SC6.6 Infrastructure Design

SC6.6.1 Introduction

SC6.6.1.1 Application

1. This planning scheme policy applies to development where an applicable code identifies Planning Scheme Policy 6 Infrastructure Design as supporting an outcome of the code.
2. If there is an inconsistency between the planning scheme policy and the planning scheme, the planning scheme prevails to the extent of the inconsistency.
3. Referenced Standards are non-Council standards which meet the outcomes of the Policy.
4. Council Standards specified in the Policy may include:
   a. Matters not otherwise referred to in Referenced Standards;
   b. A variation to the Referenced Standard;
5. Limitations may apply to one or more Referenced Standards (where multiple standards may apply).
6. Where there is any conflict between Referenced Standards and Council Standards, then Councils Standards, apply.

SC6.6.1.2 Relationship to the Planning Scheme

This planning scheme policy is to be read in conjunction with the Lockyer Valley Planning Scheme.

SC6.6.1.3 Purpose

1. The purpose of this planning scheme policy is to ensure that development complies with the local government's standards for the planning, design, location and construction of infrastructure that reflects acceptable standards in engineering, asset management, environmental management and natural resource planning by:
   a. specifying information requirements;
   b. specifying standards and guidelines;
   c. specifying administrative arrangements;
   d. specifying the circumstances in which Council may accept a security for the completion of work.

SC6.6.1.4 Technical Standards

1. Planning, design, construction and maintenance of works identified in this policy are to comply with the nominated relevant standards. Where standards and/or specifications are not stipulated for certain infrastructure elements, guidance may be obtained through engagement with Council. Standards referenced by this policy are called up in each section.

SC6.6.1.5 Consultation

1. Council may seek third party advice or comment about an application where:
   a. development may conflict with a code; or
   b. technical advice is required to assess the development.
2. Where technical advice is outsourced to an independent consultant an additional fee will apply.

SC6.6.2 Application requirements

SC6.6.2.1 Prelodgement meetings

1. It is strongly recommended that discussions are held with Council before and during the design, concerning design concepts and clarification of specific requirements related to a particular project.
2. A pre-design site inspection is expected to be undertaken before any detailed design work commencing. For designers, it is recommended that a pre-design site inspection should be held with a representative from Council to discuss specific issues and requirements for the site and surrounds.

SC6.6.2.2 Application process

1. Development applications will be assessed in accordance with the development assessment process under the *Planning Act 2016* and the *Planning Regulation 2017* when read together with the Planning Scheme.
2. Relevant development application forms are available on Council's website.

SC6.6.2.3 Application fees

1. Fees associated with applications are listed in Council's Fees and Charges Schedule available on Council's website.

SC6.6.2.4 Application preparation

1. Any conflicts or departure from the standard drawings and the policy are to be detailed in the application.
2. Where a staged development has been approved by Council, Council may require engineering design and construction to include the whole of the site, or such additional parts of the site as will enable Council to maintain the works in a satisfactory condition if the balance of the development does not proceed to completion (e.g. temporary end of road turn around and drainage outlets).
3. The development application is to include enough information outside the development footprint to verify that any future extension of the proposed works can proceed in accordance with this policy and without any undue cost to future development.
4. All design drawings and calculations are to be supervised and certified by competent persons as referred in Section SC6.6.2.5 Competent persons.

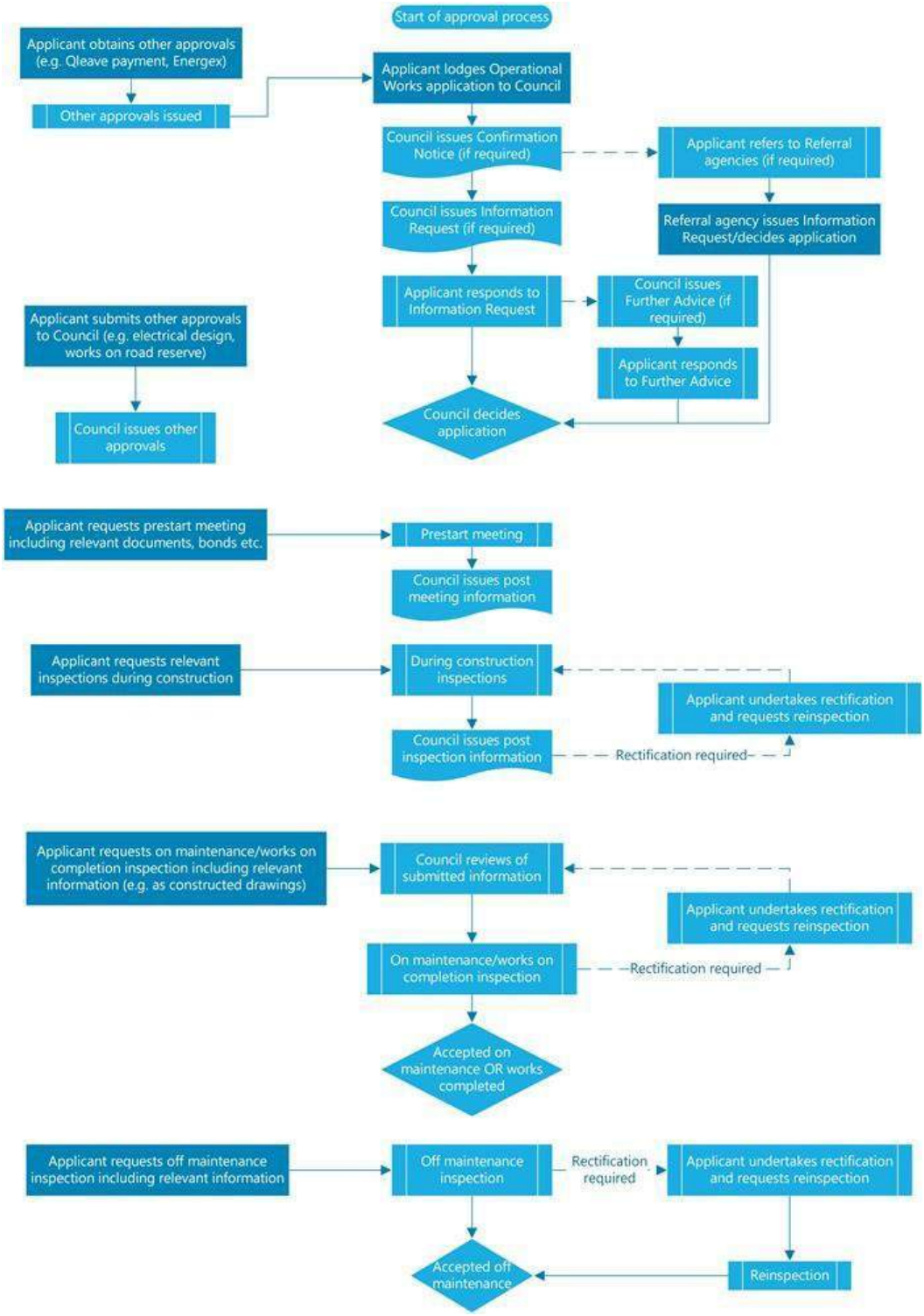
SC6.6.2.5 Competent persons

1. A person preparing a report, a plan or a drawing relating to development must be a suitably qualified person and include:
   a. in the case of geotechnical, hydraulic, stormwater infrastructure, civil, structural or electrical engineering (including lighting) issues, be a Registered Professional Engineer of Queensland (RPEQ); or
   b. in the case of non-minor landscaping issues, be a Registered Landscape Architect with the Australian Institute of Landscape Architects; or
   c. in the case of erosion and sediment control plans, be a Certified Professional in Erosion and Sediment Control (CPESC) or a RPEQ who has undertaken the Erosion and Sediment Control training provided by the International Erosion Control Association with demonstrated specialist expertise in the relevant subject matter; or
   d. in the case of ecological reports, be a suitable qualified ecologist with no less than 5 years' experience conducting field based ecological surveys in South East Queensland.
2. The report, plan or drawing must include certification signed by the relevant, suitably qualified person that the report, plan or drawing is fit for its intended purpose and can be relied upon by Council for that purpose.

SC6.6.2.6 Operational Works Process

1. The operational works process can be broken into six overall elements:
   a. applications and approvals;
   b. prestart application;
   c. construction;
   d. on-maintenance;
   e. off-maintenance.
2. The overall process is outlined in Figure SC6.6-1: Operational works application approval process, below.

Figure SC6.6-1: Operational works application approval process



SC6.6.2.6.1 Reports and certification to be submitted for approval

1. The following must be submitted with an application for operational works:
   a. Any report, certification or documentation required to be lodged at the time of operational works as required by the Planning Approval (Material Change of Use, Reconfiguring of a Lot);
   b. Approvals and clearances including but not limited to:
      i. Department of Transport and Main Roads (DTMR);
      ii. Department of Environment and Science;
      iii. Department of Resources;
      iv. lawful point of discharge;

v. clearance for works through or on other properties;
vi. water and sewer;
vii. electricity;
viii. telecommunications;
ix. other as required for the Material Change of Use and Reconfiguration of a Lot;

c. Any standard drawings included in the application;
d. Schedule of drawings submitted;
e. Plans that show:
   i. Staging;
   ii. bulk earthworks;
   iii. road geometry;
   iv. road cross and longitudinal section designs.
f. Bill of Quantities:
   i. A Bill of Quantities is to be provided at the time of submission of the engineering documentation. The Bill of Quantities need not include the contract prices. At the completion of the construction, a completed Asset Report which reflects the actual construction costs, constructed volumes, areas and length of items constructed is to be provided to Council.
g. Soils Management Plan (including but not limited to vulnerable, dispersive or saline soils);
h. Stormwater Management report and plans including but not limited to:
   i. stormwater quality;
   ii. stormwater quantity;
   iii. flooding issues;
   iv. associated calculations;
   v. stormwater drainage catchment plan;
   vi. stormwater detail plan;
   vii. roof water or inter-allotment drainage;
   viii. drainage cross and longitudinal sections;
   ix. detention basin details;
   x. detention basin landscaping plans;
   xi. water quality site management or runoff control works;
   xii. gross pollutant traps sizing and maintenance works;
i. MUSIC Modelling files (Stormwater Quality);
j. Geotechnical Report;
k. Certificate of Design - RPEQ Certified;
l. RPEQ Certified Structural Design Certificate (including Form 15 and/or 16);
m. Traffic and Transport Studies including multimodal, private and public transport strategies;
n. Erosion and Sediment Control Plan;
o. Ecological Assessment Report in accordance with PSP 1 Biodiversity;
p. Tree survey plan in accordance with PSP 1 Biodiversity:
q. Vegetation Management Report in accordance with PSP 1 Biodiversity;
r. Rehabilitation Plan in accordance with PSP 1 Biodiversity;
s. Landscaping report, plans and certification in accordance with PSP 7 Landscaping;
t. Acoustic fencing report plans and certification;
u. Referral agency responses and/or advice for matters requiring referral under the *Planning Act 2016* and *Planning Regulation 2017*.

SC6.6.3 Bonding of Development

SC6.6.3.1 Introduction

1. The purpose of this part is to:
   a. ensure the timely and proper performance of works;
   b. ensure public liability is adequately insured; and
   c. Council is indemnified.

SC6.6.3.2 Bonding of works

1. This part provides guidance to applicants, developers and consultants in respect of bonding requirements, from the construction phase to the signing of plans of subdivision or the issuing of a notice of completion of works (for other developments).
2. A bond is the payment of a security deposit to Council by a person or party responsible for the performance of works as a surety to satisfactory performance of a development condition or requirement.
3. Bonds may be used in the following circumstances:
   a. to secure compliance with a condition of a development approval in accordance with the *Planning Act*;
   b. to secure completion of works required by a development approval for operational works and/or reconfiguring a lot in accordance with the *Planning Act*;
   c. to ensure public works infrastructure dedicated to Council:
      i. has been correctly constructed and installed;
      ii. has been properly maintained;
      iii. is free of defects and is fit for its intended purpose;
   d. to mitigate the risk of damage to Council infrastructure or the degradation of environmental quality.

SC6.6.3.3 Types of bonds

1. Bond types are nominated in the Table SC6.6-1: Type of bonds, below.

Table SC6.6-1: Type of bonds

TYPE	DURATION	AMOUNT
Performance Bond for civil works	Until off maintenance of Civil Works	10% of cost of works or $20,000, whichever is the greater.
Performance Bond for Environmental protection.	Until performance benchmarks in the PSP1 Biodiversity have been achieved	10% of cost of works or $20,000, whichever is the greater.
Erosion and Sediment Control Bond	Until off maintenance of Civil Works	3% of cost of earthworks and stabilisation works or $10,000, whichever is the greater.
Maintenance Bond — Civil Works	Until off-maintenance of Civil Works	10% of cost of Civil Works or $5,000, whichever is the greater.
Maintenance Bond — Landscape Works	Until off-maintenance of Landscape Works	10% of cost of Landscape Works or $5,000, whichever is the greater.
Uncompleted Works Bond	Until works are completed and accepted on-maintenance, or otherwise accepted as completed by Council	1.5 times the value of the works or $25,000, whichever is the greater.

2. The developer must submit individual bonds for each type of bond required by Council to ensure the individual bonds can be returned expeditiously once Council permits the release of the respective bond/s.

SC6.6.3.3.1 Performance bond

1. Council may require a performance bond to mitigate risk of damage to public infrastructure or the environment. The bond may be required as a condition of an approval or at the discretion of Council officers under delegated authority.

2. The bond amount is subject to the type and scale of works carried out.
3. Typically, the bond is to be paid before commencement of works or the activity.

SC6.6.3.3.2 Erosion and sediment control bond

1. Council may require an erosion and sediment control bond as a security for the stabilisation of exposed areas where there are earthworks and the performance of restoration works, and for achieving grass coverage at completion of works.
2. The bond may be required as a condition of an approval or at the discretion of Council officers under delegated authority.
3. The erosion and sediment control bond will be 3% of the value of the earthworks and subsequent stabilisation works.
4. The minimum uncompleted works bond is $10,000.

SC6.6.3.3.3 Maintenance bond

1. All development works which are to be contributed to the Council are to be maintained by the developer for a minimum period of twelve (12) months unless otherwise advised by Council. All maintenance works are to be undertaken in accordance with the approved maintenance management plan (if applicable) or to a standard commensurate with normal Council maintenance activity. The period commences from the formal acceptance of the development works 'on-maintenance'.
2. A maintenance bond is to be submitted to Council to ensure the works are maintained during this maintenance period.
3. During the maintenance period, the developer is responsible for the maintenance of the assets to ensure all future dedicated assets are fit for purpose. This includes rectifying or replacing defective assets.
4. The maintenance bond is paid as a condition of acceptance of operational works 'on-maintenance'. If the developer requests early approval of a plan of subdivision, the maintenance bond is to be paid in conjunction with the uncompleted works bond.
5. The maintenance bond will be as follows:
   a. 10% of the total value of the works to be constructed for the development; or
   b. a minimum of $5,000 where 10% of the total value of the works is less than $5,000.

SC6.6.3.3.4 Uncompleted works bond

1. Bonding of uncompleted works by a developer enables Council to permit early approval of a plan of subdivision, where Council is satisfied the development is substantially completed and any uncompleted works do not present a risk to public safety. Council may agree to the bonding of uncompleted works such as planting of street trees, landscaping, park furniture, turfing, and the like. The following criteria must be met at the time of lodging the request for approval of the plan of subdivision to Council:
   a. All bulk earthworks are completed and stabilised. Bulk earthworks include excavation and filling of the road formations and allotments;
   b. Roadworks are completed including signage and line marking;
   c. Stormwater works are completed;
   d. Payment is received of any fee for requesting the bonding of uncompleted works;
2. The developer's engineer must provide the following information:
   a. Certification of the value of uncompleted works;
   b. Detailed schedule of the scope and cost of the uncompleted works for auditing purposes;
   c. Certification that all external and internal works can be completed and accepted on maintenance within three (3) months of approval of the plan of subdivision.
3. The uncompleted works bond will be 150% of the certified value of the uncompleted works.
4. The minimum uncompleted works bond is $25,000.
5. Council will undertake an internal risk assessment of a request to bond uncompleted works and reserves the right to refuse to enter into a bonding agreement for uncompleted works.

SC6.6.3.4 Forms of bonds

SC6.6.3.4.1 Performance or environmental and maintenance bonds

1. All bonds will be in the form of cash or bank guarantee.
2. Where bonds are supplied in the form of Bank Guarantees, the Bank Guarantees must contain the following minimum details and conform to the following requirements:
   a. Name of Development – including the Council reference number;
   b. The real property description to identify the land on which the works are being bonded (e.g. Lots 11 to 22 on SP123456);
   c. The stage of the development (if applicable);
   d. Full description of the type and purpose of the bond;

e. Is irrevocable;
f. Is unlimited by time;
g. Is unconditional; and
h. In favour of Lockyer Valley Regional Council.

3. All bonds are to be accompanied with a completed Bond Agreement.

SC6.6.3.5 Request pre-approval of bond amount

1. The developer is to lodge a written request to Council (providing 5 days' notice) for approval of the respective bonding amounts before preparing a formal bond.

SC6.6.3.6 Bond call up

1. The bond agreement describes the rights and obligations of the parties and the actions Council can take if these obligations are not fulfilled. Where Council believes the developer to be in breach of the agreement, Council may exercise its rights under the agreement to call up the bond to satisfy the bond conditions. Before exercising this right, Council will issue written advice detailing the alleged breach of the agreement specifying the actions required by the developer for compliance.
2. In the event the developer does not comply with orders specified in the timeframe stipulated, Council may exercise its legal rights under the agreement and call up the value of the works or conditions from the monies held in trust.
3. Should the fair estimated cost of the outstanding works or conditions (including Council's charges for supervision, interest, administration costs, legal costs, overheads and contingency sum) be greater than the bond, Council will apply the bond as far as it extends and look to recover any shortfall as a liquidated debt, as well as take actions regarding a breach of a development approval condition.

SC6.6.3.6.1 Recourse to security moneys

1. Council will have recourse to the Security Deposit in the following circumstances:
   a. failure to complete the works associated with conditions of a development approval within the nominated time or such other extensions as granted by Council; or
   b. failure to satisfactorily rectify defects as indicated at the On Maintenance or Off-Maintenance inspection within the time nominated in the notice of defects. Where no time is nominated, 30 days from the date of notice must be permitted to rectify defects.
2. If the value of works undertaken by Council (subject to Bonding of Development) exceeds the value of the security deposit, such costs are to be paid to Council.

SC6.6.3.7 Return or reduction of bond amount

1. The developer must submit a formal request (available on Council's website) to Council for the return or reduction of a bond. The bond can only be refunded to the depositor of the funds held in trust by Council. The request must be a written submission outlining the reasons for the bond return or reduction and must be in accordance with conditions specified for the return or reduction of the bond. The minimum details to be included in the request are as follows:
   a. real property description of the development;
   b. Council's file reference number for development and bond;
   c. the bond amount originally submitted with Council;
   d. the name of the bank (for bank guarantee bonds only);
   e. Council receipt number (for cash or bonds only); and
   f. the date the bond submitted with Council.
2. The inclusion of the above information will assist in the prompt return of bonds.

SC6.6.3.7.1 Maintenance security bond release

1. Maintenance bonds will be refunded after Council's formal acceptance of the work 'off maintenance'. Maintenance bonds cannot be reduced or refunded progressively.

SC6.6.3.7.2 Uncompleted works bond release

1. Uncompleted works bonds will be refunded at the time the works are accepted 'On Maintenance' or a notice of completion of work is issued (where works are not to be contributed to Council). Uncompleted works bonds cannot be reduced or refunded progressively unless otherwise approved by Council.

SC6.6.3.7.3 Conversion of security

1. Council may convert into money at any time, such part of the Security Deposit, which does not consist of money.
2. Council is not liable in any way for any loss occasioned by the conversion of any security into money.

SC6.6.3.8 Indemnity

1. The owner, contractor or consultant engineer is to indemnify the Local Government against any claim, action or process for damage or injury which might arise during the progress of the works for the full construction period.
2. No work is to commence unless the developer has in place the following insurances:
   a. Public Liability Insurance to a limit of indemnity of not less than $20,000,000 with a notation with the Local Government as an Insured Party; and
   b. Workers' Compensation Insurance.
3. The developer is to take steps to ensure that all contractors employed by them are also covered in relation to the above insurances and that they in turn ensure that all sub-contractors employed on the job are covered in relation to the abovementioned insurances.

SC6.6.4 Stormwater Management

SC6.6.4.1 Introduction

1. This part provides for the holistic design and construction of stormwater drainage, integrating the management of stormwater quantity and quality through and from the developed site.
2. Council and the developer have a duty of care to implement a stormwater drainage strategy that does not result in any demonstrable harm to property upstream or downstream from the proposed development. State Planning Policy July 2017 includes State interest requirements that stormwater discharge from developments meet specified outcomes for stormwater quality and quantity.
3. This part includes information to help the developer's consultant team meet Lockyer Valley Regional Council's, and the State's, minimum requirements for stormwater management.
4. The planning, design and implementation of stormwater systems will be in accordance with the purpose as outlined by the Planning Scheme.
5. In addition to this policy, urban and rural stormwater drainage systems are planned, designed and constructed in accordance with the current edition of the following:
   a. Planning and design standards:
      i. Australian Rainfall and Runoff (ARR) Guidelines;
      ii. Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures;
      iii. Department State Development, Infrastructure, Local Government and Planning — State Planning Policy.
      iv. DTMR — Road Drainage Manual;
      v. Healthy Land and Water, MUSIC Modelling Guidelines;
      vi. International Erosion Control Association — Best Practice Erosion and Sediment Control (BPESC);
      vii. IPWEA — Queensland Urban Drainage Manual (QUDM);
      viii. Seqwater Development Guidelines - Water Quality Management in Drinking Water Catchments;
      ix. Water-by-Design — Bioretention Technical Design Guidelines;
      x. Water-by-Design — Deemed to Comply Solutions — Stormwater Quality Management (South East Queensland);
      xi. Water-by-Design — Wetlands Technical Design Guidelines;
   b. Construction standards:
      i. DTMR — MRTS03 Drainage Structures, Retaining Structures and Embankment Slope Protections;
      ii. DTMR — MRTS04 General Earthworks;
      iii. DTMR — MRTS16 Landscape and Revegetation Works;
      iv. DTMR — MRTS24 Manufacture of Precast Concrete Culverts;
      v. DTMR — MRTS25 Steel Reinforced Precast Concrete Pipes;
      vi. DTMR — MRTS52 Erosion and Sediment Control;
      vii. DTMR — MRTS70 Concrete;
      viii. DTMR — MRTS71 Reinforcing Steel;
      ix. DTMR — MRTS72 Manufacture of Precast Concrete Elements;
      x. DTMR — MRTS73 Manufacture of Prestressed Concrete Members and Stressing Units;
      xi. DTMR — MRTS74 Supply and Erection of Prestressed Concrete Deck and Kerb Units;
      xii. DTMR Standard Drawings Roadworks, drainage, culverts and geotechnical series.
      xiii. IPWEAQ Standard Drawings, Drainage and Water Quality series; and
      xiv. Water-by-Design — Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands;

SC6.6.4.2 Planning

SC6.6.4.2.1 Applications for rural and urban

1. The intent of QUDM is to encourage uniformity in urban drainage design practices by providing information on current best practice urban drainage management. The intent of the manual is not to design rural drainage systems but to outline the methods for rural catchment planning and references sections of QUDM as acceptable methods of design.
2. DTMR Road Drainage Manual provides guidance on planning, design, operation and maintenance of road drainage infrastructure for small, simple rural and urban catchments. The Road Drainage Manual represents the policy of the DTMR that must be applied on all road infrastructure projects for which the department is responsible.

SC6.6.4.2.2 Stormwater Planning Process

1. Stormwater planning must form an integrated part of planning for all new development and must be undertaken using the principles of Water Sensitive Urban Design (refer to SC6.6 Appendix 3: Water-sensitive urban design).

SC6.6.4.2.3 Regional Flood Model

1. Council has developed and maintains a regional flood model. Access to the model for analysing flood impacts on development can be arranged through a Data Sharing Agreement. A request to execute a Data Sharing Agreement can be submitted to email to: mailbox@lvrc.qld.gov.au.

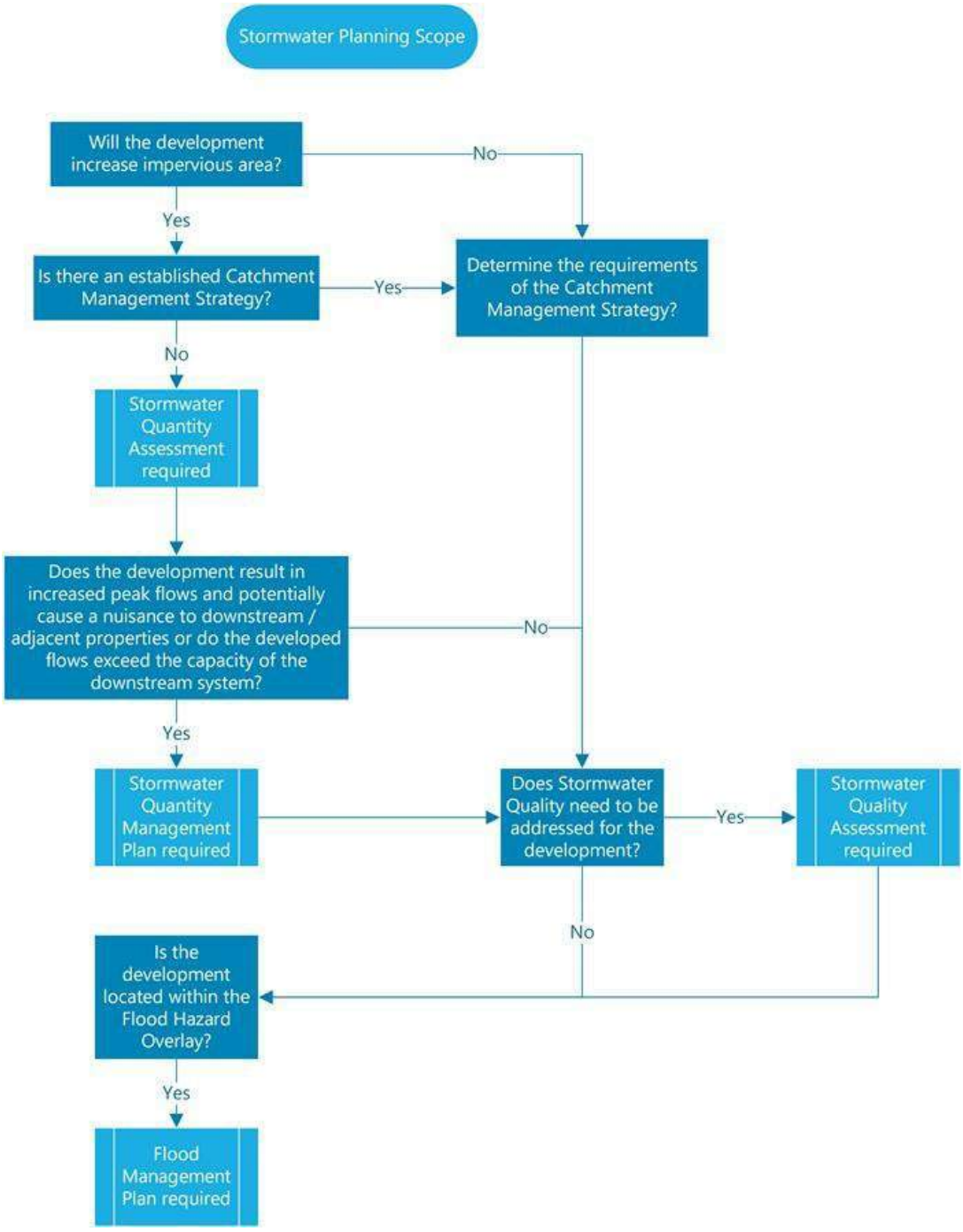
SC6.6.4.2.4 Catchment Management Strategies

1. Council is in the process of developing catchment-scale regional drainage master plans that will identify the design criteria for specific catchment and waterway requirements (e.g. waterway environmental values). Compliance with the requirements of a regional drainage master plan is compulsory where such a plan is in place. Applicants are encouraged to engage with Council to understand specific catchment and waterway requirements.

SC6.6.4.2.5 Risk Assessment

1. Figure SC6.6-2: Stormwater Planning Risk Assessment, shows the risk assessment process to determine the need for and scope of any necessary Stormwater Management Plan (refer PSP 8 Stormwater Management Plans). The various components required for a Stormwater Management Plan include:
   a. Stormwater Quantity Assessment — a preliminary assessment of the impacts from post development peak flows up to 1% AEP on upstream, downstream properties and infrastructure;
   b. Stormwater Quantity Management Plan — a management plan to mitigate the impacts of increased post development peak flows;
   c. Stormwater Quality Management Plan — a management plan to comply with the requirements of the SEQ Water Development Guidelines — Water Quality Management in Drinking Water Catchments and the State Planning Policy;
   d. Flood Management Plan —in accordance with the requirements of the Planning Scheme.

Figure SC6.6-2: Stormwater Planning Risk Assessment



SC6.6.4.2.6 Flooding Management Plan

1. The required outputs from a Flooding Management Plan vary depending upon the categorisation of the flooding (DFE, hazard category, overland flow path, investigation area) but typically include:
   a. Identification of the flood category;
   b. Mapping of the flood overlay for the proposed development;
   c. Identification of Defined Flood levels for the development;
   d. Details of any proposed flood mitigation.
2. For situations involving alteration of floodplain storage 2D modelling will be required to demonstrate the impacts of such mitigation options.

SC6.6.4.2.7 Extent of Drainage Works

This section must be read in conjunction with Section SC6.6.4.2.8 Requirements for the stormwater network, which references Lawful Point of discharge.

1. Council requires the developer to meet the full cost of providing an appropriate drainage system that has enough capacity to convey the design run-off from all upstream catchments through the development. The drainage system must be designed to minimise impact of any kind to upstream or downstream properties. The applicant must demonstrate that such discharge would in no way adversely affect any land, drainage system or watercourse.
2. All development applications identified in the risk assessment described by Figure SC6.6-2: Stormwater Planning Risk Assessment, are to include a stormwater management plan demonstrating the feasibility and function of the proposed drainage systems within the site, its compliance with any relevant Council master drainage scheme and its connection to the lawful point of discharge.
3. Open channel drainage systems need to consider soil characteristics that are not favourable grass or vegetation growth. Lockyer Valley has areas with salinity, dispersive or erosive soils. Soil characteristics are discussed in Section SC6.6.6 Earthworks.
4. All stormwater drainage works must be designed to ensure no stormwater damage, ponding or nuisance to surrounding and/or downstream properties or infrastructure.
5. Flow width within a road must meet criteria for the design event and for the ultimate developed catchment.
6. In general, the minimum stormwater drainage works to be constructed by the developer includes the following.
    a. Residential zones, rural residential zones with lot sizes <5,000m^2, industrial and commercial zones:
        i. The minor drainage system will consist of:
            A. kerb and channel on both sides of all roads;
            B. gully pits located so the flow in the channel does not exceed specified limits;
            C. roof and allotment drainage systems;
            D. drainage from lots that front roadways may be discharged to the street unless topographical constraints or Section SC6.6.4.3 Stormwater design, determines otherwise;
            E. roof water connection located at the lowest corner/s of each lot draining towards the road where a footpath is present along the frontage and discharge to two kerb adapters in accordance with IPWEAQ Standard Drawings;
            F. standard kerb adapters in the kerb frontage located at the lowest corner/s of each lo t draining towards the road which are not fronted by a concrete footpath;
            G. catch drains with a minimum free board as in QUDM to capture cumulative overland flows from created lots and discharged to:
                I. the new underground stormwater system within road by underground pipe/s where open channel (swale, catch drain) is falling towards the street;
                II. the allotment drainage system where open channel is falling away from the street;
                III. full piped drainage from all gully pits and other inlets that discharges at the boundary of the development at a lawful point of discharge approved by Council. Where the piped system traverses private property an easement with a minimum width in accordance with Section SC6.6.4.3 Stormwater design, must be dedicated in favour of Council;
        ii. The major drainage system will consist of overland flow paths that will manage run-off exceeding the capacity of the pipe system by carrying the design flow through the development clear of allotments (i.e. by the road or drainage reserve);
        iii. stormwater quality measures in accordance with Section SC6.6.4.4 Stormwater Quality, of this policy.
    b. The drainage requirements must be in accordance with the requirements for Rural residential zones lot sizes >5,000m^2 with the following considerations:
        i. Hydraulic capacity of existing table drains;
        ii. Hydraulic capacity of existing property accesses along the frontage of the development;
        iii. Changes to existing overland flow paths (e.g. access driveways, filling existing dams etc.;
        iv. the impact changes to existing overland flow paths have on existing drainage structures, flow paths, and neighbouring properties;
        v. Roofwater and inter-allotment drainage;
        vi. catch drains with a minimum free board as in QUDM to capture cumulative overland flows from upstream lots and discharge to table drain or inter-allotment drainage system.
    c. Rural residential zones lot sizes >5,000m^2:
        i. The minor and major drainage systems consist of open natural watercourses within allotments and include full piped drainage within road reserves. They must have:
            A. gravel or bitumen sealed shoulders and swale drains, but in some circumstances will require kerb and channel on both sides of all roads with associated gully pits and piped drainage;
            B. stabilised overland flow paths or watercourses, where required, for scour and erosion protection;
            C. pipe or pre-cast concrete box culvert structures (including drainage aprons) at road crossings of all natural watercourses; the structures must extend to the limits of the road reserve. Cross-drainage design must consider the possible debris load from the catchment;
            D. catch drains with a minimum free board as in QUDM to capture cumulative overland flows from created lots and discharged to lawful point of discharge.
    d. Rural zones:

i. The minor and major drainage systems are to consist of open natural watercourses. They must have:
   A. gravel or bitumen sealed shoulders without kerb and channel on all roads;
   B. pipe or pre-cast concrete box culverts, bridges or concrete causeways at road crossings of all natural watercourses; these structures must extend to the limits of the road formation. Easements must be provided either side of the reserve to allow necessary scour protection works and future maintenance works as required. These easements must be a minimum of 5m in length, encapsulate the watercourse, and allow machine access to either side of the watercourse from the road reserve. Depth-of-flow indicators and delineator posts must be used to better define the areas of more frequent inundation. Cross-drainage design must consider the possible debris load from the catchment. Council's preferred option for this the provision of reinforced-concrete box culverts;
   C. earth table drains and catch drains in road reserves are to be stone-pitched or concrete-lined, where required, for scour protection;
   D. rural access pipe crossings for entry to all allotments to be in accordance with IPWEAQ Standard Drawing RS-056 Vehicle Crossing - Rural Driveway.

SC6.6.4.2.8 Requirements for the stormwater network

SC6.6.4.2.8.1 Lawful Point of Discharge

1. All parties involved in the process of development are charged with a duty of care to ensure that there will be no case of actionable nuisance or damage to properties upstream or downstream because of the development. Potential impacts due to a proposed development should be regarded as unsatisfactory (and may result in an actionable nuisance) if:
   a. any increase in flood level afflux of greater than 10mm on nearby properties;
   b. there is a material increase in the duration of inundation of flood water on nearby properties that would cause the current or future use of the land.
2. Council would determine if it is an actionable nuisance based on the pre and post flow characteristics and type of use of the impacted property, or provide Council a written consent from affected owner/s accepting any adverse impacts at the lodgement of the development application.
3. It is the responsibility of the consultant team to establish a suitable lawful point of discharge (refer *to QUDM Section 3 Legal aspects*) for the drainage from the development, for Council's approval. In its determination, the consultant team must have considered all available options on their merits, not simply on cost, before presenting its selected option to Council. The consultant team must provide to Council:
   a. written approval from adjoining property owners whose property lies between the development and the lawful point of discharge. Such approval must be legally binding and acceptance by subsequent owners must be a condition of sale of the property. Applicant is required to submit form 1.3 the lodgement of development application.
4. Developer or applicant is responsible for all costs associated with construction of new works, upgrading or retrofitting existing infrastructure downstream from the lawful point of discharge to provide for the proposed development. Supporting information is to include the methodologies available for providing relief drainage.
5. Typical options available to the consultant team for locating the lawful point of discharge are:
   a. to concrete kerb and channel, gullies, a natural watercourse or existing enclosed stormwater drainage system abutting the development. The consultant team must obtain approval from Council for any connection to existing Council infrastructure;
   b. to the road reserve provided the concentration of stormwater does not adversely affect the drainage capacity of the road and/or adjoining properties;
   c. through adjoining private property provided prior permission is obtained from the property owner/s in writing and this written permission is contractually binding on the property and its future owners;
   d. to concrete kerb and channel and then to a new stormwater inlet to be provided by the developer at a location removed from the site;
   e. to kerb and channel or an existing enclosed drainage system higher than the proposed development by pumping from a drainage pit within a site. This method will only be considered suitable for a basement carpark of a multi-storey building where a back-up generator is provided. The pumping infrastructure will remain the asset of the site owner and will not form part of Council-owned infrastructure. The consultant team must clearly demonstrate that the alteration to catchment boundaries must not cause a worsening of any kind to existing drainage systems, property or public safety;
   f. to an underground stormwater system by pipe, if such system is available within 150m of the proposed development.

SC6.6.4.2.8.2 Easements and Reserves

1. All stormwater drainage easement discussed in this section must be dedicated at no cost to or compensation by Council.
2. Drainage reserves or easements must be required over downstream drainage paths from the development site to the lawful point of discharge.
3. Drainage reserves must be required over detention basins or bio-retention basins.
4. Drainage easements with a minimum width of 6m must be required over all pipe installation from 300mm diameter to 600mm diameter, except for pipes installed at shallow depths. For pipes installed at shallow depth (up to an invert level of

1.2m), the width of an easement may be reduced to 3m.
5. Stormwater drainage easement having a minimum width 3m or a width as determined by Council under any approval for operational work, whichever is the greater must be required over the following:
   a. all stormwater overland flow paths traversing the land centrally located within the easement; and
   b. all areas impacted by the design 1% AEP;
   c. any drainage infrastructure capturing and/or conveying stormwater runoff from an upstream catchment;
   d. rear allotment drainage pipes with a diameter of 225mm or above;
   e. a surface allotment drainage system (e.g. swale) with a minimum freeboard as in *QUDM Section 7: Urban drainage*.
6. All pipes over 600mm diameter and all open waterways or drains greater than 1m in depth must be installed on Council-controlled land.
7. Where a residential or rural residential subdivision discharges into a rural zone, an easement of minimum dimensions 20m long and 10m wide is required over the downstream drainage path.
8. Council would maintain works on a drainage easement located within a private property only if there were an issue that would impact the functionality. General maintenance such as mowing to be attended by the private property owner.

SC6.6.4.3 Stormwater Design

SC6.6.4.3.1 Method for design

1. Stormwater infrastructure is provided in accordance with the QUDM and the Australian Rainfall and Runoff (ARR), except as modified by sections of this planning scheme policy.

SC6.6.4.3.2 Major and minor system rational

1. The consultant team must ensure that the proposed drainage design meets the standards required of minor and major drainage systems for the scale and type of development proposed. The required standards are summarised in Table SC6.6-2: Drainage Design Standards.
2. The full definitions of the minor and major systems are provided in QUDM Section 7: Urban drainage.

Table SC6.6-2: Drainage Design Standards

DEVELOPMENT CATEGORY	DESIGN PARAMETER	DESIGN STANDARD
2—5 dwelling units per hectare (typically in rural or rural residential or environmental protection areas where predominant uses include houses on large allotments and farms)	Minor drainage system	Minimum 39% AEP
	Major drainage system	Minimum 1% AEP (less piped flow, if applicable)
>5 and ≤20 dwelling units per hectare (typically in low-density residential areas comprising of one or two-storey single houses)	Minor drainage system	Minimum 39% AEP
	Major drainage system	Minimum 1% AEP (less piped flow, if applicable)
>20 dwelling units per hectare (typically in low-medium- to high-density residential areas comprising multi-unit dwellings)	Minor drainage system	Minimum 10% AEP
	Major drainage system	Minimum 1% AEP (less piped flow, if applicable)
Industrial areas	Minor drainage system	Minimum 39% AEP
	Major drainage system	Minimum 1% AEP (less piped flow, if applicable)
New use centre activities (incorporating a wide range of commercial, retail and residential uses)	Minor drainage system	Minimum 10% AEP
	Major drainage system	Minimum 1% AEP (less piped flow, if applicable)
Major roads (distributer roads and above, major industrial access through-roads)	Kerb and channel flow	Minimum 10% AEP Note—The design AEP for the minor drainage system in a major road must be that indicated for the major road, not that for the development category of the

		adjacent area.
	Cross-drainage (culvert) flow	Minimum 2% AEP
	Roadway flow width and depth limits	refer to *QUDM Table 7.3.5: Essential community infrastructure* and *7.3.6: Overland flow paths*
Minor roads (collector roads, local access streets, minor industrial access)	Kerb and channel flow	refer to the relevant development category Minimum 39% AEP
	Cross-drainage (culvert) flow	Minimum 10% AEP
	Roadway flow width and depth limits	refer to *QUDM Table 7.3.5: Essential community infrastructure* and *7.3.6: Overland flow paths*

3. If upstream properties are at a low elevation, it may be necessary to install culverts of capacity greater than that for the minor-system AEP event to ensure unacceptable flooding of upstream properties does not occur. In addition, the downstream face of causeway embankments will need protection where overtopping is likely to occur.
4. Considering major, and to a lesser extent minor, flow events, and how to manage their conveyance though the site is a key component in the preparation of the development's concept and detailed design. The consultant team is urged to use Council's pre-lodgement meeting process to discuss and resolve the issues associated with designing for the major and minor flows.
5. A combined underground and overland drainage system for the minor and major systems is to be designed in conjunction with other civil infrastructure components required for the development. Designing major underground pipe systems with no overland flow component is not acceptable to Council except in extraordinary circumstances where overland flow is demonstrated to be impractical. QUDM details the minimum requirements and circumstances where a major underground pipe system is used with no dedicated open space for overland flows.
6. Development within a flood risk hazard area are to comply with the requirements of the Flood hazard overlay code and the PSP 4 Flood Hazard.

SC6.6.4.3.3 Hydraulic calculations

SC6.6.4.3.3.1 Design methodology

1. Hydraulic calculations for stormwater drainage are to be undertaken in accordance with QUDM Section 7: Urban drainage, subject to the following comments:
   a. Council mandates the Manning's Formula is to be used in the calculation of pipe full flow discharge.

SC6.6.4.3.4 Overland Flow

SC6.6.4.3.4.1 Location of overland flow paths

1. Notwithstanding the requirements of QUDM Section 9: Open channels, overland flow paths from external catchments must not be directed through private property unless they are contained within easements.
2. Overland flow paths must not be in pathways. Prior approval must be obtained from Council where an exception is sought in locating an overland flow path.
3. Where an overland stormwater flow path is required, the width must take account of:
   a. waterway width;
   b. access width;
   c. freeboard;
   d. any other services requirements.
4. Pedestrian safety and maintenance considerations must be factors considered in the cross-sectional configuration of the overland flow path.
5. Pedestrian and vehicular access to wastewater pump stations and other public utility installations must not be impeded by overland flow at any time, particularly in times of emergency, when flooding occurs.
6. In existing areas where available overland flow paths are limited, alternative methods may be considered, such as detention basins.

SC6.6.4.3.4.2 Overland flow in roads

1. In addition to the requirements of QUDM, designers must provide 50mm freeboard to the footpath crown for design flows based on roadway surface levels at the time of initial construction. Subject to normal cross-fall constraints, the height of footpath crowns above the top of kerb are raised to allow for safe pedestrian use and vehicle access to properties on the low side of the roadway. In a major storm, the maximum depth of flow must be 250mm and must meet hazard criteria (velocity x depth product) in accordance with QUDM Section 7: Urban drainage.
2. Designers must also be aware of the effects of changes of grade. Flattening a longitudinal grade, for example, will result in a greater depth of flow and the design will need to manage the resulting effects.

SC6.6.4.3.4.3 Overland flow in drainage reserves

1. Overland flow in drainage reserves must comply with the following requirements. The width of any overland flow path must be determined by calculation and must not be allowed to extend into private property. A minimum width of 5m is to be allowed from the top of the open drain to the property boundary.
2. Within drainage reserves, consideration must be given to:
   a. safety of persons who inadvertently or unwisely enter the stream;
   b. soil types, ground cover and scour protection;
   c. downstream flood reduction, the lower velocity reducing downstream peak flow;
   d. maximum side slopes of 1V:6H;
   e. the effect of the location of overland flow paths on existing native vegetation.

SC6.6.4.3.4.4 Overland flow in open-space reserves

1. Land required in open space for overland flow path will be considered against ‘drainage’ requirements rather than ‘open space’ requirements in the context of the development.
2. In its application, the consultant must demonstrate planning for drainage in open-space areas, from project identification to designs. For example, for public safety purposes, the design must demonstrate all public buildings and community facilities with amenities (i.e. toilets and/or food preparation facilities) are located 300mm above the 1%AEP flood level where in overland flow paths.
3. The drainage standards must be considered within the context of planning strategies, and, regarding the nature of the intended function and constraints of the land, for example:
   a. general open space areas with a low to high need for access by pedestrians and cyclists;
   b. passive areas with a low to high visitation;
   c. active areas in areas of low to high tourist significance;
   d. natural watercourses with low to high environmental significance.
4. Council may consider dual use of open-space areas (e.g. Council parks and gardens) for downstream drainage where the land is dedicated in favour of Council (i.e. with easements or reserves). It is expected that the consultant team will consider the following as a minimum when considering dual use:
   a. major flood capacity;
   b. convenience flood capacity — minor event in terms of interval event and the time to drain ponded sites;
   c. maintenance costs (e.g. batter slopes 1V:6H);
   d. safety (e.g. maximum velocity 2m/s);
   e. stability factors (e.g. resistance to scour, slip);
   f. ecological considerations (e.g. preserving valuable areas, and appropriate planting in waterway areas, minimum impact on existing riparian or aquatic ecosystems).
5. Within open-space reserves, consideration must be given to:
   a. safety of persons who inadvertently or unwisely enter the stream;
   b. soil type, ground cover and scour protection;
   c. downstream flood reduction, the lower velocity reducing downstream peak flow;
   d. maximum side slopes of 1V:6H;
   e. the effect of overland flow paths on existing native vegetation;
   f. restoration using native vegetation;
   g. designing to create a feature in the landscape;
   h. designing to slow stormwater movement and encourage infiltration;
   i. designing to use shallow grassed or riprap swales and/or contour banks that do not present maintenance or mowing difficulties (maximum 1V:6H slopes);
   j. existing canopy vegetation on the site;
   k. maintenance considerations;
   l. the natural hydrology of the site;
   m. the width of any swale or open-drain profile to ensure it does not constitute more than 25% of the width of the open-space reserve at any one point;
   n. the desirability of having a road or street along one side.

SC6.6.4.3.4.5 Overland flow from traps in roads

1. Sags in roads and cul-de-sacs at the end of a falling road grade must be provided with an overland flow path designed to cater for excess flow not contained in the underground drainage system for a 1%AEP event and to protect the properties on the low side of the road from inundation.
2. Where overland flow paths are required due attention is to be given to the impact on road users safety of pedestrians.

SC6.6.4.3.5 Open Channels

1. The detailed design of open channels must consider design principles within *QUDM Section 9: Open channels*.
2. For major open channel drainage systems consideration needs to be given to coincident flooding occurring with major watercourses.
3. If open cut channels and natural watercourses are permitted within the site, easements including access areas adjacent to the channel are required.
4. Where construction of new open channels is proposed, Council requires the use of natural channel design (QUDM Section 9: Open channels) and water sensitive urban design principles (refer SC6.6 Appendix 3: Water-sensitive urban design).
5. Where hydraulic constraints prevent a fully vegetated channel, grass-lined channels are acceptable, and the aesthetic value of these channels is enhanced by the liberal inclusion of native canopy trees with the species and planting density selected to enable:
   a. easy maintenance (mowing);
   b. enough light penetration to sustain the grass cover and minimise weed growth.
6. Landscaping of the open channel is especially important for visual amenity and for future maintenance. The developer must submit landscape plans before the hydraulic calculations starting, so Council is satisfied that the channel will be a feature and not merely ‘a drain’.
7. All unlined open drains must be turfed to a level at 300mm above the 1% AEP storm event level as soon as practicable after construction and regular watering must occur to ensure required establishment. Additional measures to stabilise drains must be required if flow velocities exceed 1.5m/s.

SC6.6.4.3.5.1 Natural Channel Design (NCD)

1. The basic principles of natural channel design (NCD) are to minimise erosion, flooding and maintenance of engineered or modified drainage channels, while improving environmental values.
2. NCD is important in all waterways (whether natural in formation or constructed to appear and operate as natural channels), especially where the waterway provides a link with bushland reserves or forms an important part of an aquatic or terrestrial movement corridor (refer to QUDM Section 9: Open channels, for details on design principles and application).
3. Concrete lining of any new proposed channel is unacceptable as this solution does not consider whole-of-life costs nor protect or enhance environmental values. Attributes to be considered in the design include:
   a. using linear wetlands, pond-riffle systems and off-line wetlands;
   b. for batters, landscaping and maintenance access, the side slope of the channel banks must not be steeper than 1V:6H (vegetated);
   c. intermittent use of 1V:6H or flatter (grassed or vegetated) batters for emergency egress by people;
   d. boulders intermittently provided in localised areas to improve the aesthetics of the channel;
   e. intermittent use of retaining walls where batter grades could not be achieved, less than 1m in height.
4. Rock riprap packed with soil and planted is preferred as a channel lining to minimise scour, although the design must limit scour velocity to reduce the need for riprap where possible.
5. An extended maintenance period (minimum 24 months) is required until the channel has sufficiently stabilised and vegetative cover is well established. A channel will take at least two growing seasons to stabilise using vegetation and several rainfall events will be required to show signs of any design or construction deficiencies.
6. Culvert crossings of a natural channel are to be arches or box culverts (with link slab across low-flow channel) to provide a natural creek bed in the low-flow area to scour and maintenance requirements.

SC6.6.4.3.5.2 Velocity limitations for open channels

1. An open channel with critical or supercritical conditions is not acceptable.
2. The velocity in an open channel must be limited to less than 90% critical velocity in the major storm event.
3. The maximum average velocity allowed in new vegetated channels is set out in QUDM Section 9: Open channels, and must not exceed 1.6m/s in the major storm event for the design Manning’s roughness (typically n=0.09). For bank-full flows (usually <63% AEP storm) the maximum average velocity must be no greater than 1m/s for a manning’s value of 0.15 (fully vegetated).
4. Channel velocity checks must assume that undersized culverts will be upgraded to current design standards at some time in the future.

5. Box culverts must be used for culvert crossings of creek or waterways or other natural channels (proposed or existing) to reduce outlet velocity, minimise the need for energy dissipaters, reduce the potential for blockages by debris and minimise maintenance costs.
6. Where velocity is excessive and cannot be reduced by modifying the channel geometry, armouring of the channel will be required (e.g. use of rock riprap).

SC6.6.4.3.5.3 Maintenance access

1. Where any new channel is proposed, it is provided with suitable access for vehicle maintenance by providing a 4m berm along each side of the open channel. This berm will also provide a buffer for environmental, water quality and recreational purposes.
2. Access to potential high maintenance locations such as stormwater outlets within the channel must be provided.

SC6.6.4.3.5.4 Consideration of siltation in channel design

1. If a channel is proposed in a low-lying area where grades are flat (minimum velocity 0.6m/s), the design must consider the sensitivity of the proposed waterway or channel to siltation which will cause eventual flooding of surrounding land.
2. The hydraulic analysis must include the effects of siltation in the order of 150mm having been deposited to the channel bed.

SC6.6.4.3.5.5 Design Manning’s roughness values

1. Guidelines for selecting Manning's roughness values where revegetating an existing floodplain are stated in *QUDM Section 9: Open channels*.
2. Where designing new vegetated channels minimum design roughness values are to be in accordance with *QUDM Section 9: Open channels*.

SC6.6.4.3.5.6 Service crossings of channels and creeks

1. Service crossings above channel bed will need to consider the following:
   a. isolated service pipe crossings located above the bed are not allowed where such a structure will affect visual amenity or create adverse hydraulic impacts;
   b. if Council is satisfied that visual amenity is not compromised, afflux from the structure must not exceed 150mm within the immediate area of the service crossing and does not impact any private property;
   c. it is preferable that the level of the crossing be as low as possible or above the 1% AEP flood level;
   d. the crossing must be designed to avoid debris collection and to take account of scour at the bank entry or in the bed below the pipe;
   e. maintenance holes must not be located on the assumption that the creek morphology is stable. In sand-based creeks any exposed service crossing must be avoided as the bed and banks of the creek are highly susceptible to movement. Such services must be below the expected future scour level of the creek;
   f. sensitivity analysis required to estimate impacts of 100% channel blockage as a result of the service crossing (refer to *QUDM Section 7: Urban drainage*).
2. For service crossings below channel bed:
   a. pipe crossings which are located below the bed of an unlined channel have at least 1m clear cover or additional scour protection must be provided along the open channel near a pipe crossing;
   b. if mitigation works have already been undertaken on the watercourse or if the channel is in a stable condition (and not a sand parent material-based creek), the requirement in Item a, above, may be relaxed at the discretion of Council, provided appropriate protection works are undertaken;
   c. engineering drawings must include a plan and cross-section of the proposed works and a longitudinal section of the bed and supporting evidence of potential creek scour depths.

SC6.6.4.3.6 Culverts, Floodway and Bridges

1. Unless otherwise specified, QUDM Section 10: Waterway crossings, requirement criteria applies:
   a. Ford crossings are not to be used;
   b. For further guidance on the design of culvert crossings refer to DTMR Road Drainage Manual.

SC6.6.4.3.7 Detention and Retention systems

1. Unless otherwise specified, QUDM Section 5: Detention/retention systems, requirement criteria applies:
   a. Where an online system is proposed, it must provide regional benefits to flow reduction and be designed for ultimate catchment development;

b. Where stormwater from any public asset such as a road reserve is directed into a stormwater detention system, these detention systems must be located within public land such as a park or drainage reserve, but not within road reserves. Only above-ground detention storages will be permitted in Council-owned lands. Tanks in public roads will not be accepted;
c. Above-ground detention basins must be integrated with water quality treatments by locating the detention storage requirement above the water quality extended detention depth;
d. Using stormwater detention tanks in commercial or industrial developments will be permitted where located on lots or within privately owned roads or driveways. Similarly, tanks could be used within roads or driveways owned by community title for residential developments.

SC6.6.4.3.7.1 Design objectives

1. Sufficient detention storage must be provided to ensure peak flow rates and/or flood levels at any point within the downstream drainage system do not increase because of the development from the 1-year ARI (63% AEP) storm to the 100-year ARI (1% AEP) storm events (for all relevant storm durations).
2. Where stormwater detention is considered necessary, sizing of detention storage for sites less than 2ha may use the simplified sizing method.
3. Where alternative detention storage requirements for smaller sites are proposed and/or where a site area exceeds 2ha, sizing of detention storage must be justified using a suitable run-off or storage routing model (e.g. DRAINS (ILSAX), XP-RAFTS, XP-STORM, RORB, WBNM).

SC6.6.4.3.7.2 Simplified detention storage sizing method

1. For development sites less than 2ha, avoid complex hydrological modelling. In every case, the sizing would require confirmation at the detailed design stage by a RPEQ.
2. Infill development where the site has an existing impervious area greater than 70% will not require stormwater detention because there is little change in peak flow, and redevelopment will often improve and augment older roof-water and stormwater drainage systems. Larger developments must confirm this is the case.
3. The proposed impervious percentage must be estimated from the areas affected by the development and must exclude park areas or drainage reserves that lie within the site catchment as these areas must not drain to a detention system. This may significantly bias the average imperviousness and does not reflect the intensification of land use and resulting increase in peak flows.
4. Sites larger than 2ha will need to model the hydrology and estimate stormwater detention requirements and permissible site discharges as required.
5. The applicable site storage requirements (SSR) and permissible site discharges (PSD) for development are shown in Table SC6.6-3: Site storage requirements (SS) — Deemed-to-comply solution, and Table SC6.6-4: Permissible site discharge (PSD) — Deemed-to-comply solution, and the relevant categories used for estimating the site storage requirements and permissible site discharges are:
   a. Category D1 — sites where the existing impervious surfaces are less than 10% of the proposed developed area, this is applicable to greenfield sites;
   b. Category D2 — sites where the existing impervious area is greater than 10% but less than 40% of the proposed developed area, this is applicable to greenfield sites and some infill development;
   c. Category D3 — sites where the existing impervious area is greater than 40% but less than 60% of the proposed developed area, this is applicable to infill development.

Table SC6.6-3: Site storage requirements (SSR) — Deemed-to-comply solution

PROPOSED IMPERVIOUS PERCENTAGE	DEVELOPMENT SITE STORAGE REQUIREMENT		
	CATEGORY D1 (M^3/HA)	CATEGORY D2 (M^3/HA)	CATEGORY D3 (M^3/HA)
70 or less	320	150	n/a
82	335	165	110
86	340	170	115
88	345	170	115
90	345	175	120
95 or greater	350	180	125

Note—The proposed impervious percentage must exclude park areas, drainage reserves etc. that lie within the site catchment.

6. Table SC6.6-4: Permissible site discharge (PSD) — Deemed-to-comply solution, applies except in the following circumstances:
   a. These site storage requirement volumes are to be increased by 15% where a non-high early discharge (HED) detention system is used OR where an above-ground basin (even with a high early discharge outlet) is used OR where the detention basin additionally provides a water quality treatment or ecological function;
   b. Site with an impervious area greater than 70% do not typically require stormwater detention where it is demonstrated that no adverse impact will occur on neighbouring properties.

Table SC6.6-4: Permissible site discharge (PSD) — Deemed-to-comply solution

EXISTING SITE	PERMISSIBLE SITE DISCHARGES (L/S/HA)	
	2 YEAR ARI (39% AEP)	100 YEAR ARI (1% AEP)
Category D1	180	535
Category D2	300	710
Category D3	370	790
> 60% sealed impervious surfaces	*Note—No stormwater detention is required if the development is shown to have no adverse impact on any existing properties.*	*Note—No stormwater detention is required if the development is shown to have no adverse impact on any existing properties.*

SC6.6.4.3.7.3 Detention sizing — general considerations

1. External catchments:
   a. Overland flows that enter the site from external catchments must be collected and conveyed through but kept isolated from any stormwater detention systems for all storm events;
   b. Similarly, run-off from parks and other large pervious areas must also bypass the detention system;
   c. Where bypass is not possible, the detention system must account for this additional inflow.
2. Hydraulic control at outlet:
   a. On-site detention must be gravity drained. Pumped systems are not permitted for detention systems;
   b. An essential element in preserving the integrity of an on-site detention system is ensuring that the system functions independently of the drainage network;
   c. The stormwater detention facility is not intended to handle surcharge flow from the street drainage network. The starting hydraulic grade line level of the detention system must be set at the top of the kerb and channel at the discharge point to the street system;
   d. The outlet control device must be set above this level regardless of whether the detention system is connected to the underground drainage system or to the kerb and channel, to ensure that the outlet control is unaffected by downstream hydraulic grade line or water surface levels.
3. Distributed detention storage:
   a. Distributed detention storages that drain into each other must not perform in the same way as a single storage as they reduce the effectiveness of the down-slope storages in attenuating flows, creating adverse tail-water conditions. These systems are discouraged and where proposed must be modelled as an integrated system using a hydrological model;
   b. The site storage requirements must be located within a single detention storage; otherwise detailed hydrological modelling will be required to estimate storage requirements of a distributed storage proposal.
4. Site run-off bypassing the storage facility:
   a. A portion of the new impervious areas may discharge directly to a lawful point of discharge (if it cannot be drained to the detention storage) provided the permissible site discharge (PSD) is reduced to compensate for the bypass flow. The allowable extent of impervious surfaces bypassing the detention facility must not represent more than 25% of the impervious area draining to the detention facility;
   b. For hydrological modelling, the bypass areas must not be directed into the storage. However, for the simplified sizing method the modified Permissible site discharge m2of catchment will be calculated using the following equation:

      Mod. PSD = PSD x (At / [At+Ab])
      Where Ab = impervious area bypassing the storage facility
      At = total area draining to the storage facility
      PSD = permissible site discharge.

SC6.6.4.3.7.4 Requirements for above-ground systems

1. Aesthetics:
   a. Once authorised to have a basin in parkland or other Council-controlled land, an important design criterion is that the

basin does not look like a hydraulic structure but has distinctive character. This will involve using variable slopes, retaining upstream gullies, camouflaging inlets and outlet structures and similar (a rectangular or geometrically shaped basin is undesirable);
   b. Any detention basin proposed in a park or drainage reserve that does not incorporate a 'wet' water quality function, is part of a bioretention basin or has low flow channels, must be designed as a high early discharge (HED) system where flows only surcharge into the basin when the outlet capacity is exceeded;
   c. The high early discharge system:
      i. ensures that frequent flows do not spill into the basin thereby minimising maintenance issues associated with waterlogged soils;
      ii. is more efficient in their use of storage, requiring less storage volume than a standard detention basin arrangement.
2. Unless otherwise specified, QUDM Section 5: Detention/retention systems, requirement criteria applies.
   a. Embankments holding back floodwaters must be suitably designed to be structurally adequate, certified by a RPEQ (geotechnical) and must be no higher than 1.5m above natural ground level;
   b. All detention basins are provided with a minimum 3m wide vehicle access crossover and a driveway from the nearest public road (sealed to suit the seal type of the road) into the basin and a vehicle turn around area to facilitate maintenance. The design vehicle for the driveway and the turnaround area is to be a medium rigid vehicle (MRV);
   c. For a wet retention basin, the vehicle access ramp must extend at least 500mm below the normal operating water level of the basin.
   d. In the event a spillway or weir discharge has been proposed onto an adjoining property as sheet flow (if all the other options are exhausted), the designer must demonstrate using 2D hydraulic modelling that discharge does not create actionable nuisance and would not adversely impact current or future use of the adjoining property and satisfies the safety criterion.
   e. The use of high early discharge pits can reduce storage requirements by allowing the flow at the start of a storm to pass around the basin, thereby ensuring more detention storage is available closer to the peak of the storm.
   f. High early discharge systems typically are only suitable for dry detention basins that do not perform a water quality function as low flows bypass the basin.

SC6.6.4.3.7.5 Requirements for underground detention systems

1. The design of underground detention storage must address several public health, safety and pollution issues.
2. The storage must be self-cleaning, well ventilated, not cause accumulation of noxious gas, and facilitate easy maintenance and inspection. The following requirements must be met to achieve the performance objectives:
   a. the base has a suitable fall to the outlet (minimum grade 0.5%) and is appropriately shaped to prevent permanent ponding;
   b. long-term ponding of water over the floor of the basin will not be accepted;
   c. provide a minimum 600mm x 900mm maintenance access opening over the tank outlet;
   d. provide additional 600mm x 900mm pits where required to ensure the distance between pits does not exceed 10m;
   e. provide an inspection or access pit (600mm x 600mm) directly over any inlet pipe;
   f. incorporate a child-proof locking system for the surface grates;
   g. install step irons where pit depth is greater than 1.35m;
   h. where the storage is not sufficiently deep (<1.2m), access grates must be placed at the extremities of the tank and at intervals not exceeding 3m, which must allow any point in the tank to be flushed or reached with a broom or similar implement, without the need to enter the tank;
   i. the minimum internal clearance height for accessible tanks is 1.2m in roads or driveways and 0.9m elsewhere;
   j. the tank is to be structurally designed and certified to withstand all expected service loads and provide adequate service life;
   k. provide an overflow or bypass outlet ensuring any overflow is not directed into private property;
   l. locate the tank outside of the root zone of trees that must be retained;
   m. in areas of high water tables or floodplains, the tank is to be designed to ensure it resists buoyancy effects.
3. Drainage design standard where detention is proposed:
   a. Stormwater detention tanks must capture all flows off a development up to the 1% AEP storm, which is a much larger event than the drainage design standard for development. As a result, where underground detention tank is proposed, it will necessitate that the gullies and pipes within the development are sized to capture these flows;
   b. The minor drainage system design where underground detention is proposed is to be the 10% AEP, with additional inlet capacity to 1% AEP provided closer to the detention system to capture flows.
4. Orifice plates:
   a. Orifice plates must be manufactured from corrosion-resistant stainless steel plates with a minimum thickness of 3mm (5mm where orifice diameter exceeds 150mm), with a central circular hole machined to 0.5mm accuracy:
   b. The orifice diameter must not be less than 35mm and the machined hole must retain a sharp edge:
   c. The plate must be permanently fixed to the pit wall and epoxy sealed to prevent the entrance of water around the edges:
   d. The plates must be engraved with the orifice diameter and an identifying mark, and the orifice diameters certified by the manufactures.

5. Outlet sump:
   a. A sump is required in the base of the discharge control pit to assist in minimising turbulence near the pit floor from affecting the hydraulic performance of the orifice outlet;
   b. The sump would also prevent silt and debris from blocking the orifice outlet and facilitate simple installation of the orifice plate;
   c. The invert of the sump must be at least 1.5 times the orifice diameter or 200mm (whichever is greater) below the centre of the orifice outlet and enough weepholes must be installed in the sump floor and be kept unblocked.
6. Grates and trash screens:
   a. Where an orifice plate is used with an orifice diameter less than 100mm, inflows must be screened to avoid blockage;
   b. Screening (hot dipped galvanised) must incorporate handles for easy removal;
   c. The screens must be fixed at least 150mm from the orifice and positioned as close to vertical as possible.
7. Use of oversize pipes for storage:
   a. Oversize pipes will not provide enough detention in a drainage system and are likely to adversely impact on drainage design requirements and cause frequent sedimentation;
   b. If oversize pipes for storage are proposed, the loss of storage with pipe grade must be considered along with impacts on peak flows, pipe capacity and self-cleansing velocities using appropriate hydrological models.

SC6.6.4.3.7.6 Maintenance requirements for Council and private detention systems

1. All detention and retention systems must be designed with simple, safe, cost-effective maintenance in mind.
2. A maintenance plan that documents all the maintenance requirements and responsibilities must be developed for all development applications for a material change of use applications (excluding dwelling houses). The plan must describe how the design facilitates maintenance requirements and set out how the system is to be maintained by addressing issues such as inspection, clean-out frequency, procedures, access and occupational health and safety requirements. Where a Council-owned asset, the maintenance plan must be submitted as part of the on-maintenance documentation and include the cost estimate for the construction of the detention system and estimate of annual maintenance costs.

SC6.6.4.3.8 Inlets

SC6.6.4.3.8.1 Stormwater Inlets

1. Stormwater structures must be designed and constructed in accordance with the IPWEAQ Standard Drawings, Drainage Pits series.
2. Gully pits are to be ‘lip in line’ (i.e. CM gully pits or approved similar).
3. Where alternative stormwater inlet systems are proposed, these systems must be supported by appropriate hydraulic testing information.
4. Grates, where used, must be bicycle-safe.
5. The slope of infrastructure associated with inlet and outlet structures, e.g. wing walls, must be 1V:4H or flatter.

SC6.6.4.3.8.2 Gully inlet capacity

1. Designers must ensure that gully inlets at sags achieve the required 50mm freeboard to the footpath crown, particularly if seeking to provide a 1% AEP immunity to the adjoining low-side properties. If surcharge occurs from an overland flow path from a trap in the road, attention must be paid to the ponded depth requirement for gully capture.

SC6.6.4.3.8.3 Gully inlet location

1. In addition to the requirements stated in QUDM Section 7: Urban drainage, gully inlets must be located:
   a. on straights, wherever possible;
   b. to reduce the likelihood of conflict with future driveway locations.
2. Anti-ponding gullies in curves are to be avoided wherever possible. If used, they are to be side-entry type, chamber and grate only.
3. Where two falling grades meet at an intersection, if possible, the low point must be located clear of the kerb return. The cross-fall may be varied locally within the range of 2% to 5% to achieve this.
4. The slope of infrastructure associated with inlet and outlet structures, e.g. wing walls, must be flatter than 1V:4H

SC6.6.4.3.8.4 Piped networks

1. Unless otherwise specified, QUDM Section 7: Urban drainage, requirement criteria applies.
   a. Pipes laid longitudinally along the road are to be installed as follows:
   b. Pipes less than 600mm diameter may be laid directly under the kerb and channel from the centre of one gully pit chamber to the centre of the next gully pit chamber provided sufficient clearances are maintained for services

crossing the pipe;
c. For pipes 600mm diameter and greater, the centreline of the pipe must be offset 2m from the lip of kerb and channel towards the road centreline and an offset chamber must be constructed.
d. Pipe drainage systems must be manufactured from reinforced concrete products.
e. Backfilled trenches in dispersive soils are to be properly compacted approved material (refer to Section SC6.6.6.4 Soil Management, to ensure water filtration does not cause underground erosion.
f. With the exception of inter-allotment drainage systems, the minimum size for circular pipes is to be 375mm diameter and box culvert 450mm by 300mm:
g. Pipes up to and including 600mm diameter are to be rubber ring jointed;
h. Pipes larger than 600mm diameter are to be internal flush jointed with pipe manufacturers proprietary external bands;
i. The class of pipe is to be as specified or as shown on the engineering drawings in accordance with the strength requirements of pipes in roadways, or in deep trenches or under fills;
j. Where the class of pipe is not specified it is to be a minimum of Class 2.
k. The desirable minimum grade is 0.5% with the absolute minimum of 0.3% but only for full flowing pipes.

SC6.6.4.3.9 Outlets

1. Unless otherwise specified, QUDM Section 8: Stormwater outlets, requirement criteria applies:
   a. Limited data is currently available for design outlet water levels to creeks throughout the region. Designers must make appropriate allowances where flood data is not available or of uncertain accuracy and be aware of the sensitivity of designs to outlet water level assumptions, particularly in flat terrain;
   b. Information from a Flood model where available to be used and could be obtained from Council under a Data Sharing Agreement and at a fee;
   c. Safety at all free-drainage outlets must be considered in the design;
   d. For further guidance on the design of stormwater outlets, refer to the DTMR Road Drainage Design Manual.

SC6.6.4.3.9.1 Roof, inter and rear of allotment drainage

1. Unless otherwise specified, QUDM Section 7: Urban drainage, requirement criteria applies.
2. The finished surface level of the allotment is less than 400mm, at the middle of the allotment, above the lowest top of kerb along the frontage kerb and channel.
3. The level of inter-allotment drainage required is described at Table SC6.6-5: Inter-allotment drainage levels.

Table SC6.6-5: Inter-allotment drainage levels

LAND DESIGNATION	DRAINAGE LEVEL
Emerging communities zone, Residential expansion area, Urban Residential zone, Urban Residential area, Rural residential zone, Rural residential area, Park residential Zone	II
Industrial zone, Industrial area, Commercial zone, Business area, Village Zone, Village area	IV, V

Note—Not required for all other zones.

4. Fibre Reinforced Concrete (FRC) pipes are not permitted.
5. Manning's Equation, with a minimum 'n' value of 0.011, is to be used to determine pipe sizes. Pipes may be graded 'obvert to obvert' provided that the following minimum falls are provided through pits and access chambers:
   a. 0—30 degrees — 0.02m; or
   b. 30—60 degrees — 0.04m; or
   c. 60—90 degrees — 0.08m.
6. Recommended design criteria for Level II drainage, with the following amendments to the applicable flow:
   a. 10L/s per allotment up to 600m^2;
   b. 5L/s per allotment 1,000m^2 or greater;
   c. interpolation for allotments 600m^2 to 1,000m^2.
7. The main 'line' of the pipe is to be located a minimum 1m from rear boundaries and 1m from side boundaries.
8. Access chambers are to be provided at the following locations:
   a. change of grade;
   b. change of pipe size;
   c. change of direction;
   d. end of line;
   e. maximum 100m spacing.
9. Direct connection of inter-allotment drainage to the kerb and channel will not be permitted without Council approval.
10. Discharge of inter-allotment drainage to a public reserve may be allowed where no alternative drainage structure is available. Outlets must be designed with scour protection, concrete headwalls, wingwalls and apron.

11. The minimum standard of documentation for calculations must be the development layout plan at a suitable scale to clearly show:
    a. allotment and roadway layout;
    b. set-out of the rear-of-allotment drainage line;
    c. location of the underground stormwater drainage line;
    d. locations of inspection access chambers on the rear-of-allotment drainage lines and on the underground-stormwater drainage lines;
    e. connection stub locations;
    f. allotment areas;
    g. direction of contributing fall of each allotment;
    h. design flow discharge from each allotment;
    i. pipe size and type of rear of allotment drainage lines;
    j. pipe size and type of underground stormwater drainage lines;
    k. existing natural surface levels at every corner of the allotments;
    l. finished surface levels at relevant locations to demonstrate proposed drainage paths;
    m. other information necessary to identify the development's stormwater drainage system.
12. The LVRC Standard Drawings SD-261 Regional Road Standards — Urban & Residential Streets — Underground Stormwater Drainage Typical Layout Plan, SD-262 Standard Drawing SD-261 Regional Road Standards — Urban & Residential Streets — Underground Stormwater Drainage Typical Longitudinal Section, SD-263 Regional Road Standards — Urban & Residential Streets — Underground Stormwater Drainage Typical Layout Plan As Constructed are sample drawings showing this information.
13. Calculations must include:
    i. design storm ARI or AEP;
    ii. pipe size;
    iii. pipe type and class;
    iv. grade of pipe;
    v. flow volume in each section of pipe between the inspection access chambers;
    vi. average allotment levels;
    vii. cover from future cut or fill platform to rear-of-allotment drainage lines;
    viii. This information could be included on a longitudinal section. The LVRC Standard Drawing SD-262 Standard Drawing SD-261 Regional Road Standards — Urban & Residential Streets — Underground Stormwater Drainage Typical Longitudinal Section shows a sample drawing.

SC6.6.4.3.9.1.1 Ownership and Maintenance

1. Council Responsibility: Council is only responsible for interallotment drainage systems that are installed as a requirement of the development and are accompanied by a drainage easement.
2. Privately Owned Systems: If interallotment drainage systems are constructed by the developer for the improvement of the allotments, it becomes privately owned. In such cases, the maintenance of these systems are the responsibility of the properties using them.
3. Civil Matters: Any interference with the interallotment drainage system that adversely impacts surrounding properties becomes a civil matter between the respective property owners.

SC6.6.4.3.9.1.2 Design Requirements

1. Drainage Easement: Interallotment drainage systems are to be contained within an easement granted in favour of Council.

SC6.6.4.3.9.1.3 System Requirements

1. Location of Drainage Lines: Interallotment drainage is not to be located along more than two boundaries of any Lot.
2. Pipe Size: The minimum pipe size for interallotment drainage shall be 225mm in diameter.
3. Drainage Pits: Interallotment drainage pits shall be located at the junction of changes in direction.
4. Private Interallotment Drainage: Private interallotment drainage is restricted to a maximum of four allotments. After reaching this limit, the drainage system must discharge to a lawful point of discharge.
5. Alignment with Drainage Easement: Interallotment drainage is to be install so the alignment is within the centre of the drainage easement. In cases where a stormwater allotment pipe shares an easement with a sewerage line, the stormwater pipe shall be offset from the boundary line by a minimum of 1m.

SC6.6.4.4 Stormwater Quality

SC6.6.4.4.1 Deemed to Comply Solutions

1. Exclusive of drinking water requirements, the Deemed to Comply Solutions — Stormwater Quality Management (South East Queensland) produced by Healthy Waters can be used for the four (4) applicable scenarios identified in the document as follows):
   a. Residential greater than 2 lots and up to 20 lots;
   b. Residential greater than 2 dwellings (townhouse style up to 2 storeys) for developments less than 12,500m^2;
   c. Residential high density multiple dwelling apartments flats, high-rise) for developments less than 12,500m^2;
   d. Commercial or industrial development less than 12,500m^2.

SC6.6.4.4.2 Methods of stormwater quality control

1. Permanent stormwater quality controls are implemented to control run-off water quality beyond the initial construction and maintenance stages and need to be described within a site-based stormwater management plan (SBSMP).
2. A SBSMP is to be prepared by a suitably qualified Engineer (RPEQ):
   a. conform with principles of ecologically sustainable development;
   b. demonstrate that the development is occurring on the appropriate land capability class;
   c. maximise the social value of stormwater and stormwater infrastructure;
   d. protect riparian zones from disturbance;
   e. adopt water conservation and recycling principles;
   f. not cause or worsen flooding, or create nuisance ponding;
   g. minimise the cost to Council of maintaining permanent stormwater infrastructure.
3. Minimum reductions in mean annual pollutant loads from unmitigated developments, (to be achieved by new developments) are 80% total suspended solids (TSS), 60% total phosphorus (TP), 45% total nitrogen and 90% gross pollutants > 5mm. The water quality treatment strategy and design solution provided in the SBSMP is derived by either:
   a. Computer Modelling Software (MUSIC) where reporting follows the procedures detailed in Healthy Land and Water, MUSIC Modelling Guidelines, Chapter 7: Lodgement, Reporting and Assessment; or
   b. adoption of a relevant best practice solution with supporting evidence and calculations to demonstrate the solution has been adopted correctly.

SC6.6.4.5 Erosion and sediment control

1. Controls are required to avoid the siltation or erosion of adjoining lands, streams, wetlands, watercourses, habitat areas and downstream piped drainage systems during the construction phase and the maintenance phase of a development. An erosion hazard risk assessment and consequent erosion and sedimentation control plans (ESC) are to be prepared in accordance with the recommendations contained in the latest edition of the publication:
   a. Best Practice Sediment and Erosion Control — for Building and construction sites, International Erosion Control Association (IECA);
   b. State Planning Policy 2017 Part E Water Quality;
   c. State Planning Policy State Interest Guidance material: Water quality, July 2017.
2. Adopted measures are to be captured on approved erosion and sediment control plans and approved engineering drawings and implemented during construction.
3. When any erosion or tracking of sediment from the site onto the adjoining street network or to neighbouring properties does occur immediate action is necessary to rectify the situation, repair any damage including to removal of silt and debris.
4. During the construction phase, temporary measures as outlined in publications from the IECA, are acceptable and may include:
   a. contour banks;
   b. sandbags;
   c. sedimentation basins and traps;
   d. channel lining such as riprap;
   e. energy dissipaters;
   f. geotextile or matting on slopes;
   g. proprietary methods;
   h. vegetation above and below the cut-and-fill areas is to be retained to stop run-off water coming onto the site and into the excavation, and to prevent soil from leaving the site;
   i. all excess material is to be removed immediately after excavation to prevent bogging and soil from washing away;
   j. soil stockpiles are to be stored within areas of the site nominated on the approved erosion and sediment control plans;
   k. cut-off drains are to be provided, where necessary, above and below the cut-and-fill area to minimise the volume of water entering the excavation.
5. Limited clearing and excavation at any one time are to be considered in construction design by:
   a. the staging of works;
   b. trenches are to be backfilled within 24 hours of inspection and approval;
   c. soil erosion control measures are to be placed above and below the excavated site to prevent soil movement during periods of rainfall;
   d. the erosion control measures are to be maintained throughout the progress of the work.

6. Control measures are to be implemented to adequately control non-cohesive, saline and dispersive soils.
7. All unpaved areas where earthworks have been undertaken are to be grass-seeded to achieve a good grass cover and are to be established within 14 days.

Note—Council has adopted IECA 2008 Best Practice Erosion and Sediment Control as the default ESC reference document for ground disturbing activities. This document is considered the 'minimum standard' for ESC and is to be used for development. Use of any alternative ESC reference document that specifies a lower performance standard than IECA 2008 Best Practice Erosion and Sediment Control is not permitted.

SC6.6.4.5.1 Erosion and sediment control plans

1. Engineering structures (temporary or permanent) such as inlets, outlets, spillways and sediment basin embankments that form part of an Erosion and Sediment Control Plan or Program are designed, certified and inspected by a Registered Professional Engineer of Queensland (RPEQ).
2. The primary purpose of erosion and sediment control plans (ESC Plans) is to inform those persons constructing the development on what controls need to be implemented throughout all stages of the development from site establishment to project completion. Typically, a separate ESC Plan is required for each phase of the development including the bulk earthworks, civil construction (typically roadworks and stormwater drainage), services installation, final stabilisation and the decommissioning of construction phase sediment basins. These plans could be considered an element of complying with the general environmental duty, that is, doing all that is reasonable and practicable to prevent or minimise environmental harm.
3. ESC plans must:
   a. be prepared by a suitably qualified and experienced professional;
   b. be consistent with this standard and a current best-practice document (such as the IECA 2008 Best Practice Erosion and Sediment Control — for building and construction sites). For issues where a document (i.e. manual or guideline) is not consistent with this standard, this standard prevails to the extent of the inconsistency;
   c. be based on an assessment of the physical constraints and opportunities of the development site, including those for soil, landform type and gradient, and hydrology;
   d. be supported by on-site soil testing;
   e. provide a set of contour drawings showing existing and design contours, the real property description/s, north point, roads, site layout, boundaries and features. Contours on, and surrounding, the site must be shown so that catchment boundaries can be considered;
   f. be at a suitable scale for the size of the project (as a guide around 1:1,000 at A3 for a 2ha development and 1:500 at A3 for a 3,000m^2 development);
   g. provide background information including site boundaries, existing vegetation, location of site access and other impervious areas and existing and proposed drainage pathways with discharge points also shown;
   h. show the location of lots, stormwater drainage systems;
   i. details on the nature and specific location of works and controls (revegetation, cut and fills, run-off diversions, stockpile management, access protection), timing of measures to be implemented and maintenance requirements (extent and frequency as defined in IECA Best Practice & Sediment Control — for building and construction sites, Chapter 6: Site management);
   j. show all areas of land disturbance, the way that works will modify the landscape and surface and sub-surface drainage patterns (adding new, or modifying existing constraints);
   k. for each phase of the works (including clearing, earthworks, civil construction, services installation and landscaping) detail the type, location, sequence and timing of measures and actions to effectively minimise erosion, manage flows and capture sediment;
   l. describe the scheduling of progressive and final rehabilitation as civil works progress, including the stabilisation of up-slope catchments before sediment basin removal;
   m. identify the riparian buffers and areas of vegetation which are to be protected and fenced off to prevent vehicle access;
   n. indicate the location and provide engineering details with supporting design calculations for all necessary sediment basins and ESC-related drainage structures;
   o. indicate the location and diagrammatic representations of all other necessary erosion and sediment control measures;
   p. identify the clean and disturbed catchments, and flow paths, showing:
      i. diversion of clean run-off
      ii. collection drains and banks, batter chutes and waterway crossings
      iii. location of discharge outlet points
      iv. water quality monitoring locations.
   q. show calculated flow velocities, flow rates and capacities, drain sizing and scour or lining protection, and velocity or energy checks required for all stormwater diversion and collection drains, banks, chutes, and outlets to waterways;
   r. show waterways (perennial and non-perennial) and detail of stabilisation measures for all temporary waterway crossings;
   s. locate topsoil and/or soil stockpiles;
   t. prescribe non-structural controls where applicable, such as minimising the extent and duration of soil exposure, staging the works, identifying areas for protection, delaying clearing until construction works are imminent etc.;

u. include a maintenance schedule for ensuring ESC and stormwater infrastructure is maintained in effective working order (refer to IECA Best Practice & Sediment Control — for building and construction sites, Chapter 6: Site Management and Chapter 7: Site Inspection);
v. include an adaptive management program to identify and rectify non-compliances and deficiencies in environmental performance (refer to IECA Best Practice & Sediment Control — for building and construction sites, Chapter 6: Site Management and Chapter 7: Site Inspection);
w. provide details of chemical flocculation proposed, including equipment, chemical, dosing rates and procedures, quantities to be stored and storage location, and method of decanting any sediment basin;
x. show how post-construction water sensitive urban design bioretention devices will be protected against sediment ingress during land-disturbing activities, including where applicable the transition from construction-phase sediment basins to post-construction phase bioretention basins.

SC6.6.4.5.2 Erosion and sedimentation control program

1. A construction phase erosion and sediment control (ESC) program is a set of management strategies, supporting documents and ESC plans that describe what controls are required throughout all stages of the construction of the development, including the integration and protection of post-construction stormwater management infrastructure (e.g. water sensitive urban design bioretention devices).
2. In addition to providing ESC plans, the ESC program must:
   a. be consistent with IECA 2008, Best Practice Erosion and Sediment Control – for building and construction sites. For issues where a current best-practice document is not consistent with this standard, this standard prevails to the extent of the inconsistency;
   b. be supported by on-site soil testing and analysis;
   c. include contingency management measures for the site, to ensure ESC measures are always effective, particularly just before, during and after wet weather;
   d. be consistent with current best-practice standards, considering all environmental constraints including erosion hazard, season, climate, soil characteristics, and proximity to waterways;
   e. be prepared to enough standard and level of detail such that compliance with this standard will be achieved if the construction phase ESC program is correctly implemented on site;
   f. include an effective monitoring and assessment program to identify, measure, record and report on the effectiveness of the erosion and sediment controls and the lawfulness of water releases (refer to IECA Best Practice & Sediment Control – for building and construction sites, Chapter 6: Site Management and Chapter 7: Site Inspection).
3. The supervising engineer must undertake inspections of the erosion and sediment control devices after all significant rain events. Where necessary, the devices will be modified, repaired or improved to prevent any erosion or sediment discharge from the development in future rain events.

SC6.6.4.5.3 Soil testing

1. Assessment of site soil conditions is an integral component of best-practice civil construction and erosion and sediment control. Proper assessment of site soil characteristics is necessary to objectively inform the selection and design of site ESC measures, the suitability of in-situ soils for fill embankment construction and stability, construction-phase water quality treatment (such as for dispersive soils), future asset protection (such as stormwater outlet protection), topsoil fertility and amelioration requirements to ensure successful vegetative stabilisation and revegetation.
2. Soil testing is to be consistent, of Best Practice & Sediment Control Section 3.5 Soil Data and Appendix C Soils and revegetation.

SC6.6.4.5.4 Protecting waters from development impacts

SC6.6.4.5.4.1 Landowner responsibility

1. The landowner is responsible for environmental management of the site and is:
   a. consistent with the requirements of this policy, or
   b. where not consistent with Section 6.6.4.5.3 Soil testing that actions is undertaken to achieve compliance with this policy.
2. The landowner must document compliance with this policy beyond entering into a contract with experienced engineers and/or contractors. The documentation is to be available and provided to Council upon request.
3. For subdivision works (i.e. reconfiguration of a lot), the landowner is responsible for ensuring that the site has an effectively stabilised surface to prevent erosion and that sediment from entering waters. This requirement applies throughout the development works and until such time as the Council accepts the development ‘off maintenance’ (e.g. for contributed Council assets such as parkland, roads and stormwater drainage) and whilst future private allotments remain under the land owner’s legal control (i.e. until sold).
4. The landowner and contractors have a responsibility to do all that is reasonable and practicable to ensure effective environmental management is implemented on site at all times and in accordance with the *Environmental Protection Act*

1994, and any development approval conditions.

SC6.6.4.5.4.2 Avoiding and minimising releases, flow and discharges of prescribed water contaminants

1. Sediment, earth, soil or other water contaminants must not be released from the site, or be likely to be released from the site, unless all reasonable and practicable measures are taken to prevent or minimise the release and concentration of contamination. Performance standards, principles and measures must include as a minimum, but are not limited to, the following sections 6.6.4.5.4.4 Erosion control standard to 6.6.4.5.4.8 Release limits.

SC6.6.4.5.4.3 Erosion control standard

1. The design and implementation of best-practice erosion control principles and practices will be based on monthly rainfall erosivity ratings in of Best Practice & Sediment Control, Table 4.4.1 Erosion risk rating (default) based on monthly rainfall erosivity and Table 4.4.4 Erosion risk rating based on monthly rainfall erosivity for Brisbane.
2. Minimising soil exposure:
   a. Ensure non-essential exposure of soil is avoided by:
      i. restricting the extent of clearing to that necessary for access to, and safe construction of the approved works;
      ii. protecting vegetation in all other areas of the site;
      iii. minimising the duration of soil exposure by:
         A. only clearing vegetation immediately before an area being actively worked;
         B. staging the works to minimise the area of soil exposed at any one time;
         C. effectively stabilising cleared areas if works are delayed or works are not intended to occur immediately.
         D. effectively stabilising areas at finished level without delay and before rainfall;
         E. effectively stabilising steep areas, such as stockpiles, batters and embankments, which are not being actively worked and before rainfall.

SC6.6.4.5.4.4 Drainage control standard for temporary drainage works

1. The design drainage control for temporary drainage works is to be consistent with the Table 9.4.7-3: Construction phase — Stormwater Management Design Objectives for Temporary Drainage Works.
2. Managing stormwater:
   a. Ensure clean stormwater is diverted or managed around or through the site without increasing the concentration of total suspended solids or other contaminants in the flow and without causing erosion (on site or off site). If it is not feasible to divert all areas discharging clean stormwater around or through the site, manage the clean stormwater as for contaminated stormwater, and ensure that sediment basins are sized to capture and accommodate the additional volume of run-off.

      Note—Diverting clean stormwater run-off into a sediment basin is an inferior option to diverting clean stormwater around or through the site because it will cause an increase in the volume and frequency of contaminated releases from the sediment basin. For this reason, diverting clean stormwater into a sediment basin is not acceptable unless the proponent demonstrates that diverting clean stormwater around or through the site is not feasible.

   b. Ensure sheet flows of stormwater are managed such that sheet and rill erosion is prevented or minimised;
   c. Ensure that all concentrated stormwater flows including drainage lines, diversion drains, channels, spillway and batter chutes are managed onto, though, and at release points from the site in all rain events up to and including the equivalent year within Table 9.4.7-3: Construction phase — Stormwater Management Design Objectives for Temporary Drainage Works without causing:
      i. water contamination; or
      ii. sheet, rill or gully erosion; or
      iii. sedimentation; or
      iv. damage to structures or property.

SC6.6.4.5.4.5 Sediment control standard

1. The design and implementation of best-practice sediment control principles and practices will be based on monthly rainfall erosivity ratings as defined within Best Practice & Sediment Control, Table 4.5.2 Alternative sediment control standards based on monthly erosivity and average monthly rainfall.
2. Sediment basins are to:
   a. be consistent with Best Practice Erosion and Sediment Control, Appendix B Sediment basin design and operation;
   b. ensure each sediment basin has the capacity to treat flows to current best-practice standards and as a minimum to contain all the stormwater run-off from the R(Y%, 5-day) rainfall depth equal to 40mm, unless a higher standard is prescribed in the development approval conditions;

Note—Research has shown that sediment basins designed on a 'batch' or total storm capture approach are only capable of treating a small percentage of the annual run-off volume without basin size becoming excessive. Innovation in sediment basin design to incorporate continuous flow treatment is likely to occur in the future and as this technology becomes available in best-practice guidelines, this technology is to be adopted where a better water quality outcome will result. The interim the minimum basin size is to be consistent with this section.

c. provide sediment storage volume consistent with Best Practice Erosion and Sediment Control, Appendix B, Table B8 Sediment storage volume or as a minimum store at least 2 months sediment from the receiving catchment, as determined using the Revised Universal Soil Loss Equation (RUSLE);
d. ensure sediment basins are maintained with sufficient storage capacity to capture and treat the run-off for the design rainfall depth. Where sediment basins are proposed to be oversized for storage of captured water for re-use, install survey markers in each such basin to clearly indicate the level that water within the basin must be lowered to, in order to meet the storage capacity specified in requirement (c) above;
e. ensure sediment basins are dewatered to the appropriate level as soon as practicable after each rainfall event and no longer than 5 days after a rainfall event (see also below);
f. ensure stormwater captured in sediment basins is treated before discharge to minimise the concentration of contaminants released from the site, having due regard to forecast rainfall, and ensuring that releases are consistent with 6.6.4.5.4.8 Release limits.

Note—Dewatered flows from sediment basins are to be compliant with the release limits specified in section to 6.6.4.5.4.8 Release limits, unless it can be demonstrated that a non-compliant release occurred to facilitate a better environmental outcome. For example, higher total suspended solids concentrations may be acceptable in circumstances where further rain is imminent and it can be substantiated that releasing partially treated basin water, which has a TSS concentration exceeding the release limit, would minimise the total contamination released from the site, by providing for the capture and treatment of expected run-off. However, releasing waters from sediment basins without treatment is not acceptable.

g. ensure sediment basins and associated structures such as inlets, outlets and spillways are effectively stabilised and structurally sound for ARI rainfall events defined in Best Practice Erosion and Sediment Control, Appendix B Sediment Basin Design and Operation, Table B12 Recommended design standard for emergency spillways on temporary Sediment Basins;
h. ensure accumulated sediment from basins and other controls is removed and disposed of appropriately without causing water contamination.

3. Erosion and sediment controls (other than sediment basins):
   a. Ensure measures have been implemented such that the run-off from all disturbed areas flows to a sediment basin or basins. Where it is not feasible to divert run-off from small, disturbed areas of the site to a sediment basin, implement compensatory erosion, drainage and sediment controls before rainfall to ensure that erosion of those of areas does not occur, including erosion caused by either splash (raindrop impact), sheet, rill or gully erosion processes.

   Note—Compensatory controls are erosion controls, drainage controls and sediment controls which compensate for the lack of sediment basin and are applied such that the type, timing, placement and management of controls minimise the potential for water contamination and environmental harm. This is primarily achieved by reducing the risk of erosion and subsequent sediment release, for example by turfing or mulching and managing concentrated flows in the area.

   b. Where it is not feasible to effectively stabilise cleared areas of exposed soil, such as areas being actively worked, implement a full suite of erosion and sediment controls, to maximise sediment capture in those areas and minimise erosion such that all forms of erosion, other than splash erosion (raindrop impact) and sheet erosion, do not occur;
   c. In areas of exposed soil where it is not feasible to either effectively stabilise the surface or implement a full suite of erosion and sediment controls, for example in the areas being actively worked and where the implementation of some erosion and sediment controls would impede construction activities, ensure contingency measures are available on site and are implemented, before rain, to maximise sediment capture in those areas and minimise erosion such that all forms of erosion, other than splash erosion (raindrop impact) and sheet erosion, do not occur;

   Note—This does not apply to major erosion and sediment controls such as sediment basins. Major controls should be installed before other works commence.

   d. Effectively stabilise all stockpiles, batters and embankments without delay. Where it is not feasible to effectively stabilise a stockpile, batter or embankment, such as areas being actively worked, ensure that sediment controls are installed and surface stormwater flows are managed such that erosion of stockpiles, batters or embankments is not caused by concentrated stormwater flows;
   e. Ensure sediment does not leave the site on the tyres of vehicles.

SC6.6.4.5.4.6 Work within waterways

1. Waterways, including ephemeral and permanent waterways, must not be altered, nor riparian vegetation disturbed without

written approval of the relevant administering authority;
2. Work within waterways:
   a. must only be undertaken during the lower rainfall hazard months;
   b. must be promptly rehabilitated conforming to the natural channel form, substrates and riparian vegetation as far as possible;
   c. is to be consistent with Best Practice Erosion and Sediment Control, Book 3 Appendix I — Instream works.
3. Temporary vehicular crossings of waterways must be designed and constructed to convey minimum pipe flows as defined in Table 9.4.7-3: Construction phase — Stormwater Management Design Objectives for Temporary Drainage Works and remain structurally stable for all rainfall events specified.
4. Erosion and sediment controls must not be constructed within the riparian zone unless it is impracticable to site them elsewhere.

SC6.6.4.5.4.7 Effective stabilisation and plan sealing

1. Before to the sealing of the plan of survey for the development, all site surfaces must be effectively stabilised using methods which will continue to achieve effective stabilisation in the medium to long term. For the purposes of this requirement, an effectively stabilised surface is defined as one that does not, or is not likely to, result in visible evidence of soil loss caused by sheet, rill or gully erosion or lead to sedimentation, or lead to water contamination.
2. A site is determined to be 'effectively stabilised' if at the time of the plan sealing inspection:
   a. Methods of stabilisation are:
      i. appropriate for slopes and slope lengths;
      ii. consistent with best-practice environmental management practices; and
      iii. providing a minimum of 70% soil coverage (when viewed perpendicular to the soil surface) across any square metre of the site disturbance area.
   b. Stormwater run-off from the site is not currently, and is not likely to result in visible evidence of sedimentation or erosion, or lead to water contamination, in the short, medium and long term.
   c. If at the time of request for plan sealing, the method of stabilisation has not achieved a stability that has a high probability of enduring in the medium to long term, for example, inadequate grass cover or permanent approved landscape works are incomplete, the following will be taken into consideration in determining whether the site is capable of achieving medium- to long-term stability:
      i. evidence of appropriate soil testing and amelioration having been adequately undertaken;
      ii. evidence of an adequate seed mix of annual and perennial grass species being applied at an adequate rate;
      iii. evidence that appropriate grass strike and growth has been achieved for the type of stabilisation method selected.
3. For example, while hydro-mulch can provide an immediate and effective stabilising cover to soils, the protective cover can be relatively short lived if vegetation fails to establish before the thin layer of mulch decomposes. Similarly where the hydro-mulch specification and application rate (i.e. t/ha) provides insufficient coverage and binding of the soil to prevent erosion whilst vegetation establishes, then the site will not be considered 'effectively stabilised'.
4. If hydro-mulch is selected as the method of temporary stabilisation, it is important that perennial as well as annual grasses are well established at the time of plan sealing to reduce the risk of instability of the site in the medium to long term.

Note—The bonding of uncompleted works relating to erosion and sediment control (i.e. bonding of environmental outcomes) is not permitted where it is contrary to the purpose of this standard (i.e. the protection of Waters from the impacts of land and infrastructure development). This situation can be avoided through progressive stabilisation, supplementary watering and effective site management.

SC6.6.4.5.4.8 Release limits

1. All releases of stormwater captured in a sediment basin, unless otherwise noted in this Standard, must not exceed the following limits:
   a. 50mg/L of total suspended solids (TSS) as a maximum concentration;
   b. turbidity (NTU) value less than 10% above background;
   c. pH value must be in the range 6.5 to 8.5 except where, and to the extent that, the natural receiving waters lie outside this range.

      Note—It is recommended that a site-specific relationship between turbidity and suspended solids is determined for each sediment basin. Once a correlation between suspended solids and turbidity has been established for a sediment basin, testing stormwater for compliance with release limits, before release, can be done on site with a turbidity tube or calibrated turbidity meter. This has the advantage of providing immediate assessment to justify a release rather than waiting for laboratory results to confirm concentration levels and compliance.

      Note that post-release TSS validation is appropriate to demonstrate that the NTU/TSS correlation is being maintained.

      Note—Background refers to receiving water quality immediately upstream of the site location release point at the time of the release. Where there is no immediate upstream receiving water at the location and time of the release, then the turbidity release limit (NTU) will be equal to the release limit for 50mg/L total suspended solids (TSS) based upon the onsite correlation between

TSS and NTU.

2. The concentration of TSS released by dewatering may only exceed 50mg/L where it can be demonstrated and supported through documentation that:
   a. further significant rainfall is forecast to occur before the TSS concentration is likely to be reduced to 50mg/L;
   b. releasing a higher concentration of total suspended solids will result in a better environmental outcome by providing storage for the capture and treatment of run-off from the imminent rainfall and run-off;
   c. all reasonable and practicable steps have been taken to treat the water within best-practice time frames;
   d. flocculent has been appropriately applied and the concentration of TSS in the captured water has already significantly decreased.
3. For all other stormwater releases, flows and discharges from the site, the release limits prescribed in (a) above must not be exceeded unless the development is in full compliance with this standard.

SC6.6.4.6 Design presentation

SC6.6.4.6.1 Catchment

1. The minimum standard of documentation for calculations must be the catchment plan, for both minor and major storms, at a suitable scale that clearly shows:
   a. sub-catchments;
   b. areas of sub-catchments;
   c. slopes of sub-catchments;
   d. pit location complete with labelling to clearly identify pits or access chambers to allow the drainage system to be understood.
2. Calculations must include minor system design and major system design. Minor system design must include the following elements:
   a. minor system ARI or AEP;
   b. sub-catchment area contributing;
   c. sub-catchment time of concentration;
   d. fraction impervious;
   e. discharge coefficient;
   f. rainfall intensity for the design ARI or AEP;
   g. sub-catchment discharge;
   h. road flow width and road flow depth immediately upstream of the proposed stormwater inlet;
   i. velocity or depth product immediately upstream of the proposed stormwater inlet;
   j. flow captured by gully inlet;
   k. volume of flow and width of flow bypassed at stormwater inlet.
3. Major system design must include the following elements:
   a. major system ARI or AEP;
   b. sub-catchment area contributing;
   c. sub-catchment time of concentration;
   d. fraction impervious;
   e. discharge coefficient;
   f. rainfall intensity for the design ARI or AEP;
   g. sub-catchment discharge;
   h. roadway capacity check for containment of a major storm at stormwater inlets and other critical locations;
   i. velocity or depth product at the location of the roadway capacity check.
4. These calculations must be logically ordered and legible and are to be presented in a tabulated format.

SC6.6.4.6.2 System calculations

1. Calculations for the underground stormwater drainage system design of each reach are the minimum standard of documentation required. These must be presented in tabulated format and must include:
   a. design flow in reach (L/s);
   b. pipe diameter;
   c. reach (pipe) length;
   d. grate or surface level at gully pit or access chamber;
   e. invert level of gully pit or access chamber;
   f. Manning's 'n' for type of pipe;
   g. full-flow velocity;
   h. velocity head;
   i. friction loss in pipe;
   j. hydraulic grade level at outlet;

k. hydraulic grade line slope;
l. pit or access chamber type, as nominated in QUDM Appendix 1 Pipe flow design charts, and Appendix 2 Structure pressure change coefficient charts;
m. pit loss coefficients and pit velocity head losses;
n. hydraulic grade line at the upstream side of the pit or access chamber;
o. hydraulic grade line at the downstream side of the pit or access chamber;
p. water surface elevation in the pit or access chamber;
q. freeboard in the pit or access chamber.

SC6.6.4.6.3 Longitudinal sections

1. Longitudinal sections must be presented in a similar fashion to those as shown in the LVRC Standard Drawings:
   a. SD-256 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Sections;
   b. SD-257 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Section & Typical Service Locations;
   c. SD-258 Regional Road Standard Urban & Rural Residential Streets — Rural Roads Typical Cross Sections & Details;
   d. SD-259 Regional Road Standard Industrial Streets — Typical Cross Sections.
2. Specific items to be shown on plans include:
   a. minimum acceptable horizontal and vertical scales; these must be 1:1,000 and 1:100 (at A1 size) respectively, unless otherwise approved by Council;
   b. service size, elevation and location of existing and proposed services from within the development and from other authorities;
   c. length of pipe or culvert in each reach;
   d. grate levels or finished surface levels at each pit or access chamber;
   e. invert levels of pipes;
   f. hydraulic grade line levels;
   g. depth to invert of pipes;
   h. slope (grade) of pipe;
   i. pipe size, pipe type, pipe class, pipe joint type;
   j. velocity in pipe;
   k. flow in pipe;
   l. plot of natural surface or finished surface as applicable;
   m. plot of hydraulic grade line or indication of Water Surface Elevation (WSE);
   n. plot of pipe invert and obvert;
   o. proposed access chambers, shown as a blocked-in line with the access chamber number in a circle;
   p. existing access chambers, shown as a double line with the access chamber number in a double circle;
   q. sections drawn so that the underground stormwater system drains to the right.

SC6.6.4.6.4 Stormwater Quality

1. For the purposes of reporting on the design objectives for stormwater quality, a conceptual site based stormwater management plan is to provide details including:
   a. descriptions of each treatment train for each sub-catchment ensuring that all types of pollutant (primary, secondary and tertiary) is treated in the appropriate order - primary pollutant treatment measures are located at the beginning of the treatment train and tertiary treatment measures are positioned at the end;
   b. details of each individual treatment device including total footprint, treatment area, invert levels, coarse sediment management, maintenance access and design flows. Specify whether the stormwater treatment system will be privately maintained or handed over to Council;
   c. a scale plan and section drawings showing:
      i. how stormwater is conveyed to the stormwater treatment devices;
      ii. the location of all stormwater treatment devices including filter areas and batters with respect to the development layout;
      iii. surrounding ground levels;
      iv. conceptual design levels for each treatment device and receiving drainage invert levels;
      v. scour protection and coarse sediment management devices;
      vi. maintenance access;
      vii. likely maintenance intervals;
   d. section drawings showing:
      i. conceptual design levels for each treatment device and receiving drainage invert levels;
      ii. scour protection and coarse sediment management devices;
      iii. batters, embankments or retaining walls;
   e. proof that all modelling and reporting has been undertaken in accordance with the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) and the Water-by-Design MUSIC Modelling Guidelines;

SC6.6.4.7 Harvesting

1. The harvesting of stormwater permits for the capture and reuse of stormwater for non-potable uses. It provides a valuable water resource, and assists with the management of stormwater quality. Capturing and reusing stormwater reduces the volume of contaminated stormwater entering local waterways, reduces the frequency and the magnitude of frequent runoff events.
2. The adoption of any stormwater harvesting off-take system must not impact adjacent flood levels.
3. Harvesting of water must meet the requirements of Lockyer Creek Environmental Values and Water Quality Objectives under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019*.

SC6.6.4.8 Construction

SC6.6.4.8.1 Construction standards

1. Construction of stormwater infrastructure must comply with the requirements of the current edition of the following Specifications, except as noted in the sections below:
   a. DTMR Specifications MRTS03 Drainage, Retaining Structures and Protective Treatments;
   b. DTMR Specifications MRTS04 General Earthworks;
   c. DTMR Specifications MRTS16 Landscape and Revegetation Works;
   d. DTMR Specifications MRTS24 Manufacture of Precast Concrete Culverts;
   e. DTMR Specifications MRTS25 Steel Reinforced Precast Concrete Pipes;
   f. DTMR Specifications MRTS52 Erosion and Sediment Control;
   g. DTMR Specifications MRTS70 Concrete;
   h. DTMR Specifications MRTS71 Reinforcing Steel;
   i. DTMR Specifications MRTS72 Manufacture of Precast Concrete Elements;
   j. DTMR Specifications MRTS73 Manufacture of Prestressed Concrete Members and Stressing Units;
   k. DTMR Specifications MRTS74 Supply and Erection of Prestressed Concrete Deck and Kerb Units;
   l. IPWEAQ Standard Drawings, Drainage and Water Quality series.

SC6.6.4.8.2 Stormwater drainage works

SC6.6.4.8.2.1 Pipework

1. Pipes are to conform in all respects to MRTS25 Steel Reinforced Precast Concrete Pipes.
2. Pipes are to conform in all respects to MRTS24 Manufacture of Precast Concrete Culverts.
3. Pipework is to be installed in accordance with DTMR Specifications MRTS03 Drainage, Retaining Structures and Protective Treatments except for variations detailed in the following Sections.
4. Pipes damaged because of handling and cracked in one or more places that clearly show visible cracks (exceeding 0.10mm) inside or outside are to be rejected.
5. Pipes showing visible shrinkage cracks inside or outside, with openings more than 1.25mm for a length of 300mm or more on either inside or outside, are to be rejected.
6. Pipes showing only internal cracks or only external cracks may be accepted when:
   a. the cracks do not visibly penetrate full thickness; or
   b. the cracks do not exceed 0.10mm opening for 300mm or more of length.

SC6.6.4.8.2.2 Pipe Laying

1. Pipes are to be laid true to line, grade and level to the following tolerances and are to be free draining and firmly bedded—:
   a. invert levels + 50mm - 50mm;
   b. structure locations within 1m of the approved engineering design.
2. Pipes are to be bedded in accordance with IPWEAQ Standard Drawing DS-030 Excavation, Bedding and Backfilling - Rigid & Flexible Drainage Pipes.
3. Minimum clear cover is to be 600mm.
4. The minimum vertical and horizontal clearance between a stormwater pipe and any other pipe or service conduit is to be 300mm.
5. All pipework is to be inspected post construction using CCTV.
6. CCTV operations and equipment must give accurate chainage, pipe grade and permit site locations and comments to be recorded.

SC6.6.4.8.2.3 Jointing Pipes

1. Spigot and socket pipes are to be joined by rubber ring joints.
2. Rubber joint rings are to be in accordance with AS.1646 Elastomeric seals for waterworks purposes.
3. When flush jointed pipes are used, the first pipe (downstream) is to be bedded to establish line and grade with the groove upstream.
4. The external band is to be installed after the joint is made, in accordance with manufacturers recommendations.
5. Approved jointing tape (applied in accordance with the manufacturer's instructions) may be substituted for mortar bands.

SC6.6.4.8.2.4 Laying and Jointing of Box Culverts

1. Box culverts are to be laid in accordance with DTMR Standard Drawing SD1250 - R C Box Culverts and Slab Link Box Culverts - Culverts Height > 600.
2. Box culverts are to be bedded in accordance with IPWEAQ Standard Drawing DS-031 Excavation, Bedding and Backfilling Precast - Box Culverts.
3. The base of the box culvert is to be laid true to line and grade to tolerances and free draining before the upper portion of the box culvert is laid.
4. Joints between lengths of box culverts, tops and sides are to be covered outside by a mortar band not less than 150mm in width and a minimum of 20mm thickness.
5. Mortar bands are to be reinforced with chicken wire for a minimum width of 130mm.

SC6.6.4.8.2.5 Backfilling

1. Backfilling of pipes and culverts is to be in accordance with IPWEAQ Standard Drawing DS-030 Excavation, Bedding and Backfilling - Rigid & Flexible Drainage Pipes.
2. All backfilling is to be spread in 150mm layers and compacted as follows:
   a. Under Proposed Pavements:
      i. The backfill material used for backfilling to a point 300mm above the crown of the pipe or culvert is to be the approved bedding material;
      ii. The trench above the approved bedding material to subgrade level is to be backfilled with approved subgrade replacement material with a minimum of CBR15, placed in layers not exceeding 250mm loose and compacted until the dry density is not less than 95% Modified Maximum Dry Density (refer to LVRC Standard Drawing SD-265 Bedding and Backfill to Pipes Suggested Treatment).
   b. Under Existing Pavements:
      i. The edges of the trench are to be cut with a clean, straight line before excavation;
      ii. The trench is to be backfilled to a level 350mm below finished pavement level with the approved bedding material;
      iii. The trench above the bedding material is to be backfilled with 300mm of lean mix concrete;
      iv. The top 50mm of the trench is to be filled with asphaltic concrete;
      v. The surface is to be restored to a condition at least equal to that of the original pavement.
   c. Under Footpaths and Allotments:
      i. Backfilling is to be carried out using selected material from excavations;
      ii. The material is to be placed in layers not exceeding 250mm loose in depth and is to be compacted to a minimum consolidation of 95% Standard Compaction.
3. Backfill is not to be placed until the pipe drain or box culvert has been inspected and approved by Council.

SC6.6.4.8.3 Drainage Structures

SC6.6.4.8.3.1 Access Chambers and Inlet Pits

1. Inlet pits and access chambers are to be constructed to the form and dimensions shown on the approved plans or IPWEAQ Standard Drawings:
   a. DS-050 Drainage Pits - Field Inlet - Type 1 and Type 2,
   b. DS-060 Drainage Pits - Kerb Inlet – Kerb in Line - General Arrangement; and
   c. DS-063 Drainage Pits - Kerb Inlet – Lip in Line - General Arrangement.
2. Access chambers are to be constructed to the form and dimensions shown on the approved plans or DTMR Standard Drawings:
   a. SD1307 - Access Chamber - Cast Insitu Details for 1050 to 2100 Diameter Roadway Type Access Chamber;
   b. SD1308 - Access Chamber - Precast Roof Slab for 1050 to 2100 Diameter Roadway Type Access Chamber.
3. The thickness of walls of inlet pits and manholes shown on the approved plan or on the IPWEAQ Standard Drawings (listed above) is to be the minimum adopted when inner and outer forms are used.
4. Formwork is to be constructed and braced to ensure that there is no visible deflection of the formwork and that the concrete can finish accurately to the dimensions shown on the approved plans or IPWEAQ Standard Drawings (listed above).
5. Provision is to be made in the walls of pits and access chambers for weep holes to drain the pipe bedding and surrounds.
6. Provision is to be made where required in the walls of manholes and pits for the entry of sub- soil drainage lines.

7. Concrete in manholes and inlet pits is to be placed continuously without any construction joints other than the base and the top of the walls.
8. At any construction joints, the concrete is to be well roughened to ensure a good bond.
9. Step irons are to be installed in all access chambers and gully pits in accordance with DTMR Standard Drawing SD1307 - Access Chamber – Cast Insitu Details for 1050 to 2100 Diameter Roadway Type Access Chamber, and must be down one continuous structural face.
10. The concrete used in the construction of the floors and walls of the unreinforced access chambers and inlet pits is to be in accordance with IPWEAQ Standard Drawing DS-010 Access Chamber - Stormwater Access Chamber Detail - 1050 to 2100 diameter.
11. The concrete used in the construction of reinforced access chambers and inlet pits is to be as detailed on the approved engineering drawings.
12. Cement rendering is to be undertaken on all construction joints and rough surfaces.
13. The bottoms of inlet pits and access chambers to at least the height of the half diameter of the highest pipe connecting thereto and such other concrete surfaces as shown on the plans are to be benched with cement mortar.
14. Special benching to be undertaken uses N25 concrete in large access chambers and at angle junctions in pipe lines.
15. Where the ground is solid, Council may permit the use of only the inner forms in the construction of unreinforced access chambers and pits (the concrete being placed against the earth) provided that the thickness of the wall of such inlet pit or manhole is increased by 75mm to provide an absolute minimum 50mm extra cover for reinforcing steel. However, this is unacceptable in dispersive or saline soil areas.
16. Formwork must remain in position for at least twenty-four (24) hours before stripping.
17. A coat of mortar with or without additives is to be spread over the contact surfaces after which the concrete is to be put in position and well rammed and worked to make a thoroughly bonded and water tight joint.
18. Concrete is to be well rodded and sliced or vibrated to ensure maximum density and good surface finish.
19. No foreign material is to enter the forms during placing of concrete, and concrete is not to be placed unless the excavation has been thoroughly cleaned out and dewatered.
20. Concrete surfaces are to be protected from drying out for at least seven (7) days after placing.

SC6.6.4.8.3.2 Access Chamber Covers and Frames

1. Cast iron access chamber covers and frames are to be of the best quality cast iron, free from cracks, flaws and porous spots.
2. All cast iron surfaces are to be coated with hot bitumen before being placed in the works.
3. Covers, risers and frames are to comply with the details shown on the IPWEAQ Standard Drainage and Water Quality Drawings:
   a. DS-015 Access Chamber - Manhole Frame (Roadway and Non-Roadway) - 1050 to 2100 diameter;
   b. DS-018 Access Chamber - Manhole Riser Details (Roadway);
   c. DS-019 Access Chamber - Manhole Cover (Roadway) 1050 to 2100 diameter; and
   d. DS-020 Access Chamber - Manhole Cover (Non-Roadway) 1050 to 2100 diameter.
4. The word STORMWATER is to be clearly visible on all access chamber covers.
5. The covers are to be cast iron where access chambers are situated within the road boundaries or other trafficable areas and concrete infilled elsewhere (refer to IPWEAQ Standard Drawing DS-021 Access Chamber - Manhole Cover Concrete Infill (Pedestrian Traffic) 1050 to 2100 diameter).
6. The access chamber covers are to be approved by Council before placing.

SC6.6.4.8.3.3 Inlet Pit Grates and Backstone

1. The grate and frame for the standard inlet pit is to be in accordance with IPWEAQ Standard Drawing DS-062 Drainage Pits - Kerb Inlet - Grate and Frame.
2. The precast backstone is to be in accordance with IPWEAQ Standard Drawing DS-061 Drainage Pits - Kerb Inlet - Precast Lintel Details.

SC6.6.4.8.3.4 Inlet and Outlet Structures

1. Headwalls and embankment walls and aprons are to be constructed in accordance with DTMR Specifications MRTS03 Drainage, Retaining Structures and Protective Treatments and the DTMR Standard Drawings:
   a. SD1260 - R C Box Culverts and Slab Link Box Culverts – Culverts Height = 375 to 600;
   b. SD1243 - Precast Culvert Headwalls - Headwall Connections;
   c. SD1250 - R C Box Culverts and Slab Link Box Culverts - Culverts Height > 600;
   d. SD1304 - Pipe Culverts - Wingwalls, Headwall and Apron for Pipe Diameter 750 to 2400;
   e. SD1305 - Pipe Culverts - Headwall and Apron for Pipe Diameter 375 to 675.
2. The inlet and outlet headwalls, embankment walls and aprons are to be constructed to produce a smooth transition of stormwater flowing in the open drain into the pipe and culvert inlet or out of the pipe or culvert into the open drain to reduce energy loss and reduce upstream backwater.

3. Energy dissipaters and scour protection, where required, are to be constructed in the locations as shown on the approved Engineering Plans.
4. Precast headwalls are used where constructed in accordance with the DTMR Standard Drawing SD1243 - Precast Culvert Headwalls - Headwall Connections.
5. The final form of all inlet and outlet structures is to be subject to on-site determinations with Council and in accordance with any Water Quality Management Plan.
6. All headwalls are to be constructed with adequate protection to prevent scouring occurring behind or around the headwall.

SC6.6.4.8.4 Roof, inter and rear of allotment drainage

SC6.6.4.8.4.1 Pipe Size

1. The minimum pipe size is to be 225mm diameter, and the maximum pipe size is to be 375mm diameter.

SC6.6.4.8.4.2 Pipe Types

1. The following pipe types are to be used:
   a. uPVC, sewer Class SN6 Solvent Welded AS/NZS.1260 PVC-U pipes and fittings for drain, waste and vent applications; or
   b. FRC, Class 2 Rubber ring jointed AS.4139 Fibre-reinforced concrete pipes and fittings; or
   c. RC Class 2 Rubber ring jointed AS.1342 Precast concrete drainage pipes.
2. Standard manufacturers fittings are to be used in all cases.

SC6.6.4.8.4.3 Flexible Joints

1. Flexible joints in the form of a short pipe 600mm maximum at the junction of all stormwater drainage structures are to be provided.
2. For uPVC systems:
   a. flexible joints are not necessary however rubber ring jointed connections are to be provided at all drainage structures to accommodate expansion or contraction;
   b. all pipes are to have sanded ends suitable for bonding to concrete

SC6.6.4.8.4.4 Access Chambers

1. Access chamber dimensions are to be as follows:
   a. 600mm diameter pit for a maximum depth to 750mm; or
   b. 900mm diameter pit for a depth ranging between 750mm and 1,500mm; or
   c. 1,050mm diameter manhole where depths exceed 1,500mm.
2. Access chambers are to be provided at the following locations:
   a. change of grade;
   b. change of pipe size;
   c. change of direction;
   d. end of line.
3. Covers to cast-in-situ access chambers:
   a. are to be a standard concrete infilled access chamber cover and frame;
   b. are to be embossed roofwater;
   c. are to have infill concrete at grade N25;
   d. are to match the finished surface ground slope and sit 50mm proud.
4. Access chambers are to be benched in a comparable manner to that required for sewer installations.
5. Grate installations is acceptable where surface flows are to be directed into the system and the system has been designed for these additional flows.

SC6.6.4.8.4.5 Branch Connections

1. At least one connection point is to be provided on the main line for each property.
2. The connection is to be in the form of a Slope Junction installed in the line with the property branch line diameter being a minimum of 50mm (I.D.).
3. An inspection opening is to be located at the end of the property branch line like a sewer house connection branch.
4. The connection point is to terminate 0.5m past any adjacent sewer.
5. Stormwater marking tape is to be tied to the cap of the inspection opening and extend vertically to be tied to a wooden peg at finished surface level.

SC6.6.4.8.4.6 Outlets

1. All interallotment roofwater drainage systems are to discharge into a suitably located lawful point of discharge; or
   a. where the approved Engineering Plan permit discharge into the kerb and channel, such discharge is to be through an appropriate number of pipes, not less than two, of galvanised steel rectangular hollow sections (75mm maximum height) exiting from an access chamber located 0.5m inside the property across the footpath into the kerb and channel;
   b. the rectangular hollow sections are to have adaptors and kerb adaptors installed in accordance with IPWEAQ Standard Drawing RS-081 Kerb and Channel - Residential Drainage Connection.

SC6.6.4.8.5 Open Channels, Detention Basins and Other Earthworks

1. Earthworks associated with open channels, detention basins and swales are to be undertaken in accordance with:
   a. Plans approved by Council;
   b. DTMR Specifications MRTS04 General Earthworks;
   c. DTMR Specifications MRTS16 Landscape and Revegetation Works;
   d. Council's Planning scheme.

SC6.6.4.8.5.1 Culverts and Bridges

1. Culverts are to be constructed in accordance with approved plans, DTMR Specifications MRTS03 Drainage, Retaining Structures and Protective Treatments and the DTMR Standard Drawings:
   a. SD1260 - R C Box Culverts and Slab Link Box Culverts — Culverts Height = 375 to 600;
   b. SD1243 - Precast Culvert Headwalls - Headwall Connections;
   c. SD1250 - R C Box Culverts and Slab Link Box Culverts - Culverts Height > 600;
   d. SD1304 - Pipe Culverts - Wingwalls, Headwall and Apron for Pipe Diameter 750 to 2400;
   e. SD1305 - Pipe Culverts - Headwall and Apron for Pipe Diameter 375 to 675.
2. Bridges are to be constructed in accordance with the below and as per SC6.6.5.6 Bridges:
   a. Plans approved by Council;
   b. relevant DTMR Standard Drawings;
   c. DTMR Specifications MRTS70 Concrete;
   d. DTMR Specifications MRTS71 Reinforcing Steel;
   e. DTMR Specifications MRTS72 Manufacture of Precast Concrete Elements;
   f. DTMR Specifications MRTS73 Manufacture of Prestressed Concrete Members and Stressing Units;
   g. DTMR Specifications MRTS74 Supply and Erection of Prestressed Concrete Deck and Kerb Units.

SC6.6.4.8.6 Water Quality Device Construction

1. Construction of bioretention basins, swales and wetlands must be in accordance with:
   a. Plans approved by Council;
   b. Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands IPWEAQ Standard Drawings Bioretention and Streetscape Swale series.

SC6.6.4.8.6.1 Inspection of works

1. The person who has the benefit of the development approval must comply with the inspection and testing plan for engineering work in:
   a. Location of the structures, Finish Level and Invert Level of the structure by survey co-ordinated to the local datum for each structure;
   b. Bedding materials. Visual inspection and compaction certification in accordance with the AS/NZS.3725 Design for installation of buried concrete pipes;
   c. Drainage line or pipes. Visual and CCTV inspection with certification of joint seals and asset integrity including sealed connections at junctions, chambers and pits.
2. The results of each test must:
   a. meet the specified standard;
   b. be repeated after removal work has been carried out if a test does not meet the specified standard;
3. The RPEQ Consultant Engineer may conduct audit inspections on all donated asset installations at the discretion of Council.
4. On-maintenance inspections must include:
   a. the roads, pipes, structures and flow paths to ensure that they are clear of silt and debris;
   b. the roads, pipes, structures and kerbs as flow paths to ensure that they are not subject to ponding
   c. the turfing of turfed areas shown on the approved drawings;

d. the pipes to ensure they are laid straight to grade and line;
e. the pipes to ensure they are not damaged;
f. the pipes to ensure that the pipe penetration to a manhole is finished off;
g. the quality of the concrete work;
h. the quality of the render work;
i. manhole lids to ensure that they comply with the standard specifications;
j. the correct drop through manholes;
k. gullies and grates;
l. overland flow paths;
m. the opening of GPTs to ensure cleanliness;
n. the CCTV of the complete stormwater network including rear of allotment drainage;
o. the water quality control measures;
p. the as-constructed drawings if available.

SC6.6.4.8.7 As constructed documents

1. 'As constructed' plans must be submitted for:
   a. All stormwater drainage infrastructure including open channels etc.;
   b. Rear-of-allotment drainage.

SC6.6.4.8.7.1 Underground stormwater drainage

1. 'As constructed' plans must record the following minimum standard of information, as well as other details to the project:
   a. pipe sizes, types, classes and lengths of sections of drainage lines;
   b. location of drainage lines;
   c. invert levels and grades of pipes;
   d. finished surface levels for structures;
   e. location of structures;
   f. structure types and dimensions;
   g. location of subsoil drains and clean-out points;
   h. details of relocated services, if applicable.

SC6.6.4.8.7.2 Roof, inter and rear of allotment drainage

1. 'As constructed' plans must record the following minimum standard of information, as well as other details to the project:
   a. Pipe sizes, types, classes and lengths of sections of drainage lines;
   b. location of pipes relative to property boundaries;
   c. invert levels and grades of pipes;
   d. finished surface levels for structures;
   e. location of structures relative to property boundaries;
   f. structure types and dimensions;
   g. location of connection stubs relative to property boundaries;
   h. depth to connection stub from finished surface level;
   i. finished surface levels at every corner of allotments;
   j. details of relocated services, if applicable.

SC6.6.5 Streets and Roads

SC6.6.5.1 Introduction

1. The policy provides Applicants with general guidelines for horizontal and vertical road design for developments (residential, rural residential, rural and industrial) and associated roads. It includes guidance on the policy and standards required for the provision of road design and construction in order to satisfy Council's requirements and ensure optimum design for inclusion of social, and environmental factors.
2. Design should be in accordance with the purpose as outlined by the Planning Scheme.
3. In addition to the criteria listed in the planning scheme codes and this planning scheme policy, streets and roads are planned, designed and constructed in accordance with the current edition of the following:
   a. Austroads;
   b. Crime Prevention through environmental Design (CPTED) – Guidelines for Queensland;
   c. DTMR manuals and guidelines;
   d. IPWEA Street Design Manual – Walkable Neighbourhoods.
   e. Manual of Uniform Traffic Control Devices (Qld) (MUTCD);
   f. Queensland Government, Model code for neighbourhood design – A code for reconfiguring a lot.
4. Austroads guides are to be used in conjunction with standard specifications and any 'guides to road planning and design practice' advice that is issued by DTMR from time to time. The 'minimum' standard for design must be used. Where the 'minimum' standard cannot be achieved on infill sites, consult with Council officers to obtain approval on the overall design standard to be achieved.
5. The use of extended design domain (EDD) principles is to be undertaken only by suitably experienced EDD designers. The use of EDD is to be restricted to 'brownfield' and 'infill' sites and applied in accordance with Austroads and DTMR guidelines.
6. A Safety in Design report is to be prepared identifying hazards and risk assessment method in the design process to eliminate or minimise health and safety risks throughout the life of the infrastructure.

SC6.6.5.2 Road Hierarchy and Design

1. The functional hierarchy of roads enables efficient street and road systems that caters for the movement of people and goods, while maintaining the amenity and legibility of the urban and rural area. Road hierarchy maps are provided in Planning Scheme Schedule 2.1 — Map Index - OM15 Road Hierarchy.
2. The road hierarchy and associated cross-sections represent Council's minimum standard for its street and road system, refer LVRC Standard Drawings:
   a. SD-256 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Section;
   b. SD-257 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Section & Typical Service Locations;
   c. SD-258 Regional Road Standard Urban & Rural Residential Streets — Rural Roads Typical Cross Sections & Details;
   d. SD-259 Regional Road Standard Industrial Streets — Typical Cross Sections
   e. SD-260 Regional Road Standard Urban & Rural Residential Streets — Miscellaneous Details.

SC6.6.5.2.1 Road design summary

1. SC6.6 Appendix 1 Urban and Industrial Road Design, and SC6.6 Appendix 2 Rural Road Design, summarise key design elements for each of the road classifications for use in the detailed geometric design. These summary tables should be read in conjunction with LVRC Standard Drawings:
   a. SD-256 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Section;
   b. SD-257 Regional Road Standard Urban & Rural Residential Streets — Typical Cross Section & Typical Service Locations;
   c. SD-258 Regional Road Standard Urban & Rural Residential Streets — Rural Roads Typical Cross Sections & Details;
   d. SD-259 Regional Road Standard Industrial Streets — Typical Cross Sections
   e. SD-260 Regional Road Standard Urban & Rural Residential Streets — Miscellaneous Details.
2. In many cases these elements represent the minimum requirement. The engineering of these elements needs to be considered when preparing the concept design and this information brought to Council for review and approval in the pre-lodgement meeting process.
3. Other design elements not specified in the table, should be in accordance with the design standards outlined in SC6.6.5.1 Introduction.

SC6.6.5.2.2 Kerb, channels and swale drains

1. Concrete kerbs and channels are to be provided on both sides of all streets, except where swale drains are approved for use. This includes industrial areas and the inner urban areas.
2. The standard kerbs and channels for lower order streets up to and including collectors (except for laneways) are to be lay-back, in accordance with IPWEAQ Standard Drawings, Road and Kerb Ramp series.
3. Barrier-type kerbs and channels with a 450mm channel (type B1) in accordance with IPWEAQ Standard Drawing RS-080 Kerb and Channel - Profiles and Dimensions - including Edge Restraints, Median & Channel, are to be used in the following cases:
   a. higher order roads of major collector level and above, and all industrial roads;
   b. streets adjacent to parks;
   c. shopping centres and in locations where high pedestrian volumes are likely or for greater pedestrian safety (e.g. on the frontages of schools, major sporting facilities and parks).
4. Semi-mountable-type kerb is to be used:
   a. at medians and traffic Islands: semi-mountable or low-profile kerb type SM3 for concrete in-filled treatments and type SM5 for landscaped treatments, in accordance with IPWEAQ Standard Drawing RS-080 Kerb and Channel - Profiles and Dimensions - including Edge Restraints, Median & Channel;
   b. at roundabouts: kerb type M5 on the outer island and type SM4 on the centre island, in accordance with IPWEAQ Standard Drawing RS-080 Kerb and Channel - Profiles and Dimensions - including Edge Restraints, Median & Channel.
5. The grade of kerbing and channelling is to conform to the road centreline. However, at locations where the kerb and channel grade divert from the centreline grade (such as at intersections or on superelevated curves) the minimum channel grade is to be in accordance with Austroads Guide to Road Design.
6. Kerbs and channels are to be constructed with horizontal curves at all changes in horizontal alignment. To improve appearance, where small deflections occur (e.g. on tapers), horizontal curves must be as long as possible.
7. Kerb ramps are to be constructed at all kerb returns as shown on the relevant IPWEAQ Standard Drawings, Road and Kerb Ramp series.
8. Stormwater kerb connections must be installed at subdivision stage for all road classifications, except at industrial precincts where drainage is directly connected to the underground system.
9. All concrete must be a minimum of N32. Slump concrete (slip-formed) is the preferred construction material, not kerb mix.
10. N32 slump concrete must be used for kerb and channel construction in industrial areas in accordance with IPWEAQ Standard Drawing RS-080 Kerb and Channel - Profiles and Dimensions - including Edge Restraints, Median & Channel. Industrial kerbing must have an additional minimum 50mm concrete base thickness over standard profiles. Slump or slip-form concrete, not kerb mix, must be used in industrial areas. In industrial areas where there is a large volume of high-order vehicles, all kerbing must be designed for these heavy loads.
11. Pavement must extend a minimum of 300mm behind the back of the kerb. The minimum pavement thickness under the kerb must be:
    a. for urban, residential and rural residential areas: 100mm; or
    b. for industrial areas: 150mm;
    c. Kerb and channel must be formed on the upper subbase pavement.
12. Swale drains are only permissible in drainage reserves and parklands. They are to be constructed clear of infrastructure, with a maximum side slope of 1V:6H (grass or turf surface treatment) or 1V:4H (special cases with landscaped surface treatments), and with a minimum longitudinal grade of 0.7% and maximum grade of 5%.

SC6.6.5.2.3 Street or road frontage

1. Where the street or road frontage to a development is unsealed or unformed at the time of development approval, it is to be constructed to a standard specified in the conditions of approval or, where not specified in the conditions of approval, no less than one half of the full road width plus one 3.5m wide traffic lane from the nominal centre line to the bitumen edge. Pavement is to be an additional 0.5m wider.
2. The full drainage system required within the road corridor is to be designed. However, it only needs to be constructed in accordance with the development approval.
3. In developments that do not require kerb and channel, e.g. swale drain construction, the drainage requirements for each property access are to be designed and details provided on drawings. A future property owner may construct the access to align appropriately with building location. Where table drains form part of the stormwater drainage solution (Stormwater Management Plan), consideration is to be given to culvert sizes to ensure that major storm events do not cause flooding onto properties. If the location of the access is restricted by visibility, site conditions or the like, the access is to be constructed at the time of development.
4. A drainage plan is to be prepared detailing the full drainage requirements for each lot frontage, e.g. culvert size, length, inlet or outlet levels, preferred location if applicable etc.
5. An existing, sealed, street or road frontage to a development is to be reconstructed to one half of the full width of the street or road unless the existing pavement is adequate for the ultimate design conditions; in that case, the pavement only must be widened, with kerb and channel provided at the nominated alignment. The minimum total width is to be no less than one half of the full width of the street or road (i.e. one 3.5m wide traffic lane from the nominal centre line to the bitumen edge). Pavement is to be an additional 0.5m wider.
6. An assessment by Council must be made as to whether the existing road reserve is the correct width. Additional land may

be required to provide a road corridor that complies with the road category in the hierarchy and this will be at no cost to Council.
7. For a street or road at the end of staged development or where the road will eventually be continued, the preferred treatment is construction of a circular turning movement with an allowance for refuse collection vehicle turn around. The turning area is to be full depth pavement with AC surfacing to match to adjoining road.
8. Road widening, or reconstruction must match the existing profile and cross-section, subject to meeting minimum cross-fall design standards of 3% (2% is the absolute minimum).

SC6.6.5.2.4 Active transport infrastructure

1. Paths for walking and cycling should be provided within the road network in accordance with the requirements in SC6.6 Appendix 1 Urban and Industrial Road Design with the following comments:
   a. Concrete paving must conform to the IPWEAQ Standard Drawing RS-065 Pathways - Concrete Pathway - Construction Details. It must be located in accordance with Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling from either side of the pathway boundaries;
   b. The concrete pavement within a pathway must be constructed to the adjacent kerb and channel and must include a kerb ramp;
   c. Bollards must be installed to restrict vehicular access at the ends of pathways but are to be located and delineated so as not to create a hazard for pedestrians and cyclists.
2. Pathways should be minimum width to suit the required user type, in accordance with Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling.
3. Where a pathway is not located within a road reserve, the following should be noted:
   a. The minimum width of land for a pathway is to be 5m. Where an overland stormwater flow path is required, the width must include waterway width, concrete path and any services requirement. The minimum width is 10m;
   b. Where a service is to be installed, pathway land must be widened to ensure that the service is clear of the path;
   c. All pathways must be design in accordance with Crime Prevention Through Environmental Design guidelines and principles.
   d. Pathways located in parks, open-space and drainage reserves are to be constructed above the flow of a storm event with a 20-year ARI;
   e. Pathways must include Standard Street Lighting Lamps and Luminaires, in accordance with SC.6.6.7 Infrastructure Works;
   f. Where pathways are collated with wildlife corridors, the pathways and services are to avoid habitat trees to the greatest extent possible.

SC6.6.5.2.5 Signs and road markings

1. All signs must be designed, manufactured and installed in accordance with the current edition of the DTMR MUTCD.
2. Street name signs must be erected at each intersection. Suitable direction and way-finding signage is to be considered (refer to IPWEAQ Standard Drawings RS-130 Road Furniture - Street Name Sign and Location (Finger Board) and RS-131 Road Furniture - Traffic Sign Installation Details).

SC6.6.5.2.6 Road-edge guide posts and safety barriers

1. Road-edge posts must be provided at all locations where concrete kerbing and channelling is not constructed (e.g. half-road construction, tapers, ends of roads etc.), in accordance with the DTMR MUTCD.
2. All safety barrier site selection criteria must be addressed. For higher order roads, safety barriers must be designed in accordance with the DTMR Road Planning and Design Manual and Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers. In urban residential and industrial precincts safety barriers must be located at steep embankments and roadside obstacles and hazards in accordance with the Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers.

SC6.6.5.2.7 Clear zone

1. Clear zones must be provided, as a functional element, in accordance with the Austroads design manuals for all roads. The clear zone element is to be assessed and the roadside environment designed accordingly.
2. Risk assessment for structures placed in clear zones must be undertaken using Roadside Impact Severity Calculator (RISC) or Roadside Safety Analysis Program (RSAP) in accordance with Austroads Guide to Road Design Part 6 and DTMR Road Planning and Design Manual Edition 2, Volume 3 — Supplement to Austroads Guide to Road Design, Part 6: Roadside Design, Safety and Barriers. Both quantitative evaluation and qualitative evaluation are to be undertaken.
3. The RISC program and latest accident costs are available from the DTMR web site.

SC6.6.5.2.8 Cul-de-sac geometry

1. Standard Turning areas at the head of residential cul-de-sac are to be based on typical manoeuvring areas for the service vehicles identified in Austroads Standards.
2. The turning area is to be capable of accommodating most vehicles with a single movement turn.
3. The minimum radius to kerb invert for a cul-de-sac is as follows:
   a. Urban and Rural Environment:
      i. Approach curve radius tangential to the turning circle - 20m;
      ii. Bulb Radius - 10m.
   b. Industrial Environment:
      i. Approach curve radius tangential to the turning circle- 32m;
      ii. Bulb Radius - 16m.

SC6.6.5.2.9 Intersections

1. Intersections on roads and streets are to be designed in accordance with the current Austroads: Guide to Road Design, Guide to Road Safety, Guide to Traffic Management, DTMR standards and in accordance with road hierarchy descriptions within in this policy.
2. All new intersections of local access streets, and collector and major collector roads, in rural, industrial and residential areas are preferably to be designed as three-way intersections.
3. Where four-way intersections are unavoidable, they must be designed as roundabouts in accordance with the Austroads Guide to Road Design and must give regard to the needs and safety of pedestrians and cyclists.
4. Four-way intersections are to be designed at the junctions of sub-arterial and regional arterial roads only where signalisation (preferred) or roundabouts are proposed.
5. Provision of channelisation at intersections will depend on traffic volumes and intersection layout in accordance with turn warrants assessment as specified in Austroads Guide to Traffic Management.
6. On major collector streets, median openings must be provided at all intersections except at intersections with local access street.
7. On sub-arterial and regional arterial roads, the minimum spacing of median openings must be in accordance with Austroads requirements.
8. Where intersection threshold treatments are required they must be constructed of concrete or approved alternative and must be highly visible (in accordance with the DTMR MUTCD).

SC6.6.5.2.10 Pavement tapers

1. Pavement tapers to existing construction are to be designed in accordance with the current Austroads: Guide to Road Design, Guide to Road Safety and Guide to Traffic Management based on the design speed of the road.
2. Tapers are to be constructed to the same standard as the proposed full road pavements.

SC6.6.5.2.11 Truncations

1. Truncations of the real property boundaries are to be provided at speed restriction devices, bends and intersections.
2. Roadway and footpath widths are to be maintained at the minimum specified widths at any point.
3. Minimum truncation distance must be 6m radius with three chords of equal length. This truncation may need to be increased to accommodate intersection design layout, pedestrian crossings and sight distances according to road hierarchy.

SC6.6.5.2.12 Property Access

SC6.6.5.2.12.1 Access driveway

1. An access driveway is that section of property access between the edge of the pavement or kerb and channel on a dedicated public road, and the property boundary.
2. Design elements to be considered for access driveways.
3. Urban and Rural Residential domestic access is to comply with AS/NZS.2890 Parking facilities. Consideration is to be given to adopting a higher reaction time for vehicles travelling on higher order roads.
4. Rural Access and Rural Access in a constraint environment is to comply with Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections:
   a. Sight distances at accesses are to comply with the sight distance requirements for intersections Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections, i.e. that approach sight distance (ASD), safe intersection sight distance (SISD), and minimum gap sight distance (MGSD) are achieved.
5. The current version of the following IPWEAQ Standard Drawings are to be used. However, for ‘brownfield’ developments some modification may be necessary and will be decided on a case by case basis:
   a. RS-049 Vehicle Crossings - Residential Driveways Plan 1 of 2;

b. RS-050 Vehicle Crossings - Residential Driveways Plan 2 of 2;
c. RS-051 Vehicle Crossings - Heavy Duty;
d. RS-056 Vehicle Crossings - Rural Driveway;
e. RS-065 Pathways - Concrete Pathway - Construction Details.

SC6.6.5.2.12.2 Rear Lot Access strip

1. Rear lot access provides access to lot or lots by means of a narrow length of land within the lot as part of the main body of the lot. Where the land provides access to more than one lot, access easements are to be provided.
2. Rear lot access strips and driveways must be designed and constructed in accordance with Table SC6.6-6: Rear lot access strip dimensions, and Table SC6.6-7: Rear lot access strip construction, before plan sealing.
3. Rear lots are designed such that the minimum area of the lot is achieved exclusive of any access strip.
4. No more than three lots gain access from the same access handle.
5. No more than two rear lots and/or rear lot access strips directly adjoin each other.
6. Rear lot access strips are located on only one side of a full frontage lot; and
7. Rear access strips do not change the existing overland flow path drainage lines. Installation of culverts at cross drainage points may be required.
8. Rear access strips do not divert water onto the road reserve.
9. Where more than two lots have access to a single access, the vehicle crossover, from the road pavement for a minimum distance of 12m, must be a minimum of 5.5m wide for combined entry and exit.
10. Where more than two lots have access to a single access a vehicle passing bay is to be provided on the driveway at 30m intervals, at minimum width for passing sections is 5.5m.
11. All concrete of driveways are to be designed and certified by an RPEQ in accordance with site conditions and traffic loading.

Figure SC6.6-3: Ideal Rear Lot Access Strip arrangement

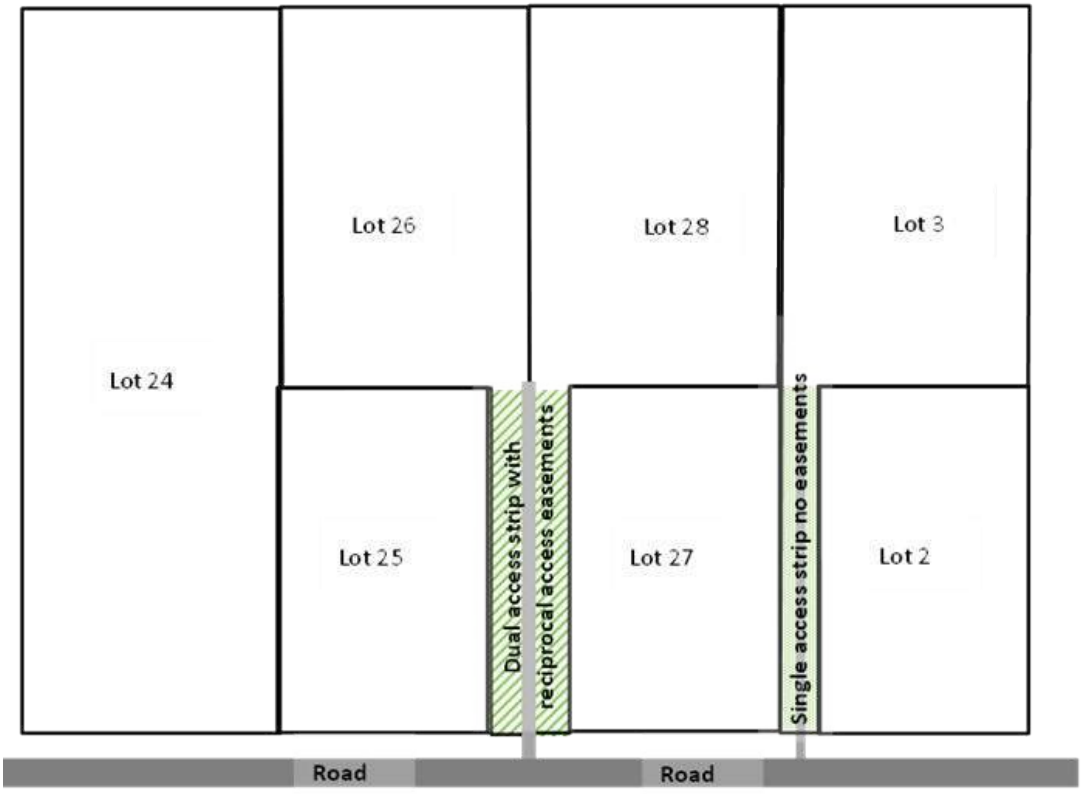


Table SC6.6-6: Rear lot access strip dimensions

ZONE OR AREA	MINIMUM WIDTH FOR ONE LOT (M)	MINIMUM WIDTH FOR MORE THAN ONE LOT (M)	DRIVEWAY WIDTH (M)	MAXIMUM LENGTH (M)	MAXIMUM GRADE
Urban Residential	5	6	3.5	30	10%

Rural Residential	6	6	3.5	60	10%
Rural	10	10	4	150	10%

Table SC6.6-7: Rear lot access strip construction

NO OF LOTS	LENGTH OF ACCESS WAY	MINIMUM REQUIREMENTS
1	Less than 30m	Where in an Urban Residential Zone or Area: Grade N32 concrete driveway. *Note—Concrete of driveway to be designed and certified by an RPEQ in accordance with site conditions and traffic loading.* Where in a Rural Residential Zone or Area: Bitumen or Asphalt, to suit nominal traffic Loading $2x10^3$; ESA. Where in a Rural Zone or Area: all weather gravel pavement
1	30m and greater	Where in an Urban Residential Zone or Area: Grade N32 concrete driveway Where in a Rural Residential Zone or Area: Bitumen or Asphalt 3.5m wide to suit nominal traffic Loading $2x10^3$; ESA. Where in a Rural Zone or Area: all weather gravel pavement
2-3	Less than 30m	Where in an Urban area: Grade N32 concrete driveway Where in a Non-Urban area: Bitumen or Asphalt 3.5m wide to suit nominal traffic Loading $5x10^3$; ESA Where in a Rural Zone or Area: all weather gravel pavement
2-3	30m and greater	Where in an Urban area: Grade N32 concrete driveway Where in a Non-Urban area: Bitumen or Asphalt 5.5m wide to suit nominal traffic Loading $5x10^3$; ESA Where in a Rural Zone or Area: all weather gravel pavement

SC6.6.5.3 Pavement Design

SC6.6.5.3.1 Introduction

1. This policy provides Council's minimum standards for pavement designs for roadworks associated with Council and development works. They must be read in conjunction with the latest version of the following publications:
   a. Guide to Pavement Technology Part 2: Pavement Structural Design, Austroads;
   b. Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, DTMR.

SC6.6.5.3.2 Subgrade Evaluation

SC6.6.5.3.2.1 Determination of Subgrade Strength

1. A subgrade design CBR must be determined for each section of road and defined based on topography, drainage and soil type. The subgrade CBR must be determined through single-point four-day soaked CBR testing in accordance with AS.1289 Methods of testing soils for engineering purposes. Testing must be carried out in a NATA registered laboratory.
2. Subgrade testing is to include the requirements as outlined in AS.1289 with the exception of:
   a. 4-day soaked CBR (1 Point), including swell @ 95% standard compaction @ 100% OMC - Fill and subgrade.

SC6.6.5.3.2.2 Frequency of Subgrade Testing

1. The frequency of sampling for determination of the subgrade CBR is to be agreed between the designer and Council, with minimum testing frequencies provided in Table SC6.6-8: Minimum Testing Frequency.

Table SC6.6-8: Minimum Testing Frequency

ROAD LENGTH	TESTING FREQUENCY
≤ 120m	Minimum of two tests for each subgrade type
> 120m	One test every 60m or part thereof, with a minimum of three tests for each subgrade type

2. When determining the testing frequency to be adopted, consideration must be given to the following:
   a. spacing of test sites must be selected to suit subgrade, topographic and drainage characteristics of the road;
   b. sampling must be taken in the general position of the outer wheel path on both sides of the road; and
   c. Where existing fill is present, an engineer (RPEQ) is required to verify that in addition to near surface fill material, deeper soil layers including fill and natural soils are considered in the design. This will require sampling and CBR testing of multiple layers with CBR values of deeper layers being considered in the design. This provision must also apply where the natural soil profile exhibits decreasing CBR values with depth.

SC6.6.5.3.2.3 Selection of Pavement Design Subgrade CBR

1. The design subgrade CBR must be calculated using the following guide:
   a. Two test results — adopt the lowest value of the results;
   b. Three test results — adopt the mean value of the lowest two results;
   c. Six tests results — adopt the lesser of the second lowest test result or the mean value of the lowest three test results (the material can be regarded as inconsistent when for a set of six test values, the mean is more than 10 above the mean of the lowest three results);
   d. 10 or more tests results - if the testing interval and data are unbiased, and the variability of test results is low, then statistical analysis can be used to determine a design CBR at an appropriate percentile level. To ensure homogeneous sub-sections of subgrade, the CBR values must have a coefficient of variation (i.e. standard deviation divided by the mean) of 0.25 or less. The ten-percentile level (i.e. 90% of results exceed this level) is commonly adopted as the design CBR of higher order roads.

SC6.6.5.3.2.4 Expansive Clays

1. This section relates to the identification and mitigation of expansive soils and must be read in conjunction with the latest version of DTMR Supplement to ‘Part 2: Pavement Structural Design’ of the Austroads Guide to Pavement Technology.
2. A guide to the identification and qualitative classification of expansive soils is presented in Section 5: Subgrade Evaluation of DTMR Supplement to ‘Part 2: Pavement Structural Design’ of the Austroads Guide to Pavement Technology. Where CBR swell and Weighted Plasticity Index (WPI) on the same material indicate different classifications, the CBR swell must take precedence.
3. Providing minimum cover should be in accordance with Section 5: Subgrade Evaluation of DTMR Supplement to ‘Part 2: Pavement Structural Design’ of the Austroads Guide to Pavement Technology.
4. In areas where it is not economical to provide a minimum cover, other treatments such as lime stabilisation may be considered. When stabilisation of the subgrade material is being considered, additional testing may also be required such as lime demand, sulphate content and UCS. Further guidance on the evaluation of materials for stabilisation is provided in DTMR Specification MRTS04 General Earthworks, the DTMR Pavement Rehabilitation Manual and the DTMR Materials Testing Manual (Part 2).

SC6.6.5.3.2.5 Lime Stabilised Subgrades

1. The following section must be read in conjunction with the latest version of the following publications:
   a. Material Testing Manual Part 2: Application;
   b. Structural design procedure for lime stabilised subgrade Guideline, DTMR.
2. If the amount of lime is insufficient to achieve enhanced properties long-term, no allowance must be made for the change in design CBR due to stabilisation.
3. For the purposes of mechanistic design, lime stabilised subgrades are considered to behave as unbound soil materials with improved stiffness and must be modelled with the properties outlined in Section 6: Design parameters of DTMR Guideline Structural design procedure for lime stabilised subgrade.

SC6.6.5.3.2.6 Subgrades with Design CBR Less Than 2%

1. Refer to Section 5: Subgrade Evaluation of DTMR Supplement to ‘Part 2: Pavement Structural Design’ of the Austroads Guide to Pavement Technology.
2. A presumptive subgrade design CBR of 2% for the assumed semi-infinite layer (that is, from the top of the treatment and extending infinitely below) is typically adopted for the following treatments with thicknesses determined in Section 5:

Subgrade Evaluation of DTMR Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology:
   a. geotextile wrapped unbound granular material;
   b. geotextile wrapped recycled material blend;
   c. geotextile wrapped rock fill.
3. Typically, the materials are modelled as selected subgrade materials with design parameters not exceeding those of a CBR 15% selected fill material.
4. Alternate subgrade treatments that meet the minimum design requirements can be submitted to Council for approval.
5. A reduction in pavement thickness due to any reinforcing provided by the geotextile is not generally applied. The exception to this may be when it is necessary to maintain cover or separation to existing services in soft subgrades and it is not practicable to construct full-depth pavement. In this case, the use is to be supported by technical information and RPEQ certified pavement design calculations from the manufacturer and the resulting design pavement based on a working platform.

SC6.6.5.3.2.7 Rural Roads

1. Rural road pavement depth design will be based on:
   a. Non-inundated areas - Unsoaked CBR;
   b. Inundated areas, including flood plains, 4 day soaked CBR. Maps defining the regions flooding areas are available on Council's website.

SC6.6.5.3.3 Design Traffic

SC6.6.5.3.3.1 Selection of Design Period

1. The design traffic must be calculated based on the following minimum pavement design period for each pavement type:
   a. Flexible pavement – 20 years;
   b. Rigid pavement – 40 years.

SC6.6.5.3.3.2 Calculation of Design Traffic Loading

1. Design traffic must be calculated for the applicable design life of the pavement in accordance with the latest version of the following publications:
   a. Guide to Pavement Technology Part 2: Pavement Structural Design, Austroads;
   b. Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, DTMR.
2. For the mechanistic-empirical design method for pavements containing one or more bound materials, the design traffic is characterised by the cumulative heavy vehicle axle groups (HVAG) together with the traffic load distribution (TLD). For the empirical design method for unbound granular pavement with thin bituminous surfacing, the design traffic is described in terms of equivalent standard axles (ESA).
3. Where the pavement design is being undertaken for the realignment or rehabilitation of an existing road, the design traffic loading must be based on current site-specific traffic survey data. If the pavement design is being undertaken for a greenfield site, the calculation of design traffic must take the following into consideration:
   a. traffic survey data for nearby roads of a similar nature;
   b. estimated traffic generated by the new road and any land development likely to occur nearby the project site calculated in accordance with the latest version of the Guide to Traffic Impact Assessment DTMR.
4. Where historical traffic data is not available, and the nature of the project does not warrant a site-specific traffic survey (e.g. for some projects on minor and local roads), minimum presumptive values provided in Appendix 1 may be used as a guide for the pavement design process for urban roads. These values may be subject to variation based on the surrounding traffic generating catchment for the road.
5. Where historical traffic data in not available for rural roads, a site-specific traffic survey must be undertaken to determine the percentage and classification of heavy vehicles to determine the design traffic loading and must take into consideration seasonal use of the road.
6. All traffic data and/or assumptions made in the calculation of the design traffic must be included in the Pavement Design Report and submitted to Council.

SC6.6.5.3.3.3 Design Traffic at Intersections

1. Design traffic at an intersection must be calculated by adding the design traffic to one road to the design traffic applicable to the crossroad. Selection of the pavement structure must take the minimum maintenance requirements into consideration.

SC6.6.5.3.3.4 Design Traffic for Car Parking Facilities

1. The design traffic calculation for car parking facilities must be based on traffic load concentrations within the car park areas, such as entrances or exits. The minimum flexible pavement thickness for car parking facilities must be 250mm.

SC6.6.5.3.4 Pavement Types

1. Guidance on the selection of appropriate pavement type is provided in Section 2 Pavement Design Systems of DTMR Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology.
2. Guidance on the commonly used pavement types is provided in the following sections.

SC6.6.5.3.4.1 Unbound Granular Pavement with Thin Bituminous Surfacing

1. Typically, unbound granular pavements with either a bituminous seal or asphalt less than 40mm thick are desirable for lightly-trafficked minor and local roads as this pavement type provides the lowest whole-of-life cost. Where asphalt is used for the surfacing, a prime and initial seal or primer seal must be applied to the surface beneath the asphalt to aid bonding of the asphalt layer to the granular material and water proofing.
2. Unbound granular material must be in accordance with the current version of DTMR Specification MRTS05 Unbound Pavements.

SC6.6.5.3.4.2 Asphalt Over Granular Pavements

1. These pavements comprise multiple asphalt layers over a granular base and/or subbase. The main application for asphalt on granular pavement is on medium traffic urban roads. It may also be suitable for rural highways and main roads depending on climate and traffic loads.
2. All asphalt pavement is to be in accordance with DTMR Specification MRTS30 Asphalt Pavements.

SC6.6.5.3.4.3 Full Depth Asphalt

1. Full depth pavements are not used for local streets. They may be used in areas where speed of construction is critical, such as on major roads or narrow pavement widening. Full depth asphalt must be underlain by a minimum of 150mm thick lightly bound improved layer.
2. Any full depth pavement design, where proposed, must be submitted to Council for consideration.

SC6.6.5.3.4.4 Cement Modified Pavements

1. Cement modified pavements, which may include lightly-bound bases or working platforms, are acceptable. Cement modified materials will typically have a maximum target UCS of 2mPa. Details of any proposed cement modified materials to be used must be submitted to Council for consideration. A NATA registered laboratory must undertake all the required testing.

SC6.6.5.3.4.5 Concrete Pavements

1. Full depth concrete pavements are used only on heavily trafficked roads with a design traffic loading of 106 HVAG or more and must be designed in accordance with the following publications current at the time the design is prepared:
   a. Guide to Pavement Technology Part 2: Pavement Structural Design, Austroads;
   b. Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, DTMR.
2. Special attention is to be paid to the jointing and subbase details regarding rideability and the provision of additional conduits for future services. Where a concrete pavement is chosen, a concrete pavement design is to be submitted to Council for approval.

SC6.6.5.3.5 Design of Flexible Pavements

SC6.6.5.3.5.1 Mechanistic Empirical Design Procedure

1. The mechanistic-empirical design procedure as specified in Section 8: Design of Flexible Pavements of Austroads Guide to Pavement Technology Part 2: Pavement Structural Design, may be used for flexible pavements with one or more bound layers and is typically undertaken using the latest version of CIRCLY or AustPADS.
2. It must be noted that thin interlayers and surfacing (less than 40mm thick) are non-structural and are not typically included in the design model.
3. Where the subgrade design CBR is less than 3%, subgrade treatments must first be applied, and a presumptive design CBR of 3% is adopted at the top of this treatment in the mechanistic-empirical design model.

SC6.6.5.3.5.2 Empirical Design Procedure for Pavements with Thin Asphalt Surfacing

1. For the design of granular pavements which are surfaced with either a bituminous seal or asphalt, the empirical design procedure as specified in Austroads Guide to Pavement Technology Part 2: Pavement Structural Design, may be used.
2. The minimum pavement thickness must be determined using one of the following methods:
   a. Figure 8.4 Design chart for granular pavements with thin bituminous surfacing of Austroads Guide to Pavement Technology Part 2: Pavement Structural Design, for moderately-heavily trafficked roads where the design traffic exceeds 105 ESA;
   b. Figure 12.2 Example design chart for lightly-trafficked granular pavements with thin bituminous surfacings of Austroads Guide to Pavement Technology Part 2: Pavement Structural Design, for lightly trafficked roads where the design traffic is less than 105 ESA;
   c. the mechanistic-empirical design procedure as specified in Section 8.2 Mechanistic-empirical Procedure of Austroads Guide to Pavement Technology Part 2: Pavement Structural Design.
3. If the thin surfacing is dense graded asphalt or stone mastic asphalt, its thickness (< 40mm) may be considered to contribute to the required total thickness over the insitu subgrade but does not affect the required thickness of granular base. Other surfacing types (such as sprayed seals) are considered to make no contribution to the required thickness of granular material.

SC6.6.5.3.6 Design of Rigid Pavements

1. The design of rigid pavements must be in accordance with the latest version of the following publications:
   a. Guide to Pavement Technology Part 2: Pavement Structural Design, Austroads;
   b. Supplement to 'Part 2: Pavement Structural Design' of the Austroads Guide to Pavement Technology, DTMR.

SC6.6.5.3.7 Rural Road Pavement

1. To be based on SC6.6.5.3.5 Design of Flexible Pavements.
2. Roadworks pavement:
   a. The developer is to submit to Council a certificate from a NATA-registered laboratory indicating conformity with the pavement requirements;
   b. The pavement material may be supplied ex-quarry or delivered to site, and the supplier is to have in place a quality system ensuring the quality of the material;
   c. A certificate indicating conformity with the pavement requirements is to accompany the pavement material.
3. Roadworks construction:
   a. Construction of works is to be undertaken in accordance with approved drawings and specifications;
   b. Table drains are to be constructed in accordance with road typologies and discharge to a lawful point of discharge and ensure no adverse impacts.

SC6.6.5.3.8 Pavement Design - Gravel Roads

1. Pavement design for gravel roads is to be based on SC6.6.5.3.5 Design of Flexible Pavements plus 50mm wearing course. Minimum depth — 200mm.
2. Gravel quality to be in accordance with Austroads Guide to Pavement Technology Part 6: Unsealed Pavements. Table 3.5 Typical properties for unsealed road wearing course, of Austroads Guide to Pavement Technology Part 6: Unsealed Pavements, is a guide to suitable gradings for unsealed road wearing course. The materials are to exhibit the characteristics of the performance base specification as outlined in Section 3: Pavement Materials, of Austroads Guide to Pavement Technology Part 6: Unsealed Pavements. The following specification is to be used:
   a. Shrinkage Product = ((% Passing 26.5mm sieve - (% Passing 2mm sieve) x (Linear Shrinkage x % Passing 0.425mm sieve));
   b. Grading Coefficient = ((% Passing 26.5mm sieve - (% Passing 2mm sieve) x (% Passing 4.75mm sieve/100)).
3. Rural road characteristics to be in accordance with Table 3.6 Typical specifications, of Austroads Guide to Pavement Technology Part 6: Unsealed Pavements.
4. The relationship between shrinkage product, grading coefficient and performance of wearing course is illustrated in Figure 3.6 Relationship between shrinkage product, grading coefficient and performance of wearing course gravels, of Austroads Guide to Pavement Technology Part 6: Unsealed Pavements.
5. California Bearing Ratio (CBR) — minimum 40.
6. Local gravel may be used if the properties conform with Section 3: Pavement Materials, of Austroads Guide to Pavement Technology Part 6: Unsealed Pavements, and is approved by Council (may require testing at applicant's expense).
7. Natural surface may be used where all weather access can be sustained.

SC6.6.5.4 Construction

1. All work is to be supervised by a RPEQ or their authorised representative competent in roadworks and undertaken by a nominated principal contractor experienced in the construction of public (municipal) works.
2. Council may request evidence of the RPEQ's or their authorised representative and the principal contractor's competency.
3. On the completion of the works, the supervising engineer is to submit RPEQ certification to Council certifying that the works have been completed in accordance with the approved plans and specifications.
4. Certification is to include the submission of 'as constructed' plans, ADAC and copies of all relevant test results.
5. Works involving State-controlled roads must be referred to the DTMR for approval.
6. Road construction methods and practices must accord with those specified in:
   a. DTMR Specifications and Standard Drawings;
   b. Austroads guidelines;
   c. DTMR MUTCD;
   d. Council's Roads and Drainage Policy;
   e. Council's Standard Drawings.
7. Where there is an inconsistency between the specified manuals and Council's Standard Drawings, the Standard Drawings are to take precedence to the extent of the inconsistency.

SC6.6.5.5 Pavement Construction

1. Each pavement course is not to be commenced until the previous course (i.e. subgrade, sub-base, base or existing pavement) has been inspected, approved and certified by the RPEQ with respect to compaction, finished levels and texture of finish.
2. Compaction tests of each layer are required, and the RPEQ is to ensure that all tests meet specification before proceeding to the next layer.
3. All test results are to be provided to Council before asphalt surfacing.
4. Subgrade affected by rainfall after final trimming is not to be accepted until appropriate drying out, testing and proof-rolling treatment has been affected.
5. Unbound pavement course material is always to be kept at optimum moisture content.
6. Minimum compacted layer thickness is to be 125mm, with the maximum compacted thickness not exceeding 150mm.

SC6.6.5.5.1 Compaction testing

1. Determination of the compaction performance of the earthworks, subgrade and pavement gravel materials (i.e. laboratory reference density, field density, optimum moisture content, field moisture content) is to be carried out in accordance with AS.1289 Methods of Testing Soils for Engineering Purposes, the 'E' series tests.
2. The laboratory reference density is to be as follows:
   a. earthworks — 97% standard maximum dry density (MDD);
   b. subgrade — 100% standard MDD;
   c. pavement — 100% standard MDD.
3. The minimum frequency of testing is to be as follows:
   a. roads <120m — 3 tests;
   b. roads >120m — 1 test every 50m.
4. A minimum of 3 tests for each project are to be undertaken.
5. A lot layout plan showing the location of the tests is to be submitted to Council with the test results.
6. All tests are to be distributed reasonably evenly through the full depth and area of pavement.
7. The testing frequencies are to be based on a 'not one to fail' basis.
8. Failure of material quality tests will require removal of the material or further in situ testing.
9. Failure of compaction tests will require:
   a. retesting at the same depth and location if the failure is minor (e.g. localised single failure by 1%—3%);
   b. removal or reworking of material if the failure is significant or widespread.
10. Subgrade and base courses are to be compacted to the following densities:
    a. earthworks up to 300mm below subgrade — 95% MDD, then 97%;
    b. natural surface and subgrade — 97% MDD;
    c. pavement courses — 100% MDD.
11. Any failed test results on any layer, together with the remedial treatment undertaken at the direction of the RPEQ, is to be submitted with other test results before the pre-seal inspection.

SC6.6.5.5.1.1 Pavement depth verification

1. Pavement depths are to be verified by the provision of 'as constructed' levels of the subgrade and top of asphalt surfacing at a frequency of three levels (right-hand side, centre and left-hand side) every 10m.
2. The surveyed information is to be provided in a tabulated format and is to be certified by both the surveyor and RPEQ.
3. A copy of the certified results is to be submitted with the engineer's certification of the works.

SC6.6.5.5.2 Pavement Surfacing

SC6.6.5.5.2.1 Asphaltic concrete surfacing

1. Asphaltic concrete surfacing of the road pavement is to be carried out to the width specified in the LVRC Standard Drawings Typical Cross Sections for the appropriate road type and in accordance with the construction requirements outlined in the DTMR Specifications.
2. Asphaltic concrete surfacing is not to be commenced until the RPEQ and Council have inspected the substrata (either as a base course or existing surface) and the RPEQ has certified that it is suitable for the laying of Asphalt Concrete (AC) surfacing.
3. Before issuing the required certification the RPEQ is to consider the quality of the finished levels, compaction and texture finish.
4. The surface of all asphaltic concrete is to be finished true to grade and profile with smooth joints and a neat finish around manholes and other road surface fittings and finished at a level at kerb lip such that the surface will remain free draining.
5. The finished compacted thickness of asphaltic concrete is to be as specified in the Deemed to Comply tables for the appropriate road type.
6. Where finished levels have been outlined in the engineering plans, the final asphalt surfacing is not to deviate from these levels by more than –5mm or +10mm except adjacent to kerb and channel and remain free draining.

SC6.6.5.5.2.2 Spray surfacing

1. Bitumen surfacing is to be hot-sprayed bitumen or approved bitumen emulsion.
2. Bitumen surfacing of the road pavement is to comprise the construction of a bitumen surface coat to the width specified in the typologies for the appropriate road type and in accordance with the construction requirements outlined in the DTMR Specifications.
3. Bitumen surfacing is not to commence until Council approves the proposed roadworks.
4. All necessary precautions are to be taken to prevent binder, aggregate or other material used on the work from entering or adhering to kerb and channelling, gratings, hydrant or valve boxes, manhole covers, bridge or culvert decks, or similar road fixtures.

SC6.6.5.5.3 Subsoil Drainage of Pavements

1. Subsoil drains are to be constructed in accordance with IPWEAQ Standard Drawing RS-140 Subsoil Drains - Details and Locations.

SC6.6.5.5.3.1 Location of subsoil drains

1. Where kerb and channel has been or is to be constructed, the subsoil drains are to be constructed immediately below the back of the kerb, as outlined in the IPWEAQ Standard Drawing RS-140 Subsoil Drains - Details and Locations.
2. Subsoil drains must be extended to interface and connect with existing subsoil system and lawful point of discharge.
3. Where the road musters are unsealed, the subsoil drains are to be placed as outlined in the approved engineering plans, except where kerb and channel is to be constructed in the future, in which case the subsoil drain is to be located as outlined in clause 1 above.

SC6.6.5.5.3.2 Order of construction

1. Subsoil drains are to be constructed after placement of the lower sub-base material (CBRI5) or after preparation of the pavement box on minimum depth pavements.
2. Council may, when conditions are suitable, approve the construction of the subsoil drains before placement of subgrade replacement material or lower sub-base material, subject to the bedding or filter material being brought to the underside of upper sub-base level.

SC6.6.5.5.3.3 Excavation of drains

1. Trenches for pipe drains are to be excavated to the required line to a depth of at least 900mm below the finished pavement surface level and to the gradients as outlined on the approved engineering plans (minimum 1%). In situations where the grade is <1% ‘strip drains’ are to be used.
2. Trenches are to be a minimum 100mm wider than the nominated pipe outside diameter.

SC6.6.5.5.3.4 Type of pipe

1. All subsoil drainage pipes are to be socked Humes ‘Draincoil’ or similar socked perforated plastic drainage pipe complying with AS.2439 Perforated Plastics Drainage Pipe and Fittings.
2. Perforations must not exceed 0.7mm diameter or width.
3. Joints are to be constructed in accordance with the manufacturer's recommendations.
4. Where approved by Council, strip drains may be used.
5. Strip drains are to be a proprietary product comprising a regular patterned cusp-shaped plastic core, of nominal thickness not less than 40mm, encased by a nonwoven geotextile.
6. The plastic core is to permit the passage of high-volume water flows and have a crush strength not less than 100 kPa.

SC6.6.5.5.3.5 Pipe size

1. The minimum pipe size is 100mm outside diameter.
2. The pipe is to be bedded on a minimum of 50mm of graded filter material in accordance with the IPWEAQ RS-140 Subsoil Drains - Details and Location.

SC6.6.5.5.3.6 Pipe laying

1. All subsoil drainage pipes are to be laid on a prepared filter or sand bed to ensure a uniform grade.

SC6.6.5.5.3.7 Outlets

1. All subsoil drainage pipes are to be connected to gully pits, as outlined in the IPWEAQ Standard Drawings RS-140 Subsoil Drains - Details and Location, and RS-142 Subsoil Drains - Access Points, or to open channels below the edge of an embankment.
2. For outlets not connected into gully pits, a concrete headwall is to be provided to the outlet.
3. Where provided, the headwall is to be at least 100mm thick and is to extend for a minimum of 150mm on all sides of the pipe.
4. The outlets to the pipes are to be fully enclosed by vermin-proof flaps.

SC6.6.5.5.3.8 Clean-outs

1. Clean-outs as outlined in the IPWEAQ Standard Drawings RS-140 Subsoil Drains - Details and Location, and RS-142 Subsoil Drains - Access Points, are to be located at the head of the subsoil drain and at subsequent spacings not exceeding 90m.
2. Clean-outs located at gully pits are to be constructed with caps or plugs, as outlined in the IPWEAQ Standard Drawings RS-142 Subsoil Drains - Access Points.
3. A marker is to be installed in the kerb adjacent to clean-out points.

SC6.6.5.5.3.9 Joining

1. Subsoil drains are to be joined in accordance with the manufacturer's recommendations.
2. Clean-out pipes are to be joined to the subsoil drains using oblique ‘T’ connections.

SC6.6.5.5.3.10 Flushing

1. After the drains are constructed, they are to be flushed out.
2. Flushing is to continue until the outlet water is clean and flows consistently.
3. Treatment of islands and speed control devices:
4. for islands and speed control devices, a mitre drain is to be constructed to drain subsurface water from these structures into the nearest gully box or access chamber.
5. Landscaped islands are to have perimeter subsoil drainage discharging into the nearest gully box or access chamber.

SC6.6.5.5.4 Traffic Control Devices and Provision for Traffic

1. Street signs, road line-marking and road furniture must be designed, located, constructed and erected in accordance with the DTMR MUTCD and the relevant Standard Drawings.
2. All permanent signs in concrete paved areas are to be sleeved and bolted.
3. Kerb-side posts are to be installed using v-locks and spears.
4. Vandal-proof bolts and fittings are to be used on all permanent signing.
5. Concrete used in traffic calming is to have a minimum strength of 32mPA.

6. Raised retro-reflective pavement markers (RRPMs) are to be installed in accordance with the MUTCD.
7. Traffic control devices:
   a. The developer must implement Traffic Management in accordance with the MUTCD.
8. Dust control:
   a. The contractor is to minimise any dust problems that may occur during the construction of the roadworks and that may affect the safety and general comfort of the travelling public and surrounding residences;
   b. As a minimum, the contractor is to carry out regular applications of water or other palliative measures along the sections of the roadworks and side-tracks traversed by the travelling public.
9. Urgent repairs and protective works:
   a. If by reason of any circumstances arising in connection with the work, any urgent remedial, protective, repair or other work is necessary to prevent damage to the work or to provide protection for pedestrians and traffic and the contractor is unable or unwilling to do such work, Council may do such remedial work;
   b. Council is to determine the reasonable costs incurred in carrying out the works, and the amount so determined is to be paid by the contractor to Council, no later than before acceptance of the works on maintenance.

SC6.6.5.5.5 Kerb and Channel Construction

SC6.6.5.5.5.1 Kerb and channel foundation

1. The foundation is to comply with the requirements of the approved engineering plans.
2. The foundation is to extend at least 300mm behind the back of the kerb.
3. No concrete is to be placed until the foundations have been inspected and approved by Council.

SC6.6.5.5.5.2 Concrete works

1. The concrete used in kerb and channelling work and vehicle crossings is to be Grade N32 concrete and conform in all respects with the IPWEAQ Standard Drawings Driveways and Kerb and Channel series and approved engineering plans.
2. Industrial kerbing must have an additional 50mm concrete base thickness over standard profiles as a minimum.
3. Concrete is to be placed true to line and grade to the depths, thicknesses and dimensions as shown on the Standard Drawings as referenced above.
4. Any kerb and channel not true to line or with noticeable kinks, bends or other faults or not of the required dimensions is to be condemned and is to be broken out and removed from the site.
5. The channel is to be shaped in true conformity with the Standard Drawings referenced above.
6. The invert of the channelling is to be finished in true grade and alignment.
7. Council will not accept channelling which is found to pond water.
8. Channelling that ponds water and surfaces that are chipped, cracked or otherwise damaged are to be cut away to a clear surface and rendered 12mm minimum thickness.
9. The concrete kerbing and channelling are to join neatly and transition smoothly with existing kerb and channel or be finished so that it will join neatly with channelling to be constructed.
10. Where kerbing and channelling joins inlet pits, the width of channel is to be uniformly widened, as shown on the Standard Drawings referenced above, to join neatly with the pit.
11. Kerb ramps are to be constructed at all street intersections as shown on the relevant IPWEAQ Standard Drawings Road and Kerb Ramp series and as required to connect cycleways and footpaths.

SC6.6.5.5.5.3 Kerb and channelling — hand-formed and finished

1. Forms are to conform to the profile specified in the IPWEAQ Standard Drawings Driveways and Kerb and Channel series, and be rigid, true to line and grade, and well braced.
2. Back forms are to be used on the footpath side of the full depth of the kerb back.
3. In the carrying out of this work, the whole of the water channel is to be cast simultaneously.
4. The casting of invert and kerb at different times is not acceptable to Council.
5. Concrete is to be well rodded and sliced or vibrated during placing to ensure maximum density and a dense surface finish.
6. Immediately following the casting of the kerb and channel, the top of the kerb and channel is to be finished with an approved steel finishing tool.
7. The ‘arris’ and ‘invert’ are to be formed with approved steel finishing tools.
8. The front board of the kerb is to be stripped within 24 hours of casting and the kerb face immediately bagged using a damp hessian bag and cement mortar.
9. The concrete kerb and channel are to be placed in 3m sections and provision made at the joints to prevent the binding of the concrete at the joint.
10. Joints are to be finished square and at right angles to the section of the water channel and show a neat joint line on the kerb face and top truly at right angles to the length.

SC6.6.5.5.5.4 Kerb and channelling — machine formed and finished

1. Kerb and channelling may be cast by approved slip form machines, provided that the kerb and channelling conforms to the profile specified in IPWEAQ Standard Drawing RS-080 Kerb and Channel - Profiles and Dimensions - including Edge Restraints, Median & Channel, and the following additional requirements:
   a. The minimum slump is to be 12mm;
   b. Concrete is to be thoroughly compacted;
   c. Exposed faces and edges of kerbs are to be finished with a steel tool to the true shape of the kerb.
   d. Grooves are to be cut with a suitable grooving tool to a depth of at least 100mm in the channels and inverts at equal intervals of 3m. Grooves are to be at right angles to the length and perpendicular.
   e. Adjacent concrete is to be finished to a smooth, level surface;
   f. Concrete is to be supplied ready-mixed and placed within 30 minutes of delivery on site. Any concrete not placed within this time is to be removed from the site.

SC6.6.5.5.5.5 Curing of concrete

1. When curing compounds are used on concrete work, they are not to be detrimental to the quality or appearance of the finished concrete.

SC6.6.5.5.6 Verges

1. Verges are to be covered full width with suitable topsoil free of stones and deleterious matter, to a depth of not less than 100mm, lightly compacted and turfed.

SC6.6.5.5.7 Urban roadworks and access

SC6.6.5.5.7.1 Vehicular crossings

1. Where applicable, all vehicular footpath crossings (together with any necessary adjustments to the kerb and channel) are to be constructed in accordance with IPWEAQ Standard Drawings Driveways and Pathways series.

SC6.6.5.5.8 Traffic islands

1. Traffic islands are to be indicated by raised kerb islands.
2. Islands may include channelling (or directional) islands, roundabouts, median islands, medians, separators and pedestrian refuge islands, and are to be classified in accordance with the DTMR MUTCD.
3. Raised kerbed islands less than $12m^2$ or less than 2m in width between kerb faces are to be constructed with a minimum 100mm thickness N32mPa reinforced-concrete on a compacted sand base.
4. The surface treatment for these islands is to be brushed or stencilled concrete.
5. A water service conduit is to be installed approximately every 80m, with a minimum of one service for each median.
6. Where the fall across an island is greater than 1V:4H, the island is to be surfaced with brushed or stencilled concrete.
7. Subsoil drainage (connected to an underground drainage system) is required in all islands where the surface treatment is other than concrete.
8. Whenever the centre island or part of a roundabout or traffic island is landscaped, a water service conduit and perimeter subsoil drainage are to be provided.

SC6.6.5.5.9 Bus stops

1. Bus stops (including indented bus bays) are to be located on arterial, sub-arterial, distributor and collector roads, as outlined in Section SC6.6.5.2.1 of this policy and as per agreement with Council and DTMR to support the bus network.
2. Where bus bays front any lot on a collector road, a driveway is to be constructed for each affected lot — not within the bus set-down area, but within the tapers of the bus bay or outside the bus bay area.

SC6.6.5.6 Bridges

SC6.6.5.6.1 Introduction

1. This policy provides Council's standards for bridges associated with Council and development works. They must be read in conjunction the relevant sections of this planning scheme policy.
2. The purpose of this part is to:
   a. provide a serviceable infrastructure for the specified lifetime with minimal maintenance;

b. provide safe and trafficable bridges for vehicles, pedestrians and cyclists;
c. ensure design is appropriate for the traffic use and water flows;

3. This part is intended as a guide only and must not take precedence over the prescribed design standards.

SC6.6.5.6.2 Siting

1. The location of the structure must comply with the strategic plans and/or approved layout plans that:
   a. Manages the location in relation to property, boundaries, existing structures and land use;
   b. Manages impact to existing vegetation;
   c. Complement existing and future infrastructure (i.e. road networks pedestrian ways and bikeways);
   d. Considers future maintenance and growth requirements;
   e. Considers construction methods including material delivery;
   f. Considers impacts that disturbance and final landform;
   g. Manages safety and security requirements;
   h. Considers flood impacts.

SC6.6.5.6.3 Bridge Design Standards

1. The following are some of the design reference for bridges but not limited to:
   a. Australian Standard Bridge Design AS/NZS.5100 Bridge design, and its relevant parts;
   b. DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures;
   c. Austroads Guide to Bridge Technology, Guide to Road Tunnels and Guide to Road Design;
   d. Authority requirements by Queensland Rail. Utility service authorities. Where a document (i.e. manual or guideline) is not consistent with the standards of the authority, the aforementioned standards prevail to the extent of the inconsistency.
2. Bridge design, construction parameters and design reports are to be in accordance with the DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures.
3. The bridge designer must be a RPEQ qualified and experienced.
4. Designers and contractors must demonstrate BD2, CE2, GE2, HE2, HD2 - DTMR pre-qualification status and must be able to demonstrate recent bridge design and construction supervision experience similar to the bridge works proposed (minimum three bridges within the last 5 years).
5. Road bridges are to be concrete in structure, incorporate footpaths and provide service ducts for existing and future services are required by Council and the service authority.
6. Scour protection and stabilisation control works are required at the bridge abutments, and at culvert inlets and outlets. These works can include grouted rock, sprayed concrete suitably finished to match the environment or formed concrete.
7. A brass plug PSM and brass Date-plaque is installed on one of the bridge abutments in a location approved by Council.
8. Terrestrial and aquatic fauna movement solutions are included in all waterway crossings in accordance with DTMR Fauna Sensitive Road Design.
9. Hydraulic analysis is a critical component for design of bridges that cross water courses and must be undertaken by a suitably qualified and experienced RPEQ.
10. The minimum clear width for a pedestrian bridge is 2.5m or where it is deemed necessary for Council to access the pedestrian bridge with maintenance vehicles, 3.5m.
11. The Applicant will arrange a review of the Bridge Design. The review will not relieve the RPEQ of responsibility for the code compliance and performance of the bridge. Work must not commence on the bridge until the review is completed and all issues raised in the review are resolved by the RPEQ and to Council's satisfaction.
12. Table SC6.6-9: Bridge design and construction requirements, sets out the minimum requirements for design and construction requirements for a bridge.

Table SC6.6-9: Bridge design and construction requirements

PARAMETER	REQUIREMENT
Design life	In accordance with the DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures or a minimum 100 years
Design load	AS.5100 Bridge design, Part 1: Scope and general principles
Waterway Design	Austroads Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures and DTMR Supplements to Austroads Guide to Bridge Technology Part 8
Traffic volume	AADT to be determined
Design average stream velocity	To be determined by stream modelling however, 4m/s must be the design minimum design value used.
Bridge carriageway	DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures.

widths	
Bridge level	To be above AEP 1% flood event (if practicable)
Bridge superstructure	Prestressed concrete construction
Bridge Barrier	DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures.
Bridge geometry	Square to flow direction (if practicable)
Abutments	1V:1.5H spill-through abutments, in accordance with AS.5100 Set: Bridge design
Public Utilities	Current and/or future provision of utility services must be considered
Scour Protection	Scour, flood and erosion protection will be required at the abutments.
Deck wearing surface	Asphaltic concrete
Relieving slabs	Cast in-situ relieving slabs must be provided in accordance with DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures.

SC6.6.5.6.4 Geotechnical parameters

1. A geotechnical investigation must be carried out by a RPEQ qualified and experienced Geotechnical Engineer before the design being commenced. In conjunction with this requirement, Council also requires that the investigation includes a minimum of one borehole at each abutment and pier location to be included in the investigation.
2. Driven piles that are likely to set prematurely on boulders will be an unsuitable design solution and will not be accepted by Council.
3. Tests are to be carried out for the presence of sulphate, salt, chloride and pH and other known aggressive soil environments. Design of concrete elements must take the results of testing into consideration.
4. DTMR, March 2020 publication - Design Criteria for Bridges and Other Structures refers.

SC6.6.5.6.5 Culverts

1. All culverts must be reinforced concrete. The use of steel, plastic or glass reinforced plastic is not permitted.
2. Precast concrete pipe or box culverts, designed and manufactured in accordance with the relevant Australian Standards, must be used. Joints between culvert units must be waterproofed across the tops of units and down both external legs, with an approved membrane (500mm wide strip of Bituthene 5000 or equivalent).
3. Culverts exposed to high salinity areas need to consider the local soil characteristics. Lockyer Valley has areas with salinity, dispersive or erosive soils. Soil characteristics are discussed in SC6.6.6 Earthworks.

SC6.6.5.6.6 Safety measures

1. Appropriate safety measures must be incorporated into all bridges and culverts including rails, barriers, approach warning signs and flood depth indicators.
2. All handrails and vehicle barriers must be designed to withstand stream and debris loads as well as other forces. Steel handrails and vehicle barriers must be hot dipped galvanised and painted with a suitable recoat paint system in accordance with AS/NZS.2312 Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings. Rigid vehicle barriers on the bridge or culvert must be suitably terminated and transitioned to flexible barriers on the approaches.
3. Lighting as required by Council is to be included in accordance with the provisions set out in this policy.

SC6.6.5.6.7 Inspection of works

1. An RPEQ must be engaged during the bridge construction period to answer design queries and make inspections as required in specifications. The RPEQ is to ensure the work is constructed in accordance with the approved plans including all relevant geotechnical information. Certification of the works is required as:
   a. The RPEQ will prepare written reports covering each inspection made, in a form acceptable to Council. Copies of each report must be submitted on the date of the inspection;
   b. Work must not proceed until the works under a nominated hold point have been inspected by Council and the inspection and test plan is presented and signed by Council;
   c. Upon completion of the piling and before any subsequent work proceeds, an RPEQ working for the designer for the project must provide a certificate verifying that the installed piles meet with the nominated design criteria and specified requirements;
   d. The RPEQ must provide a certificate at the end of construction that the works have been inspected and the works have been constructed in accordance with the documentation and meet the intent of the design;

e. Council may undertake periodic inspections during the construction phase.

SC6.6.5.6.8 Construction handover documentation

1. Bridge construction handover documentation must include:
   a. As Constructed Plans certified by an RPEQ working for the designer;
   b. Bridge Design Report including any changes during construction certified by the RPEQ working for the designer;
   c. Independent Verification Report;
   d. Construction Handover Report including all test result certificates;
   e. Certificates as nominated above.
2. Detailed requirements for construction handover documentation can be found in DTMR 'Design Criteria for Bridges and Other Structures'.

SC6.6.6 Earthworks

SC6.6.6.1 Introduction

The standards for the provision of Earthworks are to be in accordance with:

1. Bills and Legislation:
   a. Council's Planning Scheme;
   b. *Aboriginal Cultural Heritage Act 2003;*
   c. *Biosecurity Act 2014;*
   d. *Building Act 1975;*
   e. *Building Regulation 2021;*
   f. *Environmental Offset Act 2014;*
   g. *Environmental Protection Act 1994;*
   h. *Environmental Protection and Biodiversity Conservation Act 1999 (Cth);*
   i. *Land Act 1994;*
   j. *Local Government Act 2009*
   k. *Nature Conservation Act 1992;*
   l. *Nature Conservation (Koala) Conservation Plan 2017;*
   m. *Nature Conservation (Plants) Regulation 2020;*
   n. *Nature Conservation (Protected Areas) Regulation 1994;*
   o. *Planning Act 2016;*
   p. *Planning Regulation 2017;*
   q. *Vegetation Management Act 1999;*
   r. *Water Act 2000:*
2. Australian Standards:
   a. AS/NZS.1170 Structural design actions (set);
   b. AS.2870 Residential slabs and footings;
   c. AS.3798 Guidelines on earthworks for commercial and residential developments;
   d. AS.4678 Earth-retaining structures;
   e. AS.4970 Protection of trees on development sites;
3. Manuals, Guidance and Drawings:
   a. Australian Geomechanics Society's Practice Note Guidelines for Landslide Risk Management 2007;
   b. Best Practice Erosion and Sediment Control — for Building and construction sites, IECA 2008.
   c. Guideline: Listing and removing land on the land registers;
   d. IPWEA - Queensland Urban Drainage Manual;
   e. IPWEAQ Standard Drawings;
   f. Koala-sensitive Design Guideline — a guide to koala sensitive design measures for planning and development activities;
   g. Queensland Acid Sulfate Soil Technical Manual — Soil Management Guidelines v4.0, Department of Science, Information Technology, Innovation and the Arts (2014);
   h. Queensland Auditor Handbook for Contaminated Land (2015);
   i. State Planning Policy, State Interest Guidance material: Emissions and hazardous activities, February 2018;

SC6.6.6.2 Cut and Fill

SC6.6.6.2.1 Clearing

1. All clearing must be kept to a minimum and comply with current Federal, State and Local legislation, local laws and Council's conditions of approval.
2. Before the development design phase, all ecological values must be mapped and assessed in accordance with the PSP 1 Biodiversity to ensure the development results in the best outcomes for the ecological values of the site.
3. Trees on existing roads and within road reserves must not be damaged or removed without the approval of Council. The applicant is to submit a Vegetation Management Plan to Council, for approval, in accordance with Planning Scheme. Vegetation Management Plan is to include:
   a. a clear indication of all trees to be disturbed, removed and retained;
   b. details of all operational works (including cut, fill, construction of roads, services, drainage, signage, wildlife corridors and building envelopes), likely to impact on existing vegetation (both on the site and within any road reserves or other land);
   c. temporary and permanent exclusion and protection fencing;
   d. roles and responsibilities for site contractors, the proponent, and the consultant group;

e. stockpiling and reuse of cleared vegetation;
f. a clearing sequencing plan showing the commencement of clearing and the direction of removal (this should be in conjunction with the Fauna Management Plan to allow fauna time to relocate to safe haven areas);
g. methods for management of any restricted and invasive weeds present across the entire site (not just the construction area) and ongoing weed management;
h. a detailed ongoing rehabilitation and maintenance plan including the restoration and enhancement of disturbed areas in the post construction phase and processes to maximise survival opportunities for areas of retained vegetation and newly rehabilitated areas; and
i. specific details on the removal of potential habitat trees.

4. Refer to SC6.6.4.5.1 Erosion and sediment control plans (ESC Plans), which informs those persons constructing the development on what controls need to be implemented throughout all stages of the development from site establishment to project completion. Typically, a separate ESC Plan is required for each phase of the development including the bulk earthworks, civil construction (typically roadworks and stormwater drainage), services installation, final stabilisation and the decommissioning of construction phase sediment basins. These plans could be considered an element of complying with the general environmental duty, that is, doing all that is reasonable and practicable to prevent or minimise environmental harm.
5. The instruments that nominate the protection of trees and vegetation of significance are referenced in SC6.6.6.1 Introduction.
6. On slopes 16.6% and steeper special consideration must be given to the retention of groundcover. Special consideration should be given to the retention of vegetation on shaded areas or steep slopes with a southern aspect.
7. Extreme caution must be shown when undertaking clearing works near watercourses, floodplains, steep slopes, wetlands, habitat trees and any other nominated environmentally sensitive areas. Refer to impacts and recommendations for ecological assessments as outlined in PSP 1 Biodiversity.
8. Vegetation clearing is to comply with the following:
   a. Ensure that an accredited spotter catcher is present to check all potential habitat before vegetation removal or earthworks. They are to:
      i. inspect vegetation approved for removal (or any dams to be removed or dewatered) and advise contractors when it is appropriate to commence works;
      ii. clearly mark (flag) vegetation found to contain fauna or fauna habitat (such as tree hollows, arboreal termite mounds, stick nests or possum drays with flagging tape), and visually and verbally communicate this information to the tree feller to ensure flagged trees are not felled until authorised by the fauna spotter;
      iii. Where native vertebrate animals are found, clearing must only continue in coordination with a fauna spotter. All native vertebrate animals located within, on and amongst vegetation or areas of vegetation approved for clearing, are only to be managed under the guidance of the fauna spotter;
      iv. Keep and maintain accurate records of all animal captures, incidents and disposals for the site and a report prepared for Council and other relevant authorities within one month of completion of the project.

      Note—An accredited fauna spotter catcher is a person or company holding a current Rehabilitation Permit — Spotter Catcher issued by the Department of Environment and Science.

   b. Any clearing of koala habitat trees must ensure the clearing is carried out in a way the complies with the sequential clearing conditions in Part 3, Section 10, of the Nature Conservation (Koala) Conservation Plan 2017.

      Note—Koala habitat tree has the same meaning as the Nature Conservation Act.

   c. Limit the felling of habitat and hollow bearing trees to the following methods:
      i. segmental removal of the tree, with hollow-bearing limbs being checked by the wildlife spotter and cleared of fauna using a cherry picker;
      ii. segmental removal of the tree, with hollow-bearing limbs plugged and lowered to the ground for inspection by the wildlife spotter;
      iii. use of an excavator with vertical grab to lower the main trunk; or
      iv. a combination of the above methods.
   d. Preserve valuable habitat features such as large fallen logs, log piles, rock piles or outcrops wherever practicable through the translocation and re-establishment in coordination with the wildlife spotter;
   e. Ensure compliance with AS.4970 Protection of trees on development sites, including but not limited to the implementation of a 'Tree Protection Zone' where trees are to be retained onsite and undertake the following:
      i. install protective fencing to prevent any damage to areas not in the approved vegetation clearing area in general accordance with AS.4970 Protection of trees on development sites;
      ii. provide signs identifying the 'Tree Protection Zone' on exclusion fencing that are clearly visible from all areas within the development site within 20m of the exclusion fencing; and
      iii. ensure all trees to be retained within allotments are protected from harm during works on site. Ensure activities such as traffic, stockpiling and compaction are excluded from areas of retained vegetation particularly within the tree protection zones of retained trees.
   f. Ensure vegetation and rubble piles are not left to serve as a refuge for displaced or roaming wildlife through the implementation of the following measures:

i. immediately (within 12 hours) remove or destroy such materials or
ii. ensure old (>12 hours) piles of felled vegetation are treated as potential wildlife habitat and inspected by a wildlife spotter catcher before removal or destruction.

g. Ensure all vegetation cleared as a result of this development approval and requiring disposal is disposed of:
i. on the premises for landscaping and sediment and erosion control purposes (for example as mulch); and/or
ii. at a waste disposal facility operated by Council provided that the waste is delivered to the waste disposal facility in a manner and form which allows it to be mulched at the facility; and/or
iii. in such other environmentally responsible manner as meets with the written approval of Council;
iv. ensure any vegetation cleared as a result of this development approval is not burnt or incinerated except for the purpose of domestic heating inside a dwelling on the subject site.

SC6.6.6.2.2 Filling

SC6.6.6.2.2.1 Material

1. The following materials are considered unsuitable as structural fill:
   a. materials from wetlands, swamps, marshes or bogs, or containing peat, logs, stumps and perishable material;
   b. materials susceptible to spontaneous combustion;
   c. materials contaminated through past site usage or containing prohibited or restricted biosecurity matter weeds and other matter which may adversely affect the local environment, except where these are treated in an appropriate manner;
   d. materials that contain substances that can be dissolved or leached out, or which undergo volume change or loss of strength when disturbed and exposed to moisture, unless conforming to the requirements of reuse of excavated material;
   e. silts or silt-like materials, unless conforming to the requirements of reuse of excavated material;
   f. materials containing wood, metal, plastic, boulders or other deleterious material;
   g. building rubble including concrete, asphalt and other materials except where broken down or otherwise treated and proved to be suitable for use;
   h. abandoned public utility plant and any associated material;
   i. material which is not capable of being compacted in accordance with the contract;
   j. material forming the foundation for a structure which has an allowable bearing pressure less than that nominated;
   k. material forming the foundation for an embankment which has an insitu California Bearing Ratio (CBR) less than 3;
   l. material with a sulphur content exceeding 0.5 % within 500mm of cement bound elements (for example concrete structures or masonry) unless such elements are protected by impermeable membranes or equivalent means. materials prone to dissolving or that undergo physical or chemical changes on exposure to moisture;
   m. contaminated soil.
2. Such material, except for contaminated soil, must be confined to non-critical areas, and must be provided with suitable topsoil and revegetation and/or chemical treatment to prevent erosion.

SC6.6.6.2.2.2 Structural fill

1. Structural fill is any filling that will be required to support structures or pavements, or for which it is intended the time-dependent settlement will be restricted.
2. Most naturally occurring earth, soil and rock, with the exceptions of those noted in SC6.6.6.2.2.1 Material, above, are capable of being compacted to form a homogeneous mass to support commercial and residential developments and associated infrastructure.
3. Special measures will need to be undertaken if the following materials are proposed to be used for structural fill:
   a. natural material:
      i. clays of high plasticity that are reactive are only included with fill under strict moisture and density control conditions
      ii. material that, after compaction, contains large particles and will cause difficulties for:
         A. excavation of trenches and footings; or
         B. driving piles; or
         C. drilling piers; if this is necessary.
      iii. over wet materials (i.e. where filling in low-lying areas)
      iv. single-sized or gap-graded gravels or rock fill that will not break down upon compaction that leaves voids into which finer material can migrate
      v. saline, chemically aggressive or polluted soils
      vi. carbonate soils where acid dispersal may occur.
   b. waste material such as building and demolition material may be accepted as structural fill, if the supply placement and compaction is specified and supervised by a RPEQ;
   c. materials prone to dissolving and natural materials may be used for structural fill where supported by a geotechnical report, and only in accordance with the recommendations of that report;

d. All building sites that are filled will require Level 1 supervision by a suitable qualified RPEQ as set out in Section 8: Inspection and testing, of AS.3798 Guidelines on earthworks for commercial and residential developments.

SC6.6.6.2.2.3 Transportation of material

1. If the development requires either the import of fill to site or export of fill offsite, the following information must be supplied to Council at the prestart meeting:
   a. details of the source location, including a haul route plan which includes times of operation, the number of anticipated vehicle movements deliveries each day and the duration of the hauling activities;
   b. written certification from a suitable qualified (RPEQ) in geotechnical engineering that all imported material has a CBR value equal to or greater than 5 and is appropriate for the works the material is to be used for and suitable for inclusion within the development works;
   c. Adequate control measures are to be implemented to prevent soil or mud from falling from vehicles, including tyres, entering and leaving any work site.
2. Materials must not be imported to or exported from the site other than:
   a. from or to site/s that have a current Development Approval enabling them to export or accept any material; or
   b. the material is being exported to and accepted at a licensed Council refuse facility.
3. Further Development Approvals may be required for sites (e.g. Sites impacted by Flood Hazard Overlay or Steep Slope Overlay) proposed to import material from or export material to, before commencement of such work.
4. Evidence of a Biosecurity Instrument Permit (BIP) where applicable demonstrating compliance with the soil management and transport restrictions in fire ant biosecurity zones under the *Biosecurity Act 2014.*

SC6.6.6.2.2.4 Filling of dams

1. Structural and clean fill material is only acceptable.
2. Supply, placement and compaction is fully specified and supervised by a suitable qualified RPEQ.
3. Level 1 supervision, as set out in Section 8: Inspection and testing, of AS.3798 Guidelines on earthworks for commercial and residential developments, will be required if waste material is to be used as structural fill.
4. Due allowance is to be made for any implications that result from the filling of existing dams. e.g. change to drainage flow paths.
5. In some cases, a fauna spotter catcher may need to conduct a pre-works survey and potentially relocate wildlife where necessary before and during draining and/or filling of dams.
6. More guidance on dam safety can be found in the State Department of Natural Resources, Mines and Energy, Dam Safety Management Guidelines.

SC6.6.6.2.2.5 Previously filled land

1. In locations where land was previously filled is to be used for building, the site is to be investigated to identify the filled areas and remedial work undertaken to ensure that the material fulfils the requirements of structural fill material.
2. All building sites that are filled will require Level 1 supervision by a suitable qualified RPEQ as set out in Section 8: Inspection and testing, of AS.3798 Guidelines on earthworks for commercial and residential developments, for structural fill. Certification from a suitably qualified RPEQ along with supporting test results (refer to AS.3798 Guidelines on earthworks for commercial and residential developments, for testing requirements) must be provided to Council before undertaking any works within the subject area.
3. Building envelopes will be required if only part of a lot is covered by the certification.

SC6.6.6.3 Earth Retaining Works

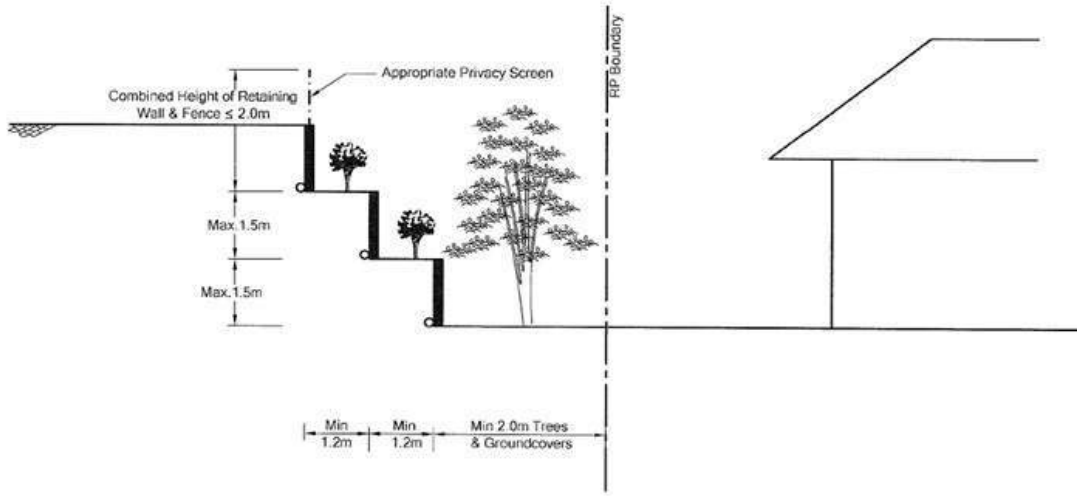
SC6.6.6.3.1 Batters and earth-retaining structures

1. Batters and earth-retaining structures should conform to the requirements set out in the current edition of the Building Regulation, the Building Code of Australia and AS.4678 Earth-retaining Structures.
2. Fill batter's steeper than 1V:6H and retaining walls greater than 1m in height will require the lodgement of building applications if the retaining walls were not approved under a development permit for operational work.
3. Batters and earth-retaining structures (including footings) are to be wholly contained within the allotments (subdivision) or development site that it supports.
4. Batters and earth-retaining structures (including footings) must not encroach on the public space or public infrastructure.
5. The maximum slope of batters, including table drains, stormwater drainage channels and road batters must not be steeper than 1V:6H.
6. Retaining walls greater than 1m in height or with a surcharge loading must be designed and certified by a RPEQ and in accordance with relevant Australian standards and relevant building code requirements.
7. Earthworks abutting public spaces are to be treated as follows:

a. Earthwork batters rather than retaining walls are preferred adjacent to existing or future public spaces (e.g. road reserves, parks). Where the slope of the batter is steeper than 1V:4H, the toe of fill batter or the top of cut batter must be provided with a minimum setback distance of 1m from the property boundary;
b. Where a retaining structure cannot be avoided, the preferred design solution is a retaining wall that does not exceed 1m in height. Where the change of level exceeds 1m, terraced retaining walls in accordance with Figure SC6.6-4: Typical acceptable treatment.

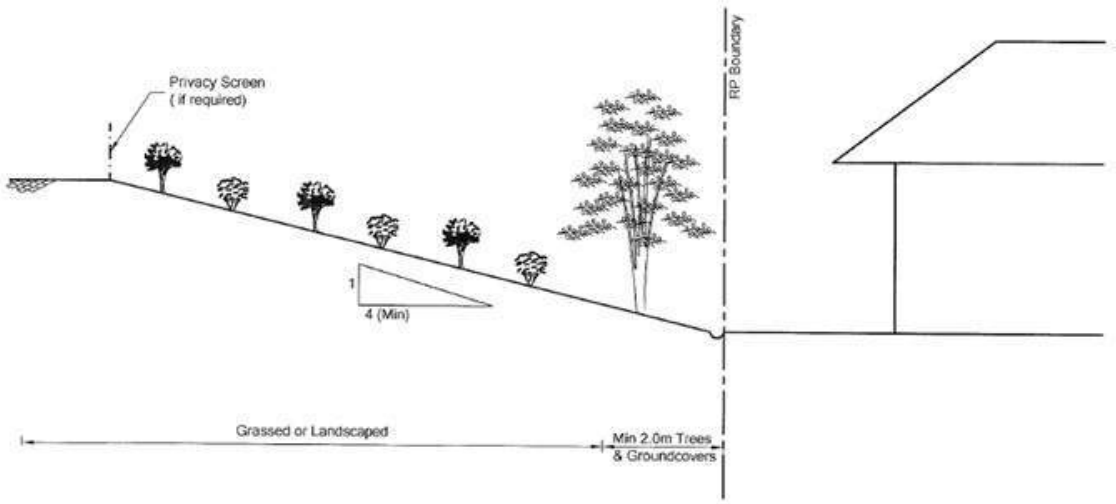
8. Fill batters no steeper than 1V:6H are to be provided adjacent to residential properties.
9. If any proposed fill or cut is likely to have a damaging effect on the visual amenity (i.e. batters greater than 1m high) of the adjoining property, or if 1V:6H batters are impracticable, consideration is to be given to providing a low retaining wall and associated landscaping of the reduced embankment.
10. The minimum treatment required for batters is topsoiling and grassing where the slope is no steeper than 1V:6H. Irrespective of the treatment, a cross-section showing the interface between the proposed development and the existing properties should be shown on the approved engineering drawings. The effects on the drainage of adjoining properties of any cut or fill operation should be considered and details shown on the engineering approved drawings. No ponding or nuisance from stormwater run-off will be accepted. Typical acceptable treatment alternatives are illustrated in Figure SC6.6-5: Fill embankment: landscaped batter, with 1V:4H slope to Figure SC6.6-8: Excavation: combined batter and retaining wall.
11. The locations of batters and earth-retaining structures are to be shown on plans certified by a registered surveyor before the development is accepted as ‘on maintenance’ or before a certificate of classification is issued.
12. Any associated landscaping species are to be included in the engineering drawings for approval by Council. Refer to PSP 7 Landscaping.

Figure SC6.6-4: Typical acceptable treatment



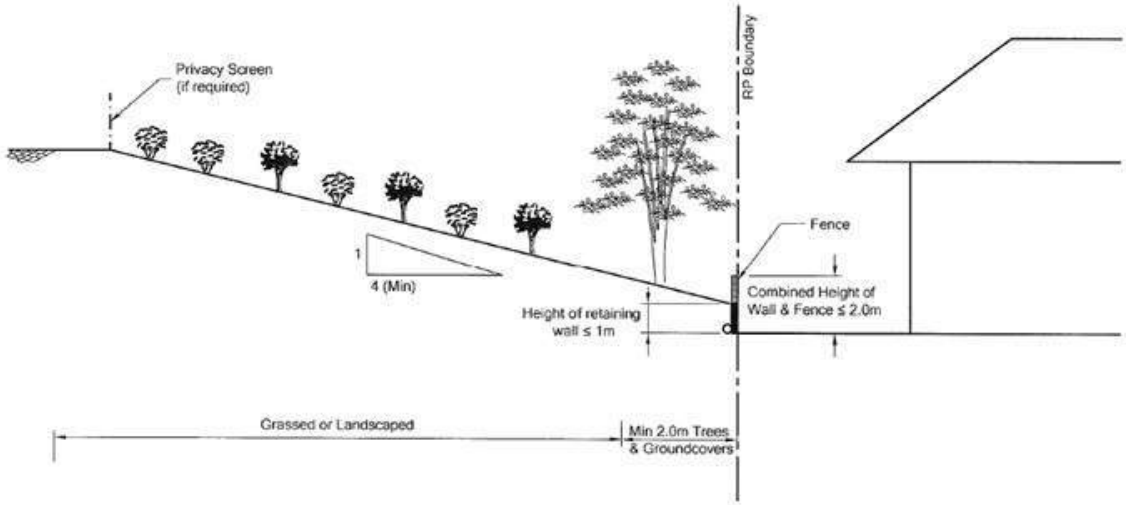
Source: Toowoomba Regional Council

Figure SC6.6-5: Fill embankment: landscaped batter with 1V:4H slope



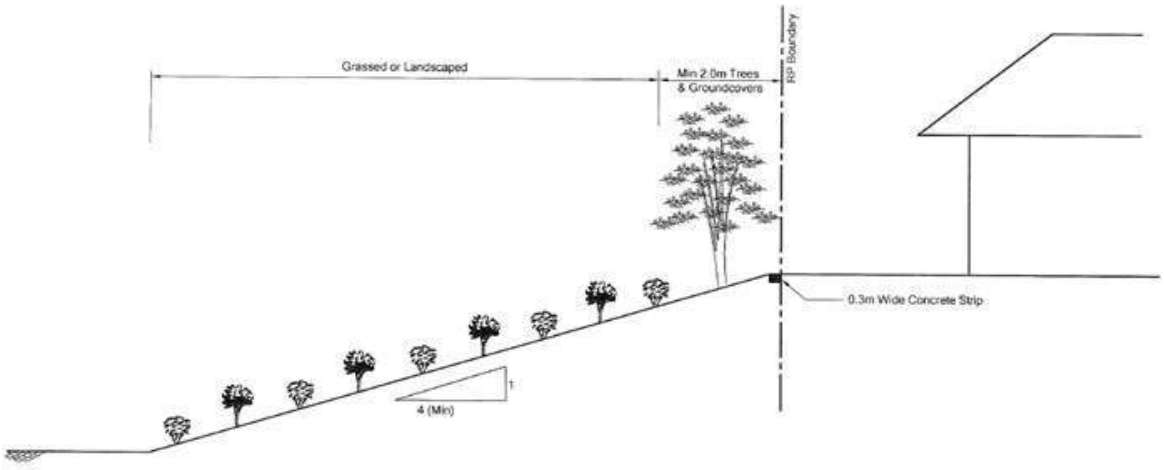
Source: Toowoomba Regional Council

Figure SC6.6-6: Fill embankment: landscaped batter with low retaining wall



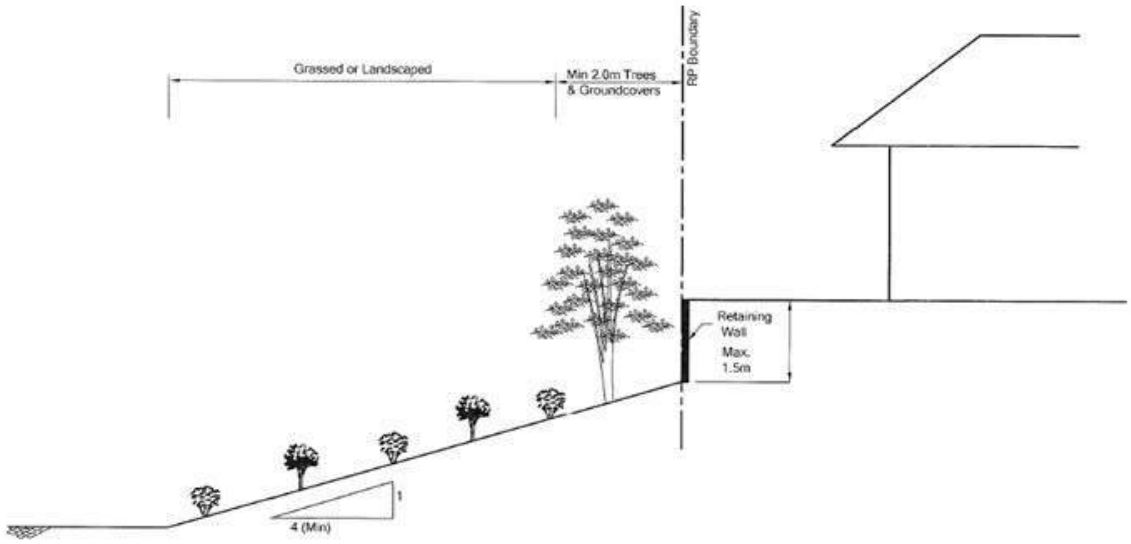
Source: Toowoomba Regional Council

Figure SC6.6-7: Fill embankment: landscaped batter adjacent to a concrete strip



Source: Toowoomba Regional Council

Figure SC6.6-8: Excavation: combined batter and retaining wall



Source: Toowoomba Regional Council

SC6.6.6.3.2 Retaining walls

1. An earth-retaining structure is built to protect land, buildings and structures near proposed excavation or filling. Retaining walls are classified into the following two categories:
   a. Category A: Council-built, Council-owned. Council builds the retaining-wall structure, and the maintenance responsibility lies with Council as stated in Section 265 of the *Local Government Act*. The wall is characterised using a consistent construction material over a lengthy stretch across several properties. The wall may be located on Council land or private property. The private property may be subject to an easement (in favour of Council) to provide unimpeded maintenance access. This category is most commonly associated with transport infrastructure upgrade projects;
   b. Category B: privately built, privately owned. The developer or property owner builds the retaining-wall structure. The ownership and maintenance responsibilities remain private. This category is characterised using different construction material or discontinuity in retaining-wall structure past the subject property boundaries. The category is most commonly associated with development applications pertaining to a material change of use and/or operational work for filling and excavation exceeding 1m in height relative to the natural ground.

2. Timber (which has a limited life span) and bush rocks (which have stability and vermin problems) are not permitted on land adjoining public space or road reserves. Construction materials acceptable to Council include grouted rock, reinforced concrete and masonry (bricks and blocks).
3. Retaining walls adjacent to existing or future public space (e.g. road reserves, parks, etc.) must be constructed of saw-cut Class-A sandstone, split faced sandstone or reinforced concrete sleepers with full-depth colouring (Suitable colour options must be submitted to Council for approval before the construction of the wall. Paints, varnishes, coatings and materials must have a matte appearance and muted colours or tones.
4. All walls are to be:
   a. aesthetically pleasing when viewed from the adjoining property (i.e. the retaining wall finishes have a high-quality appearance and are compatible with the surrounding development);
   b. Constructed without encroaching (including the footing) onto adjoining properties or public land;
   c. contained wholly within the property (i.e. consideration for access for maintenance to retaining walls is to be given at the design stage);
   d. terraced and landscaped to mitigate any adverse visual impacts. Plant species selected must preserve the structural integrity of the wall. The minimum bench width must be 1.2m to allow for plantings and maintenance access. Where planting is not practical in the area between the retaining wall and boundary fence (e.g. because it is too narrow or less than 0.5m wide), this area is to be paved with concrete or other approved materials to avoid future maintenance problems;
   e. designed with catch drains along the toe of the wall to catch any overland flow that may overtop the wall;
   f. designed for catch drains along the top of the walls;
   g. designed with approved backfill drainage material contained within a geo-fabric wrap and subsoil drainage with connection to an approved point of discharge;
   h. minimum 5kPa design surcharge load;
   i. bridge footing where applicable to not impose any additional loading upon underground services.
5. Walls exceeding 1m in height will require a building application and must be designed and certified by a RPEQ. When the combined height of a retaining wall is equal or greater than 1.5m, the RPEQ certification plus the written authorisation from the low-side neighbour will need to be provided to Council with the approved engineering drawings. Typical acceptable treatment alternatives are illustrated in Figure SC6.6-4: Typical acceptable treatment.
6. Earthworks within 4m of the road boundary of a site do not result in retaining walls facing towards the street that are greater than 1m in height.
7. Earthworks beyond 4m of the road boundary do not result in retaining walls greater than 1.5m in height within 1.5m of a side or rear boundary.
8. All retaining structures are to be shown and detailed on engineering plans for approval by Council.

SC6.6.6.3.3 Ground anchors

1. Council approval is required for ground anchor systems (permanent or temporary) proposed within 2m of infrastructure, such as sewer pipes, water mains, stormwater lines or associated structures. The application will form part of the filling and excavation or bulk earthworks plans submitted at the operational works stage.
2. The ground-anchoring system must be designed and certified by a suitably qualified RPEQ. Anchors must not be located closer than 1.2m vertically above or 1m below or 1m horizontally from the existing Council infrastructure. The following information must accompany the operational works application:
   a. payable fees;
   b. site plan (layout, elevation and sections) depicting details of the anchoring system (position, length, inclination angle and lock-off load) and surveyed locations of Council infrastructure and other services, such as telecommunications, electricity, water, sewerage and gas;
   c. approval from the Department of Environment and Resource Management if the anchoring system extends into the road reserve;
   d. approval from the providers of affected services.

SC6.6.6.3.4 Slope stability

1. The development of land or any part of any land greater than 15% (1V: 6.667H) must require a slope stability assessment report prepared by a suitably experienced and a suitably qualified RPEQ in accordance with Australian Geomechanics Society's Practice Note Guidelines for Landslide Risk Management 2007 (including all records or forms in support of assessment as outlined in Appendix D — Example Forms).
2. As a minimum, the report must include an analysis of the following:
   a. A review of the recent history upon the site and surrounding areas;
   b. A site plan of existing and proposed cross sections;
   c. A geotechnical model and site investigation including site mapping, borehole and/or test pit investigation, soil or rock characteristics, groundwater conditions;
   d. A detailed assessment of the risk posed by geotechnical hazards for works (building works, earthworks, vegetation clearing, driveway or drainage construction, on-site effluent disposal, etc.) undertaken or required to be undertaken on the site for the proposed development;

e. Recommendations of works to be undertaken to remove, reduce or manage the risks to both property and persons to either “very low” or “low”;
f. Soil classification to AS.2870 Residential slabs and footings.

SC6.6.6.3.4.1 Maximum allowable grades

1. A limit has been set on the maximum developable land to:
   a. Minimise and manage stormwater runoff;
   b. Minimise erosion and land slippage;
   c. Minimise loss of property and amenity.
2. Council will not allow development of land above the slopes of:
   a. 15% in Urban areas; and
   b. 20% in Rural and Rural Residential areas.

SC6.6.6.4 Soil Management

SC6.6.6.4.1 Dispersive soils and salinity management

SC6.6.6.4.1.1 Dispersive soils management

1. Dispersive soils have the potential to result in infrastructure and environmental impact. Typically, types of works that increase the risk to exposure of dispersive soils include:
   a. removal of topsoil;
   b. soil excavation, filling and ground profiling;
   c. trenching and supply of services;
   d. road and culvert construction;
   e. construction of dams and detention basins.
2. Field testing can be conducted to identify dispersive soils by observing the behaviour of air-dried aggregates in distilled water or rainwater. The Emerson crumb test can be used as an initial test to identify soil susceptible to dispersion, with the following steps applicable:
   a. Where evidence of dispersion is recorded, additional management techniques and the preparation of a management plan will be required;
   b. Further testing using approved Australian Standard techniques is required, where results of the field testing are inconclusive, or where large areas are likely to be disturbed by development, including for the construction of infrastructure.
3. The thresholds and dispersive soil management measures that apply are:
   a. Development within areas containing non-cohesive, saline or dispersive soils that meet or exceed the thresholds identified below are required to provide a Dispersive Soil Management Plan (DSMP), prepared and certified by a suitably qualified soil scientist or RPEQ with appropriate competence in addressing such soils, as part of the development application for the works;
   b. The DSMP is to be submitted to Council where it satisfies the requirements of Table SC6.6-10: Thresholds for Dispersive Soil Management Plan;
   c. The DSMP must be submitted with a stormwater management plan and earthworks plan as part of the development application;
   d. The DSMP must also address areas of difficult topography, with soil disturbance avoided on slopes of greater than 20% slope.

SC6.6.6.4.1.2 Thresholds for dispersive soil management

1. Development, including building works, within areas containing dispersive soils that meet or exceed the thresholds in Table SC6.6-10: Thresholds for Dispersive Soil Management Plan below are required to provide a Dispersive Soil Management Plan (DSMP).

Table SC6.6-10: Thresholds for Dispersive Soil Management Plan

DEVELOPMENT TYPE	THRESHOLD
Material change of use within an area containing non-cohesive, saline or dispersive soils	Includes newly constructed road
	5 or more additional dwellings (attached or unattached)
	Disturbing a ground area greater than 2,500m^2
	Any other use not listed above requiring on-site effluent treatment

Reconfiguration of a lot within an area containing non-cohesive, saline or dispersive soils	Includes newly constructed road
	Any number of lots requiring on-site effluent treatment
	Disturbing a ground area greater than 2,500m^2
Operational works within an area containing non-cohesive, saline or dispersive soils	Disturbing a ground area greater than 2,500m^2
	Earthworks involving the construction or decommissioning of any dam, and stormwater systems including but not limited to swales and detention basins
Building works within an area containing non-cohesive, saline or dispersive soils	All building work requiring Council approval and requiring on-site effluent treatment

2. A DSMP must address Council's expectations in relation to the reporting and presentation requirements as outlined in Table SC6.6-11: Recommended Reporting Template for DSMP's:
3. DSMP's are required to be submitted with the primary approval for Development Types as outlined by Table SC6.6-11: Recommended Reporting Template for DSMP's.

Table SC6.6-11: Recommended Reporting Template for DSMP's

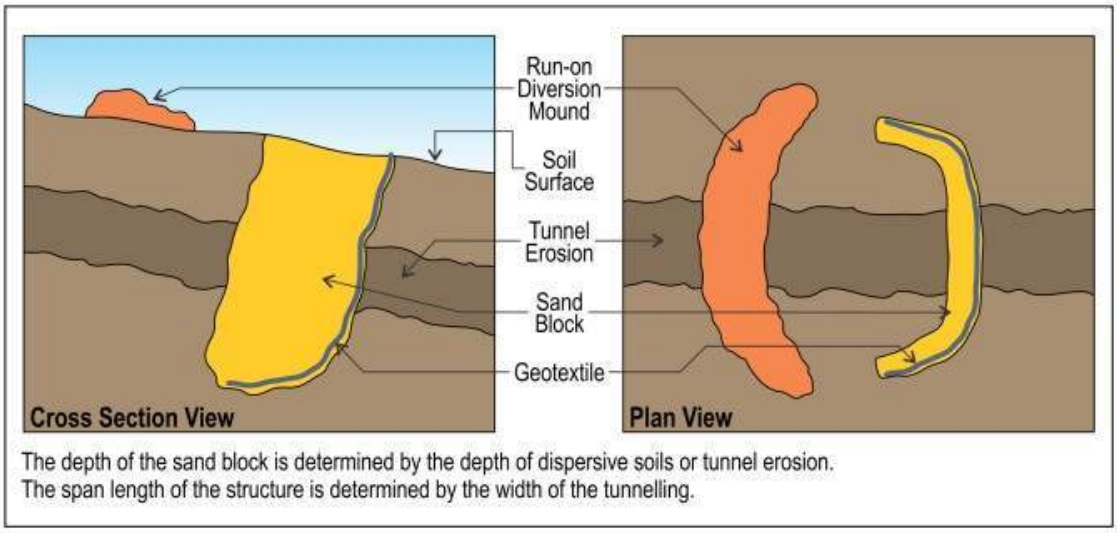
SECTION	CONTENTS
Cover Page	Title, details of development, date
Document Information Page	This page must outline information relevant to the authorship of the DSMP (ideally provided in tabular form), including document title (reference number, date and version tracking), document ownership (including names of personnel that have issued and checked the DSMP), RPEQ certification or suitably qualified and experienced professional (e.g. soil scientist) plus registration number, name of client and site address.
Summary	Concise summary of study methodology and findings
Responses to Information Request	Details of how (if any) previous information request/s from Council have been addressed
Table of Contents	
1. Introduction	General description of proposed development or works, existing site, scope of DSMP and names of the project team members
2. Site Constraints	General description of site limitations that affect on-site erosion and sediment control measures, grouped into five main categories: Soil; Topography; Water; Vegetation and Ecology. Included must be a detailed site plan showing: a. location of site or property boundaries; b. accurate location of boreholes (including reduced level) and proposed earthworks; c. site contours and drainage paths (existing and final); d. soils and associated risk mapping; e. difficult topography and associated hazard mapping; f. ecological values to be retained g. map scale suiting site area or features (maximum 1:2,000)
3. Soil Data	Document soil sampling, testing and interpretation of test results, notably in terms of salinity, acidity, dispersion and erosion potential
4. Erosion Risk Mapping	Aim to identify: a. zones of various erosion risk; b. areas where soil disturbance must be avoided; c. well-defined links between assessed risks and the required construction practices and erosion and sediment control design standards
5. Recommendations	Recommendations based on the assessment undertaken and requirements of Lockyer Valley Regional Council and must include: a. any specific soil characteristics (e.g. fine grained and dispersive soils); b. suggestion of alternative construction practices and top soil management to reduce present and future erosion (particularly tunnel) impacts c. areas where disturbance of extremely high risk or dispersive soils is to be avoided d. recommendations for monitoring to ensure implemented recommendations are appropriate for managing the risks.

6. Conclusions of the erosion assessment	Summary of site constraints, erosion hazards and recommended outcomes
7. Appendices	Include bore logs and copies of all laboratory test results

Note—The recommended reporting template table is not prescriptive but provides a summary of the type of information that Council will typically require for most developments. The onus is on the Applicant to demonstrate the performance outcomes of any proposed management techniques.

4. In preparing a DSMP, applicants are to address the management of water flowing through backfill material used in excavated trenches through dispersive soils. For example, the use of small size aggregate to intercept or carry water flows which will cause 'tunnelling' in adjacent soil may lead to subsequent road subsidence or failure. This applies to trenching for all infrastructure including water reticulation, installation of electrical conduit and the like.
5. The prevention and management of erosion is achieved using a combination of the following:
   a. Identification and avoidance of dispersive soils;
   b. Soil re-compaction;
   c. Chemical amelioration:
      i. The application of chemical treatments (e.g. gypsum) must avoid harmful changes to pH levels, particularly when near waterways (e.g. 20m from top of bank). The mechanical application of chemical amelioration must also be avoided in areas intended for tree or vegetation retention.
   d. Use of sand blocks and barriers (refer to Figure SC6.6-9: Modified Sand Block Design);
   e. Use of non-dispersive topsoil and revegetation;
   f. Adopting a risk reduction approach for soil dispersion, including:
      i. The Applicant is to commission a RPEQ or soil scientist to prepare a Dispersive Soils Management Plan (DSMP) for developments proposed within the areas effected by dispersive soils
      ii. Minimise the amount of time land is exposed (e.g. by staging development)
      iii. Discharge stormwater and runoff into erosion resistant areas (e.g. garden beds mixed with gypsum, existing well vegetated areas with ample topsoil and stony elevated areas) away from dispersive soils
      iv. Use rainwater tanks to capture runoff from roofs and buildings and pipe overflow to erosion resistant areas. (NB: Captured runoff must be dissipated and spread over as wide an area as possible)
      v. Cover exposed dispersive soils with topsoil (at least 150mm deep), mulch and use geotextile barriers
      vi. Re-vegetate and mulch all exposed areas, particularly areas of steep slopes.

Figure SC6.6-9: Modified Sand Block Design



Source: Ipswich City Council

6. The following activities must be avoided in areas affected by dispersive soils:
   a. Exposing dispersive subsoils to rain (both during construction and post construction);
   b. Allowing water to pond on dispersive soils;
   c. Stockpiling or spreading dispersive soils;
   d. Concentrating stormwater in drainage lines containing dispersive soil;
   e. Using table drains, trenches or cut and fill construction techniques in areas containing dispersive soils (unless appropriate measures are implemented in accordance with an approved DSMP);

f. Extracting topsoil or re-profile land in areas with dispersive subsoils (unless an appropriate management plan is prepared and adopted);
g. Clearing vegetation or profiling soil in areas of difficult topography, particularly where greater than 20% slope (unless appropriate measures are implemented in accordance with an approved DSMP);

7. Services such as electricity, telecommunications and water are usually provided in trenches in urban areas. Where trenching is undertaken in dispersive soils, the use of chemical amelioration, sand blocks and compaction methods is likely to be required to reduce the risk of dispersion occurring.

SC6.6.6.4.1.3 Salinity management

1. Development in salinity areas has the potential to increase infrastructure damage and cause environmental harm (e.g. water table rising bringing salts to the surface, adversely affecting water quality and causing damage to the ecosystem and infrastructure). The repair of salinity affected areas is often expensive and very difficult. Development in salinity areas must be avoided, to prevent exacerbation of salinity issues and ongoing maintenance of infrastructure. The management of salinity requires a focus on prevention at the design and construction phase rather than intervention, and a shift in standard construction techniques and development practices. Development must consider and address any negative impacts upon the development and natural environment.
2. Thresholds for salinity management:
   a. Development, including building works, construction of dams and roads within areas containing salinity that meet or exceed the thresholds contained below are required to provide a Salinity Management Plan (SalMP);
   b. The SalMP is to be submitted to Council in a format that satisfies the requirements in Table SC6.6-12: Thresholds for Salinity Management Plan;
   c. The SalMP must be submitted with a stormwater management plans and earthworks plan as part of the development;
   d. All other development undertaken in areas affected by salinity, including works such as landscaping and the installation of pools that would not normally require planning approval must ensure that adequate measures are taken to manage salinity.

Table SC6.6-12: Thresholds for Salinity Management Plan

DEVELOPMENT TYPE	THRESHOLD
Material change of use within an area affected by salinity	Includes newly constructed road
	5 or more additional dwellings (attached or unattached)
	Disturbing a ground area greater than 2,500m^2
	Any other use not listed above requiring on-site effluent treatment
Reconfiguration of a lot within an area affected by salinity	Includes newly constructed road
	Any number of lots requiring on-site effluent treatment
	Disturbing a ground area greater than 2,500m^2
Operational works within an area affected by salinity	Disturbing a ground area greater than 2,500m^2
	Earthworks involving the construction or decommissioning of any dam, and stormwater systems including but not limited to swales and detention basins
Building works within an area affected by salinity	All building work requiring Council approval and requiring on-site effluent treatment

SC6.6.6.4.1.4 Salinity management plans

1. A SalMP must address Council's expectations in relation to the reporting and presentation requirements as outlined in Table SC6.6-13: Recommended Reporting Template for SalMP's.
2. SalMP's are required to be submitted with the primary approval as outlined by Table SC6.6-13: Recommended Reporting Template for SalMP's.

Table SC6.6-13: Recommended Reporting Template for SalMP's

SECTION	CONTENTS
Cover Page	Title, details of development, date
Document Information Page	This page must outline information relevant to the authorship of the SMP (ideally provided in tabular form), including document title (reference number, date and version tracking), document ownership (including names of personnel that have issued and checked the SalMP), RPEQ certification or

	suitably qualified and experienced professional (e.g. soil scientist) plus registration number, name of client and site address
Summary	Concise summary of study methodology and findings
Responses to Information Request	Details of how (if any) previous information request/s from Council have been addressed
Table of Contents	
1. Introduction	General description of proposed development or works, existing site, scope of SalMP and names of the project team members
2. Site Constraints	General description of site limitations that affect on-site salinity, grouped into five main categories: Soil; Topography; Water; Vegetation; Infrastructure and Services. Included must be a detailed site plan showing: a. location of site or property boundaries; b. accurate location of boreholes (including reduced level) and proposed earthworks; c. site contours and drainage paths (existing and final); d. soils and associated risk mapping; e. water table heights and above and below ground water sampling; f. difficult topography and associated hazard mapping; g. ecological values to be retained; h. map scale suiting site area or features (maximum 1:2,000)
3. Soil and Water Data	Document soil and water sampling, testing and interpretation of test results, notably in terms of electrical conductivity.
4. Salinity Risk Mapping	a. Aim to identify zones of salinity risk; areas where soil disturbance and water table recharge must be avoided; b. well-defined links between assessed risks and the required construction practices and design outcomes.
5. Recommendations	Recommendations based on the assessment undertaken and requirements of Council and must include: a. any specific soil and water characteristics; b. suggestion of treatment measures and development constraints; c. areas where disturbance of water table recharge areas are of extremely high risk, are to be avoided. d. recommendations for monitoring to ensure implemented recommendations are appropriate for managing the risks.
6. Conclusions of the salinity assessment	Summary of site constraints, salinity hazards and recommended outcomes

SC6.6.6.4.2 Contaminated soils

1. Areas must be considered contaminated unless proven otherwise by NATA approved geotechnical testing.
2. Areas identified as being contaminated soils must be treated in accordance with:
   a. Department of Environment and Heritage Protection, Queensland Auditor Handbook for Contaminated Land;
   b. State Planning Policy State Interest Guidance material: Emissions and hazardous activities.
3. Areas identified as containing acid sulphate soils must be treated in accordance with State Planning Policy Guideline State Interest - emissions and hazardous activities, Guidance on acid sulphate soils, Department of Infrastructure, Local Government and Planning, and the guidelines published by Queensland Government https://www.qld.gov.au/environment/land/management/soil.

SC6.6.6.4.3 Environmental Management Register (EMR) / Contaminated Land Register (CLR)

1. Unless removed from the registers, notified activities that have been, or are being carried out on the land should be listed on the EMR (e.g. abrasive blasting, service stations, engine reconditioning and livestock dip operations) or land that is known to be contaminated should be listed on the CLR (e.g. landfill) are areas considered contaminated.
2. The official process for removing the land from a register involves undertaking an investigation of the land by a suitably qualified person, producing a site investigation and validation report, an auditor providing a compliance permit that the land is not contaminated, and finally the DES remove the land from the register https://www.qld.gov.au/environment/management/environmental/contaminated-land/assessing/change-registers.

SC6.6.6.4.4 Onsite Contamination

1. Any land affected by a contamination incident or pre-existing minor contamination (e.g. asbestos) must be managed, remediated and confirmed free of contamination by NATA approved geotechnical testing (this is dependent on the contaminant involved).
2. The remediation of land affected by a contamination incident or pre-existing minor contamination needs to be remediated in accordance with:
   a. The requirements of the *Environmental Protection Act 1994* and its regulations;
   b. State Planning Policy State Interest Guidance material: Emissions and hazardous activities.

SC6.6.6.5 Water Management

SC6.6.6.5.1 Impacts on Surface water

1. Plans submitted for approval need to indicate effects on surface water created by filling.
2. No ponding or nuisance from stormwater is to occur. In redeveloped areas, concrete spoon drains constructed along the toe of the embankment will permit drainage of an adjoining property. In low areas, subsoil drainage is required along the toe of the fill batters as the compaction of fill affects drainage of the area. Drainage or subsoil drainage is also required where seepage is likely from irrigated lawns and gardens.
3. Provide a Hydraulic Impact Assessment prepared by a suitably qualified RPEQ with recommendation to mitigate any impacts identified and undertake any mitigation works further to any approvals as applicable.

SC6.6.6.5.2 Earthworks within an overland flow path or flood hazard area

1. Earthworks are not to be carried out within overland flow path or flood hazard area unless approved by Council.
2. Council may approve earthworks within an overland flow path or flood hazard area, if it has been demonstrated by a Flood Impact Assessment or a Hydraulic Impact Assessment, prepared by a suitably qualified RPEQ that proposed works would not create adverse impacts on upstream or downstream properties.
3. As constructed ground level survey prepared by a cadastral surveyor must be submitted to Council before commencement of use or before sealing of a survey plan as applicable.

SC6.6.6.6 Earthworks construction

1. Earthworks are to be carried out in accordance with AS.3798 Guidelines on earthworks for commercial and residential developments.
2. Provide certification from a suitably qualified RPEQ for a fill over 500mm in depth has been placed in accordance with the level of supervision required under AS.3798 Guidelines on earthworks for commercial and residential developments.
3. The fill is to be compacted in layers not exceeding 150mm.
4. Dust, noise and odour generated from the site and from earthworks is to be controlled so it does not adversely affect adjoining properties and the travelling public.
5. Watering is to be undertaken on non-working days or where necessary to control dust emissions (i.e. dry windy days).
6. Implement measures to ensure that construction traffic or run-off from the development site would not track mud or sediments onto existing roads, adjoining properties or Council drainage system.
7. Mud deposited onto existing roads is to be removed immediately so it does not affect the safety of traffic or stormwater infrastructure.

SC6.6.6.6.1 Testing

1. Council will not give blanket approvals to any consulting body to carry out geotechnical testing at a level (i.e. Levels 1 or 2 as set out in *Section 8: Inspection and testing*, of *3798 Guidelines on earthworks for commercial and residential developments*).
2. The level of testing will vary with the nature of the project and the locality.
3. Section 8: Inspection and testing, of AS.3798 Guidelines on earthworks for commercial and residential developments, details the frequency of field density testing for earthworks.

SC6.6.6.6.2 Compaction

1. For areas of structural filling, the minimum relative compaction values are those outlined in Section 5: Compaction criteria, of AS.3798 Guidelines on earthworks for commercial and residential developments.

SC6.6.6.6.3 Dust control

1. The Principal Contractor is to minimise any environmental nuisances that occur during the construction of the roadworks and affect the safety and comfort of the travelling public and surrounding residences.

SC6.6.6.6.4 Stockpiling

1. All temporary stockpiles of erodible material must be:
   a. Protected from wind, rain, concentrated surface flow, and excessive up-slope stormwater surface flows; and
   b. Located up-slope of an appropriate sediment control system; and
   c. Provided with an appropriate protective cover (synthetic or organic) if the materials consist of dispersive soils or are likely to be stockpiled for more than four (4) weeks or located in close proximity of a sensitive site; or
   d. Provided with an appropriate protective cover (synthetic or organic) if the materials are likely to be stockpiled for more than ten (10) days during months of high erosion risk; or
   e. Provided with an appropriate protective cover (synthetic or organic) if the materials are likely to be stockpiled for more than five (5) days during months of extreme erosion risk.

SC6.6.6.6.5 Topsoil and grassing

1. All unpaved areas where earthworks have been undertaken are to be grass seeded or turfed as described in this section.
2. Following the placing and spreading of topsoil to a minimum depth of 100mm either won from the site or imported, the footpaths, parks, allotments and other disturbed areas are to be seeded.
3. Seeding is to consist of dehusked couch seed mixed with other seeds and fertilisers in accordance with the following criteria:
   a. the seed is to be mixed with fertiliser and loam in the following proportions:
      i. 200g, dehusked couch seed
      ii. 10kg, super phosphate fertilizer or equivalent
      iii. 12kg, loam.
   b. the resultant mixture is to be spread evenly over the surface at the rate of 21kg of mixture to 100m^2;
   c. the mix is to also include a nursery grass suitable for the growing season (e.g. millet);
   d. watering is to be continued throughout the maintenance period to ensure the continued growth of the grass.
4. Where stormwater drainage overland flow paths are constructed, grass seeding will not be acceptable, Council will only accept topsoil and turf coverage for these areas up to 1% AEP flood level plus 300mm. The turf must be established in accordance with best practice.
5. Turf is to be placed behind all kerb and channel, kerbing etc. for a minimum distance of 0.8m.
6. All unpaved areas where earthworks have been undertaken are to be grass-seeded as soon as possible to achieve a good grass cover:
   a. Following the placing and spreading of topsoil, either from the site or imported to the site, to a minimum depth of 100mm, the footpaths, parks, allotments and other disturbed areas are to be seeded with an approved seed mixture that includes a nursery grass (e.g. millet);
   b. The type of grass must be selected to suit the site soil conditions and must be drought tolerant;
   c. The rate of application will depend on the season;
   d. Immediately before the seed mixture is spread, the areas are to be watered to promote seed germination.
7. After seeding, the seeded areas are to be kept moist by watering until the grass is established. Grass is deemed to be established when vigorous green growth is in evidence from the planted seeds.
8. Such watering is to be continued throughout the maintenance period to ensure the continued growth of the grass.

SC6.6.6.6.5.1 Reuse site topsoil

1. If reusing of site topsoil has been proposed, make sure all foreign material and impurities including the following are removed before stockpiling:
   a. stones > 25mm diameter;
   b. clay lumps > 75mm diameter;
   c. prohibited or restricted biosecurity matter weeds and tree roots;
   d. sticks, rubbish and deleterious material; and
   e. material toxic to plants.
2. Remove topsoil that is unsuitable for reuse from the site as detailed in Section 6: Construction, of AS.3798 Guidelines on earthworks for commercial and residential developments.

SC6.6.6.6.5.2 Reused site topsoil testing

1. If directed, submit samples of the topsoil proposed for reuse to an approved soils laboratory to determine requirements for topsoil improvement before reuse. Submit a copy of the soil testing report received from the soils laboratory to Council.

SC6.6.6.6.5.3 Imported topsoil

1. If imported, supply topsoil that is free of material toxic to plant growth, weeds, seeds and roots, and has the properties specified in Table SC6.6-14: Topsoil Properties.

Table SC6.6-14: Topsoil Properties

PROPERTY	PROPERTIES OR LIMITS
Texture	Light — medium friable (i.e. capable of being handled when moist, but lacking cohesion so that it will fall apart easily when dry) sandy loam textured.
Organic matter by mass (minimum)	2%
Chloride content (maximum)	500 mg/kg
Electrical resistivity of a 1 in 5 soil-water mixture (maximum)	1 mS/cm
pH (minimum)	5.5
pH (maximum)	6.5
Linear shrinkage (maximum)	3% — Soil Type A 5% — Soil Type B

2. Import of topsoil to comply with soil management and transport in fire ant biosecurity zones under the *Biosecurity Act 2014.*

SC6.6.6.7 Final earthworks presentation

1. Before grassing of all unpaved areas where earthworks have been undertaken, the finished earthworks must be graded to a minimum of 1V:150H.
2. Water must not pond on finished surfaces.
3. Cut off or diversion drains with a minimum free board as in QUDM to be constructed to the appropriate standard to mitigate impacts from cumulative overland sheet flows.
4. Provide a minimum 100mm capping layer of good quality, non-dispersive soil on all areas disturbed during the earthworks operation.
5. All erosion and sediment control measures in place in accordance with the approved Erosion Sediment Control Plans (ESC Plans) or in accordance with the Best Practice Erosion and Sediment Control guidelines by the International Erosion Control Association Australasia https://www.austieca.com.au/publications/best-practice-erosion-and-sediment-control-bpesc-document. Where the drawings and the guidelines are conflicting, the requirements of the guidelines take precedence.
6. Grass cover on all disturbed areas must be achieved as follow:
   a. A minimum of 80% grass coverage at the time of on-maintenance;
   b. A minimum of 80% grass coverage at the time of off-maintenance.

SC6.6.7 Infrastructure Works

SC6.6.7.1 Road and Public Space Lighting

SC6.6.7.1.1 Introduction

1. This part has been prepared for the guidance of developers and their consultants to ensure that Lockyer Valley Regional Council's requirements for service providers Standard Street Lighting Lamps and Luminaires are achieved.
2. Sustainable developments must be provided with adequate utility services that will:
   a. operate safely and efficiently;
   b. perform to the required standard of service appropriate to the development;
   c. meet the future servicing requirements that support its intended use.
3. Unless specified otherwise in this policy or as directed by Council, the provision and detailed design of street-lighting and pathway-lighting installations must conform to the current edition of the following standards:
   a. Australian Standard AS/NZS.1158 Lighting for Roads and Public Spaces;
   b. Australian Standard AS.4282 Control of the Obstructive Effects of Outdoor Lighting;
   c. Australian Standard AS/NZS.3000 Electrical Installation Wiring Rules;
   d. Service providers policies and standards;
   e. Australian Standard AS.1798 Luminaire Mounting Height.
4. Except where specifically varied by this document, all electricity reticulation is to be constructed in accordance with the IPWEAQ Standard Drawing RS-100 Public Utilities - Typical Service Corridors and Alignments, RS-101 Public Utilities - Typical Service Conduits Sections, and RS-103 Public Utilities – Optic Fibre Pit and this planning scheme policy.
5. Council's standard requirement for the provision of electricity to new development requires underground reticulation.
6. Unless stated otherwise, it is the applicant's responsibility to provide the service providers Standard Street Lighting Lamps and Luminaires;
7. The design is to consider the DTMR and Council's future planning proposals.
8. At the time of approval, Council and/or DTMR will nominate the category and extent of service providers Standard Street Lighting Lamps and Luminaires required.
9. Service providers Standard Street Lighting Lamps and Luminaires are to be installed in association with the installation of all new traffic islands, new roads, pathways and existing road frontages.
10. Unless otherwise approved by the DTMR or Council, all road lighting installed as a condition of development is to be in accordance with AS/NZS.1158 Lighting for Roads and Public Spaces.
11. The developer must meet the cost of any alterations to the existing electricity and street-lighting networks required in connection with the development.
12. If road widening is required along the frontage of the development, the developer must apply for and seek approval from the relevant public utility authority for the undergrounding or, if approved, the relocation of the services onto the correct alignment within the new verge. In some instances, this may require lowering of services to provide enough cover where the footpath is regraded to the design profile. Services may also need to be raised if significant fill is used to raise the level of the verge.
13. The service corridors and alignments must conform to the LVRC Standard Drawings:
    a. SD-256 Regional Road Standard Urban & Rural Residential Streets – Typical Cross Section;
    b. SD-257 Regional Road Standard Urban & Rural Residential Streets – Typical Cross Section & Typical Service Locations;
    c. SD-258 Regional Road Standard Urban & Rural Residential Streets – Rural Roads Typical Cross Sections & Details;
    d. SD-259 Regional Road Standard Industrial Streets – Typical Cross Sections.
14. All service providers Standard Street Lighting Lamps and Luminaires associated with a development are to be certified by a RPEQ.
15. Service providers Standard Street Lighting Lamps and Luminaires must be provided at the following locations:
    a. new public streets (including laneways and paths) created as part of the development;
    b. all road frontage/s to the development, including any road construction required outside the limits of the development, including upgrading existing lights to current standards.

SC6.6.7.1.2 Lighting Categories

1. The lighting categories acceptable to Council are in accordance with AS/NZS.1158 Lighting for Roads and Public Spaces. The lighting categories referred to in AS/NZS.1158 Lighting for Roads and Public Spaces are broadly described as follows:
   a. Category 'V' lighting — lighting that is applicable to roads on which the visual requirements of motorists are dominant (e.g. major traffic routes) (refer to AS/NZS.1158 Lighting for roads and public spaces, Part 1.1: Vehicular traffic (Category V) lighting — Performance and design requirements);
   b. Category 'P' lighting — lighting that is applicable to roads on which the visual requirements of pedestrians are dominant (e.g. on local roads, pathways and bikeways). This category includes lighting that is applicable to outdoor

public areas such as outdoor shopping precincts, car parks and stairways (refer to AS/NZS.1158 Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting — Performance and design requirements).

2. Where special circumstances beyond the requirements of standards require, Council may vary the required service providers Standard Street Lighting Lamps and Luminaires category for any street or road requiring additional lighting, or modifications in the following situations:
   a. Intersections;
   b. Roundabouts;
   c. sharp bends;
   d. speed control devices (including local area traffic management);
   e. pedestrian crossings;
   f. cul-de-sacs;
   g. channelisation;
   h. bridges and culverts;
   i. night-time accident locations;
   j. frequently used night-time bus stops;
   k. areas that may generate pedestrian traffic or vehicle night traffic;
   l. sensitive habitat areas.
3. Decorative lighting cannot be used on 'V' category roads as the primary method to illuminate the roadway. Council will not accept any decorative light or supportive pole for the lighting of public roads and pathways unless it is a current standard stock item with service providers (i.e. available as a Rate 2 installation).
4. An RPEQ electrical engineer or lighting consultant should design and certify a lighting arrangement to meet Council's requirements.

SC6.6.7.1.3 Standard Street Light Fittings

1. In accordance with the current equipment available from service providers, luminaires are to be generally used on residential streets and along traffic routes.
2. Other wattage HPS luminaires will only be considered if acceptable to service providers as a Rate 2 installation and if they are proven to be cost-effective to Council.
3. Council will not accept any luminaires that are not acceptable to Service Providers on a Rate 2 installation.
4. Council will consider light fittings that are less vulnerable to vandalism.

SC6.6.7.1.4 Poles

1. Street light poles should not be placed in locations where they are vulnerable to damage from vehicles (e.g. narrow medians). Where this is unavoidable, suitable protection must be provided to minimise the risk of injury and/or the pole must be of a frangible (slip base) type.
2. Risk assessment for street lighting and other electrical structures placed in clear zones must be undertaken using the Roadside Impact Severity Calculator (RISC) or the Road Safety Analysis Program (RSAP) in accordance with Austroads Guide to Road Design Part 6 and DTMR Road Planning and Design Manual Edition 2, Volume 3 — Supplement to Austroads Guide to Road Design, Part 6: Roadside Design, Safety and Barriers. Both quantitative evaluation and qualitative evaluation are to be undertaken.
3. Council's preferred street-lighting column for category 'P' roads is a 7.5m mounting height, base-plate-mounted (BPM) column.
4. Twin outreach arms are available for installations requiring lighting from a central median.
5. Pole footing design is to be undertaken by a suitably qualified RPEQ to suit soil and environmental conditions to the pole manufacturer requirements.
6. To achieve a balanced streetscape, it is desirable that lights be installed alternatively on opposite sides of the street (i.e. a staggered arrangement). Installation of lights in a single-sided arrangement is unacceptable. Development layouts may require some short spans of single-sided lighting subject to the location of traffic-calming devices and side streets.
7. Energex's requirements for the provision of Public Lighting Services in the design, installation and maintenance of Public Lighting apply. Refer to Energex documents Public Lighting Standard Conditions for Public Lighting Services and Energex Limited Public Lighting Management Standard.

SC6.6.7.1.5 Standalone Solar (PV) Power Systems

1. Solar lights are acceptable in locations where the provision of reticulated electricity may not be cost efficient, e.g. parks, public car parks, pedestrians pathways.
2. Lighting output is to be in accordance with AS/NZS.1158 Lighting for Roads and Public Spaces.
3. Standalone power systems are to be in accordance with the relevant sections of:
   a. AS.4086.1 Secondary batteries for use with standalone power systems – General Requirements;
   b. AS/NZS.4909.1 Standalone power systems – Part 1: Safety and Installation;
   c. AS/NZS.4909.1 Standalone power systems – Part 2: System Design;

d. DTMR Specifications MRTS263 Standalone Solar (PV) Power Systems.

4. Warranty provisions are to meet the requirements of MRTS201 General Equipment Requirements except where the warranty period is noted for the items below:
   a. Solar photovoltaic modules and inverter: 10-year manufacturer's warranty against defects in materials and workmanship;
   b. Solar photovoltaic module power output: 25-year manufacturer's power output warranty, with the first 10 years at 90% minimum rated power output and the balance of the 25 years at 80% minimum rated power output;
   c. Charge controllers: 5-year manufacturer's warranty against defects in materials and workmanship;
   d. Lead acid batteries, minimum design life of 5 years with 5-year warranty;
   e. Lithium batteries, minimum design life of 10 years with 10-year warranty.

SC6.6.7.2 Electrical Reticulation Design Standards

SC6.6.7.2.1 Introduction

1. Electrical Reticulation is to be designed in accordance with the Electrical Authorities requirements and is to be carried out by competent electrical designers and certified by an RPEQ.
2. No development is to occur within a registered electricity easement.
3. No development is to occur within 4.6m of an electricity line.

SC6.6.7.2.2 Underground Reticulation

1. Underground electrical reticulation is to be provided in all new subdivisions or developments within zones as defined in the planning scheme. Developments in Rural zones and Rural Residential zones where 5,000m² or greater are subject to case-by-case assessment.
2. The service alignments are to be as depicted on IPWEAQ Standard Drawings:

   RS-100 Public Utilities - Typical Service Corridors and Alignments;
   RS-101 Public Utilities - Typical Service Conduits Sections.

   a. Electrical crossings are generally to be to the opposite boundary to water service crossings;
   b. Exceptions will be considered where electrical crossing is at 45° and water crossing perpendicular;
   c. Electrical crossings are not permitted within an intersection unless on standard alignment of projected intersecting property line.
3. Pillar Locations:
   a. Pillars are to be located at the property boundary in accordance with the IPWEAQ Standard Drawings RS-101 Public Utilities - Typical Service Conduits Sections and located away from hydrants;
   b. Pillars are not to be located on truncated boundaries at intersections.
4. Pad mount transformer locations are to be located within the frontage of proposed or existing parkland, as approved by Council.
5. Where minor subdivisional development occurs within an area which has existing overhead reticulation, Council may approve overhead connection subject to the relevant authority's approval.

SC6.6.7.2.3 Overhead Reticulation

1. Overhead power supply is acceptable in Rural Residential and Rural zones with lots greater than 5,000m^2.
2. Where abutting development in Rural Residential zones which has existing overhead reticulation, Council may approve extension of those services to the new areas subject to the relevant authority's approval.
3. Power pole location and alignments are referenced by IPWEAQ Standard Drawing RS-101 Public Utilities - Typical Service Conduit Sections.

SC6.6.7.3 Telecommunications

1. The service alignments are to be as depicted on IPWEAQ Standard Drawings:
   a. RS-100 Public Utilities - Typical Service Corridors and Alignments;
   b. RS-101 Public Utilities - Typical Service Conduits Sections.
2. A telephone reticulation approved plan is to be obtained and submitted to Council before the issuing of Operational Works approval.
3. Evidence of the Telecommunication Authority's agreement to provide services is to be given to Council before sealing of plans of survey.
4. Subject to the Power and the Telecommunication Authority's approval, joint use trenching will be adopted for telephone services.

SC6.6.7.4 Water

SC6.6.7.4.1 Introduction

1. Except as specifically varied by this policy, all water reticulation mains are to be designed in accordance with the SEQ Water Supply & Sewerage Design & Construction Code.
2. Evidence of the Urban Utilities agreement to provide services is to be given to Council at time of Development Application to Council.
3. Urban Utilities approved water design drawings are to be submitted to Council before the issue of Operational Works approval.
4. Evidence of the Urban Utilities agreement to accept all infrastructure 'On Maintenance' is to be provided to Council before sealing of plans of survey.

SC6.6.7.4.2 Road and rail crossings

1. All water main crossings of new and existing roads will be constructed in an 300mm enveloper pipe of ductile iron or similar. The enveloper (i.e. iron, steel, concrete) pipe will extend a minimum of 300mm beyond the back of the kerb and channel or the edge of pavement where no kerb is provided.
2. Crossings of existing roads will be bored.
3. Council may approve open trenching to roads below Collector subject to the location, traffic conditions, condition of the existing pavement and surfacing, space available for boring pits and substrate conditions.
4. If HDPE pipe is used with no joints or welds underneath roadways nor within 300mm beyond back of the kerb and channel or edge of pavement where no kerb is provided, then no enveloper pipe would be required for roads below Collector.
5. Trenching, where permitted, should be at or incorporate existing joints in pavement. Trenching is to be in accordance with IPWEAQ Standard Drawing RS-170 Pavement Extension - Trenching and Widening.
6. Written approval from either the DTMR or Queensland Rail is required if a sewer is to be constructed on land under the control of these bodies. In such cases the crossings will generally be designed and constructed in accordance with relevant bodies' requirements:
   a. All road crossings underneath a state-controlled road at to be in accordance with DTMR Technical Note 163 'Third Party Utility Infrastructure Installation in State Controlled Roads Technical Guidelines';
   b. If the water main is to be constructed underneath a railway line the crossing will be in accordance with the requirements of Queensland Rail.
7. The details of the crossing, pipe materials and grouting will be submitted to Council for approval.

SC6.6.7.4.3 Water main backfill in existing roads

1. Where crossings are not able to be bored and where approved by Council, excavation is to be carried out across existing roads and expediency in the backfilling of the trenches is required, the following methods in accordance with the IPWEAQ Standard Drawing RS-170 Pavement Extension - Trenching and Widening, are to be employed:
   a. Approved sand bedding to within 600mm of the finished surface is to be placed and compacted by flooding, vibrating or other approved means;
   b. The top 600mm is to be restored with lean mix low slump concrete (1V:20H) and 50mm of asphalt surfacing.

SC6.6.7.4.4 Water main backfilling to footpaths and other non-trafficable areas

1. Backfilling is to be carried out in accordance with the Urban Utilities specifications.
2. The material is to be placed in layers not exceeding 300mm in depth and is to be compacted to a minimum consolidation of 95% Standard Compaction.

SC6.6.7.4.5 Markers

1. Brass or stainless steel indicator discs to be placed in kerb over all conduits (refer to IPWEAQ Standard Drawings RS-100 Public Utilities - Typical Service Corridors, and Alignments and RS-101 Public Utilities - Typical Service Conduit Sections).
2. Hydrant and Valve markers are to be in accordance with Urban Utilities requirements outlined in approved water design drawings.

SC6.6.7.5 Sewer

SC6.6.7.5.1 Introduction

1. Except as specifically varied by this policy, the design and construction of reticulation sewers is to comply with the SEQ Water Supply & Sewerage Design & Construction Code.
2. Evidence of the Urban Utilities agreement to provide services is to be given to Council at time of Development Application to Council.
3. Urban Utilities approved sewer design drawings are to be submitted to Council before the issue of Operational Works approval.
4. Evidence of the Urban Utilities agreement to accept all infrastructure 'On Maintenance' is to be provided to Council before sealing of plans of survey.

SC6.6.7.5.2 Road and rail crossings

1. A sewer may cross a road to reduce the number of manholes to be used, provided house connections are not located within the road reserve.
2. Crossings of existing roads will generally be bored. Council must approve open trenching to roads below Collector subject to the condition of the existing pavement and surfacing, space available for boring pits and substrate conditions.
3. Written approval from either the DTMR or Queensland Rail is required if a sewer is to be constructed on land under the control of these bodies. In such cases the crossings will generally be designed and constructed in accordance with relevant bodies' requirements.
   a. All road crossings underneath a state-controlled road at to be in accordance with DTMR Technical Note 163 'Third Party Utility Infrastructure Installation in State Controlled Roads Technical Guidelines';
   b. If a sewer is to be constructed underneath a railway line, the crossing is to be in accordance with the requirements of Queensland Rail.

SC6.6.7.5.3 Sewer backfill in existing roads

1. All crossings of existing bitumen or AC sealed roads are to be under road bored.
2. Where crossings are not able to be bored and where approved by Council, excavation is to be carried out across existing roads and expediency in the backfilling of the trenches is required, the following methods in accordance with the IPWEAQ Standard Drawing RS-170 Pavement Extension - Trenching and Widening, are to be employed:
   a. If HDPE pipe is used with no joints or welds underneath roadways nor within 300mm beyond back of the kerb and channel or edge of pavement where no kerb is provided, than no enveloper pipe would be required;
   b. Trenching, where permitted, should be at or incorporate existing joints in pavement. Trenching is to be in accordance with IPWEAQ Standard Drawing RS-170 Pavement Extension - Trenching and Widening.

SC6.6.7.5.4 Filling over existing sewers

1. Where fill is placed over an existing sewer the Applicant will need to comply with Urban Utilities requirements.

SC6.6.7.5.5 Markers

1. Brass or stainless steel indicator discs to be placed in kerb over all conduits (refer to IPWEAQ Standard Drawings RS-100 Public Utilities - Typical Service Corridors and Alignments, and RS-101 Public Utilities - Typical Service Conduit Sections).
2. Infrastructure markers are to be in accordance with Urban Utilities requirements outlined in approved water design drawings.

SC6.6.7.6 Fences

1. Unless all survey pegs are obvious, the developer is to submit a certification by a Registered Surveyor that the fences are contained entirely within the development before the acceptance of works as 'off maintenance'. Under the *Building Regulation 2021*, fences higher than 2m above the natural ground surface would require a building application.
2. The following requirements will apply to fencing:
   a. The minimum standard of pedestrian safety fence is the galvanised tubular handrail, in accordance with IPWEAQ Standard Drawing GS-044 Fencing Tubular Steel Fence With & Without Chain Wire. However, powder-coated galvanised steel or aluminium pool fencing to AS.1926 Swimming pool safety, of minimum 1.2m height is the preferred barrier installation at traffic islands, signalised crossings and refuge islands;
   b. A galvanised tubular handrail with chain wire or galvanised weld mesh fencing is to be provided where there is a danger of children gaining access to high-risk areas or where the drop height exceeds 1m. Where the drop height exceeds 1.5m, a powder-coated steel fence (hunter rod top or approved equivalent), capable of sustaining the imposed actions specified in AS.1170 Structural design, actions is to be installed;
   c. Where required, barrier fences are to be in accordance with PSP 7 Landscaping including a lock rail for access must

be provided in accordance with IPWEAQ Standard Drawing GS-043 Fencing Locking Rail Types 1, 2 & 3.

d. A site-specific attenuation solution for each development is to be determined in accordance with the attenuation criteria and methodologies set out in the current relevant legislation;
e. The fencing must not hinder maintenance, otherwise the fencing is to incorporate vehicular access gates, or the fencing panels are designed for easy removal. Pedestrian gates are to be provided along road frontages:
    i. A concrete (extruded or cast in situ) mowing strip must be provided under all fences (including acoustic barriers) that abut lawn and landscaped areas. A minimum 150mm wide x 100mm deep strip, flush with the surrounding ground, will need to be installed under timber fences or walls or galvanised steel fences. Mowing strips are not required under masonry or concrete fences or walls as the footings are satisfy this purpose
    ii. Wildlife friendly fencing and exclusion fences are to be constructed in accordance with the Queensland Government Koala-Sensitive Design Guideline.

SC6.6.7.6.1 Hydraulic constraints

1. Fencing is not erected inside any drainage easement or overland flow path or flood hazard area or waterway corridor. The construction of fence types would promote debris-retaining or solid fences, as these structures will impact the conveyance of floodwaters and divert the flow onto adjoining properties.
2. In instances where the overland flow between private allotments is shallow (i.e. less than 125 deep), solid fences can be constructed with a clearance of 125 mm between the existing ground and the bottom of the solid fence to allow unobstructed conveyance of overland flows.
3. Council approval is required where fencing is proposed inside any drainage easement or overland flow path or flood hazard area or waterway corridor. Some suggested fencing styles include:
    a. open post and rail, where no panels of fencing are incorporated between the post and rail structure to provide minimum resistance to flood flows. Examples include log barrier fencing and galvanised tubular handrail;
    b. collapsible fencing, where sections of the fence are designed to collapse under flood loading so as not to increase flood levels but are also anchored to avoid being washed away. Low-strength ties can be used to hold the fence in place where outside a flood hazard area;
    c. swing fencing, where sections of the fence are designed to yield under the pressure of flood flows so as not to increase flood levels but are also anchored to avoid being washed away. Fence panels are fitted with hinges or pivot points to allow opening during floods. Low-strength ties can be used to hold the fence in place where outside a flood hazard area.
    d. lifting fencing, where sections of the fence may be temporarily raised to not obstruct flood flows.

SC6.6 Appendix 1: Urban and Industrial Road Design

Click here to view SC6.6 Appendix 1: Urban and Industrial Road Design

SC6.6 Appendix 2: Rural Road Design

Functional Element	Austroads Classification	Nominal AADT	Traffic Lane Width (m)	Shoulder Sealed (m)	Shoulder Unsealed (m)	Formation Width (m)	Pavement Width(m)	Primer Seal Width (m)	Bitumen Seal Width (m	Higher Order Vehicle Access	Number of Lanes	Minimum Pavement Depths (mm)
Regional Arterial	3	>1,000	3.5	1.5		10	10	10	10	B-Double A-Double	2 to 4	Pavement Design Required
Sub-Arterial	4	500 to 1,000	3.5	1		9	9	9	9	B-Double A-Double	2 to 4	
Sub-Arterial	4	100 to 500	3.5	1		9	9	9	9	B-Double A-Double	2 to 4	
Major Collector	4	150 to 1,000 or >20% CV	3.5	0.50		8.5	8.5	8.5	7.5	B-Double A-Double	2	
Collector	5	150 to 1,000 or >20% CV	3.25	0.50		8	8	8	7.5	B-Double A-Double Permit	2	300
Minor Road	5	50 to 150 or >20% CV	3		1	8	8	6.5	6	B-Double A-Double Permit	2	300
Local Access Road Bitumen Sealed	5	10 to 50 or >20% CV	3			8	8	6.5	6	Class 9 B-Double Permit A-Double Permit	2	250
Local Access Road Gravel	5	10 to 50 or <20% CV	3			6	6			Class 9 B-Double Permit A-Double Permit	1	200
Formed Track	5	<10				6				Class 9	1	

Note—Standard Drawing Typical Cross Section Rural Roads

SC6.6 Appendix 3: Water-sensitive urban design

1. Water-sensitive urban design (WSUD) applies the sustainability principles of water conservation, waste minimisation and environmental protection to the management of the urban water cycle. At various points along the drainage system, controls or combinations of controls are used to manage the quality and quantity of stormwater so that the impact on the environment and existing drainage systems is managed.
2. WSUD aims to minimise the impact of urban development on the natural water cycle, and its principles can be applied to single allotments or to whole subdivisions.
3. With regard to stormwater management, the core principles of WSUD include:
   a. Protect natural ecosystems;
   b. Integrate stormwater treatment into the urban landscape;
   c. Protect water quality;
   d. Reduce run-off and peak flows;
   e. Add value while minimising development costs.
4. These principles require a considered approach to urban development in which sustainable land and water management decisions underpin all development proposals.
5. For stormwater quality management, WSUD promotes an ‘at source’ philosophy that is based on the premise that it is easier and more cost-effective to control pollution at its source rather than remove it once it has made its way into a formal stormwater drainage system.
6. An ‘at source’ approach also allows for greater integration between stormwater management function and public realm landscape elements. Garden beds within building forecourt areas, street trees and other ‘soft’ streetscape elements can all be used as part of an integrated stormwater management system. Landscape elements can be designed to filter stormwater run-off from hard surfaces, the added benefit being the use of stormwater runoff to water the landscaped areas.

SC6.6 AP3.1 Introduction

1. The application of WSUD requires significant input from a range of professions. It is essential that a logical process is followed that considers not only the implementation of WSUD practices but integrates these within the overall urban design framework.
2. This section addresses the recommended planning and design process, and site-planning concepts and practices that must be incorporated into the design of greenfield and infill development. The practices presented are central to effective site planning and design of stormwater management facilities and the protection of receiving waters throughout the region. The focus of this policy is the consideration of stormwater management in the initial layout and design of a development rather than as an ad hoc development requirement or one that is left until all other elements (such as lot layouts, street design, hydraulics etc.) have been completed.

SC6.6 AP3.2 WSUD planning process

1. To achieve the optimum outcome in the application of WSUD principles and measures within a development, integration of detailed planning, engineering, landscaping and ecology is an absolute necessity. For this to occur, a process that addresses the relevant tasks in a logical manner is required.
2. The process set out below highlights key steps in the overall conceptual design process. In most cases, the WSUD professional will lead a team through the required tasks, or at least seek to facilitate the team through it. This process cannot be conducted separately to other processes, such as the overall urban, engineering or landscape design. This process requires several iterations through the overall urban development project.

SC6.6 AP3.2.1 Step 1: Site analysis

1. Understanding the location where WSUD is to be applied is fundamental to the overall success of implementation. This task is about gathering a broad overview of the subject site and identifying those issues that will assist or hamper the delivery of WSUD practices.
2. This task must involve initial data collection, such as land use zonings, terrain information, aerial imagery and previous studies, and reviewing the data in conjunction with planning scheme maps. A site visit is considered essential. The following items will need to be identified and considered:
   a. terrain — areas of high and low gradients, flatter areas that allow larger WSUD measures such as wetlands, level areas which may present difficulties in terms of hydraulic head and high groundwater table catchment boundaries internal to the site and catchment areas external to the site;
   b. natural features, especially creek lines, permanent water bodies, existing vegetation;
   c. planning constraints — environmental corridors, waterway corridors, flood hazard, open space or recreational nodes;

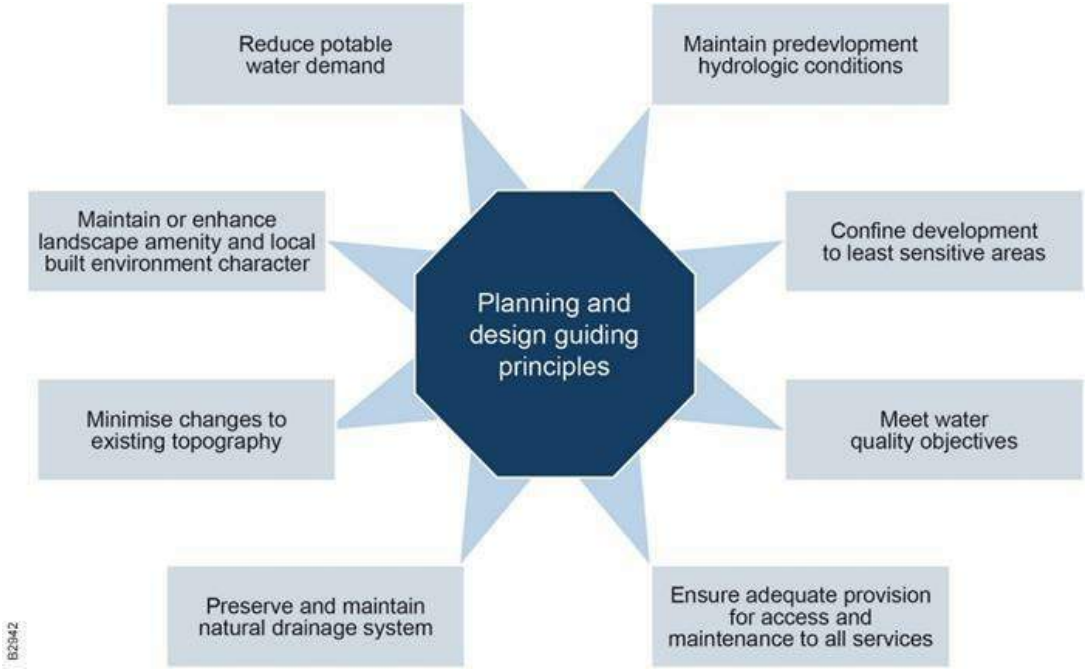
d. receiving environment — waterways or drainage lines where discharge off site is likely to occur;
e. strategic catchment planning — catchment or sub-catchment plans (in Councils region this will include catchment management plans, stormwater management plans and master drainage strategies) to identify any regional or catchment-scale strategies applicable to the site;
f. existing hydrological patterns and features;
g. extent of the the 1%AEP and 5% AEP is mapped;
h. topography and slope stability;
i. geology and soil characteristics;
j. existing water quality;
k. waterways, wetlands and floodplains;
l. minor drainage features;
m. existing known stormwater or drainage 'problem' areas;
n. vegetation;
o. erosion-prone areas;
p. groundwater and recharge areas;
q. existing infrastructure and services (potholing to obtain levels is considered a mandatory requirement in most cases);
r. planned infrastructure and services;
s. existing easements and drainage reserves on the site and the possible need to secure additional areas at downstream locations.

3. From this, a list of opportunities and constraints as they apply to WSUD at the subject site must be prepared to assist in the remaining tasks.
4. The information layers compiled during the resource mapping then need to be overlaid to provide a composite site analysis that:
   a. identifies the developable area of the site
   b. shows the relationship between constraints and opportunities at the site
   c. guides lot and road layout
   d. identifies the area's best used for stormwater treatment, storage and conveyance.

SC6.6 AP3.2.2 Step 2: Identification of objectives

1. The implementation of WSUD in a development seeks to achieve a range of outcomes relating to water quality, hydrology, conservation and amenity, as shown in Figure SC6.6-10: WSUD conceptual design outcomes.

Figure SC6.6-10: WSUD conceptual design outcomes



Source: Gold Coast City Council WSUD Conceptual Design Guidelines

2. Each of these outcomes is met by ensuring development complies with the appropriate objectives identified for the site. Before any other activities are undertaken with respect to site planning, the objectives must be clearly established using

the information provided in the sections below.
3. In most cases, site-specific objectives will be available and need to be identified clearly so that they can be referred to during the remaining tasks in the concept design process.

SC6.6 AP3.2.2.1 Water quality objectives

1. One of the primary roles of WSUD is to reduce the impacts of urban development on receiving environments. As part of the design process, relevant environmental values and water quality objectives of receiving waters or other water quality targets relevant to the site must be identified, where available, and documented. These include:
   a. concentration-based water quality objectives for receiving waters
   b. concentration-based discharge standard from a site load-based criteria (mass per unit of time) or reduction in load.
2. The relevant water quality objectives must be used as the primary performance criteria on which a development is assessed for its ability to ensure protection of receiving water quality. Stormwater Management Design Objectives are included within the Stormwater Management Code in Table 9.4.7-2: Construction Phase — Stormwater Management Design Objectives, to Table 9.4.7-5: Post Construction Phase — Stormwater Management Design Objectives.

SC6.6 AP3.2.2.2 Water quantity objectives

1. A key principal of WSUD is to reduce the impact of urban development on the natural hydrologic conditions of a site and other water quantity objectives may also be relevant. Inundation times must be considered as part of the setting of water quantity objectives. This is relevant where inundation times are increased for downstream properties.
2. Further discussions must be held with Council development assessment officers during Step 3 to ensure appropriate quantity targets have been identified.
3. It must be recognised that WSUD elements in isolation will not be enough to address all flooding or hydraulic requirements but may be integrated within the overall hydraulic design of the development.

SC6.6 AP3.2.2.3 Integrated water cycle management objectives

1. One of the major benefits of WSUD is the ability to incorporate measures that can benefit all parts of the water cycle. WSUD elements such as rainwater tanks, aquifer storage and recovery, bioretention basis and sediment control ponds can all be useful elements in an integrated water management plan.

SC6.6 AP3.2.2.4 Landscape and amenity objectives

1. When deterministic objectives are not available, broad objectives for the integration of landscape elements into WSUD should include the following:
   a. Ensure the integration of landscapes, recreational amenity and WSUD functionality facilitates creative expression and solutions, meets standards of service for recreation and landscape amenity, can be comprehended by the community, and is sensitive to the environment and the local setting.
   b. Provide appropriate buffers to open-space areas or environmental corridors. In most circumstances, the functionality of open-space areas must not be compromised by the WSUD elements.
   c. Provide a desirable community amenity and integrate WSUD into the overall design of the urban framework.
   d. Ensure the sustainability of landscape amenity through a design that accounts for longevity of the system by considering maintenance and community use aspects (e.g. vandalism, litter protection).
   e. Provide ‘green’ elements and visual breaks in the urban landscape.

SC6.6 AP3.2.2.5 Vegetation and natural features

1. The objectives of WSUD relating to vegetation and natural features include:
   a. protection and enhancement of waterways, wetlands and their buffers appropriate development setbacks from waterways and wetlands
   b. protection of remnant vegetation communities
   c. retention and reinstatement of native vegetation
   d. natural channel design responses for natural gullies and waterways.
2. Each of these objectives must be developed in conjunction with Step 6 to ensure natural features of the site are identified and their protection or enhancement is listed as an objective for that development.

SC6.6 AP3.2.2.6 Social outcomes

1. Objectives relating to public safety, community enhancement and recreational opportunities may be identified through other processes; however, it is important that they are considered as a specific outcome.

SC6.6 AP3.2.3 Step 3: Conceptual site design

1. Based on the outcomes of Steps 1 and 2, an initial conceptual site design based on broad development outcomes is undertaken.
2. This can be a simple sketch using intended land uses (e.g. residential areas, local open space, regional open space, protected zones), but must identify areas for implementation of lot-, local- and regional-scale WSUD measures. The objectives previously identified provide guidance, but key to this conceptual design will be addressing the opportunities and constraints identified in Step 1 in a whole-of-development context. This conceptual site design becomes the overall vision for more detailed design in later steps.
3. There will be occasions when the above process will generate the apparent need for stormwater treatment devices that are out of proportion or inappropriate for the proposed development. In these exceptional circumstances, Council is prepared to consider alternative 'best practice or best fit' solutions that may not deliver the targeted, desired standards of service. Council will require compelling justification to vary its position on achieving these targets against the following criteria:
   a. Cost of construction and whole-of-life cost is prohibitive.
   b. Land area required is excessive against the scale of the development.
   c. Environmental constraints prohibit the full implementation of the required facility.
   d. Topographical constraints prohibit the full implementation of the required facility.
   e. Hydraulic constraints prohibit the full implementation of the required facility.
   f. Other matters prohibit the full implementation of the required treatment measures.

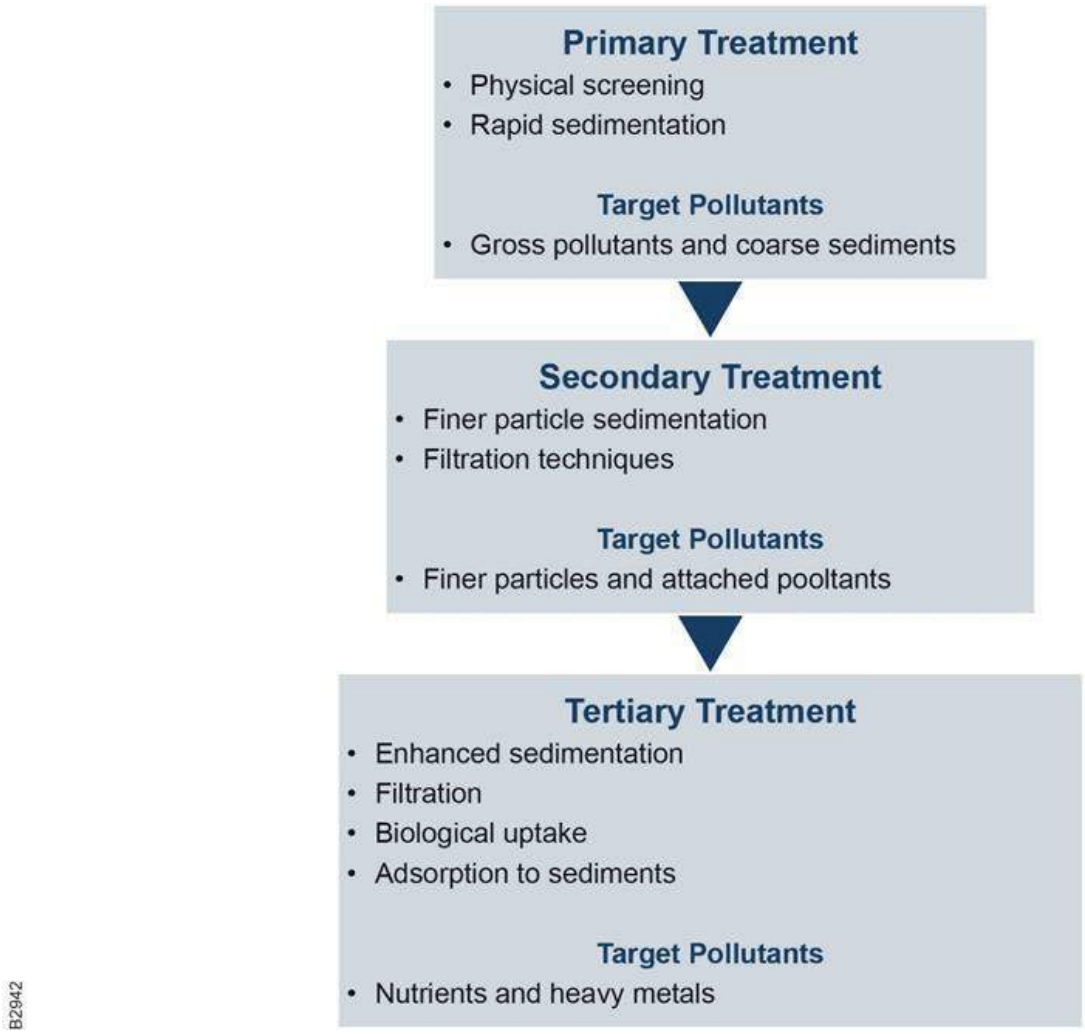
SC6.6 AP3.2.4 Step 4: Pre-lodgement meeting

1. In most applications, it will be beneficial to the overall development application process to meet with Council officers to discuss the existing site, proposed development and Council requirements. Typically, this would form part of a pre-lodgement meeting in which informal discussions are held between the developer (and its consultants) and Council.
2. A draft concept design of the proposed development (including potential WSUD locations) must be prepared and form the basis of discussion at the pre-lodgement meeting.
3. This meeting must also be used to discuss the implications, if any, of Council catchment and stormwater management plans, particularly in relation to the opportunity or requirement for larger catchment-scale regional detention or water quality treatment devices that account for upstream catchment areas.

SC6.6 AP3.2.5 Step 5: Identification of suitable WSUD measures

1. WSUD best management practices (BMPs) are best provided as a series of 'fit for purpose' treatment measures placed sequentially to form a 'treatment train'. One individual measure will not address the full range of pollutants generated from a typical urban development. An appropriate collection of individual treatment measures in series within a treatment train must be developed. This must consider the best operating environment for each treatment measure, considering:
   a. contributing catchment area
   b. hydraulic and pollutant loading
   c. treatment processes employed
   d. soil type and groundwater
   e. maintenance and public health and safety issues.
2. The treatment train must provide an integrated drainage system suitable for the site that includes a graduated level of treatment, from primary through to tertiary treatment, with a specific aim of treating stormwater for the target pollutants (refer to Figure SC6.6-11: Stormwater treatment train categories).

Figure SC6.6-11: Stormwater treatment train categories



Source: Gold Coast City Council WSUD Concept Design Guidelines

1. MUSIC Modelling can be used to develop alternate treatment measures to support the treatment train and provides information on their application and performance.
2. Subject to a risk assessment 'deemed to comply' solutions are to be implemented to meet the stormwater quality objectives. The designer is referred to Deemed to Comply Solutions — Stormwater Quality Management (South East Queensland), prepared by Water-by-Design for Healthy Waterways. The use of wetlands is not acceptable to Council as a 'deemed to comply' solution.
3. The list of possible WSUD devices must be used to develop a series of potential treatment trains for the proposed development, based on the interpreted site conditions and site opportunities and constraints. Other issues that must also be taken into consideration in selecting appropriate treatment measures include:
   a. cost—benefit ratio of the number of treatment devices (capital and maintenance costs) against the (b) water quality achieved
   b. workplace health and safety issues (for maintenance crews)
   c. public amenity and safety
   d. whether a distributed or 'bottom-of-catchment' approach will be used
   e. integration with urban design, including road and lot layouts
   f. life cycle costs and ongoing maintenance requirements and resources.
4. Several factors must be considered in the selection of the final treatment train for the site. These factors must be considered alongside the opportunities and constraints identified at the site and the opportunities to lay out the development to respond to WSUD requirements.
5. The following factors must be considered in the selection of the treatment train:
   a. maintenance
   b. life cycle costs
   c. location
   d. public safety

e. establishment
f. access
g. erosion and sedimentation control.

SC6.6 AP3.2.5.1 Maintenance

1. The devices selected must represent a reasonable maintenance burden, particularly where the asset will be handed over to Council at some time in the future.
2. The maintenance requirements must be within Council's capacity in terms of skills, resources and equipment.
3. There must be enough resources to undertake maintenance at the required frequency.
4. The treatment devices must be safe to maintain and must not require maintenance staff to have direct contact with pollutants and other trapped materials.
5. Maintenance procedures must be simple and must not require specialised equipment.
6. Disposal of waste (e.g. gross pollutants, vegetation etc.) must be considered.

SC6.6 AP3.2.5.2 Life cycle costs

1. A life cycle cost assessment may be undertaken in the process of selecting the best devices (e.g. many smaller devices rather than larger treatment devices).

SC6.6 AP3.2.5.3 Location

1. The device must be able to integrate with the local character and built environment and must be suitably located to treat the maximum amount of run-off from the site.

SC6.6 AP3.2.5.4 Public safety

1. The safety of the public adjacent to the WSUD device is a priority. Consideration must be given to the risks associated with open water bodies, ponded water etc. Risks must be appropriately managed through selection of devices and subsequent detailed design.

SC6.6 AP3.2.5.5 Establishment

1. The establishment period will be dictated by the period required for the measure to become fully functional. For vegetated systems, this may take two or three growing seasons.

SC6.6 AP3.2.5.6 Access

1. The devices and their locations must be accessible for ongoing maintenance. Maintenance access must be ensured for all equipment required for ongoing maintenance (including any heavy machinery).

SC6.6 AP3.2.5.7 Erosion and sedimentation control

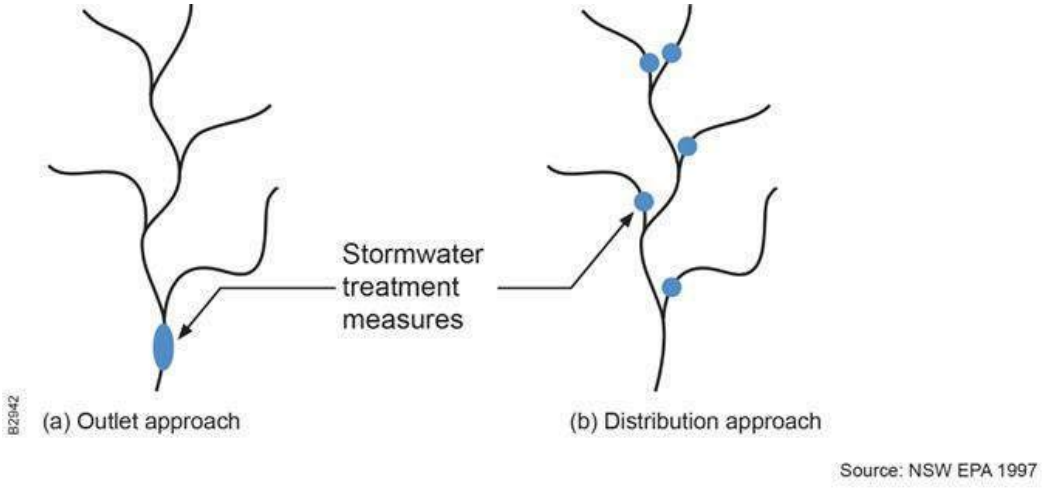
1. Construction phase performance criteria are limited to those parameters that are linked to construction site management practices. Typical parameters include turbidity or suspended solids, pH, dissolved oxygen, litter and hydrocarbons.
2. Unless otherwise stated in a Council-endorsed catchment management plan or study, the construction phase performance criteria for discharges from development sites are those listed in SPP Part E Appendix 2 — Stormwater Management Objectives. These criteria are discharge standards, so they apply to run-off events or pumped discharges from development sites.
3. It is highly recommended that a site-specific relationship be developed between turbidity and suspended solids on high-risk development sites. This will enable the rapid feedback of turbidity monitoring into site management actions (such as flocculation and timing of discharge from a sedimentation basin).
4. Setting concentration-based criteria allows for compliance checks through water quality monitoring. Construction phase water quality monitoring will be required for sites where dewatering is required.
5. The designer is referred to SC6.6.4.4 Stormwater Quality.

SC6.6 AP3.2.6 Step 6: Location of WSUD elements

1. When determining the best WSUD measures for a site, some consideration must be given to the site analysis, the opportunities available, and the 'natural' or obvious areas for WSUD devices (e.g. overland flow paths). The site analysis

may provide information on whether a bottom-of-catchment, regional approach or a distributed, treatment-at-source approach to WSUD is best for the site. These two options are shown in Figure SC6.6-12: Location of stormwater treatment measures below:

Figure SC6.6-12: Location of stormwater treatment measures



Source: Gold Coast City Council WSUD conceptual design guidelines

2. WSUD principles are most effective and economical when integrated into development design at the concept design stage. Subdivision patterns for different development types may vary significantly and present different WSUD opportunities. Different development types and suitable WSUD can include:
   a. low-density subdivisions (e.g. park residential). These developments have larger allotments and may incorporate a broad range of WSUD initiatives. These sites may have enough space to incorporate significant landscape WSUD elements, such as swales and buffer strips in road reserves, bioretention in natural depressions etc.
   b. low- to medium-density subdivisions. These contain a range of low-rise dwelling types on smaller allotments and afford less opportunity for landscape WSUD elements. In this instance bioretention devices may be incorporated into street design or through more effective lot layout design
   c. high-density development. This contains several dwellings in strata or community title. Private open space will be hard paved with limited pervious area. Open-space areas will be multifunction areas acting as treatment measures and recreational areas. WSUD opportunities may include common open-space areas, courtyards and roof areas.

SC6.6 AP3.2.6.1 Public open space

1. The open-space system must be developed with the aim of establishing a network of natural features and compatible land uses that will act as a green network throughout the development.
2. The integration of stormwater management initiatives as components of the open-space system contributes to open-space outcomes by increasing the physical area of general open-space and green elements within a community, enhancing terrestrial and aquatic habitat diversity and enhancing recreational and educational opportunities. The following are examples of techniques that can be used to integrate stormwater management and the open-space network:
   a. incorporation of waterways and bioretention systems within parks as ecological and/or recreational features
   b. integration of playfields within dry detention basins
   c. design of subsurface storage and/or infiltration systems beneath playfields within parks or school yards
   d. development of gardens within open-space areas as bioretention systems.

SC6.6 AP3.2.6.2 Road configuration and layout

1. Most impervious hard surfaces in urban developments are roads. Road designs can change the way water is transported through a development. Roads also generate water-borne stormwater contaminants including fine sediments, metals and hydrocarbons. Road alignments and streetscapes must be carefully planned to incorporate some degree of treatment. Appropriate WSUD drainage elements include:
   a. bioretention system
   b. bioretention swales
   c. buffer strips.
2. These devices collect, attenuate, convey and treat run-off before it is discharged to receiving waterways. Opportunities exist for incorporating stormwater elements in roadways by diverting flow paths to a treatment system. Traditional road

features (medians, roundabouts, street trees and car parking nodes) can be configured to collect and treat run-off as part of a stormwater conveyance system.

SC6.6 AP3.2.6.3 Lot layout

1. The requirements of the Reconfiguring a Lot code in the planning scheme will be the key document to be used in overall lot layout. However, some general principles that can be followed in lot layout to maximise WSUD opportunities and reduce stormwater impacts are:
   a. Minimise site disturbance.
   b. Locate lots in a way that stormwater can be discharged to open space (and not concentrated in one location).
   c. Maximise opportunities for on-lot treatment or for conveyance from WSUD devices.
2. Lot layout options that may be considered (refer to Figure SC6.6-13: Integration of housing with waterway corridor) include:
   a. clustering houses to use central stormwater treatment measures
   b. using open space and existing vegetation as buffers
   c. reducing the impervious area of each lot (e.g. driveway length and width).

Figure SC6.6-13: Integration of housing with waterway corridor

Source: Gold Coast City Council WSUD Conceptual Design Guidelines

SC6.6 AP3.2.6.4 Natural channel design

1. The basic principle of natural channel design is to maintain the hydraulic conveyance requirements of engineered or affected channels, while improving environmental values. Natural channel design is important in all waterways (whether natural in formation or constructed to appear and operate as natural channels), especially where the waterway provides a link with bushland reserves or forms an important part of an aquatic or terrestrial movement corridor. An extended maintenance period may be required until the channel has sufficiently stabilised and vegetative cover is well established.
2. Where rock armour is required to control erosion, partially embedded or grouted natural rocks or boulders must be used. Planting between rocks can soften visual impacts.
3. Boulders placed on the bed of the watercourse can promote habitat diversity. Boulders recessed into the low-flow channel or the pools can increase the total submerged surface area, thus increasing the available food supply for aquatic life. Concrete lining is unacceptable to Council as this solution does not protect or enhance environmental values.

SC6.6 AP3.2.6.5 Rainwater tanks

1. Council actively supports the use of rainwater tanks as they provide a simple and effective means for property owners to manage stormwater at the source, while providing a major benefit to the management of the urban water cycle through reduced water demand and improved water quality. The application of rainwater tanks is particularly suited to new and existing houses, and small-scale residential developments of four dwelling units or less. The Queensland Development Code provides minimum water tank requirements.
2. Overflows from rainwater tanks are usually connected to soakage or rubble pits. The proposed stormwater disposal method must mitigate any potential impacts worsening the existing conditions either by ponding, concentrating or increasing the flow onto adjoining properties. The acceptable solution may include soakage trenches or a combination of gravity-feed pipe through a drowned outlet to the kerb and channel and/or rainwater tank under the house. The soakage pit must be located at least 3m from any building or boundary and must provide every opportunity for the stormwater flow to broadsheet across the lawn. The removal of stormwater by adsorption or infiltration into permeable soils must be

designed to suit the topography and soil type.

SC6.6 AP3.2.7 Step 7: Model base case

1. At this stage, enough information would have been collected to allow modelling of both the existing site and the 'untreated' developed site; the model would form the base case against which to compare future modelling of the WSUD development.
2. In most developments, water quality modelling must focus on total suspended solids, total nitrogen, total phosphorus and gross pollutants as the key pollutants of interest, as well as on the hydraulic outcomes. Further guidance on water quality modelling is provided in the Healthy Waterways Water-by-Design MUSIC Modelling Guidelines.
3. Some characterisation of the natural hydrology and an assessment of the peak flow rates and volumes for the pre-development condition must be undertaken for the full range of ARI's from 2 to 100 years. For smaller catchments, preliminary assessments can be made using simple catchment calculations based on the Rational Method. For larger catchments, characterisation of the site hydrology may require use of hydrologic models (e.g. XP-RAFTS, RORB, URBS) to represent the hydrologic conditions of the site. These pre-development conditions will be used as the reference point for which the WSUD strategy must aim. The establishment of the pre-development conditions will usually be conducted through an overall hydraulic assessment of the site, to meet flood management requirements (refer to *QUDM Section 7: Urban Drainage* for guidance on hydrological and hydraulic assessment).

SC6.6 AP3.2.8 Step 8: Model treated case

1. Evaluation and assessment of alternative stormwater strategies are based on predictions made by forecasting tools. Modelling tools such as MUSIC and hydrologic models such as XP-RAFTS, URBS etc. must be used to demonstrate that the proposed strategy:
   a. achieves the load reduction targets adopted by Council.
   b. results in no change to the hydrology of the site, in accordance with Council's water quantity objectives.
2. Other tools may include water balance modelling and flood or hydraulic modelling where this is appropriate to the site. Refer to the MUSIC Modelling Guidelines (Water-by-Design) for further guidance on the use of MUSIC to assess stormwater treatment trains. The Queensland Urban Drainage Manual must be referred to for hydrologic and hydraulic assessments.

SC6.6 AP3.2.8.1 Life cycle costing

3. The life cycle costing of a WSUD practice or treatment train is a process to determine the sum of all expenses associated with a product or project, including acquisition, installation, operation, maintenance, refurbishment, discarding and disposal costs. It aims to calculate a single dollar value that can be used in the overall decision-making process.
4. The MUSIC software includes a life cycle costing module that must be used to calculate the overall life cycle cost of the WSUD treatment train. Guidance on the life cycle costing module is provided in the MUSIC user guide and MUSIC modelling guidelines. Modellers will need to be familiar with the caveats within that document when using the module.

SC6.6 AP3.2.8.2 Objectives check

1. Several iterations may be required to ensure that many objectives set out in Step 2 are achieved. It may not be possible to meet all objectives and compromise may be needed in some areas to achieve the best outcome.
2. If objectives are essential, it may be appropriate to revise the conceptual site design and/or the type of WSUD practices used.

SC6.6 AP3.2.9 Step 9: Finalisation of design

1. In the development of the WSUD conceptual design, it will be necessary to confirm sizing and locations of measures before entering the detailed design process. Of key importance at this stage will be identifying services and completed design elements (e.g. roads, open-space areas, final lot layouts, hydraulic design) within which WSUD elements may need to be integrated.
2. A conceptual design must be developed that shows:
   a. location of the WSUD device or devices within the development
   b. proposed layout of the device in its specific location (and locations of key features such as roads and other services). The proposed layout must also provide detail about proposed access to the WSUD device for maintenance and monitoring and, where relevant, any associated recreational infrastructure around the device. This is to ensure that adequate consideration has been given to ongoing maintenance and prevent future impacts on the functionality of open space or other recreational space.
3. At this stage, it will also be appropriate to document operation and maintenance plans, including all ongoing requirements of the treatment train. This information will form the basis for the concept stormwater management plan, to be lodged with

Council for approval with the Material Change of Use (MCU) or Reconfiguration of Lot (ROL) application.

4. An implementation plan must also be developed for the WSUD devices, particularly where they will be used as interim erosion and sediment control measures, and when the final setting of the system will take place sometime after initial functional installation of the device.
5. The plan must identify:
   a. when structural elements of the device are to be constructed in relation to development staging and subdivisional works.
   b. if devices are to be used as temporary sediment basins, and for what period.
   c. how the final setting of the WSUD device is to be undertaken.
6. Where it is envisaged that the final setting of the WSUD device will take place sometime after the functional installation of the device (e.g. after the building phase of the contributing catchment area has been completed), discussions must be held with Council to determine the process by which the WSUD device will be completed. Options for the developer are to either provide a contribution to Council to allow it to complete the WSUD assets or to return and complete the asset as designed later. These options must be discussed at the pre-lodgement meeting with Council outlined in Step 3.
7. Following approval of the development and the conceptual stormwater management plan, the detailed design must be undertaken in accordance with this policy for submission to Council with the detailed stormwater management plan.

SC6.6 AP3.3 Water quality monitoring

1. The monitoring parameters included in the program will depend on the agreed performance criteria, which in turn will depend on the environmental values of the receiving waters and the key pollutants generated by the development. For construction phase monitoring, a typical list of minimum parameters would include pH, dissolved oxygen, turbidity or suspended solids and hydrocarbons.

SC6.6 AP3.4 Monitoring frequency

1. Monitoring must be undertaken at least once a month following rainfall of at least 25mm in a 24-hour period. Rainfall must be based on data from an on-site rain gauge if available or from the nearest Bureau of Meteorology rainfall station. In the case of sedimentation basins requiring flocculation, monitoring must be undertaken and documented before all pumped discharges.

SC6.6 AP3.5 Monitoring locations

1. The location of monitoring sites will depend on the topographical site constraints and nature of the development. Potential monitoring locations that must be considered for inclusion in the monitoring program include:
   a. pumped discharges from sedimentation basins. A representative sample is required from within the basin before discharge.
   b. upstream and downstream of the development if a creek or permanently flowing watercourse borders the site. This is beneficial in detecting any changes in receiving water quality associated with the development.
   c. discharge points from the development site that are remote from any watercourse.
2. In practice the sampling and interpretation of discharges from sites can be exceedingly difficult. Devices such as stage-height samplers must be used to capture samples from sites with a short time of concentration.

SC6.6 AP3.6 Water quality monitoring and analysis standards

1. The water quality monitoring program must be designed in accordance with the ANZECC Monitoring and Sampling Manual, and with reference to AS/NZS.5667 Water quality - Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples.