MACKAY CITY COUNCIL

ENGINEERING DESIGN GUIDELINES

SUBSURFACE DRAINAGE DESIGN

Planning Scheme Policy No. 15.04

DATE POLICY TOOK EFFECT:
31 March 2008

Contents

1. Scope and general

1.1 Scope

This section sets out the Guidelines for the design of the subsurface drainage system for the road pavement and/or sub-grade.

This Guideline contains procedures for the design of subsurface drainage, including:

(a) Subsoil and Foundation Drains

(b) Sub-Pavement Drains

(c) Drainage Mats, including Type A and Type B Mats.

Reference guidelines for the application and design of subsurface drainage include ARRB Special Reports 35 and 41, and the AustRoads publication – *Guide to the Control of Moisture inroads*. The full titles of these references are given below.

1.2 Objective

The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or sub-grade to within the limits assumed in the pavement design.

In the areas with a history of salinity problems, subsurface drainage may be prescribed to keep the groundwater table lower in the strata to avoid progressive deterioration of the health of topsoil and upper layers due to salinity levels increased by rising and/or fluctuating groundwater tables.

1.3 Terminology

Subsoil drains are intended for the drainage of ground water or seepage from the sub-grade and/or the sub-base in cuttings and fill areas.

Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.

Sub-pavement drains are intended for the drainage of the base and sub-base pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the sub-grade.

Type A drainage mats are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage areas, or for protection of vegetation or habitat downstream of the road reserve whee a fill would otherwise cut the flow of water.

Type B drainage mats are constructed to intercept water that would otherwise enter pavements by capillary action or by other means or fills and to intercept and control seepage water and springs in the floors of cuttings.

1.4 Reference and Source Documents

(a) Council Guidelines & Specifications

C230	Subsurface Drainage –General
C231	Subsoil and Foundation Drains
C232	Pavement Drains
C233	Drainage Mats
Standard Drawings (various)	

D20	Drawing and Documentation Guideline

(b) Australian Standards

AS 2439.1	Perforated Drainage Pipe and associated fittings
AS/NZS 1477	Unplasticised PVC (UPVC) pipes and fittings for pressure applications

(c) Other

AustRoads	Guide to the Control of Moisture in Roads, 1983
ARRB-SR35	Australian Road Research Board, Special Report No. 35 – Subsurface Drainage of Road Structures, Gerke R.J., 1987
ARRB-SR41	Australian Road Research Board, Special Report No. 41 – A Structural Design Guide for Flexible Residential Street Pavements, Mulholland R.J., 1989

2. Subsoil and Sub-Pavement Drains

2.1 Warrants for Use

Subsoil drains are designed to drain groundwater or seepage from the sub-grade and/or sub-base in cuttings and fill areas.

Sub-pavement drains are designed to drain water from base and sub-base pavement layers in flexible pavements, and too drain seepage or groundwater from the sub-grade.

The designer shall ensure that subsoil or sub-pavement drains are to be provided on both sides of the formation in the following locations:

a. All urban/street developments – regardless of abutting land zoning.

b. cut formations where the depth to finished sub-grade level is equal to or greater than 400 mm below the natural surface level.

c. Locations of known hillside seepage, high water table, isolated springs or salt affected areas.

d. Irrigated, flood-prone or other poorly drained areas.

e. Highly moisture susceptible sub-grades, ie. commonly displaying high plasticity or low soaked CBRs (<7).

f. Use of moisture susceptible pavement materials.

g. Existing pavements with similar sub-grade conditions displaying distress due to excess subsurface moisture.

h. In trenches in which underground drainage has been installed.

i. At cut-to-fill transitions.

j. All landscaped islands.

k. All rural residential developments.

Where only one side of the formation is in cut, the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

A geotechnical report supporting the elimination of any subsoil drain will need to be submitted if the designer proposes to consider this option.

The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer sub-grade being uncovered that were not identified in the geotechnical investigation.

The Design Drawings shall be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

2.2 Layout, Alignment and Grade

Typical cross sections or subsoil and sub-pavement drains are shown in Council's Standard Drawings.

In kerbed roads, the two acceptable alternative options for subsoil drainage both allow for the line of the trench to be directly behind the kerb line. These options are shown in Council's Standard Drawing. Pavement layers must extend to at least the line of the rear of the trench.

In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder preferably at the edge of the pavement layers.

The minimum desirable longitudinal design grade shall be 1.0%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

Trench widths shall be a minimum of 300 mm, with a minimum depth below finished subgrade level of 600 mm in earth and 450 mm in rock, and below the invert level of any service crossings.

Outlets shall be spaced at maximum intervals of 150 metres into gully pits or outlet headwalls. Where practical, discharge shall be on the downhill side of the embankment or in the cut-fill area so as to reduce the risk of recharge to the subsurface water table. Unless otherwise authorised, where subsurface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run shall be specified.

A small precast concrete headwall shall be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

Flushpoints are to be provided at the commencement of each run of drain, and at intervals not exceeding 60 metres. Cleanouts shall generally be located:

a. within the kerb & channel transition section (when located at stormwater pit), or

b. directly at the rear of the kerb, or

c. at the edge of the shoulder, as applicable.

Where the subsoil drain is laid adjacent to new kerb, the designer shall note on the drawings a requirement for the contractor to indicate the location of the flushpoints adjacent to the freshly poured kerb.

In salinity affected areas, the designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation. Saline subsurface drainage should not be routinely discharged directly into natural watercourses.

Reference to water quality targets for downstream watercourses is essential and the designer shall provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource authority.

3. Foundation Drains

3.1 Warrants for Use

Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the Drawings. However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

Where the road formation traverses known swampy, flood-prone, salt affected areas or watercharged strata, the Drawings shall be suitably annotated to the potential need for

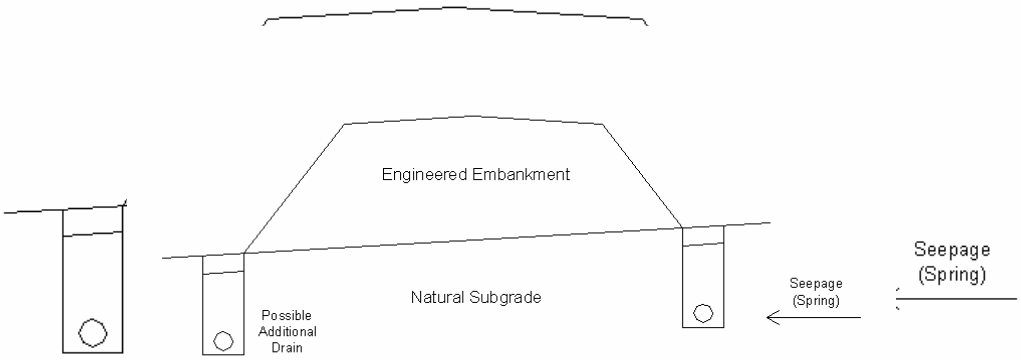

Figure D4.1 - Foundation Drains

The minimum desirable design grade shall be 1.0%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Foundation drains shall be a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

Outlets shall be spaced at maximum intervals of 150 metres.

Where practicable, cleanouts are to be provided at the commencement of each run of foundation drain and at intervals not exceeding 80 metres. Where not practicable to provide intermediate cleanouts, outlets shall be spaced at maximum intervals of 100 metres.

4. Drainage Mats (Blankets)

4.1 Warrants for Use

Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills. It is intended to collect surface seepage from a wet seepage area or for protection of vegetation of habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B drainage mats are designed where there is a need to intercept water that would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

Type B drainage mats shall be constructed after completion of the sub-grade construction and before construction of the pavement.

The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

5. Materials

5.1 Subsoil and Sub-Pavement Drain Pipe

Pipes designated for subsoil, foundation and sub-pavement drains shall be 100 mm dia. slotted pipe. However, alternative design options may be considered by Council, subject to the provision of required design detail and justification.

Corrugated plastic pipe shall conform to the requirements of AS 2439.1. The appropriate class of pipe shall be selected on the basis of expected live loading at the surface. Joints, couplings, elbows, tees and caps shall also comply with AS 2439.1.

Slotted rigid uPVC pipe shall be of a type and class approved by Council.

All pipes shall be slotted, and fitted with a suitable geotextile filter tube, except for cleanouts and outlets through fill batters that shall be unslotted pipe.

5.2 Intra Pavement Drain Pipe

Pipes designated for intra pavement drains with crushed rock sub-bases having layer thicknesses neither less than 150 mm nor more than 200 mm shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477. Alternative design options may be considered by Council subject to the provision of required design detail and justification.

Pipes designated for intra pavement drains with crushed rock sub-bases having layer thicknesses exceeding 200 mm shall be slotted pipe of a type and class approved by Council.

Pipes for use in Type B drainage mats shall be slotted thick walled uPVC pressure pipe complying with AS.NZS 1477.

5.3 Filter Material

The types of filter material covered by this Guideline include:

(a) Type A filter material for use in subsoil, foundation and sub-pavement (Trench) drains and for Type B drainage mats.

(b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains.

(c) Type C filter material comprising crushed rock for use in Type A drainage mats.

(d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.

Material requirements and gradings for each type of filter material are included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.

The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) shall depend on the permeability of the pavement layers and/or sub-grade and the expected flow rate.

Generally, Type A filter material is used for the drainage of highly permeable sub-grade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of sub-grade and pavement layers of lower permeability such as clays, silts or dense graded gravels.

Further guidance to the selection of appropriate filter material is contained in ARRB Special Report 35.

5.4 Geotextile

To provide separation (ie. prevent infiltration of fines) between the filter material in the trench and the sub-grade or pavement material, geotextile may be designated to encapsulate the filter material. The geotextile shall comply with the requirements included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.

Geotextile shall also be designated for both Type A and Type B Drainage Mats.

6. Documentation

6.1 Drawings and Calculations

The proposed location of all subsurface drains shall be clearly indicated on the Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement.

The location of outlets and cleanouts shall be indicated on the Drawings.

Assumptions and/or calculations made in the determination of the need or otherwise for subsurface drainage in special circumstances or as a variation to the requirements of this Guideline shall be submitted to Council with the Drawings.

All drawings and documentation to be submitted to Council for approval shall conform to the requirements of Council's Drawings and Documentation Guidelines D20. A copy of these Guidelines will be made available upon request.

Failure to comply with Council's Drawings and Documentation Guideline D20 may result in the drawings and/or documentation being returned to the designer without consideration by Council.