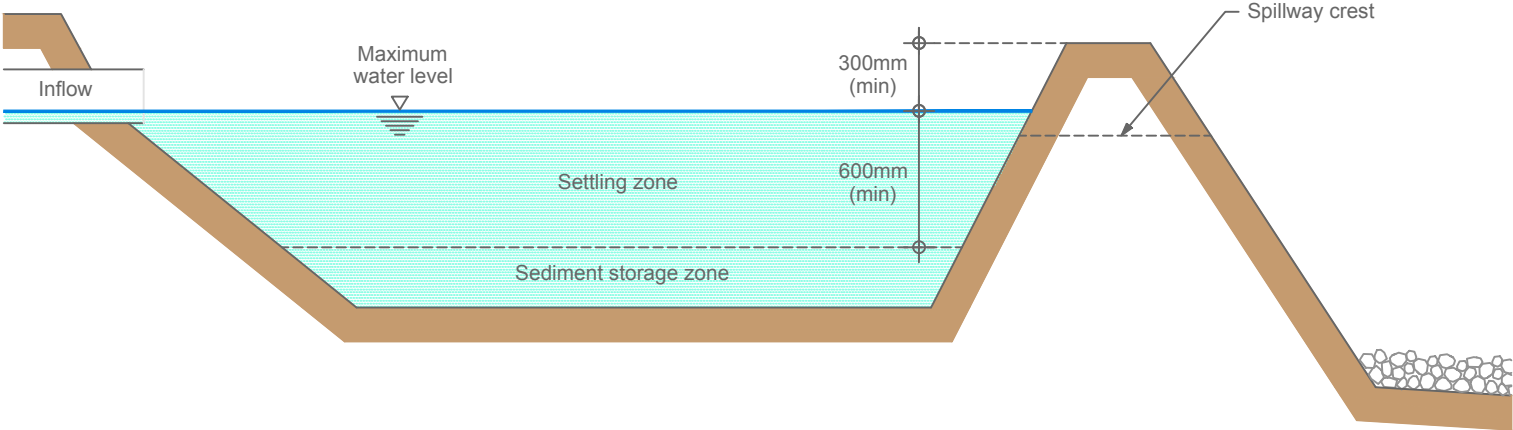
CHECKED
CMA

Source:

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TYPICAL SECTION THROUGH TYPE C (DRY) BASIN WITH RISER PIPE OUTLET SYSTEM



TYPICAL SECTION THROUGH TYPE F/D (WET) BASIN

CATEGORY
SEDIMENT CONTROL
TECHNIQUES

SUB-CATEGORY
TYPE 1 & 2
CONTROLS

DRAWING
SEDIMENT BASINS

SCALE NTS	DRAWN SPD
DRAWING NO TC.2.4	CHECKED CMA

MATERIALS

Silt curtain fabric:

Manufactured from a woven geotextile, canvas/tarp material, or a commercially available silt curtain such as nylon reinforced polyvinyl chloride (PVC) or equivalent.

Ballast chain:

10 to 13mm galvanised chain with minimum 1.9 to 3.3kg/m weight.

Marine anchor:

Minimum 5kg lightweight (Danforth) type anchor with 10 to 13mm nylon tie rope and minimum 3m length of 8mm galvanised connecting chain.

INSTALLATION

1. Unfold the first curtain panel on the slipway.
2. Insert the floats both ends for ease of installation.
3. Pull through the steel chain in the bottom sleeve using the draw cord.
4. Pull through the rope using the draw cord.
5. Prior to deploying the barrier, gather up the curtain and tie the curtain with lightweight straps or rope every 1 to 1.5m. The aim of this is to enable the curtain to be set in place in the water easily without the curtain being dragged along the bottom.
6. Set the upstream bank anchor point and tie off one end of the barrier ensuring no water will be able to flow into the upstream end.
7. Install an extra length of rope or cable in the final curtain position in the water.
8. Tie the end of the curtain rope to the extra length already in position and pull the curtain into the water stopping when the end of the first section of curtain is still on the bank.
9. Unfold the second section of curtain on the slipway making sure the curtain is correctly orientated with the first section of curtain.

10. Insert the floats, chain and rope as before.
11. Using the draw cord from the first section, tie up the end using the eyelets already in the curtain.
12. Gather up the curtain and tie together with twine or thin rope.
13. Launch as before.
14. Continue until the entire curtain is installed.
15. Anchor well to shore anchors.

16. Using a suitable boat, move along the curtain and cut the ties holding the chain and curtain and allow the weight to sink.
17. Ensure the skirt (at maximum water level) is free of large pleats that may collect sediment causing the barrier to be pulled under the water surface.

MAINTENANCE

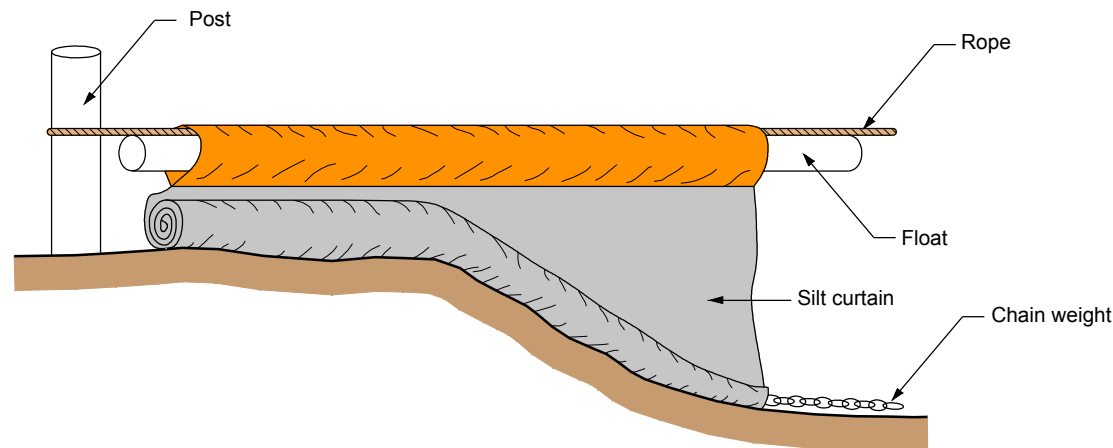
1. Inspect the silt curtain daily for damage.
2. Ensure the top of the barrier remains above the water surface and the curtain is free of tears or gaps.

3. Ensure the barrier remains in the specified location.
4. Check for turbidity leaks.
5. Check all anchors points.
6. Repair or replace any torn segment.
7. Check for sediment build-up on the bottom of the skirt that may begin to pull the curtain under water.
8. Dispose of any excessive sediment or debris deposits in a manner that will not create an erosion or pollution hazard.
9. Repair any places in the isolation barrier that have weakened or that have been subjected to damage from inflows or overtopping water.

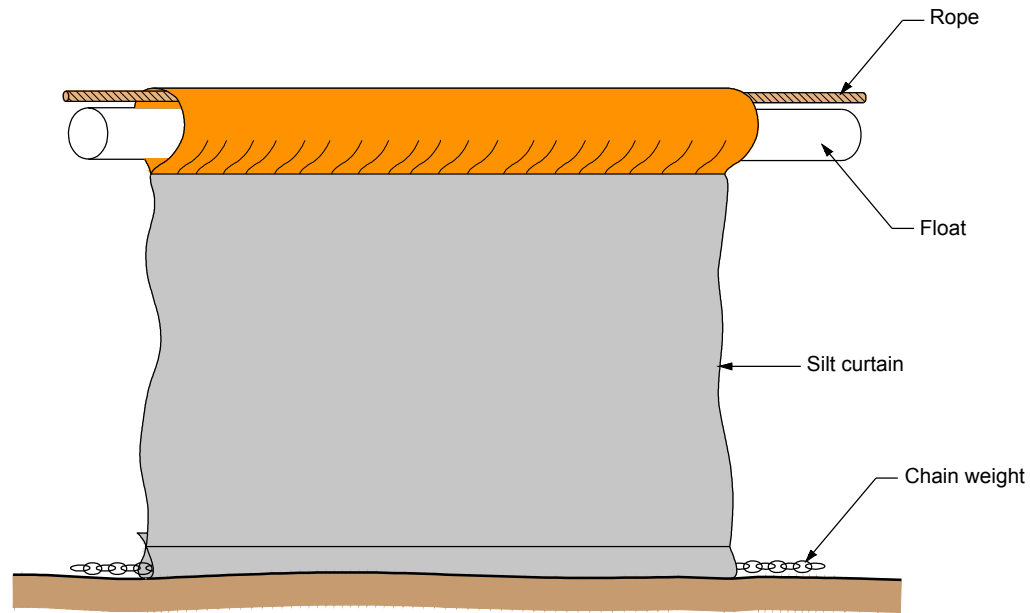
REMOVAL

1. The silt curtain should be removed as soon as possible after it is no longer needed.
2. If excessive sediment or debris has collected around the barrier, then remove such material before the barrier is removed and dispose of such material properly.

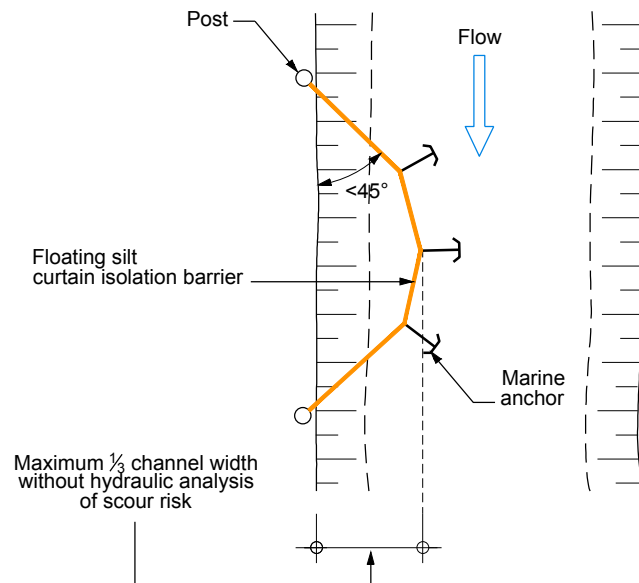
3. Ensure the channel water contained within the enclosure has achieved a suitable water quality before removing the silt curtain.
4. Ensure the release of sediment and the damage to the channel's bed and bank is minimised during removal of the silt curtain.
5. If it is not feasible to wait for adequate settlement of suspended sediment, then, where practicable, pump the sediment-laden water to an off-stream de-watering sediment control system for treatment. This treatment area should ideally be located at least 50m from the channel.
6. Remove all construction material, excessive sediment deposit and debris and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
7. Restore watercourse channel to its original cross-section and smooth and appropriately stabilise and/or revegetate all disturbed areas.



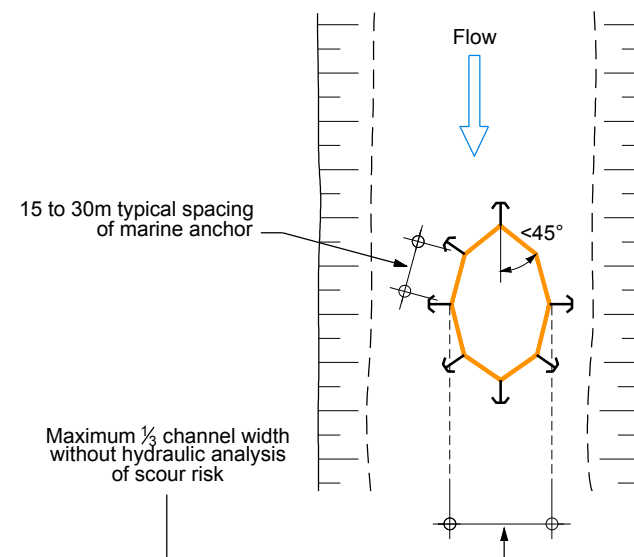
TYPICAL LAND ANCHORAGE SYSTEM



COMPONENTS OF A FLOATING SILT CURTAIN



**TYPICAL INSTALLATION OF A
LAND ANCHORED FLOATING SILT CURTAIN**



**TYPICAL INSTALLATION OF A
MARINE ANCHORED FLOATING SILT CURTAIN**

CATEGORY
**INSTREAM FLOW AND
SEDIMENT CONTROL
TECHNIQUES**

SUB-CATEGORY
**FLOW DIVERSION
MEASURES**

DRAWING
**FLOATING
SILT CURTAINS**

SCALE
NTS

DRAWING NO
FDM.2.3

DRAWN
SPD

CHECKED
CMA

MATERIALS

Fabric:

Polypropylene, polyamide, nylon, polyester, or polyethylene woven or non-woven fabric, at least 700mm in width and a minimum unit weight of 140g/m². All fabric to contain ultraviolet inhibitors and stabilisers to provide a minimum of 6 months of useable construction life (ultraviolet stability exceeding 70%).

Fabric reinforcement:

Wire or steel mesh minimum 14-gauge with a maximum mesh spacing of 200mm.

Support posts/stakes:

1500mm² (min.) hardwood, 2500mm² (min.) softwood or 1.5kg/m (min.) steel star pickets suitable for attaching fabric

Ballast (outer barrier):

Minimum 8mm chain or equivalent or minimum 50mm aggregate.

Staples:

Heavy duty wire staples at least 25mm long or wire ties.

INSTALLATION

1. Prior to commencing any works, obtain all necessary approvals and permits required to conduct the necessary works including permits for the disturbance of riparian and aquatic vegetation and the construction of all permanent or temporary instream sediment control measures.
2. Refer to approved plans for location and construction details. If there are questions or problems with the location or method of installation, contact the engineer or responsible on-site officer for assistance
3. Confirm if a single or double fence is required.
4. If there is flow within the watercourse or drainage channel at the time of installation of the isolation barrier, then take appropriate measures to minimise the release of sediment during its installation. Such measures should only be installed if considered appropriate for the local

conditions and only if their installation is judged to provide a net overall environmental benefit.

5. To the maximum degree practical, construction activities and equipment shall not operate within open flowing waters.
6. Identify the appropriate location of the outer isolation barrier. For reasons of safety, the outer barrier should not be placed in water depths exceeding 1.2m.
7. If placed in large open waters, install the isolation barrier such that the top of each fence is at least 300mm above the waterline to prevent over-topping by waves or fluctuations in water level.
8. Place the support posts (outer barrier) at a maximum spacing of 2m with wire mesh backing or 1.5m without wire mesh backing. Drive the post 600mm into the channel bed or until the posts are secure. If the support post cannot be driven 600mm into the bed, then additional bracing may be required.
9. Attach any fence reinforcement (wire mesh) as specified in the approved plans or as directed.
10. Prior to installing the fabric, secure (sew) ballast chain into the bottom of the fabric.
11. Attach the specified fabric to the channel side of the posts. Where possible, used a continuous roll of fabric. If this is not possible, construct suitable leaf proof joints in the fabric.
12. Fasten the fabric securely using heavy duty staples or nails (with a washer) at a maximum spacing of 50mm. Use wire ties to securely attach the fabric to the wire mesh (if used).
13. If it is not practicable to attach a ballast to the bottom of the fabric, then secure the bottom 300mm of fabric to the channel bed using a continuous placement (minimum 50mm) of large aggregate or clean rock fill.
14. After installing the outer isolation barrier, install the second landward

barrier (if required). The landward barrier is usually located just above the normal water line, but should be located so as not to interfere with adjacent construction activities.

15. Ensure the top of the fabric of the outer barrier is at least 200mm above the maximum expected, dry weather (i.e. non flood flow) water level.

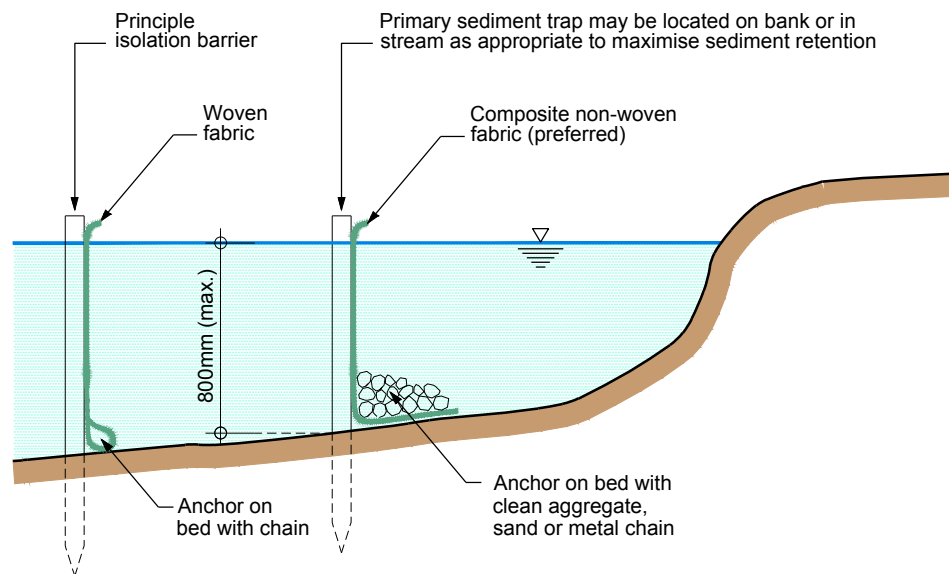
16. Install the landward sediment fence in accordance with normal installation procedures for a sediment fence, except the maximum spacing of support posts is 2m with or without a wire mesh backing. Ensure the fabric is attached to the landward side of the posts.

MAINTENANCE

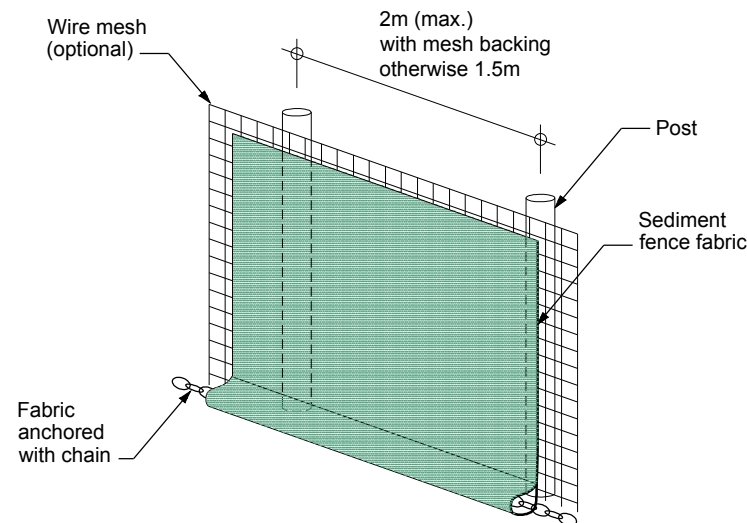
1. Inspect the isolation barrier daily and after any significant change in stream flow. Make necessary repairs immediately.
2. Inspect the barrier for turbidity leaks that might be caused by holes in the barrier or damage to the fabric-streambed contact.
3. Repair any torn sections with a continuous piece of fabric from post to post.
4. When making repairs, always restore the system to its original configuration unless an amended layout is required or specified.

REMOVAL

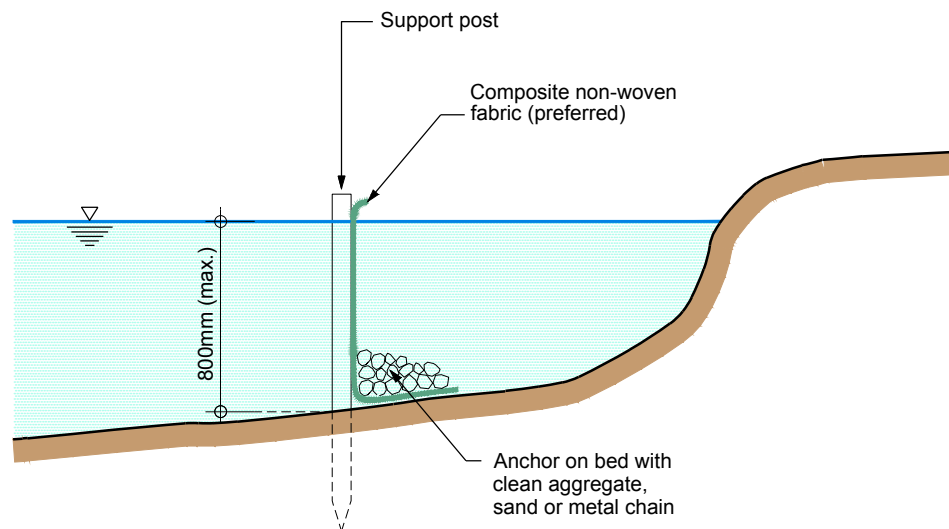
1. All components of the sediment fence isolation barrier should be removed as soon as possible after they are no longer needed.
2. If excessive sediment or debris has collected around the barrier, then remove such material before the barrier is removed and dispose of such material properly.
3. Ensure any channel water contained within the enclosed channel area is suitably treated before either the water is discharged from the enclosure or the isolation barrier is removed.
4. If it is not feasible to wait for adequate settlement of suspended sediments, then, where practicable, pump the sediment-laden water to an off stream de-watering sediment control system for treatment. This treatment area should ideally be located at least 50m from the channel.
5. Starting from the upstream end, remove all materials used to form the isolation barrier and dispose of in a suitable manner that will not cause an erosion or pollution hazard.
7. Restore the watercourse channel to its original cross-section and smooth and appropriately stabilise and/or revegetate all disturbed areas.



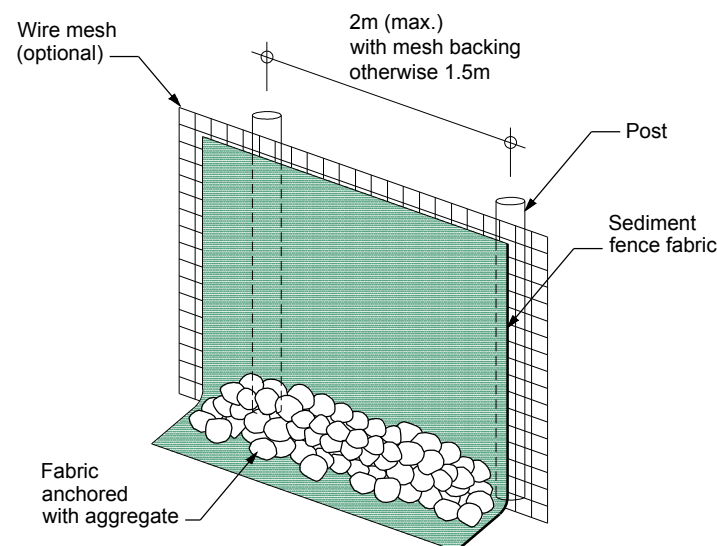
**SEDIMENT FENCE ISOLATION BARRIER
WITH SEPARATE LANDWARD SEDIMENT FENCE**



**SEDIMENT FENCE ISOLATION BARRIER
WITH FABRIC ANCHORED BY BALLAST CHAIN**



**SEDIMENT FENCE ISOLATION BARRIER
ACTING AS A COMBINED ISOLATION BARRIER AND SEDIMENT TRAP**



**SEDIMENT FENCE ISOLATION BARRIER
WITH FABRIC ANCHORED BY AGGREGATE**

CATEGORY
**INSTREAM FLOW AND
SEDIMENT CONTROL
TECHNIQUES**

SUB-CATEGORY
**FLOW DIVERSION
MEASURES**

DRAWING
**SEDIMENT FENCE
ISOLATION
BARRIERS**

SCALE
NTS

DRAWN
SPD

DRAWING NO
FDM.5.2

CHECKED
CMA

MATERIALS

Rock:

Well graded, hard, angular, erosion resistant rock, nominal diameter of 50 to 75mm (small disturbance) or 100 to 150mm (large disturbance). All reasonable measures must be taken to obtain rock of near uniform size.

Footpath stabilising aggregates:

25 to 50mm gravel or aggregates.

Geotextile fabric:

Heavy duty, needle-punched, non-woven filter cloth ('Bidim' A24 or equivalent).

INSTALLATION:

1. Refer to approved plans for location and dimensional details. If there are questions or problems with the location, dimensions or method of installation contact the engineer or responsible on-site officer for assistance.

2. Clear the location of the rock pad, removing stumps, roots and other vegetation to provide a firm foundation so that the rock is not pressed into soft ground. Clear sufficient width to allow passage of large vehicles. But clear only what is necessary for the exit. Do not clear adjacent areas until the required erosion and sediment control devices are in place.

3. If the exposed soil is soft, plastic or clayey, place a sub-base of crushed rock or a layer of heavy duty filter cloth to provide a firm foundation.

4. Place the rock pad forming a minimum 200mm thick layer of clean, open-void rock

5. If the associated construction site is up-slope of the rock pad, thus causing stormwater runoff to flow towards the rock pad, then form a minimum 300mm high flow control berm across the rock pad to divert such runoff to a suitable sediment trap.

6. The length of the rock pad should be at least 15m where practicable and as wide as the full width of the road entry or exit (at least 3m). The rock ramp should commence at the edge of the off-site sealed road or pavement.

7. Flare the end of the rock pad where it meets the pavement so that the wheels of turning vehicles do not travel over unprotected soil.

8. If the footpath is open to pedestrian movement, then cover the coarse rock with fine aggregate or gravel, or otherwise take whatever measures are needed to make the area safe.

MAINTENANCE

1. Inspect all site entry and exit points prior to forecast rain, daily during extended periods of rainfall, after significant runoff-producing rainfall or otherwise at fortnightly intervals.

2. If sand, soil, sediment or mud is tracked or washed onto the adjacent sealed roadway, then such material must be physically removed, first using a square-edged shovel, then a stiff-bristled broom and then by a mechanical vacuum unit if available.

3. If necessary for safety reasons, the roadway shall only be washed clean after all reasonable effort have been taken to shovel and sweep the material from the roadway.

4. When the void between the rocks becomes filled with material and the effectiveness of the rock ramps are reduced to a point where sediment is being tracked off the site, a new 100mm layer of rock must be added and/or the rock pad must be extended.

5. Ensure any associated drainage control measures are maintained in accordance with their desired operational condition.

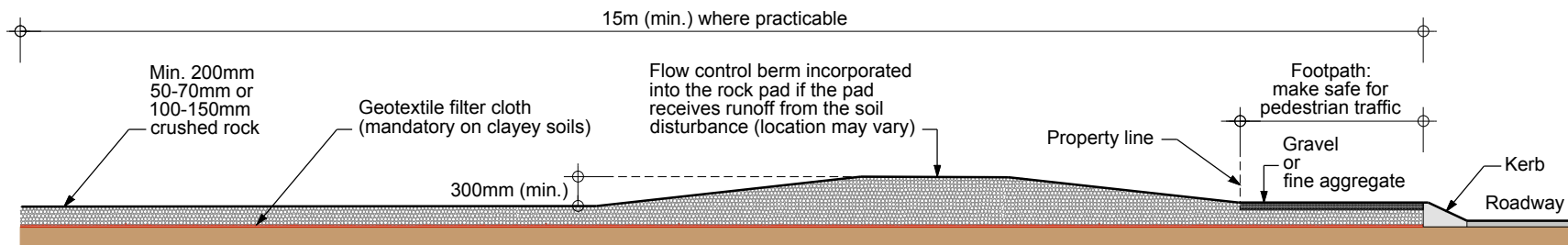
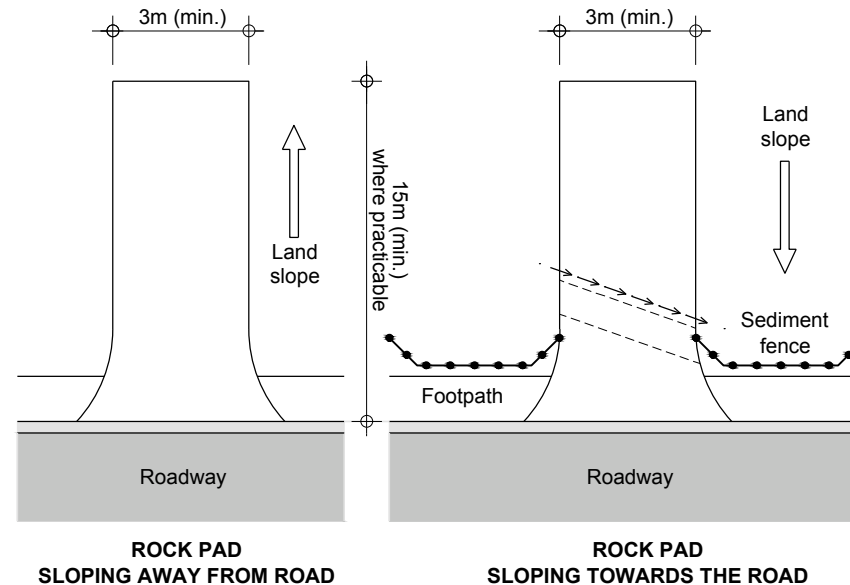
6. Dispose of sediment and debris in a manner that will not create an erosion or pollution hazard.

REMOVAL

1. The rock pad should be removed only after it is no longer needed as a sediment trap.

2. Remove all materials and collected sediment and dispose of in a suitable manner that will not cause erosion or pollution hazard.

3. Re-grade and stabilise the disturbed ground as necessary to minimise the erosion hazard.



TYPICAL PROFILE OF A ROCK ENTRY/EXIT PAD FOR CONSTRUCTION SITES

CATEGORY
SEDIMENT CONTROL
TECHNIQUES

SUB-CATEGORY
ENTRY / EXIT SYSTEMS

DRAWING
CONSTRUCTION EXIT
ROCK PADS

SCALE
NTS
DRAWING NO
EES.1

DRAWN
SPD
CHECKED
CMA

250 500 750 1000 1250
SCALE metres

ORIENTATION
NORTH

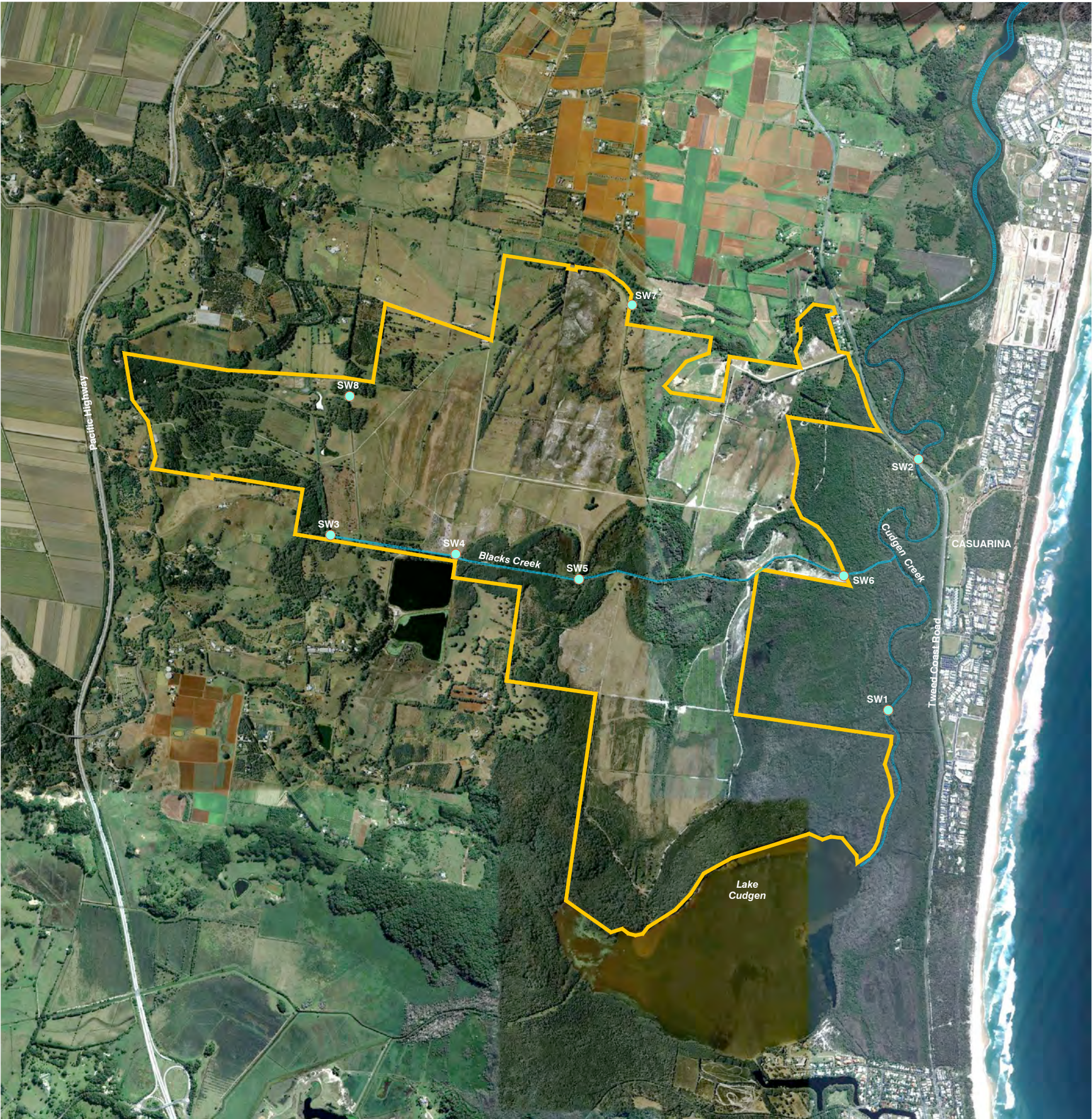
LEGEND

Site boundaries

Surface water monitoring locations

SOURCES

Image base:
Google Earth Pro 2012, imagery date 13/05/2010



Brisbane Sydney Melbourne and regions

**+GILBERT
SUTHERLAND**

Agriculture. Water. Environment.

PROJECT
KINGS FOREST
STAGE 1
PROJECT APPLICATION

CLIENT
PROJECT 28
PTY LTD

DRAWING
SURFACE WATER
MONITORING
LOCATIONS

SCALE
1:25 000@A3

DRAWN
SPD

CHECKED
MLF

DATE
27/07/2012

PROJECT NO
10927

DRAWING NO
1.1

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