



WHITSUNDAY
SHIRE COUNCIL

DEVELOPMENT MANUAL

Current as at December 2008

WHITSUNDAY SHIRE COUNCIL PLANNING SCHEME POLICY NO. 17 DEVELOPMENT MANUAL

I hereby certify that this is a true and correct copy of the adopted Planning Scheme
Policy No. 17 - Development Manual.

J Finlay

Chief Executive Officer

Commencement Date - 9 January 2009

Date of Adoption of this Policy by Council - 17 December, 2008

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

USER GUIDE DEFINITIONS

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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INTRODUCTION

The Whitsunday Shire council (hereafter to be referred to as WSC) has recognised the need to develop comprehensive, structured and practical guidelines to promote consistency in development standards throughout the Whitsunday Shire.

The development manual was prepared to achieve the following objective:

* Provide a comprehensive, practical and authoritative guide through the development approval process from inception to completion for Developers, Consultants, Contractors and Council Officers.

It is the intention of the Development manual to set out procedures and requirements that are consistent with the *Integrated Planning Act 1997* and its supporting legislation, and represent 'best practise' in accordance with accepted current state and national standards for design and construction.

While the Development Manual provides comprehensive guidelines and requirements for the preparation and submission of approval applications, designs details and construction procedures, it is not the intention of the document to prescribe mandatory conditions.

Innovation is encouraged and approval may be given to adopt practices other than those included in the Development manual providing the applicant is able to demonstrate that the proposed solution will meet as a minimum the standards of the manual.

It must be noted however that approval for practices or solutions not expressly included in the Development Manual is at the discretion of the Council, and there is no obligation for Council to approve any proposed alternative solutions.

The Development Manual is a "living document" and subject to continual review. Formal reviews of the document are anticipated to be undertaken at twelve monthly intervals. The document will be updated as required to reflect changes in legislation or relevant standards, trends in innovation, or as a result of user feedback.

HOW TO USE THIS DEVELOPMENT MANUAL

The Development Manual is comprised of 6 component documents together with the Standard Drawings, which provide detailed and comprehensive guidance of the requirements for each stage of the development process. Each of the component documents is complete and self-contained and provides all of the information relevant to its subject.

While individual component documents have been developed to be particularly applicable to particular stages of the development process, they should be considered and used in the context of the entire Development Manual. The component documents should not be considered in isolation as they may contain cross-references to other documents, or contain requirements that are over-riden in the context of other documents in some circumstances.

The component documents, which comprise the Development Manual, are:

- **Development Principles**

The over-riding principles for development that form the basis of the guidelines and procedures detailed in the other component documents of the Development Manual are set out in the development principles.

- **Application Procedures**

The application procedures provide guidance in the procedures involved in applying for Operational Works Approval for works that will ultimately be owned and maintained by Council or other service authorities, or works that are subject to approval by Council, and includes advice about pre-lodgement discussions, what to include in the design submissions, and acceptable presentation standards.

- **Construction Procedures**

The procedures involved in construction for Operational Works subject to Council Approval are detailed. The guidelines cover pre-construction and construction requirements, and the criteria for 'acceptance' and 'final acceptance' of the works.

- **Design Guidelines**

Comprehensive design guidelines have been developed to address the major design elements involving infrastructure that will ultimately become the ownership and maintenance responsibility of the local Council.

DOCUMENT CONTROL PROCEDURES

The Development Manual will be electronically available and may be downloaded from the WSC web site. Alternatively the document may be obtained in hard copy format from:

Whitsunday Shire Council
PO Box 104
Proserpine QLD 4800

A hard copy will be available for perusal at the Council office.

The document will be electronically controlled, with the latest updated version of the document available on the WSC web site www.whitsundayrc.qld.gov.au

An Amendment Register will be maintained and made available on the web site, and at the office of each participating Council.

Notification of amendments to the Development Manual will be advertised on the Whitsunday web site. Users may register to be advised directly of amendments by completing the Amendment Notification Request and mailing it to the Whitsunday Shire Coordinator.

The Amendment Notification Request may also be returned electronically to:

info@whitsundayrc.qld.gov.au

The Amendment Register should be consulted prior to using any copy of the Development Manual previously downloaded or obtained in hard copy. It is the responsibility of the individual user to ensure they are aware of recent amendments and to consult the current version of the document.

DOCUMENT REVIEW AND AMENDMENT PROCEDURES

The Development Manual has been developed as a 'living document' and will be subject to continual review.

Feedback and suggested improvements to the document are welcomed and may be submitted by completing the Document Content Feedback. This form may be lodged with at the Council office or mailed to:

Whitsunday Shire Council
PO Box 104
Proserpine QLD 4800

Document Content Feedback may also be lodged electronically to:

info@whitsundayrc.qld.gov.au

Formal reviews of the document are anticipated to be undertaken at twelve monthly intervals. The document will be updated as required to reflect changes in legislation or relevant standards, trends in innovation, or as a result of user feedback.

AMENDMENT NOTIFICATION REQUEST		
Note: Complete this form and return to the Whitsunday Shire Council. This form may be photocopied if required.		
POST PO Box 104 Proserpine QLD 4800	ELECTRONIC MAIL info@whitsundayrc.qld.gov.au	ENQUIRIES Telephone: 074945 0651
Whitsunday Shire Council Development Manual		
Forward Notification of Amendment to:		
Position Title:		
Organisation:		
Contact Name:		
Postal Address:		
Post Code:		
Telephone Number:		
Facsimile Number:		
Email Address:		
SIGNATURE:		
DATE:		
OFFICE USE ONLY		
ACKNOWLEDGEMENT SENT:		
SIGNATURE		Date:

DOCUMENT AMENDMENT REGISTER
Document Details Whitsunday Shire Development Manual
Note: Details of amendments can be found on the Whitsunday Shire Council website: www.whitsundayrc.qld.gov.au
COMMENTS:
PROPOSED CHANGES:
Proponent Details
Organisation:
Contact Name:
Postal Address:
Post Code:
Telephone Number:
Facsimile Number:
Email Address:
SIGNATURE:
DATE:
OFFICE USE ONLY
COMMENTS:
ACKNOWLEDGEMENT SENT:
SIGNATURE Date:

DOCUMENT AMENDMENT REGISTER	
Document Details	
Whitsunday Shire Development Manual	
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Document	Record of Downloaded Revision
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WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

AP1

APPLICATION PROCEDURES

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Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

AP1.01 INTRODUCTION

1. This guideline sets out procedures involved in applying for Operational Works Approval for Works that will ultimately be in the ownership and maintenance responsibility of Council or other service authorities or works which are subject to approval by Council.
2. It should be read in conjunction with the relevant preliminary approval and/or development approval conditions.
3. Conditions of a development approval may require the construction, bonding and/or submission, of various works and/or documentation before survey plans can be approved and sealed by Local Authority or before a development may be occupied, building approval issued or a land use commenced.
4. Preliminary approvals / Development approvals requiring the construction of various works generally involve the Applicant and/or a Designer applying for Operational Works Approval and requesting Council approval of designs and specifications.
5. Plans for roadworks, drainage works, water supply, sewerage reticulation, bridges, retaining walls, miscellaneous structures, pumping stations and flood control structures are to be prepared under the direction of and certified by a Registered Professional Engineer Queensland (RPEQ).
6. Plans for landscape works are to be prepared by a person of professional standing and competence in the field of Landscape Architecture or Landscape Design, at a standard acceptable to the Council. Where irrigation plans are required for public parks, traffic islands or roundabouts, they are to be prepared by an irrigation designer with a proven track record of successful irrigation design.
7. Designs, calculations, drawings and specifications are to be submitted as supporting information to an application for Development Approval for Operational Works.
8. Operational Works Approval can not be issued until evidence of payment of the Portable Long Service Leave and Occupational Health and Safety fees is provided.

DESIGN APPROVAL

AP1.02 PRE-LODGEMENT DISCUSSIONS

1. Prior to lodgement of an application for Operational Works Approval, the Designer is encouraged to meet with Council officers to discuss the following matters in the event that the following issues have not been addressed at Reconfiguration of a Lot approval.
 - Lawful point(s) of stormwater discharge.
 - Identify environmentally significant areas and heritage features.
 - Internal and external stormwater catchment boundaries.
 - Tailwater conditions including water quality requirements and determination of tailwater level.
 - Connection point(s) for water supply and available pressure and discharge capacities.
 - Discharge point(s) for sewerage.
 - Set back distances from watercourses for on-site wastewater treatment and disposal.
 - Future planning for the provision of services, eg, water supply, sewerage, drainage and road networks, stream management and stormwater quality management, structures, power, communications and gas.
 - Site conditions.
 - Development Approval Conditions for the particular development.
 - Layout design and speed restriction.
 - Landscaping works for on street works and public open space.
2. Approval of designs can be expedited where the above issues have been resolved in advance.
3. The Designer may obtain As-Constructed information in relation to existing roads, stormwater drainage, water and sewer reticulation if available from Council, on application and payment of a prescribed fee (where applicable).
4. In addition to the above, it is advisable that the Designer discuss and obtain Council's agreement to the following issues (where required) prior to submission of designs:
 - Possible variations to Council's guidelines and standards.
 - Variations to design due to inability to obtain drainage discharge approvals.
 - Requests for Council to contribute towards some aspects of the work.
5. Resolution of these issues, particularly those requiring a decision of Council, (ie, amendments to conditions of approval, or requests for Council contributions), is essential to avoid protracted approval periods and wasted design effort.

AP1.03 DESIGN REQUIREMENTS

1. The design of operational works shall comply with the relevant Development Approval conditions, Council's local laws, Policies, Planning Scheme and the provisions of this Manual. The developer shall meet all costs associated with the compliance with these requirements.

2. It is Council's requirement that the design of all operational works shall be prepared under the direction of, and certified by a Registered Professional Engineer Queensland (RPEQ). Designer must bear full responsibility for all aspects of the design of all operational works, which they prepare.

AP1.04 CONSENT OF LANDOWNERS

1. Written approval is required from property owners authorising any operational works on their property. This includes both the property the subject of the development as well as all properties through which works are proposed (private and public).
2. Approvals to discharge and/or easements over downstream drainage paths from the respective property owners are required from the development site to the approved point of discharge.

AP1.05 LOCAL AUTHORITY APPROVAL

1. The 'Statement of Compliance – Operational Works Design' (refer Appendix A) has been introduced to expedite the approval process.
2. In all but critical aspects and the nominated non-complying aspects, Council's review will be on an audit basis only.
3. If Council review reveals the Statement of Compliance to be inaccurate or incomplete, the submission may be returned to the Designer for resubmission. A subsequent review fee may be levied in these cases in accordance with Council's fees and charges.
4. It is the Designer's responsibility to ensure the design as submitted takes into account all site conditions and complies and with Council's approval conditions, Council's local laws, Policies, the provisions of these Development Guidelines and other relevant authorities.
5. Council's review process does not warrant that an approved design complies with the above in every respect, and Council reserves its right to order the rectification of non-complying or unsafe works at the cost of the Developer, despite its prior approval.
6. Within five (5) working days of Council's approval, the Designer shall submit two sets of the approved drawings (1 x A1 size plus 1 x A3 size) and one (1) copy of the amended specification (if required to be amended) for Council's use.

AP1.06 APPROVAL OF OTHER AUTHORITIES AND REFERRAL AGENCIES

1. The Applicant shall be responsible for gaining the approvals of any other Authorities having jurisdiction over any part of the works.
2. All works on State controlled roads will be subject to Department of Main Roads approval and are to be carried out in accordance with the Department's Policies, Standards and Guidelines
3. All referral agency conditions are to be included in design documents and must be approved by each agency (if required), prior to submission to Council

AP1.07 SUPPORTING INFORMATION

General

1. Supporting Information for Operational Works shall include the following:

- Design Plans (1 x A1 and 1 x A3 plus 1 additional copy of water and sewerage plans).
- Job Specification (1 copy).
- Design Report (1 copy).
- Operational Works Application.
- Prescribed Application Fee.
- Evidence of payment of the Portable Long Service Leave and Occupational Health and Safety fee.

Design Plans

2. Design plans shall be definitive and clearly set out so as to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built.
4. All design plans should be clearly numbered with separate sheets numbered as part of a set.
5. Sheets of drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information. Drawings should be true to scale A1 size sheets and be suitable for black and white copying and photo reduction.
6. Design plans certified by a RPEQ shall be prepared and submitted for all roadworks, stormwater drainage, site regrading, sewerage reticulation, sewer pump stations, water reticulation and erosion prevention and stormwater management required by Council's Approval Conditions.

Job Specification

7. A Job Specification shall be prepared by the Designer specifying site specific requirements not covered in standard specifications.
8. All works shall be in accordance with Council's standard specifications where available. Where no Council standard specifications exist for a particular type of work, the Designer may use the Department of Main Roads specification or their own standard specification. Both options shall be subject to approval by Council.

Design Report

9. The Design Report shall be a bound report signed by the Designer and shall contain all the necessary design calculations, correspondence and information to enable Council to expeditiously check the design submission and grant approval to construct.
10. The Design Report shall contain the following:
 - i) A completed "Statement of Compliance – Operational Works Design" endorsed by the Designer(s).
 - ii) A copy of the development approval conditions on which the design is based including a summary of the design submission referencing each of the development approval conditions.
 - iii) Records of pre-submission discussions with Council including confirming correspondence.
 - iv) Copies of letters of approval from property owners for any works or discharge on their properties.

- v) Evidence that negotiations have been entered into regarding provision of supply with Service Authorities (including approved reticulation/service plans, if available).
- vi) Stormwater drainage calculations in spreadsheet format in accordance with QUDM requirements including detail of pit types and capture charts used and tailwater levels adopted.
- vii) Stormwater Drainage Catchment Plan(s) detailing external catchments and internal sub catchments.
- viii) Design details of alternatives proposed which depart from the Council's Guidelines/Development Conditions with supporting arguments for how the alternative meets Council's objectives.
- ix) Design calculations for detention basins, dissipaters, open channel, catch drain, adopted tailwater levels etc.
- x) Design criteria and parameters, operating regimes and calculations for permanent water quality works such as stormwater quality interception devices (SQIDs), sediment basins, trash racks, etc and demonstrated consistency with catchment Stormwater Quality Management Plan and Water Quality Report which accompanies the development application.
- xi) An Erosion and Sediment Control Strategy (ESCS) addressing erosion prevention and sediment management during construction.
- xii) Traffic Management Plan in accordance with the Manual of Uniform Traffic Control Devices.
- xiii) Water reticulation networks in a format compatible with Council's network system.
- xiv) Pavement design including records of geotechnical tests indicating subgrade CBR's, adopted traffic load, requirements for subsoil drainage and subsoil drainage design by a geotechnical engineer. (Where substantial earthworks are necessary the pavement design may be submitted following completion of earthworks.)
- xv) Geotechnical reports, where relevant, relating to slope and batter stability, in-situ materials etc.
- xvi) Structural and Geotechnical certification of design of miscellaneous structures including retaining walls, non-standard headwalls, drainage structures, reservoirs etc.
- xvii) Design parameters and operating regimes for water supply and sewerage pump stations.
- xviii) Landscaping Design Drawings for Subdivision Works showing details of Parks/Reserve Planting, Street Tree Planting, Buffer Zone Planting and any Hillslope Development Works if applicable.
- xix) For staged development, plans showing the overall design concept for water, sewer, stormwater, roadworks, earthworks, erosion and sediment control strategy with Stage 1 and updated copies provided with subsequent stages.
- xx) Listing of assets and works to be transferred to Council ownership demonstrating compliance with Service Standards specified by Council (e.g. minimised whole of life cost; reliability etc).
- xxi) A fully priced estimate of construction costs in the form of a priced schedule of quantities.
- xxii) Sewerage reticulation networks in a format compatible with Council's network system.

PLAN PRESENTATION

AP1.08 GENERAL REQUIREMENTS

1. These presentation guidelines shall apply to engineering and landscaping plans submitted for approval for operational works associated with approved developments.
2. Standardisation of the presentation of operational works plans submitted for approval is necessary for consistency in Council's records and desirable for expedient review and approval.
3. For Staged Reconfigurations the overall road network, roadworks drainage, water, sewerage, cycleway/pathway and erosion prevention and stormwater management plans are to be submitted to Council with Stage 1 and updated copies provided with each subsequent stage.
4. Scaled Engineering Drawings in accordance with these guidelines are required for plan review.

AP1.09 TITLE BLOCK

1. Each sheet of the Design Drawings shall have a Title Block containing the following information:
 - i) Development / Estate Name (if any).
 - ii) Locality/Approved Street Name.
 - iii) Developer's Name.
 - iv) Bar Scales as a minimum (Alternately Numerical Scale with original sheet size stated).
 - v) Plan Number and Sheet Number.
 - vi) Schedule and Date of Amendments.
 - vii) Certification by RPEQ (for engineering drawings).
 - viii) Real property description.

AP1.10 SHEET SIZES

1. Preferred sheet sizes (Overall dimensions)

A1 841 mm x 593 mm

A3 420 mm x 297 mm

AP1.11 SCALES

1. Scales used for plans should preferably be those recommended by the Standards Association. Generally the following scales should be used 1:1, 1:2, 1:5 and multiples of 10 of these. All scales should be bar scales.

	Urban	Rural
Plans	1:500	1:1000
Longitudinal Section: Horizontal	1:500	1:1000
Vertical	1:50	1:100
Intersection Details	1:100; 1:200	1:500
Cross Sections	1:100	1:100
Engineering Details	1:1, 1:2, 1:5 and multiples of 10 of these scales	

AP1.12 DIMENSIONS

Dimensioning On Plans

1. Linear dimensions on all roadworks plans will be in metres, with the exception of some detail plans of small structures (eg. manholes) and some standard plans (eg. kerb and channel), which may be in millimetres.
2. Details of methods of dimensioning shall be in accordance with AS 1155 Appendix A - Metric Units in Construction.

Standard Cross-Section Intervals

3. Urban and rural cross-sections should be provided to roads at 20.0m intervals and tangent points, with further reduction to 10.0 m or 5.0 m intervals where necessary due to horizontal or vertical curvature.

Chainages and Offset Dimensions

4. Chainage and Offset Dimensions on plans shall be expressed to 0.01 m. (0.005 may be used as the order of accuracy requires).

AP1.13 LEVELS

1. All levels shall be reduced to Australian Height Datum, unless otherwise approved.
2. Reduced levels of Bench Marks and Reference Pegs including Permanent Survey Marks shall be expressed to three decimal places i.e. 0.001 m. The location of the origin of the survey shall be shown on the plan.
3. Reduced levels of roadworks and stormwater drainage shall be expressed to three decimal places i.e. 0.001 m.
4. Reduced levels of sewerage reticulation shall be expressed to three decimal places ie. 0.001 m.

AP1.14 GRADES

1. Road grades shall be shown as a percentage to two decimal places.
2. Pipe grades shall be shown either as a percentage to two decimal places or as gradient to one decimal place.

DESIGN DRAWINGS

AP1.15 DRAWINGS REQUIRED

1. Operational works drawings will generally consist of the following:

- Locality Plan.
- Subdivision Layout / Staging Plan (if applicable).
- Earthworks Plan.
- Roadworks and Drainage Plan.
- Longitudinal Section of each Road.
- Type Cross-Sections for each road.
- Cross-Sections of each Road.
- Detail Plan of each Intersection and Cul de sac.
- Longitudinal Section of each Stormwater Drainage Line.
- Sewerage Reticulation Plan and long section of each line.
- Water Reticulation Plan.
- Landscape Plan.
- Erosion and Sediment Control Strategy.
- Service providers Conduit Plan, including street lighting.
- Stormwater Catchment Plan / Drainage Calculation Table.
- Miscellaneous Details.

2. The minimum requirements for each drawing are detailed in the following sections.

AP1.16 LOCALITY PLAN

1. Locate the subdivision / development in relation to adjacent towns, main roads, major streets, etc.
2. North Point.
3. May be included on Layout / Staging Plan for large jobs or Roadworks and Drainage Plan for smaller jobs.

AP1.17 LAYOUT / STAGING PLAN

1. For large subdivisions, the layout plan should show the relationship of all new roads to each other, and to existing roads adjoining the subdivision. All adjacent structures and services are to be shown also.
2. Where development is to be carried out by Stages, the boundaries of proposed Stages should be shown on this plan, and the stages identified by numbering.

3. For small subdivisions, where all new roads can be shown on one detail plan, the layout plan may be omitted.

AP1.18 EARTHWORKS PLAN

1. The Earthworks Plan may be included with the Roadworks and Drainage Plan for smaller subdivisions and shall include:
 - Legend.
 - North Point.
 - Existing site contours and finished surface contours. (Spot levels should be used to complement contours).
 - Limits and levels of major allotment cut and fill - distinguished by hatching.
 - Locations of cut and fill batters relative to allotment boundaries.
 - Location and levels of retaining walls (if required).
 - Batter slopes and treatments.
 - Appropriate flood levels in accordance with QUDM and Council's Policies.
 - Location(s) and level(s) of permanent survey mark(s), reference stations etc, used as datum for the works.
 - Vegetation including trees proposed to be removed and those to be retained.
 - For smaller subdivisions, the earthwork details may be included on the Roadworks and Drainage Plan.

AP1.19 ROADWORKS AND DRAINAGE PLAN

1. The Plan of each road shall include:
 - Legend.
 - North Point.
 - Road reserve boundaries.
 - Allotment numbers and boundaries, both existing and proposed (including existing and proposed easements).
 - Chainages, on centreline or construction line.
 - Bearings of the centreline or construction line. (Set out co-ordinates may also be used).
 - Tangent point chainages of each curve. Radius and arc, tangent length of each curve.
 - Chainage and the Intersection Point of road centre lines or construction lines.
 - Kerb lines, kerb radii, and chainage of all tangent points of the kerb line.
 - Footpaths / bikeways and pram ramp locations, tactile paving and fencing.
 - Accesses (where required to be constructed).
 - Edge of pavement, where no kerb is to be constructed.
 - Dimensioned road reserve, footpath and pavement widths, where these differ from the standard cross-section.

- Existing and finished surface contours, highlighting cut and fill areas.
- Drain line locations, diameters (including extent of easements where required).
- Drainage structures and structure number.
- Subsoil drain locations. Location of existing utilities or other existing works within the site. Location of all service clashes including levels of services and clearance distance.
- Location and levels of Bench Marks and reference pegs.
- Line marking, and signing.*
- Street name signs.*
- Guide posts, guard rails and other traffic control devices.*
- Overland drainage paths.
- Creek protection works and the like.

* May be shown on separate plan(s).

AP1.20 LONGITUDINAL SECTIONS OF ROADS

1. The longitudinal section of each road shall include:

- Chainages.
- Existing surface levels.
- Design road centreline levels.
- Cut or fill depths.
- Design grades.
- Chainages and levels of grade intersection points.
- Chainages and levels of tangent points of vertical curves.
- Chainages and levels of crest and sag locations.
- Lengths and radii of vertical curves.
- Sections on control lines on superelevated curves (ie. pavement edges, kerb or lane edges), curve widening and superelevation details.
- Location of services where they cross the centre of the road.

AP1.21 TYPE CROSS-SECTIONS

1. A type cross-section shall be shown for each road, including:

- Road reserve width.
- Pavement widths including medians (as applicable).
- Footpath widths.
- Crossfalls of pavement and footpaths.
- Pavement depth - nominal or design.
- Type of kerb and channel.
- Type of pavement surfacing.
- Sub-soil drainage.

- Table Drain details for rural roads.
 - Batter slopes.
2. The standard cross-section may be included in the detailed cross-sections provided for each road.

AP1.22 CROSS-SECTIONS OF ROADS

1. A cross-section shall be shown at the intervals defined in this guideline for each road and shall show:
- Road reserve boundaries.
 - Pavement centre line and/or other construction line.
 - Natural surface profile.
 - Design Cross-Section.
 - Crossfall of pavement and footpath, pavement and footpath widths and pavement depths wherever these differ from the standard cross-section.
 - Chainage of cross section.
 - Datum reduced level.

AP1.23 DETAIL PLANS OF INTERSECTIONS & CUL DE SACS

1. Intersection detail plans shall include all the relevant information required for Roadworks and Drainage Plans, as listed above together with additional details such as kerb levels on all kerb returns, pavement contours, channelisation works, line marking, signing and pram ramps.

AP1.24 LONGITUDINAL SECTIONS OF STORMWATER DRAINAGE LINES

1. A longitudinal section of each drain line shall be shown, including:
- Chainages.
 - Existing surface levels.
 - Design finished surface and invert levels.
 - Drainage Structure chainages and offsets and inlet and outlet invert levels.
 - Distances between drainage structures.
 - Grade of each pipe.
 - Material and Diameter of each pipe length.
 - Hydraulic grade line.
 - Drainage structure type and sizes and/or reference to separate detail drawing.
 - Crossings with any other services (location and invert level of service).

AP1.25 SEWER CONCEPT PLAN

1. Where a development incorporates multiple stages, a sewer concept plan must be prepared by the consultant and provide evidence that the house drainage can service all points of the allotment.

2. This Concept Plan must be submitted prior to proceeding with detailed design and should include the following:

- Location, size, approximate depth, and alignment of gravity sewers.
- Location, size and alignment of rising mains.
- Location of pump stations and lift stations including justification for their use.
- Contour information at 1m intervals maximum or to suit the topography of the land for both natural surface and finished surface contours.
- Contributing catchments (internal and external) showing the equivalent tenement (ET).
- Justification for re-directing flows between Sewerage Districts where proposed.
- Details of the influence on downstream catchments and systems.
- Manhole backdrop types.
- The flow contributing to each section of main including the estimated design capacity. See Example below:

EP 300	
PWWF	14.3 L/sec
Pipe size	225 diameter
Max pipe cap	26.2 L/sec

3. Access for maintenance of the system should be considered when locating manholes etc (Refer Section D7.08).
4. During the preparation of the concept plan consideration must be given to the integration of other infrastructure design, overall site earthworks and the impacts on existing upstream and downstream developments and potential developments.
5. As part of the preparation of the Concept Plan, the requirements of Section 2-Concept Design in the Sewage Pumping Code of Australia-WSA 04-2005 shall also be included.

AP1.26 SEWERAGE RETICULATION PLAN AND LONGITUDINAL SECTION

1. The sewerage reticulation plan shall include:

- Legend.
- North Point.
- All allotments and allotment numbers.
- Boundary of the subdivision.
- Location and size of existing sewers.
- Invert levels of existing lines.
- Location of other services.
- Location of manholes with manhole numbers (including dimensions where not shown on alignment).

- Identification of allotments which are currently sewerred.
- Location and size of new sewers including line number and length of line.
- Finished surface contours sufficient to enable verification of house connection design.
- Details of permanent survey marks including AHD from which levels are to be transferred.
- Grading information for new sewer lines including distance between manholes, pipe grades, pipe diameter, pipe material and class of each pipe length.
- Manhole cover type and class.
- Manhole inlet types.
- Locations and level of sewer house connections and type.
- Finished surface contours with spot levels to compliment contours.
- Ultimate sewer design flows including catchment plan for staged development if applicable.
- Gravity sewer pipe capacities.
- Diagram showing all allotment controls.
- Details of pumping stations including location, inlet/outlet levels, overflow, cut-off levels, electrical switchboard layout and water supply, size of pumping plant.
- Diameter, material class and route of pressure main(s); indicating air valve and scour valve locations.
- Details of connections to existing mains and the fittings to be used.
- Location and angle of each bend.
- Thrust block calculation where required.
- Flow velocities under different flow conditions.
- Rising main hydraulic grade line.
- System resistance and pump curves showing static and friction head and duty points.
- Demonstration of pipeline capacity to resist cyclical pressure effects over a 100-year lifespan of the systems.
- Estimation of pump start, stop, alarm, overflow and other control levels.
- Calculations supporting the provision of wet well storage.
- Calculations showing that floatation forces are counteracted for all buried or partially buried structures.
- Estimation of electrical loads – Mains Supply proposed; and Radio Frequency interference screening measures.
- Structural calculations where necessary for the pump well and associated works.
- Calculations supporting the hydraulic design of emergency relief structures.

2. The longitudinal section of each sewerage line should include:

- Existing surface levels.
- Design finished surface.
- Manhole number.
- Distance between manholes.
- Grade of each pipe length.

Diameter, material and class of each pipe length.

Manhole diameter and cover type.

Manhole inlet types.

Invert levels of existing lines.

Crossings with any other services (including location, size and invert level of pipe crossing).

AP1.27 WATER RETICULATION CONCEPT PLAN

1. Where development incorporates a large number of lots with multiple stages, the Consultant shall submit a Water Reticulation Concept Plan of the water reticulation showing proposed main sizes, connections to existing mains and valve positions. The Concept Plan must be supported by a computer network analysis.
2. This concept plan shall be submitted prior to proceeding with detailed design and should include the following:

Layout of mains, together with the development layout.

Key to network analysis, ie. Node points, elevation, demand.

Size and type of mains, indicated graphically and distinguished by colour and/or line type.

Design parameters – number of lots, number of ET design flows.

Legend of land uses (i.e. Residential, Industrial Precincts etc.).

Supply points and pressure or Hydraulic Grade Line (HGL) as supplied by Council.

Location of pumps, pressure reducing valves and reservoir top water level (TWL) and volume where applicable.

Limit of water district serviced by the reticulation mains.

Contours for the entire development, at minimum 1m intervals.

Consideration for connection to adjoining and/or future developments as directed.

AP1.28 WATER RETICULATION PLAN

1. The water reticulation plan shall include:

- Legend.
- North Point.
- All allotments and allotment numbers.
- Boundary of subdivision.
- Location and size of existing mains.
- Location, size, material and class of new mains.
- Location of other services.
- Details of connection to existing mains
- Location of each bend.
- The location of valves, hydrants, scours and caps, T's, reducers, etc.
- Road crossing conduit locations, size and class.

- Water service connection details.
- Network Analysis.
- Thrust block calculation where required.
- Operating conditions for pressure reducing valves.
- Structural calculations where necessary for valve pits and associated works.

AP1.29 LANDSCAPE PLAN

1. The landscape plan shall contain the following details:

- Site and Layout.
- Proposed and existing contours at 5 metre intervals.
- Extent of existing vegetation including type and location.
- Significant trees showing level at base and proposed levels, indicating which trees/vegetation is to be removed.
- Proposed layout of roadways including:
 - - Kerb and channel.
 - - Stormwater drainage pits and manholes.
 - - Street lighting.
 - - Property boundaries.
 - - Traffic islands, roundabouts, traffic calming devices etc.
- Layout and numbering of individual lots.
- Existing parks, reserves etc.
- Adjoining land uses, access corridors.
- Existing watercourses, watersheds, gullies, with 10 metre buffer zone to either side of creeks, where required.
- Revegetation areas including extent, type, technique and erosion prevention proposals.

On-Street Works

- Alignment and location of proposed concrete footpaths and bike paths.
- Grass establishment areas.
- Lighting proposals and street furniture, if appropriate.

Traffic Islands and Roundabouts

- Alignment of kerb and channel and concrete backing to roadside kerb.
- Soil mix type and depth.
- Proposed planting layout and plant schedule, including species, number, size, setout, staking.
- Mulch types and depth.
- Irrigation proposals.

Public Open Space

- Dimensions and landscape treatment to buffer zones.
- Location and dimension of all off-road bikeways and pedestrian pathways, with trees at 15 metre intervals, showing size and species.
- Location of boundaries to all parkland, reserves and easements, including fencing proposals and details of removable vehicle barriers.
- Location and type of play equipment, if applicable, including type, extent and edge treatment to safety surfacing.
- Proposed lighting.
- Mounding, showing base, crown, levels and gradients.
- Proposed furniture including benches, bins, BBQ's, shade structures, signage.
- Taps, drinking fountains, irrigation couplings.
- Proposed planting and mulched garden beds.
- Irrigation plan at 1:200 scale.

2. Detailed specifications will be required to cover all proposed works including the following:

- Play equipment and safety surfacing.
- Plant schedule.
- Revegetation requirements.
- Grass establishment.
- Mulch.
- Hard landscaping.
- Furniture and lighting.
- Irrigation, if applicable.

AP1.30 EROSION AND SEDIMENT CONTROL STRATEGY

1. The Erosion and Sediment Control Strategy shall include:

- North Point.
- A plan of development showing the road and allotment boundaries.
- Existing surface and finished surface contours at an interval close enough to define terrain. Contours shall extend beyond the limits of the development site to fully define the limits of external catchments.
- Extent of clearing and trees to be removed.
- Line diagram of drain lines and drainage structures.
- The identification and location of all Erosion Prevention and Sediment Control measures (ie catch drains, diversion drains, sediment traps, sediment basins etc.) that are proposed for the period when the site is disturbed.
- Location of sensitive and restricted access areas.
- Existing significant vegetation to be retained.
- Revegetation works.

2. Calculations are to be submitted in accordance with QUDM and based on soil type(s) of the site.

AP1.31 SERVICE PROVIDERS / CONDUIT PLAN INCLUDING STREET LIGHTING

This plan shall include:

- Legend.
- North Point.
- Road Reserve Boundaries.
- Allotment Numbers and Boundaries.
- Kerb and channel or edge of pavement where no kerb is to be constructed.
- Road Crossings Conduits Type and size.
- Location of Pad Mount Transformers.
- Location of Telecommunications Authority's Roadside Cabinets & Shelters and Cables.
- Location of Street Lighting.
- Location of Electricity Authority's Cables and Facilities.
- Lux contours and street light pole details where Electricity Authority's lighting design is not used.
- Gas pipes, valve, syphon points and storage facilities.

AP1.32 STORMWATER CATCHMENT PLAN/DRAINAGE CALCULATIONS TABULATION

1. A catchment plan shall be submitted, for Council submission purposes only and shall not form part of construction documentation.

- North point.
- A plan of the development showing the road and allotment boundaries.
- Existing and finished surface contours (in different line types) at an interval close enough to define the terrain and allow definition of the sub catchments. Contours shall extend beyond the limits of the development site to fully define the limits of external catchments.
- Sub catchment boundaries, labels and areas.
- Line diagram of drainline, manhole, gully and outlet locations.
- Labelling of stormwater structures.
- Adjacent to each Stormwater Pit tabulation is to be provided illustrating the roadway approach flow, the width of approach flow, and the bypass flow.
- Overland flow paths.
- Proposed easements.

2. Stormwater calculations shall be in a spreadsheet format in accordance with the QUDM. This tabulation should include a bypass flow width value at all kerb return pits. Design pipe capacity should also be included in the spreadsheet.

AP1.33 PEST PLANT MANAGEMENT

1. In accordance with the Land Protection (Pest and Stock Route Management) Act 2002 the applicant must not remove soil or any matter containing reproductive pest plant material, and transport such matter to another location. Appropriate measures must be put in place to ensure that soil and other organic materials are not inadvertently (or otherwise) transported to other locations.

2. Prior to the issue of Development Approval for Operational Works, the applicant must:
 - Clearly state if there is an excess amount of soil on the development site.
 - Provide appropriate documentation to show where any excess soil is to be used or placed on the site.
 - Where excess soil is to be removed from the site, the proposed haul route and destination of the material.
 - Provide a plan which indicates where a shake down or wash down area will be placed to ensure that all vehicles entering and exiting the development site are subject to a cleansing procedure to remove soil and any other organic materials.
 - Construct a shakedown or wash down area during the first stage of development. This is not to be in the vicinity of a creek, or a waterway or drain which leads to a creek or other water body.
3. The site must be maintained to the point of sale so that declared weeds are eradicated or controlled.
4. Soil or other matter contaminated with weed seed or organic material should not be used in landscaping, eg buffer mounds.
5. Reference should be made to Council's Catchment Management Services to obtain advice.
6. These conditions relate to all Class 1, 2 and 3 plants identified in the Land Protection (Pest and Stock Route Management) Regulation 2003 (see web site www.nrm.qld.gov.au/pests/legislation/regulation.html). These plants may also be identified by viewing them on the Department of Natural Resources and Mines web site on the "Pest" Fact Sheets, www.nrm.qld.gov.au/factsheets/

AP1.34 MISCELLANEOUS DETAILS

1. Details are required for the following either on separate drawings or appropriate service plan:
 - Stormwater inlet and outlet structures, other than standard head walls.
 - Manhole details where pipe alignments are critical for clearances or flow considerations.
 - Water Quality permanent works structures (SQIDs, sediment basins, trash racks etc.).
 - Details of Erosion Prevention and Stormwater Management Structures.
 - Surcharge structures.
 - Overland drainage paths.
 - Sewer pump stations showing all relevant levels for pumps, etc. (where not provided elsewhere).
 - Footbridges.
 - Reservoirs.
 - Entry structures.
 - Retaining walls.
 - Buildings.
 - Any details or variations from standard drawings.

RECORDS

AP1.35 DESIGN RECORDS

1. The Designer shall provide Council with appropriate design records in a format such that design staff with no prior knowledge of the particular design can understand them readily. Appropriate formats are shown on the standard drawings.
2. For all Works that will ultimately be in the ownership and maintenance responsibility of Council, the Designer shall provide Council with all appropriate maintenance manuals, owners manuals and other data necessary for the ongoing ownership and maintenance of the Works.
3. The Developer is to provide a detailed submission for all structures being built as part of the development, for separate building approval and inspection. Submission is to include detailed design plans and a Structural Certificate from a RPEQ

APPENDIX A

STATEMENT OF COMPLIANCE OPERATIONAL WORKS DESIGN

**WHITSUNDAY SHIRE COUNCIL
STATEMENT OF COMPLIANCE
OPERATIONAL WORKS DESIGN**

This form duly completed and signed by an authorised agent of the Designer shall be submitted with the Operational Works Application for Council Approval.

Name of Development

Location of Development.....

Applicant

Designer

It is hereby certified that the Calculations, Drawings, Specifications and related documents submitted herewith have been prepared, checked and amended in accordance with the requirements of the WSC Development Manual and that the completed works comply with the requirements therein, except as noted below.

Compliance with the requirements of the Operational Works Design Guidelines	Compliance Yes/No	Non-Compliance refer to non-compliance report / drawing number
Plan Presentation		
Geometric Road Design		
Pavements		
Structures / Bridges		
Subsurface Drainage		
Stormwater Drainage		
Site Re-grading		
Erosion Control and Stormwater Management		
Pest Plant Management		
Cycleway / Pathways		
Landscaping		
Water Reticulation		
Electrical Reticulation and Street Lighting		
Associated Documentation/ Specification		
Priced Schedule of Quantities		
Referral Agency Conditions		

Conscientiously believing the above statements to be true and correct, signed on behalf of:

Designer RPEQ No.....

Name in Full

Signature Date.....

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

CP1

CONSTRUCTION PROCEDURES

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

CP1.01 INTRODUCTION

1. This section of these Operational Works Guidelines details the minimum requirements acceptable to the Council associated with developments involving Operational Works defined as any works to be constructed that are subject to Council Approval. Typically, this involves the construction of Water Supply, Sewerage, Stormwater, Roadworks and Public Open Space associated with Development, Reconfiguration or other approvals.

2. This manual does not apply to works or services under the control of other authorities (e.g. works within State controlled road corridor) Separate approvals may be required from the other relevant authorities

3. The section has been divided into four subsections as follows:

- Requirements Prior to Construction
- Requirements During Construction
- Acceptance of Works
- Final Acceptance of Works

REQUIREMENTS PRIOR TO CONSTRUCTION

CP1.02 GENERAL REQUIREMENTS

1. Prior to the construction of any works requiring Council Approval the Designer responsible for the design of the works must first obtain an approval for the drawings and specifications from Council. The procedures to be undertaken in order to achieve approvals are outlined in detail in Section AP1 of this Manual.

CP1.03 CONSTRUCTION INSPECTIONS

1. Prior to construction of the works an Engineer who is a Registered Professional Engineer Queensland (RPEQ) is to be engaged to be responsible for the provision of inspection services in accordance with a Council approved Inspection and Test Plan (ITP) and to exercise reasonable skill and diligence in order to ensure that the operational works requiring approval are executed in accordance with:

- Council's development approval conditions;
- Council's relevant policies and local laws;
- This Manual, Council approved drawings, specifications and relevant Australian Standards;
- Good engineering practice.

2. Inspections may be carried out by the Engineer or a delegate who shall be a suitably qualified/experienced person approved by Council.

CP1.04 INSPECTION AND TEST PLAN – Refer CP1 Appendix A

1. The Engineer is to submit for Council Approval an ITP identifying the following items:

- Element of work;
- Tests and checks required;
- Standard required to meet;
- Frequency of testing;
- Contractor's responsibility;
- Engineer's responsibility;
- Council's responsibility;
- Asset data recording requirements.

2. A summary of Inspection and Test Requirements is attached (**Appendix A**).

3. The Engineer, in undertaking Construction Inspections, shall:

- Allocate competent and experienced staff to site inspection and testing;
- Provide sufficient site presence, dependent on the contractor's progress and workmanship, and in accordance with the Council approved ITP, to be reasonably satisfied that the works meet the design, specification and performance requirements.
- Inspect and confirm acceptability of works prior to requesting a Council inspection.

CP1.05 DOCUMENTATION

1. Associated with the lodgement of the "Application for Operational Works Development Approval", Engineering Plans and Specifications for the works are to be submitted to Council for approval. (The specific requirements for the submission are detailed in Section AP1).

2. Following the issue of operational works approval, any plans that are required to be amended shall be re-submitted with an accompanying letter outlining the amendments and including any necessary calculations or documentation as supporting information.

3. Further, one complete specification shall be issued to Council incorporating any required amendments following the issue of operational works approval.

4. Upon receipts of all amended plans, Council shall issue a complete set of stamped approved plans for operational works.

5. Submissions with a full compliment of supporting documentation will expedite Council's approval time frame.

CP1.06 CONTRACTOR'S EROSION & SEDIMENT CONTROL PLAN

1. Prior to construction commencing the contractor shall prepare an Erosion and Sediment Control Plan (ESCP) to manage the site during construction and the defect liability period.

2. The plan shall be consistent with the approved Environmental Management Plan (EMP) and shall take into consideration the Contractor's proposed construction methodology and program.

3. The Contractor may propose an alternate construction methodology that differs from the approved EMP. In this instance the Contractor shall discuss and obtain approval from both the Engineer and Council for the alternate strategy.

4. The Contractor's ESCP shall be prepared by person or persons meeting the following criteria:

- Six years or more field experience in civil engineering construction practices;
- Educated in erosion prevention and sediment control practice through regular industry sponsored seminars, publications, etc.
- An understanding of Rainfall Hydrology and an ability to calculate rainfall runoff;
- An understanding and ability to calculate open channel flows and velocities.

5. A copy of the Contractor's current approved ESCP is to be retained on site by the Contractor's Representative and presented on demand.

6. The Contractor's ESCP shall be submitted to the Engineer for review and approval prior to the pre-start meeting.

7. The Engineer is to review the ESCP for compliance with the approved EMP. Any amendments required to ensure EMP compliance are to be incorporated by the Contractor prior to approval. A copy of the approved ESCP is to be issued to the Council representatives at the pre-start meeting.

8. It is the Contractor's responsibility to ensure that the ESCP is updated and amended to reflect any changes in the construction methodology and programme.

9. All amendments to the Contractor's ESCP shall be approved by the Engineer and a copy of the revised approved ESCP issued to Council's Representative.

10. The Contractor's ESCP shall consist of the following:

- A layout plan detailing the measures to be employed during construction. On larger sites where works are to be progressively constructed a plan shall be provided for each stage of works;
- A layout plan detailing the measure(s) to remain in place from the commencement of the defects liability period;
- A written description of the sequencing of works or construction program;
- An inspection and test plan for monitoring erosion prevention and sediment control measures during the construction and the defects liability period;
- Details of all Erosion Prevention and Sediment Control measures to be used. The Contractor may adopt standard details developed by others, e.g. Engineers Australia (Qld) "Soil Erosion and Sediment Control – Engineering Guidelines of Queensland Construction Sites";
- The name of the person within the Contractor's organisation who has the authority and responsibility for implementing, monitoring, updating or amending the Plan.

11. The Contractor's ESCP shall address the following issues:

Minimising Disturbance

- Limiting the exposure time and size of disturbed areas to a minimum;
- Allow for the use of existing vegetation as buffer zones;

Control of Run off

- Sizing of structures, channels, catch drain and diversion drains for appropriate storm events;

	Design life	ARI
Non-erosive design capacity	0-6 months	1 year
	6-12 months	2 years
Structural stability	0-6 months	5 year
	6-12 months	10 year

- Diverting clean water runoff around disturbed areas;
- Dividing the site into smaller more manageable drainage areas;
- Early installation of temporary drainage works;
- Early installation of permanent drainage system and protection works;

Erosion Prevention

- Protecting service trenches and hard engineering structures (eg. driveways, kerbs, etc.) from erosion caused by runoff;
- Prompt revegetation of disturbed areas;
- Installing structures in drainage channels to slow flow velocity and encourage settlement of soil particles;

Sediment Control

- Locating stockpiles clear of drainage paths and protecting stockpiles from traffic, runoff and wind erosion;
- Minimising number of site access points;
- Stabilising site access points to prevent vehicles transporting materials off site;
- Intercepting drainage from disturbed areas and installing sediment barriers to slow the velocity of flow and allow fine particles to settle;
- Diverting larger contaminated flows to sediment traps to allow soil particles to settle or be treated prior to release into receiving waters;
- Protecting partially constructed drainage structures from sediment infiltration;

Revegetation

- Progressive stabilisation and rehabilitation of completed works;
- Providing protection to revegetation works on steep batters during establishment period;

Inspection, Clean out and Maintenance

- The inspection, clean out and maintenance regime is to take into account the duration that the site will be disturbed and the timing of construction. If the site is disturbed (i.e. rehabilitation works are not complete) during the period December to May (wet season) a more rigorous inspection, clean out and maintenance regime will be required than for a site, which is disturbed during the period June to November.

12. The following References / Guidelines may assist in preparing the ESCP:

- Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites, Engineers Australia (Queensland), June 1996;
- Queensland Urban Drainage Manual, Edition 1, September 1992;
- Guidelines for the Preparation of Erosion and Sediment Control Plans for Building Sites, Cairns City Council July 2003;
- Brisbane City Council's Water Quality Management Guidelines (Supplement to Council's Subdivision and Operational Works Guidelines), Version 1, Waterways Program, Urban Management Division, Brisbane City Council, 2000;
- Whitsunday Shire Council Erosion Control Fact Sheets.

CP1.07 CONSTRUCTION SECURITY BOND

1. Prior to construction of the works commencing the applicant is required to lodge a security bond in cash or unconditional Bank Guarantee to the value of 5% of the estimated cost of the construction of the works prepared and certified by the Engineer.

2. A bank guarantee should include:

- a) A binding contractual relationship between Council and the guaranteeing bank;
- b) Specific requirements for renunciation of the guarantee;
- c) Require adequate notice of renunciation.

3. The bond is to be accompanied by Council's Security Lodgement Form (**Appendix B**) clearly identifying the purpose of the bond together with the Engineer's certification of the value of the works.

4. The bond is required to provide security to Council in the event that costs are incurred as a result of the following:

- Protection of on-street works from damage by contractors, sub-contractors and suppliers;
- Repairs to on-street works resulting from damage caused by contractors, subcontractors and suppliers;
- Protection and repair of existing Council services (i.e. sewerage connections, water connections etc);
- Non-compliance with the approved Erosion and Sediment Control Plan during construction;
- Failure to provide adequately for traffic;
- Urgent action required by Council to resolve unsafe construction or emergency repairs required to protect persons and/or property from consequential damages.

5. Any costs incurred by Council in responding to the above circumstances will be recovered from the Security Bond.

6. At the completion of the works and the commencement of the Defects Liability period, the construction security bond shall be returned to the developer or may be substituted for the defects liability bond.

CP1.08 NOTICE TO COMMENCE WORK

1. Council requires a minimum of five (5) working days written Notice of Intention to Commence Works. The notice may be forwarded by facsimile or email. Council may relax the minimum Notice requirements however no works will be permitted to commence until the following information is provided:

- Name, address, telephone number (including after hours contact) and email of the Engineer for the works;
- Name, address, telephone number (including after hours contact) and email (where available) of the Contractor(s) and major sub-contractor(s) for the works;

- Name and telephone number of the person to be contacted in regard to any matter arising from the construction of the works;
- Intended date of commencement of works, and contract period;
- An invitation to the relevant Council Officer to attend a pre-start meeting at a time acceptable to all relevant parties;
- A request to Council to confirm that environmentally significant areas and/or trees which are to be preserved in accordance with any Tree Preservation Declaration, have been identified and adequately protected;
- Location of Project Sign (if required).

2. This submission will form official notification of the date of the "Pre-Start" meeting.

CP1.09 PRE-START MEETING

1. After documentation has been approved by Council, a pre-start meeting is to be held onsite prior to the commencement of works. Council requires the attendance of the Engineer, the Contractor's Representative and any relevant Specialist Consultants.

2. Items to be considered at this meeting will include but not be limited to the following:

- Introduction of the Council's representative(s), Engineers(s), Contractor(s) and any other relevant parties ie. Geotechnical Engineers (if required);
- Review of relevant conditions of development approval;
- Review of Council's construction requirements;
- A presentation of the Environmental Management Plan (EMP) by the Engineer;
- A presentation of the Contractor's Erosion and Sediment Control Plan (ESCP) approved by the Engineer;
- A review of the processes for monitoring, compliance assessment and auditing of the ESCP;
- Inspection and identification of parks and environmentally significant areas and/or trees for preservation;
- Site access conditions;
- Identification of areas to be left undisturbed;
- Evidence of compliance with the Workplace Health and Safety Act; including site safety inductions, site safety plans, notifications;
- Review of Inspection and Test Plan including a notice of nominated Hold / Witness points;
- Relevant provisions of any other Acts;
- Provision of Construction Security Bond;
- Evidence of payment of any relevant Council fees and charges;
- Public Liability Insurance;

- Traffic Management Plan;
- Review location of Project Sign (if required).

3. Approval for construction of the works to proceed may be withheld in the event that the following documents are not provided to an acceptable standard:

- Evidence of Public Liability Insurance;
- Contractor's Erosion and Sediment Control Plan;
- Traffic Management Plan;
- Inspection and Test Plan;
- Construction Security Bond;
- Safety Plan;
- All fees and charges have been paid;
- Concurrence agency, neighbouring Authority or landowner consents/approvals have been given.

4. The pre-start meeting is a Hold Point and works may not proceed until the meeting is held and any further requirements identified during the conduct of the meeting are satisfied.

5. Council Officers will not attend site inspections or visit the site until a Site Safety Induction has been undertaken for each Officer.

REQUIREMENTS DURING CONSTRUCTION

CP1.10 GENERAL REQUIREMENTS

1. The general requirements during the construction of the project are as follows:
 - Work may only proceed when Council has been issued with all the "Pre-Start" documentation;
 - No work shall commence on any existing road open to the public unless specifically approved by Council;
 - Any damage to existing services under the control of Council or another Authority must be notified immediately and made good by the relevant Authority at the Contractor/Developer's expense prior to acceptance of the works;
 - Use of Council services, (eg water from existing mains), is subject to approval by Council and payment of appropriate fees;
 - Work involving the use of machinery of any description shall only be carried out on the site 6.30 am to 6.30 pm, Monday to Saturdays, with no work to be carried out on Sundays or Public holidays. (In certain circumstances Council may approve works outside these hours. All applications for changes to working hours must be in writing.)
2. The Developer, Engineer and Contractor shall take all necessary steps, in accordance with the provisions of the Workplace Health and Safety Act, to ensure safety of the public in regard to construction activities. In particular, work on roadways shall be signed in accordance with Queensland Department of Main Roads "Manual of Uniform Traffic Control Devices". Council will require submission of plans indicating traffic control proposals and a program of work for sites involving the travelling public.
3. No public road may be closed and traffic diverted from public roads, or traffic diverted elsewhere without the prior approval of the Council and the District Superintendent of Traffic (if required). Public advertising of the proposed diversion must be carried out. Proposals to divert traffic shall include full details of the alternative route and proposed signing.
4. Works shall not be undertaken on any adjoining private properties without the prior written consent of the relevant registered proprietor. A written acceptance (by the registered proprietor) of the completed works shall be submitted to Council upon finalisation of the works.

CP1.11 PUBLIC NOTICES / PROJECT SIGNAGE

1. Where as a condition of approval, Council requires the posting of a public notice prior to the commencement of works, the developer is required to post a notice in the Public Notices section of the local newspapers advising of the following:
 - Name of developer;
 - Name of the project;
 - Street address of the site;
 - Project managers name and contact detail;
 - Consulting engineers name and contact number;

- Contractors name and contact number;
- Other specialist consultant contact numbers (e.g. geotechnical, landscaping, architects, hydraulic etc).

2. Where as a condition of approval, Council requires a project sign(s) to be erected on the sites' frontages to constructed roads and any other location as required. The sign shall contain the following information:

- An overall concept plan of the development showing the stage or works about to commence construction;
- Name of Developer;
- Name of the Project;
- Street address of the site;
- Project Manager's name and contact number;
- Consulting Engineer's name and contact number;
- Contractor's name and contact number;
- Other Specialist Consultants (geotechnical, landscaping, architects, hydraulics etc) names and contact numbers.

3. Material and size of the sign shall be as follows:

- Made of a weatherproof material;
- Not less than 1200mm x 900mm.

4. Position of the sign on the land:

- The sign must be place on, or within 1.5m of, the road frontage of the land;
- The sign must be mounted at least 300mm above ground level;
- The sign must be positioned so that it is visible from the road.

5. The lettering on the sign:

- Each item listed above must start on a new line;
- The minimum lettering height shall be 50mm in height.

CP1.12 DOCUMENT CONTROL

1. A copy of the approved Project Drawings and Specification shall be kept on the job site at all times during construction.

2. Should amendments be required to Engineering Plans and/or Specifications during construction, the Engineer shall ensure that Council is in receipt of two (2) copies of all amended drawings and/or specifications. Council shall stamp these plans for approval as operational works plans and return one copy to the Engineer.

3. Any amended drawings and/or specifications shall be submitted with an accompanying letter outlining the amendment together with any supporting information.

4. Submissions with a full compliment of supporting documentation will expedite Council's approval time frame.

5. All amendments shall be issued to Council for acceptance prior to the works being undertaken.

CP1.13 EROSION PREVENTION AND SEDIMENT CONTROL

1. The Engineer shall ensure that the construction contract contains provisions requiring the Contractor to implement the approved Environmental Management Plan and to prepare and implement an Erosion and Sediment Control Plan complying with the approved Strategy.

2. The Contractor shall ensure that all reasonable measures are taken to protect nearby properties from dust pollution, erosion, siltation and/or sediment transport.

3. Council reserves the right to order whatever action deemed necessary and appropriate at the time, including ordering temporary cessation of work in extreme cases.

4. As Erosion Prevention and Sediment Control is also an issue of public amenity and safety, the developer shall be responsible for any costs arising from dust or water pollution generated by its development.

CP1.14 NOISE

1. The requirements of the Council's local laws regarding Noise Nuisances (if applicable) shall apply to the development works.

CP1.15 PARKS & ENVIRONMENTALLY SIGNIFICANT AREAS

1. In cases where the subject land or the adjacent land is an existing or proposed Park, Bushland Reserve, declared Tree Preservation area, or area otherwise declared by Council as environmentally significant, the following general precautions shall be mandatory:

- The areas shall be clearly pegged, flagged (and fenced if ordered by Council), inspected and approved by Council Officers at the pre-start meeting;
- The approved design, or Certificate of Approval for tree clearing issued pursuant to tree preservation Local Law (if applicable), shall have identified any unavoidable intrusion into such areas and nominated work practices such as maximum widths of disturbance, nominated access routes, methods and timing of rehabilitation, which shall be strictly adhered to.

2. Council shall be notified immediately the Engineer is aware of any damage or disturbance beyond the approved limits. Rehabilitation of this damage or disturbance shall be to the satisfaction of Council.

CP1.16 INSPECTION AND TESTING

1. During the construction phase, the Engineer shall be responsible for undertaking the minimum number of required inspections and tests in accordance with the approved Inspection Test Plan (ITP). Refer CP1 Appendix A

2. The approved Inspection and Test Plan is to be implemented and certification that the plan has been followed is to be submitted with the "As Constructed" documentation.

3. Council will, on a random basis, call upon the Engineer to provide evidence of conformance with the approved ITP in the form of diary records, site visit reports etc.

4. During construction, Council reserves the right to conduct audit inspections of any or all of the works without prior notification.

5. Where any non-compliance is observed by Council officers, Council officers may request inspection of any other similar works to check for compliance of these elements.

5. Council requires a number of major inspections that are mandatory Hold Points for the Engineer and Hold Points or Witness Points for Council to be included in the ITP. These are:

- **Earthworks**

- Upon completion of Survey to define road centrelines and the limit of clearing;

- **Roadworks**

- Prior to placement of fill for embankments;
- Subgrade on completion of trimming and removal of soft spots;
- Kerb and Channel/Kerb foundations;
- Subbase on completion of final preparation;
- Base on completion of final preparation;

- **Concrete**

- Foundations prior to placing forms, reo etc.;
- Formwork complete prior to pouring concrete;

- **Stormwater –**

- Prior to culvert/pipe placement after bedding sand;
- Prior to backfill;

- **Water**

- After excavation prior to placement of bedding sand;
- Insert water service connections to existing mains – Prior to pouring concrete for thrust blocks, bends and vertical offsets etc.;
- Visual inspection prior to backfill;
- Anchor blocks prior to backfilling;
- Water service connection prior to backfilling;
- Pressure testing;

- **Sewer**

- After excavation and prior to placement of bedding sand;
- Visual inspection prior to backfill;
- Manholes prior to and after benching;
- Hydrostatic testing.

CP1.17 APPLICATION FOR COUNCIL TO COMPLETE PRIVATE WORKS

1. Unless otherwise approved, Council requires any connections and alterations to Council's live sewer or water mains associated with developments to be completed by the contractor and witnessed by a Council officer.

2. Sewer and water mains are considered to be live once the Defects Liability period has commenced. All work on live sewers and water mains must be carried out by the contractor and witnessed by a Council officer.

3. Alterations to existing Council sewer and water mains, resulting from the development (including cutting in of new sewer house connections), are to be completed prior to

commencement of the Defects Liability period. This is normally handled in the Decision Notice Approval.

4. Where Council is requested to undertake the works, and Council staff are available for this purpose, the procedure shall be as follows:

- Application should first be made in writing. The nature and extent of works shall be clearly identified on copies of the approved plans submitted with the application;
- Council will require payment based on a Council quotation before the work commences.

CP1.18 APPLICATION FOR APPROVAL TO DRAW WATER FROM COUNCIL MAINS

1. The drawing of construction water from Council's mains must be approved and the relevant fees paid in advance. Application for approval should be made, on the prescribed form. The attached form shall include Council's endorsements on the form that the relevant fee has been paid.

2. Permission to draw water shall be subject to the following conditions:

- Backflow prevention;
- Water may only be taken between the hours of 8.00am and 4.30pm;
- Must be through a metered connection or metered standpipe;
- The approval shall be limited to the days and dates nominated in Council's notice of approval;
- Water may only be taken from the approved hydrant point;
- A copy of this approval is to be held by the driver of any vehicle taking water covered by this approval;
- Council may withdraw this approval at any time. Such notice shall be in writing and will become effective immediately;
- The applicant is responsible for the cost of the reinstatement of damages to Council property caused by the taking of water covered by this permit.

ACCEPTANCE OF WORKS

CP1.19 INTRODUCTION

1. For works requiring Council approval, a Defects Liability period is a period of twelve months minimum after the works have been accepted as complete by Council. During the Defects Liability Period, it is the responsibility of the Developer to rectify any works found to be defective due to design faults or found to exhibit faults attributed to the performance of the construction activities in terms of quality and conformance with the design and specifications.

2. The following are required to be completed prior to Council's acceptance of works:

- Completed "As Constructed" submission lodged with Council a minimum of five (5) working days prior to the "Works Acceptance" Inspection or early plan sealing inspection for bonding or uncompleted works and being to Council satisfaction;
- Satisfactory "Works Acceptance" Inspection;
- All appropriate documentation to be completed by the Engineer and submitted to Council for records purposes. This consists of the "Works Acceptance Inspection Checklist" (**Appendix D**), the certified "Inspection and Testing Plan" and all test results and records for the works;
- Approval has been given by Council for construction of buildings/structures.

3. Following the satisfactory completion of all of the above matters, the Engineer shall make a written request for acceptance of the works and commencement of the Defects Liability period and release of any uncompleted works bond held.

CP1.20 DEFECTS LIABILITY BOND

1. Council requires a bond, in an amount of 5% of the value of the works, which is kept for the period of twelve months or until the works are finally accepted.

2. The bond is to be submitted with Council's Security Lodgement Form (**Appendix B**) clearly identifying the purpose of the bond together with the Engineer's certification of the value of the works.

3. The Construction Security Bond lodged prior to construction may be used for the purposes of the Defects Liability bond subject to Council's approval.

CP1.21 "AS CONSTRUCTED" SUBMISSION

1. "As Constructed" documentation serves two distinct functions:

- Checking: To enable a quantitative check of the "As Constructed" works against the approved design, so as to ensure design philosophies and criteria have been achieved;
- Recording: To provide an accurate record of the "As Constructed" services.

2. Information required for the checking function must be presented in a form which allows ready comparison between design and "As Constructed" data by experienced engineering staff, whereas information required for the recording function must be presented in a form which allows ready and unambiguous interpretation and understanding by a wide range of users including engineers, maintenance and tradespersons, and the general public.

3. "As Constructed" documentation in accordance with these requirements is essential in order to achieve acceptance of development works and commencement of the Defects

Liability period and is required to be forwarded to Council a minimum of five (5) working days prior to the "Works Acceptance " inspection or early plan sealing inspection for bonding of uncompleted works.

4. The following items must be submitted as part of the "As Constructed" submission:

- Compliance / Certifications;
- Operation and maintenance manuals (where applicable);
- "As Constructed" drawings;
- Any necessary information required for Councils asset management records;
- Copy of approved design plans for buildings/structures and copy of Structural Certificate.

CP1.22 COMPLIANCE / CERTIFICATIONS

1. All "As Constructed" works (with the exception of the Sewerage House Connection branches) must be surveyed by a Registered Surveyor (Consulting), who shall certify the details upon completion of the project. The certification must note that the "As Constructed" survey data represents the true and accurate location of the relevant construction element presented in the data, relative to all appropriate survey datums. (i.e. the exact location in space of each construction element/entity). The Registered Surveyor's (Consulting) certification must accompany the "As Constructed" submission to Council. An example of an acceptable Registered Surveyor's (Consulting) Certification is attached. (**Appendix G**)

2. Council accepts the submission of "As Constructed" information for the location of House Connection Branches documented by the Contractor during the construction phase providing the Contractor completes the standard form (**appendix H**) for "Sewer House Connection Branches - As Constructed". This enables the Contractor to expedite the backfilling of these fixtures and will minimise "open excavations" awaiting final survey. This information shall be documented on the "As Constructed" Sewerage Plan and shall reference the Contractor's field notes used to document the "As Constructed" information.

3. All "As Constructed" works must also be certified by the Engineer responsible for design of the works. The certification must note that the design intent and function of the proposed works have not been compromised by the constructed works. To this extent, the Engineer will be responsible for checking the "As Constructed" details so that the tolerances for construction are within specified limits.

4. It is recognised that in some circumstances, the tolerances for construction are exceeded. In these instances, the Engineer will be responsible for performing confirmation design calculations to ensure that the original design intent and function are not compromised.

5. Further, should the "As Constructed" details indicate a change to the design intent or function of the works, revised design calculations shall be provided by the Engineer to indicate the acceptability of the proposed change relative to Council's requirements. Council's approval of the change is required prior to the formal acceptance of the works.

6. The Engineer shall be responsible for the completion of the "Statement of Compliance – As Constructed works, which satisfies the requirements for Certification. (**Appendix F**)

CP1.23 OPERATION AND MAINTENANCE MANUALS

1. Where works comprise pump stations, reservoirs, treatment plants etc., Operations and Maintenance Manuals for all components of the works shall be provided. Operating and Maintenance Manuals shall include spare parts lists, electrical documentation and any other relevant information.
2. Maintenance Manuals and procedures are also required for drainage structures which incorporate Gross Pollutant Traps, interceptor devices or other water quality measures. The Maintenance procedures should indicate recommended frequencies for maintenance/cleaning functions in wet and dry seasons.

CP1.24 "AS CONSTRUCTED" DRAWINGS

1. Council requires "As Constructed" Drawings to be produced using "AutoCAD" Software and submitted in DWG or DXF format. No drawing sheets or title blocks shall be used on the file.
2. All "As Constructed" Drawings shall be prepared on MGA 94 projection Zone 55 coordinates.
3. All levels data on "As Constructed plans shall be to Australian Height Datum (AHD).
4. In addition to this, a hard copy Tracing and two (2) hard copy prints should be produced for each service on the consultants drawing sheets to accompany the Electronic Data. These hardcopy Tracing shall be prepared according to the following scales and sheet sizes:-
 - Stormwater Drainage - 1: 500 (A1 Sheets)
 - Sewerage - 1: 500 (A1 Sheets)
 - Water - 1:500 (A1 Sheets)
5. Detailed "As Constructed" Tracings of all Sewerage and Water Pump Stations, Treatment Plants and Reservoir Sites at 1:200 shall also be provided.
6. Electronic Data shall be supplied on a CD or by e-mail.
7. The "As Constructed" Drawing may be prepared by either the Engineer or the Registered Surveyor (Consulting) but must comply with the requirements presented herein.
8. Survey accuracy to be metres to three decimal points
9. The AutoCAD Drawing shall be a single drawing containing five (5) main elements:
 - Cadastral Base – showing property boundaries and easements;
 - Topographical Features – including kerbing/edge of seal, top and toe of batters, change of grades, retaining wall, watercourses, structures etc.;
 - Water - showing offsets from boundary, connection points, main size, valves, hydrant locations to property boundaries etc.;
 - Sewerage - showing pipe invert levels, pipe diameter and grades, cover levels, location to property boundary, distance from downstream manhole to HCB's, HCB's levels and type;
 - Stormwater Drainage - showing pipe invert levels, pipe diameter and grades, pipe material, finished surface levels, drainage structure description, catch drains, open drains/swales etc.

CP1.25 DRAFTING REQUIREMENTS (“AS CONSTRUCTED”)

1. The general drafting requirements for the preparation of "AutoCAD" drawings shall be as detailed in this section. Any elements encountered in the preparation of these drawings not specifically covered by this manual shall be confirmed with Council's Asset Management Section prior to submission of drawing file. A digital file of Council's linetypes, layers and blocks will be made available.
2. All symbols and line types to be as per Department of Main Roads – Standards for the provision of Road Transport Infrastructure Surveys.
3. All colours are to be by layer
4. All linetypes are to be by layer
5. All other colours to have a pen width of 0.25. In the plot style table the colour setting for colour numbers 1 to 10 and 30 is to be black. For all other colours, the colour setting is to be as per the object colour.
6. AutoCAD layer names shall be in accordance with Table CP1.2.

Table CP1.2 Layering Standards

Description of Layer	Annotation	AutoCAD Layer	AutoCAD Linetype	AutoCAD Colour Index
2.0 mm high text	2.0 mm	020_TXT	Continuous	9 (light grey)
2.5 mm high text	2.5 mm	025_TXT	Continuous	7 (white)
3.5 mm high text	3.5 mm	035_TXT	Continuous	2 (yellow)
5.0 mm high text	5.0 mm	050_TXT	Continuous	1 (red)
7.0 mm high text	7.0 mm	070_TXT	Continuous	5 (blue)
10.0 mm high text	10.0 mm	100_TXT	Continuous	30
Contours	N/A	CONTOUR	Continuous	8 (dark grey)
Contour heights	2.0 mm	CONTOUR_HEIGHT	Continuous	9 (light grey)
Boundary	N/A	BNDY	Continuous	3 (green)
Easement Boundary	N/A	BNDY_EASE	Dashed	3 (green)
As Constructed Water Supply	N/A	WATER_MAINS	-W---W-	5 (blue)
As Constructed Water Supply (Services)	N/A	WATER_SERVICES	-W---W-	4 (Cyan)
As Constructed Water Supply (Symbols)	N/A	WATER_SYMBOLS	Continuous	2 (yellow)
As Constructed Sewerage	N/A	SEWERAGE_MAINS	-S---S-	1 (red)
As Constructed Sewerage (Symbols)	N/A	SEWERAGE_SYMBOLS	Continuous	3 (green)
As Constructed Sewerage (House Branches)	N/A	SEWERAGE_BRANCHES	-S---S-	1 (red)
As Constructed Stormwater	N/A	STORMWATER	-D---D-	6 (magenta)
As Constructed Above Ground Electricity	N/A	ELECTRIC_ABOVE	-E-E-	220
As Constructed Underground Electricity	N/A	ELECTRIC_UNDER	-E---E-	220
As Constructed Aboveground Telecommunication	N/A	TELECOM_ABOVE	-T-T-	133
As Constructed Underground Telecommunications	N/A	TELECOM_UNDER	-T---T-	133
As Constructed Above ground Optical Fibre	N/A	OPTIC_ABOVE	-OF-OF-	133
As Constructed Underground Optical Fibre	N/A	OPTIC_UNDER	-OF---OF-	133
As Constructed Fuel Line	N/A	FUEL_LINE	-F---F-	44
As Constructed Gas Line	N/A	GAS_LINE	-G---G-	23
Water Supply Text	2.5 mm	WATER_TXT	Continuous	7 (white)

CP1.26 PROJECT DOCUMENTATION

1. Development works will not be accepted until the following documentation has been certified as being completed by the Engineer and assembled and retained as a part of the project documentation within the Engineer's record storage facilities. A complete copy of this data shall be provided to Council prior to the acceptance of the works.

The data comprises:

- Inspection and Testing certification by the Engineer(s);
- "Works Acceptance" Inspection Checklist and copies of Council's Inspection certificates;

2. Copies of all test results shall be retained for all tests required to conform to Council's Standard Specifications. While not a complete listing, the following details some major components to be included:

- Fill compaction test results;
- Subgrade CBRs;
- Subgrade replacement material quality, thickness and locations; *
- Subgrade replacement material compaction test results; *
- Subsoil drain filter media quality statements (or gradings where required);
- Subbase course and base course material quality statements and thicknesses;
- Subbase course and base course compaction test results;
- Prime or primer seal spray and application rates;
- AC core test results;
- Sewer pressure test records;
- Grading to sewer bedding quality statements;
- Grading to water main bedding quality statements;
- Water main pressure test records;
- Any concrete testing required by the technical specifications;
- Pipe work material quality statements for all pipe work material (water, sewer, stormwater, etc.);
- Geofabric material quality statements;
- Any other testing results or statements required to conform with Council's Standard Specifications;
- Any other job specific testing carried out or ordered by the Engineer, if used.

** Where required to be used.*

3. Should any of the above test results fail to meet specification the Engineer shall include in the submission, details of retesting/rectification carried out.

4. The documentation should be presented in a logically assembled and bound document including a table of contents confirming completeness.

CP1.27 "ON MAINTENANCE" INSPECTION

1. The "On maintenance " inspection requires attendance by:

- The Engineer for the project;
- The Contractor;

- Council's nominee/s.
2. It is the responsibility of the Contractor and the Engineer to ensure the necessary requirements of the works are to an acceptable standard (as defined in approved design and construction documentation) prior to the conduct of a "On maintenance" inspection.
 3. The general requirements to be met prior to Council's "On maintenance" inspection of the works are as follows:
 - The site is clean, tidy, free of rubbish, rocks, sticks, unauthorised stockpiles, etc;
 - Allotment earthworks and site grading to be free draining and in accordance with the approved Design
 - Relevant Erosion and Sediment Control measures are in place
 - Integrity of environmentally significant areas is maintained
 - Defects Liability Bond lodged
 - Building approval for all buildings/structures
 4. Prior to requesting a "Works Acceptance" inspection, the Engineer is responsible for confirming:
 - That the approved works have been completed
 - Any non-compliant issues or defects noted during the construction process, have been rectified to Council satisfaction
 - The above listed items are in accordance with the approved drawings, Council's technical specifications and accepted engineering and landscaping practice. Failure to do so may result in cancellation of the inspection and/or the incurring of a reinspection fee.
 5. Further to the above, and prior to the "Works Acceptance" inspection, the Engineer shall be responsible for the completion of the "Works Acceptance" Inspection Checklist (**Appendix D**) as appropriate to the works being constructed.
 6. The completed checklist shall be presented to the relevant Council Officer prior to the "Works Acceptance" inspection. Council Officer will not undertake a detailed check of all items raised in the checklist, but will examine some aspects of the works on an audit basis. The original of the completed checklist shall be retained with the records for the project upon completion of the works.

CP1.28 BONDING OF UNCOMPLETED WORKS

1. For subdivision works Council may, at its discretion, approve the bonding of uncompleted works to enable early sealing of survey plans.

The council may only consider the lodgement of a bond for the following matters:

Landscaping:

Where minor landscaping works are required to bring the landscaping requirements of a subdivision approval to completion. Such landscaping works are not to include major earthworks or provision of associated infrastructure (i.e. footpaths, drainage, built structures including walls, buildings, fences, lighting or the like). Outstanding landscaping works are not to exceed a value of \$50,000 or 10% of the overall estimated cost of completing the entire landscaping works, whichever is the lesser amount.

Streetscaping:

Where minor streetscaping works are required to bring any streetscaping requirements to completion of any development or subdivision approval. Such works are not to involve any significant earthworks or provision of drainage, water, sewer, road or footpath, cycleway infrastructure. Such works can include lighting bollards, signage, seating and the like. Such outstanding works are not to exceed 10% of the cost of the overall streetscaping requirements, or a maximum value of \$50,000, whichever is the lesser amount.

Internal Roadworks

The Council will only consider acceptance of bonds for the completion of minor outstanding roadworks involving the final completion and sealing of minor sections of the internal roadwork, which are requirements of a Development Approval condition, where it can be demonstrated that:

- i) Subsequent construction phases may cause damage to the sealed road;
- ii) Completion of the road (sealing) can be achieved within three (3) months of requesting the release of a relevant Plan of survey;
- iii) The outstanding works account for no more than 10% of the overall cost of required roadworks and do not exceed a value of \$50,000, whichever is the lesser amount.

The Council will not accept bonds for incomplete works associated with the provision of water, sewer, drainage or external roadworks (i.e. intersection upgrades or road widening).

Bonds are required to be paid in accordance with the provision of the Council's Development Manual (i.e. 1.5 times the estimated cost of required works).

The requirement for an 'on maintenance' bond in accordance with Council's Development manual is a separate bonding arrangement and is in no way associated with the outstanding works bond as outlined in this policy.

In this regard where outstanding works are estimated to cost \$50,000 (i.e. the maximum allowed amount), the applicant will be required to lodge a bond to the value of \$75,000.

3. Upon confirmation that the above matters have been completed, the Applicant or Engineer shall submit the following to Council.

- Security Lodgement Form (**Appendix B**) to be completed clearly indicating that the purpose of the bond is for uncompleted works.
- Fully priced schedule of outstanding works including the cost of preparation of the "As Constructed" submission.
- Unconditional Bank Guarantee to the value of 1.5 times the estimated value of the uncompleted works as certified by the Engineer. A bank guarantee should include:
 - a) A binding contractual relationship between Council and the guaranteeing bank.
 - b) Specific requirements for renunciation of the guarantee.
 - c) Require adequate notice of renunciation.
 - Certification from the Engineer, that the works on each allotment have reached a stage acceptable to Council and that the outstanding works are programmed for completion within 90 days.

- All bonds submitted shall be clearly identified as to the particulars of the site and, the purpose of the bond.
- "Contribution Payment" Form to be completed clearly noting all required contributions associated with the Development.

4. Subject to its discretion Council may require an Uncompleted Works inspection to ensure that the on-allotment works and all associated documentation have been completed to Council's satisfaction. Should an inspection be required Council will require seven (7) days notice and payment of the required inspection fee in advance of any inspection.

5. Council's policy titled "Lodgement of bonds for outstanding works associated with subdivision approvals (19th November 2004) shall apply to all requests for bonding of uncompleted works.

CP1.29 SEALING OF PLAN OF SURVEY

1. Where operational works are associated with the reconfiguration of land or creation of new titles the Applicant is required to submit plan of survey which accords with the proposal plan approved by Council, suitable for deposit in the office of the Registrar of Titles and duly certified by a Registered Surveyor (Consulting), together with 4 copies of the plan, and a completed application form for sealing of final plan of survey within 2 years from the date of approval of engineering drawings and specifications for subdivisions involving works.

2. Where the survey plans differ from the approved proposed plan details of any changes are to be provided with the application.

3. The application form and plans, certificate(s) of compliance for any water and sewer reticulation, together with the relevant fee are to be lodged with Council.

4. Upon being satisfied that the plan of survey conforms with the approval granted, and all required works have been carried out, or adequate security in accordance with Council's policy for bonding of uncompleted works is provided and all outstanding rates, contributions and charges have been paid, Council will note its approval under seal on the plan of survey and return the plan of survey to the Applicant for lodgement in the Titles Office.

5. The Applicant is required to submit the plan of survey to the Titles Office within 6 months of Council sealing the plan. Failure to do so will require the plan of survey to be resubmitted to Council for resealing.

FINAL ACCEPTANCE OF WORKS

CP1.30 "OFF MAINTENANCE" INSPECTION

1. The "Off maintenance" inspection will generally confirm the matters raised in the "Off maintenance" Inspection checklist (**Appendix E**) and any other matters outstanding relevant to the works. The Checklist is to be completed by the Engineer prior to the conduct of the "Off maintenance" Inspection. Failure to do so may result in cancellation of the inspection and/or the incurring of a reinspection fee.

CP1.31 GENERAL REQUIREMENTS

1. During the defects liability period, it is the responsibility of the Developer to rectify any works found to be defective or found to exhibit faults attributed to the design of the works and/or the performance of the construction activities in terms of quality and conformance with the design and specifications.
2. Once a period of twelve months minimum has elapsed from Council's "Works Acceptance", a "Final Acceptance" inspection is to be arranged with Council. Payment of an appropriate Inspection Fee may be required
3. The "Final Acceptance " inspection is to be attended by:
 - Council's nominee/s.
 - The Engineer for the project.
 - The Contractor.
4. The Engineer for the works shall be responsible for ensuring that Council's requirements for acceptance of the works are satisfied prior to requesting a Final Acceptance inspection.
5. Council's requirements for acceptance of the works comprise the following:-
 - No outstanding payments are due to Council or other Authorities from the development
 - Completion of the "Final Acceptance " Inspection Checklist (**Appendix E**)
 - Satisfactory "Final Acceptance " Inspection by relevant Council Officers.
6. Following a satisfactory "Final Acceptance" inspection, the Engineer shall submit a written request to Council for "Final Acceptance" of the works and release of the Defects Liability bond. Council will, upon confirmation that no outstanding payments arising from the development are due to Council, confirm acceptance of the works, and arrange for the release of the Defects Liability bond.

APPENDIX A

INSPECTION AND TEST

REQUIREMENTS

Elements of Work	Engineer's Responsibility	Council's Responsibility
Clearing and Grubbing	HOLD POINT Upon completion of survey, inspect defined limits of clearing.	WITNESS POINT Joint inspection of defined limits and tree removal if considered warranted.
Location		
Allotment Filling	Examine and assess all test results.	Visit site for random audit inspections if considered warranted.
Quality of Material		
Compaction		
Alignment		
Subgrade	Routinely visit site. HOLD POINT Attend during proof rolling. Examine and assess all test results and cross section geometry.	Visit site for random audit inspections HOLD POINT Joint inspections during proof rolling.
Compaction		
CBR Tests (if ordered)		
Horizontal and Vertical Alignments		
Profile		
Subgrade Replacement	Make sufficient routine visits to assess quality of materials and that operations will achieve a sound compacted layer Examine and assess all test results.	Visit site for random audit inspections if considered warranted.
Material Quality		
Compaction		
(a) For on site material		
(b) For graded material		
Profile & Depth		
Building/Structures	Ensure Council Approval of all building/structures	Inspect and ensure compliance

Elements of Work	Engineer's Responsibility	Council's Responsibility
Sub-base Layer Material Quality Compaction Profile & Depth	Routinely visit site. HOLD POINT Attend during proof rolling. Examine and assess all test results and cross section geometry.	Visit site for random inspections if considered warranted
Base Layer Material Quality Compaction Horizontal and Vertical Alignments (a) With no Kerb & Channelling (b) With Kerb & Channelling Profile	Routinely visit site. HOLD POINT Attend during proof rolling Examine and assess all test results and cross section geometry.	Visit site for random audit inspections HOLD POINT Joint inspections during proof rolling.
Surfacing Material Quality Compaction and Thickness Horizontal & Vertical Alignments Profile	HOLD POINT Undertake a Pre-seal Inspection.	Visit site for random inspections if considered warranted

Elements of Work	Engineer's Responsibility	Council's Responsibility
Subsoil Drains Pipe Filter Material Cleaning Joints and Markers Geofabric	Routine inspections of Contractors Performance and progress of works.	Visit site for random inspections if considered warranted
Kerb and Channel Material Quality Horizontal & Vertical Alignments	HOLD POINT Inspect foundations prior to kerb placement Inspect completed kerb. Water test where appropriate.	Visit site for random inspection if considered warranted.
Road Crossing Conduits Location Markers	Routine inspections of Contractors Performance.	Visit site for random inspection is considered warranted.
Stormwater Drainage Location of Structures SL & IL at Structures Material Quality (Bedding, Concrete, Pipes) Manholes Drain lines Backfilling	Sufficient visits to assess compliance and to view progress and works.	Visit site for inspection prior to backfilling.

Elements of Work	Engineer's Responsibility	Council's Responsibility
<p>Landscaping</p> <p>Grass establishment Tree Planting Irrigation (a) Pipelines (b) Pressure Testing Pipelines (c) Performance Testing</p>	<p>Routine inspections of Contractors Performance. Confirm all affected areas are topsoiled, grassed and maintained.</p>	<p>WITNESS POINT Witness and approve pressure test. WITNESS POINT Witness and approve performance test. Visit site for check at defects liability inspection.</p>
<p>Soil and Water Quality</p>	<p>HOLD POINT Examine and approve contractors ESCP for compliance with ESCS. Randomly audit and inspect ESC measures for compliance with contractors ESCP.</p>	<p>Visit site for random inspection if considered warranted. Ensure compliance with Council's local laws and EPA requirements.</p>
<p>Sewerage Reticulation</p> <p>Location MH's & HC's IL at MH & HC's Material Quality (Bedding, Concrete, Pipes) Manholes & Benching Pipelines Backfilling Pressure Testing Pipelines Hydrostatic Testing of Manholes</p>	<p>Routine inspections of Contractors Performance. Assess all test results. HOLD POINT Witness pressure test of lines and hydrostatic testing of manholes. Mirror all lines.</p>	<p>Visual inspection of lines prior to backfill. HOLD POINT Witness and approve pressure test of lines and hydrostatic testing of manholes. Audit inspections to mirror some lines only.</p>

Elements of Work	Engineer's Responsibility	Council's Responsibility
<p>Water Reticulation</p> <p>Location RP Boundary Set Out Valves, Hydrants, Scours, Bends Depth Material Quality (Bedding, Concrete, Pipes) Pipelines Backfilling Pressure Testing</p>	<p>Routine inspections of Contractors Performance. Assess all test results. HOLD POINT Witness pressure test of lines.</p>	<p>HOLD POINT Witness and approve pressure test of lines. Visual site inspection prior to backfill and line sterilisation.</p>

Elements of Work	Engineer's Responsibility	Council's Responsibility
Prior to Acceptance of works for "Defects Liability Period"	<p>Forward "As Constructed" submission to Council with Registered Surveyors (Consulting) and Engineers certification attached.</p> <p>Finalise all other Documentation in accordance with Construction Procedures.</p> <p>Complete "Defects Liability" Inspection Checklist prior to joint inspection with Council</p>	<p>Council to accept and conduct Audit checks of As Constructed Drawings and advise any requirements.</p> <p>Council Inspector to accompany Consulting Engineer and Contractor and to advise any requirements.</p> <p>When completed advise in writing of acceptance of works for commencement of "Defects Liability Period"</p>
During "Defects Liability Period"	<p>Consulting Engineer to confirm all minor omissions and defects have received suitable attention and to examine and approve site prior or asking for "Final Acceptance of works" Inspection</p>	<p>Council to advise Consulting Engineer of any defects</p>
Prior to Final Acceptance of works.	<p>Consulting Engineer to accompany Council Inspector and to note any requirements</p>	<p>Council Inspector to accompany Consulting Engineer and Contractor and to advise any requirements.</p> <p>When completed advise in writing of final acceptance of works.</p>

Construction Activity	Verification Requirement - Test Description	Test Method	Test Frequency	Specification	Minimum Number Of Tests
Subgrade	Subgrade Evaluation - CBR	Q113C (soaked)	1/subgrade material type	97% MDD 100% OMC	n/a
	Compaction - relative dry density	Q111A/B/C or AS 1289.5.4.1 or AS 1289.5.7.1	1/1000m ² as above as above	97% SRDD	3
	Compaction - moisture/density relationship	Q110A or AS 1289.5.1.1 or AS 1289.5.7.1	1/relative dry density as above as above		n/a
Pavement Layers	Material Quality - manufacturers test results	All materials shall be sourced from a Quality Assured material supplier and the results of the manufacturer's testing to assure quality of the product shall be incorporated with the Contractor's quality records		MRS11.05 Section 7.2 "Type 2 Unbound Material"	
	Compaction - relative dry density	Q111A/B/C or Q112 or AS 1289.5.4.1	1/500m ² 2/500m ² 1/500m ² (2/500m ² if using AS1289.5.8.1)	100% SRDD	4 8 4 (8)
	Compaction - moisture/density relationship	Q110A or AS 1289.5.1.1 or AS 1289.5.4.2	1/material type/5000m ² as above as required		n/a

Construction Activity	Verification Requirement - Test Description	Test Method	Test Frequency	Specification	Minimum Number Of Tests
Culvert Excavation	Compaction - relative dry density	Q111A/B/C or AS 1289.5.4.1 or AS 1289.5.7.1	1/50m ² as above as above	95% SRDD	1
	Compaction moisture/density relationship	-Q110A or AS 1289.5.1.1 or AS 1289.5.7.1	1/relative dry density as above as above		n/a
Culvert Bedding/Haunch (RCP, RCBC or similar)	Material Quality - grading, linear shrinkage	Q103A or AS 1289.3.6.1 Q106 or AS 1289.3.4.1	1/material type as above as above as above	Table 20 MRS11.04	n/a
	Compaction - relative dry density or density index	Q111A/B/C or AS 1289.5.4.1 Q132B or AS 1289.5.6.1	1/side/barrel as above as above as above	95% SRDD (Cohesive) 65% I _D (Cohesionless)	2
	Compaction moisture/density relationship or min/max dry density	-Q110A or Q132A AS 1289.5.1.1 or AS 1289.5.5.1	1/material type as above as above as above		n/a
Culvert Backfill (RCP, RCBC or similar)	Material Quality - grading, linear shrinkage	Q103A or AS 1289.3.6.1 Q106 or AS 1289.3.4.1	1/material type as above as above as above	Table 17 MRS11.04	n/a
	Compaction - relative dry density	Q111A/B/C or AS 1289.5.4.1 or AS 1289.5.7.1	1/side/500mm lift/barrel as above as above	>0.3m below pavement subgrade - 95% SRDD <0.3m below pavement subgrade - 97% SRDD	2
	Compaction moisture/density relationship	-Q110A or AS 1289.5.1.1 or AS 1289.5.7.1	1/material type as above 1/field density		n/a

Construction Activity	Verification Requirement - Test Description	Test Method	Test Frequency	Specification	Minimum Number Of Tests
Culvert Backfill - Stabilised Sand	Material Quality	Stabilised sand shall comprise sand meeting the requirements of Table 19 MRS11.04 in an intimate mixture of 12 parts sand and 1 part of either Type GP or GB cement		Table 19 MRS11.04	
Culvert Bedding/haunch/ Backfill/Overlay (Buried Metal Corrugated Structures)	Material Quality	All materials shall be in accordance with the manufacturer's recommendations. Evidence of these recommendations and subsequent compliance shall be incorporated with the Contractor's quality records		As per manufacturer's recommendations	
	Installation	Installation shall be in accordance with the manufacturer's recommendations. Evidence of these recommendations and subsequent compliance shall be incorporated with the Contractor's quality records		As per manufacturer's recommendations	
Backfill - in place structures other than culverts	Material Quality - grading, plastic index	Q103A or AS 1289.3.6.1 Q105 or AS 1289.3.3.1	1/material type as above as above as above	100% < 50mm $2 \leq I_p \leq 12$	n/a
	Compaction - relative dry density	Q111A/B/C or AS 1289.5.4.1 or AS 1289.5.7.1	2/500mm lift as above as above	>0.3m below pavement subgrade - 95% SRDD $\leq 0.3m$ below pavement subgrade - 97% SRDD	2
	Compaction moisture/density relationship	Q110A or AS 1289.5.1.1 or AS 1289.5.7.1	1/material type as above 1/field density		n/a

Construction Activity	Verification Requirement Test Description	Test Method	Test Frequency	Specification	Minimum Number Of Tests
Turnouts and Entrances subgrade	Compaction - relative dry density	Q111A/B/C or AS 1289.5.4.1 or AS 1289.5.7.1	1/100m ² as above as above	97% SRDD	1
	Compaction moisture/density relationship	Q110A or AS 1289.5.1.1 or AS 1289.5.7.1	1/field density as above as above		n/a
Turnouts and Entrances pavement layers	Compaction - relative dry density	Q111A/B/C or Q112 or AS 1289.5.4.1	1/100m ² 2/100m ² 1/100m ² (2/100m ² if using AS1289.5.8.1)	100% SRDD	1
	Compaction moisture/density relationship	Q110A or AS 1289.5.1.1 or AS 1289.5.4.2	1/material type as above as required		n/a
Structural Concrete	Compressive Strength	AS 1012.1 AS 1012.3.1 AS 1012.8.1 AS 1012.9 AS 1012.12.1	1 sample of 2 cylinders for each 15m ³ or part thereof placed in an essentially continuous manner	Table S7.1 "Concrete Classes" FNQROC Development Manual	1 sample per casting day

Table 17 - Select Backfill Properties

MRS11.04

AS SIEVE SIZE (mm)	Percent (by mass) Passing Sieve	
	Gravel †	Loam
37.5	100	100
9.5	60 - 85	100
2.36	25 - 70	70 - 100
0.425	10 - 40	10 - 40
0.075	3 - 30	3 - 30
Other Properties Linear Shrinkage	8 maximum	6 maximum

† Material of size greater than 2.36mm shall be stone

Table 19 - Sand Properties

MRS11.04

Property	Natural Sand	Blended and Manufactured Sand
Percent passing 6.7mm AS sieve	100	100
Percent passing 0.075mm AS sieve (maximum)	5	20
Plasticity Index (maximum)	5	10

APPENDIX B

SECURITY LODGEMENT

FORM

.....Whitsunday Shire Council.....

SECURITY LODGEMENT FORM

This sheet must be completed prior to the acceptance of any bond by Council.

Development Name:

Stage:File No:.....

Applicant:

Consultant:

Purpose of Bond:

Construction Security Uncompleted works Defects liability

.....
.....

Uncompleted Works Bond Assessment

Estimated time to complete bond works (not greater than 90 days)days

Current contract Completion date

Anticipated Completion date

Engineer's estimated value of completed works \$.....

Bond value (apply factor 1.50) \$.....

Construction / Defects Liability bond assessment

Engineer's estimated value of uncompleted works \$.....

Construction / Maintenance Bond value (apply factor 0.05)(min \$500) \$.....

Council shall retain any interest accrued on cash monies paid to Council and held in trust fund by Council, including monies paid pursuant to Section 6.3 of the *Local Government (Planning and Environment) Act 1990*.

Engineer:

SignatureRPEQ No:.....

Date:

APPENDIX C

INSPECTION CERTIFICATE FOR WITNESS/ HOLD POINT

APPENDIX D

WORKS ACCEPTANCE INSPECTION CHECKLIST

WHITSUNDAY SHIRE COUNCIL

WORKS ACCEPTANCE INSPECTION CHECKLIST

DEVELOPMENT NAME: File No:

DEVELOPMENT LOCATION:

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
ALLOTMENT DRAINAGE		
The works have been finally inspected and:		
a) Concrete catch drains constructed in approved location and to a satisfactory standard.		
b) Field Inlets constructed in approved location and to a satisfactory standard.		
c) Overland flow path constructed to correct profile.		
d) Pipework has been visually inspected and is satisfactory ie., – alignment and grade – free of debris and siltation – no visual sign of trench subsidence – outlets are satisfactory		
e) Lots not provided with Allotment Drainage can be drained to the kerb and channel.		
STORMWATER DRAINAGE SYSTEM		
The works have been finally inspected and:		
a) Pipe layout is as per plan or approved amendments with respect to pipe size, levels and location.		
b) Pipework has been visually inspected and is satisfactory, ie., – alignment and grade – free of debris and siltation – pipe joints satisfactory – lifting plug holes sealed – no visible sign of trench subsidence – no damaged pipes		
c) Gully pits and manholes have been constructed to the correct standards, ie., – correct type of grate or cover – lintels – side entry slots – benching (no water ponding) – grates are satisfactorily seated in frames – weepholes provided to bedding material – no damaged structures – converter slabs/sections mortar bedded – correct drops through gullies/manholes – all lids/grates finished to match surface level		
d) All density tests to backfill are available and satisfactory.		
e) Material gradings are available for bedding material and satisfactory.		
f) Outlet/Inlet structures are satisfactorily constructed and are free from scour or siltation.		

WHITSUNDAY SHIRE COUNCIL

WORKS ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
g) All manhole and gully pit pipe connections are mortared flush with the walls and no pipe reinforcement is exposed.		
h) Open cut channels have been finally inspected are satisfactory, ie., – cut to design profiles – lining of channel is to the required thickness and reinforcement, with appropriate weepholes		
i) Overland flow, the works have been finally inspected and appropriate flow paths are provided and clear of obstruction.		
j) Outlets and outfalls have been constructed to control discharge flow in accordance with the plans.		
k) Subsoil drainage discharges to gullies or other approved points of discharge.		
l) All grassing requirements to channels, swales, outlets, inlets etc have been completed.		
WATER QUALITY		
The works have been finally inspected and:		
a)Water Quality structures have been constructed in accordance with approved engineering drawings		
b)Structures are free of debris and sediment		
EROSION AND SEDIMENT CONTROL		
The works have been finally inspected and:		
a)Control structures required until the site is stabilised in accordance with the Contractor's ESCP are in place		
b)Structures are free of debris and sediment		
EARTHWORKS		
The works have been finally inspected and:		
a) Toe of batters not on Council road reserve except as approved.		
b) Retaining walls clear of road reserve except as approved.		
c) Retaining walls constructed in accordance with drawings.		
d) Batter slopes constructed in accordance with drawings.		
e) Batter slopes stabilised against erosion.		
f) Interim drainage constructed in accordance with drawings.		
g) All areas disturbed by the works have been rehabilitated.		

WHITSUNDAY SHIRE COUNCIL
WORKS ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
SEWER RETICULATION The works have been finally inspected and:		
a) Pipe layout is per the plan or approved amendments with respect to size; levels and location. b) Pipework has been visually inspected and is satisfactory i.e.: - pipework flush with internal walls of manhole - alignment and grade - flexible joints - line flushed and clean - HC location indicator - no visible sign of trench subsidence - A density test of backfill are available and satisfactory		
c) Manholes have been constructed to the correct standards i.e.: - benching - curvature satisfactory - no ponding - profile satisfactory - no weeps (free of infiltration) - concrete work - no honey combing - no weeps, etc - covers - correct type - imprint in accordance with standards - depth of cover surround - depth of top slab - location - relative to lot boundaries - 50-75mm proud of finished surface level.		
d) Material gradings for bedding material are available and satisfactory.		
e) Pressure test results are available and satisfactory		
f) Manhole hydrostatic test all satisfactory		
g) Sewerage connection Private Works paid		
h) Ovality testing satisfactory		
WATER RETICULATION The works have been inspected and:		
a) Pipe layout and service fixtures (valves and hydrants is as per the plan or approved amendments respect to pipe size and location.		

b) Pipework has been pressure tested in accordance with Council's requirements and test results are available and satisfactory.		
c) Pipework has been chlorinated in accordance with Council's requirements.		
d) There are no visible signs of trench subsidence or leaks.		

WHITSUNDAY SHIRE COUNCIL
WORKS ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION Yes/No/NA	COMMENT
e) Valves and hydrants have been inspected and are satisfactory, i.e.: - location - setts and surrounds correctly installed to prevent ingress of soil etc. - mortar packing to boxes correctly completed - depth to top of hydrant or valve stem within limits - dust caps to hydrants - colour of marker plate correct - marking plates correctly installed - size of plate correct - service marker spigots in place		
f) Material gradings for bedding material are available and satisfactory.		
g) Water supply connection Private works fees paid.		
ROAD PAVEMENTS The works have been finally inspected and:		
a) Plan layout and geometry of road system is in accordance with the drawings.		
b) Finished levels at crown and channel are at design levels.		
c) Crossfalls are to the approved plan		
d) AC is satisfactory with regard to finish and thickness.		
e) Joints in the seal (especially where various developments apply) are flush.		
f) The sealed surface is free of blemishes.		
g) All compaction tests, material quality (CBR), material grading, AC core tests are satisfactory and available.		
h) Ponding of stormwater does not occur.		
SEGMENTAL PAVERS (Where constructed) The works have been finally inspected and:		
a) All pavers have been correctly laid to pattern, within allowable tolerance, compacted, and the joints filled.		
b) Bedding sand for pavers drains to subsoil drainage		
c) Pavers adjacent to concrete kerb and channel, edge restraints etc, have been cut and laid in accordance with relevant requirements.		

<p>CONCRETE WORKS The works have been finally inspected and:</p>		
<p>a) The correct type has been used to all locations in accordance with drawings.</p>		
<p>b) Ponding of stormwater does not occur.</p>		
<p>c) Transitions and connection to existing construction are smooth and to a satisfactory standard of workmanship.</p>		

WHITSUNDAY SHIRE COUNCIL

WORKS ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
d) Service conduit markers have been placed to kerb face.		
e) Lip and back of kerb are flush with the roadway and footpath respectively.		
f) All channelisation works and medians have been satisfactorily completed.		
g) Infill treatment of medians has been inspected and found satisfactory. Any landscaping has been completed to standard.		
h) Subsoil drains have been provided (including under medians).		
i) Appropriate expansion and contraction joints provided		
j) Subsurface finish is to approved design and within tolerances		
FOOTPATHS		
The works have been finally inspected and:		
a) Profiles are as per plan.		
b) Footpath has been topsoiled and satisfactory.		
c) Footpaths have been stabilised/turfed..		
d) All service fixtures (such as valves etc.) 25mm above the surrounding footpath.		
e) Concrete footpaths have been constructed to Council		
f) Pram ramps constructed as required.		
g) Footpaths to be free of rock and loose stones.		
BIKEWAYS		
The works have been finally inspected and:		
a) Location and width are as per the drawings.		
b) Kerb ramps and crossings are constructed.		
c) Safety rails and signs have been installed where required.		
LIGHTING		
The works have been finally inspected and:		
a) Lighting has been installed and is operating as per approved design		
b) If lighting is yet to be installed, or made operational, copy of service agreement has been provided from the lighting/energy provider and all uncompleted works have been adequately guarded.		
FENCING AND FEATURES		
The works have been finally inspected and:		
a) All fences including approved entrance features have been constructed within allotments. Survey pegs are visible.		
b) Specifically approved entrance features are constructed in accordance with the drawings.		
c) Entrance features and fences have satisfied Building Approvals (if required).		

WHITSUNDAY SHIRE COUNCIL

ITEM	VERIFICATION Yes/No/NA	COMMENT
d) Sound attenuation fences and/or mounds are constructed on private property and in accordance with the drawings where required.		
BUILDING / STRUCTURE The works have been finally inspected and:		
a) Council approval for building/		
b) Building/structure		
OTHER		
a) Approvals for completed works received from applicable referral agencies		
b) Street name signs, traffic signs and pavement markings have been installed.		
c) Works have not resulted in problems on neighbouring properties. Clearance letters from property owners are available where applicable.		
d) All boundaries of Subdivision / Development have been inspected to ensure works as constructed will not affect adjoining properties.		
e) All necessary testing to ensure the quality of the work has been carried out and results are available		
f) Engineer's compliance certificate is completed (refer AP1- Appendix A)		
g) "As constructed" submission has been provided to Council, and is to Council's satisfaction, including manhole numbering on the sewer, and Node numbering on the water to be compatible With Council's asset register		
h) All allotment boundaries, easements etc, have been pegged.		
i) All test results and records have been compiled and stored in the record storage facilities of the Engineer's office and a copy forwarded to Council.		
j) All operating Manuals, maintenance procedures, mechanical warranties etc have been submitted to Council.		
k) Parkland is in a mowable condition where practical and free of rock and loose stones.		
l) Irrigation systems have been provided, are operating as designed and AS CON drawings provided.		
m) Easement registered over sewer gravity mains where they deviate from the specified alignment Within the property boundary.		

INSPECTING ENGINEER'S SIGNATURE.....

NAME.....

ENGINEER.....

APPENDIX E

FINAL ACCEPTANCE

INSPECTION CHECKLIST

WHITSUNDAY SHIRE COUNCIL

FINAL ACCEPTANCE INSPECTION CHECKLIST

DEVELOPMENT NAME:File No.....

DEVELOPMENT LOCATION:

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
STORMWATER DRAINAGE SYSTEM		
a) Pipework has been visually inspected and is satisfactory, ie., – free of debris and siltation – pipe joints satisfactory with no deflection or movement – no visible sign of trench subsidence – no exposed reinforcing steel to cut pipe ends		
b) Gully pits and manholes have been visually inspected and are satisfactory, ie., – no ponding – no excessive cracking or distress of reinforced concrete works – clear of silt and debris – all mortar is in place, no excessive spalling, flaking or cracking – no visible sign of subsidence		
c) overland flow paths clear		
WATER QUALITY		
a) Water Quality Structures have been visually inspected and are satisfactory, ie., – free of debris and siltation – no cracking or distress of concrete at fixing points – fasteners are secure – structures have not misaligned due to excessive loads – no corrosion at any location evident		
ALLOTMENT DRAINAGE		
a) Concrete catch drains have been visually inspected and are satisfactory, ie., – clear of silt and debris – no damage or cracking – overland flow path profile maintained		
EARTHWORKS/SITE WORKS		
a) All batter slopes stable and no distress exhibited.		
EROSION AND SEDIMENT CONTROL		
a) Site has been visually inspected and has no obvious signs of erosion or sediment deposits and has achieved 80% grass cover		
b) Erosion and sediment control measures no longer required have been removed and rehabilitation works completed.		
WATER RETICULATION		
a) No visible signs of trench subsidence.		

WHITSUNDAY SHIRE COUNCIL

FINAL ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION Yes/No/NA	COMMENT
b) Valves and hydrants have been inspected and are satisfactory, i.e.: - no leaks - valve and hydrant markings - Service marker spigots in place - no damage		
SEWERAGE RETICULATION		
a) No visible signs of trench subsidence		
b) Pipework has been inspected and is satisfactory i.e.: - alignment satisfactory - clear of silt and debris (flushed) - no ponding - H.C Location indicators - pipework not oval or compressed		
c) Manholes/ structures have been visually inspected and are satisfactory i.e.: - benching no signs of cracking - no weeping or infiltration - no ponding or disposition of solids.		
ROADWORKS		
a) Road pavement has been visually inspected and is satisfactory i.e.: - no damage to wearing course - clear of siltation and debris		
b) Kerb and channel has been visually inspected and is satisfactory i.e.: - no excessive cracking or distress to Concrete works - no ponding - service conduit markers ok - no differential settlement or dislocation of Pavement surface and concrete kerb and Channel.		
c) Linemaking and road signage satisfactory		
BUILDING / STRUCTURE		
a) building/ structure inspected		
MISCELLANEOUS		
a) Footpaths and concrete works satisfactory		
b) Bikeways and associated works satisfactory		
c) Street name signage satisfactory		
d) Alternative pavement surfacing (e.g. pavers, stamped concrete) is satisfactory		
e) street lighting has been installed and is operating as per the approved design.		

f) Landscaping has been provided for a minimum 13 week period and is an acceptable condition for handover to Council.		
OTHER MATTERS		
a) Specific matters in relation to the site		

WHITSUNDAY SHIRE COUNCIL

FINAL ACCEPTANCE INSPECTION CHECKLIST

ITEM	VERIFICATION (Yes/No/NA)	COMMENT
<p>INSPECTING ENGINEER'S SIGNATURE:</p> <p>NAME:</p> <p>ENGINEER: RPEQ No: DATE:..... /..... /.....</p>		

APPENDIX F

STATEMENT OF COMPLAINT

“AS CONSTRUCTED”

STATEMENT COMPLIANCE “AS CONSTRUCTED” DOCUMENTATION

Whitsunday shire council

Name of Development:

Location of Development:

Applicant:

Consulting Engineer:

Registered Surveyor (Consulting):

It is hereby certified that the “As Constructed” drawings submitted herewith have been prepared, checked and amended in accordance with the requirements of the Whitsunday Shire council Development manual and that the completed works comply with the requirements therein.

- Certification by registered surveyor (consulting) attached? YES

Note: Certification is to be in accordance with the Development manual

Compliance with the manual Design Intent and Function not compromised by the “As Constructed” Works.	Compliance Yes / No	Non-Compliance refer to attached redesign of works to ensure satisfactory performance
Earthworks		
Roadworks		
Stormwater Drainage <ul style="list-style-type: none"> • Minor Flow System and Structures • Major Flow System and Structures 		
Water Reticulation		
Sewerage Reticulation		
“As Constructed” Documentation		

Conscientiously believing the above statements to be true and correct:

Consulting Engineer

Name in Full **RPEQ No**

Signature

Date

APPENDIX G

EXAMPLE OF SURVEYOR'S CERTIFICATION OF "AS CONSTRUCTED" WORKS

APPENDIX H

AS CONSTRUCTED DATA

SEWER HOUSE

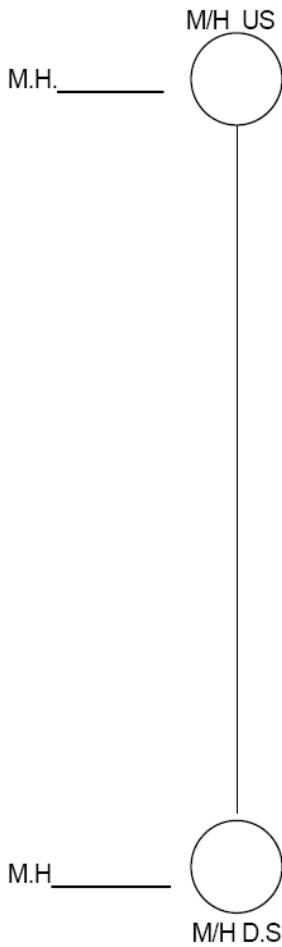
CONNECTION BRANCHES

AS CONSTRUCTED DATA SEWER HOUSE CONNECTION BRANCHES

Development Name:..... Date:.....

Contractor:..... By:.....

Stage:.....



Φ	D/S IL	U/S IL	Grade	Length

HOUSE CONNECTIONS

	D/S Mh No.	U/S Mh No.	Total	Lot. No.
Ch				
IL				
SL				
Ch				
IL				
SL				
Ch				
IL				
SL				
Ch				
IL				
SL				
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U/S M/H
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NOTES:.....
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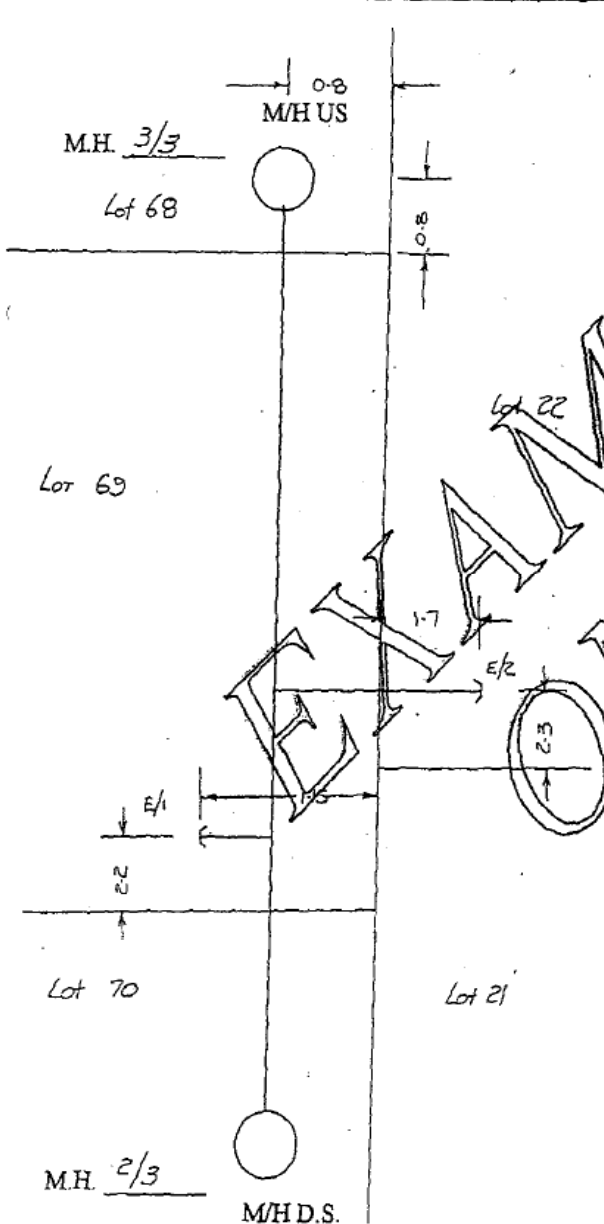
Certified as True and Correct on Behalf of the Contractor: Name:.....

Signature:.....

Date:.....

AS-CONSTRUCTED DATA
SEWER HOUSE CONNECTION BRANCHES

Development Name Stillson Estate Date 16-5-96
 Contractor Digwell Constructions By KLM
 Stage 2



φ	D/S IL	U/S IL	Grade	Length
0.150	8.190	8.601	1:150	61.45

HOUSE CONNECTIONS				
	D/S Mh No.	U/S Mh No.	Total	Lot No.
Ch	12.2	15.26	61.46	69
IL	9.539	9.542		
SL	10.855	10.863		
Ch	15.32	46.12	61.44	22
IL	9.935	9.936		
SL	10.978	10.984		
Ch				
IL				
SL				
Ch				
IL				
SL				
Ch				
IL				
SL				

U/S M/H
TOP RL 11.23

NOTES: _____

Certified as True and Correct on Behalf of the Contractor: Name: John Treadwell
 Signature: J Treadwell
 Date: 18/5/96

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DP1

DEVELOPMENT PRINCIPLES

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

DP1.01 INTRODUCTION

1. This section of the Development manual has been prepared to provide guidance on the design principles and issues to be considered by the designer in the preparation of layout plans for new urban developments. It is to be read in conjunction with the relevant planning scheme, and any local laws and policies.

DP1.02 URBAN DEVELOPMENT OBJECTIVES

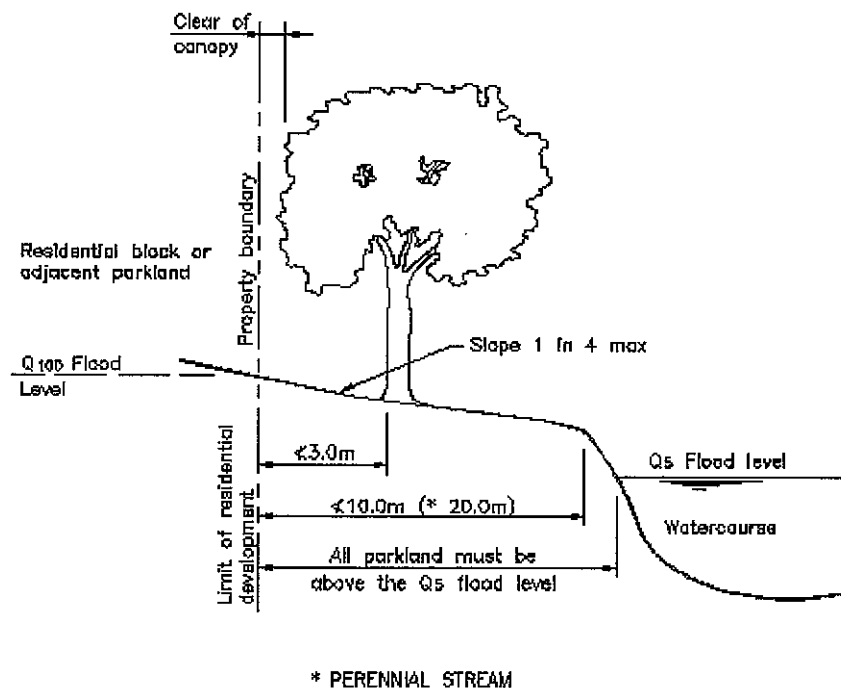
1. In addition to the requirements of the relevant planning scheme, local laws and policies, urban development layouts should:
 - Protect and enhance environmentally significant areas
 - Be sympathetic to the existing topography and landform
 - Minimise the impacts on the surrounding environment
 - Facilitate the provision of urban services
 - Provide a safe urban living environment

DP1.03 IDENTIFICATION OF SITE CONSTRAINTS AND VALUES

1. in preparing an urban development layout, it is important to identify the natural constraints and values of the site and any engineering constraints on the provision of urban services and amenities.
2. Factors that may impose constraints on the development layout include but are not limited to the following:
 - Existing significant vegetation;
 - Road and service connections to adjoining properties;
 - Public transport networks;
 - Railway and cane tramway lines;
 - External stormwater drainage and receiving waters;
 - Low lying areas subject to flooding and ponding;
 - Constraints and impact on adjoining properties;
 - Constraints and limitation of existing utility services and planned augmentation works;
 - Main roads resumption requirements;
 - Existing topographical features;
 - Water quality issues;
 - Geotechnical considerations;
3. Designers are encouraged to consult with the Council and other relevant authorities prior to, or during the preparation of the site layout and design concept. Designers should in addition to requirements of this guideline, ascertain any specific requirements of these authorities as they relate to the designs in hand.

DP1.04 VEGETATION PROTECTION AND ENVIRONMENTALLY SIGNIFICANT AREAS

1. Prior to preparing a development layout, all areas that have significant environmental value should be identified and incorporated into the layout design to enable them to be preserved and protected. Any disturbances within these areas shall be minimised to the satisfaction of Council and other relevant authorities, as may be appropriate.
2. All existing natural streams, watercourse and riparian vegetation shall be preserved. To minimise the impacts on stream bank vegetation, all streams and watercourses shall be protected by a drainage reserve. The extent of the drainage reserve shall be determined by the following criteria:
 - Not less than 3m clear of tree trunks of adjacent trees;
 - Not less than 10m clear of the high bank of the adjacent drainage path;
 - Not less than 20m clear of the high bank of a perennial stream;
 - Clear of the ARI 100 year storm event influence from the adjacent drainage path;
 - Clear of the vertical projection of the tree canopy of the adjacent trees.



3. In order to retain any established landscape character, all trees located within existing road reserves shall be protected and retained unless approved otherwise by Council
4. Reference should be made to the Vegetation Management Act and any local laws and policies to ascertain any requirements in relation to tree clearing.

DP1.05 CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

1. It is important when designing development layouts that the principle of crime prevention through environmental design are considered, in particular:
 - Natural surveillance of public open spaces is optimised;
 - Long pathway or obscured park areas that can become a potential assault sites are avoided.

ENGINEERING ISSUES

DP1.06 GENERAL

1. The optimum site and road layout needs to be developed through consideration of social, environmental, town planning, traffic and engineering issues.
2. Although the engineering design of roads is the province of the Engineer, it is essential that the surveyor, and planner preparing the site layout be fully aware of the engineering issues to ensure that the road layouts proposed are satisfactory in this respect. Major alterations to the development layout may otherwise be necessary to accommodate engineering requirements.
3. The factors to be taken into consideration when designing new development layouts include the following:
 - Proposed land use;
 - Road hierarchy, interim and ultimate;
 - Public transport network;
 - Local planning policies, bikeways / pathways and open space;
 - Council's drainage management plans;
 - Railway and cane tramway lines;
 - Access requirements for services and emergency vehicles;
 - Topography of the area;
 - Adequate road frontage to parks and drainage reserves;
 - Existing utility services constraints and proposed augmentation works;
 - Crime prevention through environmental design;
 - Impacts on adjoining properties;
 - Existing stormwater drainage;
 - Flooding and ponding;
 - Preservation of natural watercourses;
 - Significant existing vegetation;
 - Bushfire protection measures;
 - Impact of earthworks;
 - Water quality improvement structures and features;
 - Existing soil conditions;
 - Geotechnical considerations

DP1.07 ROAD NETWORK

1. The provision of a road network within a subdivision development is to be designed so as to achieve the following aims:
 - Convenient and safe access to all allotments for pedestrians, cyclists and vehicles;
 - Safe, logical and hierarchical transport linkages with existing street system;
 - Appropriate access for buses, emergency and service vehicles;
 - Convenient service corridors for public utilities;
 - Opportunity for street landscaping;
 - Convenient parking for visitors
2. A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the serves a distinct set of functions and is designed accordingly. A typical hierarchy is shown on figure DP1.2

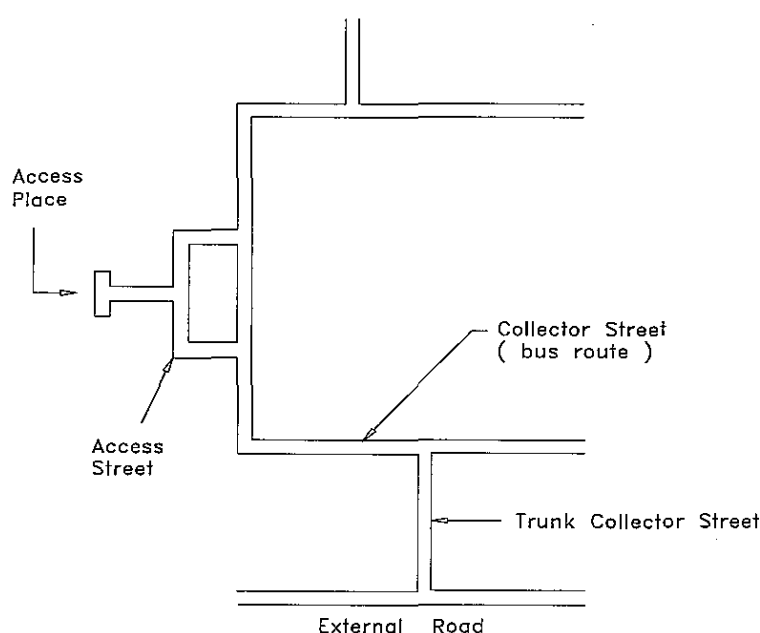


Figure DP1.2
Typical Road Hierarchy

1. The maximum number of turning movements at intersections or junctions that a visitor should be required to undertake to reach a particular address within the development should be minimised.
2. The road network should be designed to ensure that roads connect to the next order of road in the hierarchy. Only under exceptional circumstances should a road connect to another road, which is more than two levels higher or lower in the hierarchy.
3. Where an Access place forms part of a pedestrian or cycle network, suitable connectivity with adjoining Access places or open space systems should be provided so as to ensure such pedestrian and cycle network are functionally efficient.
4. Development layouts should be designed with a road layout to achieve the desired speed environment. The use of traffic control devices in lieu of a suitable road layout is not preferred.

5. It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 10 per cent of residents should have to walk in excess of 500 meters to catch a bus. Normally roads above the Access street in the hierarchy are designed as bus routes.

DP1.08 SITE REGRADING CONCEPT

1. Excessive site regrading should be avoided. Wherever possible site layouts should be developed to position roads and drainage networks to take advantage of natural surface grades. Site layouts that minimise the disturbance of the land will require less erosion and sediment control measures during construction phase and reduce the risk of environmental harm.
2. Where earthworks are proposed in any development where the slope of the land exceeds 1 in 4, input should be sought from a qualified geotechnical engineer to ascertain slope stability and potential construction issues.

DP1.09 STORMWATER DRAINAGE

1. The design of the drainage system, and earthworks for the proposed development shall be such that the upstream drainage is not adversely affected and that the downstream drainage system is capable of adequately catering for the discharge of the additional flow produced as a result of the development. If the downstream system is not adequate the developer shall provide on site retention and /or upgrade the downstream system.
2. The development layout shall be designed to accommodate both existing and future developed flows from upstream catchments on the basis of development in accordance with the relevant Planning scheme.
3. In preparing a development layout, consideration should be given to the overall site drainage philosophy, and overland paths, to ensure that the road network has sufficient drainage capacity to safely convey stormwater runoff to its receiving waters with minimal nuisance or damage to the community.
4. Consideration should be given in the preparation of the layout to ensure that in the event of drainage system failure, adequate emergency relief paths are provided. In particular downhill sloping cul-de-sac heads should be avoided where a sufficient width pathway or open space cannot be provided to convey the overhead flow.

DP1.10 STORMWATER QUALITY MANAGEMENT

1. In recognition of the impacts that development may have on the quality of water within the waterways, the over-riding objective for water quality management is to minimise the potential for development activity to cause harm to the environment / receiving waters.
2. All developments are required to include appropriate interception devices that ensure removal of suspended matter (litter) and treatment of contaminated stormwater prior to crossing the boundary of the development or discharge into downstream roadside gutters, stormwater drainage systems or waterways.
3. The location of the interception devices within the drainage system is to be planned to ensure that the first flush waters from all parts of the site are treated and they can be easily accessed for cleaning and maintenance.

DP1.11 SEWERAGE RETICULATION

1. In preparing a development layout, consideration should be given to the provision of sewerage reticulation connections to adjoining properties on the basis of their future development in accordance with Council's strategic plan.
2. Where an existing sewerage reticulation line passes through an un-developed site, the development layout should, where possible incorporate the sewer within the development layout. Where this is not practical, the layout should be prepared so as to minimise the extent of the sewerage relocation work necessary.

DP1.12 ELECTRICITY SUPPLY AND TELECOMMUNICATION SERVICES

1. In preparing a development layout, the relevant Service authorities should be consulted to confirm that the provision of services to the proposed development would be provided and if the provision of land for the purpose of sitting infrastructure would be necessary.

DP1.13 TRAMLINES THROUGH URBAN AREAS

1. Where cane tramlines run through urban areas, a tramway reserve shall be created over tramline and transferred to Council.
2. The width of the tramway reserve for a single line shall be a minimum of twelve meters. The reserve should be centrally located around the tramline except where exceptional circumstances prevent this. (e.g. adjoining tramway easement or reserve is placed off centre)
3. Under certain embankment / cutting conditions it may be necessary to widen the easement to provide a 3.0m wide access to at least one side of the track.
4. Where multiple tracks exist, the tramway reserve shall include all tracks plus a distance of six meters from the centreline of the outermost tracks on each side.
5. This widened section shall be continued past the point of convergence of the tracks (i.e. the point of the switch of the first turnout of single line) a minimum of twenty metres before becoming a standard twelve metre easement again.
6. Residential areas should be sited away from siding locations if at all possible because of major dust and noise pollution problems. For cases where development will adjoin siding locations (closer than one hundred metres from any part of the planned subdivision to the cane unloading point) the each such location would need to be the subject of a special study between the developer, the appointed consultants, representatives of the Mill and Council, in order to identify the unique problems of the location.
7. The number of road crossings should be kept to a minimum. Factors affecting the positioning of road crossings include: sight distances, track grades, proximity of the nearest crossing and the noise problem associated with the use of the train whistle at close successive crossings. Of particular importance is the adjacent grading of the track. The locating of road crossings on or near the base of falling grades should be avoided. Any road crossing proposal must be submitted to the Mill for the assessment of its likely implications on its own and on road users and residents.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D1

ROAD GEOMETRY

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
20 November 2007	Simon Aalbers Manager Infrastructure Development		Council	1.1

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GENERAL

D1.01 SCOPE.

1. This section sets out the Guidelines developed specifically for the design of road works using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.
2. This Guideline shall be read in conjunction with the Institute of Public Works Engineering Australia publication Design Guidelines for Subdivisional Street works - 'Queensland Streets'.

D1.02 AIMS.

1. The geometry of a road is to be designed so as to achieve the following aims:
 - Provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists.
 - Provide appropriate access for buses, emergency and service vehicles.
 - Provide a convenient way for public utilities.
 - Provide an opportunity for street landscaping.
 - Provide convenient parking for visitors.

D1.03 REFERENCE DOCUMENTS

Australian Standards

- AS1742 Manual of Uniform Traffic Control Devices – Part 9, Bicycle Facilities

Department of Main Roads

- Road Planning and Design Manual
- Manual of Uniform Traffic Control Device (MUTCD)

Institute of Public Works Engineering Australia, QLD Division. (IPWEA)

- Design Guidelines for Subdivisional Streetworks, 1995 – 'Queensland Streets'.

AUSTROADS

- Guide to the Geometric design of rural roads.
- Guide Policy for the Geometric design of major urban roads.
- Guide to Traffic Engineering practice:
 - PART 5 Intersections at grade
 - PART 6 Roundabouts
 - PART 10 Local Area Traffic management
 - PART 11 Parking
 - PART 13 Pedestrians
 - PART 14 Bicycles
 - PART 15 Motorcycles

Joint Venture for More Affordable Housing

- Australian Model Code for Residential Development (AMCORD).

D1.04 CONSULTATION

1. Designers are encouraged to consult with the Council and other relevant authorities prior to or during the preparation of the design. Designers should in addition to requirements of this Guideline ascertain specific requirements of these authorities as they relate to the designs in hand.

ROAD DESIGN CRITERIA

D1.05 DESIGN SPEED

1. For geometric design of roads, design speeds shall be as nominated in Table D1.1 unless specified otherwise by Council. Developments should be designed with a road layout to achieve the desired speed environment. The use of Traffic Control Devices in lieu of a suitable road layout is not preferred.
2. Adoption of a low design speed discourages speeding, attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.
3. Design speeds shall be calculated on largest radius track between kerb and centreline unless a physical constraint is incorporated in the design to maintain vehicle tracking in traffic lane.

D1.06 LONGITUDINAL GRADIENT

1. A general minimum gradient of 0.5 % should be adopted for all roads, which will ultimately include kerb and channel. In very flat conditions where approved by Council it may be reduced to 0.3 %.
2. A desirable minimum gradient of 1.0 % should be adopted for all roads, which will have earth table drains, except where approved otherwise by Council, in exceptional cases.
3. Roads constructed, without kerb and channel, completely in embankment may have zero grade.
4. Maximum grades shall be as nominated in Table D1.1
5. Longitudinal grade through intersections should not exceed 4 %, the actual gradient being dependent on the type of terrain. Design of the road alignment and the grades used are interrelated. A steep grade on a side street is undesirable if vehicles have to stand waiting for traffic in the priority road.
6. Turning circles in cul-de-sacs on steep grades should have grades less than 5 %
7. Where minimum radius crest vertical curves are used local widening is to be provided to facilitate safe ingress/egress from properties.

D1.07 HORIZONTAL ALIGNMENT

1. Horizontal alignment shall generally comply with the requirements of 'Queensland Streets', Department of Main Roads or AUSTRROADS manuals, as applicable.
2. Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers can safely negotiate the curve. Curves that progressively tighten produce an uncomfortable sense of disorientation and alarm. Sudden reverse curves that drivers cannot anticipate also have a potential to cause similar conditions.
3. The horizontal alignment shall ensure adequate sight distances taking into account construction of solid fencing on property boundaries.

D1.08 VERTICAL CURVES

1. Vertical curves should be used on all changes of grade where the algebraic change of grade exceeds:
 - Access Place, Access Street, Collector Streets - 1.0 %
 - Trunk Collector Streets - 0.6 %
2. The length of the crest vertical curve for stopping sight distance should conform to 'Queensland Streets'.
3. For adequate riding comfort, lengths of sag vertical curves should conform to 'Queensland Streets'.
4. Every effort should be made to provide vertical curves as long as possible, for improved appearance.
5. Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades should be adopted. This is to avoid water ponding in excessively flat sections of kerb and channel. A minimum grade of 0.5% should be maintained in the kerb and channel.
6. In general, a minimum 10m vertical curve shall be provided where the side road joins the through road at three way intersections.
7. The tangent point of a vertical curve in the side road shall be located at, or outside of, the kerb line of the through road. Council may approve the use of a concrete invert in lieu of a vertical curve where the side road is an Access Place and the algebraic change of grade is less than 6.0 %.
8. The three dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improved traffic safety and aesthetics. The following principles should be applied:
 - The design speed of the road in both horizontal and vertical planes should be of the same order.
 - Combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.
 - Sharp horizontal curves shall not be introduced at or near the crest of a vertical curve.
 - Horizontal curves should leave the vertical curve and be longer than the vertical curve.
 - A short vertical curve on a long horizontal curve or a short tangent in the grade line between sag curves may adversely affect the road's symmetry and appearance.

D1.09 CROSSFALLS

1. Carriageway crossfalls for streets shall conform to the requirements of 'Queensland Streets'.
2. Generally pavement crossfalls on straight roads shall be:

Pavement Type	Crossfall
Bituminous seal coat	3 %
Asphaltic concrete pavement	3 %
Cement concrete pavement	3 %
Paved surfaces	3 %
Gravel	5 %

Table D1.1 Street and Road Hierarchy – Deemed to comply requirements

Roadway Classification	No. of dwellings	Traffic Generation	Reserve Width ⁷ (Minimum)	Carriage Width ^{3,6} (Minimum)	Verge Width (Each sides) Min	Max. Grade (Desirable)%	Design speed kph
Access place	0 - 4 4 - 19	0 – 40 vpd 40 – 190 vpd	15	3.5m ¹ 5.5m ¹	4 m	(12) 16 ⁴	30
Access street	20 - 74	200 – 740 vpd	15	6.5 m ¹	4 m	(12) 16 ⁴	30
Collector street	75 – 299	750 – 2,900 vpd	16	7.5 m ²	4 m	(8) 10	40
Trunk Collector street	300 – 599	3,000 – 5,900 vpd	20	10.0 m ⁸	4.5 m	(8) 10	50
Sub Arterial road	600 – 2,000	6,000 – 20,000 vpd	28	2 x 7.0 m carriageway 5.0 m median	4.5 m	(6) 8	50
Low Density Residential	0 – 74 75 - 240	740 vpd 750 vpd	20	6.0 m 7.5 m	5 m	(12) 16 ⁴	50
Rural	Refer table D1.4 for details of Rural Road Elements						
Arterial and Major Arterial	The requirements for these categories shall be provided by the Council or Relevant Authority (QDMR) Traffic volumes shall be identified in a traffic management report.						
Industrial Access	<8 ha	-	20	12 m	4 m	(6) 10	50
Industrial Collector	<30 ha	-	22	14 m	4 m	(6) 8	50

Notes:

1. Carriageway (and reserve) widening shall be provided on bends in accordance with Queensland Streets.
2. Widening of carriageway to 10 m shall be required on all bus routes.
3. Carriageway widths are measured from the invert of kerb and channel on one side of the carriageway to the invert of the kerb and channel on the opposite side of the carriageway.
4. The absolute maximum grade shall be 20% for a maximum length of 60m. The maximum length of grades less than 20% but not less than 16% shall be 60m plus 25m for each 1% the grade is less than 20%. The maximum length of any grade greater than 16% shall be 160m.
5. Where the ultimate traffic catchment exceeds 30 allotments and Council considers bicycle use likely, shoulders shall be sealed to provide a total seal minimum width of 9.0m.
6. Where the road is nominated as part of the bikeway network, allowance for bike lanes shall be added to this width (minimum bikeway width is 1.5m).
7. Road reserve width shall be widened to accommodate bus stops as required.
8. Based on 2 x 3.5m traffic lanes and 2 x 1.5m bicycle lanes. (May be reduced to 7.0m only where identified that bicycle lanes are not required).
Provision must also be made for on street parking where properties front the road.

3. Median Crossfalls - The maximum crossfall on grassed medians on divided roads shall be desirably 1 in 6 with an absolute maximum of 1 in 4. Refer also Department of Main Roads Design Manuals. However, at median openings, the pavement crossfall should not exceed 5%.
4. For roundabouts detailed consideration of crossfall is required taking into account diameter, heavy vehicle turning etc.
5. For Intersections detailed consideration of crossfall is required to take into account longitudinal grades and the implication for high vehicles turning through an intersection.

D1.10 CARRIAGEWAY WIDTH

1. Minimum carriageway widths for all streets shall be as nominated in Table D1.1.
2. The carriageway width must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include trucks, emergency vehicles and, on some roads, buses.
3. The safety of pedestrians and cyclists where it is intended they use the carriageway must also be assured by providing sufficient width and visibility.
4. The carriageway width should also provide for unobstructed access to individual allotments. Motorists should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked on the carriageway opposite the driveway.
5. The design of the carriageway should discourage motorists from travelling above the intended speed by reflecting the functions of the road in the network. In particular the width and horizontal and vertical alignment should not be conducive to excessive speeds.
6. Appropriate road reserve width should be provided to enable the safe location, construction and maintenance of required paths and public utility services (above or below ground) and to accommodate the desired level of streetscape.
7. Where a "split level" road is proposed, a stable form of retaining structure such as reinforced concrete, crib block or masonry walling (or other approved alternative) is required between upper and lower road levels. Carriageway widths are to be exclusive of the plan area of the retaining structure. Excessive earth batters will not be permitted.
8. Traffic islands shall be designed in accordance with the current Department of Main Roads or AUSTRROADS Design Manuals.

D1.11 VERGES

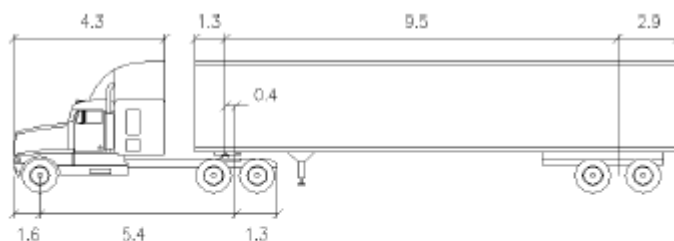
1. Minimum verge widths for all streets shall be as nominated in Table D1.1.
2. A suitable design of the verge will depend on utility services, access to allotments, pedestrian usage, tree preservation and stormwater drainage.
3. All verges shall fall from the frontage property boundary to the adjacent kerb and channel with acceptable crossfalls of between 3% - 5%. In the case where the allotment falls away from the road reserve (i.e. the allotment is lower than the level of the road), the verge shall have a minimum fall from the frontage property boundary to the adjacent kerb of 3%.

4. Batters within verges are not acceptable. The maximum slope permissible within a road verge is 1 in 4.
5. The verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements.
6. Utilities service locations shall be in accordance with the relevant Authorities requirements.
7. Verges shall be covered full width with topsoil to a depth of not less than 75mm and shall be lightly compacted and grassed in accordance with Council's Guidelines and Specifications.

D1.12 INTERSECTIONS

1. A roundabout shall be any four way intersection and shall only be used to intersections of Collector streets and Access streets or higher order roads only.
2. All new intersections of Access Places, Access Streets with Collector Streets, shall be three way intersections designed and located in accordance with "Queensland Streets", unless otherwise approved by the engineer.
3. Intersections of Trunk Collector, Industrial, and Sub Arterial roads shall be designed in accordance with AUSTRoads Design Manuals and shall allow for potential improvement to incorporate other traffic control methods e.g. Traffic signals.
4. Intersections with Main Roads controlled roads shall be designed and constructed in accordance with the requirements of the Queensland Department of Main Roads.
5. The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes shall be used in designing all intersections or junctions on trunk collector streets or higher order roads.
6. Truncations shall be provided to real property boundaries in order to maintain minimum verge widths and adequate sight distances taking into account potential for construction of solid fencing on the property boundaries.
7. The turning radii at intersections measured at the kerb invert shall be 9.0m minimum, and accommodate the intended movements without allowing desired speeds to be exceeded.
8. All vehicle turning movements are accommodated utilising AUSTRoads Design Vehicles and Turning Templates, as follows:
 - For turning movements involving trunk collector streets or collector streets, the "design semi-trailer" with turning path radius 15.0 m.
 - For turning movements involving access streets but not involving collector streets, the "design single unit truck/bus" with turning path radius 13.0 m.
 - For turning movements on access places but not involving, collector streets or access streets, the garbage collection vehicle with turning path radius 12.0 m.
 - For turning movements at the head of cul-de-sac streets sufficient area is provided for the "design single unit truck" to make a three-point turn.
 - Road furniture shall be located to allow for clear manoeuvring of the design semi-trailer
9. Intersection channelisation is to be provided and designed in accordance with the current Department of Main Roads or AUSTRoads Design Manuals.

10. All channelisation shall be designed to accommodate a design vehicle providing a clearance of not less than 0.6 m between the wheel track and the kerbs at all points, unless specified otherwise by Council.
11. Traffic islands or medians of less than 2m width to be hard surfaced in concrete with a patterned or broomed finish incorporating a coloured pigment in accordance with Council's requirements. This colour should generally be terracotta unless otherwise approved by Council.
12. Traffic islands, which are to be grassed or landscaped, shall be provided with a water service conduit and a perimeter subsoil drainage line connected to the underground drainage system or an open drainage channel.
13. On Trunk Collectors, Sub-Arterial and Arterial roads, median breaks will only be permitted at approved intersections.
14. Pavement markings associated with channelisation and signs shall be provided in accordance with the Department of Main Roads - 'Manual of Uniform Traffic Control Devices'.



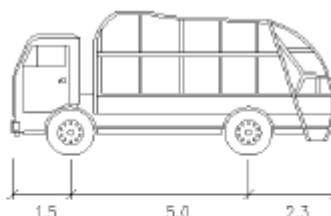
Tractor Width : 2.50 Trailer Width : 2.50
 Tractor Track : 2.50 Trailer Track : 2.50
 Turning Radius (Outside) : 15.00

Semi-Trailer



Width : 2.50
 Track : 2.50
 Turning Radius (Outside) : 13.00

Single Unit Truck / Bus



Width : 2.50
 Track : 2.50
 Turning Radius (Outside) : 12.00

Garbage Truck

Figure D1.3 - Standard vehicles

D1.13 ROUNDABOUTS

1. Roundabouts shall only be used at intersections of Collector Streets and Access Streets.
2. Design of roundabouts will generally be in accordance with current Department of Main Roads manuals and AUSTROADS Guide to Traffic Engineering Practice PART 6 – Roundabouts
3. All roundabouts shall have a minimum inscribed circle diameter of 30.0m.
4. Centre islands which are to be grassed or landscaped shall be provided with a water service conduit and a perimeter subsoil drainage line connected to the underground drainage system or an open drainage channel.
5. Landscaping to centre islands to be in accordance with Council Guidelines and Specifications.
6. Roundabouts shall include provision for on road cycle lanes unless alternate cycle paths are provided.

D1.14 CUL-DE-SAC TURNING AREAS

1. The turning areas at the ends of the cul-de-sac in streets shall be designed in accordance with 'Queensland Streets', excepting, that where a full turning circle is not provided to the minimum radius below, provision for turning within the kerbs of Council's design garbage truck must be demonstrated.
2. Where a full turning circle is provided the minimum kerb radii shall be:
 - Approach and departure curves - 15 m
 - The turning circle: - 10 m
3. Turning areas at the ends of cul-de-sac in industrial developments shall be full turning circles based on criteria nominated by the Chief Executive Officer for the specific application, with the following minimum kerb radii:
 - Approach and departure curves - 30m
 - The turning circle: - 15m
4. All turning heads shall have adequate provision for on-street parking at cul-de-sacs in accordance with the Queensland Streets

D1.15 LOCAL AREA TRAFFIC MANAGEMENT

1. Traffic management devices such as thresholds, slow points, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of the AUSTROADS Guide to Traffic Engineering Practice - PART 10 Local Area Traffic Management and are to be approved by Council.
2. Devices other than at intersections should be located to be generally consistent with streetscape requirements, existing street lighting, drainage pits, driveways, and services may decide the exact location of devices
3. Emergency vehicles must be able to reach all residences and properties.
4. Where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers.

5. Traffic management devices and associated road furniture must not prevent the passage of larger vehicles (i.e. semi trailers) however their principle function is not to be compromised.
6. In newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be catered for.
7. Maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds.
8. Speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings)
9. Speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by 'segmenting' streets into relatively short lengths (less than 200-300m), using appropriate devices, streetscapes, or street alignment to create short sight lines.
10. Adequate critical sight distances should be provided such that either party in a potential conflict situation may take evasive action. Sight distances should relate to likely operating speeds.
11. Sight distances to be considered include those of and for pedestrians, cyclists and property accesses, as well as for drivers.
12. Night time visibility of street features and LATM devices must be adequate and in accordance with Australian Standard AS/NZS.
13. Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:
 - Pavement narrowing
 - Single lane 3.50m between kerbs
 - 3.75m between obstructions
 - Two lane 5.50m minimum between kerbs
 - Bicycle lanes (including adjacent to pavement narrowings) - 1.5m minimum
 - Plateau or platform areas
 - 75mm to 150 mm height maximum, with 1 in 15 ramp slope
 - Dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates.

D1.16 BUS STOPS

1. Bus stops should be provided on all bus routes so no more than 10 per cent of residents should have to walk in excess of 500 metres to catch a bus. Normally roads above the access street in the hierarchy are designed as bus routes. Table D1.2 details minimum criteria for bus stops.
2. Unless otherwise approved, bus stops shall be constructed in accordance with AUSTROADS Guide to Traffic Engineering Practice and AS 1742 Manual of Uniform Traffic Control Devices

Table D1.2 Bus Stop Criteria

Road	Stops (Spacing)	Description
Collector Streets	400 metre ¹	Single Bay
Trunk Collector or higher order Road	400 metre	Single Bay and Shelter ²
Notes:		
1. Loop roads with single entry / exits only require stops and bays on one side of the road.		
2. Shelters are subject to Council's requirements.		

D1.17 ACCESS TO ALLOTMENTS

1. Criteria for acceptable access to allotments are to be in accordance with Design Guideline D2.
2. All rear access (Hatchet or Battleaxe) allotments shall be provided with a reinforced concrete driveway a minimum width of 3.0m, extending the full length of the access leg of the allotment. The driveways shall commence at the adjacent kerb and channel with a standard kerb crossover or at the existing edge of pavement. Conduits for internal allotment services are to be provided adjacent to the concrete driveway for the full length of the driveway unless otherwise approved

D1.18 PARKING PROVISIONS

1. Parking provisions in accordance with the relevant sections of 'Queensland Streets' shall be accorded with on all roads, except that for Trunk Collector Street with a traffic generation of 3000 vpd - 6000 vpd,
2. Streets which cannot comply with the on-street parking provisions of 'Queensland Streets', due to reduced allotment frontage widths or carriageway widths, shall make provision for indented or verge parking bays at a minimum frequency of 1 parking bay per 2 tenements. Particular attention should be made to providing adequate provision for on-street parking at cul-de-sacs, turning heads and elbow bends.
3. Verge widths are to be maintained alongside indented or verge parking areas. Where necessary, property boundaries shall be adjusted to meet this requirement.

D1.19 PATHWAYS

1. Where a pathways link is located between allotments, the minimum width of land dedicated to Council shall be 5.0m. A 2.5m wide concrete cycleway shall be constructed and shall extend to the adjacent kerb and channel together with a kerb ramp. Vehicular access is to be restricted at the ends of pathways through the installation of bollards at the property line in accordance with the Council's requirements.
2. Maximum cross fall on all pathways 2.5%
3. Pathways constructed using alternate material (eg Asphalt, Paving blocks) are to be approved by Council.
4. The pathway shall extend to the property boundary remote from the roadway where the path is not connecting two street frontages.
5. Bends shall be provided with a minimum internal radius of 6m.

6. All pathways shall have a non-slip surface; generally this can be achieved by applying a stiff broom to the wet surface. (Alternate methods shall require Council approval).
7. Where a pathway link is used for stormwater drainage overland flow relief it shall have a one way crossfall and be constructed in full width concrete with a layback kerb and channel or approved equivalent along one edge to contain the required flow within the concrete.
8. Pathways are not to be aligned with stormwater pits Where a stormwater pit is required to be located at the end of a pathway for overland flow, the pedestrian path is to be offset and appropriate measures provided to guide pedestrians away from the pit and remove any potential hazards.
9. The requirements for pathways to be constructed longitudinally along roads shall be in accordance with Table D1.3.

Table D1.3 Pathways along Roads

Road Classification	Pathway Requirements
Access Place	Nil (Kerb ramps to intersections only) ¹
Access Street	1.5m wide Pathway on one side of reserve ³
Collector Streets	1.5m wide Pathway on each side of reserve ³
Trunk Collector	2.0m wide Pathway on each side of reserve ³
Sub Arterial and Arterial	2.5m wide Pathway on each side of reserve
Industrial	1.5m wide Pathway on each side of reserve
Notes: 1. Unless required as part of a pedestrian / cycle network 2. Minimum widths in the above table may be varied with the approval of Council 3. Increase to 2.5m for cycleways	

10. All pathways shall have appropriate immunity against cross drainage
11. The maximum gradient shall be 16 % with a maximum crossfall of 2.5 per cent. Where the pathway is parallel with a road with a grade greater than 16 %, the footpath gradient shall match that of the road.
12. The finished surface level of concrete work shall be not more than 20mm above the finished surface level of adjoining ground and shall finish flush with adjoining hard surfaces.

D1.20 BIKEWAYS

1. The minimum width of land dedicated to Council for a bikeway shall be 5.0 metres with a minimum 2.5 metre wide concrete paving in accordance with AUSTRROADS Guide to Traffic Engineering Practice - Part 14 Bicycles and AS1742 Manual of Uniform Traffic Control Devices - Part 9, Bicycle Facilities.
2. Bikeways constructed using alternate material (eg Asphalt, Paving blocks) are to be approved by Council.
3. Bikeways located in parks shall be constructed above the flow of a storm of 5 year ARI, unless approved otherwise by Council.

4. All bikeways shall have a non-slip surface. Generally this can be achieved by applying a stiff broom to the wet surface. (Alternate methods require Council approval).

D1.21 KERB AND CHANNEL

1. Concrete kerb and channel, and layback kerb and tray shall be provided on both sides of all roads except as otherwise provided for in 'Queensland Streets'.
2. Standard kerbs in accordance with Standard Drawing R-0080 shall be used in the following cases:
 - Residential Streets – Mountable Kerb and Channel.
 - Medians – Edge Restraint.
 - Grassed and Landscaped Traffic Islands – Edge Restraint.
 - Concrete Traffic Islands - Semi-mountable Kerb.
 - Roundabouts (centre island only), - Edge Restraint.
 - Shopping centres and in locations where high pedestrian volumes are likely e.g. on the frontage of schools, major sporting facilities and parks. – Barrier Kerb and Channel.
3. Where proposed construction adjoins existing kerb and channel the Designer shall confirm with Council whether the existing profile shall be extended or whether the new construction will be tapered smoothly to the existing kerb and channel.
4. The grading of kerb and channel will normally conform to the road centreline grading. However, at locations where the kerb and channel grading diverts from the centreline grade, such as at intersections or on superelevated curves the following shall apply:
 - Minimum channel grade should be 0.5 per cent unless approved other approved by Council.
 - Every effort should be made to provide vertical curves as long as possible, for improved appearance.
5. At all changes in horizontal alignment, kerbs and kerb and channel shall be constructed with horizontal curves.
6. To improve appearance where small deflections occur (eg on tapers), horizontal curves shall be as long as possible. Refer also to current Department of Main Roads or AUSTROADS Design Manuals.
7. Kerb ramps shall be provided at all intersection kerb returns, at park entrances and at any other locations where required by Council.
8. Access crossovers for Industrial, Commercial and Multi Residential site shall be installed in accordance with Standard Drawing R-0051 and R-0052.

D1.22 SIGNS AND ROAD MARKINGS

1. Permanent signing and road marking shall be in accordance with the current edition of Department of Main Roads 'Manual of Uniform Traffic Control Devices' (MUTCD).
2. Temporary or construction signing and road marking shall be in accordance with current edition of Department of Main Roads 'Manual of Uniform Traffic Control Devices' (MUTCD).

3. The relevant sign reference number from the Department of Main Roads MUTCD shall be included on the construction drawings.
4. All signs and pavement markings shall be adequately dimensioned to ensure accurate setting out.
5. Signs located in grassed areas shall have a surrounding 500mm dia x 100mm thick concrete mowing strip.
6. Signs located in concrete islands or medians shall be installed with the "V Loc" socket system and fitted with anti-theft bolts.
7. The bottom of all un-sleeved posts shall be flattened prior to placing in concrete footing.
8. Vandal proof bolts and fittings shall be used on all permanent signing.
9. Street Name signs shall be installed in accordance with Standard Drawing R-0130.

D1.23 ROAD EDGE GUIDE POSTS AND GUARDRAILS

1. Road edge guide posts shall be provided at all locations where concrete kerb and channel is not constructed e.g. half road construction, tapers, ends of roads etc.
2. Guide posts shall conform to and be installed in accordance with Department of Main Roads 'Manual of Uniform Traffic Control Devices'.
3. Guardrails shall be installed in accordance with the Department of Main Roads Road Planning and Design Manual.

D1.24 PEDESTRIAN FOOT BRIDGES

1. Pedestrian foot bridges are to be provided where necessary and are to be constructed from concrete, steel or timber (all steelwork is to be hot dipped galvanised) and shall be provided with handrails / fences for pedestrian safety.
2. The clear width of all pedestrian bridges shall match the width of the approaching pathway / bikeway unless otherwise approved by Council and shall have squeeze points to control access.
3. Designers shall consult with Council at concept stage to confirm location, widths, flood immunity etc.

D1.25 TRAMLINES CROSSINGS

1. Road crossings are to be constructed in accordance with Queensland Department of Main Roads Standard Drawing 881.
2. Flashing lights and crossing warning signs to the Department of Main Roads standards are to be erected on all new road crossings or crossings where the traffic density will increase because of the development.
3. Prior to commissioning of flashing lights and warning lights appropriate temporary controls including warning signage shall be installed and maintained at all road crossings.

D1.26 FENCING

1. All fencing located inside the road reserve shall have a minimum height of 1.2m, and shall be of a type that discourages climbing and constructed in accordance with Standard Drawing S1026.
2. A continuous chain wire mesh fence shall be constructed along all interfaces between the development and the tramway reserve and shall be constructed in accordance with Standard Drawing S1026.

D1.27 FRONTAGE STREETS / ROADS

Where the frontage street/road to a development is unsealed or unformed at the time of development approval it shall be constructed to a standard no less than the greater of one half of the full width street/road or 6.0 metres from the nominal kerb line to the bitumen edge; but a greater width may be specified in conditions of subdivision approval.

An existing sealed frontage street/road to a development shall be reconstructed to one half of the full width of the street/road as a minimum requirement. Approval conditions shall generally nominate the required standard.

RURAL DESIGN CRITERIA

D1.28 GENERAL

1. In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farms types of developments. Table D1.4 details specific road demands for rural roads.

Table D1.4 Rural Road Elements

Traffic Volume or Road Class (VPD)	<100	100 - 199	200 – 999 (or rural collector)	1000 – 7999 (or sub-arterial)	>8000 (or arterial)
Road Reserve (flat terrain \leq 5%) ²	20m	20m	20m	25m	25m
Road Reserve (Undulating/Hilly > 5%)	25m	25m	25m	30m	30m
Formation	8m	8m	8m	10m	12m
Pavement Width	5.5m gravel ¹	5.5m	6.5m	8m	10m
Seal Width	Nil	4m	6.5m	8m	10m
Shoulders ³	1.25m Select material from site	1.25m gravel	0.75 gravel	Incl. 0.5m sealed on each side	Incl. 1.5m sealed on each side
Desirable Speed Environment	80kph	80kph	100kph	100kph	100kph
Design Speed for Individual Elements (Minimum)	80kph	80kph	80kph	80kph	80kph
<p>Notes:</p> <ol style="list-style-type: none"> 1. Sealing 4.0m wide shall be required for longitudinal grades in excess of 10% and may be required at sites where existing adjacent roads are sealed. 2. In undulating terrain this width shall be increased to enable services to be constructed on accessible flatter land on top and below batters. 3. Where the road is a designated on-road bicycle route (signposted and pavement marked) the shoulder provision needs to conform to the AUSTRROADS – PART 14 BICYCLES. 					

2. Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in AUSTRROADS Guide to the Geometric Design of Rural Roads.
3. Where appropriate superelevation, widening and centreline shift and their associated transitions are to comply with AUSTRROADS Guidelines.
4. Where the table drain will have a flow velocity greater than 2.5m/s or is likely to scour, a stone pitched or suitably lined dish drain is to be constructed along the invert. (Generally table drains steeper than 6 per cent will require scour protection)

D1.29 HORIZONTAL AND VERTICAL ALIGNMENT

1. Horizontal and vertical curves are to be designed generally to the requirements of AUSTRROADS - Guide to Geometric Design of Rural Roads. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform to the terrain to achieve desirable aesthetic quality and being in harmony with the landform.

D1.30 INTERSECTIONS

1. Intersections should generally be designed in accordance with the publication AUSTRROADS Guide to Traffic Engineering Practice - Part 5, Intersections at Grade.
2. Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location shall be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

D1.31 ACCESS TO ALLOTMENTS

1. All accesses onto sealed roads are to be sealed the whole access shall be sealed from the edge of the sealed bitumen to the property boundary. Accesses off gravel roads do not have to be sealed.
2. Calculations for the sizing of pipe culverts shall be carried out by a Registered Professional Engineer and approved by Council. Minimum pipe size – 375mm diameter, Minimum length – 4.8m long.
3. All pipe and box culverts under accesses shall have headwalls to protect and retain gravel fill.
4. Precast vertical headwalls with wings are preferred, but inset cast concrete or grouted stone may be used subject to Council Approval.
5. Precast sloping headwalls to be used on all access where the road design speed is 100km/h or where the culvert is within 4.5m of the traffic lane and the road speed is 80 km/h.
6. Accesses are to be designed to ensure that stormwater runoff from the road and the access discharge to the table drain.
7. Allotment Accesses shall be constructed in accordance with Standard Drawing R-0035 unless otherwise approved by Council.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D2

SITE REGRADING

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

D2.01 SCOPE

1. This section sets out the Guidelines specifically developed for site regrading involved in land development and subdivision.
2. The designer needs to make reference to the associated design guidelines related to, D1 Road Geometry, D4 Stormwater Drainage and D5 Stormwater Quality Management.

D2.02 OBJECTIVES

1. This Guideline aims to assist the Designer in achieving:
 - Efficient and economical design
 - Enhancement of the environmental character and maintenance of natural features of the site.
 - Minimal impact on adjoining properties and developments.

D2.03 REFERENCE DOCUMENTS

Australian Standards

- AS3798 Guidelines on Earthworks for Commercial and Residential Development.

D2.04 SITE REGRADING CONCEPT

1. Areas of a site proposed for building or recreational purposes may not be suitable in their natural state for their intended function without improvement works, the designer shall review the natural surface contours and where necessary shall design finished surface levels that ensure the land is suitably prepared.
2. Excessive site regrading should be avoided, wherever possible site layouts should be developed to position roads and drainage networks to take advantage of natural surface grades. Site layouts that minimise the disturbance of the land will require less erosion and sediment control measures during construction phase and reduce the risk of environmental harm.
3. The designer shall consider the implications of site regrading in relation to the existing natural environment. Generally site regrading shall be minimised in heavily treed areas.
4. The design of site regrading areas preferably should aim to achieve a balanced cut to fill to minimising haulage of imported fill or spoil to and from the development site.
5. Where practical, areas should be regraded to minimise the necessity for underground drainage systems with surface inlet pits, and allow surface water to flow naturally to roads or drainage reserves without excessive concentration.

D2.05 CLEARING

1. Clearing must be kept to a minimum. Trees and vegetation of significance shall be identified prior to design in order that the amount of disturbance may be minimised through appropriate design.
2. Reference should be made to the Vegetation Management Act and any relevant Local Laws and Policies prior to any tree clearing.
3. Generally, in areas with significant trees and vegetation:
 - Roadways clearing shall be limited to the limits of approved earthworks plus a sufficient lateral clearance to ensure that the works are not interfered by the trees or vegetation.
 - Allotment clearing shall be limited to the minimum areas required to safely construct services such as sewers and catchment drains, and the limits of approved earthworks to allotments plus a sufficient lateral clearance to ensure the works are not interfered by the trees or vegetation.
4. No trees shall be damaged or removed from areas to be dedicated under the control of Council without prior written approval of Council.
5. Trees on existing roads shall not be damaged or removed without the approval of Council. All trees on existing roads affected by the works shall be shown and details given of proposed protection or relocation methods.
6. Prior to any clearing, all existing and future parkland shall be delineated to ensure its protection from unauthorised clearing.

D2.06 GENERAL STANDARD OF LOT PREPARATION

1. Special requirements will apply where necessary but generally lots are to be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of Council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the development. Prior consultation with Council is necessary. Such requirements shall be shown on the design plan.
2. Class 1, 2 and 3 Pest Plants are to be removed and disposed of in accordance with Land, pest and Stock Route Management Act and Regulation
3. All timber and other materials cleared from lots shall be removed from the site. All roots, loose timber, etc which may contribute to drain blockage shall be removed.
4. All trees nominated by Council in its conditions of approval shall be preserved by approved means to prevent destruction normally caused by placement of conventional filling or other action within the tree drip zone. Details of the proposed protection measures shall be detailed on the design plans.

D2.07 FILLING

1. If any land is to be filled all practices must ensure compliance with AS 3798 Guidelines on Earthworks for Commercial and Residential Developments.
2. Fill comprising industrial wastes or by-products is not permitted.
3. No person shall be permitted to fill any land where, in the opinion of Council, such filling will detrimentally affect the area available in any natural or artificial watercourse for either

present or estimated future flood flows, or will detrimentally reduce the volume within a flood plain available for the storage of flood waters.

4. No person shall be permitted to fill any land if such filling may detrimentally affect natural drainage of any of the surrounding land.
5. All new allotments are to be flood free. Immunity levels shall be in accordance with relevant Council Policies and Planning Scheme requirements.
6. Every allotment shall be filled and drained to achieve Council's performance criteria, such that an area is available above the adopted flood line, or stipulated flood level, in accordance with the following documents:
 - Queensland Urban Drainage Manual (QUDM)
 - Council's Local Laws & Policies
 - Council's Flooding and Drainage Policies

D2.08 COMPACTION

1. Compaction of earthworks shall be in accordance with AS 3798 - Guidelines on Earthworks for Commercial and Residential Developments.

D2.09 CARTAGE OF SOIL

1. The designer shall nominate in their design submission whether excess spoil is generated by the proposed earthworks and in these cases shall nominate the proposed spoil dump site and external haul route which shall be subject to the written approval of the Council.
2. In cases where the spoil is generated from works within existing declared roads, Council may nominate that the spoil be placed on Council controlled land within 5 km of the project site.
3. Where rock is disposed of on site, the position of the rock is to be approved by Council and shown on the 'as constructed' drawings
4. Unless otherwise approved by Council all topsoil shall be retained on the development site and utilised effectively to encourage appropriate revegetation.

D2.10 ALLOTMENT EARTHWORKS

1. Allotments shall be provided with a minimum finished surface gradient of 0.5%, including catch drains, to facilitate drainage.

D2.11 BATTER TREATMENTS

1. Cut and fill batters shall not straddle allotment boundaries unless otherwise approved by the Council.
2. Cut batters shall not extend into existing or proposed parks or bushland reserves unless specifically approved by Council. Fill batters may extend into proposed parks or bushland reserves with a maximum slope of 1 in 10 unless otherwise approved by Council.
3. In general cut and fill batters shall be limited to a maximum slope of 1 in 4 (1 in 10 in parks), such that stabilisation is achieved by topsoiling and grassing which can be maintained by conventional tractor slasher.

4. All embankments and cuttings must be outside the road reserve. The toe of any cut batter is to be 300mm inside the property boundary, the top of any fill batter is to be 300mm inside the property boundary.
5. Where subdivision roads are constructed in fill and the batter slope exceeds 1 in 2, Council may require an easement over the batter and to a nominated distance past the toe of the batter.
6. Batters in road reserves steeper than 1 in 4 may be retained by a retaining structure subject to approval by the Council.
7. On private land batters should preferably be 1 in 4 or flatter. Batters to a maximum of 1 in 2 may be approved, subject to the submission of an acceptable landscape treatment.
8. All batters steeper than 1 in 2 or higher than 1.5m shall require certification as to stability by a Geotechnical Engineer.

D2.12 ALLOTMENT ACCESSES

1. Steep side slope of the natural surface can result in difficulty in providing vehicular access to allotments fronting the road. Driveway grades should be limited for safety and amenity. Refer Table 2.1 for Maximum Driveway Grades

Table D2.1 Maximum Driveway Grades

Location	Desirable	Maximum
Residential	16.6% (1 in 6)	25% (1 in 4)
Industrial	10% (1 in 10)	16.6% (1 in 6)
Maximum change in driveway grades - All areas	8%	10%

2. Allotment access and drainage in rural and steep areas shall be designed and constructed to include the following (unless otherwise approved by council):
 - a. Where the driveway grade exceeds 10% the driveway shall be a minimum of 3.0 metre wide concrete slab, with barrier kerb and channel provided on one side for vehicular safety and drainage purposes;
 - b. The driveway shall be constructed in such a manner as to ensure that the crossfall of the driveway be one-way and directed into the hill, for vehicle safety and drainage purposes
 - c. A turn around shall be provided adjacent to each of the proposed dwellings sufficient to allow turning movements for an emergency services vehicle;
 - d. The driveway shall be located to minimise the visual impact, and minimise the amount of earthworks required; and
 - e. Both sides of the areas adjacent to the driveway shall be re-vegetated to minimise visual impact. This information is to be included in the application for engineering approval.

D2.13 RETAINING WALLS

1. Council will allow retaining walls to be constructed up to a maximum height of 900mm without structural certification provided they are constructed fully in accordance with the technical literature provided by the manufacturer (ie. Koppers logs, Keystone or similar).

2. All retaining walls greater than 900mm high must be designed, detailed and certified by a structural engineer. Structural certification and geotechnical assessment if required shall be submitted to Council with design submission.
3. Retaining walls shall be designed so as to consider the location of any adjacent services (e.g. sewer). The minimum horizontal clearance between any adjacent sewer line and the outermost edge of the retaining wall structure shall be 800mm. Retaining walls must be designed to ensure that no imposed loads are applied directly to the sewer. Retaining walls adjacent to services shall be subject to Council approval.

D2.14 EARTHWORKS ON HILLSLOPES

1. Where earthworks are proposed in any development where the slope of the land exceeds 15% (unless otherwise agreed), Council requires a report from a qualified Geotechnical Engineer addressing slope stability and construction issues.
2. The designer shall incorporate the specific measures and recommendation contained within the geotechnical report to control soil and rock movements into the design of roads and house bench pads.

D2.15 EARTHWORKS TO PARKS

1. All earthworks within proposed or existing parkland shall:
 - Be adequately drained.
 - Have no batters exceeding 1 in 10.
 - Have acceptable landscaping in accordance with Council's Guidelines.

D2.16 FOOTPATHS / VERGE CROSSFALL

1. All Footpaths / Verges shall fall from the frontage property boundary to the adjacent kerb and channel with acceptable crossfalls of between 3% - 5%. In the case where the allotment falls away from the road reserve (ie. the allotment is lower than the level of the road), the footpath / verge shall have a minimum fall from the frontage property boundary to the adjacent kerb of 3%.

D2.17 TOPSOILING AND GRASSING

1. Topsoil is defined as surface soils high in organic matter and contaminated by residual grass seeds and grass roots.
2. The area under paved areas, footpaths, batters and areas of fill shall be stripped of topsoil and any other organic matter.
3. On the completion of the works, topsoil shall be re-spread to allotments, batters and footpaths and fill areas to a depth of 75mm.
4. The footpath areas, batters and all disturbed areas including allotments are to be trimmed and drill seeded with an approved grass species.
5. All cut and fill batters shall be hydro mulched or approved equivalent.

D2.18 INSPECTION REQUIREMENTS

1. Inspections and testing requirements for all allotments and roads shall be to Level 2 in accordance with AS 3798 - Guidelines on Earthworks for Commercial and Residential Developments.
2. A higher level of inspection and testing may be required for more significant works as determined by Council.
3. Council may approve a lower level of inspection and testing for minor works and drainage works.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D3

ROAD PAVEMENTS

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
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GENERAL

D3.01 SCOPE

1. This section sets out the Guidelines for the design of the road pavement to meet the required design life, based on the sub grade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select sub grade, sub base, base and wearing surface.
2. The Guideline contains procedures for the design of the following forms of road pavement construction:
 - (a) Flexible pavements
 - (b) Rigid pavements (i.e. concrete pavements);
3. Generally flexible pavements designed in accordance with this guideline are preferred for road pavement construction in Whitsunday Shire Council may examine pavement designs for rigid pavements subject to detailed engineering submissions of any such proposals. Council reserves the right to refuse any alternate proposal for pavement design.

D3.02 OBJECTIVES

1. The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

D3.03 REFERENCE DOCUMENTS

Department of Main Roads

- Pavement Design Manual

AUSTROADS / ARRB Publications

- Design of Sprayed Seals, 1990.
- Pavement Design, A Guide to the Structural Design of Road Pavements
- Guide for Control of Moisture in Roads
- ARRB-SR35 – Special Report No. 35 – Subsurface Drainage of Road Structures.
- APRG 21 – Report No. 21 – A guide to the design of new pavements for light traffic

Cement and Concrete Association of Australia

- T51 Concrete Pavement Design for Residential Streets.

Concrete Masonry Association of Australia

- T44 Concrete Segmental Pavements – Guide to Specifying
- T45 Concrete Segmental Pavements – Design Guide for Residential Access Ways and Roads.
- T46 Concrete Segmental Pavements – Detailing Guide.

PAVEMENT DESIGN CRITERIA

D3.04 DESIGN VARIABLES

1. Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following five input variables:
 - (a) Design Traffic
 - (b) Sub grade Evaluation
 - (c) Environment Factors
 - (d) Pavement and Surfacing Materials
 - (e) Construction and Maintenance Considerations

D3.05 DESIGN TRAFFIC

1. The design traffic shall be calculated based on the following minimum design lives of pavement:-
 - (a) Flexible, - 20 years
 - (b) Rigid (Concrete) - 40 years
 - (c) Segmental Block - 25 years
2. Unless determined otherwise by the Council, the minimum number of design Equivalent Standard Axles (ESA's i.e., 80 kN axle load passes) for the various road categories shall be as calculated in accordance with the requirements of the AUSTRODS publications "Pavement Design - A Guide to the Structural Design of Road Pavements" and "APRG Report 21 - A guide to the design of new pavements for light traffic". For design traffic volumes approaching or exceeding 5×10^5 ESA's (Trunk Collector Street), Main Roads Pavement Design Manual shall be used.
3. Design traffic shall be calculated for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity. For new subdivisions, the design traffic shall take account of both the construction traffic associated with the subdivision development, the in-service traffic, proposed and potential public Transport routes and connection to adjacent development.
4. For interlocking concrete segmental pavements, the simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA – T45 is acceptable up to a design traffic of 5×10^5 .
5. The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic.
6. In the absence of other traffic data, the traffic values provided in Table D3.1 may be taken as a guide to the minimum design traffic, but shall be subject to variation depending on the circumstances for the particular development.

Table D3.1 Minimum Traffic Loadings			
Street Type	%CV¹	%ESA/CV	Minimum ESA's
Urban			
Access Place	3.6	1.0	5×10^4
Access Street	5	1.0	1×10^5
Collector Street	7	1.0	5×10^5
Trunk Collector Street	10	1.0	1×10^6
Sub Arterial	10	1.0	3.25×10^6
Rural			
<250vpd	5	1.0	2.5×10^5
>250vpd	9	1.0	2.5×10^6
Industrial	To be determined by specific design data		2.5×10^5
Business / Commercial	To be determined by specific design data		5×10^5
Note 1. Consider potential for bus routes			

D3.06 SUBGRADE EVALUATION

1. Sub grade evaluation shall be carried out by a NATA registered materials test authority on each different natural sub-grade material evident and shall be by the conduct of soaked 4 day CBR laboratory testing.
2. Design CBR for each sub grade area shall be determined in accordance with the method outlined in AUSTRROADS publications "Pavement Design - A Guide to the Structural Design of Road Pavements" and "ARRG Report 21 - A guide to the design of new pavements for light traffic".
3. The following factors must be considered in determining the design strength/stiffness of the sub grade:
 - (a) Sequence of earthworks construction
 - (b) The compaction moisture content and field density specified for construction
 - (c) Moisture changes during service life
 - (d) Sub grade variability
 - (e) The presence or otherwise of weak layers below the design sub grade level.
4. The sub grade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and sub grade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.
5. If the insitu sub grade test results in a CBR of 3 or less, the pavement is to be designed with input from geotechnical engineer experienced in the design of road pavements.

D3.07 ENVIRONMENT FACTORS

1. The environmental factors, which significantly affect pavement performance, are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to AUSTRROADS publications "Guide to Control of Moisture in Roads" and "Special Report No. 35 Subsurface Drainage of Road Structures".
2. The following factors relating to moisture environment must be considered in determining the design sub grade strength/stiffness and in the choice of pavement and surfacing materials:
 - (a) Rainfall/evaporation pattern
 - (b) Permeability of wearing surface
 - (c) Depth of water table
 - (d) Relative permeability of pavement layers
 - (e) Whether shoulders are sealed or not
 - (f) Pavement type (boxed or full width)
 - (g) Subject to flooding (eg. Causeways and Floodways).
3. The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength parameters (ie. CBR or modulus) at the highest moisture content likely to occur during the design life, ie the Design Moisture Content. The provision of subsurface drainage may, under certain circumstances, allow a lower Design Moisture Content, and hence generally higher Design CBR.
4. The pavement design shall include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength, or affect the choice of pavement and surfacing materials.

D3.08 MATERIALS TESTING

1. All materials testing shall be carried out by a NATA registered materials testing authority using the procedures described in the manuals or codes of practice as appropriate to the following authorities:
 - Department of Main Roads
 - Standards Association of Australia

PAVEMENT THICKNESS DESIGN

D3.09 PAVEMENT STRUCTURE – GENERAL

1. The minimum pavement provided shall be as detailed in Table D3.2.

Table D3.2 Minimum Pavement Design Criteria

Street Type	Minimum Pavement (mm) ¹	Surface Treatment	Minimum Base Course CBR	Minimum Subbase Course CBR
Access Place / Access Street	175	30mm AC	80	45
Collector Streets	200	30mm AC	80	45
Trunk Collector Street	225	50mm AC	80	60
Sub Arterial	225	50mm AC	80	60
Low Density Residential	200	30mm AC	80	45
Rural				
• < 100 vpd	150	Gravel	-	45
• 100 – 199 vpd	150	2 coat seal	80	45
> 200 vpd	200	2 coat seal	80	45
Industrial	250	50mm AC	80	60
Notes:				
1. Minimum pavement thickness does not include the depth of surfacing.				
2. All cul-de-sac heads and intersection turnouts in Rural and Rural Residential developments are required to have a 30mm asphalt surface treatment				

2. Notwithstanding subgrade testing and subsequent pavement thickness design, the thickness of subbase and base layers shall not be less than the following:
- (a) Flexible pavement: Subbase 100mm, Base 100mm
 - (b) Rigid pavement: Subbase 100mm, Base 150mm
3. The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing.
4. The base and surfacing shall extend to the face of any kerbing. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing. Regardless of pavement design, all kerbing to be constructed on a minimum of 100mm pavement material.
5. For uncurbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder.
6. A change of pavement types may be considered for intersection thresholds and traffic control features.

D3.10 FLEXIBLE PAVEMENTS

1. Flexible pavements with a design traffic up to 5×10^5 ESA's shall be designed in accordance with AUSTRROADS publications "Pavement Design - A Guide to the Structural Design of Road Pavements" and "ARRG Report 21 - A guide to the design of new pavements for light traffic".
2. Flexible pavement with a design traffic above 5×10^5 ESA's shall be designed in accordance with Main Roads Pavement Design Manual.
3. In areas of high water table (within 300mm of sub grade level). Base course should be cement modified (1% by weight)
4. Concrete segmental pavements with design traffic up to 5×10^5 and estimated commercial vehicles exceeding 3T gross shall be designed in accordance with CMAA-T45.
5. For design traffic above 5×10^5 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTRROADS Pavement Design, with the calculation of design traffic in terms of ESA's.

D3.11 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 5×10^5 ESA's shall be designed in accordance with either CCAA -T51 or AUSTRROADS Pavement Design.
2. Rigid (concrete) pavements for design traffic above 5×10^5 ESA's, the design shall be in accordance with AUSTRROADS Pavement Design.

SURFACING DESIGN

D3.12 BITUMEN WEARING SURFACE

1. Except where the pavement is designed for asphaltic concrete or segmental paver surfacing or where a gravel pavement is permitted, the wearing surface shall be a bituminous seal as follows:

(a) Urban Residential, Low Density Residential, Park Residential
(Only permitted on widenings adjacent to existing bituminous seals)
Primer, plus 2 coat sprayed bitumen seal (14mm / 7mm Aggregate).

(b) Rural & Rural Residential
Primer, plus 2 coat sprayed bitumen seal (16mm / 10mm Aggregate).

D3.13 SEGMENTAL PAVERS

1. Segmental pavers shall be concrete segmental pavers 80mm thick, shape Type A, and designed to be paved in a herringbone pattern unless otherwise approved by Council. The use of clay pavers on road wearing surfaces is not permitted.
2. The edges of all paving shall be constrained by either kerbing and/or guttering, or by concrete edge strips.
3. Sand bedding layers are to be provided with adequate drainage.

D3.14 ASPHALTIC CONCRETE

1. All roadworks shall be surfaced with an appropriate thickness of Asphaltic Concrete in accordance with Table D3.2.
2. Council requires the use of dense graded asphalt on all roads.
3. All roads greater than 10% shall have a 10mm primer seal or other Council approved measure applied to the base course prior to the placement of the AC.

SUBSURFACE DRAINAGE

D3.15 SUBSOIL DRAINS

1. Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:
 - (a) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level.
 - (b) Locations of known hillside seepage, high water table or isolated springs.
 - (c) Irrigated, flood-prone or other poorly drained areas.
 - (d) Subgrades, which are highly susceptible to moisture, (i.e. commonly displaying high plasticity or low soaked CBRs).
 - (e) Pavement materials, which are susceptible to moisture.
 - (f) Existing pavements displaying signs of distress due to excess subsurface moisture.
 - (g) At cut to fill transitions.
 - (h) Landscaped islands and medians.
2. Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.
3. In some circumstances it may be necessary to note on the engineering design the need for additional subsoil and sub-pavement drains that may become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation.
4. The requirements for subsoil drains should be assessed and designed by a registered geotechnical engineer or specialist pavement engineer.
5. In kerbed roads, the preferred location for the line of the trench is directly behind the kerb.
6. In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers.
7. At the time of sub-soil drainage installation tree root barriers are to be installed in the appropriate locations and the kerb suitably marked (temporarily) to indicate where the tree is to be planted
8. The minimum desirable longitudinal design grade shall be 1.0 - 1.5%. (Absolute minimum grade of 0.5%).
9. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 300mm in earth and 200mm in rock.
10. Outlets shall be spaced at maximum intervals of 150 metres. Where possible, subsoil and sub-pavement drainage pipes shall discharge into gully pits or other stormwater drainage structures. Where not possible, outlets shall be provided through fill batters.

11. Flushing Points are to be provided at the commencement of each run of drain, and at intervals not exceeding 50 metres. Flushing points shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.
12. Flushing Points and Outlets shall be constructed in accordance with Standard Drawing R-0140.

D3.16 DRAINAGE MAT (BLANKETS)

1. Drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to intercept and control seepage water and springs in the floors of cuttings, to intercept water which would otherwise enter pavements by capillary action or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.
2. In embankments drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.
3. In excavations drainage mats are constructed after completion of the subgrade construction and before construction of the pavement.
4. The minimum thickness of compacted filter material shall be 300mm plus an allowance for the expected consolidation or 500mm if the amount of consolidation of embankment foundation is not known.
5. The requirements for and design of drainage mats shall be undertaken by a geotechnical engineer experienced in the design of road pavements.
6. All drainage mats shall be wrapped in appropriate geotextile.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D4

STORMWATER DRAINAGE

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No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
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GENERAL

D4.01 SCOPE

1. This section sets out the guidelines for the design of stormwater drainage systems for urban and rural areas.
2. The designer needs to make reference to the associated design guidelines related to D1 Road Geometry and D5 Stormwater Quality Management.
3. The Queensland Urban Drainage Manual (QUDM) shall be the basis for the design of stormwater drainage, except as amended by these Guidelines.

D4.02 OBJECTIVES

1. The objectives of stormwater drainage design are as follows:
 - (a) To collect and convey stormwater from a catchment to its receiving waters with minimal nuisance, danger or damage and at a development and environmental cost which is acceptable to the community as a whole.
 - (b) Limit flooding of public and private property, both within the catchment and downstream, to acceptable levels.
 - (c) To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed velocity/depth limits.
2. For new developments a stormwater drainage system in accordance with the "major/minor" system concept in accordance with Queensland Urban Design Manual (QUDM); that is, the "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.
3. For redevelopment areas where the proposed development replaces an existing development, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the site for the design average recurrence interval (ARI) of the receiving minor system is no greater than that which would be expected from the existing development and is not concentrated in such a way as to cause nuisance to downstream properties.

D4.03 REFERENCE DOCUMENTS

Department of Natural Resources (jointly with Brisbane City Council & IMEAQ)

- Queensland Urban Drainage Manual, Volumes 1&2, 1993

Institute of Engineers Australia

- Australian Rainfall and Runoff – A guide to flood estimation. August 1987.

DESIGN CRITERIA

D4.04 GENERAL

1. The Queensland Urban Drainage Manual (QUDM) shall be the basis for design of stormwater drainage except where amended by these guidelines.
2. Minor system flows (as defined by QUDM) are to be conveyed underground to a legal point of discharge unless otherwise approved by council
3. The design of the stormwater drainage system, for the development shall be such that the upstream drainage is not adversely affected and that the downstream drainage system is capable of adequately catering for the discharge of the modified flow produced as a result of the development
4. If the downstream system is not capable of carrying the modified discharge, the designer shall indicate the measures proposed to ensure the downstream system is capable of carrying the modified discharge. This will involve negotiation with adjoining landowners of minor creek systems to produce easements over downstream drainage paths. Written approval from the respective property owners is required for the easement and any engineering works on their property from the development site to the lawful point of discharge.
5. Alternatively where a development will result in increased runoff the stormwater drainage system may include on-site measures to such as detention basins, to ensure that the peak discharge from the development area is restricted to a level no greater than that discharging prior to the development.
6. All works proposed within creeks and natural watercourses, or lands under the control of other Authorities must have the approval of all relevant authorities prior to commencing the work and evidence of such approvals shall be provided with the design submission.
7. The design of the stormwater drainage system shall accommodate the future developed peak flows from upstream catchments on the basis of development in accordance with the Planning Scheme.
8. The designer shall be responsible for assessing the existing and future developed flow regime entering the development site from upstream catchments and shall provide detailed calculations with the design submission.
9. Unless approved otherwise by the Council, piped drainage systems shall extend to the boundaries of the subject land, with inlet and discharge works within the subject property.
10. All Material and components of the Stormwater Drainage system shall be durable and fit for purpose, with a minimum lifespan 60 years.

D4.05 DESIGN AVERAGE RECURRENCE INTERVAL

1. Design Average Recurrence Interval (ARI) shall be in accordance with QUDM Section 5.06 unless noted otherwise in the Local Authority Specific Requirements.
2. For the purpose of drainage, a major road shall be defined as a trunk collector or higher order road.

D4.06 CATCHMENT AREA

1. The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or man made paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.
2. The catchment boundary shall be determined by using the most accurate information available and details of catchments shall be provided to Council with the design submission.

D4.07 KERB INLETS AND MANHOLES

1. Kerb Inlet pits shall be in accordance with Standard Drawings D-0060, D-0063 and D-0067. All pits are to be recessed sufficiently to maintain a continuous lip line in accordance with these drawings. Alternate proprietary kerb inlets systems may be used only where approved by Council.
2. Kerb Inlet capacity design charts have been prepared for the standard kerb inlets (Refer Appendix B in this guideline). Where an alternate proprietary kerb inlet systems have been approved for use by Council, a copy of certified inlet capacity design charts for the alternate inlets shall be provided to Council with the design submission.
3. Blockage Factors shall be used for the design of the drainage system as shown in Table D4.2.

Table D4.2 Kerb Inlet Blockage Factors

Inlet Type	Blockage Factor
On Grade - Side Entry, (no Grate)	20%
On Grade - Side Entry, (with Grate)	10%
On Grade – Grate only	50%
Sag - Side Entry, (no Grate)	20%
Sag - Side Entry, (with Grate)	Nil
Sag – Grate only	50%

4. The kerb inlet capacity design charts shall be used in accordance with the following guidelines:
 - Curves indicated on the charts that are shown in full are considered "Reliable" curves.
 - Curves indicated on the charts that are shown dashed up to an Approach Flow of 250 l/sec are considered "Satisfactory" for use.
 - Curves indicated on the charts that are shown dashed with an Approach Flow in the range 250 l/sec to 500 l/sec are "Estimates Only" and are to be used with caution in critical locations.
 - No extrapolation beyond the limits of these charts shall be permitted.
5. Side entry pits with grates are preferred. Grated inlet pits with no side entry shall only be used in areas with a low risk of consequential damage from blockage and shall be subject to Council approval.
6. Manholes shall be provided on stormwater drainage lines in accordance with the requirements of QUDM. Manholes for pipes up to 1200mm dia shall be constructed in accordance with the Standard Drawing D-0010. Council may examine proposals for the

use of proprietary manufactured directional changes for stormwater systems and the acceptance of these will be subject to the satisfaction of the Council.

7. Other factors to be considered in the design are as follows:

- Pits to be free draining.
- Kerb inlet pits at intersections generally are to be located at the tangent point taking into account the position of pedestrian paths and kerb ramps. Inlets shall not be placed on kerb return unless specifically approved by Council.
- Reductions in pipe sizes shall not be permitted.
- Pipework openings are to be located within a single wall. i.e. pipes shall not be permitted to enter through the corner of the pit structure.
- Pits are to be located on straights opposite side property boundary lines so as to reduce the likelihood of conflict with future driveways.

8. The desirable maximum gully pit depth should be limited to 1.5m to enable maintenance,

9. The desirable minimum and maximum stormwater manhole depth is to be limited to 1.2m and 3.0m respectively

10. Gully pits should be located at the mid point of allotment frontages to reduce the likelihood of conflict with service conduits and future driveways

D4.08 PIPES / BOX CULVERTS

1. Stormwater drainage pipes and boxes shall generally be of reinforced concrete (including FRC) construction and in accordance with the following:

- Minimum pipe size 375mm diameter, minimum box culvert size 450mm x 300mm.
- Minimum clear cover shall be 600mm in general or in accordance with manufacturer's specification, otherwise approved by the Council.
- The minimum vertical and horizontal clearances between a stormwater pipe and any other pipe or service conduit shall be 150mm.
- In areas of high water table and sandy soils, rubber ring joint pipes shall be used.
- In aggressive environments or where any part of the pipe / box culvert is below the Highest Astronomical Tide (2.19 AHD), pipes / box culverts will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.

D4.09 OVERLAND FLOW

1. Overland flow paths or emergency relief paths shall be formed and located in accordance with the requirements of QUDM. The following additional requirements shall also be required.

- Where a pathway link is used for overland flow the pathway shall be concrete for its full width, shall have a maximum crossfall of 2.5 per cent and be constructed with a layback kerb and channel or approved equivalent along one edge. The ARI 100 year flow shall be contained completely within the pathway.
- The footpath profile at the overland flow tip out point shall be designed to provide a fall from the kerb at the road edge towards the pathway / park.
- Flows through parks shall have non-erosive velocity or adequate protection against scouring to the satisfaction of Council.

- Where a stormwater pit is required to be aligned with a pathway for overland flow, the pedestrian path is to be offset and appropriate measures provided to guide pedestrians away from the pit and remove any potential hazards.
- Where flows discharge into receiving waters or drainage reserves, adequate protection against scouring of the batter slope shall be provided to the satisfaction of Council.

D4.10 DRAINAGE CALCULATIONS

1. If a lawful point of discharge and tailwater conditions have not been provided by Council as development conditions they shall be confirmed with Council prior to proceeding with detailed design.
2. Hydraulic calculations shall generally be carried out in accordance with QUDM. The calculations shall substantiate the hydraulic grade line adopted for design of the system. A sample of a summary sheet for hydraulic calculations is given in QUDM Volume 2.
3. Catchment plans and hydraulic calculations including any additional calculations in support of overland flow path capacities, weir flows over kerbs, culvert designs etc shall be provided to Council with the design submission. Where a hydraulic modelling programme is used, calculations to be provided with the design including listings of all programme input parameters.

D4.11 OPEN CHANNELS

1. Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where Council permits the use of an open channel to convey flows from a development site to the receiving water, such a channel shall be designed in accordance with QUDM.
2. Maximum side slopes on grass lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 10.
3. Low flow provisions in open channels to prevent scouring from trickle flows shall be provided to all grass lined channels. Trickle flow protection shall be contained within a pipe or hard lined channel and shall be designed to cater for the 3 month ARI storm event (60 per cent of the 1 Year ARI storm event flow).
4. Subsurface drainage shall be provided in grass-lined channels to prevent water logging of the channel bed.
5. Profiles of all grass lined channels shall be such that mowing may be undertaken by a tractor and slasher to the satisfaction of Council.
6. Where the flow velocity and / or depth within an open channel pose a safety hazard, barrier fencing and / or appropriate hazard warning signs shall be provided to discourage access to the channel. The extent of precautions should be determined following consultation with Council.
7. The depth velocity product and the gutter flow widths are to be included in the submitted drainage calculations

D4.12 INTERALLOTMENT DRAINAGE

1. Interallotment drainage systems shall be designed in accordance with Q.U.D.M section 5.18. The minimum standard shall be Level 2 as defined in Q.U.D.M figure 5.18(b) and 5.18.3, however the Engineer may direct a higher level for specific developments or parts thereof.
2. Interallotment drainage system shall be provided to all allotments where:-
 - Any part of the allotment falls away from the frontage roadway; or the mid block finished surface level is less than 600 mm above the lowest invert level along the frontage kerb and channel.
 - Easement shall be required over level 2 interallotment drainage systems.
3. Interallotment pipes shall generally be:
 - uPVS sewer pipe minimum class SEH
 - uPVC drainage pipe PLASCOR or equivalent, of equivalent class to uPVC sewer class SHE.
 - R.C. Pipe class "1" rubber ring jointed
 - F.R.C pipe class "X" rubber ring jointed
 - uPVC pipes to be rubber ring jointed. Standard manufacturers fittings shall be used in all cases; site fitted saddles are not permitted.
4. Interallotment drainage systems shall be discharged into an underground drainage system or approved open channel. Discharge of interallotment systems to kerbs and channel shall not be permitted.

Cover

5. The general minimum cover to pipe shall be 500 mm. The minimum cover to house connections shall be 500 mm.
6. The depth of the house connection shall be determined as follows (subject to the above minimum):
 - Determine the longest run of house drain to the connection point possible within the allotment
 - Allow 0.3 metres cover to the house drain at the head of the line.
 - Allow minimum grade of 1 in 100 for the house drain.
7. Inspection manholes may be precast+ or cast insitu concrete boxes or precast FRC or RC pipe systems to the dimensions shown in table D4.3

Table D4.3 – Inspection Manholes

Maximum Depth to invert (mm)	Boxes – internal Dimensions (mm)	FRC or RCP Systems
900	600 x 600	600 mm diameter
>900	600 x 900	750 mm diameter
Minimum Wall thickness	100 +	N/A
+precast boxes shall be approved prior to installation, wall thickness may vary according to manufacturer.		

8. Manholes shall be provided in the following locations:

- One per lot
- Changes in grade
- Changes in direction
- Changes of pipe diameter
- Ends of lines

D4.13 RETAINING WALLS

1. Where retaining walls are incorporated in the retention of earth batters, adequate drainage shall be incorporated behind the top of the wall to ensure surface stormwater flows do not flow over the top of the wall but are contained in a designed system to pass the wall.
2. Appropriate scour protection is to be provided to the base of the wall.

D4.14 DETENTION BASINS

1. Detention basins may be considered as drainage solutions but shall be subject to approval of Council. Where approved detention basins shall be designed in accordance with QUDM.

D4.15 HEADWALLS

1. Pipe / Box culvert headwalls shall be in accordance with Standard Drawings D-0080 and D-0081. Proprietary precast headwall may also be used as an alternative to cast insitu structures.
2. The designer shall ensure that in addition to standard aprons and cut-off walls adequate protection works commensurate with design velocities and flows shall be provided to prevent downstream scouring and erosion.
3. Where floodgates are to be used, headwalls and aprons shall be specifically designed to accommodate the floodgate and minimise the potential for debris and siltation to impede the operation of the floodgate. Most precast headwalls are not suitable for use with floodgates.

D4.16 TABLE DRAINS

1. Table drains shall generally be constructed with a minimum depth of 600mm or to a depth of 300mm below the pavement subgrade, whichever is greater.
2. Table drain profiles may be either v-shaped or trapezoidal. Reference should be made to the Local Authority Specific Requirements for each Councils preferred profile.

D4.17 EASEMENTS

1. Easements are to be provided over all stormwater drains (including pipes, open drains and natural waterways) which pass through property other than a road reserve.
2. Where stormwater drainage pipes pass through property other than a road reserve an easement shall be provided over the line in favour of the Council. The width of this easement is determined by the depth at which the stormwater pipe is laid and based on twice the depth to the pipe obvert plus the pipe diameter (with a minimum width of three (3) metres) and located centrally over the pipe.
3. If a stormwater pipe passes adjacent to a property and based on the above formula the area of influence passes within the property, an easement over that portion shall be required.
4. The width of easement shall contain the ARI 100 year storm flow from the upstream catchment or be three (3) metres wide, whichever is greater.
5. Allotment drainage or catch drains which have a change in horizontal alignment greater than 45 degrees shall be provided with concrete or wire-reinforced rock mattresses at such change points which shall be designed to cater for flows in accordance with QUDM.

D4.18 OUTLET / OUTLET PROTECTION

1. Outlets into natural watercourse, open channels and tidal areas shall be designed in accordance with the requirements of QUDM.
2. All outlets shall be located to facilitate inspection and maintenance access.
3. Protection works to outlets shall be designed to meet the following criteria:
 - Dissipate the outflow velocity to minimise scouring.
 - Provide protection from stream flows in receiving waters,
 - Provide protection from overland (Major Storm) flows into receiving waters.
 - Provide protection from local scouring or undermining of the outlet structure.
4. Where a headwall is located within the tidal splash zone, it will be designed to comply with the exposure classification requirements of AS 3600
5. An energy dissipating outfall shall be provided where the velocity of the outflow or nature of the discharge from the pipe system into the receiving water could cause scouring in the receiving channel.
6. All tidal outlets shall be fitted with floodgates to prevent the intrusion of salt water into the system.
7. Outlets with floodgates shall be designed to ensure that they can operate freely at all times, and are protected from siltation, excessive vegetation growth, debris and the impacts of stream flows in the receiving waters.

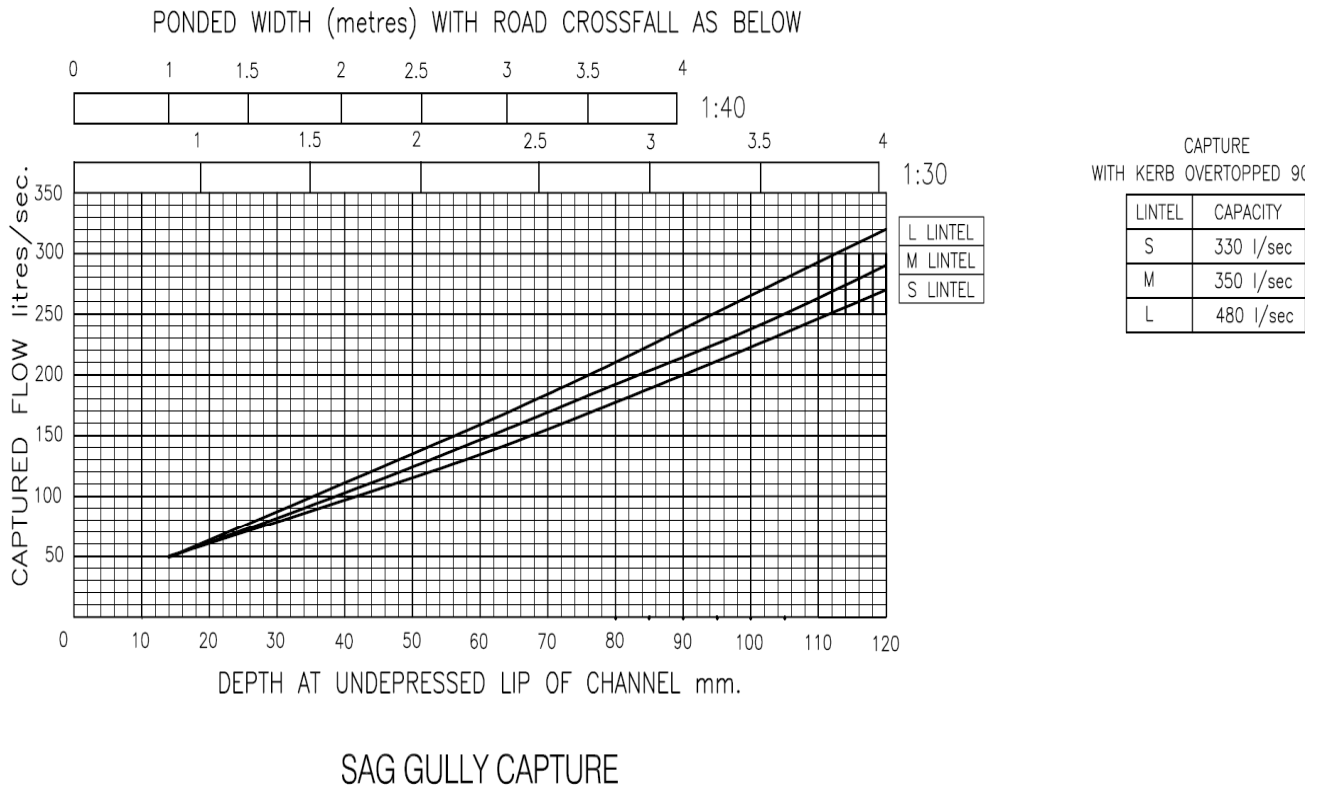
8. The designer shall provide calculations to show that they have accounted for losses due to floodgates or other water control devices in the hydraulic design.
9. Where the flow velocity and / or depth at any outlet (pipes or RCBC) pose a safety hazard, barrier fencing and / or appropriate hazard warning signs shall be provided to discourage access. The extent of precautions should be determined following consultation with Council.

WHITSUNDAY SHIRE COUNCIL

APPENDIX B

KERB INLET

CAPACITY CHARTS



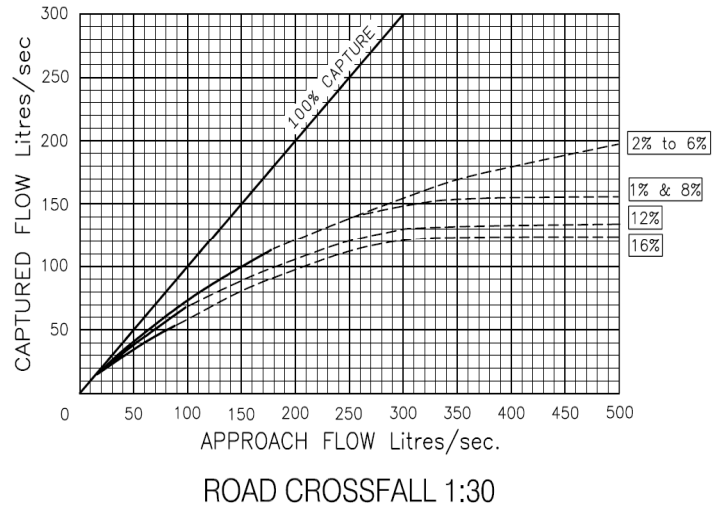
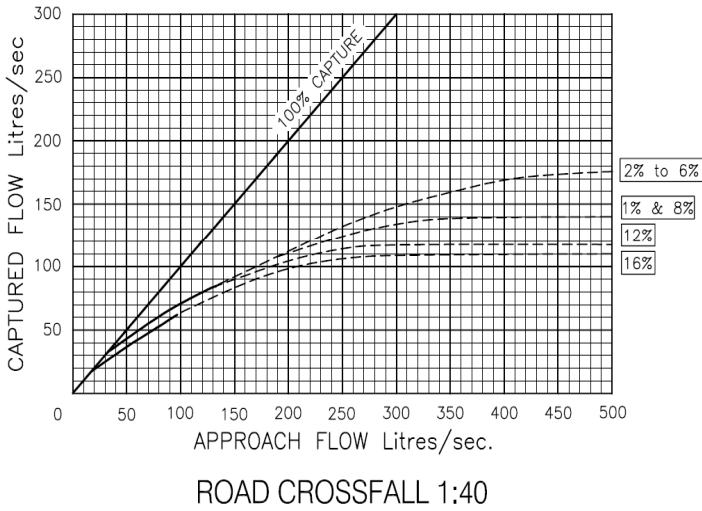
LEGEND

_ % Kerb & channel longitudinal slope

NOTES

1. This capture chart should only be used in conjunction with the requirements of Design Guidelines D4 Stormwater Drainage.
2. Refer to standard drawings S1050, S1055, and S1060 for Kerb Inlet Pit details.

KERB INLET
CAPACITY DESIGN CHART
ON GRADE - TYPE 'S'
10% BLOCKAGE FACTOR



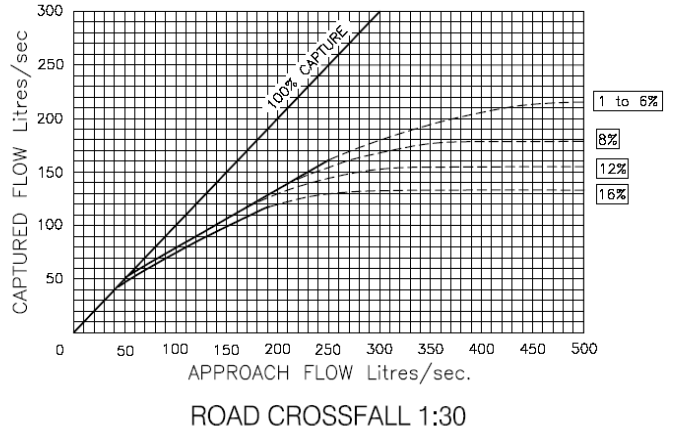
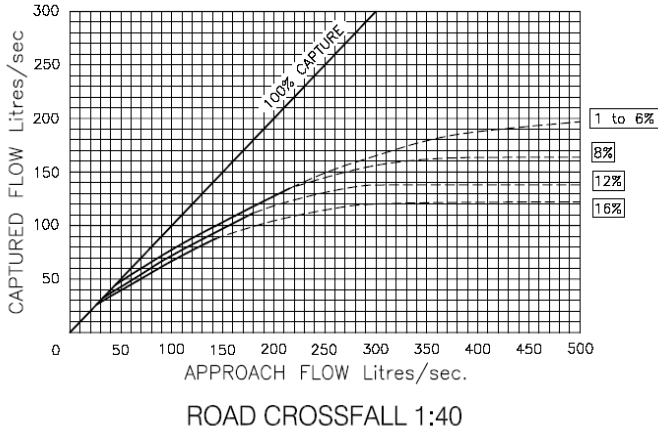
LEGEND

— % Kerb & channel longitudinal slope

NOTES

1. This capture chart should only be used in conjunction with the requirements of Design Guidelines D4 Stormwater Drainage.
2. Refer to standard drawings S1050, S1055, and S1060 for Kerb Inlet Pit details.

KERB INLET
CAPACITY DESIGN CHART
ON GRADE - TYPE 'S'
10% BLOCKAGE FACTOR



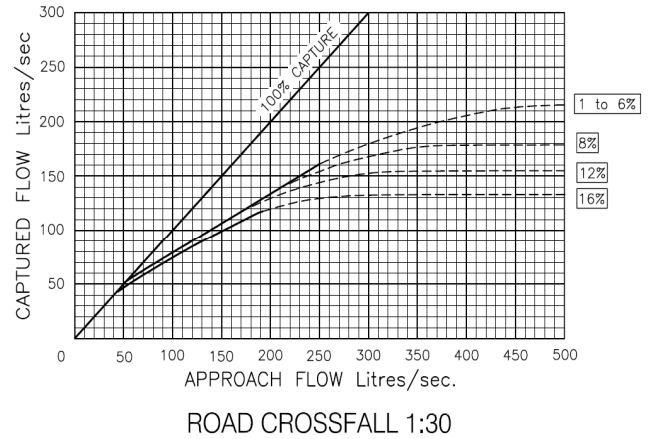
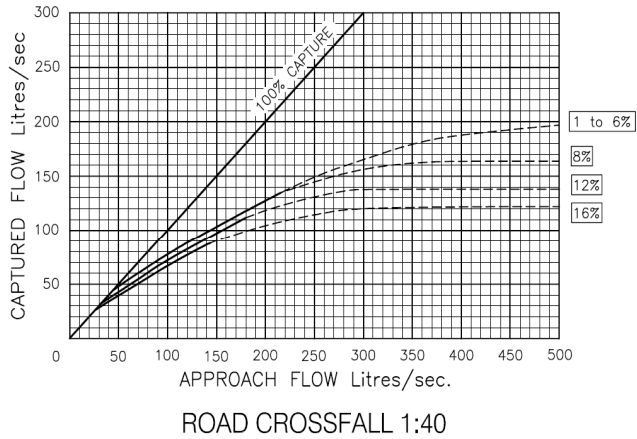
LEGEND

_ % Kerb & channel longitudinal slope

NOTES

1. This capture chart should only be used in conjunction with the requirements of Design Guidelines D4 Stormwater Drainage.
2. Refer to standard drawings S1050, S1055, and S1060 for Kerb Inlet Pit details.

KERB INLET
CAPACITY DESIGN CHART
ON GRADE - TYPE 'M'
10% BLOCKAGE FACTOR



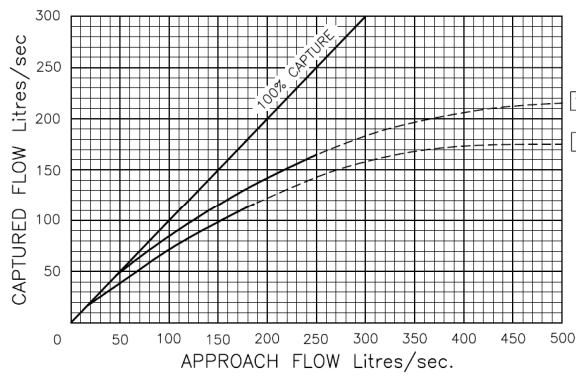
LEGEND

_ % Kerb & channel longitudinal slope

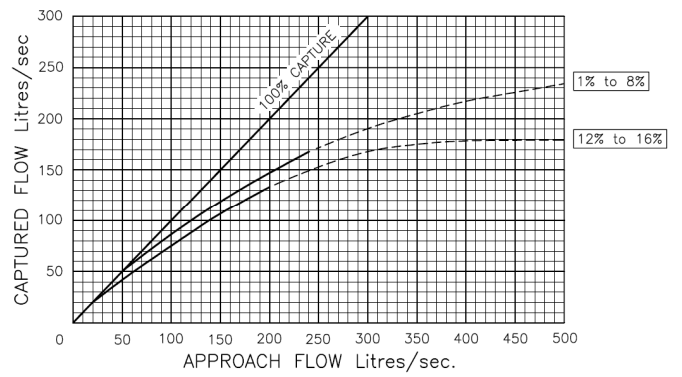
NOTES

1. This capture chart should only be used in conjunction with the requirements of Design Guidelines D4 Stormwater Drainage.
2. Refer to standard drawings S1050, S1055, and S1060 for Kerb Inlet Pit details.

KERB INLET
CAPACITY DESIGN CHART
ON GRADE - TYPE 'M'
10% BLOCKAGE FACTOR



ROAD CROSSFALL 1:40



ROAD CROSSFALL 1:30

LEGEND

— % Kerb & channel longitudinal slope

NOTES

1. This capture chart should only be used in conjunction with the requirements of Design Guidelines D4 Stormwater Drainage.
2. Refer to standard drawings S1050, S1055, and S1060 for Kerb Inlet Pit details.

KERB INLET
CAPACITY DESIGN CHART
ON GRADE - TYPE 'L'
10% BLOCKAGE FACTOR

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

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D5

STORMWATER QUALITY MANAGEMENT

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

D5.01 SCOPE

1. This section sets out the Guidelines for the management of stormwater quality related to land development and sub-division activities that are subject to development assessment in accordance with an applicable council planning scheme.
2. The Guidelines set out the requirements for the management of both long term and short-term water quality impacts.

D5.02 OBJECTIVES

1. Management of water quality is founded on the need to protect the baseline water quality to ensure that there is no risk to public health and minimise the stresses placed on the ecosystems within and reliant on waterways within the catchment.
2. In recognition of the impacts that development may have on the quality of water within the waterways, the over-riding objective for water quality management is to minimise the potential for development activity to cause harm to the environment / receiving waters.
3. The key principles adopted for water quality management to achieve the objective are:
 - (a) Minimisation of increase in flows arising from the development of land for urban use;
 - (b) Stabilisation of the stream profile to maintain hydraulic capacity and ensure public safety;
 - (c) Ensuring that the quality of the water within the waterways throughout each catchment is consistent with the ecological needs of the environment and the health needs of the community, and that environmental values are preserved;
 - (d) Vegetative enhancement of the riparian zone to ensure the overall stability of the waterways throughout each catchment and improve its resistance to contaminants;
 - (e) Adoption of appropriate management practices for the control of erosion and sedimentation for the period that a development site is disturbed

D5.03 TERMINOLOGY

1. ESC refers to Erosion and Sediment Control, for example ESC measures are practices and devices used to minimise erosion and control sediment transport.
2. An ESCS is an Erosion and Sediment Control Strategy. It is a document, which details the acceptable management practices and strategies to be employed during the construction period of the development. The ESCS must be prepared by an appropriately qualified consultant to be submitted with Operational Works applications
3. An ESCP is a site plan, including explanatory notes detailing the site specific controls for the management of erosion and sediment transport.
4. SQID's are Stormwater Quality Interception Devices, which shall be a propriety product, or an alternative, which complies with requirements as, determined by Council.

D5.04 REFERENCE AND SOURCE DOCUMENTS

QLD Government Legislation

- Environmental Protection Act 1994
- Environmental Protection (Water) Policy 1997
- Integrated Planning Act 1997

Department of Natural Resources (jointly with Brisbane City Council & IMEAQ)

- Queensland Urban Drainage Manual, Volume 1&2.

Institute of Engineers Australia (Queensland)

- Soil Erosion and Sediment Control, Engineering Guidelines for Queensland Construction Sites, June 1996.

Cairns City Council

- Guidelines for the Preparation of Erosion and Sediment Plans for Building Sites, July 2003.

Brisbane City Council

- Water Quality Management Guidelines Version 1, Waterway Program, Urban Management Division 2000.

PERMANENT (LONG TERM) WATER QUALITY WORKS

D5.05 GENERAL

1. Water quality issues related to land use or changes in land use are long-term issues and are addressed by long term, or permanent measures involving policy and planning.
2. Water quality issues relevant to development can be divided into two distinct categories ie site based issues and catchment-based issues.

D5.06 CATCHMENT BASED WATER QUALITY ISSUES

1. Catchment based water quality issues are common throughout an entire catchment, or subcatchment, and are outside the responsibility of any particular development or individual.
2. Catchment and subcatchment infrastructure will generally be focussed on the removal of suspended solids, nutrients heavy metals etc which may not be intercepted by site based infrastructure.
3. Management of these issues will generally be covered by an applicable Catchment Drainage Management Plan, which incorporate Stream Management and Stormwater Quality Management Plans.

D5.07 SITE BASED WATER QUALITY ISSUES

1. Site-based water quality issues refer to impacts or potential impacts from a particular development or land use that may affect the long-term water quality either locally or elsewhere within the catchment.
2. Site based infrastructure will be required to address the impacts identified in the Water Quality Report.
3. Site based infrastructure will be focussed on interception of gross pollutants such as trash, sediment, hydrocarbons prior to their entry into drainage systems and water ways.
4. Site based issues are dealt with by interception solutions ie stormwater quality interception devices (SQIDs) such as proprietary interceptors, trash racks, sedimentation basins, etc which will be permanent works to be incorporated into the design of the subdivision / development. Works may be developed in stages in conjunction with the staging of the development.

D5.08 ACCEPTABLE DESIGN SOLUTIONS

1. All developments are required to include appropriate interception devices that ensure removal of suspended matter (litter) and treatment of contaminated stormwater prior to crossing the boundary of the development or discharge into downstream roadside gutters, stormwater drainage systems or waterways.
2. Water quality interception devices or a combination of interception devices and treatments are required to remove at least 95% of suspended matter (litter) of size greater than 3.0mm as well as sand and shall be configured to prevent re-injection of captured contaminants.

3. All in-line and end-of line interception devices shall be of a proprietary design and construction and require a manufacturer's performance guarantee as to removal of foreign matter from stormwater and structural adequacy of the unit.
4. Water quality interception devices or a combination of interception devices and treatments are required to treat all first flush runoff, which shall be defined as that volume of water equivalent to the runoff from the 3 month ARI storm event (60% of the 1 year ARI storm event).
5. The location of the interception devices within the drainage system is to be planned to ensure that the first flush waters from all parts of the site are treated.
6. Water Quality Infrastructure may be located within a dedicated road reserve or other public space, the latter subject to approval by Council. Infrastructure within a dedicated road reserve is to be adjacent to the carriageway. Infrastructure within other public spaces shall be provided with a suitable formed and sealed access and maintenance area.
7. Interception devices shall be fitted with a basket/s or other collection facilities, which shall be sized and configured to enable removal with a maximum wet, full weight of the collection facility is to be not greater than 2 tonnes.
8. Interception devices are to be designed to provide for routine cleanout at three monthly intervals. The design of the Interception device(s) shall not compromise the hydraulic performance of the overall drainage system.
9. Interception devices are to be designed to allow for economic and efficient maintenance operations. Multiple small scale devices at drainage system inlets will not be acceptable. Interception devices should generally be located at outlets to downstream trunk drainage, waterways or receiving waters.

CONSTRUCTION PHASE (SHORT TERM) WATER QUALITY WORKS

D5.09 GENERAL

1. As well as considering the protection of long term water quality resulting from changes in land use designers are also required to quantify and reduce the impacts on water quality resulting from the construction phase of a development for the period from when the site is initially disturbed until it is stabilised by permanent works.
2. Construction phase water quality works relates to temporary works and management measures required to manage a development site during periods when the site is disturbed to minimise the potential for release of Pollutants / Contaminants / Sediments to downstream properties and / or receiving waters.
3. The objective for the management practices to be applied during the time when sites are disturbed is:

"To minimise the potential for construction activities to cause harm to the environment / receiving waters."
4. The requirements for implementation of management practices applies to all sites (i.e. subdivision and building sites) that involve disturbing of earth irrespective of size, timing for construction and / or the approval processes which preceded the construction. The extent of the management practices required will be influenced by consideration of the risk, which will take into account the scope of the works, the timing of works and other site specific factors.
5. The developer shall be held responsible for the rectification works required to clean up all pollutants and sediments that may leave the site as a result of construction activities (e.g. removal of silt from downstream culverts).

D5.10 EROSION AND SEDIMENT CONTROL STRATEGY

1. An Erosion and Sediment Control Strategy (ESCS) detailing management practices and strategies to ensure erosion and sediment control during construction period is to be prepared and submitted for Council approval as part of the supporting information/engineering submission for a Development Application for Operational Works.
2. The ESCS is to be prepared by a Certified Professional in Erosion and Sediment Control (CPESC) or a suitably qualified person with erosion and sediment control experience, eligible to apply to the CPESC program.
3. The ESCS is to be prepared in plan format, with a supporting report where necessary, (Refer AP1 Application Procedures) to achieve the following objectives:
 - Provide a level of assurance that the risk of soil erosion and sediment loss as a result of the construction activity shall be minimised.
 - Detail the major erosion and sediment control measures necessary to provide protection to downstream land owner(s) and receiving waters
 - Provide a base plan to which the Contractor can add site specific erosion and sediment control measures relating to its construction methodology and sequencing of works
 - Provide direction to the Contractor in relation to construction sequencing and major construction items to be incorporated into the Contractor's Erosion and Sediment Control Plan (ESCP).

4. In preparing the ESCS the following are to be addressed either on the plan or accompanying report:

- Identification of environmentally sensitive areas
- Establishment of the environmental values of the receiving waters
- The presence of Acid Sulphate Soils (ASS) or Possible Acid Sulphate Soils (PASS) or contaminated land.
- Determination of the risk of erosion and anticipated sediment yields
- An assessment of whether water quality monitoring is necessary
- All relevant requirements of the Planning Scheme, Development Manual, Drainage Management Plans and Development Control Plans and the Water Quality Report submitted with the development application.
- Clean water diversion measures to minimise runoff through the site.
- Sediment and erosion control measures to protect downstream land owners and receiving waters.
- Design criteria for Contractor's ESCP including for the management of materials stockpiles.
- Revegetation requirements.
- Recommended inspection, clean out and maintenance regime,
- Areas which will be cut and filled to be shown on a plan
- Areas which will be cleared and grubbed to be shown on a plan
- Demonstrate that stormwater leaving the site will meet ANZECC water quality guidelines.

D5.11 ACCEPTABLE DESIGN SOLUTIONS

1. All erosion and sediment control structures, channels, catch drains, diversion drains, etc. shall be designed for an appropriate storm event which will be detailed in the ESCS report. The minimum design criteria are shown in Table D5.1:

Table D5.1 ESC Structures - Design Criteria

	Design life	ARI
Non erosion design capacity	0-6 months	1 year
	6-12 months	2 years
Structural stability	0-6 months	5 years
	6-12 months	10 years

2. In providing a recommended inspection, clean out and maintenance regime the ESCS is to take into account the duration that the site will be disturbed and the timing of construction.

3. If the site is disturbed (i.e. rehabilitation works are not complete) during the period of prolonged or high rainfall (wet season) it is likely to be more vulnerable to the risk of erosion and a more rigorous inspection, clean out and maintenance regime will be required than for a site which is disturbed during the drier months.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

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D6

WATER RETICULATION

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No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
22 December 2008	Simon Aalbers Manager Infrastructure Development			1.1

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GENERAL

D6.01 SCOPE

1. This section sets out the Guideline for the design of water reticulation systems within new subdivisions and developments.
2. The water reticulation system shall be defined as mains less than 300mm diameter. Design of main 300mm diameter and greater shall be subject to the specific criteria nominated by Council. All mains less than 300mm diameter shall be designed in accordance with this guideline.
3. Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2002 are detailed in Appendix A of this document.
4. The requirements of this Manual are to take precedence of the Water Services Association of Australia Codes.

D6.02 OBJECTIVE

1. The objective of a water supply system is to provide to the consumer a reticulated potable water supply to meet the demands imposed upon it by both the consumers and fire fighting requirements.

D6.03 REFERENCE DOCUMENTS

Australian Standards

- AS1657 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation
- AS2368 Test Pumping of Water Wells
- AS3500 National Plumbing and Drainage

QLD Government Legislation

- Water Supply (Safety and Reliability) Act 2008

Department of Natural Resources

- Guidelines for the Planning and Design of Urban Water Supply Schemes

Water Services Association of Australia

- WSA 03 Water Supply Code of Australia

Agriculture and Resource Management Council of Australia and New Zealand

- Minimum Construction Requirements for Water Bores in Australia

National Health and Medical Research Council

- Australian Drinking Water Guidelines

WATER RETICULATION

D6.04 GENERAL

1. All connections or alterations to Council water reticulation mains shall be made by Council at the Developers cost.
2. The design of the water reticulation will take into consideration all external demands that are presently acting on the system or are likely to do so in the future. Council shall be consulted to ascertain these external demands, points of connection to existing reticulation and operating parameters.
3. In large staged developments, to ensure an efficient distribution system is established, the designers are required to submit to the Council an overall layout of the proposed subdivision, including all stages, showing the sizing of mains to be incorporated. This proposal shall be submitted to the Council for approval in principal before the submission of any construction plans and specifications will be accepted for review.
4. The designer will be required to provide digital data compatible to Councils software, with the design submission, to enable the reticulation network to be input into Council's network model for checking.
5. Prior to proceeding with detailed design, the Consultant shall liaise with Council to ascertain whether a network analysis (to determine the optimum size of the internal mains) is required by Council as part of the design submission for the development. For the design of water reticulation schemes and where Council requires a network analysis, it shall be completed by the Consultant following discussions with Council and be based on the design criteria detailed in Section D6.06 below.
6. The network analysis shall be undertaken using Watercad compatible software and available for handover to Council for incorporation into the Council network program.
7. The network analysis shall be based on the design drawings and be spatially accurate

D6.05 EXISTING MAINS

1. Council should be contacted to obtain copies of any "As Constructed" plans and details of any planned augmentation works.
2. Where, as a result of the development, existing mains are located on non-standard alignments or have less than minimum cover, or greater than maximum cover, the developer shall bear the cost of relocation, replacement or lowering, subject to the approval of the Council.
3. Pavement widening associated with some developments can place existing mains under the new pavement. In such cases, where the existing main has inadequate cover, the developer shall bear the cost of its replacement in a material approved by the Council or reconstruction at an adequate cover depth.

D6.06 DESIGN CRITERIA

Flow Parameters

1. Unless advised otherwise by Council, the Average Daily consumption and peaking factors for the design of Water Supply Schemes shall be as follows:

- Average Daily Consumption (AD) 500 litre/person/day
- Mean Day max Month (MDMM) 1.50 x AD
- Peak Day (PD) 2.25 x AD
- Peak Hour (PH) 1/12 x PD

2. In the absence of specific flow consumption data the Average Daily Consumption shall be calculated using the equivalent demands shown in Table 6.1.

Table D6.1 Equivalent Demands

Description	Equivalent Persons/Connection
Single Family Dwelling	
Lot > 1500m ²	4.0
Lot 1101m ²	3.7
Lot 901m ² to 1100m ²	3.4
Lot 401m ² to 900m ²	3.1
Lot < 400m ²	2.5
Multi Unit Accommodation	
Units > 3 bedrooms	0.4 + 0.6/bedroom
Units = 3 bedrooms	2.2
Units = 2 bedrooms	1.6
Units < 2 bedrooms	1.0
Caravan Parks	
Van Site / Camping Site	1.2
Shops / Offices	
Per 90m ² GFA	1.0
Notes:	
1. Based on 3.1 Equivalent Persons/Equivalent Domestic Connection (EP/EDC), with 1 EDC equivalent to a single residential dwelling on a standard size allotment (401m ² to 900m ²).	
2. For undeveloped land equivalent populations shall be calculated in accordance with the maximum allowable population density in the Planning Scheme.	

Pressure Parameters**Table D6.2 Minimum Service Pressure**

Minimum Pressure	22 metres head at peak hourly consumption
Minimum Pressure Location	For lots at or below road reserve level at the property boundary. For lots above the road reserve level at a nominated level practical building site. Or in the absence of a natural or benched building site the mean lot level shall be used.
Minimum Pressure Network Condition (for modelling from a reservoir).	Based on the reservoir level for Peak Hour of the third day of three consecutive Peak Day events (for dynamic models). In the absence of dynamic model results the minimum reservoir level shall be assumed at 15% of storage height. Liaise with Council to confirm minimum pressure constraints available at the connection to the existing system.

Table D6.3 Maximum Service Pressure

Maximum Pressure	80 metres head, see Note 1
Maximum Pressure Location	At the building pad
Maximum Pressure Network Condition (for modelling from a reservoir).	Based on reservoir level at 95 percent of top water level

Note 1: Where the pressure in a main exceeds 800 kPa, Council shall require the installation of Pressure Reducing Valves (PRV) that may (at Council's discretion) include telemetry control. Prior to proceeding with any design, Council shall be provided with details of the area affected and the number of lots involved.

Fire Fighting Parameters**Table D6.4 Fire Fighting Parameters**

Category	Fireflow Requirement	Number & Duration
Residential (i.e. An area comprising of predominantly residential dwellings of a maximum of 3 storeys)	15 L/s for 2 hours	1 @ 2 hours
Commercial (i.e. An area comprising of shop and office accommodation of a maximum of 3 storeys) and Industrial	30 L/s for 4 hours For schemes serving a population of less than 1000 a fireflow of 15 L/s for 2 hours should be satisfactory except where a special hazard or risk development exists	1 @ 4 hours

High Risk (i.e. A development where there is a probability of a fire occurring or there is a high cost of resultant damage (personal injury or property))	To be determined	Adopt a special hazard or risk fire
Residual pressure is to be 12m minimum at hydrant at all times.		

3. Fire flows should be superimposed on a reticulation system base flow. Where a dynamic analysis is undertaken, the base flow will be that represented by the peak demand section of the diurnal flow curve for the adopted peak day, taking into account the period of the design fire event.

4. For static analysis the base flow will be:

- - The peak hour for schemes servicing more than 3000 population;
- - $\frac{2}{3}$ of peak hour for schemes servicing less than 2000 population;
- - An interpolation between $\frac{2}{3}$ PH and PH for schemes servicing between 2000 and 3000 population.

Storage Parameters

Table D6.5 Storage Parameters

Component	Sizing
Reservoirs (ground level)	3 (PD-MDMM) + (greater of Emergency Storage/Firefighting Storage)
Elevated reservoir	6 (PH – MDMM) 12 + firefighting reserve

Pump Parameters

Table D6.6 Pump Parameters

Treated water pumps feeding a ground level reservoir	MDMM over 20 hours
Treated water pumps feeding an elevated reservoir	Capacity (L/s) = $\frac{6PH - \text{reservoir operating volume}}{6 \times 3600}$ Volume in litres
Standby pumps	Standby pump capacity to match the largest single unit pump capacity
Reticulation booster pump station	PH + fireflow

Pumped System	Peak instantaneous flow + fireflow	This situation may exist in smaller systems if variable speed pumps would replace any elevated storage. In these instances it would be necessary to calculate instantaneous flow based on concurrent demand. This would exceed PH by a significant margin.
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Pipeline Parameters

Table D6.7 Pipeline Parameters

Pipe capacity – Trunk & Reticulation Mains	Size for PH + Fire Flow
Friction Equation	Hazen-Williams
Maximum Velocity	2.5m/s
Minimum Velocity	N/A

Headloss Calculations

5. For headloss calculations, the Hazen-Williams formula is generally used. Values of the Hazen Williams friction co-efficient (C) to be adopted are:

Table D6.8 Hazen Williams Friction Co-efficient

Pipe Diameter (D)	C Value
D ≤ 150mm	100
150mm < D ≤ 300mm	110
300mm < D ≤ 600mm	120
D > 600mm	125

6. The above values take into account losses for pipe fittings such as bends, valves, tees, crosses etc and the effect of pipeline ageing.

D6.07 RURAL AND RURAL RESIDENTIAL DEVELOPMENTS

- Where a development is approved subject to the provision of domestic water supply from an underground source to service individual lots, water bores shall be installed in accordance with the "Minimum Construction Requirements for Water Bores in Australia" booklet as published by the Agriculture and Resource Management Council of Australia and New Zealand and to the satisfaction of Council.
- Bores must produce a minimum sustainable yield of one litre per second as determined by a 4 hour pump test in accordance with AS 2368 "Test Pumping of Water Wells" and pump test analysis, including observations of potential interference between bores, by a person qualified in groundwater hydrology.
- Water samples must be collected from the bores in accordance with AS 2368 and analysed by a N.A.T.A. registered laboratory or other laboratory as approved by Council. Water must be chemically suitable for human consumption in accordance with the "Australian Drinking Water Guidelines" issued by National Health and Medical Research Council.

4. The placement of the bore must be determined by an appropriately qualified person and shall be positioned in conjunction with the placement of any on-site wastewater disposal system to be used on the allotment.
5. Boreholes shall be cased and sealed at its surface to prevent the inflow of contaminated surface water.
6. Maximum bores casements size shall be 125mm in diameter.
7. Bores shall be sunk to a minimum depth of 60 metres, or until the bore reaches bedrock.

D6.08 RETICULATION NETWORK

1. All water mains shall be laid on a standard alignment specific to the relevant local authorities requirements and unless directed otherwise alignments shall be as follows;

Urban – 2.5m
Rural – 2.5m

2. All offset dimensions shall be from the real property boundary.

D6.09 IRRIGATION

1. All irrigation systems connected to Council's water supply shall be installed to satisfaction of Council. The installation of water meters, backflow prevention device and isolation valves are mandatory in all irrigation system. Refer Design Guideline D9 Landscaping for design of irrigation systems.
2. All connections to Council's existing system shall only be completed by Council staff or approved subcontractors.

PUMP STATIONS

D6.10 GENERAL

1. Pump stations shall be subject to specific requirements of the local authority. Council should be consulted prior to design to confirm the specific requirements for pumps, electrical, switchboards, telemetry, etc. Outlined below is Council's minimum requirements unless otherwise specified.
2. Refer to Appendix B Whitsunday Shire council standard conditions for water supply above RL50.

D6.11 PUMP STATIONS

1. Pump stations are to be contained in an above ground structure. The structure is to be constructed from reinforced masonry block and/or reinforced concrete. The structure is to be sized to allow for adequate internal access to all items for operational control but particularly for maintenance works. Openings will allow the easy reach and replacement of the largest item contained in the pump station. The use of multistage/centrifugal pumps is preferred.
2. A back-up power supply is to be provided either by a generator or diesel pump unless a five (5) day reservoir capacity is provided. Suitable arrangements for ducting airflow to the generator/diesel pump and the disposal of exhaust gases so as not to create a nuisance is required. Sufficient fuel is to be stored to operate for 12 hours at rated load.
3. Noise suppression is to be addressed and incorporated into the pumps station design. The pump station design is to comply with the Environmental Protection Act during normal use.
4. The tenure of property on which pump stations and access roads are situated is to be transferred to Council as freehold title. Pump station sites are not to encroach upon gazetted road areas unless otherwise approved by Council.
5. Access to the pump station site is to be via an appropriate standard sealed access and the pump station site is to accommodate maintenance vehicles and their manoeuvring.
6. Internal and external pump station surfaces are to be painted as directed.

D6.12 TELEMETRY SYSTEMS

1. Where required by the Local Authority pump station control panel shall incorporate SCADA equipment for transmission of monitoring data and control to Council's existing master system. Council should be contacted to obtain a copy of their Technical Specification for Telemetry Systems.

APPENDIX A

WHITSUNDAY SHIRE COUNCIL

ADDENDUM TO WATER

SUPPLY CODE OF AUSTRALIA

WSA 03-2002

Addendum to Water Supply Code of Australia

WSA 03-2002

2.1 SYSTEM PLANNING PROCESS

2.1.1 Extending on Existing Water Supply Scheme

Where a water supply network simulation model exists Council shall assess the impacts of the proposed development on the existing water supply system. The assessment shall be based on the details of the system extension provided by the Consulting Engineer.

2.2 DEMANDS

Refer to Section D6.06 – Design Criteria of this Manual for the water supply demand requirements to be adopted in design.

2.4.3 Operating Pressures

Refer to Section D6.06 – Design Criteria of this Manual for operating pressure parameters to be adopted in design.

2.6 PUMPING STATIONS

2.6(c) Standby Arrangements:

Council requires standby pump units to be provided. The standby capacity shall be as directed by Council.

The power supply to pumping stations shall have 50% spare capacity for future upgrading and be electrically configured such that the pumping station can operate from an emergency generator supply at times of power failure (thus, a provision of space in the switchboard for a manual ATS change over panel is required).

2.7 SERVICE RESERVOIRS

Refer to Section D6.06 – Design Criteria of this Manual for storage parameters.

2.10 CONCEPT PLAN

Refer to Section D 6.04 – Water Reticulation Concept Plan of this Manual for requirements for a Concept Plan.

3.2.3 Empirical sizing of reticulation mains

Table 3.1 is not to be used for sizing of reticulation mains. Refer to Section D6.06 – Design Criteria of this Manual for population and design flow requirements.

3.2.5.3 Hydraulic Roughness Valves

Refer to Section D6.06 – Design Criteria of this Manual for roughness values to be used in design.

The Hazen-Williams formula is to be used for head loss calculations.

3.7.2 Minimum pressure class

The minimum class for pipe and fittings shall be PN 16.

3.8 PIPELINE MATERIALS

Pipes used for water mains shall comply with the following table.

Nominal Size DN	Type of Pipe	Class of Pipe
63, 90	MDPE	Series 1 PE100 – SDR11 MIN PN 12
100, 150, 200, 250, 300	PVC, PVC-M & PVC-O	Series 2 MIN PN12
100, 150, 200, 250, 300	Ductile Iron	PN20, K9 & K12

4.1.1 Design Tolerances

Horizontal alignment shall be referenced to the MGA co-ordinate system.

4.3 LOCATION OF WATER MAINS

4.3.1 General

The location and alignment of water mains shall generally be in accordance with Council's Standard Drawing No W-0020

4.4 SHARED TRENCHING

Shared trenching shall not be specified without prior approval of Council.

4.6 RIDER MAINS

Rider mains are not permitted.

4.7 CONNECTION OF NEW MAINS TO EXISTING MAINS

The connection of new water reticulation to Council's existing system is to be at the Developer's expense.

Council staff shall undertake all connections to Council's water infrastructure. The Contractor shall not carry out the connection unless Council gives special approval in exceptional circumstances.

4.8.3 Permanent ends of water mains

Dead Ends to water mains should be avoided. However, should Dead Ends be unavoidable, the following facilities shall be constructed to facilitate scouring of the lines;

- For mains 100mm diameter or greater a hydrant shall be positioned at the end of the line.

4.10.7 Deviation of mains around structures

Deviation of mains around other structures shall only be permitted as a fully flanged offset complete with 1.200m tail pieces.

6.7 SWABBING POINTS

Swabbing points shall be provided where specified by Council.

6.8.3 Hydrant types

Hydrants shall be the spring hydrant "Maxi Flow" 2000 type (DN80) manufactured in accordance with AS 3952 by an Australian Standards quality endorsed company.

Hydrants are to be coated with a thermosetting epoxy powder to AS 2638 and AS 3952.

6.8.7 Hydrant Spacing

The maximum spacing between hydrants shall be 80 metres.

7.3 RECORDING OF WORK AS-CONSTRUCTED INFORMATION

As constructed information shall conform to Section CP1 – Operational Works Construction Procedures of the WSC Development Manual.

11.5.4.2 Traffic Management

Traffic management shall be in accordance with the requirements of the authority responsible for the roads where construction activities are carried out.

15.2.3 Bending Pipe

Bending of pipes is not permitted.

APPENDIX B

WHITSUNDAY SHIRE COUNCIL

STANDARD CONDITIONS FOR WATER SUPPLY ABOVE RL50

Water Supply

1. The water supply system shall be designed in accordance with Water Resources Commission Guidelines and amendments, Council's Development Manual, Council's Standard Drawings, and to the requirements of the Council's Water Supply and Sewerage Engineer. Similarly, adherence to Acts, Regulations, relevant standards and Council's By-Laws is required.

Reservoirs

2. The reservoir is to be reinforced concrete cast insitu with a concrete roof, as per Whitsunday Shire Council, Standard Drawings and notes, fully secured and to the full satisfaction of Council's Water and Sewerage Engineer.
3. The land on which the reservoir is constructed and sufficient surrounding land, 4 meters minimum, shall be dedicated to Council at no cost to Council.
4. A 240v power supply shall be provided to the reservoir site.
5. A suitable sealed access and turning area shall be constructed and dedicated to Council at no cost to Council, in accordance with Council's Development Manual.
6. The access road to the reservoir is not to be utilised as a common access. Land in which the access road is situated is to be dedicated to Council at no cost to Council.
7. The gradient of the access road is not to exceed 20%.
8. Storm water layout with details of overflow / scour / underdrainage flow path is to be identified.
9. Security fence details are to be provided.

Pump Station Building

1. Shall be constructed as per Whitsunday Shire Council specifications. To be painted internally and externally.
2. The land on which the pump station is constructed and sufficient surrounding land, 3 meters minimum, shall be dedicated to Council at no cost to Council.
3. The finished floor level of the pump station should be self draining and no less than 200mm above the surrounding finished ground level.
4. Should be situated at a suitable RL AHD so that the return gravity system does not exceed to maximum head recommended by the Water Resources Commission Guidelines.
5. Provision is to be made within the building, opening to external, for a suitable sized room to house the disinfection equipment and storage tank. The room shall be independent of all mechanical and electrical equipment.
6. Pump control room is to be fitted with sufficient ventilation to allow air flow within the room.
7. A suitable sealed access and hard standing area shall be provides and constructed as per Council's Development Manual.
8. Security fence details are to be provided.
9. Building to be sized to house the following but not limited to;
 - A. Duty / Stand-by pump arrangement.
 - B. Electromagnetic type flow metering. (ie. Kent or combined Instruments.)
 - C. Control cabinet and switching equipment as per council's standard specifications.
 - D. Telemetry connected and commissioned to be fully compatible with Councils existing telemetry control system.

- E. Low pressure safety cut out switch on the suction side of the pumping system, shall be installed in a manner so that it can be isolated from the main and release the pressure to test the suitability without having to close down the water supply to the pumps.
- F. Room to house the disinfection equipment.

Pumps

1. For calculating the duty head of the pump please note that the BWL of the Cannonvale reservoir is at RL 72.
2. Duty / Stand-by pump arrangement is to be provided. They must be able to run in parallel if required.
3. Pumps must be fitted with mechanical seals.
4. Reflux valves shall be on the discharge side of the pump.
5. Valving is to be provided so each pump can be isolated and removed if necessary should the case arise.
6. Vacuum and pressure gauges are to be fitted -
7. Pumps and system should be protected against water hammer.
8. All pumping equipment is to be new.

Power to the site

1. All power used up until the project is placed on maintenance shall be the developers responsibility. At On MTCE the developer shall have the Ergon account transfer to Council

Pipework

1. All appropriately sized pipe work into / out of the pump station and pipe work associated with the pump connections shall be DLCL and fully flanged.
2. A dedicated rising main, appropriated sized, of K9 DICL shall link the pump station to the reservoir.
3. All gravity mains, appropriately sized, may be uPVC Class 16.
4. Water mains are to be installed on the topside of the road, in natural ground, where possible.
5. Horizontal separation of the rising main and the gravity main shall be maintained at 300mm.
6. Any under-boring of main roads shall utilise 6mm steel for the sleeve as a minimum or as their approval.
7. Long section of the main on the suction side of the pumps shall be submitted, to ensure air locks can not affect the performance of the pumps.

Disinfection

Disinfection facilities (sodium hypochlorite) to be provided should include but not limited to;

1. Adequate sized room to house all equipment to comply with WHS regulations.
2. Adequate sized storage tank complete with an approved measuring device.
3. Pumping equipment with adequate pumping capacity to maintain a chlorine residual in the reticulation system to the satisfaction of Council'.
4. Bunding details, pump out pit (300 x 300 x 200mm deep) and the method of sealing all of the concrete works and walls are to be provided.
5. The retractable injection quell shall be installed external to the building and suitably protected from damage.
6. The injection point is to be installed on the discharge side of the pumps.

7. Provide an approved safety shower / eye wash basin in a secured area, external to the building
8. Provide a 20mm hose tap in a secured area.

Consultation

1. It is essential that the applicant's water supply consultant discuss in full the system with Council's Water and Sewerage Engineer prior to and during the design phase.
2. An Elpro approved installation contractor is to be used for the telemetry system. (Belmont Electrical.)

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D7

SEWERAGE SYSTEM

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
22 December 2008	Simon Aalbers Manager Infrastructure Development			1.1

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GENERAL

D7.01 SCOPE

1. This section sets out the Guideline for the design of sewerage systems within new subdivisions and developments.
2. The sewer reticulation system shall be defined as gravity sewers of 150mm and 225mm diameter, used to collect and convey sewage from properties. Designs for gravity sewers larger than 225mm diameter shall be subject to specific criteria nominated by the Council. All gravity sewers 225mm diameter or less shall be in accordance with this guideline.
3. Aspects of modification or clarification of the codes are detailed in Appendix A
4. The requirements of this Manual will take precedence over the Water Services Association of Australia Codes

D7.02 OBJECTIVE

1. The objective of the sewerage system is to transport sewage from domestic, commercial and industrial properties using gravity flow pipes and, where this is uneconomic, by pumping to the treatment plant.
2. While various options can be determined that meet the minimum technical requirements, the selected option should meet least community cost for whole lifecycle. To achieve the optimum solution will require sewerage reticulation issues to be considered at the commencement of the planning process and to integrate with other planning issues, and not be considered an end of process infrastructure provision exercise.

D7.03 REFERENCE DOCUMENTS

Australian Standards

- AS/NZS1547 On-site domestic wastewater management
- AS3500 National Plumbing and Drainage

QLD Government Legislation

- Sewerage and Water Supply Act, 1949 and Amendments
- Water Supply (Safety and Reliability) Act 2008

Department of Natural Resources

- Guidelines for the Planning and Design of Sewerage Schemes
- On-Site Sewerage Code – 2002

Water Services Association of Australia

- WSA 02 Sewerage Code of Australia
- WSA 04 Sewerage Pumping Station Code of Australia

DESIGN CRITERIA

D7.04 GENERAL

1. Sewers shall be designed to accommodate flows from upstream catchments, calculated on the basis of their future development in accordance with Council's Strategic Plan, and accordingly, shall be extended to the upstream boundary(ies) of the proposed development (where required). Designers should consult with Council to confirm location of any future connections points and details of any planned augmentation works.
2. In large staged developments, to ensure an efficient distribution system is established, the designers are required to submit to the Council an overall layout of the proposed subdivision, including all stages, showing the sizing of mains to be incorporated. This proposal shall be submitted to the Council for approval in principal before the submission of any construction plans and specifications will be accepted for review. Refer to Application Procedures

D7.05 EXISTING SEWERS

1. Prior to the proceeding with design, the designer shall obtain from Council, "As Constructed" sewer information relevant to the proposed development and confirm point(s) for connection.
2. Works associated with some developments can impact on existing mains. Where as a result of the development an existing main has inadequate cover, it shall be reconstructed with a material approved by the Council or such other alternate protection measures deemed necessary by Council.
3. Where finished surface levels around existing manhole covers are altered, the manhole shall be reconstructed to conform with the requirements of this guideline.
4. All connections or alterations to Council sewerage network, shall be made by Council at the Developers cost. It may be possible for some works to be performed by the contractor under special circumstances and subject to appropriate conditions agreed to with Council.

D7.06 UNCONVENTIONAL INFRASTRUCTURE

1. Conventional infrastructure includes gravity sewers, lift stations, area pumping stations and rising mains. Unconventional infrastructure includes small bore systems of any kind, including vacuum systems, hybrid low pressure systems, common effluent drainage systems, grinder pumps serving small clusters of properties and the like, and any other unconventional or unusual systems.
2. The use of unconventional infrastructure shall require special approval and may require extended maintenance periods and a higher value for performance bonds.
3. In unconventional systems, Council may not have approved design criteria. Accordingly proposals will be considered on the basis of good engineering practice and are to be subject to a benefit cost analysis.
4. The Consultant shall submit an initial report and associated recommendations for consideration by Council prior to any detailed design. The report should include as a minimum:
 - Description of proposed infrastructure.
 - Reasons for departing from Conventional systems.

- Reasons for and cost benefits to Council.
 - Connection points to existing system
 - Schematic layout plan
 - Maintenance and operational issues.
5. Subject to Council's assessment of the Consultant's initial report and prior to any detailed design, Council may engage an independent Consultant to act for Council in assessing the initial report and to recommend suitable system parameters.
 6. All costs associated with the engagement of the independent Consultant shall be at the Developers expense.
 7. Any subsequent designs of infrastructure shall be planned to satisfy the requirements to meet Council Customer Service Standards, which are published pursuant to the requirements of the Water Act 2000, at a minimum whole-of-life cost (capital cost, operational and maintenance cost) for an environmentally acceptable solution and not simply a least capital cost solution.

D7.07 DESIGN CRITERIA

Capacity

1. Population estimates shall be based on those equivalent demands detailed in Table D7.1

Table D7.1 Equivalent Demands

Description	Equivalent Persons/Connection
Single Family Dwelling	
Lot > 1500m ²	4.0
Lot 1101m ² to 1500m ²	3.7
Lot 901m ² to 1100m ²	3.4
Lot 401m ² to 900m ²	3.1
Lot < 400m ²	2.5
Multi Unit Accommodation	
Units > 3 bedrooms	0.4 + 0.6 / bedroom
Units = 3 bedrooms	2.2
Units = 2 bedrooms	1.8
Units < 2 bedrooms	1.0
Caravan Parks	
Van Site / Camping Site	1.2
Shops / Offices	
Per 90m ² GFA	1.0
Notes: 1. Based on 3.1 Equivalent Persons / Equivalent Domestic Connection (EP/EDC), with 1 EDC equivalent to a single residential dwelling on a standard size allotment (401m ² to 900m ²). 2. For undeveloped land equivalent populations shall be calculated in accordance with the maximum allowable population density in the Planning Scheme for that land use.	

2. The minimum pipe capacity shall be based on the criteria detailed in Table D7.2

Table D7.2 Sewage Loading

3	Average Dry Weather Flow (ADWF)	270l/EP/day	Based upon analysis of pump station flows and STP inflow records during dry weather
4	Peak Wet Weather Flow (PWWF)	(5 x ADWF) or (C ₁ x ADWF) whichever is greater	C ₁ = Peaking Factor = 15 x (EP) ^{-0.1587}
5	Peak Dry Weather Flow (PDWF)	C ₂ x ADWF	C ₂ = Peaking Factor = 4.7 x (EP) ^{-0.105}

3. Design for wet weather infiltration shall be based on an allowance of 20m³ per kilometre of sewer and house drains per day.

4. In low-lying areas the implications of high water table should be taken into account.

Pipe Velocity

5. Pipe velocities shall be based on the details shown in Table D7.3

Table D7.3 Pipe Velocities

Flow Equation	Mannings n
Mannings 'n'	0.013
Minimum velocity @ PWWF	0.6 m/s
Minimum velocity @ PDWF	0.3 m/s
Depth of Flow @ PWWF – Proposed sewers	Max Flow depth shall not exceed ¾ pipe full

Minimum Grades

6. Minimum grades for sewer reticulation mains are to be as summarised in Table D7.4.

TABLE D7.4 Minimum Grades

DIAMETER	MINIMUM GRADE	
100mm - House connection branches	1 in 60	1.66%
150mm - House connection branches	1 in 80	1.25%
150mm - First MH length, head of sewer	1 in 100	1.00%
- Second MH length	1 in 150	0.67%
- Remaining MH lengths (see note below)	1 in 150	0.67%
225mm	1 in 290	0.34%
300mm	1 in 420	0.24%
375mm	1 in 570	0.18%
450mm	1 in 730	0.14%
525mm	1 in 900	0.11%
600mm	1 in 1000	0.10%
675mm	1 in 1200	0.08%
> or = 750mm	1 in 1500	0.07%

Gravity Sewer Flows in Equivalent Domestic Connections

7. Table D7.5 details the maximum allowable Equivalent Domestic Connections for various gravity sewer pipeline grades and diameters.

TABLE D7.5 Gravity sewer flows in Equivalent domestic connections

GRADE	150DIA	225DIA	300DIA	375DIA
570				1352
550				1377
500				1444
450				1522
420			856	1575
400			878	1614
350			938	1726
300			1013	1864
290		496	1031	1896
250		534	1110	2042
200		597	1241	2283
180	213	629	1308	2406
150	234	690	1433	2636
125	256	755	1570	2482
100	286	845	1755	3228
75	331	975	2027	3728
50	405	1194	2482	4566

D7.08 SEWER ALIGNMENT

1. The preferred alignment of sewer lines in relation to property boundaries is presented in Table D7.6

Table D7.6 Preferred Alignment of Sewers

Location	Alignment
Carriageway	Not permitted, crossings only
Verge	Not usually permitted, subject to Council approval
Private property	
- Side boundary	0.8m
- Front and rear boundary	1.5m

2. Where sewer lines are located along the road frontage of allotments, the preferred alignment is 1.5m inside the allotment. However, to reduce the number of manholes on curved roads and where truncations occur, the sewer alignment may be varied slightly subject to Council approval.
3. Where the allotment is located adjacent to a Park or Drainage Reserve, and the sewer is proposed to be constructed adjacent to the Park or Drainage Reserve boundary, the sewer shall be constructed on a minimum 0.8m alignment and wholly within the Park or Drainage Reserve. Where the sewer is proposed to be located elsewhere in the park, approval for the location must be obtained from Council's Precincts and Facilities Branch.

4. Where sewers are to be located within existing road reserves, the designer shall check that the sewers do not conflict with other utility services and locate the sewers to the satisfaction of Council.
5. Where retaining walls are located on or near the boundary of allotments, sewers, property connection points, manholes etc must not be constructed under or within the zone of influence of the retaining wall foundations.
6. Adequate clearance must be provided around access structures and property connection points. For access structures, an area within a 1.5 metre radius must be provided around the central point of the facility to permit the set up and use of confined space equipment and other maintenance equipment such as jet rodders and remote cameras.

D7.09 DEDICATION OF LAND, EASEMENTS, AND PERMITS TO ENTER

General Infrastructure

1. All pumping stations, lift stations, storage tanks, reservoirs, water towers and the like are to be located on land that is owned by or will be dedicated to Council at the time of plan sealing, except that lift stations, and small pumping stations may, with State Government's approval, be located in land that is or will become road reserve.
2. Pumping Stations and lift stations that are not sited in road reserve are to be located in an easement and is to be provided with a 5-metre wide access easement dedicated to Council.

Pipelines

3. When pipelines and appurtenances relating to pipelines are constructed in land other than in what is or will become, a dedicated road reserve or property owned by Council, Council requires easements to be registered in its favour as follows:
 - All sewage rising (pressure) mains.
 - All sewers in properties of a commercial or industrial nature.
 - All sewers where the depth to invert is greater than 3 metres, except as stipulated below.
 - All sewers in residential properties that are not on standard alignment, which is 1.5 metres from the front or rear boundary or 0.8 metre from a side boundary. Except that, regardless of the sewer depth, no easement is required if the sewer is laid anywhere within 3 metres of the front boundary for lots with a standard 6 metre building setback.
4. Easements shall be minimum of 3 metres wide and located centrally over the pipeline, or in the case where a pipeline is laid on standard alignment near a property boundary, the boundary of the lot and one boundary of the easement may be coincident.
5. In the event that works are to be constructed through properties not under the control of the Developer, the Developer shall submit with the Operational Works Application:
 - A 'Permit To Enter' letter, signed by each property owner through whose property the infrastructure is to be constructed, consenting to the construction of the works.
 - Where the property is owned or to be dedicated to Council approval of the relevant section of Council that will manage the property.
 - Proof of the registration of easements in favour of Council as specified above.

D7.10 PROPERTY CONNECTIONS

1. Property connections shall be installed in accordance with Standard Drawing S-0030 in all allotments.
2. Property connections should generally be located at the lowest corner of the allotment between 0.5 and 1.5m upstream of the allotment boundary or manhole.
3. Property connections into manholes will be permitted at ends of lines only. Elsewhere, property connections are required “on line” and not into manholes.
4. Combined House Drains are not permitted in any development works.
5. Where a sewer main lies within an adjoining allotment, the property connection is to extend a distance of 1.0m into the allotment. For battle-axe allotments with the property connection located within the access, the property connection shall extend along the access to a point 1.0m within the main part of the allotment or, where a sealed driveway is required for the full length of the hatchet ‘handle’ then 1m past the extents of the driveway to allow a suitable future point of connection. Where a sewer is contained within a stormwater drainage easement, then the property connection should extend a minimum of 1m past the easement boundary and into the lot it is serving. All property connections should be finished a minimum of 1m clear of any infrastructure.
6. Property connections sizes shall be as follows:
 - Residential (single Dwelling) – 100mm dia.
 - Others (i.e. Commercial, Industrial, Multi Residential) – 150mm dia.
7. Property connections to existing sewer mains shall only be permitted when the construction of a new main to service the proposed properties is not possible. Contractors shall be required to notify Council prior to commencing any works. All works to live sewer mains shall be carried out under the direction of Council.
8. Property connections to existing sewer mains shall be constructed in accordance with Standard Drawing S-0010.
9. All Property connections shall be deep enough to service the entire lot using the following property drain design criteria:
 - 300mm minimum cover at the start of the drain or at any other control point on the allotment, (where property drains are subject to vehicular traffic, cover shall be increased to 600mm).
 - 1 in 60 minimum grade from the most distant corners of any house or structure to be located on the allotment.
 - Consideration to be given to the finished level of the lot after all earthworks are complete including likely benching for building platforms.

D7.11 ON-SITE SEWERAGE FACILITIES – TREATMENT AND DISPOSAL

1. Due to the increased loading of on-site sewerage facilities on the environment and legislative considerations, the consultant shall submit a report containing a detailed assessment of site and soil factors, an elevation of the site constraints and review of all relevant information available. The report shall consider all major constraints and opportunities relating to the management of wastewater in relation to the development. The report shall also include a cumulative impact on the effects to the existing ground water table, creeks and watercourses so that the development achieves environmental objectives of air, land and water resources.

2. The Consultant should refer to On-site Sewerage Code and AS/NZ 1547 so that the most appropriate on-site sewerage facility can be chosen for the development and, in particular, be of sufficient capacity to receive, treat and absorb all wastewater outputs from premises on a property, complete the treatment, uptake, and absorption of the final effluent within the boundaries of the property, and avoid likelihood of creating unpleasant odours, or the accumulation of offensive matter.
3. The minimum requirements for the wastewater disposal report :
 - Site plan showing dams, creeks and water courses;
 - Contour plan maximum of 1 metre intervals;
 - Areas of each block with proposed Lot No's and property boundaries;
 - Proposed use of the land to be developed;
 - Soil survey, including permeability of soil by either a percolation test or textural classification of soil;
 - Depth of ground water, if any encountered during testing;
 - Estimated daily flows and site evaluation in accordance with AS1547;
 - Method of disposal, e.g. DSTP, split septic system or other;
 - Size of estimated disposal area to suit system;
 - Calculations to justify disposal site;
 - Assessment of any additional nutrient loadings of the area caused by on-site waste water disposal.

PUMPING STATIONS AND PRESSURE MAINS

D7.12 GENERAL

1. Pump stations shall be subject to specific requirements of the local authority. Council should be consulted prior to design to determine specific requirements for pumps, electrical, switchboard and telemetry etc. Outlined below is Councils minimum requirements unless specified otherwise.
2. Council prefers that sewage be conveyed by gravity and a pumping station be used only when all other options have been considered and rejected.
3. Council requires documentary evidence that life cycle costs of all options have been analysed before approving a pumping station.
4. When the use of a pumping station has been approved it must be designed and constructed in accordance with this Manual and WSA 04-2005 "Sewage Pumping Station Code of Australia".
5. A submersible sewage pumping station built to Council requirements and incorporating two submersible sewage pumps with motor sizes up to 22 kW each will be regarded as a "standard" installation. Any station with pumps larger than 22kW will be regarded as a "non-standard" installation and will need to be specifically designed to suit the design flows. The design of a "non-standard" station must be carried out in consultation with Council.
6. Wetwell washers are required in all sewerage pumping stations

D7.13 PUMP STATIONS

1. Pump stations shall be constructed as detailed on Standard Drawings S-0050, S-0051, S-0052, S-0057, S-0058, S-0059, S-0060, and S-0061. The relative levels (A through G) as denoted on these drawings as well as all pump start stop and alarm levels appropriate to operating conditions shall be provided with the pump station design.
2. Operation levels for all pump stations to be controlled by Ultrasonic level controllers, and not by float switches.
3. The pump station overflow pipe shall be designed to cater for the maximum possible flow (5 x ADWF). Council and the Environmental Protection Authority should be consulted to determine emergency storage and overflow requirements.
4. The designer shall be responsible for obtaining all necessary licenses and approvals associated with the provision of pump station emergency overflow.
5. Pump station shall be located as far as possible away from existing or proposed habitable dwellings. A 100m setback is desirable with absolute minimum of 30m unless otherwise approved by Council.
6. The tenure of property on which pump stations and access roads are situated shall be transferred to Council as freehold title. Pump station sites shall not encroach upon gazetted road areas unless otherwise approved by Council
7. Access to the pump station site shall be via an appropriate standard sealed access and the pump station site shall accommodate maintenance vehicles and their manoeuvring.

8. Pump stations shall be located clear of the ARI 100 year storm event and the finished ground level around the pump station shall be shaped to fall away from the pump station.
9. Detailed calculations of pump station and pressure main sizing shall be submitted to Council with the design submission.

D7.14 SEWERAGE PUMPING SYSTEMS

Sewage Pumping Station Design Criteria

1. Sewage pumping stations shall be designed in accordance with the minimum specific design criteria shown in Table D7.14 and WSA 04-2005.

Table D7.14 Sewage Pumping Station Design Criteria

ITEM	DESCRIPTION	ADOPTED DESIGN PARAMETER	COMMENTS
1	Pump motor drives	Variable speed drives or soft starters shall be used	
2	Number of pumps	Two (2)	Pump station controls must allow for automatic alternating duty pumps.
3	Fixed speed pumps Wet well operating Volume (kl)	$\frac{0.9 \times Q}{N}$	Where Q is the flow rate (l/s) of a single pump operating and N is the allowable number of pump starts, the number of pump starts (N) should be not more than 50kW rating. For pumps greater than 50kW rating, according to manufacturer's recommendations.
4	Variable speed pumps Wet well operating Volume (kl)	$\frac{0.9 \times Q}{N}$	Q = discharge of a single pump (l/s) at 50 Hz. N = maximum number of starts per hour recommended by the motor manufacturer.
5	Bottom water level (duty pump cut-out)	a) For fixed speed pumps - 100mm above minimum submergence level of pumps. b) For variable speed pumps: -minimum of 100mm above top of motor casing	In case of variable speed drives, a permanent water level must be maintained above the motor cooling of the motor.

6	Well Diameter	Minimum internal well diameter – 2100mm internal well diameter may be increased in increments of 300mm depending upon considerations such as: a) Clearance around pumps and pipework. b) Depth of pump station, and c) Geotechnical conditions.	
7	Top Water Level (TWL) (standby start)	Must be set 300mm below invert level of inlet sewer.	
8	Operating Range (TWL – BWL)	Generally this range should be between 1000mm and 2800mm.	
9	Duty Point	With static head corresponding to top water level and pipe friction factors as follows determine Duty Point 1 and 2: Duty Point 1 – Single Pump Operation: $C_1 \times \text{ADWF (l/s) vs. Static Head + Friction Head (m)}$ Duty Point 2 – Duty Pump operating in parallel with Standby Pump: $5 \times \text{ADWF (l/s) vs. Static Head + Friction Head (m)}$	Where: Static Head = Highest Point in Rising Main – Water Level in Wet Well Friction Head is derived from the Hazen Williams formula $C_1 = \text{Peaking Factor from Table 6.2 of this Manual.}$
10	Pump Selection	Select a pump that is capable of operating at both duty points and which operates within the range of the system resistance curves that are determined by the Conditions detailed below: Condition 1 – Normal Operating Condition lower limit system resistance curve: Static head corresponding to Top Water Level with rising main friction factors as follows: $C = 120 \text{ (dia. } \leq 300\text{mm)}$ $C = 140 \text{ (dia. } > 300\text{mm)}$ Condition 2 – Normal Operating Condition Upper limit system	The friction factors used in pump selection depend on Top and Bottom Water Level so as to ensure the fullest possible range of heads are taken into account in the selection of the pumps

		resistance curve: Static Head corresponding to Bottom Water Level with rising main friction factors as follows: $C = 100$ (dia. < 300mm)	
11	Emergency Storage	6 hours ADWF	May vary dependent on locating of overflow. Emergency storage may include gravity sewers, manholes and pump station wet well volume above TWL.
12	Duty Pump Capacity	Not less than $C_1 \times$ ADWF	C_1 from Table 7.2 of this Manual
13	Standby Pump Capacity	Equivalent to capacity of the duty pump	
14	Total Pump Station Capacity	Not less than $5 \times$ ADWF	

D7.15 PRESSURE MAINS

- For detailed design of sewer pressure mains (Rising Mains) the requirements of Design Guideline D6 Water Reticulation should be noted and the mains shall be designed as per the procedures relevant to Water Supply Mains with the exception of the following:
 - Air release valving should be provided to high points as required.
 - Scour valving should be provided to low points as required.
 - Thrust Block and Trenching Details shall be as per the Standard Drawings W-0040 and W-0041.
- Consideration needs to be given to the potential for sulphide generation in Pressure Mains and the requirements specified in Sections 4.1, 8.6 and 8.7 of the Department of Natural Resources "Guidelines for Planning and Design of Sewerage Schemes" should be noted in this regard.
- Sewer pressure mains shall be a minimum 100mm DICL class h9 unless approved otherwise by Council.
- All Discharge manholes shall be fitted with a HDPE or wound PVC manhole liner suitable for exposure to sewerage.
- Sewer pressure mains shall be designed in accordance with the minimum specific design criteria shown in Table 7.15 and WSA 04-2005.

Table 7.15 Pressure Main Design

ITEM	DESCRIPTION	ADOPTED DESIGN PARAMETER	COMMENTS
1	Flow equation	Hazen Williams	
2	Minimum diameter	100mm unless otherwise approved by council	
3	Friction factors	Refer item 10 in Table 10.1	

4	Minimum velocity (On a daily basis)	0.75m/s	To prevent the deposition of solid materials such as grit
5	Preferred minimum velocity	1.5 m/s	To provide for slime stripping on a regular basis
6	Maximum velocity		To prevent damage to pipe lining
7	Configuration	<p>Pressure mains should be sized to optimise the balance between reduction and detention times and life cycle cost. Factors to be considered but not limited to:</p> <ul style="list-style-type: none"> -Population growth -Staging -Operational features to provide for maintenance and replacement activities -Minimisation of energy costs -Detention times (reduction of odors) 	
8	Interconnection from rising mains from different pump stations	Only with the approval of Council. Generally interconnection of rising mains from different pump stations will be approved unless there are substantial economic and operational benefits	

PRIVATE PUMP STATION AND PRESSURE MAINS

D7.16 GENERAL

1. Sewage pumping stations serving more than one "Titled" property shall meet the requirements of this Manual and WSA 04–2005 Sewage Pumping Station Code of Australia.
2. Where a gravity sewer connection is not directly available to a development, Council may approve a private sewage pumping station, which will discharge to the existing gravity sewerage system via a private rising main.
3. All costs associated with connection of a private pressure main to an existing gravity sewer system (system analysis, design and upgrades to provide capacity) shall be met by the Developer.

D7.17 CONNECTION TO EXISTING GRAVITY MAIN

1. The approval connection point for a private rising main shall be discharge manhole that is connected to an existing gravity sewer manhole. Discharge manholes shall conform to Council's Standard Drawing S-0070.
2. Council may require the provision of a non corrosive pipe installed for the length of sewer to the next downstream manhole and will require the provision of an inert lining to all internal surfaces of the pressure main discharge manhole.

D7.18 ALTERNATIVE CONNECTION POINTS

1. Council may consider an alternative connection point. Where an alternative is proposed, the Developer shall request written approval from Council. The request shall outline the reasons for the alternative connection point and the connection methodology proposed.
2. A private pressure main is not permitted to inject into another private pressure main.

D7.19 PRIVATE PUMP STATION SIZING AND OPERATION

1. Pumping stations shall be designed with sufficient in-system storage (in the well, upstream sewers or a dedicated self draining high level storage) so that in the event of pump or power failure, no overflows occur for a minimum period of 2 days with inflow at average dry weather flow. In system storage shall be measured from duty start level to the level of the lowest relief point.
2. The pumps are to be set up to operate automatically as Duty/Standby and should be of the submersible electric type.
3. An alarm shall be provided in the form of a prominently positioned flashing red light set to activate at the invert level of the incoming house drain.

D7.20 PRIVATE PRESSURE MAINS

1. Medium density polyethylene pressure main is approved for use.

D7.21 SPECIFIC REQUIREMENTS

1. As the private sewage pumping station is a component of the internal plumbing and drainage, Council's Plumbing and Drainage Services Section shall check the design drawings for compliance with current legislation and relevant standards.
2. Owners of private pumping stations are responsible for all costs and charges associated with the installation, operation and maintenance.
3. As constructed details and the location of the pressure main shall be submitted to Council.

D7.22 INFORMATION TO BE PROVIDED TO COUNCIL

1. The following information shall be provided when the plans are submitted for approval:
 - Place of Manufacture of all components;
 - Rating of the motor;
 - Weight of the motor;
 - Duty Points;
 - KWH/1000 litres pumped;
 - Performance curves;
 - Guarantee;
 - Flow meter connected to Telemetry shall read in litres per second.
2. Upon commissioning, the following information shall be provided to the Council for checking prior to survey plans being endorsed by Council.
 - Curves with at least four points plotted of the actual performance established in the field, or similar supervised works certificate;
 - Actual KWH/1000 litres pumped;
 - Complete wiring diagrams and details;
 - Mechanical details and parts list of pump and motor;
 - Maintenance catalogue showing daily, weekly, monthly and annual requirements;
 - A complete set of the manufacturers recommended spares shall be held by an approved service agent.
 - A set of cover lifters delivered to an approved service agent.

D7.23 TELEMETRY SYSTEMS

1. Where required by the Local Authority pump station control panel shall incorporate SCADA equipment for transmission of monitoring data and control to Council's existing master system. Council should be contacted to obtain a copy of their Technical Specification for Telemetry Systems.

APPENDIX A

ADDENDUM TO

SEWERAGE CODE OF

AUSTRALIA WSA 02-2002

APPENDIX A - Addendum to Sewerage Code of Australia WSA 02-2002

2.3.1 Loading per Serviced Property

Refer to Section D7.07 - Design Criteria of this Manual.

2.3.2 Assessment of future loads

Refer to Section D7.07 - Design Criteria of this Manual.

3.1 DESIGN FLOW ESTIMATION

Refer to Section D7.07 - Design Criteria of this Manual.

3.2 DESIGN FLOW ESTIMATION METHOD

Refer to Section D7.07 – Design Criteria of this Manual.

4.2.5 Easements

Refer to Section D7.09 – Dedication of Land, Easements and Permits to Enter of this Manual.

4.3.7 Horizontal Curves in Sewers

Horizontal curves in sewers are not permitted.

4.5.3 Minimum Air Space for Ventilation

Refer to Section D7.07 – Design Criteria of this Manual.

4.5.4 Minimum pipe sizes for maintenance purposes

Refer to Section D7.010 – Property Connections in this Manual.

4.5.7 Minimum Grades for Self Cleansing

Refer to Section D7.07 – Design Criteria of this Manual.

4.6.5 Minimum Depth of Sewer Connection Point

The sewer shall be deep enough to drain the entire lot except where a private pump station is approved on the lot.

4.6.7 Vertical Curves

Vertical curves are not permitted.

4.6.8 Compound Curves

Compound curves are not permitted.

5.2 LIMITS OF CONNECTION TO SEWERS

Add: connections into manholes will be permitted at end of lines only, elsewhere connections are required in line only.

5.3 METHODS OF PROPERTY CONNECTION

The methods of property connection shall be as per Council's Standard Drawing S-0030.

5.5 NUMBER OF PROPERTY CONNECTIONS

5.5.2 Multiple Occupancy Lots

An application shall be made at design stage for determination of servicing method.

5.6 LOCATION OF CONNECTION POINTS

5.6.1 Undeveloped lots

Property connections should generally be located at the lowest corner of the allotment between 0.5 and 1.5m upstream of the allotment boundary or manhole.

Where a sewer main lies within an adjoining allotment, the property connection is to extend a distance of 1.0m into the allotment. For battle-axe allotments with the property connection located within the access, the property connection shall extend along the access to a point 1.0m within the main part of the allotment or, where a sealed driveway is required for the full length of the hatchet 'handle' then 1m past the extents of the driveway to allow a suitable future point of connection. Where a sewer is contained within a stormwater drainage easement, then the property connection should extend a minimum of 1m past the easement boundary and into the lot it is serving. All property connections should be finished a minimum of 1m clear of any infrastructure.

5.7 Y – PROPERTY CONNECTIONS

Y-property connections are not permitted.

6. MAINTENANCE STRUCTURES

Table 6.1

The use of horizontal and vertical bends is not permitted.
The use of Maintenance shafts shall be by conditional approval only.
The use of terminal maintenance shafts is not permitted.

6.3.2 Maintenance Structure Spacing – Reticulation Sewers

The maximum distance between any two consecutive maintenance structures shall be 90m.

6.6.3 Design Parameters for MHs

External drops are not permitted for use with precast manholes.

6.6.4 Property Connections in MHs

Property connections must not be connected into maintenance holes.

6.6.8 Ladders Step Irons and Landings

Ladders, step irons and landings are not required.

6.7 MAINTENANCE SHAFTS

6.7.1 General

The use of maintenance shafts is permitted, subject to approval in reticulation sewers subject to the design parameters detailed in this Manual and WSA 02-2002.

6.7.2 Design Parameters for MSs and TMSs

The following design parameters apply to maintenance shafts and terminal maintenance shafts in addition to or instead of those detailed in WSA 02-2002.

- Sizing and installation of maintenance shafts to generally comply with the manufacturers recommendations.
- Maintenance shafts shall be graded to the intersection point of the sewer main and maintenance shaft coupling/bend/fitting.
- Maintenance shafts may be used on 100mm, 150mm and 225mm diameter sewer mains and house connection branches only.
- Maintenance shafts shall be used to a maximum depth of 3.0m.
- Maintenance shafts must be supported on a concrete cradle/surround.
- Testing of maintenance shafts shall generally be carried out in conjunction with the testing of the sewer main.
- Property connection branch inspection tees shall be 200mm clear of the centre of the Maintenance Shaft.
- Property connections must not be made into maintenance shafts.
- Maintenance shafts must be provided with a 600mm dia Ductile Iron Class B cover located within a precast surround. The trench bedding material shall extend below the shaft inspection opening surround.
- A maximum of five (5) Maintenance Shafts will be permitted between two conventional maintenance holes with a total length of sewer of not more than 250m between maintenance holes.
- Maintenance Shafts shall be located with a maximum spacing of 50 metres to an adjoining structure.

Maintenance shafts are not permitted in the following locations:

- As the receiving manhole at a pumping/lift station;
- As a discharge manhole for a rising main;
- Within roadway central medians, roundabouts or within kerb and channel;
- As the connection structure for future development stages;
- In an area zoned Industrial, Commercial, or Multi-unit.

7.2 WATER SEALS, BOUNDARY TRAPS AND WATER – SEALED MH'S

Water seals are not required.

7.3 GAS CHECK MH'S

Gas check MH's are not required.

7.4 VERTICAL AND NEAR VERTICAL SEWERS

Prior approval must be obtained from Council for the use of vertical or near vertical sewers.

7.7 VORTEX INLETS AND WATER CUSHIONS

Prior approval must be obtained from Council for the use of water inlets and water cushions.

7.8 INVERTED SYPHONS

The use of inverted syphons is not permitted.

7.10 FLOW MEASURING DEVICES

Flow measuring devices are not required to be installed. Notwithstanding this provision shall be made in the design of the valve chamber to allow the future installation of an electromagnetic flowmeter.

7.11 WET WEATHER STORAGE

Prior approval must be obtained from Council for using wet weather storage as a means of reducing downstream infrastructure.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D8

UTILITIES

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
22 December 2008	Simon Aalbers Manager Infrastructure Development			1.1

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GENERAL

D8.01 SCOPE

1. This section sets out the Guidelines for the provision of utility services within new subdivisions and developments.
2. The designer needs to coordinate the provision of services within the confines of the road verge in consultation with and to the requirements of the Service Authorities/Providers.

D8.02 OBJECTIVE

1. The objective of the Guidelines is to assist the designer in making provision for the following utility services within the design of new subdivisions and developments:
 - Telecommunications
 - Electricity Supply
 - Road Lighting
 - Gas

D8.03 REFERENCE DOCUMENTS

Australian Standards

- AS/NZS1158 Road Lighting

Ergon Energy Standard Drawings

- Standard Drawing 5162/1 – Joint Electricity, Gas and Telecommunications
- Standard Drawing 5162/2 – Joint Electricity, Gas and Multiple Telecommunications

Civil Aviation Safety Authority Australia

- Manual of Standards Part 139 Aerodromes

D8.04 SERVICE AUTHORITY'S GENERAL REQUIREMENTS

1. Prior to an application to reconfigure a lot, the Service Authorities should be consulted to confirm that the provision of services to the proposed development would be provided.
2. Following receipt of Development Approval from Council the designer shall make application to both Authorities for "Offer of Connection Services" for electricity and telecommunication services.
3. Approved proposal plans shall be supplied to both Authorities, for staged developments, this shall include an overall concept layout outlining stages and expected timing for each stage.
4. Should any amendment occur in the design, both Authorities are to be notified immediately together with an amended plan.
5. Where a development includes lots that may have higher service demands (i.e. Industrial, Commercial, Multi Residential etc.), details of the expected yields and the maximum permissible development yield for each lot in accordance with its current zoning shall also be provided to both Authorities.

6. Underground telecommunication services shall be provided to all new developments.
7. Unless otherwise approved by Council, an underground electricity supply is to be provided to all new developments
8. The designer shall be responsible for coordinating and checking the locations of all telecommunication and electrical services to avoid conflicts with other services (i.e. Stormwater pits etc).
9. Layout plans for telecommunication and electrical services including the road lighting design shall be submitted to Council with the design submission.
10. Evidence of the agreement to provide a electricity supply and telecommunication services must be given to Council prior to the sealing of plans of survey.

D8.05 TELECOMMUNICATION SERVICES

1. Installing of underground telecommunication conduits shall be in accordance with the Service Authority's requirements.
2. Consideration shall be given to the location of any roadside cabinets, pillars and pits within the subdivision design.
3. Where an underground telecommunication service is to be provided, telecommunication conduits shall be placed in a shared trenching arrangement, Refer Ergon Energy Standard Drawings 5162/1 and 5162/2 for shared trench arrangement that incorporates telecommunication, electrical and gas services.
4. Unless approved otherwise by Council, all telecommunication services shall be located within the road reserve at a distance of 0.3m – 1.2m from the property boundary.
5. The developer is responsible for the provision of telecommunication conduits across roads, existing roads are to be bored.
6. Permanent non-ferrous cable markers are to be installed in the kerb to mark the location of all road crossings.

D8.06 ELECTRICITY SUPPLY

Underground Supply

1. Unless otherwise approved by Council, overhead electricity reticulation is to be placed underground. Where it has been approved by council – points 2 and 3 then apply.
2. Where an underground electrical service is to be provided it shall be placed in a shared trench arrangement. Refer relevant Ergon Energy Standard Drawings for shared trenching arrangements that incorporates telecommunication, electrical and gas services.
3. Sharing of trenches with sewerage and water mains shall not be permitted. Where existing or proposed services are likely to impede on standard electricity alignments, Council and the Electricity Authority are to be consulted to confirm service alignments and clearances.
4. Unless approved otherwise by Council, all electrical services shall be located within the road reserve at a distance of 0.3m – 1.2m from the property boundary.
5. The developer is to liaise with the Electricity Authority in relation to any requirement for an electrical substation with a view to providing sufficient suitable land on which to site the infrastructure.

6. Where a padmount substation is to be located within the frontage of a proposed or existing parkland, the location shall be subject to Council's approval.
7. No other services shall pass beneath the Electricity Authority's pillars or substations.
8. The developer is responsible for the provision of electrical conduits across roads, existing roads are to be bored.
9. Permanent non-ferrous cable markers are to be installed in the kerb to mark the location of all road crossings.
10. Electrical pillars shall generally be located at an alternate boundary to water meters and gas service crossings. Exceptions may be considered in individual circumstances where unusual conditions or lot layouts exist and where approved by Council and the Electricity Authority.
11. Pillars shall be located at property boundaries, exceptions can occur where there are stormwater easements or other constraints. The Electricity Authority should be consulted to determine alternate locations in these cases.
12. The Electricity Authority's conditions of connection including contributions for initial cable installation works shall be met prior to the acceptance of the works "On Maintenance" by Council.
13. Where advised by the Electricity Authority an additional communication conduit supplied by the service provider shall be laid to the Electricity Authority's requirements.

Overhead Supply

1. The overhead electrical reticulation shall be designed in accordance with the Electricity Authority's requirements.
2. Power poles shall be placed on an appropriate alignment as approved by Council and the Electricity Authority.

D8.07 ROAD LIGHTING

1. All road lighting designs shall be prepared by the Electricity Authority or an approved Engineering Consultant i.e. a Registered Professional Engineer Queensland and shall be included in the design submission for acceptance by Council.
2. All road lighting designs shall be in accordance AS/NZS 1158, "Lighting for Roads and Public Spaces " and shall address the amount of spill light on abutting properties i.e. the initial value of the environmental vertical illuminance (Eve) shall be not more than 1 lux calculated in accordance with the relevant clause for assessment of obtrusiveness to abutting properties.
3. All light columns, luminaires and lamps are to be specified from the Electricity Authority's Lighting Construction Manual.
4. All installation works shall be in accordance with the Electricity Authority's Lighting Construction Manual.
5. Lighting on declared roads shall be designed and installed to the requirements of the Department of Main Roads.
6. It is a Council requirement that road lighting be installed under Rate 2 conditions of Tariff 71 - Public Lamps at all new subdivisions and developments.

7. The required lighting category for a particular road hierarchy shall be determined from Table D8.1.

Table D8.1 Lighting Categories

Category	Application	Luminaire Type	Lamp Type	Rate ²
V3	Sub Arterial Road	Aeroscreen	150 – 400 Watt HPS	2
V5	Trunk Collector Road	Aeroscreen	150 - 400 Watt HPS	2
P3	Collector Road	Normal	80 Watt MV	2
P4	Access Road	Normal	50 Watt MV ³	2
		or Nostalgia	80 Watt MV ³	2
P5	Low Density Residential Road	Normal	50 Watt MV	2
	Rural Residential Road	or Nostalgia	80 Watt MV	2
P1 – P3	Pathway and Cycleway	Normal ¹	80 Watt MV	2
		or Nostalgia	80 Watt MV	2
		or Council Specific	100 Watt MH	3
P8	Bus Stop	Aeroscreen or Normal	Wattage as Required HPS – Cat V Lighting MV – Cat P lighting	2

Note:

- Where lighting is located next to residences then a Type 4 – Aeroscreen luminaire is required.
- Rate 2 – Lighting owned and maintained by the Electricity Authority.

Rate 3 – Lighting owned and maintained by Council

- Maximum spacing distance between lighting columns is approximately 50m or every second property boundary to maintain uniformity and to limit shadowing from streetscaping.

8. Lighting shall be provided at the following locations in accordance with the development approval conditions and AS/NZS 1158, “Lighting for Roads and Public Spaces”:

- Straight Sections;
- Curves;
- Intersections and Junctions;
- Pedestrian Refuges;
- Cul-de-sacs;
- Local Area Traffic Management Devices including Roundabouts. (The maintained horizontal illuminance is not to be less than 3.5 lux)

Note: Where a pedestrian crossing has been installed it shall be lit in accordance with AS 1158.4 – 1987, “Supplementary Lighting at Pedestrian Crossings.”

9. Lighting of entry points to pathways and cycleways shall be achieved by the selected placement of a road light nearby.
10. Additional lighting shall be provided at a designated bus stop facility, the design shall include the entry and exit lengths of the bus stop.
11. The use of normal 80 Watt MV luminaires is permitted at locations requiring a minimum maintained horizontal illuminance of 3.5 lux.
12. Lighting columns are to be offset 800mm behind the invert of kerb and channel to centre of the pole.
13. The placement of lighting columns shall not occur within 1m of any water main that crosses the road.
14. Lighting columns that are to be installed at all new subdivisions and developments are to be a four hole base plate mounted steel pole as specified in the Electricity Authority's Lighting Construction Manual.
15. When joining to an existing installation or extending a subdivision in stages, lighting columns and luminaires shall match as near as possible with the existing infrastructure.
16. The use of aeroscreen luminaires may be required when road lighting is installed near airports, refer to the Civil Aviation Safety Authority Australia – Manual of Standards Part 139.
17. Documentation shall be submitted to Council with the design submission demonstrating compliance with the AS/NZS 1158, "Lighting for Roads and Public Spaces".

D8.08 PARK LIGHTING

1. Lighting requirements in parks will be advised by Council in accordance with the classification of the park.
2. A point of supply is required to all parks, location will be advised by Council in consultation with Electricity Authority.
3. Pathways or cycleways within parks that require lighting shall be lit to the minimum lighting category P3 or above as deemed appropriate from the selection criteria tabled in AS/NZS 1158, "Lighting for Roads and Public Spaces".

D8.09 GAS

1. Gas reticulation within a new subdivision or development may be installed subject to Council's approval.
2. Where reticulated gas is approved by Council, the gas service shall be located in the shared trench arrangement. Refer Ergon Energy Standard Drawings 5162/1 and 5162/2 for shared trenching arrangements that incorporates telecommunications, electrical and gas services.
3. The location of a central storage facility shall be on a separate freehold parcel of land with appropriate security to the satisfaction of the Council.
4. The Developer shall be responsible for obtaining all relevant approvals and licences necessary for installation

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

DESIGN GUIDELINE

D9

LANDSCAPING

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Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

D9.01 SCOPE

1. This section sets out the Guidelines for landscaping within new subdivisions and on-street works for private developments.
2. This Guideline contains procedures for the design of:
 - On-street landscaping works, including buffers mounds, traffic islands and roundabouts.
 - Public Open Spaces including, signage, furniture and playgrounds.

D9.02 OBJECTIVE

1. The objective of this guideline is to define Councils minimum landscaping requirements and to assist the designer in achieving the following:
 - Visually enhancement of the streetscapes;
 - Enlargement of the habitat and plant diversity in order to provide a food source for indigenous fauna;
 - Enhanced living environments by reducing the impacts of noise, fumes and car headlights;
 - Provision of shade trees;
 - Crime prevention through environmental design (CPTED).

D9.03 REFERENCE DOCUMENTS

Australian Standards

- AS/NZS1158.3 Pedestrian Area (Category P) Lighting
- AS3500 National Plumbing and Drainage, Part 1.2 Water Supply – Acceptable Solutions

QLD Government Legislation

- Queensland Land Protection Act (2002)

Whitsunday Shire Council

- Planning Scheme
- Local Laws and Policies.
- Whitsunday Pest Management Plan

ON-STREET LANDSCAPING WORKS

D9.04 GENERAL

1. At the time of development, the developer shall provide all on-street landscaping, this shall include street tree planting, grass establishment to road verges, and landscaping of traffic islands and buffer mounds.
2. Council should be consulted prior to commencement of the design to ascertain whether there are any site specific design requirements.
3. Council's plant selection guidelines are included in Appendix A.
4. Landscaping plans shall be prepared by a person of professional standing in the field of Landscape architecture or landscape design, at a standard acceptable to Council.

D9.05 EXISTING VEGETATION

1. In order to retain any established landscape character, all trees located within existing road reserves shall be protected and retained unless approved otherwise by Council.
2. Significant trees located within the verge of new road reserves shall be protected wherever possible and where advised by Council. This may require the adoption of non-standard utility service alignments, therefore designers are encouraged to discuss proposed solutions with Council.
3. Existing trees along drainage lines, flood prone areas (inundated during a Q20 flood event) and creeks should be retained where possible.

D9.06 VERGES

1. All verges shall be covered full width with topsoil to a depth of not less than 75mm and shall be lightly compacted and grassed in accordance with Councils Guidelines and Specifications.
2. In order to guarantee a high standard of maintenance all verges are to be in a mowable condition, free from rocks and loose stones, and graded to even-running contours.
3. Aside from grass establishment and tree planting, landscaping of the verge between the property boundary and kerb is not a Council requirement. However, additional landscaping within the verge may be considered subject to Council approval.
4. Should any excavation of the underground services in the vicinity of the additional verge landscaping be required, thus destroying the vegetation, Council will not be held responsible for plant replacement. Maintenance of planting in this vicinity will be the sole responsibility of the adjacent property owner/occupier.

D9.07 STREET TREE PLANTING

1. The ultimate aim of street tree planting is to provide:
 - An attractive streetscape with character and charm. An individual character may be obtained by using a specific tree species for each street.
 - Shade, and the reduction of heat and glare from the road pavement. Parked cars may remain cool during the summer months.

- Habitat provision and enhancement. Native flowering trees provide a source of food and shelter for insects, birds and animals.
2. Where a development is occurring in an established street setting, an assessment of the existing trees should be made, and the most prevalent and healthy species chosen for verge planting.
 3. Tree species shall be selected for their suitability to the site conditions (eg. small trees under power lines, drought resistance, soil suitability) and shall be in accordance with any relevant Council plant selection guidelines and suburban planting themes.
 4. To ensure consistency in growth rate and form all trees shall be no less than two (2) metres in height and shall be well established in their root and branch formation. A minimum 25 litre container should ensure a good survival factor.
 5. The alignment and placement of street trees measured from the tree at the estimated ultimate size shall be in accordance with the following:
 - Greater than 4.0 metres from electricity or telecommunication poles or pillars.
 - Greater than 7.5 metres from streetlights to ensure effective street lighting.
 - Greater than 4.0 metre radius from high voltage transmission lines.
 - Greater than 2.0 metres from stormwater drainage pits.
 - Trees are to be planted in the front of properties at the centre of the lot at a rate of one per lot, or at the necessary rate to provide a maximum 20 metre spacing (or as per planning scheme requirements).
 - Trees are to be placed a minimum of 800 mm and a maximum of 1000mm from the back of kerb.
 - Trees are to be placed a minimum of three (3) metres from driveway.
 - At intersections trees are to be placed a minimum of ten (10) metres back from the face of the kerb of the adjoining street.
 - Trees are to be located so as not to obstruct access to any services or signage.
 - Trees are to be located so as not to obstruct pedestrian or vehicular traffic, nor create traffic hazard or cause damage to existing trees.
 6. Street Trees shall be planted in accordance with Standard Drawing S4210 and installed in accordance with Council Specifications.
 7. Street trees should not be a plant listed in:
 - Land Protection (Pest and Stock Route Management) Regulation 2003
 - Local governments Pest Management Plan or the
 - Publication "Agricultural and Environmental Weeds – Far North Queensland" (Wet Tropics Management Authority, Department of Natural Resources and Mines)

D9.08 BUFFER ZONES

1. The aim of the Buffer Mound landscaping is to:
 - Reduce the visual impact of adjacent development by screening rooflines.
 - Reduce the visual impact of proposed noise attenuation barriers, which may be constructed at some time in the future on the mound crest.
 - Reduce the visual impact of the mound's severe geometric landform by screening with foliage to ground level.
 - Introduce a "natural" vegetated landscape appearance by replacing open agricultural land with a facade of dense planting.
 - Reinforce the local character by indigenous tree and shrub species.
 - Provide additional functions, i.e. shade over adjacent bikeways.
2. In order to accomplish the above aims, the species mix of plant selection should incorporate a range of species to provide variation in form, colour and texture, to contribute to a natural appearance. The front line of planting should have foliage down to ground level.
3. To ensure that buffer mounds are given the best possible chance of successful establishment and prolonged survival, a temporary irrigation system is required to be installed to the mounding. The preferred system is with a drip-style irrigation system or similar below the surface of the mulch, which reduces the chances of vandalism and reduces excess water loss as a result of runoff and evaporation.
4. Strong recognisable character is further reinforced by repetition of some suitable species as street and park trees in the adjacent subdivision
5. Use of disciplined plant selection based on themes such as colour, texture, or natural species associations, in addition to site suitability, creates higher quality landscapes than random assortments of nursery stock chosen solely for short notice availability and growth suitability.
6. Advance ordering and growing on contracts are desirable to ensure availability of desired species in the large quantities required.
7. Local rainforest species, which typify and reinforce the regions image, are preferred. Most are hardy, long-lived and have dense growth, which suppress weeds and reduce long-term maintenance.
8. The landscaping shall be designed so as not to create a safety risk to people using the mound and adjacent areas (i.e. no thorns, heavy nuts or poisonous fruits or berries).
9. Mounds / Buffers adjacent to major roads controlled by the Department of Main Roads must comply with the requirements as specified by the Department of Main Roads and as detailed herein. Generally, these buffers are ten (10) metres wide along the full frontage of the major road.
10. For buffer plantings required to separate conflicting land uses as described in the Queensland State Planning Policy 1/92, the buffer must comply with the guidelines within the Policy. In addition, suitable local native plants should be used to create the buffer. The distance between the vegetation rows should be 3m with plants 2m apart.
11. For buffer plantings adjacent to water ways, the distance of the buffer will be determined based on the provisions of the Whitsunday Shire council IPA planning scheme, or a minimum of 10m either side for stream order 1 and 2 waterways.

PUBLIC OPEN SPACE

D9.09 GENERAL

1. At the time of development, the developer shall landscape all public open spaces to the satisfaction of Council and in accordance with this guideline.
2. Where a development is proposing to undertake any work within existing or proposed park a landscaping plan shall be prepared for consideration by Council.
3. Landscaping plans shall be prepared by a person of professional standing in the field of landscape architecture or landscape design, at a standard acceptable to Council.

D9.10 CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

1. It is important when designing parks that the principles of crime prevention through environmental design are considered, in particular:
 - Dense stands of vegetation should be confined to park peripheries, and should not be located alongside paths and play equipment. Vegetation should not block casual surveillance of picnic and play areas from adjacent residences.
 - Landscaping should not restrict sightlines and opportunities for natural surveillance within and of a site therefore landscaping should avoid the cluster of shrubs which could form concealment areas. Shrubs which grow between 0.5m and 4m should be separated by at least 4m where they occur within 15m of playground equipment or pathways.
 - Lighting where required should be sufficient to deter loitering and vandalism.
 - Large shrubs and trees should be planted in such a way as to prevent or reduce illicit access to buildings and neighbouring properties.
 - Safety in large parks or areas of vegetation within a development may be enhanced by planting trees in thin strips which maximises the number of trees planted but which also restricts the ability of offenders to hide within a “mass” of vegetation.

D9.11 TREATMENT TO PARK BOUNDARIES

1. Vehicles should be prevented from driving into parks, drainage reserves and public open spaces by the provision of barriers along the road frontages. These may be log barriers, bollards or natural features such as existing vegetation or newly planted and staked trees. Access for maintenance vehicles shall be provided through a lockable gate or removable bollard.
2. Definition of the park side boundaries should be indicated by installing log barrier fencing or bollards at approximately 20 metre centres, down each side. These should be offset from the surveyed boundary by 100 mm in order to allow future erection of private fencing without having to remove Council's markers. Definition of the park boundary is intended to deter encroachment onto park by adjacent private properties and to define the park limits.
3. Log barriers and bollards shall be in accordance with Standard Drawing S4300 unless otherwise approved by Council.

D9.12 INTERNAL CIRCULATION

1. The park layout should be designed to ensure that internal circulation or movement within the park is:
 - Safe
 - Unencumbered
 - Highly visible internally and externally
 - Linked to external cycle and pedestrian networks.
2. Design features including access points, street frontages, carparks, pedestrian/bike paths, park equipment and lighting should be considered.
3. Design of paths, carparking and access points should consider the needs of people with mobility challenges. Pathways shall be in accordance with Design Guideline D1 and comply with accessibility standards.

D9.13 PLANTING

1. Council parks seek to provide a range of recreation opportunities and there is scope to utilise planting design to help achieve this objective, options include:
 - Tall shade trees should be planted at strategic locations to maximise shade to high use areas. As a guide, shade trees should not be planted closer than 6m apart;
 - Island or corridor planting to concentrate trees for easy maintenance and encourage bird life for pleasure viewing;
 - Grouped planting will also provide shade adjacent to open space to allow unencumbered active play areas;
 - Lines of tree planting to define edges of informal kick-about areas.
2. A minimum 75% of the proposed tree planting should be endemic, and species should be selected on their adaptability to site conditions, and their value to local fauna. Where the proposed park adjoins an area of established native vegetation, an extension of this habitat into the park should be implemented by using compatible species. The designer should also be encouraged to use rare and endangered plant species, or species proven to have excellent bird, butterfly and insect attracting qualities.
3. In order to promote the unique landscape characteristics of the region exotic flowering trees and non-native palms should only be used as features or emphasis, where necessary.
4. Council's plant selection guidelines are included in Appendix A.
5. Street trees should not be a plant listed in:
 - Land Protection (Pest and Stock Route Management) Regulation 2003
 - Local governments Pest Management Plan or the
 - Publication "Agricultural and Environmental Weeds – Far North Queensland" (Wet Tropics Management Authority, Department of Natural Resources and Mines)

D9.14 GRASSING

1. Parks may require additional topsoil to a depth of not less than 75mm and shall be lightly compacted and grassed if Council considers the in-situ topsoil of poor quality and is too rocky.
2. In order to guarantee a high standard of maintenance all parks shall be in a mowable condition, free from rocks and loose stones, and graded to even-running contours.
3. Grass should be established within the proposed park as quickly as possible in order to avoid erosion and sedimentation to the local waterways, and prevent the establishment of weeds in accordance with Council's Guidelines and Specifications.

D9.15 MOUNDING

1. Mounding may be used within the park design to provide topographical interest, to emphasise views, to help screen adjacent properties or eyesores, or as part of the internal design. The mounds should not exceed a gradient of 25% (1 in 4) in order to reduce erosion and allow mowing. Planting of trees and shrubs over the mound will further emphasise height and shape.
2. Care should be given to ensuring that the mound does not restrict visibility into and out of the park thus threatening the safety of users or provide unwanted visibility into private properties.
3. Landscape mounding shall be in accordance with Standard Drawing S4220 unless otherwise approved by Council.

D9.16 FURNITURE

1. Park furniture should reflect the intended function of the park and compliment any distinguishing features present eg seating situated to maximise a viewscape. Some preferred features of furniture include:
 - Park benches located under a natural or built shade structure to allow day long use. If the shade is built, it should have an impervious roof eg colorbond to provide shelter during rain.
 - Well drained ground and hard surfacing below any structure. Surface material could be pavers, coloured or exposed aggregate concrete etc.
 - Shade structures should maximise protection from the sun during the hours of 11 am - 2 pm.
 - Refuse bins should be located for ease of use and pickup by refuse trucks eg adjacent to playgrounds or picnic areas, at park exits.
2. Designs of furniture should reflect a strong aesthetic and vandal resistant appearance.
3. Where possible, natural features may be used eg mounding for seating, trees or natural rock for bollards to simulate park furniture.
4. Some Local Authorities have park furniture themes and master plans, designers are encouraged to consult with Council in the preparation of the landscaping design.

D9.17 SIGNAGE AND INTERPRETATION

1. A park name sign is to be provided in accordance with the Standard Drawing S4390. The park name is to be submitted to Council for approval with the landscaping drawings. The proposed name is to preferably have the same theme as the subdivision's street names. The name is to be creative and imaginative in order to appeal to children for local parks and to adults for district and regional parks.
2. If the park has any historic, cultural or natural value the provision of interpretive signage will provide further interest to local users. Council can provide assistance in developing interpretive concepts.

D9.18 LIGHTING

1. Lighting requirements within parks will be advised by Council in accordance with the classification of the park.
2. As a guide two (2) park lights on poles shall be provided for every park of 4,000 square metres. However, this may vary depending upon the shape and alignment of the park, and the presence of existing vegetation. Generally, parks should be well lit providing a safe nocturnal environment for local users. Council will consider the relaxation of one or both lights where existing street lights are adjacent to the park area. Underground power should be provided to each pole. Light fittings should be vandal resistant.
3. Pathways within parks that require lighting shall be lit to the lighting category determined from the road Lighting Standards AS/NZS 1158.3, "Pedestrian area (Category P) lighting".

D9.19 PROVISION OF WATER

1. Facilities for drinking, such as drinking tap / bubbler, shall be provided for each park area, and should be located near active recreational areas, adjacent to a well-used access route, and within an area serviceable from the road frontage. A soak-away trench shall be provided to the base of each tap to prevent ponding and waterlogging.
2. In order to irrigate the park one (1) water service connection in a cast iron valve box should be provided for each 2,000 square metre of park and should be a minimum 40 mm diameter with hose connection.
3. As an alternative, irrigation may be provided, on condition that the proposed system complies with the Council Standard Specification for Irrigation.

D9.20 WATER FEATURES

1. Water should also be considered as an aesthetic feature of the park. Council does not recommend a formal water feature incorporating concrete structures and pumps, due to the excessive maintenance requirements, but utilising an existing watercourse as a park highlight could be possible. Sensitive manipulation of an existing creek could facilitate a year-round aquatic environment, thus encouraging greater bio-diversity and providing an exciting focal point to the park and surrounding subdivision.

D9.21 PLAYGROUNDS

1. To ensure play equipment is as safe as possible and appropriate for the intended users, it should conform to the current and relevant Australian Standards for playgrounds and play areas and additional standards as may be established by Council.

2. Where playground equipment is required by Council as a condition of the development permit of the subdivision, or proposed to be installed by the developer, the following requirements should be considered and incorporated into the design:
 - Type of play equipment proposed should be selected in consultation with Council.
 - The age range of the users should influence the type of equipment provided.
 - The siting of the playground should not infringe upon adjacent residential properties; a minimum distance of 10 metres between equipment and park boundaries should be provided and suitably landscaped with a minimum of 3 metre of screen planting to reduce noise and visual impact. Such landscaping is to be consistent with CPTED Principles.
3. To conform to safety requirements impact absorbing surfacing should be installed to the play area, eg sand, continuous rubberised matting, shredded car tyres. Playground edging shall be in accordance with Standard Drawing S4370 unless otherwise approved by Council.
4. Shade cover over playgrounds is to be provided, in order to encourage day long use. Preferably this should be a permanent shade structure approved by Council, however shade trees planted at maximum 6 metre centres around the safety area are acceptable.
5. The provision of seating overlooking the playground will be required.
6. Typical details of timber and concrete bench seating are shown on Standard Drawings S4340 and S4350. Alternate seating (ie. proprietary seating) may also be used subject to Council approval.

D9.22 MAINTENANCE

1. The design of a park should carefully consider long-term maintenance requirements. Mulched garden beds containing trees and shrubs are easier to mow around than numerous small trees and shrubs planted individually throughout the grassed areas.
2. Where single shade trees occur they should be mulched to 100 mm depth in a minimum 1.2 metre diameter circle, thus avoiding damage to trunks by mowers or whipper snippers.
3. Typical details of acceptable garden bed edging are shown on Standard Drawing S4380.
4. Access to the parks, drainage reserves and public open spaces for maintenance vehicles should be via a lockable gate or removable bollards.
5. A maintenance programme is required to be submitted to Council with the submission of the landscape designs. The programme should be prepared by the Landscape Architect / Designer and should detail all proposed maintenance works.

IRRIGATION

D9.23 GENERAL

1. All irrigation systems connected to Council's water supply shall be installed to satisfaction of Council. The installation of water meters, backflow prevention device and isolation valves are mandatory in all irrigation system. Refer AS 3500 "National Plumbing and Drainage, Part 1.2 Water Supply – Acceptable Solutions".
2. The installation of an irrigation system to all landscaped traffic islands and roundabouts is mandatory.
3. An irrigation plan prepared by an irrigation consultant, shall be submitted to Council for approval together with the landscaping plans, and the proposed planting plans for the traffic islands / roundabouts.
4. The design of all watering systems must ensure an efficient and economical application of water. Such systems are to be designed to use low water application, and shall run only during Council's nominated times.
5. The irrigation system shall use the following components and shall be installed in accordance with Council Specifications.
 - A backflow prevention unit, installed 300mm above the highest sprinkler.
 - 20mm, 25mm or 32mm or 40mm diameter PVC pipework (as required) to garden bed areas; laid in a ring around the periphery of each garden bed.
 - Pop-up sprinklers to periphery of garden beds. Fixed shrub heads to centre of islands only.
 - Automatically operated controller in PVC box laid flush with finished ground level.
6. All irrigation pipework installed under roadways shall be laid in minimum 100mm dia. uPVC Class 9 conduit.
7. The water connection and installation of the irrigation system shall be carried out by Council personnel or an approved contractor at the developers / applicants cost. The maintenance period for irrigation works shall be three months and shall run concurrently with the "On Maintenance" / establishment period for landscaping works. Thereafter all maintenance and watering will be the responsibility of the Council.
8. The installation of an irrigation system on Council property, other than buffer mounds, traffic islands and roundabouts, eg. verges will not be permitted unless:
 - The system is separate from the development and all pipework is located adjacent to the kerb and channel.
 - Or the verge is irrigated from sprinklers that fall within the development property boundaries.
9. These requirements have come about in order to prohibit the installation of water lines across the underground services located within the verge. These water lines would not appear in Council records and are therefore at risk of breakage during service repair work/trench excavation.
10. If a separate irrigation system within the verge is desired, the developer will be required to pay all installation costs, which include:
 - Tapping into main

- Installation of 25mm diameter (typical) backflow prevention device
- Installation of pipework and pop-up sprinklers
- Installation of solenoid valves and automatic controller.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S1

EARTHWORKS

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APPENDIX A - PROCEDURE ON DEVELOPMENT OF EROSION AND SEDIMENT CONTROL PLANS

GENERAL

S1.01 SCOPE

1. This specification details all requirements pertaining to earthworks operations associated with construction sites. This specification excludes earthworks associated with roadworks construction.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S1.02 REFERENCE DOCUMENTS

Australian Standards

- AS 3798 Guideline on Earthworks for Commercial and Residential Developments.

MATERIALS

S1.03 TOPSOIL

1. Topsoil is defined as surface soils normally high in organic matter and contaminated by residual grass seed and grass roots. Topsoil shall be free from large roots, stones, rocks and unsuitable material as defined below.

S1.04 UNSUITABLE MATERIAL

1. Reference is made to AS 3798 Section 4.2 "Unsuitable Materials" for definitions and guidelines regarding unsuitable materials with regard to earthworks operations.

S1.05 SUITABLE MATERIAL

1. Reference is made to AS 3798 Section 4.3 "Suitable Materials" for the definition and guidelines regarding acceptable materials for earthworks operations.

CONSTRUCTION

S1.06 GENERAL

1. Specific reference is made to AS 3798 in relation all activities pertaining to earthworks operations. Specific construction details are noted in Section 6 of AS 3798 and all appropriate methods of testing, frequency of testing and reporting procedures are to be in accordance with this Australian Standard.

S1.07 PROTECTION OF EARTHWORKS

1. The Contractor's responsibility for care of the works shall include the protection of earthworks in accordance with the approved Erosion and Sediment Control Strategy.
2. The Contractor shall install effective erosion and sedimentation control measures, prior to commencing earthworks, and shall maintain these control measures as required.
3. Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.
4. When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface.
5. Should insitu or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

S1.08 CLEARING AND GRUBBING

1. Clearing and grubbing operations shall be in accordance with AS 3798 Section 6.1.4.
2. The extent of clearing and grubbing shall be taken to mean the removal and disposal of:
 - Trees, Shrubs and overhanging branches, both living and dead;
 - Tree stumps and roots to a depth not less than 300mm below ground surface;
 - Rocks, rubbish and other artificial obstructions from the ground surface;
 - Abandoned services to a depth not less than 300mm below ground surface;
 - Old foundations, buildings and structures;
 - Minor made structures (such as fences);
 - Other materials, which are unsuitable for use in the works.
3. Un-grubbed rocks under embankments may be left undisturbed providing there is a depth of at least 600mm of earth covering over them when the filling operations are completed.
4. Unless otherwise specified or directed, the area to be cleared is the minimum width required to construct the works plus a margin of 2m beyond tops of cuts and toes of embankments. The area to be cleared and grubbed should be shown on a plan, preferably the Erosion and Sediment Control Plan.
5. Any trees, shrubs and overhanging branches identified on the Project Drawings to be retained or protected shall be clearly marked by the contractor prior to commencing clearing operations.

6. Beyond the areas to be cleared only those trees, shrubs and over hanging branches which directly interfere with the construction of the works shall be removed or pruned as necessary.

S1.09 TOPSOIL OPERATIONS

1. Stripping of topsoil shall be in accordance with AS 3798 Section 6.1.5.
2. Removal of topsoil shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the Works.
3. Topsoil throughout the extent of the work shall be removed and stockpiled separately clear of the work with care taken to avoid contamination by other materials.
4. Topsoil material stripped from the site shall be stockpiled for later use in spreading on footpaths, allotments and parkland areas.
5. Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.
6. To minimise erosion, stockpiles are to be protected by effective usage of erosion and sediment control devices, which are to be defined within the Erosion and Sediment Control Management Plan.
7. Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with the Specification S8 LANDSCAPING.
8. Nominally 75mm depth of topsoil is to be re-spread over such areas with an absolute minimum of 40mm material to be provided in any one location.

S1.10 GENERAL EARTHWORKS

1. Placement and Compaction of earthworks shall be in accordance with AS 3798 Sections 5 and 6.
2. The methods of testing and frequency of testing shall be in accordance with AS 3798 Sections 7 and 8.
3. Unless a higher level of testing is specified or directed the minimum level of geotechnical testing services to be accorded earthworks activities shall be as determined by Level 2 in Appendix B of AS 3798.
4. All testing is to be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel

S1.11 EXCAVATIONS

1. Materials encountered in excavation shall be loosened and broken down as required so that they are acceptable for incorporation in the works.
2. All excavations shall be constructed to the shape and slopes shown on the approved Project Documents.
3. Batter shall be trimmed neatly to the shapes specified and shall be free of loose or unstable material.

4. Horizontal tolerances for the excavation of batters, measured at right angles to the batter line, shall be $- 50\text{mm} +250\text{mm}$ (where the + tolerance is in the direction which increases the width of excavation).
5. Vertical tolerances for all excavation shall be $\pm 50\text{mm}$.
6. When completed all culvert excavations, benches, berms and drains shall be free draining.
7. At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.

S1.12 EMBANKMENTS / FILL AREAS

1. All embankments and fill areas shall be constructed to the shape and slopes shown on the approved Project Documents.
2. When completed, the average planes of the batters of embankments shall conform to those shown on the approved Project Documents.
3. Horizontal tolerances for the embankment batters, measured at right angles to the batter line, shall be $- 0\text{mm} +250\text{mm}$ (where the + tolerance is in the direction which increases the width of embankment).
4. Vertical tolerances for all embankments / fill areas, shall be $\pm 50\text{mm}$ except where such fill defines the subgrade level for a structure, then the vertical tolerances are to be $+15\text{mm} - 30\text{mm}$.
5. When completed all embankments / fill areas shall be free draining.
6. At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.
7. Stabilise final embankment and fill areas with suitable revegetation, landscaping, turf or grass seeding. These areas and works should be shown in the landscape plans

S1.13 TRENCHING OPERATIONS

1. The excavation for trenches shall be taken out to the exact alignment, width and level as shown on the Project Drawings and associated specifications.
2. Trenches shall not be excavated wider than the dimensions shown on these relevant drawings and the Contractor shall take all precautions as necessary to ensure that the excavation is made in a careful manner and that it is rendered secure and safe by all appropriate means.
3. At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.
4. Suitable drainage shall be accorded to all trenching activities and de-watering of trenches shall be undertaken should infiltration of water occur. All materials excavated from trenches shall be separated by material type for later inclusion into the works or disposal from the site should these materials be deemed unsuitable in accordance with the requirements of AS 3798.
5. Excavation and trenching operations shall proceed with sufficient resources to ensure uninterrupted progress and continuance of the works with subsequent services. Completion and backfilling are to be undertaken as soon as possible so as to minimise the extent of site open to the effects of the environment.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S2

ROAD PAVEMENTS

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

S2.01 SCOPE

1. This specification details all requirements pertaining to the construction of flexible road pavements, including kerbing, subsoil drainage and trimming of verges.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S2.02 REFERENCE DOCUMENTS

Australian Standards

- AS1289 Methods of Testing Soils for Engineering Purposes
- AS2439.1 Perforated Drainage Pipe and Associated Fittings
- AS3706.7 Determination of Pore-sized Distribution – Dry Sieving Methods

All Australian Standards referenced in this specification shall be the current edition.

Department of Main Roads Standard Specifications

- MRS 11.03 Drainage, Retaining Structures and Protective Treatments
- MRS 11.04 General Earthwork
- MRS 11.05 Unbound Pavements
- MRS 11.11 Sprayed Bitumen Surfacing (Excluding Emulsions)
- MRS 11.14 Road Furniture
- MRS 11.17 Bitumen
- MRS 11.19 Bitumen Cutter and Flux Oils
- MRS 11.20 Cutback Bitumen
- MRS 11.22 Supply of Cover Aggregate
- MRS 11.30 Dense Graded Asphalt Pavements
- MRS 11.45 Pavement Marking

Department of Main Roads Publications

- Manual of Uniform Traffic Control Devices

Australian Asphalt Pavement Association (QLD Branch)

- Asphalt Specification for Subdivision Pavements – Edition 1 November 1993

MATERIALS

S2.03 PAVEMENT MATERIAL

1. Pavement materials used for pavement construction shall comply with Table S2.1 unless otherwise approved by the relevant authority.

Table S2.1 Pavement Materials

Pavement Material	Type of Material Permissible	Grading	CBR (Minimum)
Subgrade Replacement	Type 2.5	B,C or D	15
Sub-base (for Access Places and Access Streets)	Type 2.3	B,C or D	45
Sub-base (for all roads of Major Collector or higher in the hierarchy)	Type 2.2	B, C or D	60
Base (for Access Places and Access Streets)	Type 2.2	B,C or D	60
Base (for all roads of Major Collector or higher in the hierarchy)	Type 2.1	B or C	80

2. All references to material type in the above table refer to the Main Roads Standard Specification MRS11.05 "Unbound Pavements".
3. All materials shall be sourced from a Quality Assured material supplier and the results of the manufacturer's testing to assure the quality of the product shall be incorporated with the Contractor's Quality records.

S2.04 ASPHALTIC CONCRETE SURFACING

1. For surfacing on pavements with nominal depth 30mm, the material quality requirements, material quality compliance testing requirements and all other matters pertaining to Asphaltic Concrete road pavement surfacing shall conform to the requirements as specified in the "Asphalt Specification for Subdivision Pavements" Edition 1 November 1993, published by the Australian Asphalt Pavement Association (Queensland Branch).
2. For surfacing on pavements with nominal depths greater than 30mm, the material quality requirements, material quality compliance testing requirements and all other matters pertaining to Asphaltic Concrete road pavement surfacing shall conform to the appropriate Main Roads Standard Specification.
 - Main Roads Specification MRS 11.30 "Dense Graded Asphalt Pavements".

S2.05 SPRAYED BITUMEN SURFACING

1. For surfacing of pavements with sprayed bitumen. the material quality requirements, material quality compliance testing requirements and all other matters pertaining to hot bitumen road pavement surfacing shall conform to the appropriate Queensland Department of Main Roads Specification.
 - Main Roads Specification MRS 11.11 "Sprayed Bitumen Surfacing (Excluding Emulsions)"

- Main Roads Specification MRS 11.17 “ Bitumen”
- Main Roads Specification MRS 11.19 “ Bitumen Cutter and Flux Oils”
- Main Roads Specification MRS 11.20 “ Cutback Bitumen”
- Main Roads Specification MRS 11.22 “Supply of Cover Aggregate”

S2.06 CONCRETE INTERLOCKING PAVERS

1. Concrete interlocking pavers shall be manufactured and supplied in accordance with the requirements of Specification S3 SEGMENTAL PAVING

S2.07 ROAD FURNITURE

1. The manufacture, supply and material requirements appropriate to the specification for Road Signs and guidepost shall be as per the Main Roads Standard Specification "MRS11.14 Road Furniture".
2. All signs to be Class 1 reflectivity
3. Signs located in concrete islands or medians shall be supplied with the “V Loc” socket system and fitted with anti-theft bolts.

S2.08 PAVEMENT MARKING

1. The manufacture, supply and material requirements appropriate to the specification for Pavement Marking shall be as per the Main Roads Standard Specification "MRS11.45 Pavement Marking".

CONSTRUCTION

S2.09 INSPECTION, SAMPLING AND TESTING

1. Inspection, sampling and testing of the pavement shall be in accordance with the requirements of this specification before, during and after the construction of the pavement.
2. All testing shall be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

S2.10 SETOUT

1. The construction setout for roadworks construction shall be by reference to a datum line established by a Registered Surveyor. The datum line may be either the road centreline, a pegged chainage offset line or any alternative datum suitable for the purposes of accurately setting out the roadworks in accordance with the drawings for the works.

S2.11 CLEARING AND GRUBBING

1. All clearing and grubbing works shall be in accordance with the Specification for S1 EARTHWORKS.

S2.12 TOPSOIL OPERATIONS

1. All topsoil operations associated with roadworks construction (topsoil stripping, stockpiling and re-spreading), shall be in accordance with the Specification for S1 EARTHWORKS.

S2.13 EARTHWORKS

1. All earthworks operations up to subgrade level shall comply with the requirements detailed in Main Roads Standard Specification MRS11.04 "General Earthworks".

S2.14 TRIM AND COMPACT SUBGRADE

1. The subgrade material is defined as the top 300mm of earthworks profiled and compacted upon which pavement materials are to be placed. The subgrade material shall be compacted in accordance with the requirements detailed in Main Roads Standard Specification MRS11.04 "General Earthworks", with the testing frequency and requirements are detailed herein:
2. The subgrade material shall be compacted to provide a relative compaction determined by AS1289 for a standard compactive effort as follows:
 - Minimum Dry Density Ratio (Cohesive soils) - 98%
 - Minimum Density Index (Cohesion less soils) - 80%
3. Testing frequency not less than one (1) test per 1000m² with a minimum number of three (3) tests per sample area being tested.
4. At least one (1) sample area shall be tested for type of subgrade material evident on site.

5. The subgrade material shall not include any "Unsuitable Material" as defined in Main Roads Standard Specification MRS 11.04 "General Earthworks" and shall be trimmed to the profile required to conform with the Project Drawings and the tolerances specified herein.
6. Where unsuitable material is encountered in the subgrade, a suitable "Subgrade Replacement Material" in accordance with the requirements of this specification shall be incorporated in the works.
7. In this instance, the unsuitable material shall be excavated to a level sufficient to obtain a sound foundation for the pavement. The compaction requirements and testing frequency noted previously shall apply to all operations involving any subgrade replacement material required for the works.
8. The tolerances appropriate to the construction of subgrade and to subgrade replacement material shall comply with the following:
 - Design Level Tolerance +15mm, - 30mm
 - Shape Tolerance of 25mm maximum deviation from a 3m straight edge laid in any direction.
9. Following completion of subgrade compaction, trimming, and satisfactory density testing, the whole of the subgrade area shall be inspected by proof rolling with a fully loaded single rear axle truck with a minimum axle loading of 8 tonne (or acceptable equivalent). Acceptable proof rolling shall be taken to be no visible signs of deformation or instability in the subgrade.

S2.15 PAVEMENT COURSES

1. The pavement course materials (Base Course and Sub-base Course) shall be transported from the material supplier to the spreading area without segregation and shall be placed at the correct moisture content.
2. The pavement course materials shall be spread in uniform loose layers on the prepared subgrade, subgrade replacement, or sub-base course and compacted to conform with the grades, profiles and cross sections as indicated on the Project Drawings and to the tolerances and compaction standards specified herein.
3. The thickness of any loose layers shall be such that after compaction it shall not be less than 100mm nor more than 200mm thick. Appropriate compaction equipment shall immediately follow the spreading and shaping of the loose materials and under no circumstances shall the materials be allowed to dry out before compaction.
4. After compaction of each pavement course, the whole of the surface shall be watered and rolled with a steel drum roller to give a hard, dense, tightly packed surface free of lenses, compaction planes and caking, in accordance with the tolerances specified herein.
5. No placement of base course material on the sub-base shall commence until the compaction standards and tolerances for construction of the lower layer have been inspected and confirmed satisfactory. [Hold Point].
6. The pavement course material shall be compacted to provide a relative compaction determined by AS1289 for a standard compactive effort as follows:
 - Base Course - 100%
 - Sub-base Courses - 100%

7. Testing frequency not less than one test per 500m² with a minimum of four (4) tests per sample area being tested for sand replacement method and two tests per 500 m² with a minimum” of eight (8) tests per sample for nuclear test.
8. The tolerances for the construction of the pavement courses shall comply with Table S2.2.

Table S2.2 Construction Tolerances

Course	Design Level Tolerance	Layer Thickness Tolerance	Shape Tolerance
Sub-base	+ 20mm - 20mm	+ 40mm - 20mm	25mm in 3m Maximum
Base	+ 10mm - 10mm	+ 15mm - 15mm	15mm in 3m Maximum
Overall	+20mm -10mm	+20mm -10mm	

S2.16 FINAL TRIM

1. Following placement and compaction of the base course material, the whole of the surface of the base course shall be final graded and trimmed to the specified tolerances so as to leave a hard, dense, tightly packed surface free of lenses, compaction planes and caking.
2. Sprayed bituminous or asphaltic concrete surfacing works shall not be commenced until the profile, surface, compaction, quality and finish of the base course has been inspected and confirmed satisfactory. [Hold Point].

S2.17 ASPHALTIC CONCRETE SURFACING

1. For Asphaltic Concrete surfacing with a nominal depth 30mm, the construction requirements, method of construction works, and compliance testing requirements for Asphaltic Concrete surfacing, shall be in accordance with the "Asphalt Specification for Subdivision Pavements" Edition 1 November 1993, published by the Australian Asphalt Pavement Association (Queensland Branch).
2. For Asphaltic Concrete surfacing with a nominal depth greater than 30mm, the construction requirements, method of construction works, and compliance testing requirements for Asphaltic Concrete surfacing, shall be in accordance with Main Roads Specification MRS 11.30 "Dense Graded Asphalt Pavements".
3. All roads greater than 10% gradient shall have a 10mm primer seal or applied to the base course prior to the placement of the Asphaltic Concrete. Alternate methods where approved by Council shall be as noted on the approved Project Drawings.
4. The tolerances appropriate to Asphaltic Concrete surfacing shall comply with the following:
 - Design Level Tolerance - +10mm, - 10mm
 - Layer Thickness Tolerance - +15mm, - 0mm
 - Shape Tolerance - 7mm in 3m Maximum (Any direction).

S2.18 SPRAYED BITUMEN SURFACING

1. The construction requirements, method of construction works, and compliance testing requirements for Hot Sprayed Bitumen surfacing, shall be in accordance with the following Queensland Department of Main Roads Specifications.
 - Main Roads Specification MRS 11.11 "Sprayed Bitumen Surfacing (Excluding Emulsions)"
 - Main Roads Specification MRS 11.17 " Bitumen"
 - Main Roads Specification MRS 11.19 " Bitumen Cutter and Flux Oils"
 - Main Roads Specification MRS 11.20 " Cutback Bitumen"
 - Main Roads Specification MRS 11.22 "Supply of Cover Aggregate"

S2.19 CONCRETE SEGMENTAL PAVERS

1. Concrete interlocking pavers shall be constructed in accordance with the requirements of Specification S3 SEGMENTAL PAVING

S2.20 KERBING AND CHANNELLING

1. Concrete kerb, kerb and channel shall be constructed by a continuous slip form extrusion machine true to line and grade and to the profile for each kerb type in accordance with the Standard Drawing R-0080.
2. Kerbing shall be constructed on sub base material compacted to 100% standard compaction as determined in accordance with the relevant Test Methods contained in AS 1289.
3. The finished kerbing shall be well compacted and shall have exposed surfaces free from voids and honeycombing.
4. Contraction joints shall be made at regular intervals not exceeding 3m. The joints shall be made by forming grooves 40mm deep and not more than 6mm wide in all exposed surfaces of the kerb and kerb and channel. All grooves shall be normal to the top surfaces and square to the alignments of the kerb and kerb and channel.
5. The horizontal and vertical alignments of the kerb and kerb and channel shall not vary from the design level by more than ± 10 mm, provided that:
 - The difference between the deviations from correct levels at any two points 30m apart shall not exceed 30mm
 - The deviation from a straight edge laid parallel to the centreline shall not exceed 10mm in 3m.
6. The invert of all channels shall be finished true to grade and alignment and no channelling in which water is found to pond will be accepted.
7. Any kerb or kerb and channel not true to line or with noticeable kinks, bends or other faults, or not of the required dimensions (considering the tolerances specified herein), may be condemned and shall be broken out and removed from site.

S2.21 SUBSOIL DRAINAGE

1. Unless otherwise detailed on the Project Drawings subsoil drainage shall be constructed beneath the kerbing on an alignment as shown on Standard Drawing R-0140.
2. Subsoil drainage trenches, drainage pipe, backfill material, geotextile shall be constructed in accordance with the requirements of Main Roads Standard Specification MRS 11.03 "Drainage, Retaining Structures and Protective Treatments".
3. Subsoil Drainage cleanouts shall be constructed in accordance with the requirements of Standard Drawing R-0140 and shall preferably, be located with the upstream flushing point internally within a stormwater gully pit or manhole.

S2.22 TRIM VERGES AND BATTERS

1. Following completion of all earthworks operations associated with roadworks construction, all verges and fill batters shall be graded and trimmed to the line and level indicated on the Project Drawings. Allowance shall be made in the final trimming operations for topsoiling and grassing activities.
2. Cut batters shall be lightly tined to a depth of 25 - 50mm prior to respreading of topsoil material

S2.23 ROAD FURNITURE AND PAVEMENT MARKING

1. The construction of all Road Signs and associated Road Furniture shall comply with the requirements of the following:
 - Main Roads Standard Specification MRS 11.14 "Road Furniture"
 - Main Roads "Manual of Uniform Traffic Control Devices"
 - Standard Drawing R-0130 for Street Name Signs.
 - Standard Drawing S1041 for Traffic Control Devices.
2. All Pavement Marking shall comply with the requirements of Main Roads Standard Specification MRS 11.45 "Pavement Marking"

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S3

SEGMENTAL PAVING

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No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

S3.01 SCOPE

1. This specification details all matters pertaining to the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycle ways, footpaths and other pedestrian areas.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S3.02 REFERENCE DOCUMENTS

Australian Standards

- AS1012 Method of Testing Concrete
- AS1141.1 Particle Size Distribution of Dry Sieving
- AS/NZS4455 Masonry Units and Segmental Pavers
- AS/NZS4456 Masonry Units and Segmental Pavers – Methods of Test – General Introduction and list of Methods

Concrete Masonry Association of Australia Specifications

- T44 Concrete Segmental Pavements - Guide to Specifying
- T45 Concrete Segmental Pavements – Design Guide for Residential Access Ways and Roads
- T46 Concrete Segmental Pavements – Detailing Guide

Clay Brick and Paver Institute Specifications

- Paver Note 1 – Specifying and Laying Clay Pavers

MATERIALS

S3.03 CONCRETE SEGMENTAL PAVERS

1. Concrete segmental pavers are units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges.
2. Concrete pavers are identified by shape as being one of the following types:

Shape Type A

Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.

Shape Type B

Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces.

Shape Type C

Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

3. Figure S3.1 shows examples of some of the more common shapes.

Figure S3.1 Paver Shape Types



4. Concrete segmental pavers shall comply with the requirements of T44, T45, T46, and AS/NZS 4455 for each area of application.
5. The material requirements for concrete pavers for each application, derived from T44, are shown in Table S3.1.
6. The pavers shall meet the requirements for the relevant application given in Table S3.1 when tested in accordance with the test methods outlined in AS/NZS 4456.

Table S3.1 Material Requirements for Concrete Segmental Pavers

Application	Characteristic breaking load ² (kN)	Characteristic flexural strength ² (MPa)	Minimum Thickness (mm)	Shape ³ (Type)	Dimensional deviations (Category - AS 4455)	Abrasion resistance (mean abrasion index)
Residential Driveways						
Light Traffic	3	2	No limit	Any	DPA1 or DPB1	7
Medium Traffic ¹	5	3	No limit	Any	DPA1 or DPB1	7
Public Footpaths						
Low Volume	5	3	No limit	Any	DPB2	5
High Volume and Pedestrian Malls ¹	5	3	No limit	Any	DPB2	3.5
Roads³						
All Roads	5	3	80	A	DPB2	5

Notes:

1. Capable of taking occasional 8.2-t axle loads.
2. At 28 days.
3. Interlocking shapes offer superior performance in road applications.

S3.04 CLAY SEGMENTAL PAVERS

1. Clay pavers are manufactured from clay, shale or argillaceous materials, which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2mm.
2. Clay segmental pavers shall comply with the requirements of Part 1 - Specifying Clay Pavers of Paver Note 1 - 'Specifying and Laying Clay Pavers' and with the requirements of AS/NZS 4455.
3. Clay pavers shall be classified as Class 2, 3 or 4 in accordance with Paver Note 1 - Specifying and Laying Clay Pavers. Unless otherwise indicated, Class 4 pavers shall be used for all driveway pavements, medians and traffic islands. Class 2 or 3 pavers may be used for footpaths, cycleways and other pedestrian areas, except where they are subject to vehicular traffic with axle loads greater than 2.7 tonnes, in which case Class 4 pavers shall be used.
4. The abrasion resistance as determined by the SCC Abrasion Test (Paver Note1) shall conform to the recommended characteristic abrasion losses contained in Paver Note 1.
5. Laying patterns of pavers are identified as being Herringbone, Basket weave, or Stretcher as shown in Annexure A. Each of these may be laid at either 90° or 45° to the line of edge restraints. A variation of Stretcher is the Zig Zag Running Bond, also shown in Annexure A.

S3.05 BEDDING SAND

1. The bedding sand shall be well graded sand, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75mm sieve and shall conform with the grading limits specified in Table S3.2.

Table S3.2 Bedding Sand – Grading Limits

AS Metric Sieve (mm)	% Passing
9.52	100
4.75	95 - 100
2.36	80 - 100
1.18	50 - 85
0.600	25 - 60
0.300	10 – 30
0.150	5 – 15
0.075	0 -10

2. The sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration.
3. The bedding sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.

S3.06 JOINT FILLING SAND

1. The joint filling sand shall be well graded passing a 2.36mm sieve, and shall conform with the grading limits specified in Table S3.3.

Table S3.3 Joint Filling Sand – Grading Limits

AS Metric Sieve (mm)	% Passing
2.36	100
1.18	90 - 100
0.600	60 - 90
0.300	30 - 60
0.150	15 - 30
0.075	5 - 10

2. The sand shall be dry when spread. It shall be covered when stored on site to protect it from rain penetration.
3. The sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.
4. Sand used for bedding is not suitable for joint filling.

S3.07 CONCRETE FOR EDGE RESTRAINTS

1. Concrete supplied and placed for the construction of edge strips shall comply with the Specification for S7 CONCRETE WORKS.
2. Unless otherwise indicated on the Project Drawings, or where the edge restraint is provided by kerb and / or channel, the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 25MPa for edge restraints to pavers on road pavements and 20MPa for edge restraints to pavers on footpaths, bikeways, and medians.

CONSTRUCTION

S3.08 PAVER TYPE, SHAPE, CLASS AND LAYING PATTERN

1. The choice of concrete or clay segmental pavers, the paver class (for clay pavers), shape type (for concrete pavers), shape name, colour, thickness and laying pattern shall be as shown on the Project Drawings for each area of application.

S3.09 SUBGRADE PREPARATION

1. For road pavements and areas subject to vehicle loads (ie. delivery traffic areas to pedestrian malls) the subgrade shall be trimmed and compacted to the required depth below finished surface level as shown on the approved Project Drawings and in accordance with Specification S2 ROAD PAVEMENTS.
2. Following completion of subgrade compaction and trimming, the whole of the subgrade area shall be inspected by proof rolling with a fully loaded single rear axle truck with a minimum axle load of 8 tonnes (or acceptable equivalent). Acceptable proof rolling shall be taken to be no visible signs of deformation or instability in the subgrade. [Hold Point]
3. For pedestrian and light traffic areas (ie. footpaths, bikeways, medians and driveways) all soft, yielding or other unsuitable material shall be replaced with sound material and the subgrade shall be compacted to provide a minimum of 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. The subgrade shall be trimmed to be ± 30 mm of the design subgrade level.

S3.10 SUBBASE / BASE

1. Base course for pedestrian and light traffic areas (ie. footpaths, bikeways, medians and driveways) shall be as shown on the Project Drawings, where not otherwise specified the base course shall be a 125mm thick compacted to 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. Base course material shall be minimum of Type 2.3 Pavement Material in accordance with the Specification for S2 ROAD PAVEMENTS.
2. For road pavements and areas subject to vehicle loads the subbase and base shall be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the approved Project Drawings in accordance with Specification r S2 ROAD PAVEMENTS.
3. The base course shall extend in width to at least the rear face of all new edge restraints.
4. Notwithstanding the finished level tolerances contained within Specification S2 ROAD PAVEMENTS for base of ± 10 mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving shall be trimmed to within + 10mm or - 0mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 10mm. Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances.
5. The finished surface of the base shall drain freely without ponding.

S3.11 EDGE RESTRAINTS

1. Edge restraints in the form of kerb and / or channel or edge strips shall be constructed along the perimeter of all segmental paving as shown on the approved Project Drawings. Concrete kerb and / or channel and edge strips shall be constructed in accordance with specifications S2- ROAD PAVEMENTS and S7 CONCRETE WORKS
2. Faces of edge restraints abutting pavers shall be vertical.
3. Edge restraints shall be supported on compacted base and / or subbase of the thickness as shown on the approved Project Drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the edge restraints shall be 100mm adjacent to road pavements and medians, and 50mm adjacent to footpaths, bikeways and driveways.
4. Unless otherwise shown on the Project Drawings, expansion and contraction joints shall be provided in accordance with Specification S7 CONCRETE WORKS.
5. After the concrete has hardened and not earlier than three days after placing, the spaces at the back of the edge restraint shall be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding of design levels.
6. Hidden edge restraints may be used as an alternative for pedestrian and light traffic areas and shall be as detailed on the approved Project Drawings.

S3.12 SAND BEDDING COURSE

1. The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 25-35mm layer following final compaction of the segmental paving.
2. Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and rescreeded before laying pavers.
3. Screeded sand left overnight if subject to rain shall be checked for level and rescreeded where necessary before pavers are placed. The sand shall not be screeded more than two metres in advance of the laying face at the completion of work on any day.
4. Drainage of the bedding course shall be as detailed on the approved Project Drawings.

S3.13 LAYING PAVERS

1. Unless otherwise specified, concrete pavers for road pavements shall be placed in herringbone laying pattern.
2. Pavers shall be uniformly placed on the screeded sand bedding to the nominated laying pattern. Pavers shall be placed so that they are not in direct contact with each other and shall have uniform 3mm nominal joint widths.
3. The first row shall be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.
4. In each row, full units shall be laid first. Edge or closer units shall be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in size than one quarter of a full block shall not be used.

5. Manholes, drainage gullies and similar penetrations through the pavement shall be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.
6. Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic shall be allowed on the pavement prior to compaction and provision of joint filling sand.
7. On completion of subsequent bedding compaction and joint filling operations, no more than 10 per cent of joints along any 10 metre line along a major axis of the laying pattern shall have widths outside the range of 2 - 4mm.

S3.14 BEDDING COMPACTION

1. After laying the pavers, the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor, which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.
2. Any units which are structurally damaged during bedding compaction shall be removed and replaced. The pavement shall then be recompacted for at least one metre surrounding each replacement unit.
3. The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.
4. The finished surface level shall not vary from the design level at any point laid in any direction, by more than 6mm for all road pavements and 8mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8mm for all other areas of segmental paving.
5. The abutting edges of two adjacent pavers should match, but in no circumstances should they differ by more than 2mm.
6. The surface level of pavers immediately adjacent to surface drainage channels shall finish not less than 5mm nor more than 10mm above the channel edge.
7. All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.

S3.15 FILLING JOINTS

1. As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.
2. To ensure complete filling of the joints, both the filling sand and pavers shall be as dry as practicable when sand is spread and broomed into the joints.
3. The pavement shall then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

S3.16 PROTECTION OF WORK

1. Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until bedding compaction and joint filling operations have been completed.

S3.17 OPENING TO TRAFFIC

1. As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of 'lock-up'.
2. Excess joint filling sand shall be removed prior to opening to traffic.
3. The pavement shall then be inspected by the Contractor at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.

S3.18 TOLERANCES

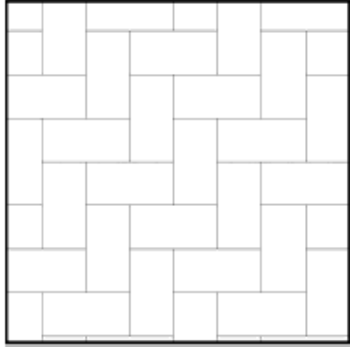
1. Where tolerances for individual components and associated dimensions are not specified on the Project Drawings, deviations from established lines, grades and dimensions in the completed work shall not exceed the values stated herein.
2. The dimensional tolerances as shown in Table S3.3

Table S3.3 Summary of Limits and Tolerances

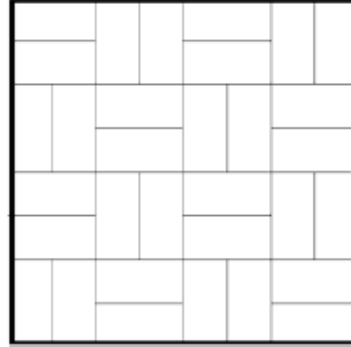
DESCRIPTION	LIMITS / TOLERANCES
BASE	Finished level of base for pavements to be within +10mm or -0mm of design levels.
	Finished level of base other than for road pavements, to be within +/- 10mm of design levels.
	The top surface of the base for all segmental paving shall not deviate from a 3m straight edge, laid in any direction, by more than 10mm.
SEGMENTAL PAVING UNITS (JOINT WIDTHS)	No more than 10% of joints along any 10 metre line of joints along a major axis of the laying pattern shall have widths outside the range 2 – 4mm.
SEGMENTAL PAVING UNITS (SURFACE LEVEL)	Finished surface level of pavers shall not vary from design levels by more than +/- 6mm for road pavements and +/- 8mm for other than road pavements.
	Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other road pavements.
	The abutting edges of two adjacent pavers shall not differ by more than 2mm.
	Finished surface level of pavers adjacent to surface drainage channels shall be no less than 5mm and no more than 10mm above the level of adjacent channel edge.

APPENDIX A

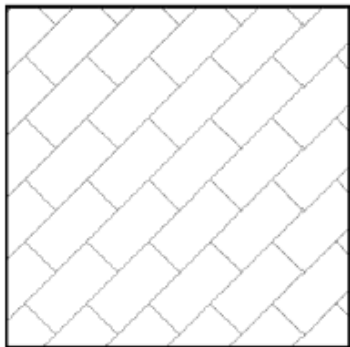
PAVER LAYING PATTERNS



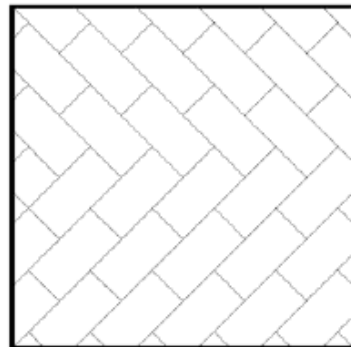
Herringbone



Basketweave



Stretcher



Zig Zag Running Bond

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S4

STORMWATER DRAINAGE

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
1 December 2007	Simon Aalbers Manager Infrastructure Development			1.1

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GENERAL

S4.01 SCOPE

1. The specification details are all the requirements pertaining to the construction of stormwater drainage works.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S4.02 REFERENCE DOCUMENTS

Australian Standards

- AS1597 Precast Reinforced Concrete Box Culverts
- AS1650 Hot-Dipped Galvanised Coatings on Ferrous Articles
- AS1761 Helical Lock-Seam Corrugated Steel Pipes
- AS2338 Preferred Dimensions of Wrought Metal Products
- AS2423 Galvanised Wire Fencing Products
- AS3725 Loads on Buried Concrete Pipes
- AS4058 Precast Concrete Pipes (pressure and non-pressure)
- AS4159 Fibre-Reinforced Concrete Pipes and Fittings
- AS5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

All Australian Standards referenced in this specification shall be the current edition.

Department of Main Roads

- MRS 11.03 Drainage, Retaining Structures and Protective Treatments

Others

- American Association of State Highway and Transportation Officials (AASHTO) – M197-82 (1986) Aluminium Alloy Sheets for Culverts and Underdrains
- American Association of State Highway and Transportation Officials (AASHTO) – M196-84 Corrugated Aluminium Alloy Culverts and Underdrains.

MATERIALS

S4.03 STEEL REINFORCED CONCRETE PIPES (RCP)

1. Pipes shall conform in all respect to AS 4058.
2. Pipes up to and including 600mm diameter can be rubber ring jointed or flush with manufacturer's external bands; pipes larger than 600mm diameter shall be flush jointed with manufacturer's external bands.
3. In locations where the pipes are to be laid in a subgrade of sand or influenced by saltwater, rubber ringed joints shall be used.
4. Pipes laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide (RL 2.19m AHD) the pipe will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.
5. The class of pipe shall be as specified or shown on the drawings. All pipes under roadways shall be a minimum of Class "2".

S4.04 FIBRE REINFORCED CONCRETE PIPES (FRC)

1. Pipes shall conform to the AS 4139. Pipes of the same diameter and class can be used in lieu of Steel Reinforced Concrete Pipes.
2. In locations where the pipes are to be laid in a subgrade of sand or influenced by saltwater, rubber ringed joints shall be used.
3. Where rubber ring joints are specified the "V" section rubber ring shall be used and are to be jointed using the manufacturer's lubricant.

S4.05 REINFORCED CONCRETE BOX CULVERTS (RCBC)

1. Box culverts shall be of the "Inverted U" type unless specified otherwise and shall conform in all respects to the current edition of AS 1597.
2. Box culverts laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide (RL 2.19m AHD) the box culvert will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.

S4.06 CORRUGATED ALUMINIUM ALLOY PIPES

1. The pipes shall be manufactured in accordance with AASHTO M196-84 and to the tolerances shown in AS 1761 and incorporate a staked, double offset lock-seam joint.
2. The base metal shall conform to AASHTO M197-82 and shall comprise "Alclad 3004-H34" alloy or approved equivalent.

S4.07 POLYPROPYLENE PIPES

1. Pipes shall conform to the AS 5065. Pipes shall only be used within allotments with the prior approval of Council. "As Constructed" drawings shall clearly indicate location of polypropylene pipes. Polypropylene pipes shall not be used within road reserves.

S4.08 BEDDING MATERIALS

Concrete and Fibre Reinforced Concrete Pipes

1. Bedding shall consist of clean coarse sand with 100% passing the 19mm AS Sieve and not more than 15% passing the 0.075mm AS Sieve.

Reinforced Concrete Box Culverts

2. The bedding material to be used in conjunction with box culverts should conform to the grading specified in the Main Roads Standard Specification MRS11.03.

Corrugated Aluminium Alloy Pipes

3. Where rock is encountered at the foundation, the bedding material shall consist of a loose granular cushion of maximum 12mm aggregated size to a depth sufficient to allow the corrugations to become filled. This material shall form the top portion of the bedding material.
4. Where soft unstable foundation material is excavated below the invert, backfill material shall consist of gravel, crushed stone or other suitable material.
5. All material directly in contact with the pipe shall be within a pH range 4-9 and have a resistivity greater than 500 ohm cms.

S4.09 STEEL WIRE GABION AND MATTRESS PROTECTION WORKS

1. Steel wire gabions and mattresses shall be proprietary products manufactured from heavily galvanised hexagonally woven steel-wire mesh and filled with rock conforming to the material requirement specified in Main Roads Specification MRS 11.03.

S4.10 CONCRETE

1. The concrete and reinforcement used in the construction of gully pits, manholes, headwalls and aprons etc shall comply with Specification S7 CONCRETE WORKS.

S4.11 MANHOLE COVERS AND FRAMES

1. Cast iron covers and frames are to be supplied for all stormwater manholes and shall be manufactured and tested in accordance with AS 3996.
2. All openings shall conform to the details on Standard Drawing D-0010
3. All covers shall have a raised stud pattern with the letters SW (65mm high) cast into the centre of the lid and "gatic" type lifting holes.
4. Minimum classes of manhole covers shall be as follows:
 - Within Residential Properties and Parks Class B
 - Residential Road Reserves
(Up to collector street status) Class C
(Trunk Collector or higher) Class D
 - Industrial, Commercial Road Reserves Class D

S4.12 GRATES AND FRAMES

1. Grates and frames of gully pits are to be fabricated from grade 250 steel and shall comply with the requirements of AS 3996 They shall be constructed to the dimensions and details supplied on the Standard Drawing D-0060 and shall be Hot Dipped Galvanised to the requirements of AS 1650.
2. Grates for structures other than gully pits shall be bicycle safe, and of a classification applicable to its location in accordance with AS 3996.

S4.13 FLOODGATES

1. Floodgates shall be a proprietary product manufactured from non-corrosive material of a type specified on the approved Project Drawings.

S4.14 BACKFILL MATERIAL

1. Backfill material shall generally be selected fill material, not markedly different in character from the surrounding soil, free from large stones, lumps of clay, topsoil, tree roots and other rubbish. It shall have an even grading free of lumps retained on a 75mm sieve and free of stones retained on a 25mm sieve.
2. Stabilised Backfill material may need to be required when utilising Corrugated Aluminium Alloy Pipes. Where such materials are required, only approved mixes in accordance with the manufacturers recommendations shall be accepted.

CONSTRUCTION

S4.15 SETOUT

1. The alignment of the stormwater pipes and position of the gully pits, manholes and headwalls shall be as stated in the approved Project Drawings and set out from a datum line established by a Registered Surveyor. The datum line may be either the road centreline, property boundary, a pegged chainage offset line, or any alternative datum suitable for the purposes of accurately setting out the works.
2. The invert levels of the pipes shall be maintained in strict accordance with site bench marks and only approved and tested equipment shall be used to establish and maintain these levels.

S4.16 CLEARING AND GRUBBING

1. All clearing and grubbing works shall be in accordance with Specification S1 EARTHWORKS.
2. Where stormwater lines pass through allotments any trees or obstructions not on the line of the pipes shall be preserved.

S4.17 TRENCHING

1. All trenching and foundation works necessary for the installation of stormwater drainage works, shall be in accordance with Specification S1 EARTHWORKS.
2. Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed from the bottom of the trench.
3. The width of trenching excavation shall be in accordance with the Standard Drawings S1045 and S1046 at the trench base and comply with all regulations of Workplace Health and Safety Act.
4. In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.
5. Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

S4.18 DIVERTING WATER AND DEWATERING

1. During construction all care should be taken to ensure any water, which may interfere with the progress of the works, be diverted to keep the trenches and excavations free from water so as to prevent any damage to the works due to flooding or other causes.
2. The necessary pumping items shall be kept on hand to ensure the excavation is constantly dewatered during the progress of the works.
3. Discharge for dewatering pumps shall be directed to location approved by and to the satisfaction of Council.

4. Care shall be taken to ensure that discharge flows do not cause any flooding, erosion or environmental harm, where necessary appropriate measure shall be put in place to trap and dispose of entrained sediments.
5. In areas where acid sulphate soils are present, discharge flows shall be disposed of and/or treated in accordance with an approved acid sulphates soils management plan.

S4.19 BEDDING

General

1. Pipe support and bedding shall be in accordance with AS 3725 for pipe support types shown on the approved Project Drawings. Where the pipe support type is not shown on the Drawings, the minimum pipe support type shall be HS2 within road reserves and H1 elsewhere.
2. The bedding and haunch zone material shall be placed and compacted in accordance with AS 3725, with care be taken around the Haunch zone area to avoid disturbing the position of the pipe. The surface of every pipe should have full and even contact with the bedding material.
3. In trenches with bad ground water conditions and/or unsuitable material the trench should be over excavated to allow a foundation layer of crushed rock material (min. depth 250mm) to be placed to provide an adequate foundation. A geofabric to engineering design should be placed for the full width of the trench and overlapped 450mm prior to placing the bedding material and laying the pipes in this instance.

Corrugated Aluminium Alloy Pipes

4. Where soft unstable foundation material is encountered below the pipe invert, the minimum width of replacement material under the pipe shall be twice the pipe diameter. The depth of replacement material shall be such as to achieve a good foundation for the constructed works.
5. When rock is encountered in the foundation, the rock shall be excavated and replaced with suitable bedding material to a depth of $D/4$ or 250mm, whichever is lesser (where D is the pipe diameter).

Box Culverts

6. Bedding for precast and cast insitu base slabs shall be selected backfill to a compacted depth of 150mm laid to the line and level of the underside of the base slab. The bedding shall be finished to a smooth surface with a tolerance of ± 10 mm in level and ± 50 mm in line.

S4.20 LAY AND JOINT PIPES

Concrete and Fibre Reinforced Concrete Pipes

1. Pipe laying shall begin at the downstream end of the line with the socket or grooved end of the pipe facing upstream. When the pipes are laid, the barrel of each pipe shall be in contact with the bedding material throughout its full length.
2. When elliptical pipes with circular reinforcement or circular pipes with elliptical reinforcement are used, the pipes shall be laid in such a position that the manufacturer's marks, designating the "Top" or "Bottom" of the pipe shall not be more than 5 degrees from a vertical plane through the longitudinal axis of the pipe.

3. External joints shall be taped with the manufacturers supplied tape or rubber external sand bands upon final bedding and alignment.
4. Lifting holes in pipes shall be plugged with mortar, precast tapered concrete / plastic plugs, or other approved means prior to backfill material being placed.
5. Joints shall not be made under water. The trench must be de-watered to facilitate joint making and inspection. Precautions must be taken to prevent erosion of joint material by moving currents of water.
6. Drainage lines shall be constructed with a tolerance of $\pm 15\text{mm}$ in line or level over any section 30m in length (providing each pipe unit has a fall in the direction of flow) from the alignment and levels shown on the approved Project Drawings.

Reinforced Concrete Box Culverts

7. The base of the box culvert shall be laid true to line and grade before the crown units of the box culvert segments are laid.
8. All construction methods, tolerances and requirements for box culverts shall conform to the requirements detailed in Main Roads Standard Specification MRS 11.03.

Helical Lock Seam - Corrugated Aluminium Alloy Pipes

9. Coupling of one pipe segment to another shall be by means of an external coupling band.
10. Large diameter pipes may be end match marked in the factory in order to simplify installation. Where multiple cell structures are being installed, each difference shall be marked in a unique manner for ease of identification.
11. Bands have corrugations or dimples that correspond to those of the pipe sections. They shall be fitted so as to overlap each pipe section equally. Where the pipes have not been re-corrugated and "dimple" bands are being used, the pipes shall be rotated sufficiently for the helical corrugations to match adjacent pipes.
12. To speed the coupling operation, especially for large diameter structures, a chain or a cable-cinching device may be used to help draw the band tight. On large structures merely tightening the bolts and nuts will not assure a tight joint, due to the friction between the band and the pipe ends. In such installations, the band shall be tapped with a rubber or wooden mallet as the band is tightened to reduce any tendency for the band to bend on the pipe.
13. The coupling bands shall be evenly tightened to provide a firm tough clamp to the jointed pipes.

S4.21 BACKFILL

Concrete and Fibre Reinforced Pipes

1. Compaction standards for backfill material shall conform to Table S4.1.

Table S4.1 Backfill Compaction

Location	Minimum Dry Density Ratio (Cohesive soils)	Minimum Density Index (Cohesionless soils)
Under Road embankments		
> 0.3m below pavement subgrade	95% Standard	65%
< 0.3m below pavement subgrade	98% Standard	80%
Elsewhere	95% Standard	65%

Note: Compaction requirements are with reference to the relevant Test Methods Contained in AS 1289.

2. For trench installations, mechanical compacters shall be used. Where impact tampers are used caution must be exercised not to allow a direct blow on the pipe. The material should be compacted at near optimum moisture content and should be brought up evenly in layers not exceeding 150mm on both sides of the pipe up to 150mm over the pipe. It should not be bulldozed into the trench nor dropped directly on the pipe.
3. Heavy mechanical equipment must not be used for tamping of backfill or be permitted to run over pipelines at shallow depths except at prepared crossing places and where approved.
4. For trenches not contained within the road reserve the trench shall be refilled to natural surface level with fill material placed evenly in 150mm to 300mm layers, tamped thoroughly.
5. The backfilling should be completed as soon as possible after pipe laying, and before the pipeline is charged with water. This will avoid the risk of pipes floating if the trench becomes flooded.

Helical Lock Seam - Corrugated Aluminium Alloy Pipes

6. Backfill material shall be placed in layers not exceeding 200mm loose thickness both sides of the structure such that the difference in fill height either side of the pipe is minimal.
7. Tamping may be done with hand or mechanical equipment, tamping rollers or vibrating compacters. Each layer shall be compacted to a standard of compaction in accordance with Table S4.1
8. Where very fine granular material is encountered in conjunction with a high ground-water table, special provision may need to be made to prevent infiltration of the surrounding material into the pipe (such as at coupling band joints), which could cause loss of backfill material surrounding the pipe. Geotextile fabrics or gasket material are typically used.

S4.22 DRAINAGE STRUCTURES

1. Gullies, manholes and field inlets shall be constructed to the form and dimensions shown on the plans and in accordance with Standard Drawings D-0060, D-0063 and D-0067. Where the ground is solid, back forms need not be used in the construction of drainage structures, the concrete being poured against the earth. Where this is done, the thickness of the wall of such gully or manhole shall be increased to a minimum of 50mm greater than the dimension shown on the plan.

2. The joints between drainage structures and pipes shall be made watertight using cement mortar. The mortar shall be used within one hour of mixing and shall not be retempered. The joints shall be finished to provide smooth surfaces, uniform with the inner surfaces of the structure.
3. Concrete benching shall be shaped as specified and shall have smooth, even surfaces and neat edges. Step irons shall be installed horizontal, vertically in line, and shall project uniformly from the walls, where the depth of the structure is greater than 1.5m.
4. Where step irons are not cast-in-place, they shall be epoxy mortared into drilled holes. The joints between the step irons and the walls shall be completely filled so that the step irons are held rigid and the joints are watertight.
5. Concrete top slabs in Manholes shall be joined to the walls using cement mortar or epoxy mortar. The opening in the top slab shall be closed with temporary covers, after which excavations shall be backfilled. Cast in situ concrete surrounds shall be constructed on the top slabs to encase the frames. Alternatively, precast concrete surrounds may be employed, using epoxy mortared joints. Only approved covers in accordance with this Specification shall be installed in the frames.
6. Temporary covers to Gullies and Manholes may remain in position and installation of the frames and surrounds deferred until pavement construction has reached a stage where the frames and surrounds can be positioned accurately. Where construction is in a staged format, the joint between each pour shall be suitably roughened to ensure an adequate bind and seal is achieved between the successive concrete pours.
7. Compaction of material surrounding drainage structures shall be in accordance with Table S4.1

S4.23 STEEL WIRE GABIONS AND MATTRESS PROTECTION

1. These proprietary products shall be assembled and installed in accordance with the Main Roads Standard Specification MRS 11.03.

S4.24 HEADWALLS, WINGWALLS AND APRONS

Cast Insitu

1. Where necessary, localised excavations shall be carried out to allow construction of cast insitu end structures.
2. Cast insitu endwalls, wingwalls and aprons, shall be constructed to the dimensions and other requirements shown on the approved Project Drawings and in accordance with Standard Drawings D-0080 and D-0081.
3. Concrete work shall comply with Specification S7 CONCRETE WORKS. Construction of endwalls and wingwalls shall include the construction of integral cut-off walls, where required.

Precast

4. Where necessary, localised excavations shall be carried out to allow installation of precast concrete end structures.

5. End structures shall be laid on foundation bedding, which provides continuous even support to the structures. Foundation bedding material shall be compacted to the relevant standard specified below:
 - Cohesive material - to not less than 95% Standard Compaction.
 - Non-cohesive material - to a density index of not less than 65.
6. The joints between end structures and culverts shall be filled with cement mortar. The joint areas shall be thoroughly cleaned and wetted just prior to filling. All points shall be finished smooth and uniform with the surfaces of the end structures.
7. Any holes and recesses provided in end structures to assist installation shall be neatly plugged or filled with cement mortar.
8. Mortared joints and filled holes and recesses shall be cured for a period of not less than 48 hours. Backfill operations against end structures shall not be carried out during this curing period.

S4.25 FLOODGATES

1. Floodgates can be sleeved over the end of the pipe, secured with stainless steel bands or fixed to with a flange to headwalls. Installation shall be in accordance with the manufacturers recommendations.

S4.26 TOLERANCES

1. Tolerances for the construction of Stormwater Drainage Works shall comply with Table S4.2.

Table S4.2 Construction Tolerances

Location	Tolerance
Invert Levels	+10mm - 10mm
Surface Levels	+50mm - 50mm in Allotments +10mm - 10mm in Roadways
Structure Locations	Within 100mm of design in Allotments or Park Within 50mm of design longitudinally along roadway Within 10mm of design at right angles to road centreline
Crest of Spillways and Detention Basins	Trimmed to +25mm - 10mm

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S5

WATER RETICULATION

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
22 December 2008	Simon Aalbers Manager Infrastructure Development			1.1

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GENERAL

S5.01 SCOPE

1. This specification details all matters pertaining to Water Supply Reticulation Construction.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.
3. Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2002 are detailed in Appendix A of Design Guideline – D6.
4. Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2002 – Water Supply Code of Australia – Standard Drawings are detailed in Appendix A of this document.

S5.02 REFERENCE DOCUMENTS

Australian Standards

- AS1289 Methods of Testing Soils for Engineering Purposes
- AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- AS/NZS1477 PVC Pipes and Fittings for Pressure Applications
- AS1646 Elastomatic Seals for Waterworks Purposed
- AS/NZS1906 Retroreflective Material and Devices for Road Traffic Control Purposes
- AS2032 Code of Practice for Installation of PVC Pipe Systems
- AS2033 Installation of Polyethylene Pipe Systems
- AS2129 Flanges for Pipes, Valves and Fittings
- AS/NZS2280 Ductile Iron Pressure Pipes and Fittings
- AS2638 Sluice Values for Waterworks Purposes
- AS3500 National Plumbing and Drainage Code
- AS3952 Water Supply – DN80 Spring Hydrant Valve for General Purposes
- AS/NZS4129 Fittings for Polyethylene (PE) Pipes for Pressure Applications
- AS/NZS4130 Polyethylene (PE) Pipes for Pressure Applications
- AS4441 Oriented PVC (PVC-O) Pipes for Pressure Applications
- AS/NZS4765 Modified PVC (PVC-M) Pipe for Pressure Applications

All Australian Standards referenced in this specification shall be the current edition.

Department of Main Roads

- MRS 11.45 Pavement Markings

Water Services Association of Australia

- WSA 03 – Water Supply Code of Australia

MATERIALS

S5.03 PIPES GENERAL

1. All pipes used for water main reticulation shall be constructed from the following materials:

- (i) Polyvinylchloride (PVC)
- (ii) Polyethylene (PE)
- (iii) Ductile Iron

S5.04 UNPLASTICISED PVC (PVC-U)

1. Unplasticised PVC (PVC-U) pipes shall be manufactured in accordance with AS/NZS 1477 by an Australian Standards quality endorsed company.

2. Modified PVC (PVC-M) pipes manufactured in accordance with AS/NZS 4765 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

3. Oriented PVC (PVC-O) pipes manufactured in accordance with AS 4441 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U

4. PVC pipes 100mm diameter and greater to be Class 16 rubber ring jointed (Ductile iron O.D compatible).

5. Rubber Rings shall be manufactured and tested in accordance with AS 1646. Jointing lubricant in accordance with the manufacturers' specification should be used to facilitate jointing.

S5.05 POLYETHYLENE PIPE

1. Polyethylene pipe shall be manufactured in accordance with AS/NZS 4130 by an Australian Standards quality endorsed company.

2. PE pipes up to 50mm inside diameter to be Class 12.5

3. Fittings shall comply with AS/NZS 4129.

S5.06 DUCTILE IRON

1. Ductile Iron pipes shall be manufactured and cement lined in accordance with AS/NZS 2280 by an Australian Standards quality endorsed company.

2. Socketed pipes to be Class K9 suitable for the patented "Tyton" type rubber ring joint. Flanged pipes to be Class K12.

3. Flanges shall comply with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129.

4. All pipes and fittings shall be wrapped in a loose polyethylene sleeving 0.25mm thick. Wrapping and taping shall be carried out in accordance with the pipe manufactures recommendations.

S5.07 BEDDING MATERIAL

1. Bedding Material shall consist of a clean coarse sand free from organic matter, clay, shells and deleterious material with 100% passing the 6.7mm AS sieve and not more than 5% passing a 0.150mm AS sieve.

S5.08 VALVES

1. All Valves shall be manufactured in accordance with AS 2638 by an Australian Standards quality endorsed company.
2. Valves of 80mm diameter and larger, are to be coated with a thermosetting epoxy powder to AS 2638 and AS 3952.
3. All 50mm diameter valves shall be DR brass construction with appropriate pressure rating or approved equivalent and certified by QAS to Standards Mark or Water Mark. All valves shall be fitted with bronze tee handles.
4. All valves 80mm and greater to be anti clockwise to close

S5.09 HYDRANTS

1. Hydrants shall be the spring hydrant "Maxi Flow" 2000 type (DN80) manufactured in accordance with AS 3952 by an Australian Standards quality endorsed company. Hydrants are to be coated with a thermosetting epoxy powder to AS 2638 and AS 3952.

S5.10 BENDS AND TEES

1. All bends for mains of 80mm diameter or larger and all other associated fittings shall be constructed in accordance with AS/NZS 2280, and have flanged or spigot and socket type joints as specified on the approved Project Drawings. Where flanges are used, bolts shall be matched sets and conform to the following criteria:
 - In above ground uses, bolts shall be Hot Dipped Galvanised
 - In below ground uses, bolts shall be Grade 316 Stainless Steel with nuts and washers Grade 304 stainless steel.
2. All bends, tees and miscellaneous fittings shall be factory nylon powder coated unless otherwise specified.

S5.11 PAVEMENT MARKING

1. The manufacture, supply and material requirements appropriate to the specification of pavement marking shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

S5.12 RAISED RETRO REFLECTIVE MARKING

1. Raised retroreflective pavement markers used to locate hydrants shall be blue bi directional markers.
2. The material requirements of the raised retroreflective pavement markers shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

CONSTRUCTION

S5.13 SETOUT

1. The location and sizes of the mains and position of valves and hydrants shall be as stated on the approved Project Drawings.
2. Bends shall be positioned such that the correct alignment is maintained and remains within the allotted service corridor.
3. Where levels are nominated on the approved Project Drawings the Contractor shall ensure the main is laid within the given tolerances and the equipment used to level the main is approved and tested.
4. Alignment of the water main shall be 2.500m off the property boundary, with horizontal centreline deviations permissible provided the main remains entirely within the 450 mm wide footpath allocation.
5. Deflection of water mains is not allowed. Bends are to be used for change of direction.
6. Where a hydrant is placed at the end of a water main which will not be extended in the future, eg, in cul-de-sac; the hydrant shall be installed with a hydrant bend located adjacent to the boundary of the last property serviced.
7. In cases where the main may be extended in the future, a hydrant tee and dead end shall be used, located as near as practicable (<0.5m) to the development boundary or nearest RP boundary.
8. The maximum spacing of hydrants shall be 80m with hydrants located at all crests, sags and ends of lines in cul-de-sacs.
9. Spring hydrants are to be oriented with bolts parallel to the water main

S5.14 CLEARING AND GRUBBING

1. All clearing and grubbing works shall be in accordance with Specification S1 EARTHWORKS.
2. Any trees or obstructions not on the line of the pipes shall be preserved.

S5.15 TRENCHING

1. All trenching and foundation works necessary for the installation of the pipeline or thrust blocks, shall be in accordance with Specification S1 EARTHWORKS.
2. The width of trenching excavation shall be in accordance with the Standard Drawing W0440 at the trench base and comply with all regulations of Workplace Health and Safety Act.
3. In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.
4. Where public utilities exist in the vicinity of water main drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

5. The safety of the public shall be considered at all times. Where necessary, fenced walkways and controlled vehicular crossways shall be provided across trenches to maintain access from carriageway to individual properties or within individual properties. All such installations shall be of adequate size and strength and satisfactorily illuminated.
6. In the event of any trenching being left open for longer than one week, the Contractor shall provide erosion control measures to ensure minimal soil disturbance and material loss off the site. Some or all of these measures shall be provided immediately upon the onset of rain with an open trench.
7. The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

S5.16 COVER

1. Unless noted otherwise on the approved Project Drawings the minimum depth of cover to be provided for mains shall be as follows:
 - For mains of 100mm and 150mm diameter: minimum 600mm - maximum 750mm, in a verge or roadway; measured from the top of pipe to the adjacent top of kerb.
 - For 225mm and 300mm diameter: minimum 700mm, maximum 850mm
 - For mains greater than 225 mm diameter, individual assessment dependent upon valve height shall be determined by the Engineer.
 - Where normal cover for mains is unable to be maintained due to the presence of existing services or other restricting factors ductile iron pipe, may be used, subject to the approval of the Engineer.
 - Main shall not be laid under stormwater, sewerage pipes or electricity conduits unless approved by the Engineer.

S5.17 CROSSINGS

Major Road Crossings

1. Written approval from the Queensland Department of Transport is required if a main is to be constructed underneath or along a declared Main Road.
2. All road crossings shall have an envelope pipe and the main shall be grouted in the envelope pipe.
3. The design and construction of the enveloping conduit must be in accordance with Queensland Department of Transport's "Installation of Underground Conduits within the Boundaries of Declared Roads".

Crossings of Other Existing Roads and Streets

4. Unless otherwise approved in writing, all crossings of existing roads and streets shall be bored or jacked with no disturbance to the pavement, shoulders or kerb.
5. The Engineer may permit open trenching to streets below Collector, determined by the location, traffic conditions and age of the existing pavement.

6. The details of the crossing, pipe materials and grouting shall be submitted to Council for approval.
7. Crossings of other carriageways shall be trenched unless the Engineer specifies otherwise.

Railway Crossings

8. Written approval from the Queensland Rail is required if a main is to be constructed underneath a railway line. In such cases the crossing shall generally be designed and constructed in accordance with the requirements of Queensland Rail.

S5.18 BEDDING

1. All pipes shall be uniformly bedded in order to ensure solid and uniform support for the full length of the barrel with bell holes formed to accommodate the sockets to ensure a minimum clearance of 20mm.
2. The depth of bedding shall be as detailed on Standard Drawing W-0040 with the bedding material complying with the "Bedding Material" section of this Specification.

S5.19 LAYING AND JOINTING OF PIPES

1. All contractors shall have undertaken a manufacturers pipe laying accreditation course.
2. All pipe lines shall be laid to such lines, offset, gradients and levels as shown on approved Project Drawings.
3. Care shall be taken to preserve uniform gradients and correct alignments. Bends shall be used to effect horizontal and vertical changes of direction.
4. The manufacturers' recommendations for maximum deflection at each joint shall be strictly adhered to, if approval is granted by Council to use deflections.
5. Jointing of pipes, valves and fittings is to be carried out to the manufactures recommendations and in accordance with Australian Standards where applicable.
6. For pipes with rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. When the joint is made, the witness mark shall at no point be more than 1mm from the end of the socket.
7. Before being laid, all pipes, fittings, valves, etc shall be cleaned and examined by the Contractor.
8. Approved plugs shall be used to prevent foreign matter entering sections of pipeline, which are left uncompleted overnight.
9. The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.
10. Pipes shall be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.
11. For field cuts, only an approved mechanical pipe cutter shall be used, except that uPVC pipes may be cut using a power saw or a fine toothed hand saw and mitre box.
12. Any pipes cut in the field shall have their ends prepared in accordance with the manufacturer's written instructions.

13. Where pipes are cut in the field, a witness mark shall be made on the pipe at the length specified by the manufacturer from the end of the pipe. Scoring of uPVC pipes shall not be permitted.

S5.20 CONNECTION TO EXISTING MAINS

1. Ready tap, or equivalent, connection points shall be laid with the main within 300 mm of the side property boundaries.
2. The Ready tap connection point is to be installed with a valve on one side and a bung on the other.

S5.21 FITTINGS

1. The laying and jointing of mains shall include the fixing in position of all valves of any description, fire hydrants and all other fittings, which are necessary for the completion of the mains.
2. Joints to secure fittings to pipes shall be approved under Australian Standard AS1646.
3. All sluice valves, gate valves, air valves and hydrants shall be carefully placed in the final position so as to be the correct distance from the surface and installed in accordance with Standard Drawings W-0060 and W-0061. With air valves and hydrants, risers shall be installed where necessary and if required, trenches shall be deepened and graded in the vicinity of all valves and hydrants in order to secure the correct depth below the surface.
4. Valves, hydrants and specials shall be thoroughly cleaned out prior to installation in main.
5. The spring hydrants shall be bolted to the flange of the hydrant junction so that the bolts of the hydrants are in line with the main, and the hydrant cover box fitted with its long axis along the centre line of the main. Hydrants must be protected during backfilling in such a manner as will prevent earth or grit from damaging the seating. Refer to standard drawing W-0060 and W-0061.
6. Hydrants and valves shall be fully protected during laying and backfilling, on completion all glands shall be well screwed down, and all valves shall operate freely.

S5.22 VALVE / HYDRANT MARKERS

1. The position of all stop valve, scour valve, air valve and hydrants shall be indicated by a kerb marker plate, painted kerb marker or marker post and raised reflective pavement markers. The type of marker to be installed shall be as stated on the approved Project Drawings.
2. Painted symbols used to indicated hydrants shall be in accordance with Standard Drawing W-0060
3. Kerb marker plates used to indicate valve and hydrant locations shall be fixed to the kerb face it shall be in accordance with Standard Drawing W-0061.
4. Kerb and channel shall be stamped or engraved, and posts with marker notice plates are to be located adjacent to each valve, hydrant, air valve and scour valve. The posts are to be located 0.3m on the kerbside of the property alignment unless otherwise directed by the Engineer.
5. Kerb stamping or engraving, and marker plates shall be marked "V", "H", "AV" and "S" indicating sluice valve, hydrant, air valve and scour valve respectively shall be installed on the posts.

6. In addition to painted kerb markers / marker posts, all hydrants shall have a road pavement marker to indicate the location of the hydrant. The road pavement marker shall be either a painted teardrop or blue bi directional raised retro reflective pavement marker as stated on the approved Project Drawings.
7. Where a painted teardrop is specified the teardrop shall be painted with a solid yellow enamel paint and be 630mm overall length with 200mm radius base and a 25mm radius tip. The teardrop shall be painted across the centreline of a two-lane road or in the middle of the near side lane of a multi laned road. The tapered end of the teardrop shall point towards the relevant hydrant
8. Where a blue bi-directional raised retro reflective pavement marker is specified it shall be fixed securely to the road pavement opposite the hydrant. On two lane roads, the marker is to be positioned on the road centreline. For multi-lane roads, it is to be positioned on the lane line between the first and second lane.
9. The installation requirements of and pavement makings and raised retroreflective pavement markers shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

S5.23 ANCHOR BLOCKS

1. Where a main is installed at a grade of 1 in 6 or steeper, concrete anchor blocks shall be provided in accordance with Standard Drawing W-0041
2. Concrete works shall comply with Specification S7 CONCRETE WORKS.

S5.24 THRUST BLOCKS

1. For vertical bends with an upward thrust additional concrete shall be placed so that the mass of concrete is greater than the thrust on the filling. Sufficient steel reinforcement shall be included to bend the weight of the block below the pipe centreline to the upper part of the block. These thrust blocks shall be designed to manufacturer's specifications.
2. Thrust blocks, sized in accordance with the requirements detailed on Standard Drawing W-0041.
3. Concrete works shall comply with Specification S7 CONCRETE WORKS.

S5.25 WATER SERVICE CONNECTIONS

1. Ready tap, or equivalent, connection points shall be laid with the main within 300 mm of the side property boundaries.
2. The Ready tap connection point is to be installed with a valve on one side and a bung on the other.
3. All services shall be turned on during the testing process.

S5.26 BACKFILLING AND COMPACTION

1. Material for the side support and overlay of the pipe shall comply with the pipe bedding material specification. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.

2. The remainder of the excavation shall be backfilled with excavated material. The backfill shall be compacted in layers of not more than 150mm thick to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289. Flooding of cohesive material shall not be permitted as a means of compacting backfill.
3. Backfilling and compaction shall be carried out without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.
4. The edges of the trench shall be cut with a clean, straight line prior to excavation. The trench above the approved filling shall be backfilled with approved subgrade replacement material conforming to specification No. 3.2 - Pavements, to a level 350mm below the level of the existing pavement surface and shall be compacted to 95% of the maximum dry density as determined by compaction test Department of Transport Q110A - 1993. 300mm of cement stabilised gravel and 50 mm of asphaltic concrete shall be used to complete the trench backfilling. The surface shall be restored to a condition at least equal to that of the original pavement
5. Backfill material down to a depth of 300mm below the underside of the pavement material shall be compacted to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289, and backfill material below such depth shall be compacted to not less than 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.
6. In cases other than those covered by the above clause backfilling above the level of 300mm above the top of the pipes in open trenches may be carried out by dumping from mechanical plant into the trench providing that no rock is placed in the trench until the pipes are covered by at least 300mm of soil backfill.
7. Compaction testing shall be carried out at a rate of 1 test for each 150 metres of trench backfilled or in the case where trenches are constructed under road pavements and road shoulders, 1 test for each 25 metres of trench backfilled.

S5.27 RESTORATION OF SURFACES

1. Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Lawns shall be restored with turf cut and set aside from the original surface and / or with imported turf.
2. All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces. Pavements shall be maintained with crushed metal, gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavement.
3. Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre-mixed asphaltic material shall be used for such temporary restoration. Temporary restoration works shall be maintained by the Contractor until final restoration is carried out.
4. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Unless noted otherwise on the approved Project Drawings all trenches excavated through bitumen or concrete pavement shall be sawcut each side to facilitate a neat finish to the final restoration. Final restoration may include, if required, the removal of temporary restoration.
5. Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the

adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor.

6. In locations where surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench in such a way as to minimise future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the end of the Defects Liability Period.
7. Where, within public or private property, the reasonable convenience of persons will require such, trenches to be levelled off at the time of backfilling. Any subsequent settlement shall be made good by the Contractor, as required by placing additional fill.
8. All tunnels shall be completely backfilled. The space between the outer surface of the pipes, internal lining and the face of the tunnel excavation shall be backfilled with sand which shall be compacted by flooding. Sand used for backfilling shall comply with the grading requirements for bedding sand as hereinbefore specified.
9. The Superintendent may direct the Contractor to backfill the tunnel with Grade N20 concrete in lieu of sand.

S5.28 TESTING OF LINES

1. Hydrostatic pressure testing of all water mains shall be carried out prior to the acceptance of the works and witnessed by the consulting Engineer and a council officer.
2. The contractor shall have carried out a successful test prior to arranging a Council witness test.
3. Pressure testing shall not be carried out during wet weather unless otherwise approved by Council.
4. Before testing a pipeline section, it shall be cleaned and filled slowly with water, taking care that all air is expelled.
5. The minimum test pressure acceptable shall be 1200 KPa unless advised otherwise by the relevant Local Authority and shall be considered to be satisfactory if:
 - (a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
 - (b) There is no visible leakage; and
 - (c) There is no loss of pressure in the 15 minute test period
6. The specified test pressure shall be maintained as long as required, while the whole section is examined, and in any case not less than 15 minutes.
7. Any failure, defect, and / or visible leakage, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the contractor and re-tested.

S5.29 FLUSHING

1. Upon completion of pressure testing, lines shall be adequately flushed and water samples taken for testing by a Council approved testing authority to the requirements of the National Health and Medical Research Council (NHMRC).

S5.30 TOLERANCES

1. Tolerances for the construction of water reticulation works shall comply with Table S5.1.

Table S5.1 Construction Tolerances

Alignment	On the allocated alignment (2500m off property boundary)
Hydrants, Fittings	Within 0.3m of design relative to side property boundary
Water service connections / conduits	Extend 300mm behind back of kerb, be laid 100mm below pavement subgrade
Valves	Opposite the nearest RP boundary, spaced at 300m apart

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S6

SEWERAGE RETICULATION

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
1 December 2007	Simon Aalbers Manager Infrastructure Development			1.1

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APPENDIX A - Amendments to Standard Drawings

APPENDIX B - Amendments to Standard Drawings

GENERAL

S6.01 SCOPE

1. This specification details all matters pertaining to Sewerage Reticulation Construction.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.
3. Aspects of modification or clarification of the codes are detailed in Appendix A of Design Guideline – D7
4. The requirements of this Manual will take precedence over the Water Services Association of Australia Codes
5. Aspects of modification or clarification of the codes Standard Drawings are detailed in Appendix A and B of this document.

S6.02 REFERENCE DOCUMENTS

Australian Standards

- AS/NZS 1260 Unplasticised PVC (UPVC) Pipes and Fittings for Sewerage Applications
- AS1289 Methods of Testing Soils for Engineering Purposes
- AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- AS/NZS1477 PVC Pipes and Fittings for Pressure Applications
- AS1646 Elastomatic Seals for Waterworks Purposed
- AS2032 Code of Practice for Installation of PVC Pipe Systems
- AS2129 Flanges for Pipes, Valves and Fittings
- AS/NZS2280 Ductile Iron Pressure Pipes and Fittings
- AS3500 National Plumbing and Drainage Code
- AS3996 Metal Access Covers, Road Grates and Frames
- AS4198 Precast Concrete Access Chambers for Sewerage Applications
- AS4441 Oriented PVC (PVC-O) Pipes for Pressure Applications
- AS/NZS4765 Modified PVC (PVC-M) Pipe for Pressure Applications
- AS5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

All Australian Standards referenced in this specification shall be the current edition.

QLD Government Legislation

- Sewerage and Water Supply Act

Water Services Association of Australia

- WSA 02 – Sewerage Code of Australia
- WSA 04 – Sewerage Pumping Station Code of Australia

MATERIALS

S6.03 PIPES GENERAL

1. All pipes used for sewer reticulation shall be constructed from the following materials:

- (i) Polyvinylchloride (PVC)
- (ii) Ductile Iron

S6.04 UNPLASTICISED PVC (PVC-U)

1. Unplasticised PVC (PVC-U) pipes and fittings for gravity systems shall be manufactured in accordance with AS1260 suitable for rubber ring joints. Pipe classes shall be in accordance with the manufacturers' recommendation and shall be as shown on the approved Project Drawings.

2. Unplasticised PVC (PVC-U) pipes and fittings for rising mains and suction pipes shall be manufactured in accordance with AS/NZS 1477 minimum Class 12 suitable for rubber ring joints with a mauve coloured pigment.

3. Modified PVC (PVC-M) pipes manufactured in accordance with AS/NZS 4765 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

4. Oriented PVC (PVC-O) pipes manufactured in accordance with AS 4441 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

5. Rubber Rings shall be manufactured and tested in accordance with AS 1646. They shall be of natural rubber and only those impregnated with a Root Inhibitor shall be used.

6. All pressure mains 100mm diameter and greater shall be D.I.O.D compatible.

S6.05 DUCTILE IRON

1. Ductile Iron pipes shall be manufactured and cement lined in accordance with AS 2280 by an Australian Standards quality endorsed company.

2. Socketed Pipes to be Class K9 suitable for the patented "Tyton" type rubber ring joint. Flanged Pipes to be Class K12.

3. Flanges shall comply with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129

4. All pipes and fittings shall be wrapped in a mauve coloured loose polyethylene sleeving 0.25mm thick. Wrapping and taping shall be carried out in accordance with the pipe manufactures recommendations.

5. All bends for mains of 100mm diameter or larger and all other associated fittings shall be constructed in accordance with AS2280, and have flange or spigot and socket type joints as specified on the approved Project Drawings. Where flanges are used, bolts shall be matched sets and conform to the following criteria:

- In above ground uses, bolts shall be Hot Dipped Galvanised
- In below ground uses, bolts shall be Grade 316 Stainless Steel with nuts and washers Grade 304 stainless steel.

S4.06 POLYPROPYLENE PIPES

1. Pipes shall conform to the AS 5065. Pipes shall only be used with the prior approval of Council. "As Constructed" drawings shall clearly indicate location of polypropylene pipes.

S6.07 BEDDING MATERIALS

1. After the excavation has been completed, inspected and approved by the Superintendent, the foundation layer of bedding concrete or approved bedding material shall be placed. The minimum bedding depth shall be 100mm of approved material. Refer to standard drawing S-0090

2. Where directed, pipes shall be bedded on Grade N20 concrete cradle or encased in Grade N20 concrete surround or otherwise bedded in accordance with the drawings or such instructions as may be given by the Superintendent in writing.

3. Unless shown otherwise on the drawings, no pipes encased in concrete shall extend more than 150mm beyond the face of that concrete. Short pipes laid in sewers shall not exceed 600mm in length and short pipes laid in house connections shall not exceed 300mm in length.

4. Both approved bedding and approved filling or blanket course to 100mm above the crown of the pipe shall be compacted to 95% of the maximum density as determined by the Standard Compaction Test Department of Transport Q110A 1993.

5. The material used for bedding, surround and cover for pipes shall be sieved sand, 5mm pea gravel, or 5mm crushed rock free from dust and foreign material.

6. All junction pipes in a line of sewer shall be concrete bedded and encased with a minimum 150mm cover of Grade N20 concrete unless directed otherwise by the Superintendent.

7. Concrete blocks in Grade N20 concrete shall be built across the trenches where directed by the Superintendent.

8. Where passing through concrete, brickwork or masonry, pipes shall be cleaned and washed over with fresh cement grout and bedded on and surrounded with cement mortar at least 12mm clear thickness.

S6.08 CONCRETE

1. The concrete and reinforcement used in the construction of cast insitu manholes shall comply with Specification S7 CONCRETE WORKS.

S6.09 PRECAST MANHOLES

1. Precast manhole components shall comply with AS 4198. Standard drawing S-0020 and S-0021

2. Precast manholes may only be used subject to separate Council approval.

S6.10 MANHOLE COVERS

1. Manhole covers and frames shall be supplied for all sewer manholes shall be Cast Iron sealed (gastight) covers manufactured in accordance with AS 3996.

2. All openings shall conform to the details on Standard Drawing S-0024 and S-0025 (min 600c for opening).

3. All covers shall have a raised stud pattern with the letters SEWER (65mm high) cast into the centre of the lid and "gatic" type lifting holes.

4. Unless noted otherwise on the approved Project Drawings the minimum class of manhole covers shall be Class C or D

CONSTRUCTION

S6.11 SETOUT

1. The alignment and grade of sewer lines and position of manholes shall be stated on the approved Project Drawings.
2. The position of the centre of each manhole shall be pegged on the ground by a Registered Surveyor prior to the commencement of work.
3. Offset pegs shall be established prior to commencing construction of any line, at a convenient distance to remain clear of all works and remain intact for the duration of the work.
4. The levels of the sewers shall be maintained in strict accordance with bench marks and only approved and tested equipment shall be used to establish and maintain these levels in accordance with the design documents.

S6.12 CLEARING AND GRUBBING

1. All clearing and grubbing works shall be in accordance with Specification S1 EARTHWORKS.
2. Where sewer lines pass through allotments any trees or obstructions not on the line of the pipes shall be preserved, Clearing and grubbing shall be carried out in accordance with Specification No. 3.1- Earthworks.

The Contractor shall be responsible for all damage to grass, cultivation, fences, building or stock, by fire, falling timber or other causes arising from his operations.

S6.13 TRENCHING

1. All trenching and foundation works necessary for the installation of the pipeline or thrust blocks, shall be in accordance with Specification S1 EARTHWORKS.
2. The width of trenching excavation shall be in accordance with the Standard Drawing S-0090 at the trench base and comply with all regulations of Workplace Health and Safety Act.
3. In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.
4. Where public utilities exist in the vicinity of sewer reticulation works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.
5. In the event of any trenching being left open for longer than one week, the Contractor shall provide erosion control measures to ensure minimal soil disturbance and material loss off the site. Some or all of these measures shall be provided immediately upon the onset of rain with an open trench.
6. The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.
7. Where necessary the Contractor must arrange suitable traffic and pedestrian management.

S6.14 CROSSINGS

1. Where a sewer main crosses a State Controlled Road, Railway line or creek, the affected work shall be carried out in accordance with the requirements of the relevant Authority / Corporation. It shall be the Contractor's responsibility to complete written notification to the Authority / Corporation of the intention to carry out the work.
2. Where a sewer main crosses an existing road, the affected work shall be carried out in accordance with the requirements of Council. It shall be the Contractor's responsibility to notify Council of the intention to carry out the work.
3. Unless otherwise approved in writing, all crossing or existing roads and streets shall be bored or jacked with no disruption to the pavement, shoulder or kerb.

S6.15 BEDDING

1. Bedding types shall be as detailed on Standard Drawing S-0090 with the bedding materials complying with the "Bedding Material" section of this Specification.

Type 1 Bedding

2. The bedding material shall be as specified and shall be placed and compacted for the full width of the trench to the level of the underside of the pipe.
3. An area of bedding adjacent to the position of the pipe collar should be removed to provide a minimum 20mm clearance to the collar while the remainder of the pipe is bedded evenly on the bedding material.
4. The remainder of the bedding material is then placed and carefully tamped to avoid disturbing the position of the pipe thus ensuring that the surface of every pipe is in full and even contact with the bedding material.
5. All bell holes shall be rammed prior to completion of the bedding operation. The bedding material shall be uniformly compacted so as to achieve the following standards:
 - Minimum dry density ratio 95% Standard (cohesive soils).
 - . Minimum density index 65% (cohesionless soils)
6. Compaction requirements are with reference to the relevant Test Methods contained in AS1289.

Type 2 Bedding

7. Used in wet conditions particularly where the trench bottom requires stabilising the trench invert shall be over excavated to accommodate a "Crushed Rock Foundation" with a geotextile surround.
8. Water is to be removed from the excavation as work proceeds to allow for placement of the geotextile crushed rock layer. The crushed rock layer shall be laid in 100mm layers and compacted as required.
9. The geotextile shall surround the crushed rock layer and be overlapped minimum of 500mm.
10. The pipe bedding material shall placed and compacted over the crushed rock foundation as specified for Bedding Type 1.

Type 3 Bedding

11. Type 3 bedding incorporating designed piles that are driven by air or electric hammer on a heavy dolly.
12. Piles shall be driven to give a set in accordance with the design requirements and spaced accordingly as stated on the approved Project Drawings.
13. A 150 x 50 hardwood sleeper is placed on top of the pile with 150 x 50 hardwood planks spanning the sleepers.
14. A concrete cradle as detailed on the approved Project Drawings shall then be poured on the planks to support the pipes.

S6.16 LAYING AND JOINTING OF PIPES

1. All contractors shall have undertaken a manufacturers pipe laying accreditation course.
2. All pipelines shall be constructed of pipes of such sizes and laid true to such levels and grades as shown on the approved Project Drawings.
3. The lines, levels and grades of all lines shall be checked and all pipes found incorrect shall be removed and re-laid.
4. Trenches shall be kept free of water during pipe laying, and until completion of backfill.
5. Jointing of pipes, valves and fittings is to be carried out to the manufactures recommendations and in accordance with Australian Standards where applicable.
6. For pipes with rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. When the joint is made, the witness mark shall at no point be more than 1mm from the end of the socket.
7. Before being laid, all pipes, fittings, valves, etc shall be cleaned and examined by the Contractor.
8. Approved plugs shall be used to prevent foreign matter entering sections of pipeline, which are left uncompleted overnight.
9. The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.
10. Pipes may be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.
11. For field cuts, only an approved mechanical pipe cutter shall be used, except that uPVC pipes may be cut using a power saw or a fine toothed hand saw and mitre box.
12. Any pipes cut in the field shall have their ends prepared in accordance with the manufacturer's written instructions.
13. Where pipes are cut in the field, a witness mark shall be made on the pipe at the length specified by the manufacturer from the end of the pipe. Scoring of uPVC pipes shall not be permitted.
14. Gravity lines shall be constructed to the tolerances specified hereafter:
 - The maximum horizontal deviations to either side from the design axis of a pipeline shall be 100mm for all sizes of pipes.

- The maximum vertical deviations from the design grade of pipelines of any diameter and grade, shall be + 5mm.

15. During the progress of the works the Contractor shall have at least two (2) days supply of tested and approved pipes, including junctions on the ground in advance of quantity fixed in position

S6.17 CONNECTIONS TO MANHOLES

1. Pipelines shall be connected to manholes, structures or embedded concrete by means of 600mm long pipes such that two flexible joints are provided, the first joint being at the face of the structure. Refer to standard drawing S-0020
2. The position of the access chamber shall be as shown on the approved Project Drawings. The Contractor shall check the alignment prior to commencing construction and advise the design engineer of any obstructions (Structure, Flora, Services etc)
3. Allowable lateral deviations from the final design position of access chambers shall be in accordance with the tolerances for horizontal deviations of pipelines as specified. Longitudinal deviations from that position shall not exceed 300mm.

S6.18 CONNECTION TO EXISTING

1. Connection to existing live sewer mains and manholes shall be carried out in accordance with the requirements of Council. It shall be the Contractor's responsibility to notify Council of the intention to carry out and arrange for the timing of such works.
2. The upstream side of the existing manhole is to be plugged until all new sewer mains have been approved, tested and cleaned.

S6.19 ANCHOR BLOCKS

1. Concrete anchor blocks shall be provided in accordance with Standard Drawing W-0040 for 150 dia. lines laid at a grade of 1 in 6 or steeper and 225 dia. lines laid at 1 in 10 or steeper.
2. Concrete works shall comply with Specification S7 CONCRETE WORKS.

S6.20 HOUSE CONNECTION BRANCHES

1. House Connection Branches (HCB) to all properties shall be constructed in accordance with Standard Drawing S-0030 and to the types, locations, levels and dimensions stated on the approved Project Drawings.
2. Concrete surrounds shall be provided to all HCB's. All concrete works shall comply with Specification S7 CONCRETE WORKS.
3. Backfill around risers shall be sand compacted to the top of the socket or coupling, for the full width of trench and for a minimum distance of 500mm upstream and downstream of the riser.
4. The position of each riser, junction or end of a sideline shall be clearly marked by the Contractor on completion of backfilling, with a approved 13mm orange electrical conduit tied to the end of HCB and held in a vertical position during backfilling. The top end of the tape shall be left flush with ground level.

S6.21 RISING MAINS

1. All works necessary for the installation of the rising mains including installation of thrust block and anchor blocks, shall be in accordance with Specification S5 WATER RETICULATION.
2. Air release valves and scour valves shall be installed where shown on the approved Project Drawings.
3. Unless otherwise noted on the approved Project Drawings, pipes for rising mains shall be laid on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.
4. Marking plates bearing the letters "AV" for air valves, "SV" for scour valves and "RM" at changes of direction and at such chainages that the location of the main is marked at least once each 200 metres.
5. Sewer rising main connections to discharge manholes are to be constructed in accordance with Standard Drawings S-0020, S-0021, S-0022, S-0023 and S-0024

S6.22 MANHOLES

1. All concrete work associated with the construction of manholes shall comply with Specification S7 CONCRETE WORKS.
2. Manholes shall be constructed in accordance with Standard Drawing S-0020 and S-0022, and to the types, locations, levels and dimensions stated on the approved Project Drawings.
3. Rendering of this invert and benching shall be in accordance with the Standard Drawing S-0020.
4. Precast manholes are an acceptable alternative with precast base units for Inlet Type A manholes in accordance with Council's standard procedure for pre cast manholes.
5. Precast Manhole risers are acceptable for use with cast insitu manhole bases.
6. Precast riser units shall be jointed in accordance with the manufacturers' specifications utilising the recommended method and materials. Inlets into precast units shall be constructed in accordance with the details illustrated on Standard Drawing S-0020.
7. The installation of all precast manhole components shall be in accordance with the manufacturers' recommended procedures, requirements and Council's standard installation procedure.

S6.23 COVERS AND SURROUNDS

1. Manhole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces. Elsewhere, unless noted otherwise on the approved Project Drawings, covers shall be finished 50mm above the surface of the surrounding ground, in a manner designed to avoid as far as possible, the entry of surface water.
2. Manhole covers are to be located such that the position of the access opening is directly over the outlet pipe.
3. The installation of all precast manhole covers shall be in accordance with the manufacturers' recommended procedures and requirements.

S6.24 BACKFILL AND COMPACTION

1. Material for the side support and overlay of the pipe shall comply with the pipe bedding material specification. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289. Flooding of non-cohesive material shall be considered as an acceptable method of compacting bedding material.
2. The remainder of the excavation shall be backfilled with excavated material. The backfill shall be compacted in layers of not more than 150mm thick to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289. Flooding of cohesive material shall not be permitted as a means of compacting backfill.
3. Backfilling and compaction shall be carried out without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.
4. Where trenches are under constructed pavements or in other situations where required, the material used for backfilling shall be approved excavated material with linear shrinkage of the fines passing a 2.36mm sieve of not greater than 6 per cent. The Contractor may elect to use imported, select fill or sand for this purpose. The backfill shall be spread in layers not exceeding 300mm in loose depth at or near optimum moisture content and compacted using mechanical vibration equipment.
5. Backfill material down to a depth of 300mm below the underside of the pavement material shall be compacted to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289, and backfill material below such depth shall be compacted to not less than 95 percent of the standard maximum dry density of the material used when determined in accordance with AS1289.
6. In cases other than those covered by the above clause backfilling above the level of 300mm above the top of the pipes in open trenches may be carried out by dumping from mechanical plant into the trench providing that no rock is placed in the trench until the pipes are covered by at least 300mm of soil backfill.
7. Compaction testing shall be carried out at a rate of 1 test for each 150 metres of trench backfilled or in the cast where trenches are constructed under road pavements and road shoulders, 1 test for each 25 metres of trench backfilled.

S6.25 CLEANING SEWERS

1. Before the sewers, manholes and house drains are accepted they shall be cleaned to remove all clay, sand and other materials.
2. All water plus materials used in the flushing of the reticulation system shall under no circumstances be discharged into existing sewers downstream of construction. All lines shall be inspected after flushing and will not be accepted until they present a clear barrel, free from any obstruction.

S6.26 TEST OF MANHOLES

1. All manholes shall be subjected to hydrostatic or vacuum tests to prove their water tightness unless directed otherwise by the Local Authority.
2. For hydrostatic tests, all pipe openings out of the manhole shall be plugged and the manhole filled with water to the lowest point on the top of the manhole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the access chamber. After allowing an interval for absorption, the manhole shall be refilled.

3. The test on the manhole will be considered satisfactory provided the level does not drop more than 25mm in twenty four (24) hours. The plug of the outlet shall be fitted with a suitable release for emptying the manhole on satisfactory completion of the test.

4. Manholes failing the test shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained.

5. Where the ground water level is high, an infiltration test may also be required. This shall not take place until ten (10) days after the placing of concrete.

S6.27 TESTING OF LINES

1. All gravity lines shall be subject to air testing to prove their water tightness unless directed otherwise by the Local Authority.

2. Testing may be done progressively, a minimum of 24 hours notice shall be provided to Council before commencement of testing. Ensure that pipes are clean before any test is performed.

3. If any of the tests proved to be unsatisfactory, the contractor shall be required to detect and repair the fault and then re-test. The contractor shall continue to repair and re-test until a satisfactory test is obtained. Even if testing produces satisfactory test results, the contractor shall repair any pipeline or conduit in which there is a visible or detectable leak or blockage.

4. The contractor shall carry out a visual inspection to ensure that all sewer lines present a full clean bore.

Air Testing General

5. Air testing shall be either pressure testing or vacuum testing, as directed by the Local Authority. The tests shall include the house connection branches and inspection tee.

6. Air Testing (Pressure) - The sewer line to be tested shall be pressurised to the "Initial Pressure" shown in the Table S6.2 for a minimum of 3 minutes to stabilise the temperature.

Table S6.2 Pressure Air Testing – Initial Pressures

	Sewer depth range (metres)				
	0-1.5	1.5 - 3.0	3.0- 4.5	4.5- 6.0	Over 6.0
Initial pressure (KPa)	30	35	40	45	50
Test start pressure (KPa)	25	30	35	40	45

7. After the 3 minute stabilisation period the pressure shall be dropped to the "Test Start Pressure" shown in the above table and the pressure gauge monitored for 5 minutes.

8. The sewer line under test shall be considered to have passed the test when the pressure does not fall by more than 5 KPa during the 5 minute period.

9. Air testing (Vacuum) - The sewer to be tested shall be drawn to a vacuum of 28 KPa and the vacuum gauge monitored for 5 minutes. The sewer under test shall be considered to have

passed the test when the vacuum does not fall by more than 5 KPa during the 5 minute period.

Ovality Testing

10. All gravity sewer pipes shall be tested to determine any excessive pipe deflection (Ovality) by using a proving tool.

11. Testing for ovality shall be carried out in accordance with Appendix G of WSA 02-2002 Sewerage Code of Australia

12. The proving tool shall be:

(a) Fabricated from steel or aluminium alloy with pulling rings at each end and marked to indicate the nominal pipe size and the provers' outside diameter.

(b) Rigid, non-adjustable, have an odd-number of legs (min 9) and an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as shown in Table G1 of WSA 02-2002 Sewerage Code of Australia.

(c) The shape of the proving tool must be approved.

13. Sewer pipes that exhibit excessive ovality, by failing the maximum allowable deflection as shown above, shall be replaced and the re-laid section retested for ovality.

S6.28 TESTING OF RISING MAINS

1. Hydrostatic pressure testing of all sewer rising mains shall be carried out prior to the acceptance of the works.

2. The contractor shall have carried out a successful test prior to arranging a Council witness test.

3. Pressure testing shall not be carried out during wet weather unless otherwise approved by Council.

4. Before testing a pipeline section, it shall be cleaned and filled slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves.

5. The hydrostatic test pressure which shall be applied to each section of the pipeline shall be such that at each point of the section the test head shall be equal to or greater than the design head specified or shown on the approved Project Drawings, but shall not exceed same by more than 20 per cent.

6. The pressure testing of a section shall be considered to be satisfactory if:

(a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;

(b) There is no visible leakage; and

(c) There is no loss of pressure in the 15 minute test period

7. The specified test pressure shall be maintained as long as required, while the whole section is examined, and in any case not less than 15 minutes.

8. Any failure, defect, and / or visible leakage, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the contractor.

S6.29 RESTORATION OF SURFACES

1. Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Lawns shall be restored with turf cut and set aside from the original surface and / or with imported turf.

2. All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces. Pavements shall be maintained with crushed metal, gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavement.

3. Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre-mixed asphaltic material shall be used for such temporary restoration. Temporary restoration works shall be maintained by the Contractor until final restoration is carried out.

4. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Unless noted otherwise on the approved Project Drawings all trenches excavated through bitumen or concrete pavement shall be sawcut each side to facilitate a neat finish to the final restoration. Final restoration may include, if required, the removal of temporary restoration.

5. Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor.

6. In locations where surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench in such a way as to minimise future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the end of the Defects Liability Period.

7. Where, within public or private property, the reasonable convenience of persons will require such, trenches to be levelled off at the time of backfilling. Any subsequent settlement shall be made good by the Contractor, as required by placing additional fill.

8. Where shown on the approved Project Drawings or where the Contractor elects to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period.

S6.30 TOLERANCES

1. Tolerances for the construction of sewer reticulation works shall comply with Table S6.4.

Table S6.4 Construction Tolerances

Location	Tolerance
Invert levels	+25mm - -25mm
Location of alignment and structures	Lateral deviation from line + 100mm Longitudinally along line + 300mm
Grade on pipe	Design grade not compromised

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S7

CONCRETE WORKS

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

S7.01 SCOPE

1. This specification details all matters pertaining to the supply, placement, compaction and finishing of Concrete Works.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S7.02 REFERENCE DOCUMENTS

Australian Standards

- AS1012 Methods of Testing Concrete
- AS1379 The Specification and Manufacture of Concrete
- AS1478 Chemical Admixtures for Concrete
- AS1553.1 Low Carbon Steel Electrodes for Manual Arc Welding of Carbon Steels and Carbon-Manganese Steels
- AS1554.3 Welding of Reinforcing Steel
- AS2203 Cored Steel Electrodes for Arc Welding
- AS2717.1 Ferritic Steel Electrodes
- AS3600 Concrete Structures
- AS3610 Formwork for Concrete
- AS3735 Concrete Structures for Retaining Liquids
- AS3799 Liquid Membrane-forming Curing Compounds for Concrete
- AS/NZS4671.2 Steel Reinforcing Bars for Concrete
- AS/NZS4671.3 Steel Reinforcing Wire for Concrete
- AS/NZS4671.4 Welding Wire Reinforcing Fabric for Concrete

All Australian Standards referenced in this specification shall be the current edition.

MATERIALS

S7.03 CONCRETE - GENERAL

1. All concrete to be incorporated in the works shall be sourced from a Quality Assured Concrete supplier.
2. The production and delivery of ready-mixed concrete shall be in accordance with the requirements of AS 1379.
3. The quantity of concrete delivered in any truck shall not exceed the rated capacity of its agitator drum. The timing of deliveries shall be such as to ensure an essentially continuous placing operation.
4. Ready-mixed concrete shall be placed and compacted within 1 hour of charging the mixer for concrete temperatures up to 32°C and within 45 minutes of charging the mixer for concrete temperatures exceeding 32°C but less than 35°C. These times may be varied at the Consulting Engineer's discretion where approved set-retarding admixtures are used. In this instance approved admixtures shall conform with the requirements of AS 1478 and shall be used in accordance with AS 1379. Calcium Chloride shall not be used as an admixture in concrete works.
5. A Manufacturer's Certificate in the form of a delivery docket in accordance with AS 1379 shall be supplied for each batch and shall be retained by the Contractor. Such certificates shall be held and maintained in the Contractors Quality records for the project. Further, the Contractor shall obtain a statement from the manufacturer qualifying the quality standard of the concrete in accordance with the requirements as specified herein.
6. The consistency and workability of concrete shall be such that it can be handled and transported without segregation and can be placed, worked and compacted into all corners, angles and narrow sections of forms, and around all reinforcement.
7. Concrete class shall be classed as Nx where x is the minimum 28-day compressive strength in megapascals.
8. For construction elements involving structural concrete construction activities, (eg. bridge slabs, bridge abutment footings etc.) the concrete class and slump shall be as detailed in the Project Documentation. The material quality compliance testing in this instance shall involve on-site sampling and testing in accordance with Australian Standard AS 1012. The testing of the 200mm x 100mm diameter test cylinders shall be at a frequency not exceeding one sample of 2 cylinders for each 15m³ or part thereof placed in an essentially continuous manner with a minimum of two samples of 2 cylinders for each casting day.
9. All testing shall be undertaken by a NATA registered testing authority.
10. The class of concrete relative to each construction element shall be as shown in Table S7.1.

Table S7.1 Concrete Classes

Construction Element	Concrete Strength ¹
Kerb / Kerb & Channel	N25
Manholes (Sewer & Stormwater) ²	N25 or N32 as shown on Standard Drawings
Gully Pits / Field Inlets ²	N25 or N32 as shown on Standard Drawings
Headwalls/Wingwalls & Apron Slabs ²	N25
Pathways / Bikeways	N25
Access Driveways	N25
Edge Restraints for Segmental Pavers (On Road Pavements)	N25
Edge Restraints for Segmental Pavers (On footpaths, bikeways and medians)	N20
Stamped Concrete (where used in road pavement)	N32
Stamped Concrete (where used as parking bay behind kerb or not subject to regular street traffic loadings)	N25
Thrust Blocks	N20
Concrete Surrounds for Sewerage House Connection Branches	N20
Concrete Cradle for Sewer Bedding Type 3	N15
General Concrete Works (Sign Post Bases, Bases for Post and Rail Fences etc.)	N20

Notes:

1. Tested in accordance with the relevant sections of AS 1012.
2. Where any part of the structure is located below RL 1.800 AHD, concrete to be in accordance with the appropriate exposure condition in AS3600

S7.04 NO FINES CONCRETE

1. No fines concrete shall consist of cement, water and coarse aggregate. The quantity of cement used shall be as specified below. The nominal size of the aggregate for no-fines concrete shall conform with the grading limits specified in Table S7.2.
2. The water / cement ratio shall be within the range 0.5 to 0.6 by mass.

Table S7.2 No Fines Concrete – Grading Limits

AS Metric Sieve (mm)	Percentage Passing by Mass	
	Nom. Size 20 mm	Nom. Size 10 mm
26.5	100	-
19.0	85 - 100	-
13.2	0 - 10	100
9.5	0 - 5	85 - 100
4.75	0	0 - 10
2.36	0	0 - 2
Minimum Cement Content (kg/m ³)	210	250

S7.05 LEAN MIX CONCRETE

- Lean mix concrete shall consist of a graded sand and gravel aggregate of 40mm maximum size with the addition of 5% by mass of Portland Cement or 1 part Portland Cement to 19 parts of graded aggregate and sufficient water to ensure a slump of less than 12mm.

S7.06 REINFORCING STEEL

- All reinforcement shall comply with the following requirements where applicable:-
 - Steel Reinforcing Bar - AS/NZS4671.2 Steel Reinforcing Bars for Concrete
 - Hard-draw Steel Reinforcing Bar - AS/NZS4671.3 Steel Reinforcing Wire for Concrete
 - Reinforcing Wire Fabric - AS/NZS4671.4 Welding Wire Reinforcing Fabric for Concrete
- All reinforcement shall be sourced from and Quality Assured manufacturer of such products and the Contractor shall obtain a statement from the manufacturer qualifying the Quality Standard of the reinforcing steel in accordance with the above noted standards.

CONSTRUCTION

S7.07 TEMPERATURE LIMITS FOR CONCRETE PLACEMENT

1. No concrete shall be placed in the Works if:
 - (a) The temperature of the concrete is less than 5°C or exceeds 30°C;
 - (b) The ambient air temperature is likely to be greater than 45°C during placement or within two (2) hours subsequent to placement.
2. If the ambient air temperature measured at the point of placement is likely to exceed 30°C during placing and finishing operations, the Contractor shall take practical precautions, to ensure that the temperature of the concrete does not exceed the permitted maximum so that the concrete can be placed and finished without defects, otherwise it shall be rejected. Typical precautions include those listed below:

At the Concrete Manufacturing Plant

- Shading aggregate stockpiles;
- Painting water tanks white;
- Insulating or burying delivery lines;
- Adding crushed ice to replace mixing water (in part) or chilling the water;
- Injection of liquid nitrogen into the mixer.

At the Site

- Cooling the formwork by dampening with water sprays;
 - Shading the work areas;
 - Erecting wind breaks;
 - Minimising the time for placing and finishing;
 - Use of evaporation retarding curing oil.
3. Special attention shall be paid to providing early curing for hot weather concreting operations.

S7.08 FOUNDATIONS

1. Foundations for concrete structures shall be prepared as specified on the Project Drawings.
2. Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned.
3. Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified).
4. All soft, yielding or other unsuitable material shall be replaced with sound material and the subgrade shall be compacted to provide a minimum of 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

5. The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

S7.09 FORMWORK AND FALSEWORK

1. All Formwork and Falsework shall conform to AS 3610 unless otherwise required by the specific Project Documentation.
2. All forms shall be built mortar tight and of sufficient rigidity to prevent distortion by the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained to prevent warping and the opening of joints due to shrinkage of the timber. The forms shall be substantial and unyielding and shall be so designed and set that the finished concrete will conform to the proper dimensions and within the tolerances specified herein. The design of the forms shall take into account the effect of vibration of the concrete as it is placed.
3. When forms are re-used, their original shape, strength, rigidity, mortar tightness and surface smoothness shall be maintained at all times. Material previously used in formwork must be cleaned off and oiled before re-use. Warped timber shall not be used.
4. Forms, which are unsatisfactory in any respect, shall not be re-used.
5. All timber shall be free from knotholes, loose knots, cracks, splits, warps and other defects, which would affect the strength of the structure or the appearance of exposed surfaces.
6. For narrow walls and columns where the bottom of the form is otherwise inaccessible, openings shall be provided so that they may be cleaned before placing the concrete, and for purposes of compaction and inspection.
7. All forms shall be treated with the lightest practical coating of release agent before the reinforcement is placed. Release agent shall not be placed on reinforcement or construction joints.
8. All forms shall be set and maintained to the line and level designated. Forms shall remain in place for periods, which shall be determined as specified herein. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall not proceed until the defects have been corrected.
9. Metal form ties shall be of an approved type, and if cast in, shall be of a type which permits removal of the end fittings to a depth of at least 30mm below the finished surface of the concrete. Ordinary wire ties shall not be used.
10. Form ties shall be located in a uniform symmetrical pattern relative to the finished surface. The cavities left when the end fittings of embedded ties are removed shall be as small as possible and shall be filled with cement mortar at the earliest possible time. The surface of such filled cavities shall be left smooth and uniform in colour.
11. Forms for plain exposed surfaces shall consist of plastic-coated plywood, waterproof plywood, timber lined with tempered hard-board or close-fitting unwarped metal forms. Unless otherwise specified, joints in the form sheeting for plain exposed concrete surfaces shall be either vertical or horizontal and spaced with a regular pattern.
12. Forms for surfaces not exposed to general view may consist of modular timber or metal panels. Timber forms shall be constructed and maintained in such a manner as to prevent warping and opening of joints due to shrinkage of the timber. The timber shall be free of any defects, which will affect the structure.

13. Forms shall be removed with care and without unnecessary hammering or wedging, and so as not to injure the concrete or disturb the remaining supports. Methods of form removal likely to cause overstressing of the concrete shall not be used.

S7.10 REINFORCING STEEL

1. Reinforcement shall be free of kinks or other unwanted deformations, and shall be cut to length, and bent in accordance with the Project Drawings. Fabric reinforcement shipped in rolls shall be straightened into flat sheets before use.
2. The surface condition of reinforcement shall comply with the following requirements:
 - At the time concrete is placed reinforcement shall be free from mud, oil, grease and other non-metallic coatings and loose rust which would reduce the bond between the concrete and the reinforcement.
 - For the purpose of this Specification, rust shall not be deemed to be loose if on rubbing with the thumb it leaves only a stain thereon.
 - Nevertheless, a deformed bar complying with AS 1302, or a welded wire fabric complying with AS 1304, and having mill scale or rust or both shall be deemed to comply with this Specification if, after wire-brushing the cross-sectional dimensions, including height of deformations; and mass, are not less than the dimensions and mass required by the applicable Australian Standard.
 - Any reinforcement projecting from a previous concreting operation shall be cleaned free of adhering concrete or loose slurry prior to any further embedment.
 - Any reinforcement placed within 1km of the coastline shall be thoroughly washed with a high pressure fresh water jet immediately prior to pouring concrete to remove any salts deposited during storage and placement.
 - Reinforcement which has been submerged by tidal or flood waters shall also be cleaned with a high pressure fresh water jet prior to pouring concrete.
3. Reinforcement shall be placed in position as shown on the Project Drawings. In the case of bar reinforcement, the bars shall be tied together by wiring each intersection using annealed wire not less than 1.25mm in diameter or by such other fastening devices as may be approved by the Designer, provided that, where the bar spacing is 300 mm or less, alternate intersections only need to be tied.
4. Clearance from forms shall be maintained by use of approved chairs. The shape of the chair shall be such that minimum obstruction is offered to the formation of the homogeneous concrete both within and around the chair. Tubular or cylindrical types shall not be used. Some bar chairs are suitable for soffit use only and should not be used against side forms. Bar chairs shall be sufficient structural strength to support the weight of reinforcement and workmen at temperatures experienced on site.
5. Metal chairs shall not be approved for any locations.
6. Precast mortar blocks shall not be used unless the blocks are manufactured from vibrated concrete of strength equivalent to that of the main concrete, and to a size and shape so as not to interfere with the structural integrity of the works. Such blocks shall have suitable fixing wires cast-in.
7. Layers of bars shall be separated by means of approved bar spacers. Stirrups and ligatures shall pass around the main reinforcement and shall be securely tied thereto.
8. Reinforcement shall be spliced by lapping or where permitted, by welding or by approved mechanical splices. Fabric reinforcement shall be lap spliced only.

9. The system of fixing shall be such as to form a rigid cage which maintains dimensional tolerances under loads experienced during placement of concrete. Welding of reinforcement to form a rigid cage shall comply with the following requirements:-
- Welding shall be in accordance with AS 1554.3. In particular tack welds shall not substantially reduce the cross-section of the reinforcing steel nor adversely affect its strength and shall have:-
 - A throat thickness not less than 4 mm;
 - A length not less than the diameter of the smaller bar.
 - Welding shall not be carried out within 75 mm of any portion of a bar which has been bent or will be bent.
 - No more than one-third of the main reinforcement at any cross-section shall be so welded.
 - Hard drawn wire and fabric reinforcement shall not be welded or heated unless approved by the Engineer.
 - Welding electrodes that are to be used complying with AS 1553.1 or AS 2203 or AS 2717.1.
 - Splices shall be made by butt or by fillet welding. Butt welds shall be qualified complete penetration butt joints in accordance with AS 1554.3.
 - Suitability experienced and competent welding personnel shall be engaged to complete the works.
10. Splicing of reinforcement shall occur only in the locations shown on the Project Drawings. Where practical, splices in bar reinforcement shall be staggered.
11. The length of lap splices in bar reinforcement shall be as shown on the Project Drawings. All reinforcement shall be spliced in such a manner as to maintain specified clear cover to the surface of the concrete. Splicing of fabric reinforcement shall be achieved so that the two outermost transverse wires of one sheet of fabric overlap the outermost transverse wire of the sheet being lapped.

S7.11 CONCRETE PLACEMENT - GENERAL

1. The Contractor shall be solely responsible for placing and compacting the concrete in the forms to comply with this Specification and for achieving dense, sound concrete without voids and to the lines and levels shown on the Project Drawings.
2. When rain threatens or seepage exists in excavations, the Contractor shall have on site sufficient dewatering equipment and covers as applicable to prevent any additional water entering the concrete.
3. Concrete shall be placed in an essentially continuous manner between approved construction joints so as to avoid being placed against partially set concrete.
4. Any troughs and chutes used as aids in placing concrete shall be metal or metal lined and shall be arranged and used in a manner that does not cause segregation. The use of water to facilitate the movement of concrete along troughs or chutes is expressly prohibited, but all troughs and chutes shall be kept clean and free of coating of hardened concrete by flushing thoroughly with water, which shall be discharged well clear of concrete in place.
5. Troughs and chutes shall discharge into vertical downpipes at least 1 metre in length. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement so that the concrete slides without segregation.

6. Pneumatic placers and concrete pump may be permitted for use subject to such equipment being arranged so that no vibrations will damage freshly placed concrete. The delivery end of the pipe shall terminate in a fitting of approved design, which shall prevent segregation of the concrete. After the completion of any concreting operations the equipment shall be thoroughly cleaned before re-use.
7. Concrete shall not be dropped from a height or in such a manner as will cause segregation or loss of material on the reinforcing steel or forms. When placing operations would involve dropping the concrete more than 2 metres it shall be deposited through a sheet metal or other approved downpipe in such a way that the concrete does not segregate. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. The depositing of a large quantity of concrete at any point with the intention of moving it along the forms, will not be permitted.
8. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

S7.12 CONCRETE PLACEMENT – UNDER WATER

1. Concrete shall not be placed under water unless specifically approved. The slump of the concrete to be placed underwater shall be between 150mm and 200mm.
2. Concrete shall not be placed in running water. Any pumping must cease and the water level must be constant where placement commences. The concrete shall be placed carefully in position by a tremie, a closed bottom-dump bucket or by other approved means. Concrete seals shall be placed in one continuous operation, the concrete shall not be disturbed after being deposited and the placing shall be regulated to continually maintain an approximately horizontal surface.
3. When a tremie is used it shall consist of a watertight tube and at no time shall concrete in the tube come in contact with water when it is being filled. The means of supporting the tremie shall be such as to permit free movement of the discharge end and to permit its being lowered rapidly when necessary to choke off or retard the flow of concrete. No water shall enter the tremie tube. The discharge end shall be completely submerged in concrete at all times and the tremie tube shall always be filled to a height to overcome the head of water.
4. When concrete is placed with a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the prepared foundation or upon concrete already placed. It shall then be raised slowly during the discharge travel so as to maintain as far as is practicable still water at the point of discharge and to avoid agitating the mixture. The concrete so placed shall not be disturbed.

S7.13 COMPACTION IN CONCRETE FORMS

1. Concrete during and immediately after depositing shall be thoroughly compacted. Concrete other than no fines concrete shall be compacted with high frequency internal vibrations in the manner described below:-
2. The vibrators shall be of an approved type and shall be capable of transmitting vibrations at a frequency not less than 150 Hz with an intensity which will visibly affect the concrete at a radius of 300mm.
3. The number of vibrators to be used by the Contractor shall be not less than one for each 4m³ of concrete placed per hour, with a minimum of 2 vibrators to be provided at any time.

4. Vibrators shall be inserted vertically at successive positions not more than 450mm apart and in a manner, which ensures compaction of the concrete around the reinforcing steel and any other embedded fixtures, and into all parts of the forms.
5. Vibration shall continue at each position until air bubbles cease to emerge from the concrete. The vibrators shall then be withdrawn slowly so as to avoid leaving a "pocket". The vibration shall be of sufficient duration to thoroughly compact the concrete, but shall not be continued so as to cause segregation.
6. Care shall be taken to ensure that newly deposited concrete is vibrated into any fresh concrete adjacent to it to provide a homogeneous concrete mass.
7. Vibration shall not be applied either directly or through the reinforcement to any concrete, which has taken its initial set.

S7.14 REMOVAL OF FORMS AND FALSEWORK

1. Unless otherwise specified, forms and falsework shall remain in position until the times stated below have elapsed after completion of concreting:

Non Structural Concrete

- Until such time as the concrete has reached 50% of the characteristic 28-day strength or a period of 3 days, whichever is the lesser.

Structural concrete

- Soffits of slabs, headstock and diaphragms - Until such time as the concrete has reached 70% of the characteristic 28-day strength or 7 days, whichever is the lesser.
 - Side forms on structural concrete - 3 days minimum.
2. Where the timing for the removal of forms is based on concrete strength as specified herein, the strength shall be proven by testing in accordance with AS 1012.
 3. Forms shall be removed with care, without hammering and wedging, and in a manner, which will not injure the concrete or disturb the remaining supports. Centre Forms shall be lowered gradually and uniformly in such a manner as to avoid injurious stress in any part of the structure.
 4. Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

S7.15 FINISHING OF EXPOSED SURFACES

1. Unless otherwise specified in the Project Documentation, all surfaces of concrete exposed to view in the completed structure shall be finished in accordance with the following:
 - Kerb and channel, invert crossings, vehicle crossings and industrial crossings shall be finished with an approved steel finishing tool.
 - Footpaths, bikeways and pram ramps shall be finished with a wooden float and broomed.
 - Where a sample panel is supplied or specified associated with a particular project. The concrete finish shall be in accordance with the specified requirement.
2. All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arrises shall be sharp and true, and mouldings shall

be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result.

3. Immediately after removal of forms from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.
4. Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.
5. The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer.

S7.16 WEEPHOLES

1. Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:
 - (a) The maximum particle dimension shall not exceed 50mm
 - (b) No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve.
2. The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.
3. Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions.

S7.17 JOINTS

1. Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Consulting Engineer. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.
2. Where vertical expansion joints are shown on the approved Project Drawings in retaining walls or other walls and structures the expansion joints shall consist of jointing material of approved quality, and of thickness stated on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.
3. Extruded or cast in place kerbing, shall have narrow transverse vertical grooves, 40mm deep and not more than 6mm wide, formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints shall be at intervals not exceeding 3 metres.
4. In footpaths, median toppings and driveways, unless otherwise shown on the approved Project Drawings, expansion joints, 10mm in width for the full depth of paving, shall be constructed at intervals not exceeding 16m and where the pavement abuts against gutters, pits and structures. Expansion joints shall have an approved preformed jointing

material. In addition, narrow vertical grooves 20mm deep and not more than 6mm wide shall be formed at internals not exceeding 2m to induce contraction joints for the control of cracking.

5. All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep and not more than 6mm wide to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form "slabs" no bigger than 2m². The ratio of the longest side to the shortest side shall not exceed 1.6.

S7.18 CURING

1. The curing of unformed surfaces of concrete shall commence as soon as finishing operations are complete.
2. If forms are removed in less than 7 days, curing of the formed surface shall commence within two hours of stripping.
3. Curing shall continue for a period after placing the concrete of not less than:-
 - Top surface of slabs - 14 days;
 - Other surfaces - 7 days.
4. Curing shall be effected by either Water or Membrane Curing.
5. Water curing shall comprise surfaces being kept moist for the period specified by continuous spraying, ponding, wet hessian or wet sand blankets.
6. Membrane curing shall be effected by application of a sprayed curing compound or by covering with polythene sheet.
7. Sprayed curing compounds shall be of a paraffin wax emulsion type formulated and tested by the manufacturer to conform to AS 3799. The compound shall be mixed if necessary and applied at the rate recommended by the manufacturer.
8. Resin and PVA based compounds shall not be used.
9. Polythene sheet shall be of sufficient strength to withstand wind and any imposed foot traffic. Torn or punctured sheeting shall not be used. Laps should be 300mm minimum and edges and laps shall be sealed by tape or held down by boards or reinforcing bars. Water shall be sprayed under the sheeting at edges and at laps on the day after placing concrete and at regular intervals to maintain moist conditions.

S7.19 BACKFILLING

1. Backfilling at barriers, paving, etc, and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.
2. No filling shall be placed against retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts or when the Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved.
3. Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 12893.3.1. The material shall be placed in layers not exceeding

150mm and shall be compacted to provide a relative compaction of not less than 98 per cent as determined by AS 1289.5.4.1 for standard compactive effort.

S7.20 SPRAYED CONCRETE

1. The minimum depth of sprayed concrete to be applied shall be 75mm.
2. Sprayed concrete shall have a minimum 28-day compressive strength of 25 MPa.
3. Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.
4. Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete.
5. The Contractor shall remove free water and prevent the flow of water, which could adversely affect the quality of the sprayed concrete.
6. Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.
7. Spraying shall be discontinued if wind causes separation of the nozzle stream.
8. Concrete shall not be sprayed in air temperatures less than 5 °C.
9. Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.
10. When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.
11. Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.
12. Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with manufacturer's specifications.
13. In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days.

S7.21 NO FINES CONCRETE

1. Where no fines concrete is incorporated in the works it shall be rodded sufficiently only to ensure the form is completely filled. It shall be screeded to the required surface level without tamping or vibrating. No fines concrete shall be moist cured for at least four (4) days by covering with wet hessian, polythene sheet or other similar materials. The use of

wet sand or any other material, which can enter the voids, will not be permitted for curing purposes.

S7.22 TOLERANCES

- Where tolerances for individual components and associated dimensions are not specified on the Project Drawings, deviations from established lines, grades and dimensions in the completed work shall not exceed the values stated herein.
- The dimensional tolerances as shown in Table S7.3 are to cover strength, durability and fit of prefabricated elements and cast-in-situ elements.

Table S7.3 Dimensional Tolerances

Description	Tolerance (mm)
Cross-sectional dimension of members and thickness of slabs	+ 10, - 3
Length of members, length and width of slabs: - Up to 18m dimension - 18m or over dimension	± 6 1mm for every 3m in length
Clear cover to reinforcement	+ 6, - 3
Fitments for prefabricated elements – girder anchorages (including dimensions between anchorages on adjacent piers), cored holes, handrail anchorages and other embedded items	± 5 max. 1mm for every 1m in length

- Positional tolerances, as shown in Table S7.4 refer to the departure of any point, plane or component of a structure from its correct position within the layout of the structure as shown on the Project Drawings.

Table S7.4 Positional Tolerances

Description	Tolerance (mm)
Level of footings	± 20
Level other than footings	± 5
Horizontal location, where tolerances on fit is not applicable	+ 25

- Relative tolerances refer to departures from linearity or planarity in any part of the structure. Tolerances are measured as the departure of any point in a line or surface from the remainder of that line or surface.
- Departure may be sudden (eg. misfit at joint in formwork) or gradual (eg. a wobble in the surface). Tolerance on gradual departure is the value calculated by multiplying the overall length of the line or surface under consideration by the factor given below in Table S7.5.

Table S7.5 Relative Tolerances

Description	Tolerance (mm)
Exposed edge - Gradual departure	0.001
Exposed surface - Gradual departure - Sudden departure	0.004 (10mm max.) 3mm max.

WHITSUNDAY SHIRE COUNCIL

DEVELOPMENT MANUAL

OPERATIONAL WORKS

SPECIFICATION

S8

LANDSCAPING

This Document is the property of Whitsunday Shire Council and is issued to Developers, Consultants, Contractors and Council Officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Infrastructure Development for consideration.

Date:	Prepared by:	Checked by:	Approved by:	Revision:
14 August 2007	Simon Aalbers Manager Infrastructure Development		Council	1.0

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GENERAL

S8.01 SCOPE

1. This specification details all requirements pertaining to Tree Planting, Grassing, Turfing, Hydromulching and Irrigation works associated with permanent and temporary revegetation works.
2. Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

S8.02 REFERENCE DOCUMENTS

Australian Standards

- AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- AS/NZS1477 PVC Pipes and Fittings for Pressure Applications
- AS2032 Code of Practice for Installation of PVC Pipe Systems
- AS2507 The storage and Handling of Pesticides
- AS2845 Water Supply – Back Flow Prevention Devices
- AS3785 Solvent Cements and Priming Fluids for Use with UPVC Pipes and Fittings
- AS4419 Soils for Landscaping and Garden Use
- S4454 Composts, Soil Conditioners and Mulches

All Australian Standards referenced in this specification shall be the current edition.

QLD Government Legislation

- Queensland Land Protection Act (2002)

Whitsunday Shire Council

- Whitsunday Pest Management Plan

MATERIALS

S8.03 GRASS SEEDING

1. The grass seeding species mix shall consist of the following:
 - 30% Cynodon Dactylon (green couch) - hulled
 - 30% Cynodon Dactylon (green couch) - unhulled
 - 30% Axonopus Affinis (carpet grass)
 - 10% Tetila Rye (in dry season) or Japanese Millet (in wet season)
2. The accepted final mix shall be dependent upon local conditions, soil properties, and method of works.

S8.04 TURFING

1. Turf shall consist of 25mm depth of dense, well rooted, vigorous grass growth with 25mm depth of topsoil. It should be free from any material toxic to plant growth, declared weeds, seeds or roots including nut grass and oxalis. The soil attached to the turf shall be free from rubbish, sticks and other deleterious material.
2. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300mm, and shall be in sound unbroken condition.
3. The moisture level in the cut turf should be kept relatively consistent so that it is not saturated or severely dried out when laying. Both of these situations can cause turf to fall apart during laying.
4. The type of grass turf to be used shall as stated on the approved Project Drawings, where not stated broad leaf buffalo shall be used for un-irrigated areas and couch for irrigated areas.
5. Acceptable species for this region are as follows:
 - Axonopus compresus (Broad leaf buffalo)
 - Digitaria didactylia (Blue Couch)
 - Cynodon dactylon (Bermuda Couch / Green Couch).

S8.05 HYDROMULCH

1. The hydromulching mixture shall consist of the following:

Mulch

Pulped Paper / Bagasse or Cane fibre

Fertiliser

Broad spectrum type CK55 or equivalent.

Seed

- 33% Cynodon Dactylon (Green Couch) - hulled
- 33% Cynodon Dactylon (Green Couch) - unhulled
- 33% Axonopus Affinis (Carpet Grass)

Water

Water used to establish and maintain the grassing shall have a pH of between 5.0 and 8.0, a total soluble salts concentration less than 1000mg/l and contain no chemicals or compounds toxic to growth.

Binder / Tackifier

Binder is to be non-toxic, inert, water soluble and non-flammable, e.g. Curasol or equivalent.

Tackifier is to be a non-toxic and biodegradable e.g. Envirotack or equivalent.

S8.06 PLANT STOCK

1. All plant species shall be as detailed on the approved Project Drawings. There shall be no substitution of any species without Council approval.
2. All palms, trees, shrubs and groundcovers shall be true to name. The root system of each plant shall be conducive to successful transplantation, all specimens shall be free from pests and disease, especially Phytophthora, palm beetle, sooty mould and scale, and all containers shall be free from pernicious weeds.
3. All plants shall be grown in containers and shall comply with the following minimum size requirements:
 - Trees - 25 litre container for street tree planting
 - Trees - 45 litre container for medians, tree guards, traffic islands and roundabouts
 - Single stemmed palms - 45 litre container
 - Clumping Palms - 45 litre container
 - Shrubs - 200mm container
 - Groundcovers – 140mm container.
4. Plants shall be watered before transportation to the planting site, and shall be delivered to the site in a covered container. During loading and unloading damage in handling shall be avoided.
5. Species identified in the following are prohibited from use:
 - Land Protection (Pest and Stock Route Management) Act 2002, and the associated
 - Land Protection (Pest and Stock Route Management) Regulation 2003
 - Species identified in the Local governments Pest Management Plans, and
 - Publication "Agricultural and Environmental Weeds – Far North Queensland" (Wet Tropics Management Authority and Department of Natural Resources and Mines)

S8.07 SOIL MIX

1. A good quality landscaping soil mix shall be imported from an approved source to the planting site for backfilling the planting pits.
2. Specification for the landscaping soil mix are as follows:
 - It shall contain approximately 70% sandy loam and 30% composted or mature organic matter;
 - It shall be friable and not contain any clay;

- The pH shall be between 5.5 and 7.0;
- It shall be free from contaminants such as the seed of declared weeds, rocks sticks and salts;
- It shall not contain any chemical fertilisers.

S8.08 FERTILISER

1. Fertiliser shall conform to the requirements stated in Table S8.01.

Table S8.01 Fertiliser Types

Location	Chemical Type	Type of Application	NPK Analysis
Grass Seeding (Complete lawn fertiliser)	Inorganic	Surface broadcast	N 15 to 24 P 6 to 9 K 10 to 20
Turfing (Complete lawn fertiliser)	Inorganic	Surface broadcast	N 15 to 24 P 6 to 9 K 10 to 20
Tree Planting (Controlled Release Fertiliser)	Organic or Inorganic	Fertiliser Tablets (2 per tree)	N 15 to 25 P 3 to 9 K 5 to 18
Planting Beds (Controlled Release Fertiliser)	Organic or Inorganic	Granular	N 18 to 25 P 3 to 7 K 9 to 18

S8.09 IRRIGATION PIPEWORK

1. All below ground pipework shall be unplasticised Poly-vinyl Chloride (uPVC) unless otherwise approved. All pipes shall be Class 12 minimum with Class 18 fittings.
2. All above ground pipe work shall be copper tube (hard drawn) Type D manufactured in accordance with AS 1432 by an Australian Standards quality endorsed company.

CONSTRUCTION

S8.10 GRASS SEEDING

1. Prior to grass seeding all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.
2. Prior to grass seeding the ground surface shall be lightly tyned to a depth of 100mm below finished surface levels (where slopes are less than 10%). All large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.
3. Parks may require additional topsoil to a depth of not less than 75mm and shall be lightly compacted and grassed if Council considers the in-situ topsoil of poor quality and is too rocky.
4. Grass seeding applied by drill seeding at the minimum rate of 50kg per hectare using the species mix specified.
5. Fertiliser should be applied following seeding at a minimum rate of 350kg per hectare, subject to specific site conditions, soil analysis and desired outcomes.
6. Seed and fertiliser should be applied at an even rate using a calibrated disc drill seeder followed by a chain and roller.
7. Disc's should cut approximately 12mm and create enough friable material for chains to cover the seed.
8. Where one pass fails to develop enough friable material a second pass should be made in a transverse direction.
9. Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the following minimum requirements:-

Periods after grassing	Watering(s)
Immediately	Once
Week 1	Twice / day during hot, dry or windy periods Once / day during cool / overcast periods
Weeks 2	Once / day
Weeks 3 & 4	Once every second day
Week 5 until necessary	Twice a week

or as necessary to ensure 80% minimum strike rate.

10. Acceptance shall be the achievement of a minimum vegetative cover of 80% of both the annual and perennial grass cover over the whole area. Grassed areas shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material. Maximum deviation from finished ground levels 50mm in any 2 metres

S8.11 TURFING

1. Prior to turfing all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.

2. Topsoil shall be uniformly applied to provide an average thickness of 50mm with a minimum compacted thickness of 25mm at any location and graded to even-running contours, so that no ponding or waterlogging occurs across the surface of the grassed area.
3. The prepared surface shall be watered within twenty four (24) hours prior to turfing at an application rate of 10mm of water in not less than 1 hour. Watering is to be carried out in such a way as not to cause any scouring or erosion.
4. After watering an approved lawn pesticide shall be applied at the rate specified by the supplier and in accordance with the Agricultural Chemicals Distribution Contract Act and Regulations.
5. Fertiliser should be applied prior to laying turf at a minimum rate of 350kg per hectare, subject to specific site conditions, soil analysis and desired outcomes.
6. Topsoil shall be raked before turf is laid. Turf shall be laid in straight lines with staggered cross joints on the general line of the contour of the slope. The gaps between adjacent sections of turf should not exceed 5mm.
7. A light top dressing shall be worked into the open joints between the turf and then the turf lightly rolled with one pass of a roller weighing about 80kg on a 1m width of roller. Alternative methods to rolling shall be used where slopes exceed 10%.
8. On steep slopes (exceeding 10%) turf may be held in position by softwood pegs or stakes, located at each end of the turf sections.
9. Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the following minimum requirements:-

Periods after grassing	Watering(s)
Immediately	Once
Week 1	Once every second day
Weeks 2, 3 and 4	Three times each week
Weeks 5 to 12	Twice a week

10. Acceptance shall be the achievement of an even green colour with a dense continuous sward over the whole area. Turf shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material. Maximum deviation from finished ground levels 50mm in any 2 metres.

S8.12 HYDROMULCHING

1. Prior to hydromulching all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.
2. Batter slopes less than 20% shall then be lightly tyned to a depth of 50mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.
3. Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 75mm with a minimum compacted thickness of 40mm at any location.
4. Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

5. The slurry mixture of mulch, binder, fertiliser and seed is to be kept in a homogeneously mixed state throughout the mulching operation.
6. During preparation of the hydromulch, a liquid form pesticide may be added to the storage tank, to facilitate surface application. Application rate should be in accordance with the manufacturer's recommendation.
7. Additional protective treatments (eg. fibre matting, anionic bitumen emulsion etc) shall be as specified on the approved Project Drawings.
8. Hydromulch shall not be applied under the following weather conditions at the site:
 - when temperature is higher than 35°C
 - when winds exceed 15 km/hr;
 - where the surface is too wet or
 - during rain periods or when rain appears imminent.
9. The rate at which the mulch is applied is dependent on slope shall be in accordance with Table S8.02.

Table S8.02 Hydromulching Material and Application Rates (per 1000m²)

Slope	< 5%	5% - 12%	12% - 20%	20% - 50%	> 50%
Pulped Paper	200kg	120kg	120kg	140kg	200kg
Bagasse (Wet weight)	200kg	400kg	500kg	700kg	800kg
Cane Fibre (Alternative to Bagasse)	200kg	200kg	300kg	400kg	500kg
Fertiliser	50kg	50kg	50kg	50kg	50kg
Seed	5kg	5kg	5kg	5kg	5kg
Water	8000 litres	8000 litres	10,000 litres	12,000 litres	18,000 litres
Binder Curasol Enviro tack	5 litres 3kg	5 litres 2kg	7.5 litres 3kg	15 litres 4kg	30 litres 5kg
Mulch Thickness	1-2mm	2-3mm	2-4mm	2-4mm	4-6mm

11. Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the following minimum requirements:-

Periods after grassing	Watering(s)
Immediately	Once
Week 1	Twice / day during hot, dry or windy periods Once / day during cool / overcast periods
Weeks 2	Once / day
Weeks 3 & 4	Once every second day
Week 5 until necessary	Twice a week

or as necessary to ensure 80% minimum strike rate.

12. A follow up fertiliser treatment is to be applied to 4 – 6 weeks after germination has occurred. Fertilisation should be with a product that provides for the following elements: Nitrogen (N) 13%, Phosphorus (P) 4% and Potassium (K) 12%.
13. Acceptance shall be subject to the achievement of a minimum vegetative cover of 80% of both the annual and perennial grass cover over the whole area. Hydromulched areas shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material.

S8.13 PLANTING

1. Planting shall be carried out as soon after delivery to the site as possible. All containers, unless fully biodegradable, shall be removed at the latest point before planting.
2. All plants shall be obtained from a nursery located in an area having a similar climate to the site of the Works.
3. Shrub and ground cover planting to verges and traffic islands etc. shall be as detailed on the approved Project Drawings.
4. Prior to planting all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.
5. Street trees shall be planted at the locations as shown on the approved Project Drawings.
6. During backfilling around the plants the soil shall be lightly firmed to ensure intimate contact with the roots, but with large material successive layers of soil will need to be firmed as backfilling proceeds.
7. Ensure the plants are held securely by the soil but not so that moisture penetration of the soil is restricted. After planting, damaged, dead, diseased or crossing branches shall be removed by pruning.
8. Plants should be watered directly after planting prior to spreading of mulch. The mulch shall be left just clear of the plant stem.
9. All trees shall be staked with three (3) 38 x 38 x 2400mm hardwood stake, extending into the ground to a depth of 500mm. Do not allow the stake to penetrate the root ball. Secure the tree to the stake with plastic multi-purpose chain ties. Refer Standard Drawing S4210 for details.

10. Mulch shall be aged hardwood woodchip, stockpiled for a minimum of 6 weeks, or other mulch approved by Council, free from rocks, non-biodegradable and toxic material. In paved footpath planters it shall be installed to a depth of 75mm, in tree guards, traffic islands and mulched, mass planted garden beds within parkland and reserves to a depth of 150mm depth.
11. Peanut shell or forest litter mulch may be used in "natural" planting areas only, such as buffer planting or parkland planting. It should be installed to a minimum 150mm compacted depth, free from rocks, nut grass, and any other invasive weed.
12. Tea-tree mulch is prone to combustion and shall not be used unless permission is obtained from Council. .
13. All plants shall be watered, immediately upon planting, and at the rate of 10 litres per plant every third day for the first twelve weeks.
14. Weed and grass growth in mulched areas shall be killed by treatment with herbicide in accordance with the manufacturer's instructions at monthly intervals during the construction period and contract maintenance period. Contact of the herbicide with the new plants shall be avoided and any damage repaired or damaged plant material replaced.
15. Acceptance shall be subject to achieving the following criteria. Plants, which do not meet the acceptance criteria, shall be replaced. Replacement plants shall be of similar size and quality and of identical species and variety to the plant being replaced.
 - Plants shall exhibiting signs of healthy growth,
 - Plants shall be well formed,
 - Plants shall be free from disease or insect pests,
 - Plants shall be free of physiological disease symptoms (yellowing, wilting etc)
 - Mulch shall be free from weeds, sticks, rubbish and other deleterious material,

IRRIGATION

S8.14 GENERAL

1. Application shall be made to Council for connection of irrigation systems to the water main. The Contractor shall arrange with the Council for the timing of the work. All works shall be carried out by the relevant Local Authority at the applicants cost.
2. The Applicant will be responsible for the payment of all water used during construction, testing, establishment and maintenance of the irrigation system and landscape works.

S8.15 EXCAVATION

1. Do not excavate by machine within 500mm of existing underground services.
2. The standard width of trench for pipes shall be 150mm.
3. Unless noted otherwise on the approved Project Drawings or directed by Council all pipe work is to be installed with a minimum cover of 350mm.

S8.16 LAYING OF PIPES

1. All pipe work to be bedded in clean fill sand with a minimum cover of 50mm all round.
2. Special precautions are to be taken to exclude dirt, sand, grit or gravel from entering pipelines.
3. The open ends of pipes shall be plugged at the end of the day's work to prevent entry of water or mud.

S8.17 PRESSURE TESTING

1. All work shall satisfy a test pressure of the nominated working pressure for a period of two (2) hours. The test shall be carried out during the coolest part of the day. The point at which the test pressure is measured shall be at the lowest point in the profile of that section of main under test.
2. All tests shall be carried out under the supervision and in the presence of the Council Inspector.
3. Any defects that arise during the tests shall be repaired in an approved manner. Any leak however small will be classed as a defect. All such repair work shall be similarly tested and approved before acceptance.
4. The Contractor shall give 48 hours notice to Council so that arrangements can be made for supervision of the testing.
5. The Contractor shall accept all risks and expenses incurred during testing and shall provide all labour together with all pumps, engines, pipes, temporary valve plugs, flanges and all other equipment as may be necessary to undertake testing.

S8.18 FLUSHING

1. After pressure testing has been carried out the new pipework shall be flushed as thoroughly as possible with the available water pressure.

S8.19 CONTROLLERS

1. All Council landscaped areas, which require irrigation systems shall be controlled by electrically, operated solid state controller.

S8.20 FILTRATION

1. All irrigation systems shall be fitted with an approved flow strainer installed in a secure enclosure.

S8.21 VALVES

1. Electrically actuated solenoid valves shall have flow control, manual bleed screw, 24 VAC solenoid, Buna N diaphragm, and be constructed of PVC and stainless steel. They shall be suitable for direct burial and have 150 psi maximum working pressure. They shall be pressure regulating solenoid valves.
2. Isolation valves shall be of bronze construction and of the BSP screwed gate type as approved by the engineer. They shall be installed on the supply side at every solenoid valve to enable isolating.
3. Protective valve boxes are to be provided for each solenoid valve. They shall be constructed of green high density polyethylene, be 450 x 300 x 300mm in dimension, and have a lockable lid with the word "Irrigation" clearly marked on it.
4. The wiring from the solenoid to the controller shall be laid in conduit and shall be of 250 volt grade and shall be installed to approved standards. The wiring shall be located with all pipework.
5. All solenoid valves shall be connected to controller by 0.05mm² solid core wire and to have seven insulated cores within a common plastic protective shield. It shall be similar in all respects to RIS multi-core 7/0.5mm electrical control wire and shall be continuous between valve and controller, and valve to valve. An additional one metre length of cable shall be provided at each wire termination. Cable shall be sized for voltage drop not exceeding four (4) volts over total route length.

S8.22 BACKFLOW PREVENTION DEVICES

1. All Council landscaped areas, which require irrigation systems, shall have a backflow prevention device installed. This device should comprise of a stand constructed fully from hard drawn copper pipe (Type D) and should have an inline strainer both before and after the backflow preventer. This should comply with AS 2845.

S8.23 PERFORMANCE TEST

1. On completion of the installation the system shall be tested in the presence of a Council Inspector.
2. The system shall be operated to demonstrate that all components function as required by the design.

3. The Contractor is responsible for making all necessary alterations to the system so that the performance is in accordance with the design specifications.

S8.24 BACKFILLING OF TRENCHES

1. Trenches shall be backfilled with the excavated material. If the excavated material is considered unsuitable for backfilling by the Council Inspector, it shall be removed from the site and replaced with clean approved backfill material.
2. All trenches so backfilled shall be compacted and lightly raked to ensure that surface levels marry with adjacent surface levels, are free draining and free from mounds or depressions. All rocks or evidence of excavated subgrade shall be raked up and removed.