SPECIFICATION FOR PIPE SUBSOIL DRAIN CONSTRUCTION

1. SCOPE

Pipe subsoil drains shall be constructed in accordance with this specification and in conformity with the lines, grades and cross-sections shown on the drawings. The work shall include: the construction of trenches; the supplying and laying of perforated pipes of the specified type and size; the jointing of the pipes; the supplying and compacting of approved backfilling materials; the construction of connecting and outlet drains; the supply of all materials, labour, plant, tools and transport required for the proper completion of the contract.

2. DEFINITIONS

Filter material or (Filter aggregate): Clean durable stone as defined in section 3.3.
Geotextile: A fabric complying with NZ Transport Agency Specification F7: Specification for Geotextiles.
Pipe: A geocomposite drain or conventional pipe capable of providing for water flow along its length.
Rigid geocomposite strip drain: A proprietary product with both vertical and horizontal stiffness where the drainage path is provided by the inner pipe / core and the outer corrugations support the geotextile.
Flexible geocomposite strip drain: A proprietary product consisting of a cuspated (single or double) or column type plastic core with or without slotted perforations, encased in a nonwoven geotextile which acts as part of the structural composite. Such drains only have horizontal stiffness and the drainage path is provided by the gap between the plastic core and the surrounding geotextile.

3. MATERIALS

3.1 Pipe Types

Subject to the minimum requirements for geocomposite drains and to the performance requirements set out in the Design Process below any pipe and filter system may be used for subsoil drainage. This includes geocomposite strip drain products.

The perforated pipes shall conform to the requirements for the class, type of joints, diameter and length shown on the drawings and as defined in the job specification and prior to perforation shall be one of the following types:

3.1.1 Ceramic pipes complying with NZS 1823:1967, "Ceramic (Earthenware) Sewer Pipes for Use with Flexible Joints".

3.1.2 Unreinforced concrete pipes complying with the requirements specified for Class C pipes in NZS 3107:1978, "Precast Concrete Drainage and Pressure Pipes".

3.1.3 Reinforced concrete pipes complying with the requirements specified for Class S (standard reinforced) or stronger pipes in NZS 3107:1978, “Precast Concrete Drainage and Pressure Pipes”.

3.1.4 Corrugated steel pipes complying with AS 1761-1979, "Helical Lock-Seam Corrugated Steel Pipes".

3.1.5 Nestable corrugated steel pipes complying with AS 2041-1977, “Corrugated Steel Pipes, Pipe-Arches and Arches”.

3.1.6 Plain wall PVC pipes complying with AS/NZS 1260:1999, “PVC pipes and fittings for drain, waste and vent applications”, Class SN4 or SN6.

3.1.7 High density polyethylene pipes complying with the requirements specified for drain pipes in NZS 7604:1981, “High Density Polyethylene Drain and Sewer Pipe and Fittings”. The perforations shall be circular 6.5mm (+ 1.5mm) in diameter, arranged as shown in Appendix 1 of this specification.

3.1.8 High density Polyethylene smooth bore perforated Corrugated Plastic pipe which shall, when tested in accordance with Appendix H of AS:2439, Part 1-1981 “Perforated Drainage Pipe and Associated Fittings”, have a pipe stiffness of not less than 500 at 5% deflection, and 400 at 10% deflection.

$$\text{Pipe stiffness} = \frac{F(kN)}{y(m) \times \text{Measured specimen length (m)}}$$

This pipe shall also comply with clause 10.5 elongation requirement of AS2439, Part 1 - 1981.

Pipe that complies with the above requirements shall be permanently identifiable by either of the following methods:

1. At least one clearly visible continuous longitudinal red line on the outside of the pipe.

2. or, in legible lettering on both sides at approximately 1 metre intervals as detailed below:
   (i) Brand Name
   (ii) TNZ F/2 Class 500

3.2 Joints

The manufacturers’ recommended jointing system shall be used. When rubber rings are used in flexible joints they shall comply with BS 2494:1986, “Materials for Elastomeric Joint Rings for Pipework and Pipelines”, and shall be of a type approved for use with the particular joint.

3.3 Filter Material

Unless otherwise specified the filter material shall be as follows:

Filter material shall be clean, durable stone having a crushing resistance of not less than 100 kN when tested in accordance with NZS 3111:1986, Section 14 or a mixture of such material with clean hard sand. The filter material when tested in accordance with NZS 4402, Part 2:1986, shall comply with the following gradings:

TEST SIEVE APERTURE	PERCENTAGE PASSING
26.5mm	100
13.2mm	85-100
9.5mm	80-95
4.75mm	65-85
2.36mm	50-70
1.18mm	35-55
600µm	18-40
300µm	3-25
150µm	8 max
75µm	0

4. EXCAVATION

Trenches shall be cut in such a manner as will ensure that the pipes will be laid true to the depths, grades and lines shown on the drawings. The width of the trench shall not exceed the specified dimensions.

Unless otherwise specified trenches shall have:

(i) a gradient of not less than 1 in 100;

(iii) vertical sides from the trench bottom to a minimum of 300mm above the top of the pipe;

(iv) a minimum depth that will ensure that, when the pipes are laid, the invert level shall be not less than 1 metre below finished subgrade level; and

(iv) a minimum depth of cover over buried flexible pipes of: 750mm for unsealed roads/embankment conditions/construction equipment; 600mm for sealed roads and 450mm for areas not in roadways. These requirements are as per AS / NZS 2566:1998, “Flexible Buried Pipelines – Structural Design.

Excavation material shall be stacked at least the excavation depth away from the edge of the excavation and the size of the spoil bank shall be limited to avoid any danger to stability of the trench or adjacent buried services. Surplus excavated material shall be disposed of as directed by the Engineer.

5. BEDDING

Unless specified otherwise the pipe shall be evenly bedded on a continuous cushion of the filter material specified in section 2.3. The thickness of the cushion under the pipe shall be not less than 75mm. Bedding requirements for geocomposite drains should be consistent with the manufacturer's guidelines.

For plastic and steel pipes the filter shall be shaped to provide support to the invert of the pipe over the lower 60 degree segment of its circumference.

For all pipes the filter shall be excavated so as to ensure that no length of pipe is supported on a socket, e.g. a chase is excavated in the bedding to prevent the socket from bearing on the filter. The filter material shall be placed and compacted in layers around the pipe until 150mm above the top of the pipe. The thickness of layers shall not exceed 75mm for pipes of 250mm and smaller diameter, and shall not exceed 150mm for pipes of greater diameters. The material at the pipe haunches shall be adequately compacted prior to placing material over the pipe.

6. GEOCOMPOSITE DRAIN REQUIREMENTS

The minimum requirements for geocomposite drains are:

1. The drain shall be encased with a geotextile which complies with the following performance requirements of NZTA F7:
   i. For flexible geocomposite strip drains – Strength class B and filtration class 1,
   ii. For rigid geocomposite strip drains – Strength class A and filtration class 1;
2. The core of the drain shall be made from a high density polyethylene, or material of similar strength and durability,
3. The minimum dimensions of a geocomposite strip drain shall be:
   i. Height 300mm, and
   ii. Width 25mm;
4. The geotextile sleeve may be seamed by sewing, gluing, or thermally bonding, or may be a tubular kit, where:
   i. For flexible geocomposite strip drains with cusps, the top of each cusp shall be glued to the geotextile; and
   ii. In addition, for flexible geocomposite strip drains with a flat face, the flat face shall be sufficiently glued to ensure no slippage of the geotextile on the flat face;
5. For rigid geocomposite strip drains the geotextile shall be placed around the core;
6. The minimum horizontal compressive strength, at 20% deflection, measured in accordance with ASTM D2412 / ASTM D1621 shall be 200kPa; and
7. Flow capacity, measured in accordance to ASTM D4716 with 200kPa confining pressure at 0.5 to 1 hydraulic gradient, shall be at least 300 litres per minute per metre-width.

7. DESIGN PROCESS FOR DRAINS (INCLUDING GEOCOMPOSITE DRAINS)

To ensure the most economic subsoil drainage system is installed, the following design process shall be undertaken:

Step 1: Calculate the peak inflow water volume. Depending on the certainty of the calculation, and the importance of the pavement, the design flow should be multiplied by at least a factor of 1.5 for the remainder of this design process.

Step 2: Size the inflow portion of the perimeter of the drain to ensure the design flow can enter the drain at an acceptable rate. Where clogging may occur, this should be allowed for in the design.

Step 3: Define or calculate the required drainage water level at the subbase or other critical point.

Step 4: Calculate head losses as water flows through surrounding soil, filter aggregate (or geotextile) and enters the pipe.

Step 5: Determine the outlet point spacing and water height for longitudinal water flows and available outlet points. The manufacturer's data should be used for the flow calculations.

Step 6: Calculate the top water level in the pipe (circular pipe or geocomposite drain)

Step 7: Calculate the invert level of the pipe and define the long section.

Step 8: From the design soil loads and vehicle loads, check that the geocomposite strip drain or pipe is capable of resisting the applied loads at acceptable deflections. The manufacturer's data should be used.

8. LAYING AND JOINING PIPES

Each pipe shall be individually set true to line and level.

All types of joints must be assembled according to the manufacturer's instructions. Geocomposite drains shall be joined using the jointing accessories produced by the manufacturer.

Solvent weld joints may be used for PVC pipes.

Couplers to connect corrugated plastic pipes shall have gripping lugs to engage the external corrugations.

Pipe jointing shall be carried out in such a manner that the finished joints present a smooth invert surface between pipes.

The spigot and the inside of the socket of pipes shall be clean before jointing.

When rubber rings are used for flexible joints in concrete and ceramic pipes they shall be free of dust, grease or dirt. The rubber rings shall be mounted evenly on the extreme end of the spigot, and the pipe lined up truly concentric with the pipes already laid. The spigot shall then be forced into the socket leaving a gap between the socket shoulders and the spigot of between 5 and 10mm, care being taken to maintain the pipes concentric. The rubber ring shall be equidistant from the end of

the socket all round and at least 20mm from the back of the socket chamfer when the joint is completed.

For geocomposite drains, the contractor shall ensure adequate sealing of the geotextile at joins in the pipe and at the entry to manholes or sumps.

9. BACKFILLING

The trench shall be backfilled in accordance with the cross-sections shown on the drawings. Unless otherwise specified the trench shall be backfilled as follows:

1. The backfill shall be filter material as detailed in section 2.3 of this specification. The backfill material shall be placed in layers not exceeding 150mm loose depth and shall be positively compacted to provide support of not less than that of the adjacent material. Where geocomposite drain is used the backfill shall follow the manufacturers recommendations.
2. Heavy construction equipment and rollers shall not be operated over or near the subsoil drain until backfilling of the trench has been completed.

10. OUTLETS

Outlets from subsoil drains shall be constructed to discharge clear of embankments, and there shall be sufficient slope to prevent silting.

11. MAINTENANCE

The contractor shall ensure at all times that subsoil drainage installations are protected from inadvertent, or deliberate, use for temporary surface drainage. The contractor shall maintain the subsoil drains and outlets until the end of the maintenance period. He shall make good any subsidence of the subsoil drain by ascertaining the cause and taking appropriate action to repair the damage and to prevent further subsidence.

12. BASIS OF PAYMENT

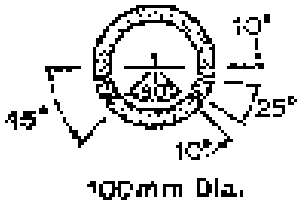
All miscellaneous items, board, supervision, contingencies, conveyance of plant, and incidental work, plus general overhead, and administration are incorporated in the unit rates listed in the schedule.

Payment will be made on the total number of metres of subsoil drains installed in accordance with the plans and specification, at the various depths as detailed in the schedule. The unit rate in each case shall be in full compensation for the supply of all materials, labour and plant, necessary to construct the drains as specified.

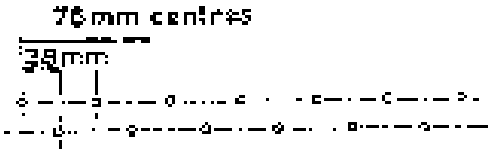
APPENDIX 1

PERFORATIONS IN SUBSOIL DRAIN PIPES
(Except for Corrugated High Density Polythene)

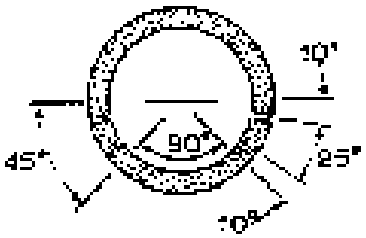
76 mm centres



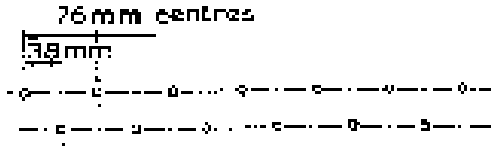
100mm Dia.



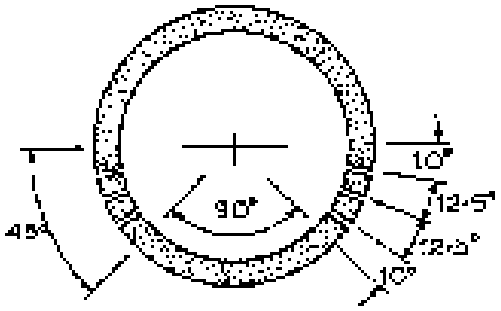
6·5mm dia. holes
Two rows each side



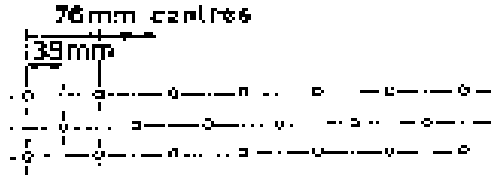
150mm Dia.



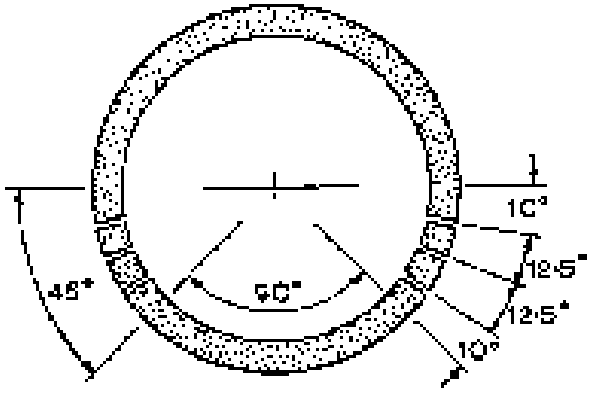
6·5mm dia. holes
Two rows each side



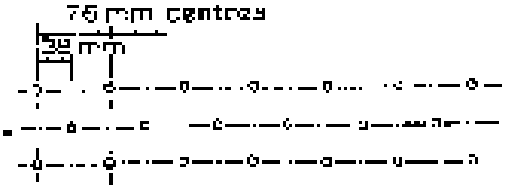
200mm Dia.
& 225 " "



6·5mm dia holes
Three rows each side



300mm Dia.



6·5mm dia. holes
Three rows each side