

Appendix B

Stormwater

Our Ref 7214/29-10 :adm

Contact Rod Barry



18 December 2007

NSW Government
Department of Planning
PO Box 39
SYDNEY NSW 2001

Attention: Ms Sally Laing

Dear Sally,

RE: PROPOSED DEVELOPMENT FRASER DRIVE MP06- 0243

Further to your summary of submissions letter dated 20 August 2007, we comment on the issues you raise in terms of water quality as follows:

DEPARTMENT OF PLANNING COMMENTS

Stormwater Issues

27. Provide design confirmation that the 3 cell 1500mm diameter piped system is adequate to cater for ARI 100 year stormwater runoff from a future urbanised catchment east of Fraser Drive, without resulting in flooding in Fraser Drive. Preliminary design details of Q100 inlet structures shall also be provided.

Response:

This piped system has been modelled in PC Drain. Any head loss that may occur through the bends has been accounted for in this modelling. Our developer can not impose construction requirements onto another landowner. If Council want the culverts to cross Fraser Drive, then the existing landowners future access and current drive way entrance would have to be moved and the existing drainage path 900 dia culvert would have to be re-routed. It is not reasonable to impose conditions which we can not lawfully impose on another landowner. It is also unreasonable to impose the requirement for the allowance of flows from a developed upstream catchment. Given the requirement for our site to have on site detention to maintain existing peak flows, it should be the responsibility of the upstream property owners to also maintain existing peak flows from their site. Should this condition remain it would be necessary for the applicant to request stormwater headworks credits for any additional infrastructure and loss of land due to allowing for flows greater than the property currently accepts.

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28. **Amend the design of the 3 cell 1500mm diameter piped system to provide a straighter alignment (eliminating 90 degree bends) between the catchment east of Fraser Drive and the bypass channel for the treatment/detention ponds in Part A of the subdivision, to maximise inlet capacity and minimise the chance of blockage. Further investigation of solutions to the potential conflict between stormwater services and the existing water main in Fraser Drive shall also be provided, to allow for the relocation of the stormwater inlet to the eastern side of Fraser Drive to eliminate the existing 900mm culvert.**

Response:

Council have previously requested that this site and the site across the road share a common intersection for access to Fraser Drive. The entrance to this site was placed in accordance with Council's recommendation. As the stormwater pipes are located under the roadway due to their size, it makes it impossible to align the stormwater line perpendicular to Fraser Drive without affecting opposite properties driveway access, or possible future development. Even placing pipes under Fraser Drive at a 45 degree angle to the road would require earthworks in the opposite property to change the existing overland flowpath, and re-grade it to the new culvert crossing.

29. **Identify the location of and provide preliminary design for drainage services, including inter allotment drainage and ARI 100 year overland flow paths, to collect and convey runoff from external stormwater catchments to the west of the site (Hillcrest Avenue, Ridgeway St, Ocean Avenue and Seaview Street) through the subdivision to a lawful point of discharge.**

Response:

Inter allotment drainage will be considered in the detailed design phase.

30. **Provide an assessment of impacts on downstream properties and public infrastructure south of the subdivision site (Shiraz Place, Merlot Court) due to increased urban stormwater runoff.**

Response:

No increased runoff is attributed to the external downstream properties as the catchment is modified to ensure nil increase in runoff. Refer Cardno Stormwater Management Plan (page 3 first paragraph). I.e, the percent impervious of the catchment has increased, but the overall area has decreased, creating no net increase in runoff. We are currently awaiting response from TSC's Danny Rose on this point.

31. **Provide justification that the existing culverts under Fraser Drive and receiving downstream private land represent a lawful point of stormwater discharge for the eastern catchment of Part B of the subdivision, as defined by Council's Subdivision Manual (Section AS of the Tweed Shire DCP).**

Response:

The existing culverts are the existing discharge point for the site. No increased runoff occurs as the detention pond on our site controls outflow. We are currently awaiting response from TSC's Danny Rose on this point.

32. **Provide preliminary design for outlet control measures for the on site detention pond proposed on the eastern boundary of Part B of the subdivision, including any works required at the inlets to the receiving culverts under Fraser Drive.**

Response:

A preliminary design sketch can be provided in accordance with normal development application documentation. Council still have final approval during construction & s68 approvals.

- 33. Provide an assessment of the existing cross sectional capacity of the open channel through the SEPP14 wetland, downstream of the subdivision. This assessment shall include a design and plan of works to upgrade this channel as necessary to cater for post development flows from the subdivision.**

Response:

The existing drain, by survey, has no capacity. It grades up hill and in some places is over 0.5m lower than outlet at James Road. See Figure DA 20 which shows levels. The regime is to maintain existing flows into the channel and wetland by detention control. The channel should remain unchanged to maintain ecological balance.

- 34. Provide a plan of management for the SEPP14 wetland and buffer zone for the concurrence of Council, the Department of Planning and other relevant government agencies. The plan of management must identify the required channel design to adequately cater for the post development flows from the Subdivision, and protocols for Council to carry out maintenance works to maintain an adequate cross section in the open channel, without compromising the ecology of the wetland. These maintenance works must be able to be carried out by Council using conventional equipment, and the plan of management must address maintenance access into the wetland.**

Response:

See response 33 above and refer to the SEPP 14 Wetland and Endangered Ecological Community Buffer analysis.

- 35. Provide preliminary design for outlet control measures for the on site detention pond proposed for Part A of the subdivision, to maintain a hydraulic regime compatible with the receiving SEPP14 wetland.**

Response:

The outlets will be designed at detailed design phase. Council still have final approval during construction & s68 approvals. Refer attached Sketch SK-016 for typical details.

- 36. Provide an engineering assessment as to the compatibility of the pond in Part A of the subdivision as a combined water treatment and on site detention device. Required volumes for on site detention must account for standing water levels necessary for water quality control in constructed wetlands. The assessment must consider how the combined device can cater for ARI 100 year storm detention, and water quality measures up to the ARI 3 month storm, without the remobilisation of pollutants under larger flows.**

Response:

This is a query relating to detailed design. Council still have final approval during construction & s68 approvals. Similar wetlands that incorporate water quality treatment and detention have been approved and constructed in the Terranora Azure development, located approximately 5 km from the Fraser Drive site. The wetland is designed so the water level remains constant during dry periods, but rises during rainfall events to attenuate the flows leaving the site. Additional storage volume is allowed for in the design of the wetland. See attached pictures of similar wetland located in Terranora.

37. **Amend stormwater drawings to Include proprietary treatment devices on all minor road drainage systems that do not discharge to the water quality wetland in Part A of the subdivision. Flows from external catchments do not require treatment.**

Response:

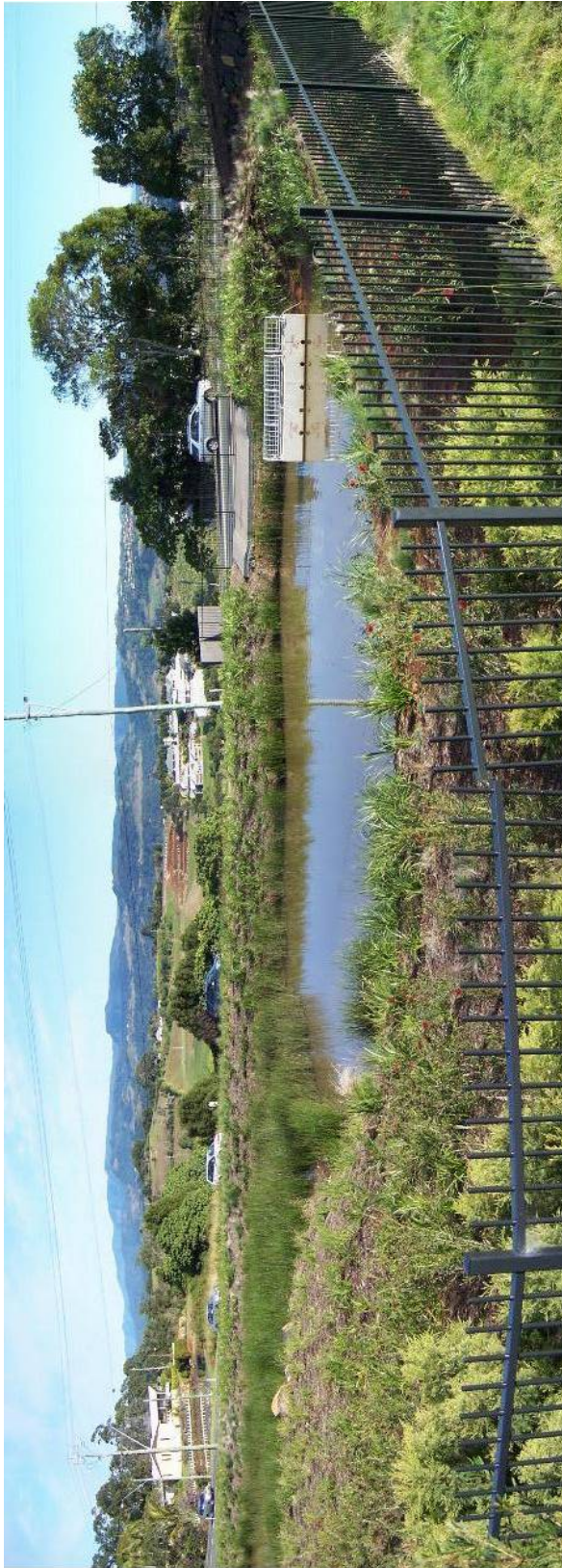
All flows from the northern portion of the site go into the wetland except for the medium density site which has a GPT. The medium density site catchment has been included in the sizing of the wetland as requested by Danny Rose via email (28th August 2006). It is proposed install Ecosol RSF100 or similar stormwater treatment devices into the Gully pits connecting into the 3x1500dia line before discharging into SEPP14 wetland as opposed to an additional dedicated drainage line for these pits.

Should you have any further questions, please contact Alaister Macrae or the undersigned.

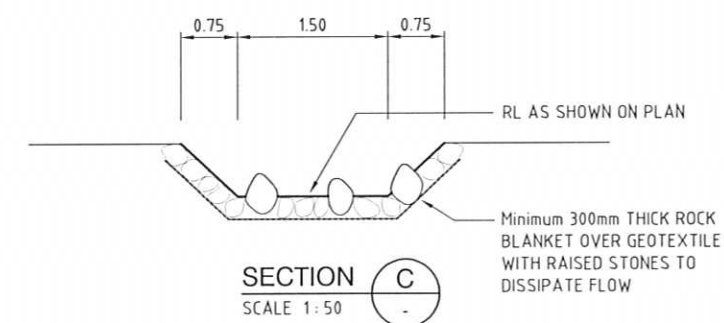
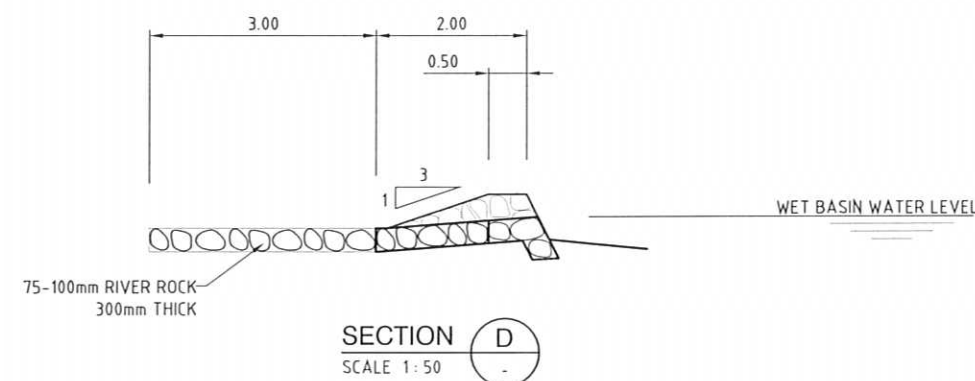
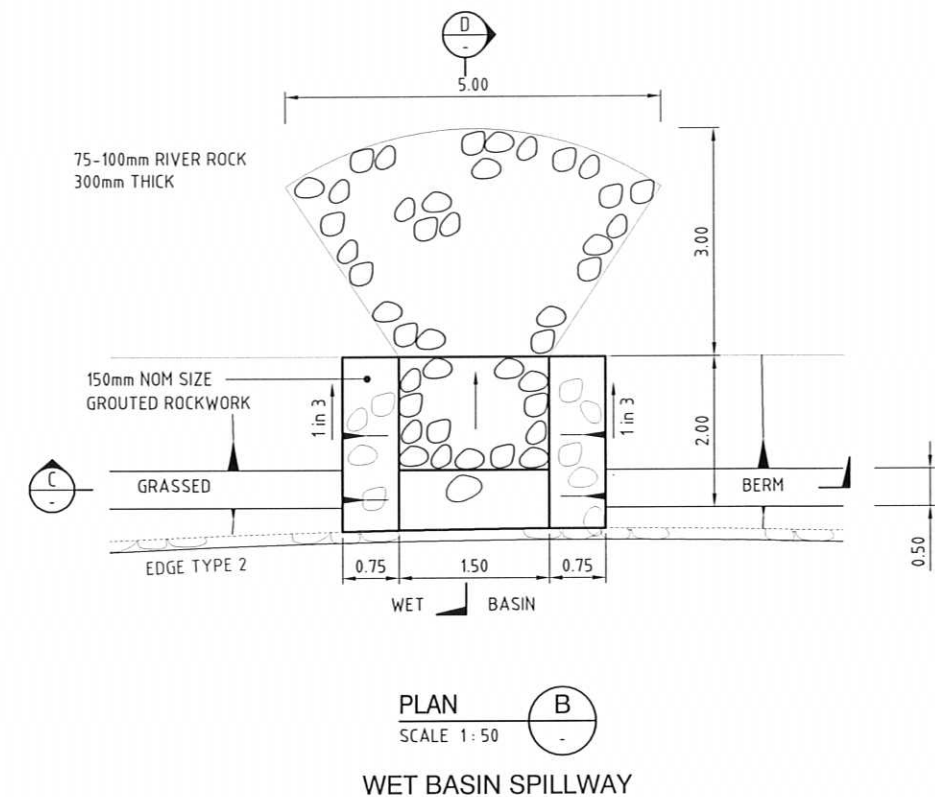
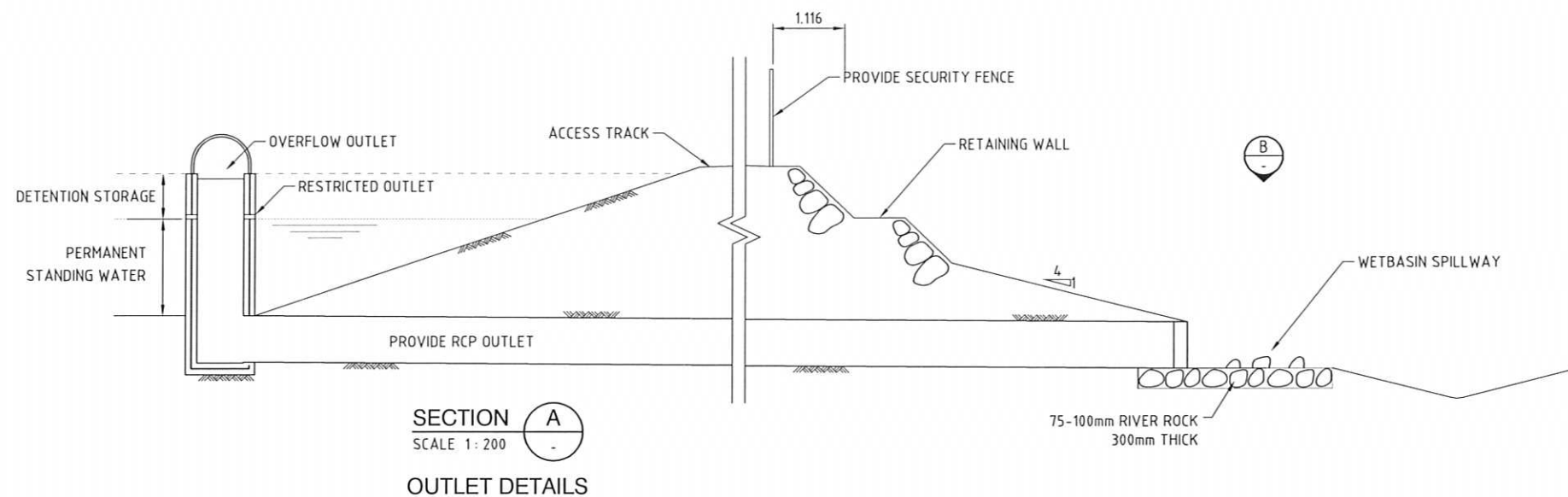
Yours faithfully



Rod Barry
for Cardno



Plates 1 & 2. Existing Water Quality / Detention Wetland Located in Terranora



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MFS DIVERSIFIED GROUP

PROPOSED WET BASINS

TYPICAL OUTLET DETAILS

SECTIONS AND DETAILS

SCALE - 1: 250 A1
DATE - DECEMBER 2007 Rev. A
DRAWING No.
7214/29-01

SKETCH No. 16 (18/12/07)

WET BASINS
TYPICAL SECTIONS AND DETAILS

Status Information	Whole Instrument	List Regs etc	Historical Versions
Historical notes	Search Title		

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Schedule 4A

Conveyancing Act 1919 No 6

Schedule 4A Easements in gross

(Section 88A)

Part 1 Right of carriage way

Full and free right for the body in whose favour this easement is created, and every person authorised by it, to go, pass and repass at all times and for all purposes with or without animals or vehicles or both over the land indicated herein as the servient tenement.

Part 2 Right of footway

Full and free right for the body in whose favour this easement is created, and every person authorised by it, to go, pass and repass on foot at all times and for all purposes without animals or vehicles over the land indicated herein as the servient tenement.

Part 3 Easement to drain water

Full and free right for the body in whose favour this easement is created, and every person authorised by it, from time to time and at all times to drain water (whether rain, storm, spring, soakage, or seepage water) in any quantities across and through the land herein indicated as the servient tenement, together with the right to use, for the purposes of the easement, any line of pipes already laid within the servient tenement for the purpose of draining water or any pipe or pipes in replacement or in substitution therefor and where no such line of pipes exists, to lay, place and maintain a line of pipes of sufficient internal diameter beneath or upon the surface of the servient tenement and together with the right for the body in whose favour this easement is created and every person authorised by it, with any tools, implements, or machinery, necessary for the purpose, to enter upon the servient tenement and to remain there for any reasonable time for the purpose of laying, inspecting, cleansing, repairing, maintaining, or renewing such pipe line or any part thereof and for any of the aforesaid purposes to open the soil of the servient tenement to such extent as may be necessary provided that the body in whose favour this easement is created and the persons authorised by it will take all reasonable precautions to ensure as little disturbance as possible to the surface of the servient tenement and will restore that surface as nearly as practicable to its original condition.

Part 4 Easement to drain sewage

Full and free right for the body in whose favour this easement is created, and every person authorised by it, from time to time and at all times by means of pipes to drain sewage and other waste material and fluid in any quantities across and through the land herein indicated as the servient tenement, together with the right to use, for the purposes of the easement, any line of pipes already laid within the servient tenement for the purpose of draining sewage or any pipe or pipes in replacement or in substitution therefor and where no such line of pipes exists, to lay, place and maintain a line of pipes of sufficient internal diameter beneath or upon the surface of the servient tenement and together with the right for the body in whose favour this easement is created and every person authorised by it, with any tools, implements, or machinery, necessary for the purpose, to enter upon the servient tenement and to remain there for any reasonable time for the purpose of laying, inspecting, cleansing, repairing, maintaining, or renewing such pipe line or any part thereof and for any of the aforesaid purposes to open the soil of the servient tenement to such extent as may be necessary provided that

the body in whose favour this easement is created and the persons authorised by it will take all reasonable precautions to ensure as little disturbance as possible to the surface of the servient tenement and will restore that surface as nearly as practicable to its original condition.

Part 5 Easement for repairs

1 The body having the benefit of this easement may:

- (a) at the expiration of at least one week's notice served on the owner or occupier of a lot burdened, use the lot for the purpose of carrying out necessary work on any structure used by that body which cannot otherwise reasonably be carried out, and
- (b) do anything reasonably necessary for that purpose, including:
 - entering the lot burdened, and
 - taking anything on to the lot burdened.

2 In exercising those powers, the body having the benefit of this easement must:

- (a) ensure all work on any structure used by that body is done properly and carried out as quickly as is practicable, and
- (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
- (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
- (d) restore the lot burdened as nearly as is practicable to its former condition, and
- (e) make good any collateral damage.

Part 6 Easement for drainage of sewage

1 The body having the benefit of this easement may:

- (a) drain sewage, sullage and other fluid wastes in pipes through each lot burdened, but only within the site of this easement, and
- (b) do anything reasonably necessary for that purpose, including:
 - entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - using any existing line of pipes, and
 - carrying out works, such as constructing, placing, repairing or maintaining pipes and equipment.

2 In exercising those powers, the body having the benefit of this easement must:

- (a) ensure all work is done properly, and
- (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
- (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
- (d) restore the lot burdened as nearly as is practicable to its former condition, and

- (e) make good any collateral damage.

Part 7 Easement for drainage of water

1 The body having the benefit of this easement may:

- (a) drain water from any natural source through each lot burdened, but only within the site of this easement, and
- (b) do anything reasonably necessary for that purpose, including:
- entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - using any existing line of pipes, and
 - carrying out work, such as constructing, placing, repairing or maintaining pipes, channels, ditches and equipment.

2 In exercising those powers, the body having the benefit of this easement must:

- (a) ensure all work is done properly, and
- (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
- (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
- (d) restore the lot burdened as nearly as is practicable to its former condition, and
- (e) make good any collateral damage.

Part 8 Easement for electricity purposes

1 The body having the benefit of this easement may:

- (a) transmit electricity through each lot burdened, but only within the site of this easement, and
- (b) do anything reasonably necessary for that purpose, including:
- entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - carrying out work, such as constructing, placing, repairing or maintaining poles, wires, conduits and equipment.

2 In exercising those powers, the body having the benefit of this easement must:

- (a) ensure all work is done properly, and
- (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
- (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
- (d) restore the lot burdened as nearly as is practicable to its former condition, and
- (e) make good any collateral damage.

Part 9 Easement for services

- 1 The body having the benefit of this easement may:
 - (a) provide domestic services supplied by that body through each lot burdened, but only within the site of this easement, and
 - (b) do anything reasonably necessary for that purpose, including:
 - entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - carrying out work, such as constructing, placing, repairing or maintaining pipes, poles, wires, cables, conduits, structures and equipment.
- 2 In exercising those powers, the body having the benefit of this easement must:
 - (a) ensure all work is done properly, and
 - (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
 - (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
 - (d) restore the lot burdened as nearly as is practicable to its former condition, and
 - (e) make good any collateral damage.
- 3 For the purposes of this easement, *domestic services* includes supply of water, gas, electricity, telephone and television and discharge of sewage, sullage and other fluid wastes.

Part 10 Easement for water supply

- 1 The body having the benefit of this easement may:
 - (a) run water in pipes through each lot burdened, but only within the site of this easement, and
 - (b) do anything reasonably necessary for that purpose including:
 - entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - carrying out work, such as constructing, placing, repairing or maintaining pipes and equipment.
- 2 In exercising those powers, the body having the benefit of this easement must:
 - (a) ensure all work is done properly, and
 - (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
 - (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
 - (d) restore the lot burdened as nearly as is practicable to its former condition, and
 - (e) make good any collateral damage.

Part 11 Right of access

- 1 The body having the benefit of this easement may:
 - (a) by any reasonable means pass across each lot burdened, but only within the site of this easement, for the purpose of exercising or performing any of its powers, authorities, duties or functions, and
 - (b) do anything reasonably necessary for passing across each such lot, including:
 - entering the lot burdened, and
 - taking anything on to the lot burdened, and
 - carrying out work within the site of this easement, such as constructing, placing, repairing or maintaining trafficable surfaces, driveways or structures.
- 2 In exercising those powers, the body having the benefit of this easement must:
 - (a) ensure all work is done properly, and
 - (b) cause as little inconvenience as is practicable to the owner and any occupier of the lot burdened, and
 - (c) cause as little damage as is practicable to the lot burdened and any improvement on it, and
 - (d) restore the lot burdened as nearly as is practicable to its former condition, and
 - (e) make good any collateral damage.

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Villa World Ltd

Proposed Development
Fraser Drive – South Tweed

Stormwater Management Plan

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8TH DECEMBER 2006
JOB NO. 7214/29-1

PROPOSED DEVELOPMENT FRASER DRIVE – SOUTH TWEED

STORMWATER MANAGEMENT PLAN

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CLIENT

VILLA WORLD LTD
Job No. 7214/29-1

DOCUMENT NAME

PROPOSED DEVELOPMENT LOT 9 on DP1039569
FRASER DRIVE – SOUTH TWEED
STORMWATER MANAGEMENT PLAN

Preliminary	☐	Author	S Walter
Draft	☐	Signature	
Draft Final	☐	Date	11/2/06
Final	☒	Reviewer	C de Byl
Superseded	☐	Signature	
Revision A	☐	Date	11/12/06

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1.0 INTRODUCTION

1.1 PURPOSE

This Stormwater Management Plan (SWMP) has been prepared on behalf of Villa World Ltd for the proposed development on Lot 9 on DP1039569 and part of Lot 2 on DP1000385, Fraser Drive, Tweed Heads South (the subject site). The aim of this management plan is to provide detailed policies, performance criteria and procedures to minimise the impact of the development on the physical and social environment. In particular, the SWMP provides monitoring and reporting mechanisms whereby the performance of the development can be measured and that agreed corrective actions are implemented in a timely manner if problems occur.

1.2 IMPLEMENTATION

This SWMP has been prepared in accordance with Tweed Shire Council's (TSC) '*Tweed Urban Stormwater Quality Management Plan*' and Development Design Specification '*D7-Stormwater Quality*' and good local engineering and environmental practice.

2.0 WATER QUALITY ASSESSMENT

Existing Conditions

The majority of the undeveloped site has previously been cleared for agricultural and farming use and is void of major vegetation, with the exception of the wetland area in the north-west corner of the site which contains Mangroves, Melaleucas and She-oaks. The cleared areas of the site are generally well grassed. The lower area at the northern end of the lot is in the process of being filled to bring the existing surface levels up above the regional 100 year ARI flood level of 2.6m AHD. These filling works are part of a previously approved application for the subject site.

The proposed subdivision development site is divided into four main existing site catchment areas. Approximately 2.4 hectares (ha) of the subject site discharges south towards existing residential lots on Shiraz Place and Merlot Drive. Two site catchment areas of approximately 1.8ha and 5.3ha discharge east towards Fraser Drive. The largest existing site catchment of approximately 23ha discharges north towards James Street. A SEPP 14 wetland area has been identified in the north-western corner of the subject site at the downstream outlet of the existing northern catchment area. As it is intended to retain the existing wetland area within the SEPP 14 zone the northern catchment point of discharge will be situated along the southern boundary of the SEPP 14 zone. Cardno Figure No DA19 in Appendix A shows the existing internal catchments for the site and the external catchments contributing to the site.

A number of external catchment areas contribute to the subject site. These external areas include approximately 8.4ha of existing residential lots along Seaview Street, Ocean Avenue and Hillcrest Avenue and a catchment of approximately 14.8ha contributing from the eastern side of Fraser Drive.

Based on typical pollutant loads as specified in Table 5.3 of Tweed Shire Council's 'Tweed Urban Stormwater Quality Management Plan' it was assumed that under existing site conditions the development site would generate pollutant loads equivalent to undeveloped land use loads.

TABLE 1 - TYPICAL POLLUTANT LOADS

Land Use	Typical Pollutant Loads (kg/ha/yr) for Tweed coastal areas* (Average Year)		
	Suspended Solids	Total Nitrogen	Total Phosphorus
Undeveloped	125	1.5	0.4
Rural	410	6.0	1.0
Urban	1200	18.0	3.0

* Taken from *Tweed Urban Stormwater Quality Management Plan* Table 5.3.

Proposed Site Drainage Strategy

The proposed drainage strategy for the Fraser Drive subdivision development is intended to incorporate water sensitive urban design (WSUD) wherever practical. The topography of much of the proposed development site limits the use of many WSUD techniques. It is therefore proposed to utilise conventional street drainage to convey stormwater runoff from the upper reaches of the catchment areas down to the stormwater treatment and detention devices to be constructed around the lower parts of the development site.

To assist in minimising the volume of stormwater runoff to be detained and treated from the catchment areas discharging to the south and south-east of the subject site, a number of strategies are proposed to be incorporated into the development. These strategies include minimising the density of the lots to be developed within the catchment discharging to the south and diverting catchment area from the southern catchments towards the eastern catchment.

Stormwater runoff from the northern and eastern catchment areas will be conveyed to detention and treatment devices to be located within open space areas situated at downstream outlet of each catchment. It is proposed to incorporate treatment devices such as gross pollutant traps and wetlands into the open space areas to assist in meeting Council's water quality objectives. These devices will be sufficiently sized to meet Council's 'deemed to comply' criteria outlined in the *Development Design Specification D7-Stormwater Quality*. Sufficient on-site detention storage volume will be provided within these open space areas to assist in maintaining peak flow rates equivalent to existing peak flows discharging off-site.

For the catchment areas discharging to the south and south-east it is proposed to retain the existing vegetation outside of the proposed building areas to assist in filtering and dispersing stormwater runoff from the subject site. Where necessary, areas will be revegetated to aid in this process. Inter-allotment drainage will be used to convey flows to the legal point of discharge of each catchment area.

Developed Conditions

The subject site will be developed into approximately 168 residential allotments and 66 medium density dwellings which are expected to increase pollutant loads at the stormwater discharge points. Cardno Figure No DA20 shows the catchments of the developed site. To assist in minimising the expected increase in suspended solids and nutrients discharging from the developed subject site it is proposed to install and construct gross pollutant traps and wetland areas in some of the open space areas proposed on-site.

Based on the typical pollutant loads summarised in Table 1 Council have outlined stormwater treatment objectives and maximum permissible loads that may be discharged from new urban developments. Table 5.4 of Council's *Tweed Urban Stormwater Quality Management Plan* outlines stormwater treatment objectives that new developments must demonstrate compliance with. Table 2 summarises part of the operational phase stormwater treatment objectives relating to the maximum permissible pollutant loads that may be discharged.

TABLE 2 - STORMWATER TREATMENT OBJECTIVES

Parameter	Maximum Permissible Pollutant Load Discharged (kg/ha/yr)* (Average Year)
Suspended Solids	300
Total Nitrogen	4.5
Total Phosphorus	0.8

* Taken from *Tweed Urban Stormwater Quality Management Plan* Table 5.4.

3.0 PRELIMINARY WATER QUANTITY ASSESSMENT

A preliminary water quantity assessment has been carried out by Cardno for the pre-development and post-development catchments of the site. The assessment was undertaken in accordance with Tweed Shire Council's Development Design Specification D5 'Stormwater Drainage Design' and QUDM Section 5, using the Rational Method.

3.1 On-site Detention

The proposed development is expected to increase the amount of impervious area on the site. The potential impacts of this increase in impervious area will be a larger volume of runoff, and possibly a shorter time of concentration. As a result there is expected to be an increase in the peak stormwater discharge leaving the site. To avoid impacts on the downstream properties and to maintain the existing peak flow rate of runoff discharging from the developed site for all rainfall events up to and including the local catchment 100 year ARI event, on-site detention is proposed to be incorporated into the development works to control the rate of discharge entering the downstream floodplain.

The on-site detention storage proposed for this site will be sized to maintain the equivalent pre-developed condition peak flows discharging from the subject site for the local catchment 100 year ARI rainfall event. To control the peak rate of discharge from the storage areas it will be necessary for the outlets to be designed for all events up to and including the 100 year event.

A preliminary assessment of the on-site detention storage requirements has been carried out for the proposed development area, using the initial sizing manual techniques in Section 6.06.1 of QUDM. These calculations indicate that estimated preliminary total storage volumes of approximately 956m³ and 11726m³ will be required to detain the increase in the 100 year ARI peak discharge and maintain the equivalent pre-developed 100 year ARI peak flow discharging off site for the Eastern and Northern catchments respectively. The calculations for the preliminary assessment of the detention storage volumes are included in Appendix B.

For the Northern catchment, it is proposed to provide this required storage volume within the proposed open space detention basin located in the open space area on-site. The storage volume would be provided above the permanent standing water level within the wetland. A controlled discharge point will be used in the open space detention basin to limit the flows exiting the storage area to ensure that flows discharging from the overall development site into the existing SEPP 14 wetland area are equivalent to the pre-development flows.

By utilising the wetland constructed within the open space area on the site for stormwater detention, the proposed development can be designed and constructed in such a manner that ensures there will be no increase in runoff for all storm events up to and including the local catchment 100 year ARI event, without compromising the water quality of the site.

During the detailed design phase (for the construction certificate) the required storage volume for each catchment will be optimised in conjunction with the final determination of the outlet and bypass flow structures in an effort to find a solution that best suits the layout of the site.

3.2 External Catchments

As mentioned above, there is an existing external catchment area of approximately 14.8ha contributing from the eastern side of Fraser Drive (refer Cardno Figure No DA19, Appendix A). The runoff from this catchment currently enters the subject site via 900mm diameter culvert under Fraser Drive. In larger storm events where the runoff volume is greater than the capacity of the culvert, Fraser Drive acts as a weir with the flow building up until it flows across the road into the development site.

It is proposed to catch the runoff overtopping Fraser Drive, up to the local 100 year ARI event, before it enters the subject site using sufficiently sized inlet pits. It is proposed to convey the external flow from the eastern catchment through the subject site as shown on Figure No DA21. The external catchment runoff will then be discharged into the south-east corner of the existing SEPP 14 zone in a dispersed manner in order to prevent erosion and scouring caused by high velocities. The intent of this proposed external flow by-pass network is to reduce the catchment area contributing to the proposed northern water quality treatment area, which is to be constructed as part of the proposed development.

Stormwater runoff contributing from the other external catchment areas to the west of the subject site has been allowed for in the preliminary detention calculations discussed in section 3.1.

4.0 PROPOSED TREATMENT DEVICES

To comply with Part 5.5 of Council's *Tweed Urban Stormwater Quality Management Plan* and Part 7.11 of the *Development Design Specification D7-Stormwater Quality* a number of stormwater quality management measures are proposed to be incorporated into the development of the site. To assist in minimising the expected increase in suspended solids and nutrients discharging from the developed subject site it is proposed to install and construct a number of gross pollutant traps and a wetland area into some of the open space areas proposed on-site.

The stormwater treatment process for each catchment of the project is described below.

4.1 Stormwater Treatment Trains

The proposed stormwater runoff treatment trains for the different catchments of the site are as follows:

Northern Catchment

Gross Pollutant Trap / Trash Rack ⇒ Stormwater Wetland

Eastern Catchment

Proprietary Gross Pollutant Trap

Southern & South-Eastern Catchments

Roof Area Runoff ⇒ Inter Allotment Drainage

Surface Area Runoff ⇒ Vegetated Buffer Strips

4.2 Stormwater Treatment Devices

The correct design and implementation of the following stormwater treatment devices is 'deemed to comply' with the performance criteria and stormwater treatment objectives outlined in Council's *Tweed Urban Stormwater Quality Management Plan*.

Litter Baskets/Racks

Litter baskets and trash racks are generally located upstream of other treatment measures such as extended detention basins or constructed wetlands. They are primarily used as a pre-treatment device for stormwater runoff, removing litter, debris and other gross pollutants from the runoff before it discharges into other secondary and tertiary treatment devices located downstream. A trash rack is recommended for this site upstream of the proposed northern wetland. The trash rack/litter basket device will be sized to comply with the requirements outlined in Section 7.11-2.21 of Council's *Development Design Specification D7-Stormwater Quality*.

Gross Pollutant Traps

A proprietary Gross Pollutant Trap (GPT), capable of trapping oils and removing litter and sediment, will be used as the treatment device for pipe flows leaving the proposed eastern catchment area. This GPT device will be sized to have sufficient sediment and oil storage capacity to comply with the requirements outlined in Section 7.12.1 of Council's *Development Design Specification D7-Stormwater Quality*. As required by Council this GPT device will be designed to treat runoff generated by storm events up to the 3 month ARI event for the nominated catchment area.

Maintenance for these proprietary GPT units is generally minimal and will involve the periodic removal of the accumulated oils, litter and sediment. Typically this is done on a six monthly basis by the nominated maintenance staff.

Stormwater Wetlands

Stormwater wetlands are designed to help in the removal of sediments and nutrients from stormwater runoff. The slow movement of water through the wetland allows time for the sediments suspended in stormwater runoff to settle out, while macrophytes located within the wetland absorb the nutrients transported into the waterbody via the stormwater runoff.

Stormwater wetlands work most effectively when used in-conjunction with a pre-treatment device such as a trash rack or GPT provided upstream of the wetland to remove litter and trap oils.

Sections D7.9 and D7.11 and Table 7.11-WS of Council's *D7-Stormwater Quality* specification provide design criteria for the construction of wetlands. Provided that the stormwater wetlands are appropriately designed and constructed to meet these criteria then the wetlands are 'Deemed to Comply' with the performance criteria outlined in Part 5.5 of Council's *Tweed Urban Stormwater Quality Management Plan*.

Table 7.11-WS indicates that where no formal sedimentation or pre-treatment processes are installed, such as sedimentation basins, the total wetland surface area including deep water zone and macrophyte zone shall be a minimum of 500m² per 1ha of urban development catchment area. This equates to 5% of the contributing development catchment area. Table 7.11-WS provides other pre-treatment processes that may be adopted within the development to assist in reducing the total wetland size.

Rainwater Tanks

Rainwater tanks can not only provide property owners with a low cost supply of water, but can also be used to assist in the reduction of peak flow rates from runoff events. However, as rainwater tanks are installed at a lot scale and become the responsibility of the property owner, incorporating these devices into the stormwater management scheme cannot be relied upon. Property owners in Part B of the development should be encouraged to install rainwater tanks to assist in complying with the Basix assessment set by the New South Wales Government. Water collected in the rainwater tanks can be re-used within the dwellings for outdoor water use, toilet flushing and/or laundry use.

For the proposed allotments where the roof drainage cannot be connected directly to the road drainage network, the concentrating of roof water runoff at a single discharge outlet can lead to erosion and scour problems. As roof water runoff is considered to be relatively 'clean' the roof water drainage should be connected directly to the proposed inter-allotment drainage network to minimise the potential for the runoff to become contaminated with general sediments and nutrients associated with surface runoff from other hardstand areas.

Vegetated Buffers / Filter Strips

Vegetated buffers / filter strips can be either areas of planted vegetation or strips of retained vegetation left in its natural state. These vegetated areas may provide an effective way of reducing peak flows and improving stormwater runoff quality.

During the construction phase of the development, including house construction, the retention of existing vegetation in-conjunction with other erosion control measures can help to stabilise exposed areas.

In the case of proposed housing allotments in Part B of the development that grade away from the road drainage network, buffer strips along the rear of the allotments are considered one of the key stormwater management techniques, particularly where no other stormwater treatment techniques are possible. Upon completion of the housing works, any exposed areas should be turfed, seeded or landscaped as soon as possible to reduce the risk of erosion.

5.0 STORMWATER MANAGEMENT – OPERATIONAL

Cardno Figure No DA21 shows details of the proposed stormwater system and treatment devices. The intent of the proposed systems is to minimise the impact of the development on the surrounding environment by the implementation of the element below.

Element 1: STORMWATER MANAGEMENT

Policy: To minimise the impact of the development on the water quality within external water bodies and protect the biological integrity of the aquatic ecosystem.

Performance Objectives: To avoid detrimental impact on the water quality and aquatic environment, as a result of the discharge of contaminated stormwater runoff.

To comply with the *Environmental Planning and Assessment Act* and with Tweed Shire Council's *Tweed Urban Stormwater Quality Management Plan* pollutant load objectives and Development Design Specification *D7-Stormwater Quality*.

Control Measures: All stormwater treatment devices should be sized to treat the 1 in 3 month rainfall event as required by Tweed Shire Council.

The proposed stormwater treatment trains for the different catchments of the site are as follows (for further descriptions refer to Section 4.0):

Northern Catchment

Gross Pollutant Trap / Trash Rack ⇒ Stormwater Wetland

Eastern Catchment

Proprietary Gross Pollutant Trap

Southern & South-Eastern Catchments

Roof Area Runoff ⇒ Inter allotment drainage

Surface Area Runoff ⇒ Vegetated Buffer Strips

A summary of the typical pollutant removal rates for the proposed treatment techniques is contained in Table 3.

TABLE 3 SUMMARY OF TREATMENT TECHNIQUES AND EFFECTIVENESS

TREATMENT TECHNIQUE	OBJECTIVE	POLLUTANT REMOVAL EFFICIENCY (1) (Source NSW EPA 1998 & Brisbane City Council Water Quality Management Guidelines 2000)		
		SS	TP	TN
Constructed Wetland	Reduce Peak Runoff - Treat SS, TN & TP	30-50%	30-50%	30-50%
In ground GPT's	Retain coarse sediment/litter	10-30%	10-30%	10-30%
Vegetated Buffer Strip	Reduce SS, TN & TP	30-50%	10-50%	10-50%

(1) Effectiveness rating subject to adequate design
 SS Suspended Sediment
 TN Total Nitrogen
 TP Total phosphorous

Monitoring: A monitoring program will be established for the stormwater treatment devices as detailed below and in Tables 4, 5 and 6.

To maximise the effectiveness of the stormwater management measures within the steep slope areas of the proposed development the individual property owners should be encouraged to regularly visually monitoring the condition of the vegetated areas within their allotments.

Table 4 outlines a number of activities that the owners may choose to monitor regularly upon development of their property.

TABLE 4 MONITORING PROGRAM FOR VEGETATED BUFFER STRIPS

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Erosion/scour of buffer zones	Monthly following the completion of the house construction.
	• Weed inundation/presence of litter	
	• Vegetation density/health of vegetation	
	• Inappropriate/excessive wear or damage	
> 6 months	• Erosion/scour of buffer zones	As required
	• Weed inundation/presence of litter	
	• Vegetation density/health of vegetation	
	• Inappropriate/excessive wear or damage	

The property owner will be responsible for all monitoring activities associated with the operation of the vegetated buffer strips within their allotments.

TABLE 5 MONITORING PROGRAM FOR GROSS POLLUTANT TRAPS (GPTs)

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Discharge water quality	After major storm event
	• Debris/litter in trash rack, blockages in oil/grit separators	After major storm events and/or every 2 months
	• Structural condition/integrity of devices	Every 3 months
	• Removal efficiency of devices	Every 3 months
	• Gross pollutant/coarse sediment accumulation	Every 2 months
	• Odour within GPT	Every 2 months
	• Erosion downstream of GPT	Every 2 months
> 6 months	• Debris/litter in trash rack, blockages in oil/grit separators	After major storm events and/or every 3 months
	• Structural condition/integrity of devices	Annually
	• Gross pollutant/coarse sediment accumulation	Every 3 months
	• Odour within GPT	Every 3 months
	• Discharge water quality	Six monthly

The Developer will be responsible for all monitoring activities associated with the operation of the Gross Pollutant Traps (GPTs) during the maintenance period, with the Council responsible for all monitoring following the maintenance period.

TABLE 6 MONITORING PROGRAM FOR STORMWATER WETPONDS/WETLANDS

TIME FRAME (after construction)	MONITORING ACTIVITY	FREQUENCY
0-6 months	• Basin/discharge water quality	Monthly, following storm events > 25mm in 24 hours
	• Sediment accumulation	6 months
	• Vegetation condition	Monthly
	• Weed invasion	Monthly
	• Algal growth	Monthly
	• Erosion/scour of pond banks, at inlet and outlet structures	Monthly
> 6 months	• Basin/discharge water quality	Monthly, following storm events > 25mm in 24 hours
	• Sediment accumulation	6 months
	• Vegetation condition	Monthly
	• Weed invasion	Monthly
	• Algal growth	Monthly
	• Erosion/scour of pond banks, at inlet and outlet structures	Monthly

The Developer will be responsible for all monitoring activities associated with the operation of the Stormwater Wetpond/Wetland during the maintenance period, with the Council responsible for all monitoring following the maintenance period.

Maintenance: The on-going performance of the treatment devices will be dependent on the maintenance conducted.

The maintenance programs detailed below and in Tables 7, 8 and 9 are to be implemented for the stormwater treatment devices.

TABLE 7 MAINTENANCE PROGRAM FOR VEGETATED BUFFER STRIPS

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Irrigating (dependent on Council restrictions)	As required by monitoring
	• Erosion/scour repairs	
	• Infilling of vegetation to maintain sufficient cover	
	• Removal of weeds and accumulated litter and sediments	
> 6 months	• Irrigating (dependent on Council restrictions)	As required by monitoring
	• Erosion/scour repairs	
	• Infilling of vegetation to maintain sufficient cover	
	• Removal of weeds and accumulated litter and sediments	

The maintenance program detailed in Table 7 outlines a number of maintenance activities that the property owners within the steep slope areas should be encouraged to undertake to ensure the effective performance of the vegetated area within their property. Any maintenance works required on any level spreader devices should be undertaken by a suitably qualified technician.

All maintenance activities associated with the operation of the vegetated buffers shall be the responsibility of the property owner.

TABLE 8 MAINTENANCE PROGRAM FOR GROSS POLLUTANT TRAPS (GPTs)

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Clean out device	Every 2 months, as required by monitoring
	• Remove sediment/litter/oils from device	
>6 months	• Clean out device	Every 3 months, as required by monitoring
	• Remove sediment/litter/oils from device	

The Developer will be responsible for all maintenance activities associated with the operation of the Gross Pollutant Traps (GPTs) during the first six months of operation (0-6 months). After this period Council will be responsible for the maintenance and operation of the devices.

**TABLE 9 MAINTENANCE PROGRAM FOR STORMWATER
WETPONDS/WETLANDS**

TIME FRAME (after construction)	MAINTENANCE ACTIVITY	FREQUENCY
0-6 months	• Removal of built up sediments	As required by monitoring.
	• Check for erosion/scour of pond banks	
	• Removal of weeds and litter	
> 6 months	• Removal of built up sediments	As required by monitoring.
	• Check for erosion/scour of pond banks	
	• Removal of weeds and litter	

The Developer will be responsible for all maintenance activities associated with the operation of the Stormwater Wetpond/Wetland during the first six months of operation (0-6 months). After this period Council will be responsible for the maintenance and operation of the wetpond/wetland.

Reporting: At the completion of the maintenance period, the Developer shall prepare a report to Council on the performance of the stormwater treatment devices located within the development site based on the monitoring undertaken.

The Contractor shall notify the Developer of system failure, any incidences of non-compliance and corrective actions implemented during the maintenance period, with Tweed Shire Council to be notified of any significant failures during the maintenance period.

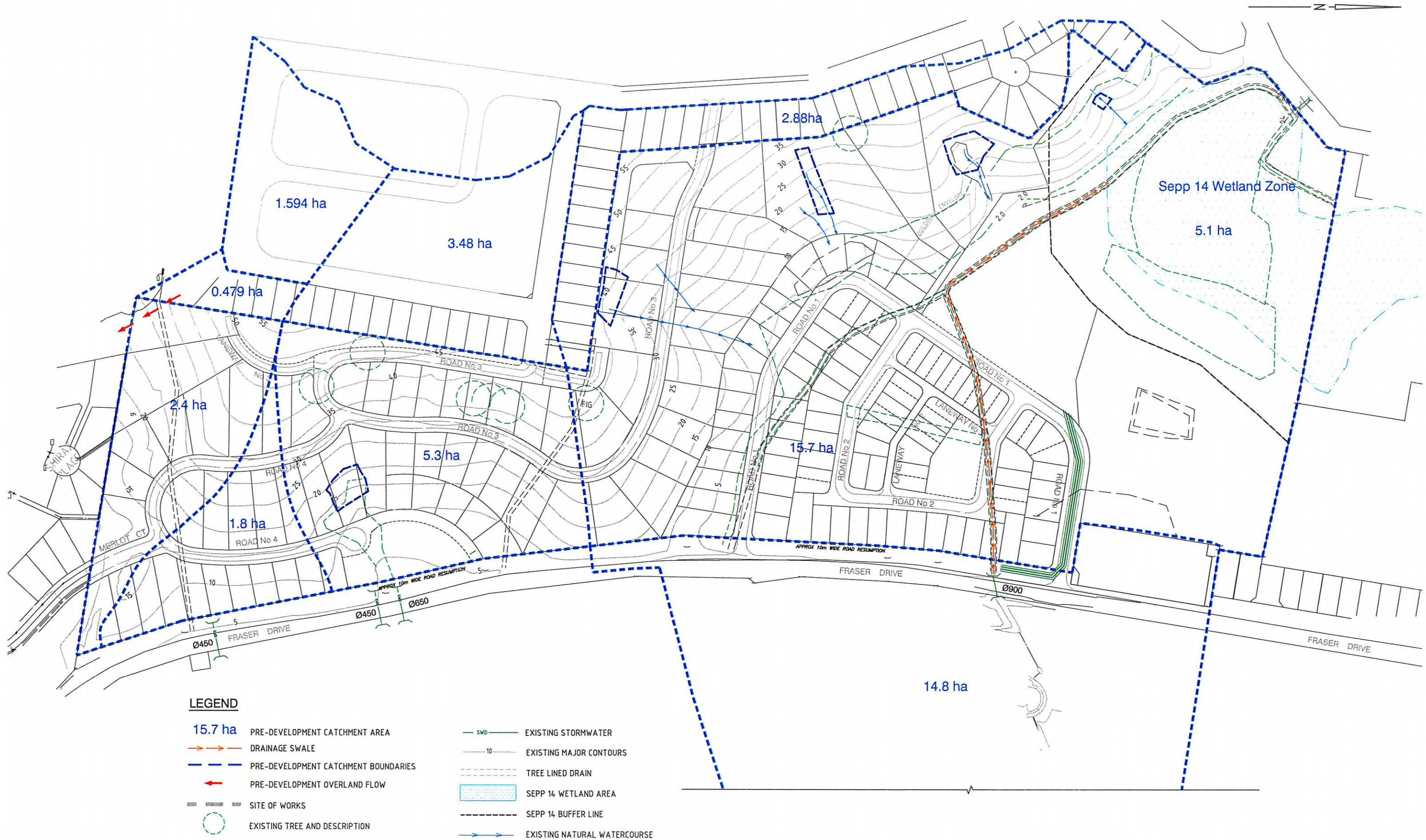
Corrective Action: When water quality objectives are not met investigation into cause and source of pollutants is to be carried out and remedial action taken.

APPENDIX A

DRAWINGS & FIGURES

Cardno Figure No DA19
Cardno Figure No DA20
Cardno Figure No DA21

Pre-development Stormwater Network
Post-development Stormwater Network
Proposed Stormwater Drainage Network



0 50 100 150m
SCALE BEFORE REDUCTION 1: 1500

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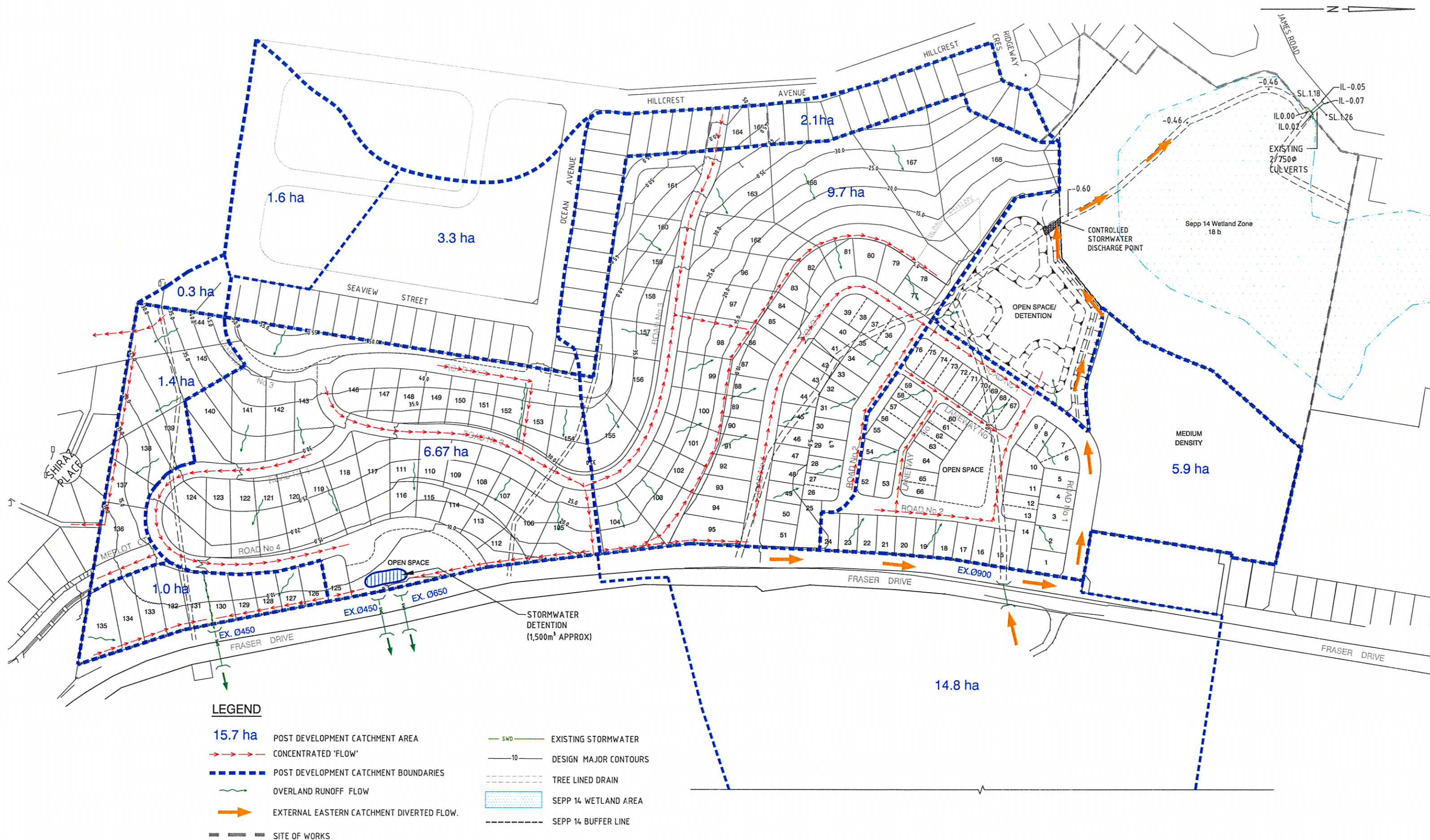
VILLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS
FRASER DRIVE, SOUTH TWEED HEADS
ENGINEERING REPORT

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7214/29/01-DA 19

FIGURE No.DA 19

PRE DEVELOPMENT
STORMWATER NETWORK



0 50 100 150m
SCALE BEFORE REDUCTION 1:1500

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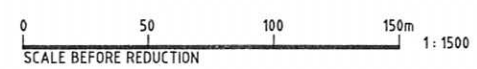
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FIGURE No.DA20

POST DEVELOPMENT
STORMWATER NETWORK



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DATE - 8 DECEMBER 2005	Rev.	
DRAWING No.	7214/29/01-DA21	

FIGURE No.DA21

PROPOSED STORMWATER DRAINAGE NETWORK

APPENDIX B

DETENTION VOLUME CALCULATIONS

Eastern Catchment - 5 year ARI flow

Existing Case

Low Density Urban Dev (Ext)	
Area	3.5 ha
(using QUDM Table 5.04.2)	
C_{10}	0.78
$F_5 \times C_{10}$	0.72
C_5	0.72
Time of conc	8 mins
Intensity	170 mm/h
Flow	1.19 m ³ /s
Total Flow	2.80 m ³ /s
Volume	1343.0 m ³

Open Space (Int)	
Area	5.3 ha
(using QUDM Table 5.04.2)	
C_{10}	0.70
$F_5 \times C_{10}$	0.64
C_5	0.64
Time of conc	8 mins
Intensity	170 mm/h
Flow	1.61 m ³ /s

Developed Case

Low Density Urban Dev (Ext)	
Area	3.3 ha
(using QUDM Table 5.04.2)	
C_{10}	0.78
$F_5 \times C_{10}$	0.72
C_5	0.72
Time of conc	8 mins
Intensity	170 mm/h
Flow	1.12 m ³ /s
Total Flow	3.33 m ³ /s
Volume	1598.6 m ³

Low Density Urban Dev (Int)	
Area	6.7 ha
(using QUDM Table 5.04.2)	
C_{10}	0.76
$F_5 \times C_{10}$	0.70
C_5	0.70
Time of conc	8 mins
Intensity	170 mm/h
Flow	2.21 m ³ /s

Detention Basin Sizing (preliminary)

Peak inflow	3.33 m ³ /s
Peak outflow	2.80 m ³ /s
Volume	2131.49 m ³
r	0.16

Required storage volume

Culp	Boyd	Carroll	Basha	Average
149.97	340.88	161.90	245.43	224.55

Applying factor of safety 2

Required volume is - 449 m³

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.0 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m ²)	Volume (m ³)
0.0	52.0	13.0	676.0	
1.0	60.0	21.0	1260.0	968.0

Eastern Catchment - 100 year ARI flow

Existing Case

Low Density Urban Dev (Ext)	
Area	3.5 ha
(using QUDM Table 5.04.2)	
C_{10}	0.78
$F_{100} \times C_{10}$	1.00
C_{100}	1.00
Time of conc	8 mins
Intensity	260 mm/h
Flow	2.52 m ³ /s
Total Flow	5.95 m ³ /s
Volume	2857.6 m ³

Open Space (Int)	
Area	5.3 ha
(using QUDM Table 5.04.2)	
C_{10}	0.70
$F_{100} \times C_{10}$	0.90
C_{100}	0.90
Time of conc	8 mins
Intensity	260 mm/h
Flow	3.43 m ³ /s

Developed Case

Low Density Urban Dev (Ext)	
Area	3.3 ha
(using QUDM Table 5.04.2)	
C_{10}	0.78
$F_{100} \times C_{10}$	1.00
C_{100}	1.00
Time of conc	8 mins
Intensity	260 mm/h
Flow	2.38 m ³ /s
Total Flow	7.09 m ³ /s
Volume	3401.7 m ³

Low Density Urban Dev (Int)	
Area	6.7 ha
(using QUDM Table 5.04.2)	
C_{10}	0.76
$F_{100} \times C_{10}$	0.97
C_{100}	0.97
Time of conc	8 mins
Intensity	260 mm/h
Flow	4.71 m ³ /s

Detention Basin Sizing (preliminary)

Peak inflow	7.09 m ³ /s
Peak outflow	5.95 m ³ /s
Volume	4535.55 m ³
r	0.16

Required storage volume

Culp	Boyd	Carroll	Basha	Average
319.12	725.36	344.51	522.24	477.81

Applying factor of safety 2

Required volume is - 956 m³.

Assuming a rectangular basin with 1 in 4 side slopes
and maximum depth of 1.0 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m ²)	Volume (m ³)
0.0	52.0	13.0	676.0	
1.0	60.0	21.0	1260.0	968.0

Northern Catchment - 5 year ARI flow

Existing Case

Low Density Urban Dev (Ext)		Rural Res (Ext)		Open Space (Int)	
Area	2.0 ha	Area	15.2 ha	Area	17.5 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C ₁₀	0.78	C ₁₀	0.71	C ₁₀	0.70
F ₅ xC ₁₀	0.72	F ₅ xC ₁₀	0.65	F ₅ xC ₁₀	0.64
C ₅	0.72	C ₅	0.65	C ₅	0.64
Time of conc	53 mins	Time of conc	53 mins	Time of conc	53 mins
Intensity	71.1 mm/h	Intensity	71.1 mm/h	Intensity	71.1 mm/h
Flow	0.28 m ³ /s	Flow	1.96 m ³ /s	Flow	2.23 m ³ /s
Total Flow	4.47 m ³ /s				
Volume	14215.2 m ³				

Developed Case

Low Density Urban Dev (Ext)		Rural Res (Ext)		Medium Density Urban Dev (Int)		Low Density Urban Dev (Int)		Low Density Urban Dev (Int)		Open Space (Int)	
Area	2.1 ha	Area	10.8 ha	Area	2.5 ha	Area	6.6 ha	Area	6.4 ha	Area	1.5 ha
(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)		(using QUDM Table 5.04.2)	
C ₁₀	0.78	C ₁₀	0.71	C ₁₀	0.82	C ₁₀	0.76	C ₁₀	0.78	C ₁₀	0.70
F ₅ xC ₁₀	0.72	F ₅ xC ₁₀	0.65	F ₅ xC ₁₀	0.75	F ₅ xC ₁₀	0.70	F ₅ xC ₁₀	0.72	F ₅ xC ₁₀	0.64
C ₅	0.72	C ₅	0.65	C ₅	0.75	C ₅	0.70	C ₅	0.72	C ₅	0.64
Time of conc	15.5 mins	Time of co	15.5 mins	Time	15.5 mins	Time	15.5 mins	Time	15.5 mins	Time	15.5 mins
Intensity	131.5 mm/h	Intensity	131.5 mm/h	Intensity	131.5 mm/h	Intensity	131.5 mm/h	Intensity	131.5 mm/h	Intensity	131.5 mm/h
Flow	0.55 m ³ /s	Flow	2.58 m ³ /s	Flow	0.69 m ³ /s	Flow	1.69 m ³ /s	Flow	1.68 m ³ /s	Flow	0.35 m ³ /s
Total Flow	7.53 m ³ /s										
Volume	7005.1 m ³										

Detention Basin Sizing (preliminary)

Peak inflow	7.53 m ³ /s
Peak outflow	4.47 m ³ /s
Volume	9340.11 m ³
r	0.41

Required storage volume

Culp	Boyd	Carroll	Basha	Average
2294.79	3797.09	2388.69	3045.94	2881.63

Applying factor of safety 2

Required volume is - 5763 m³

Assuming a rectangular basin with 1 in 4 side slopes and maximum depth of 1.5 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m ²)	Volume (m ³)
0.0	77.0	88.0	6776.0	
1.5	89.0	100.0	8900.0	11757.0

Northern Catchment - 100 year ARI flow

Existing Case

Low Density Urban Dev (Ext)	Rural Res (Ext)	Open Space (Int)
Area	Area	Area
(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)
C ₁₀	C ₁₀	C ₁₀
F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀
C ₁₀₀	C ₁₀₀	C ₁₀₀
Time of conc	Time of conc	Time of conc
Intensity	Intensity	Intensity
Flow	Flow	Flow
Total Flow		
Volume		

Developed Case

Low Density Urban Dev (Ext)	Rural Res (Ext)	Medium Density Urban Dev (Int)	Low Density Urban Dev (Int)	Low Density Urban Dev (Int)	Open Space (Int)
Area	Area	Area	Area	Area	Area
(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)	(using QUDM Table 5.04.2)
C ₁₀	C ₁₀	C ₁₀	C ₁₀	C ₁₀	C ₁₀
F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀	F ₁₀₀ x C ₁₀
C ₁₀₀	C ₁₀₀	C ₁₀₀	C ₁₀₀	C ₁₀₀	C ₁₀₀
Time of conc	Time of coi	Time of coi	Time of coi	Time of coi	Time of coi
Intensity	Intensity	Intensity	Intensity	Intensity	Intensity
Flow	Flow	Flow	Flow	Flow	Flow
Total Flow					
Volume					

Detention Basin Sizing (preliminary)

Peak inflow	16.16 m ³ /s
Peak outflow	9.87 m ³ /s
Volume	20032.96 m ³
r	0.39

Required storage volume				
Culp	Boyd	Carroll	Basha	Average
4622.81	7797.83	4821.25	6210.32	5863.05

Applying factor of safety 2

Required volume is - 11726 m³.

Assuming a rectangular basin with 1 in 4 side slopes and maximum depth of 1.5 metres, required surface area is.....

Depth (m)	Length (m)	Width (m)	Area (m ²)	Volume (m ³)
0.0	77.0	88.0	6776.0	
1.5	89.0	100.0	8900.0	11757.0

SIGNATURE AND SEALS ONLY

Handwritten signature: A.R. Miller

DP1039569

Registered: 9.4.2002

DA: SEE CERTIFICATE
Title System: TORRENS
Purpose: SUBDIVISION
Ref Map: X45/5-52, X45/5-54, X45/5-61, X45/5-63
Last Plan: DP1009074

PLAN OF SUBDIVISION OF
LOT 7 DP 1009074

Lengths are in metres. Reduction Ratio 1: 4000

LGA: TWEED
Suburb/Locality: TWEED HEADS SOUTH
Parish: TERRANORA
County: ROUS

Title is sheet 1 of my plan in 3 sheets.
(Delete if inapplicable)

Survey Certificate
Surveyors (Practising) Regulation 1996
1. BASIL JOHN McLAUCHLAN
P.O. BOX 710, TWEED HEADS NSW 2485
a surveyor registered under the Surveyors Act, 1926, as amended, hereby certify that the survey represented in this plan is accurate, has been made in accordance with the Surveyors (Practising) Regulation 1996, and was completed on 12-02-2002
The survey relates to: LOTS 8 AND 9 AND EASEMENTS AND ASSOCIATED CONNECTIONS
Datum line: PM 41589 - PM 41583
Zone: Suburban/County
Signature: [Signature]
Surveyor registered under the Surveyors Act, 1926
2.C

Plans used in preparation of survey/compilation:
DP 1000385 DP 1009074
DP28266 DP 844423 DP 243372
DP 28390

PANEL FOR USE ONLY for statements of intention to dedicate public roads or to create public reserves, drainage reserves, easements, restrictions on the use of land or positive covenants.

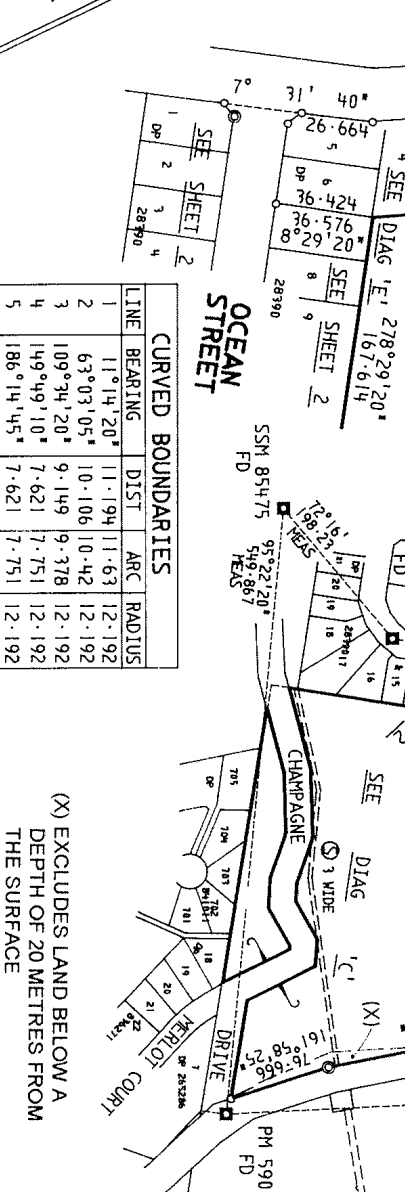
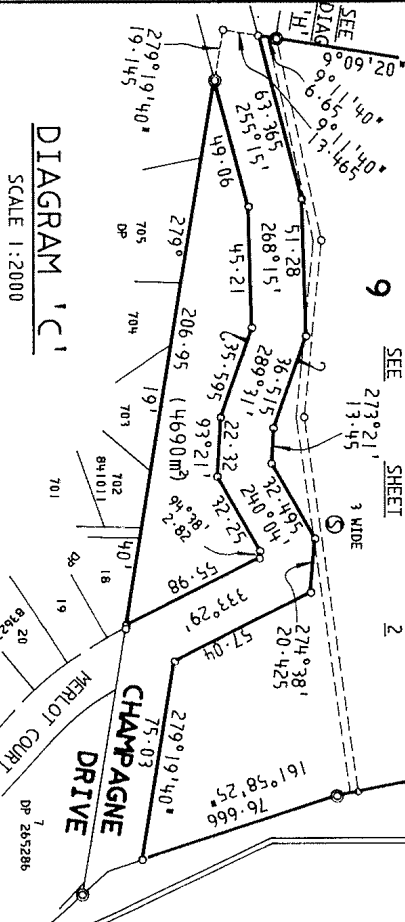
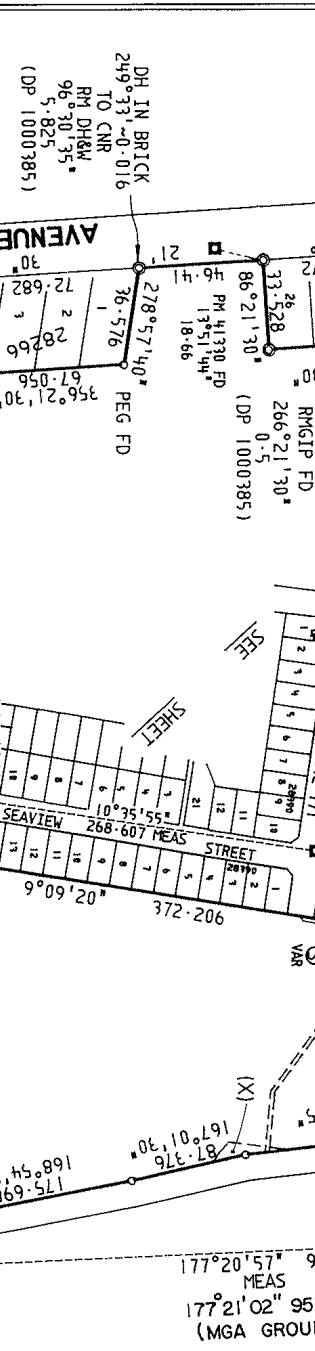
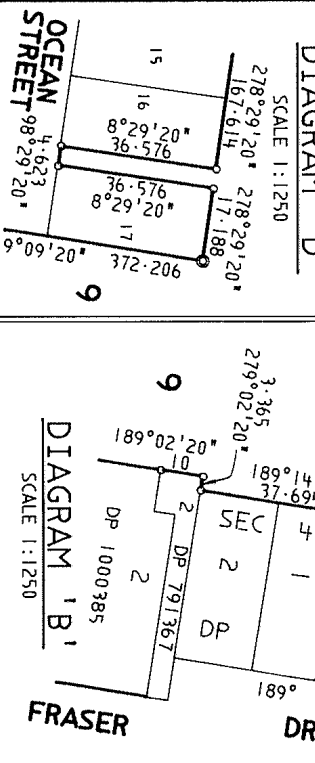
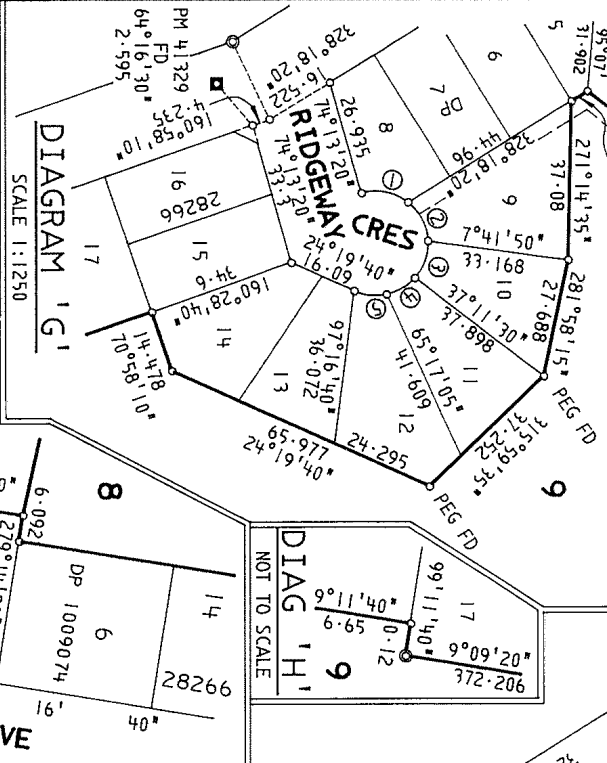
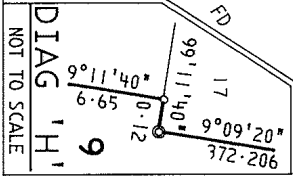
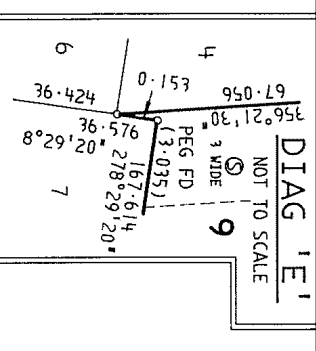
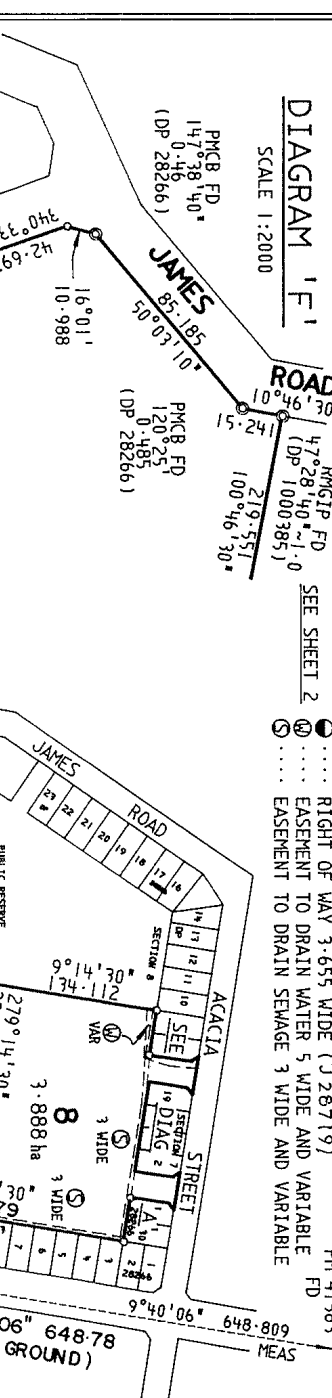
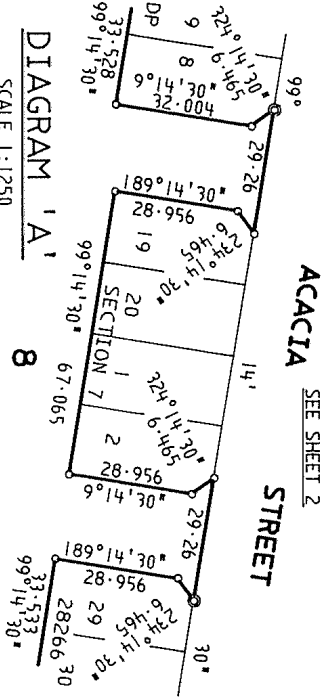
PURSUANT TO SECTION 88B OF THE CONVEYANCE ACT 1919-64 IT IS INTENDED TO CREATE -
1. EASEMENT TO DRAIN WATER 5 WIDE AND VARIABLE
2. EASEMENT TO DRAIN SEWAGE 3 WIDE AND VARIABLE
3. RESTRICTION ON USE OF LAND

Plan Drawing only to appear in this space

DIAGRAM 'E'

SCALE 1:2000

RIGHT OF WAY 3.655 WIDE (J 28719)
EASEMENT TO DRAIN WATER 5 WIDE AND VARIABLE
EASEMENT TO DRAIN SEWAGE 3 WIDE AND VARIABLE



LINE	BEARING	DIST	ARC	RADIUS
1	11° 14' 20"	11.194	11.63	12.192
2	63° 03' 05"	10.106	10.42	12.192
3	109° 34' 20"	9.149	9.378	12.192
4	149° 49' 10"	7.621	7.751	12.192
5	186° 14' 45"	7.621	7.751	12.192

(X) EXCLUDES LAND BELOW A DEPTH OF 20 METRES FROM THE SURFACE

10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360 370 380 390 400

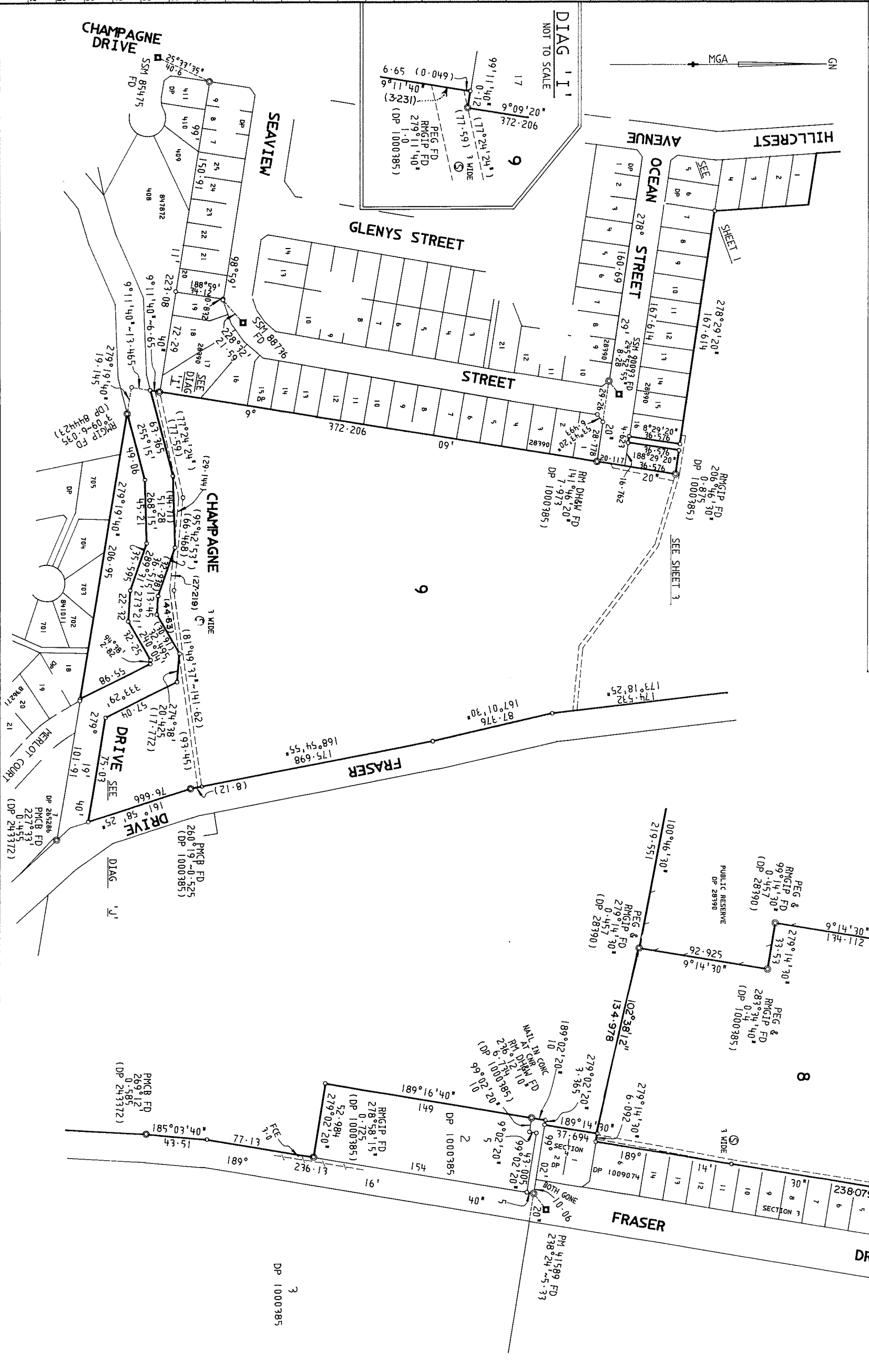
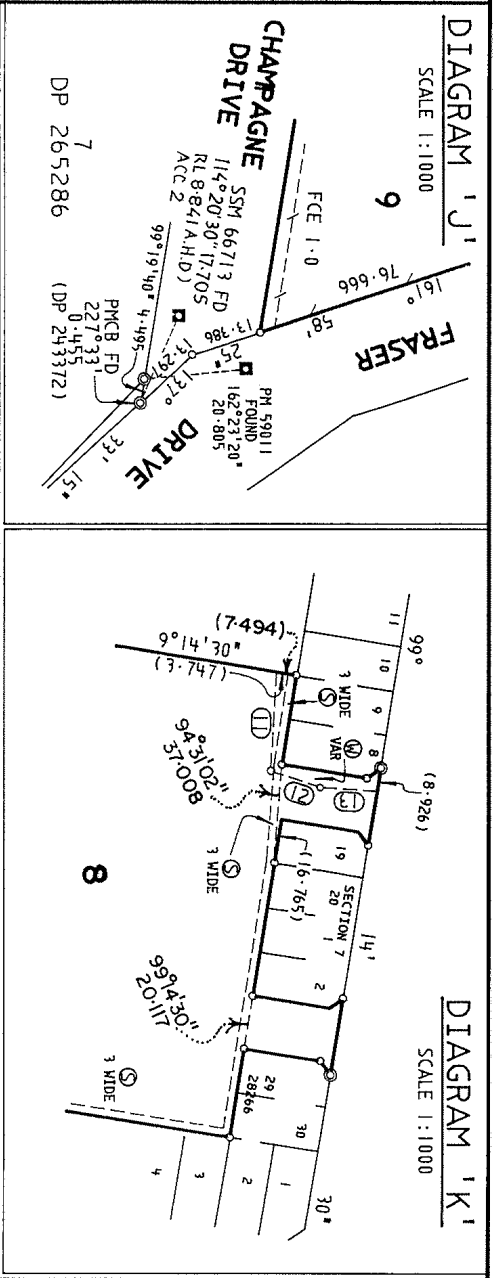
SURVEYORS REFERENCE N1141-SCHOOL COUNTRY

CHECK LIST

WARNING : CREASING OR FOLDING WILL LEAD TO REJECTION

Subdivision Certificate
I certify that the provisions of a 1094 of the Environmental Planning and Assessment Act 1979 have been satisfied in relation to the proposed subdivision.
(Insert 'subdivision' or 'new road') and out here
SUBDIVISION
1. Authorised Person/General Manager/Controlled Activities
Consent Authority: Tweed Shire Council
Date of endorsement: 5.11.2002
Accreditation No.: 51102
Subdivision Certificate No.: 51102
File No.:
When the plan is to be lodged electronically in the Land Titles Office, it should include a signature in an electronic or digital format approved by the Registrar-General.
† Dates whenever applicable

PLAN APPROVED
Crown Lands Office Approval
Land District
Paper No.
Field Book



DP1039569

Registered: 9.4.2002

This is sheet 2 of my plan in 3 sheets dated 12.2.02

Surveyor registered under Surveyors Act 1928

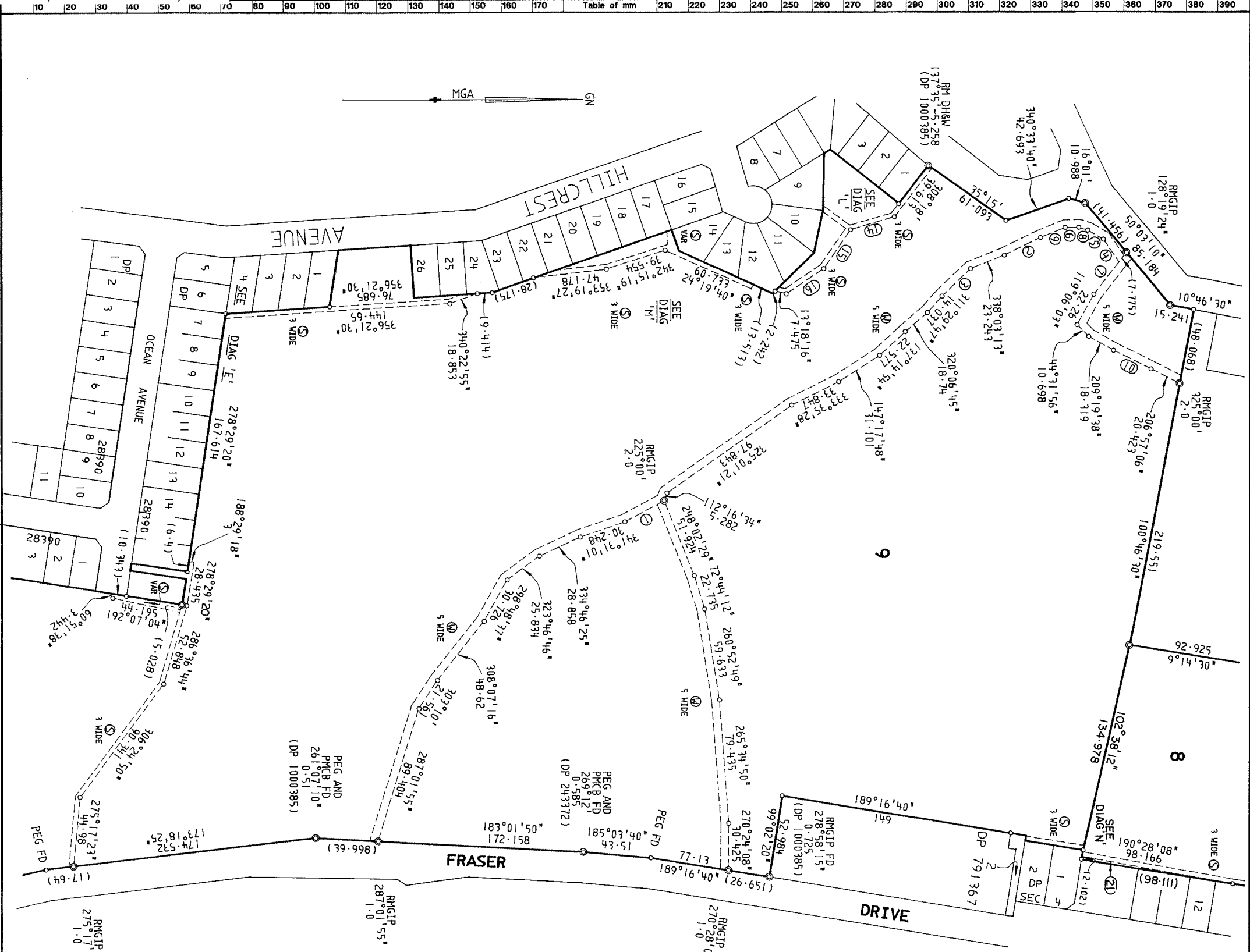
This is sheet 2 of the plan of 3 sheets covered by my Certificate No. 67 of 02

AUTHORISED PERSON
General Manager

For use where space is insufficient in any panel on Plan Form 2

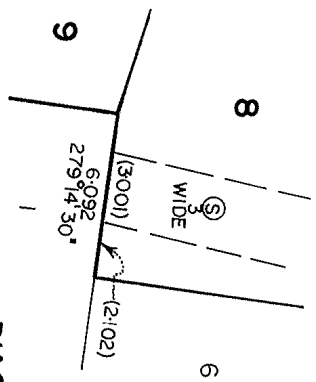
Reduction Ratio 1:2000

SURVEYOR'S REFERENCE
N1141-SCHOOL

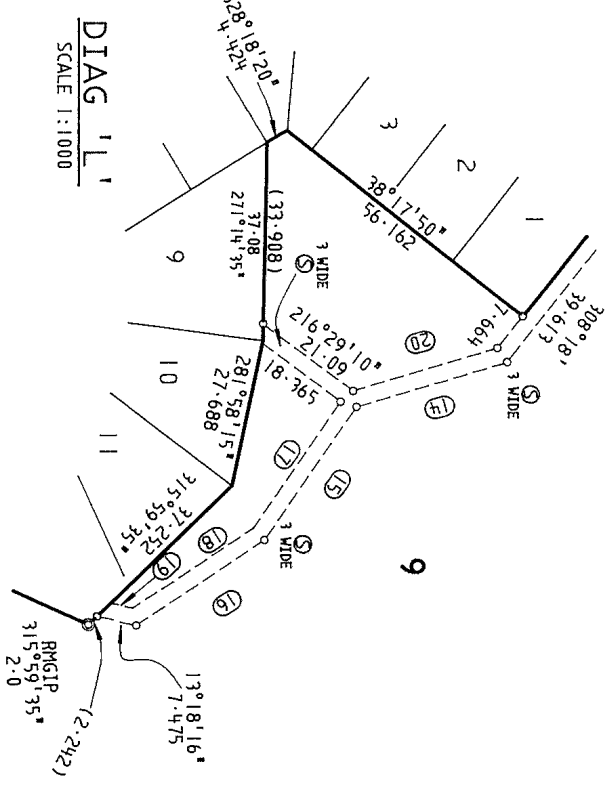


SURVEY PRACTICE REGULATIONS 1996 : CLAUSE 32 (2)				
MARK	M.G.A. CO-ORDINATES		ZONE	CLASS
	EASTING	NORTHING		
PM 41583	551313.983	6881260.594	56	B
PM 41589	551205.062	6880621.265	56	B
PM 59011	551249.319	6879664.743	56	B
PM 66713	551243.915	6879651.476	56	B
COMBINED SEA LEVEL AND SCALE FACTOR 0.999632				
SOURCE : M.G.A. CO-ORDINATES ADOPTED FROM LPI				
ON 15-02-2002				
ORIENTATION ADOPTED: PM 41589 - PM 41583				

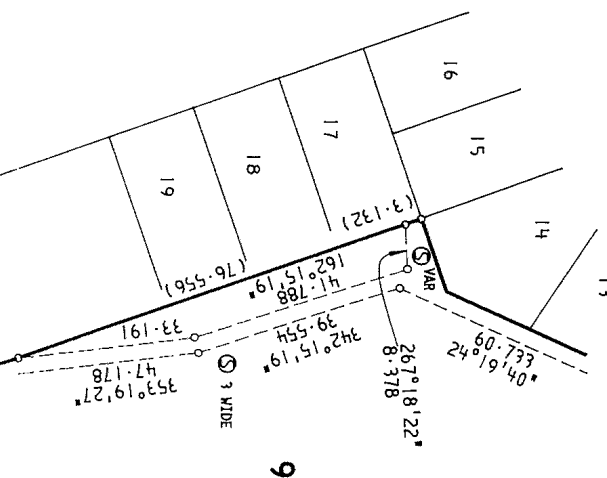
EASEMENTS		
LINE	BEARING	DISTANCE
1	151°42'33"	28.587
2	154°13'30"	25.829
3	136°39'34"	25.390
4	55°19'47"	17.614
5	30°40'38"	11.544
6	179°17'21"	8.787
7	128°19'24"	33.847
8	197°28'57"	6.128
9	337°43'26"	16.94
10	26°13'17"	26.836
11	93°28'21"	36.787
12	18°29'45"	19.512
13	4°12'58"	21.196
14	163°31'41"	29.192
15	124°45'27"	30.314
16	146°29'13"	28.825
17	124°45'12"	28.811
18	146°29'13"	26.950
19	13°18'15"	4.251
20	163°31'40"	28.020
21	190°28'08"	98.134



DIAG 'N'
N.T.S.



DIAG 'L'
SCALE 1:1000



DIAG 'M'
SCALE 1:1000

DP1039569

Registered: 19.4.2002

This is sheet 3 of my plan in 3 sheets dated 12.2.02

Surveyor registered under Surveyors Act 1928

This is sheet 3 of the plan in 3 sheets covered by my Certificate No. 47 of 02

For use where space is insufficient in any panel on Plan Form 2

Reduction Ratio 1:2000

SURVEYORS REFERENCE N141-SCHOOL

DP1039569

**INSTRUMENT SETTING OUT TERMS OF EASEMENT OR PROFITS A PRENDRE
OR RESTRICTION AS TO USER OR A POSITIVE COVENANT INTENDED TO
BE CREATED PURSUANT TO SECTION 88B OF THE CONVEYANCING ACT
1991**

PLAN NO:

**OF SUBDIVISION LOT 7 IN DP
1009074 COVERED BY COUNCIL
CERTIFICATE NO. G7**

OF 2002 Dated 5th March, 2002

(Sheet 1 of 3 sheets)

Lengths are in metres

PART 1

**FULL NAME AND ADDRESS
OF PROPRIETOR OF THE LAND**

**WILLIAM HEWITT SULLIVAN &
ROBERT THOMAS IAN SULLIVAN
of 43 Fraser Drive, Tweed Heads in
the State of New South Wales**

1. **IDENTITY OF EASEMENT
OR RESTRICTIONS FIRSTLY
REFERRED TO IN THE
ABOVEMENTIONED PLAN:**

Easement to drain water 5 wide and
variable width

SCHEDULE OF LOTS AFFECTED

Lots burdened

Lots benefited (or Authority benefited)

Lot 8

Tweed Shire Council

Lot 9

Lot 8, Tweed Shire Council and Lot 3 in
DP 1000385

2. **IDENTITY OF EASEMENT
OR RESTRICTIONS SECONDLY
REFERRED TO IN THE
ABOVEMENTIONED PLAN:**

Easement to drain sewage 3 wide and
variable width

SCHEDULE OF LOTS AFFECTED

Lots burdened

Lots benefited (or Authority benefited)

Lot 8 and 9

Tweed Shire Council

R J Sullivan

**INSTRUMENT SETTING OUT TERMS OF EASEMENT OR PROFITS A PRENDRE
OR RESTRICTION AS TO USER OR A POSITIVE COVENANT INTENDED TO
BE CREATED PURSUANT TO SECTION 88B OF THE CONVEYANCING ACT
1991**

PLAN NO:

DP1039569

**OF SUBDIVISION LOT 7 IN DP
1009074 COVERED BY COUNCIL
CERTIFICATE NO. G7**

OF 2002 Dated 5th March, 2002

(Sheet 2 of 3 sheets)

Lengths are in metres

3. **IDENTITY OF EASEMENT
OR RESTRICTION THIRDLY
REFERRED TO IN THE
ABOVEMENTIONED PLAN:** Restriction as to User.

SCHEDULE OF LOTS AFFECTED

Lots burdened

Authority benefited

Lot 8 & 9

Tweed Shire Council

PART 2

1. **TERMS OF RESTRICTION AS TO USER THIRDLY REFERRED TO IN
THE ABOVEMENTIONED PLAN:**

No proprietor of any burdened lot shall connect that lot to services such as sewer, water, power, or telephone as the land has not been filled to the required development height of R.L. 2.65 AHD.

Filling and access to such services are subject to separate future development applications.

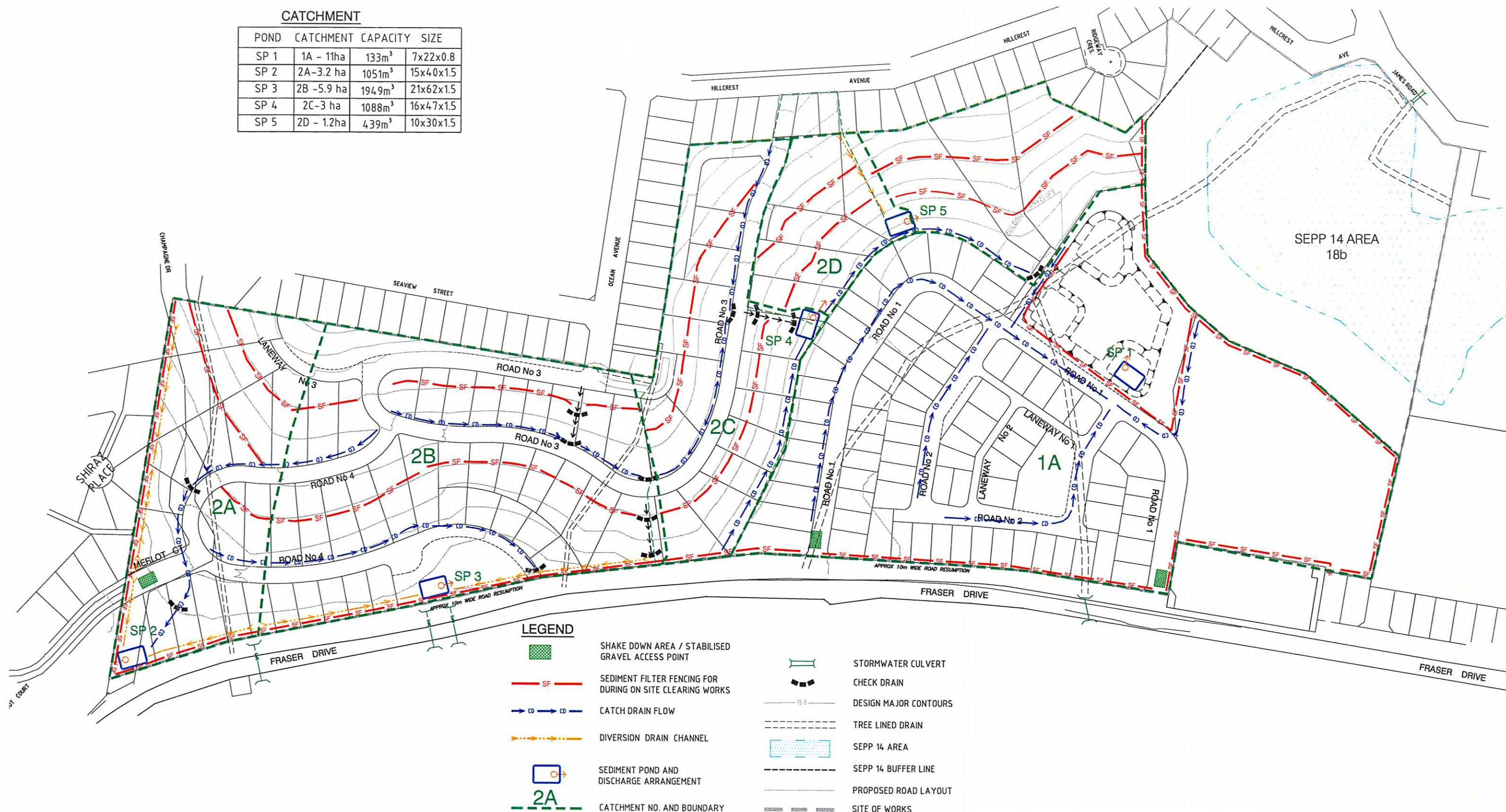
2. **NAME OF PERSON EMPOWERED TO RELEASE, VARY OR MODIFY
RESTRICTIONS THIRDLY REFERRED TO IN THE ABOVEMENTIONED
PLAN.**

Tweed Shire Council of Tumbulgum Road, Murwillumbah in the State of New South Wales

R F Lullman

CATCHMENT

POND	CATCHMENT	CAPACITY	SIZE
SP 1	1A - 11ha	133m ³	7x22x0.8
SP 2	2A-3.2 ha	1051m ³	15x40x1.5
SP 3	2B -5.9 ha	1949m ³	21x62x1.5
SP 4	2C-3 ha	1088m ³	16x47x1.5
SP 5	2D - 1.2ha	439m ³	10x30x1.5



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Cardno (Qld) Pty Ltd ACN: 051 074 992
Commercial Centre, Isle of Capri
Gold Coast City, Queensland 4217
Email: gco@cardno.com.au

VILLA WORLD LIMITED

LOT 9 DP 1039569 & Part LOT 2 DP 1000385
FRASER DRIVE, SOUTH TWEED HEADS
FRASER DRIVE, SOUTH TWEED HEADS
ENGINEERING REPORT

SCALE - 1:1500
DATE - 8 DECEMBER 2006
DRAWING No.
7214/29/01-DA10

FIGURE No.DA10

EROSION AND SEDIMENT
CONTROL PLAN

0 50 100 150m
SCALE BEFORE REDUCTION 1:1500

CAD FILE NAME: G:\7214\29\01\DA_Figures\72142901_DA10.dwg

Our Ref 7214/29-10 :rs

Contact Rod Barry



27 September 2007

NSW Government
Department of Planning
PO Box 39
SYDNEY NSW 2001

Attention: Ms Sally Laing

Dear Sally,

RE: PROPOSED DEVELOPMENT FRASER DRIVE MP06- 0243

Further to your summary of submissions letter dated 20 August 2007, we comment on the issues you raise in terms of water quality as follows:

KEY ISSUES

Stormwater Management

It is proposed to drain part of the site to the SEPP14 wetland in the northwest of the site. Clause 7(e) of SEPP14 states that the consent authority should give consideration to establish whether any feasible alternatives exist to draining to the wetland (either on other land or by other methods) and if so, the reasons given for choosing to drain to this location. Alternative methods for draining this land have not been considered.

Response:

Currently overland flow on the site drains to the wetland in the north west of the site, contributing suitable hydrological conditions for the continued existence of the wetland and associated vegetation. The proposal aims to maintain the existing conditions and flow regime on the site through the provision of water sensitive urban design concepts in a treatment train configuration. The proposed treatment train will maintain the existing flow regime whilst ensuring stormwater pollutants are treated to the required standard.

Diverting stormwater run-off to an alternate location would limit the stormwater recharge into the wetland, thereby disrupting the flow regimes required to maintain the wetland and associated vegetation.

If the only method for managing stormwater in the north west of the site is to drain to the SEPP14 wetland, further certainty regarding the effectiveness of the proposed management techniques to provide an acceptable level of protection to the wetland ecology is required. A conceptual MUSIC modelling exercise should be undertaken to demonstrate that the proposed stormwater management techniques will provide adequate protection to the wetland in terms of stormwater quantity (environmental flows) and quality.

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Wollongong
Busselton

Papua New Guinea
Indonesia
Vietnam
China
Kenya
United Arab Emirates
United Kingdom
United States



Response:

- The preliminary design of the treatment devices on-site have been sized in accordance with TSC "Deemed to Comply" provisions.
- The correct design and construction/ installation of the nominated devices are deemed to comply with the performance criteria outlined in the Tweed Urban Stormwater Quality Management Plan part 5.5.3

Tweed Shire Council has outlined stormwater treatment objectives and maximum permissible loads that may be discharged from new urban developments. Table 5.4 of Council's Tweed Urban Stormwater Quality Management Plan outlines stormwater treatment objectives that new developments must demonstrate compliance with. Table 1 summarises part of the operational phase stormwater treatment objectives relating to the maximum permissible pollutant loads that may be discharged.

TABLE 1 - STORMWATER TREATMENT OBJECTIVES

Parameter	Maximum Permissible Pollutant Load Discharged (kg/ha/yr)* (Average Year)
Suspended Solids	300
Total Nitrogen	4.5
Total Phosphorus	0.8

* Taken from *Tweed Urban Stormwater Quality Management Plan* Table 5.4.

Sections D7.9 and D7.11 and Table 7.11-WS of Council's D7-Stormwater Quality specification provide design criteria for the construction of wetlands. Provided that the stormwater wetlands are appropriately designed and constructed to meet these criteria then the wetlands are 'Deemed to Comply' with the performance criteria outlined in Part 5.5 of Council's Tweed Urban Stormwater Quality Management Plan.

Table 7.11-WS indicates that where no formal sedimentation or pre-treatment processes are installed, such as sedimentation basins, the total wetland surface area including deep water zone and macrophyte zone shall be a minimum of 500m² per 1ha of urban development catchment area. This equates to 5% of the contributing development catchment area. Table 7.11-WS provides other pre-treatment processes that may be adopted within the development to assist in reducing the total wetland size.

In summary the proposed wetland has been sized to meet Tweed Shire Council's stormwater treatment objectives thus producing a water quality suitable for discharge to the existing wetland. The proposed wetland which meets the nominated objectives can be accommodated within the size of the proposed open space area.

6. Stormwater Management

- *Appendix 13 sets out the proposed concept for stormwater management. It is noted that external catchment runoff from the eastern side of Fraser Drive is proposed to be collected, treated by a Gross Pollutant Trap and discharged into the south-eastern corner of the existing SEPP14 wetland zone. The Department is concerned that a GPT will not provide an adequate level of treatment to the stormwater prior to discharging into the SEPP14 wetland. Will the volume of runoff be controlled such that it mimics the pre-development discharge?*
- *Conceptual sizing of the stormwater detention ponds / wetlands should be undertaken prior to determination of this application to confirm that there will be sufficient area for the proposed treatment ponds in the proposed open space areas.*

Response:

- There has been some confusion in reference to the eastern catchment. The applicant is not proposing to treat any external eastern catchment flows. The eastern catchment as referred to in the Department's correspondence is simply piped un-treated to a point immediately downstream of the proposed wetland. Flows and water quality remain unchanged. Tweed Shire Council in their response to the Department also stated that external catchments do not have to be treated. See Clause 37 of Council's letter.
- The eastern catchment referred to in Cardno Stormwater Management Plan is part of the development site - Part B as shown on Figure 20 being 6.67ha. As this catchment contains less than 50 lots, the deemed to comply criteria outlined within the provisions of clause 7.11-2, Small Subdivisions of Tweed Shire Council Development Design Specification D7 have been applied. On-site detention is proposed for this catchment to ensure post development peak flows discharging from the site are equivalent to pre development conditions.

Should you have any questions or matters for discussion please contact the undersigned.

Yours faithfully



Rod Barry
Environmental Manager
for Cardno

