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Province of KwaZulu-Natal

REPORT

Stormwater Management Plan for the Rehabilitation of Main 50-1 between km 17,340 and km 26,100

Client: KwaZulu-Natal Department of Transport

Reference: T&PMD1730R001F0.1
Revision: 0.1/Final
Date: 31 March 2017

transport
Department:
Transport
Province of KwaZulu-Natal

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Date / initials:	31/03/2017	
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Date / initials:	31/03/2017	

Classification
Project related

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1 INTRODUCTION

1.1 Background

Royal HaskoningDHV (Pty) Ltd have been appointed by the Province of KwaZulu-Natal: Department of Transport (hereafter referred to as KZN: DOT) to undertake the engineering specialist studies, preliminary design, detailed design and the construction supervision for the rehabilitation of the existing Main Road P50-1 which is approximately 26,0 km in length.

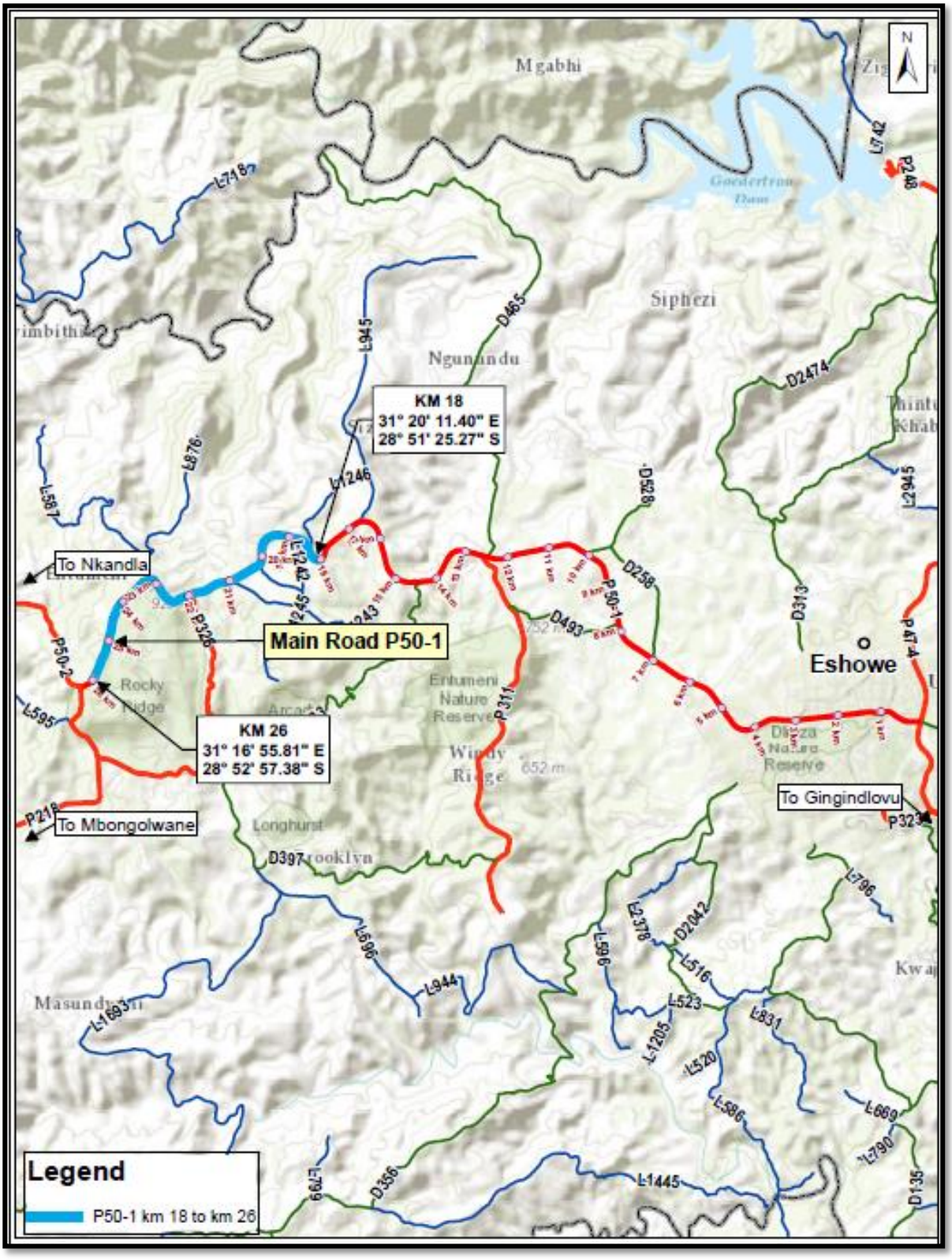
The rehabilitation of Main Road P50-1 comprises the relocation of services, the construction of bulk earthworks required for the horizontal and vertical alignment of the existing road formation and the construction of road layerworks and surfacing, including the associated ancillary works for the construction of the access roads off this main road to neighbouring communities. The required roadwork's start at km 17,34 and continue to km 26,1 totalling a length of approximately 8,760km.

This portion (km 17,340 to km 26,100) of road will be rehabilitated and widened to a Class 2 single carriageway 10,0 m wide surfaced road with surfaced shoulders but will be trimmed on the surfaced road edges with gravel rounding's which are 1,0m and 0,5m wide in fill and cut conditions respectively including adequate stormwater drainage facilities being provided. Details of the typical cross-section can be seen in Appendix A.

1.2 Site locality and description

The project is located on Main Road P50-1 north-west of Eshowe in the UThungulu District Municipality (DC28) of the Province of KwaZulu-Natal.
P50-1 links the communities of Entumeni Mission and Eshowe up to the intersection of P47-5, and in to P47-6 which connects to the National Route 2 (N2). The KwaZulu-Natal Department of Transport is responsible for the maintenance and operation of this road. The location of the road under investigation is shown in Figure 1.

Figure 1: Locality Plan



2 OBJECTIVE

The primary objective of the report is to outline the stormwater management plan for the rehabilitation of Main Road 50-1. The objectives include the following:

- Protecting all life and property from damages by floods and stormwater;
- Protecting the water resources in the catchment areas from pollution and siltation;
- Protecting and enhancing the watercourses locally and downstream;
- Conserving the natural flora and fauna in the environment; and
- Preventing soil erosion by wind and water.

This report has been prepared to provide details of the generic analysis to ensure that adequate drainage measures are implemented to promote the dissipation of stormwater run-off, during and after construction.

2.1 Environmental Concern

Poor stormwater management can result in stormwater becoming contaminated. This can also result in flooding, erosion and damage to the environment and public property. Soil erosion through poor stormwater management can result in loss of valuable topsoil, damage to public property through slope destabilization, collapsing of banks and in extreme cases, mudslides. Erosion can also result in silt depositions in watercourses and wetlands adding to the existing silt problem.

Exposed soils are vulnerable to erosion by wind and water. Soil erosion is more likely to occur in summer months due to higher rainfall and temperatures causing shrinkage and collapse of soils. Soils are particularly vulnerable to erosion during construction as they are exposed to the elements while changes in surface runoff patterns due to construction activities.

3 METHODOLOGY

3.1 Introduction

The main aim of the proposed stormwater system is to conserve the natural drainage system around the road alignment.

The existing stormwater system consists of natural water ways, including streams, and seasonal wetlands. The system includes existing devices constructed to control the stormwater. The existing has drainage structures that forms part of this stormwater system.

The management of stormwater runoff has been planned to militate against the effects of increased water runoff from hardened areas and to control the movement of sand and silt.

Roads and associated embankments have been designed to ensure free surface drainage.

The proposed stormwater system will be dependent on factors such as the topography (natural and artificial slopes), the zoning of the site and the natural soil conditions.

Silt and trash traps will need to be provided within the stormwater system to ensure that the water quality is not compromised. Open ditches, drains and channels should be used instead of pipes, where conditions permit. To prevent erosion of the channels, where the flow velocities are high, an appropriate lining should be provided to protect these channels. Types of lining include natural vegetation, stone pitching and reinforced concrete linings.

The proposed road rehabilitation should not adversely impact the environment within its footprint and the surrounding areas by means of erosion and sediment deposition. The frequency of flooding and the runoff volume will increase unless adequate provisions are made to maintain the current natural rate of stormwater attenuation and infiltration in the catchment areas.

The proposed storm water system will have mitigation measures against road drainage and also cross drainage, with the aim of eliminating blockage and to reduce erosion. Stone pitching and gabion structures have been designed in such a way that water velocities are reduced as much as possible.

3.2 Stormwater Design Philosophy

The design methodology used for the stormwater is in accordance with The South African National Roads Agency SOC Limited (SANRAL) Drainage Manual 6th Edition. The stormwater design also complies with the KZN: DOT Standard Specifications, KZN: DOT Drainage manual and KZN: DOT standard drawings.

The Rational Method Alternative 3 (SANRAL Drainage Manual 6th Edition) were used to calculate the flood peaks for the stormwater design, the individual catchment areas for the roads and minor culvert structures are less than 15km^2.

3.3 Stormwater Design Considerations

3.3.1 Minor drainage culverts and Structures

Design approach is to allow the stormwater to flow through the culverts aligned along the natural watercourse. The existing culvert capacity of 1: 20 year storm has been assessed in sizing of critical pipes.

New 600mm or larger pipe culverts will be installed at intervals where required to disperse overland and road surface runoff collected in side drains.

Outlet structures at a culvert or a natural watercourse were designed and equipped with energy dissipaters to reduce velocities to natural flow in order to mitigate the impacts of erosion in addition also protecting the unlined downstream channels against soil erosion.

Each outlet condition has been assessed to control and minimise scour by installation of energy dissipaters and slope protection works. Larger concrete pipes will be installed on natural watercourses, while special attention is given to erosion protection.

3.3.2 Roads

The proposed road was designed and graded to avoid the concentration of water flow along and off the road. Where the flow concentration is unavoidable, measures were incorporated in the road and stormwater system at suitable points.

Concrete lined v-drains were provided along the edge of the road as necessary. These drainage facilities will serve to channel the stormwater to the predetermined discharge positions. Stormwater will either be discharged directly onto the grassland or onto the gabion mattress structures stone pitching, depending on the discharge velocities.

Concrete kerbing and channelling will be provided along the edge of the road as necessary. These drainage facilities will serve to channel the stormwater to the predetermined discharge positions. Stormwater will be discharged directly onto the grassland.

The flow depth along these side drains were designed to satisfy the criteria in Figure 5.2 of the SANRAL Drainage Manual 6th edition. The applicable KZN: DOT standard details for the kerb and channel elements shall be in accordance with SD0701/A.

The applicable KZN: DOT standard details for the entire drainage elements are from SD0406 to SD0702/A. Details of the drainage elements can be seen in Appendix B. Table 1 outlines the options adopted for use as side drain outlets.

Table 1: Options adopted for use as side drain outlets

Discharge Type	Standard Detail Name	Condition for use
Drop inlet and grid inlet	SD 0702/A	Deep fill > 3 m
Kerb and Channel drains	SD 0701/A	Shallow fill < 3 m
Side drain outlets	SD 0603/1	Shallow fill < 3 m
1,5 m / 2,4 m v-drain grid inlet	SD 0602/B	In cuttings
2,5 m Meadow drain	SD 0601/1	Flat terrain
1,5 m concrete/grass v-drain	SD 0601/2	Deep cuttings > 5 m
0,75 m concrete v-drain	SD 0601/3	Shallow cuttings < 5 m
1,5 m concrete v-drain	SD 0601/4	Shallow cuttings < 5 m
1,5 m / 2,4 m v-drain	SD 0603/1	Shallow fill < 3 m
Side drain and grid inlet	SD 0602/B	In cuttings

3.4 Stormwater Management

Stormwater management encourages the engineer and contractor to conduct the following aspects:

i) Maintaining adequate ground cover at all times and in all areas to negate erosion caused by wind, water and vehicular traffic:

- Preventing the concentration of stormwater runoff where the soil is susceptible to erosion;
- Adding devices to reduce the stormwater flows to acceptable levels;
- Ensuring that the development does not increase the stormwater flow above that of which the natural ground can safely accommodate;
- Ensuring that the construction of the stormwater devices is carried out in safe and aesthetic manner;
- Preventing pollution of water ways and water features;
- Containing soil erosion during construction; and
- Avoiding conditions where the embankments may become saturated and unstable.

ii) Poor stormwater management can result in the stormwater becoming contaminated and can also result in erosion, pollution and flooding. These issues are discussed further in following sub items.

3.4.1 Environmental management and mitigation measures

(i) Erosion control

Suitable erosion control measures shall be implemented at stormwater discharge points, exposed areas and high embankments. These measures may include the following options:

- Sand bags on trenches (trench breakers);
- Bunds or grips adjacent to watercourses;

- Technologies similar to Soil Saver on embankments;
- Planting of indigenous vegetation on embankments;
- Minimise clearing and grubbing to necessary sections within the road reserve; and
- Over-wetting, saturation and unnecessary runoff during dust control, curing and irrigation activities will be avoided.

Sandbag berms will be placed at regular intervals on all steep slopes and on the trench line before and after backfilling in order to minimise erosion and the discharge of contaminated storm water runoff into water courses.
If there is a scour risk or risks that potholes may form on the existing roads, it can be managed by using suitable gravel to temporarily repair the scouring or potholes

(ii) Pollution

Pollution and or contamination of the surface water and stormwater must be well controlled. This can be achieved by managing activities such as:

- Mixing concrete on wooden boards in a plastic lined and leak-proof area;
- Removing all surplus material from the watercourse;
- Reducing spills of hazardous substances (e.g. Fuel);
- Opening of frequent chutes on long steep grades with unlined drains;
- Ensuring that banks are re-vegetated as soon as construction work is completed;
- Avoid water contamination by construction as well as general traffic; and
- Containing the first-flush runoff, collectively or individually.

The stormwater system must be maintained to remove and reduce debris that may pose any pollution risk. The lack of maintenance will lower the transportation of the runoff to the existing watercourses and which may cause flooding.

(iii) Flooding

The proposed development will not increase the stormwater runoff significantly as it is existing roads that are being rehabilitated. Adequate attenuation of flood runoff will be provided as the latter may increase downstream flood damage.
The design of the stormwater system addresses the above issues and was designed as such that the post-development flood risks are not greater than the pre-development flood risks.

4 CALCULATIONS

4.1 Pre-Construction

The stormwater catchment area of concern for the rehabilitation of P50-1 roads is divided into fifteen (15) catchment areas. The schedule of the catchment areas is listed in Table 2.

Table 2: Schedule of Catchment Areas

Catchment number	Area (km^2)	Catchment number	Area (km^2)
18-1	0.360	22-3	0.008
18-2	0.127	22-4	0.006
19-1	0.380	23-1	0.002
20-1	0.550	23-2	0.004
20-2	0.780	23-3	0.012
21-1	0.013	24-1	0.001
22-1	0.013	25-1	0.001
22-2	0.006		

4.2 Rainfall Return Period and Intensity

Three rainfall intensities that have been considered are listed in Table 3.

Table 3: Rainfall Return Period and Intensity

Point of consideration	Return period (years)	Rainfall intensity (mm/hr)
Surface drainage	5	100
Critical points	20	56.13
Cross drainage	20	55.71

4.3 Design Principals

The stormwater drainage systems will be designed based on the following parameters:

- Mean Annual Rainfall :
  - 1167 mm average from TR102
- Site characteristics:
  - C ≤ 0,207 to 0,300
- Design used:
  - Rational Method: $Q = \frac{CIA}{3,6}$ (equation 3.8, SANRAL Drainage Manual 6th Edition)
- Time of concentration:
  - Varies for each catchment and 0.25hr if Tc<0.25hr or Tc>0.25hr.
- Stormwater pipe material:
  - For buried pipelines: Class 100D prefabricated concrete pipe culverts on class C bedding; and
  - For subsoil drainage: 100 mm internal diameter perforated pipes.
- Stormwater culverts:
  - Pipe sizes: 600 mm diameter.
- Stormwater pipe gradient:
  - Minimum gradient of 2% for all prefabricated concrete pipe culverts.
- Stormwater inlets:
  - For roads: kerb inlets.
- Stormwater manholes:
  - Materials: concrete foundation, 230 mm thick masonry walls; and
  - Benching: smooth concrete channel formed to the soffit of the pipe.
- Stormwater headwalls:
  - Materials: concrete foundation, 230 mm thick masonry walls.

4.4 Hydrology

See Table 4 for the hydrological calculations analysis:

Table 4: Catchment Hydrological Calculations

Catchment Area No.	Overland Catchment Area (km²)	Design Flow Rate Q20 (m³/s)
18-1	0.360	1.97
18-2	0.127	0.81
19-1	0.380	1.95
20-1	0.550	2.08
20-2	0.780	2.95
21-1	0.013	0.13
22-1	0.013	0.28
22-2	0.006	0.21
22-3	0.008	0.30
22-4	0.006	0.23
22-5	0.003	0.12
23-1	0.002	0.07
23-2	0.004	0.06
23-3	0.012	0.06
24-1	0.001	0.02
25-1	0.001	0.01

Table 5: Catchment Hydraulic Calculations

Catchment Area No.	Catchment Area (km^2)	Design Flow Rate Q20 (m^3/s)	Existing Pipe Culvert Size	Proposed Pipe Culvert Size
18-1	0.360	1.97	unknown	2 x 900 dia.
18-2	0.127	0.81	2 x 600 dia.	3 x 600 dia.
19-1	0.380	1.95	unknown	2 x 900 dia.
20-1	0.550	2.08	unknown	2 x 900 dia.
20-2	0.780	2.95	unknown	2 x 1200 dia.
21-1	0.013	0.13	1 x 600 dia.	1 x 600 dia.
22-1	0.013	0.28	1 x 600 dia.	1 x 600 dia.
22-2	0.006	0.21	1 x 600 dia.	1 x 600 dia.
22-3	0.008	0.3	1 x 600 dia.	1 x 600 dia.
22-4	0.006	0.23	1 x 600 dia.	1 x 600 dia.
22-5	0.003	0.12	1 x 600 dia.	1 x 600 dia.
23-1	0.002	0.07	1 x 600 dia.	1 x 600 dia.
23-2	0.004	0.06	1 x 600 dia.	1 x 600 dia.
23-3	0.012	0.06	1 x 600 dia.	1 x 600 dia.
24-1	0.001	0.02	1 x 600 dia.	1 x 600 dia.
25-1	0.001	0.01	1 x 600 dia.	1 x 600 dia.

5 CONCLUSION

It is often impossible to make reliable predictions concerning the full extent of erosion protection likely to be required until the road drainage system is fully functioning and the slopes and drainage channels have responded to the new drainage regime.

From the design principles specified in this report, it was seen that there was only a marginal increase in the run-off coefficient (C) hence resulting in a marginal increase in the run-off rate.

Pipe culverts have been designed and strategically placed to ensure that cross and surface drainage is drained to the natural low lying areas, watercourses and valley lines without affecting the designed road.

This roads rehabilitation project will include lane widening in certain sections of the surfaced road, which will result in reduced infiltration areas, loss of vegetation and evapo-transpiration potential. There will be a slight increase in surface runoff and peak flow rates.

Side drains will be used to channel the stormwater away from the road prism. Gabion boxes and Reno mattresses will be used to retard the velocity of the stormwater and will allow the ground water to recharge and prevent scouring at outlet structures. In addition, stone pitching will be constructed at outlet structures to mitigate the scouring of the natural ground and simultaneously ensure efficient drainage of stormwater run-off from the outlet structures.

Where possible, stormwater will be discharged into the nearest existing natural drainage path via headwalls. Soil erosion and scouring will be prevented by providing gabion boxes, Reno mattresses and/or energy dissipation splitter blocks at the inlet and outlet structures.

Siltation of the stormwater systems will be prevented by ensuring that the drainage facilities are built such that the flow velocity is greater than 0, 25 m/s.

Landscaping and the planting of indigenous plants will be carried out along the footprint of the proposed roads upgrade footprint to ensure the stabilisation of the embankments.

Maintenance of the stormwater system must be carried out on a continuous basis to control and minimise pollution, blockages, siltation and scouring.

The detailed designed drawings and contract document indicates the measures provided in the design to ensure that the stormwater management requirements are implemented.

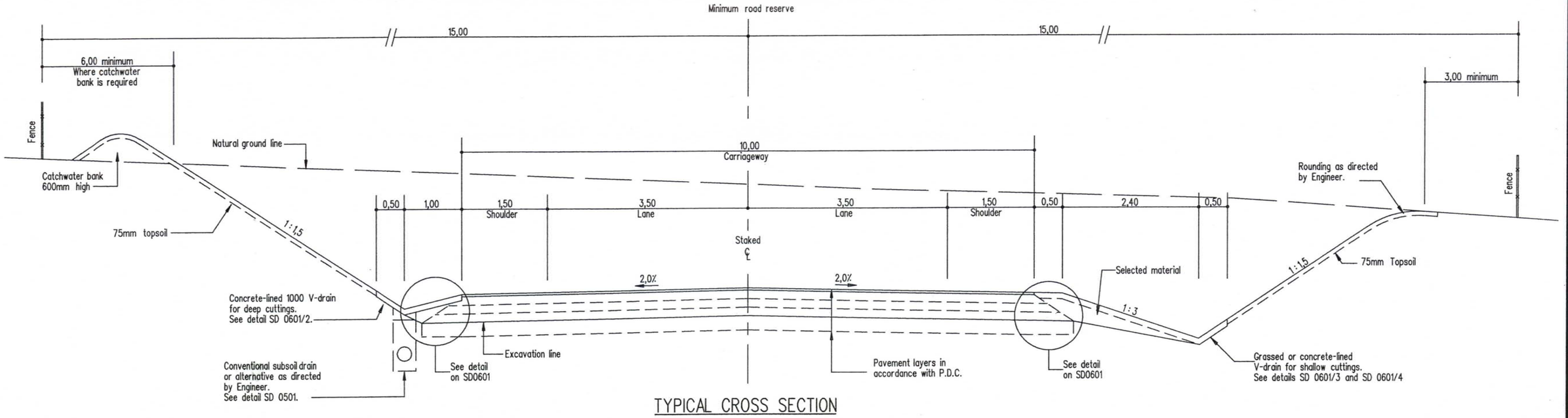
The contractor shall prepare a stormwater control plan that will ensure that all construction methods adopted on site do not cause, or precipitate, soil erosion. The contractor shall take adequate steps to ensure that the requirements of the stormwater management plan are met before, during and after construction. The contractor shall ensure that no construction activity commences before the stormwater control measures are in place and approved by the engineer on site.

6 REFERENCES

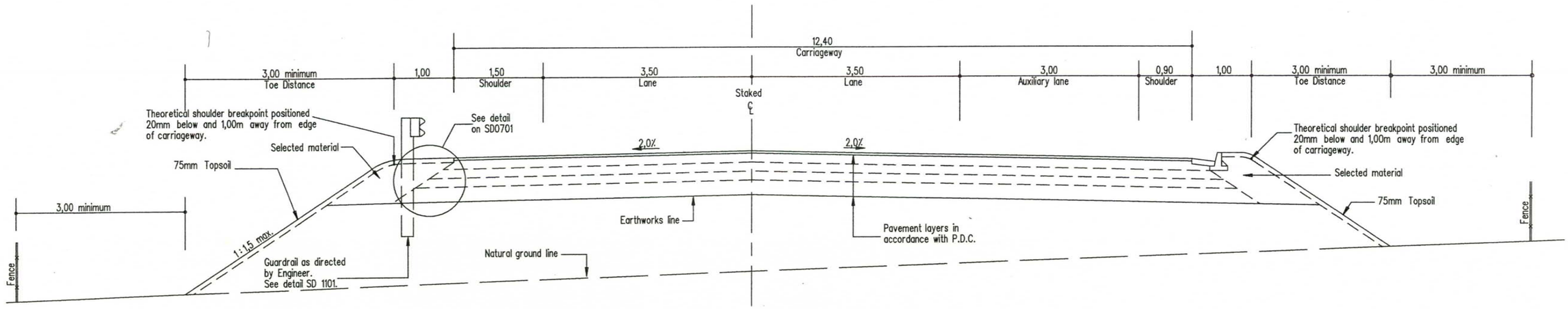
1) The Province of KwaZulu-Natal: Department of Transport, 1984. Drainage Manual. 1 ed. Pietermaritzburg: Geometric Design Section, Provincial Roads Department.

2) The South African Roads Agency SOC Limited, 2013. Drainage Manual. 6th Edition. Pretoria: The South African Roads Agency SOC Limited.

APPENDIX A: TYPICAL CROSS-SECTION



TYPICAL CROSS SECTION



TYPICAL CROSS SECTION : WITH AUXILIARY LANE

Symbol	Date	Description	Dir.
		Amendments	
B	Oct 06	Unsurfaced shoulder for 2,4m v-drain added	
A	July 94	General updating and revision	

PROVINCE OF KWAZULU-NATAL

DEPARTMENT OF TRANSPORT

Head: Transport

06.06.2007.
Date

Standard Details

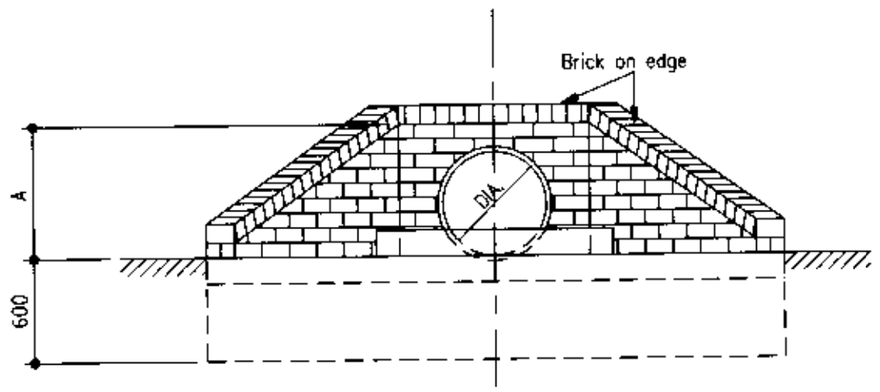
TYPICAL CROSS SECTION
TYPE 2C PRIMARY ROAD

Scale
1 : 50

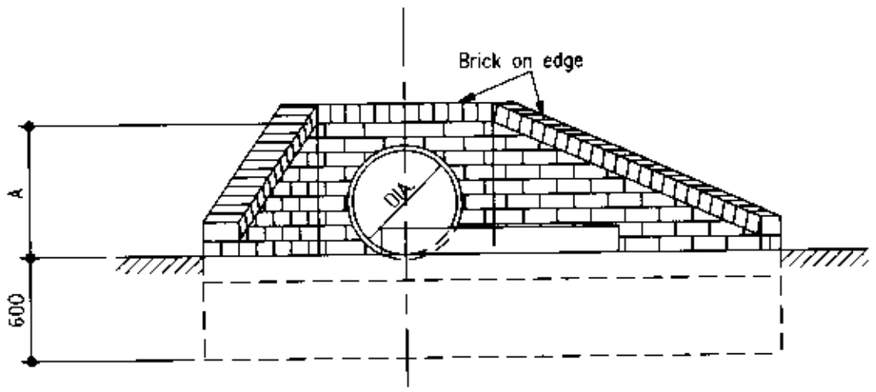
Drawing Number
SD 0206/B

M 2303

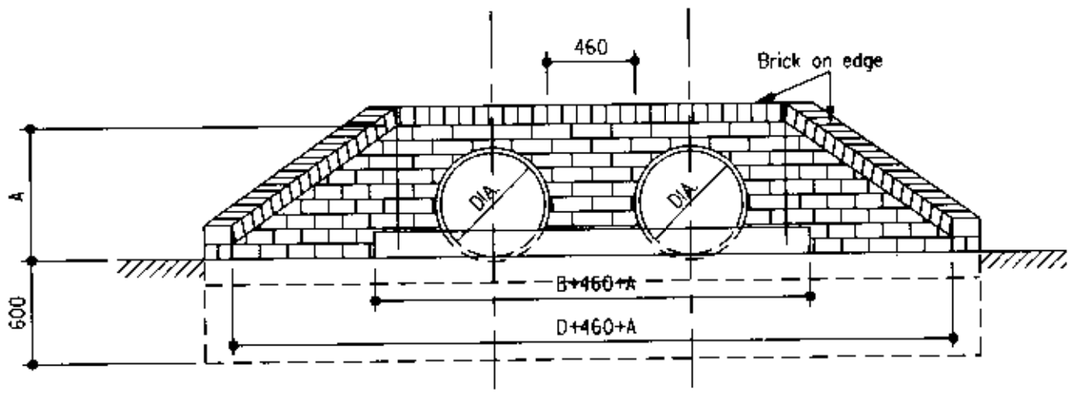
APPENDIX B: DRAINAGE ELEMENTS



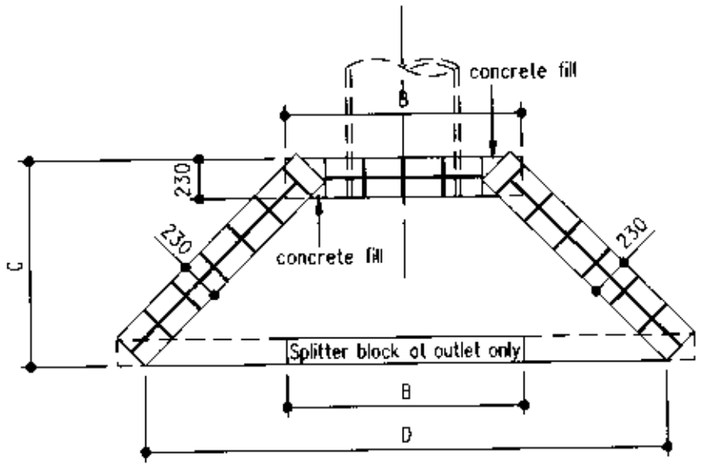
FRONT ELEVATION - SINGLE PIPE



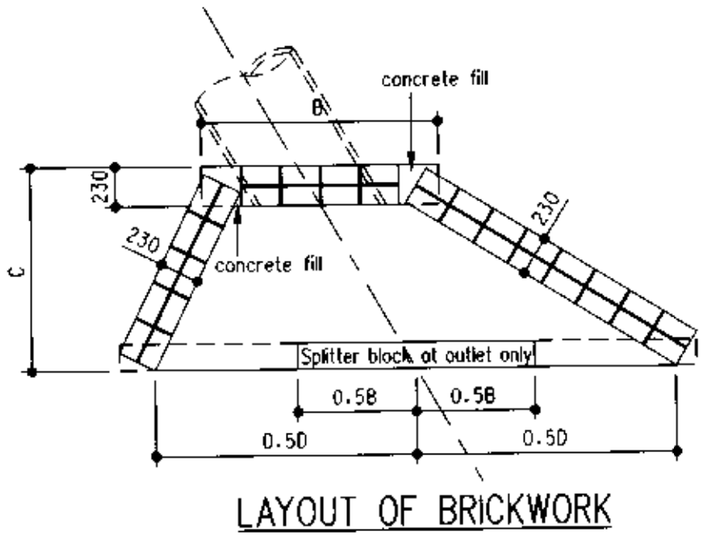
FRONT ELEVATION - SKEW PIPE



FRONT ELEVATION - DOUBLE PIPE



LAYOUT OF BRICKWORK



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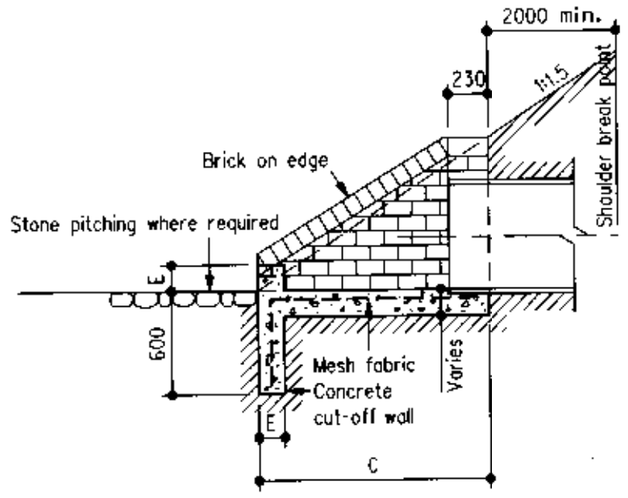
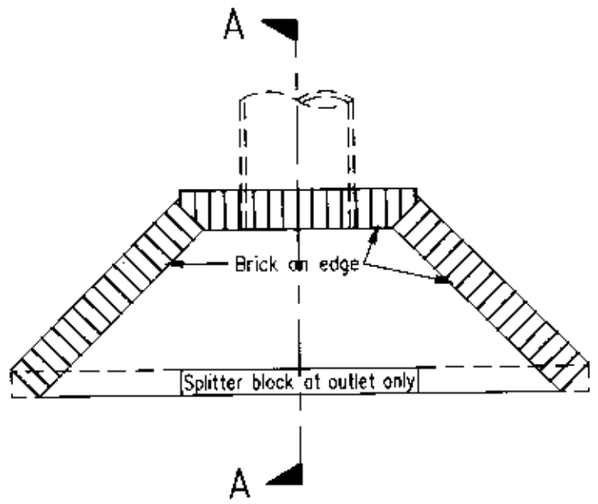
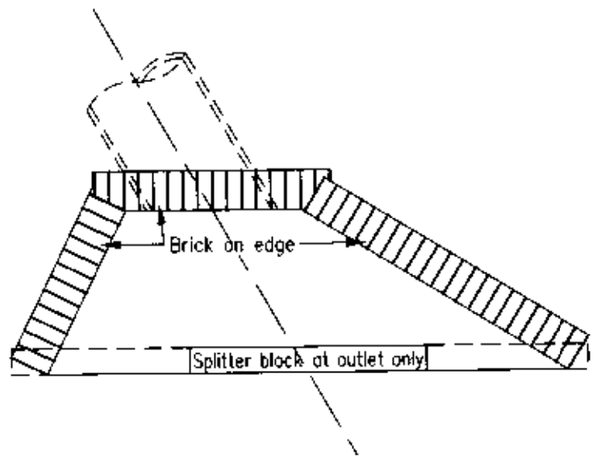


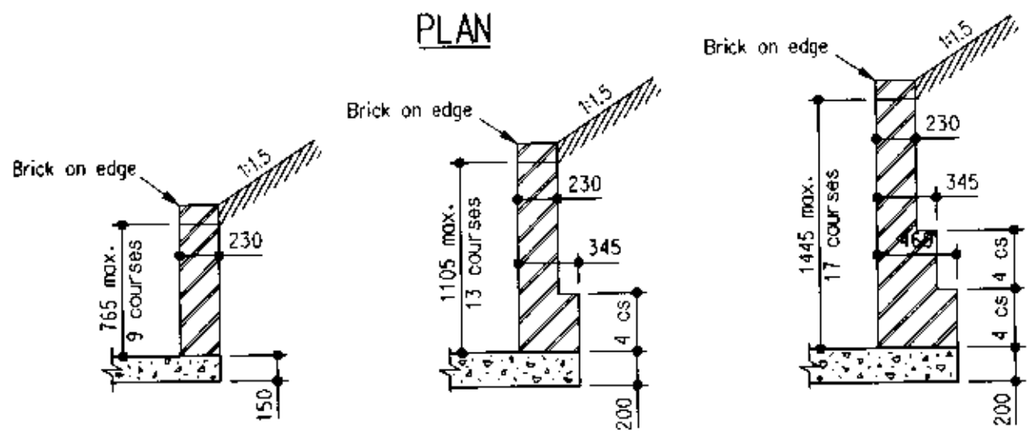
SECTION A-A



PLAN



PLAN OF SKEW CULVERT



TYPICAL RETAINING WALL DETAILS

Dimensions (mm)					
Norminal Dia.	A	B	C	D	E
450	595	1 150	1 050	2 700	150
600	765	1 380	1 200	3 000	150
750	935	1 610	1 350	3 300	150
900	1 105	1 840	1 500	3 600	230
1 050	1 275	2 070	1 750	3 900	230
1 200	1 445	2 300	1 900	4 200	230

NOTES :

1. Splitter block and pitching to be provided at all outlets where erosion is likely to occur.
2. Splitter block may be omitted if discharge velocity is less than 0.9 m/s.
3. Cut-off walls may be omitted if structure is founded on rock.
4. For multiple pipe culverts increase dimensions 'E' and 'F' by (n-1)(A+460)mm : Where n = number of pipes and A = nominal diameter of pipes
5. Pipes to be cut flush with headwall.
6. For skew pipe culverts the headwall shall be parallel to the centre line of the road.
7. If corrugated metal pipes are used 4x20mmx150mm long galvanised anchor bolts in the hollows of the corrugation are to be used.
8. All concrete is to be 20MPa.
9. Square mesh fabric (Reference S.M.F.193) is to be placed 50mm from top in all apron slabs and centrally in cut-off walls.
10. Brickwork is to consist of good quality burnt clay common bricks in accordance with SABS 227 Specification, or cement bricks in accordance with SABS 987 Specification, uniform in size and shape layed in stretcher bond style with the skins tied together with galvanised crimped wire wall ties.
11. Brickforce is to be placed every 4th course.
12. Jointing on all visible faces to be pointed
13. No in-fill shall be larger than a half standard brick size unless 15MPa concrete is used.

Symbol	Date	Description	Dir.
		Amendments	

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Deputy Director-General: Transport
1999/05/13
Date

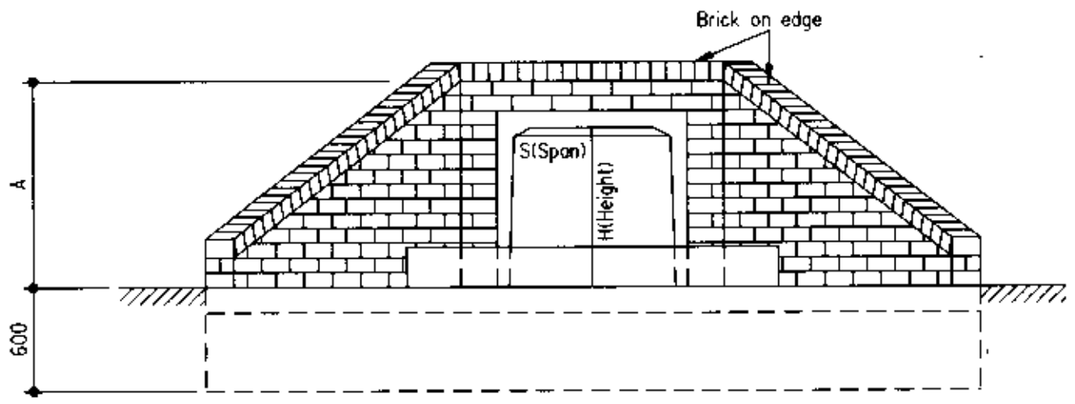
Standard Details

PIPE CULVERT HEADWALL (MASONRY)

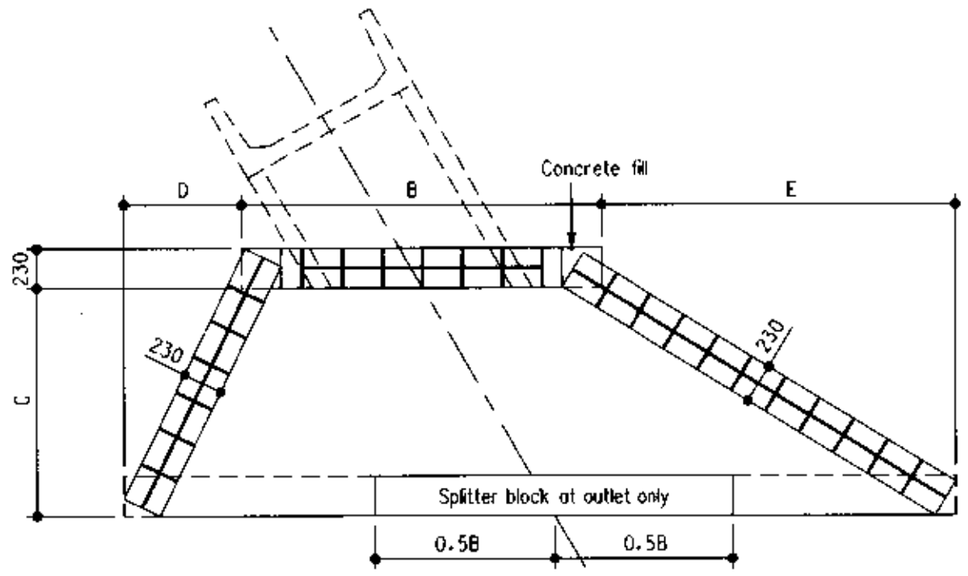
Scale
N.T.S.

Drawing Number
SD 0406

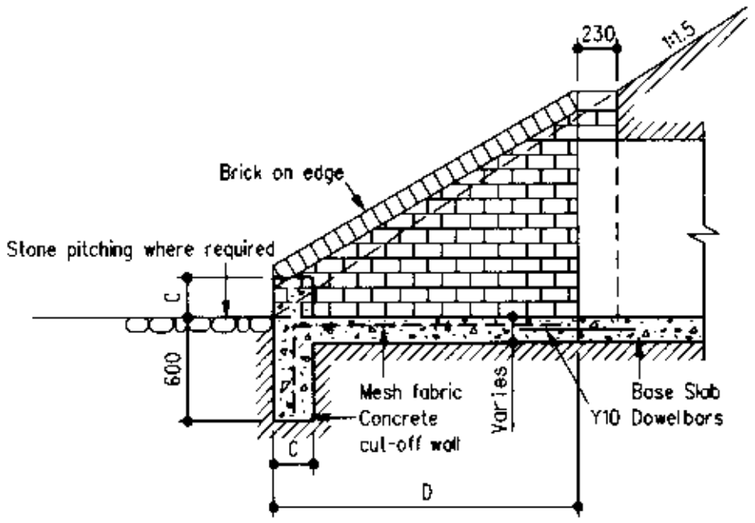
M 23221



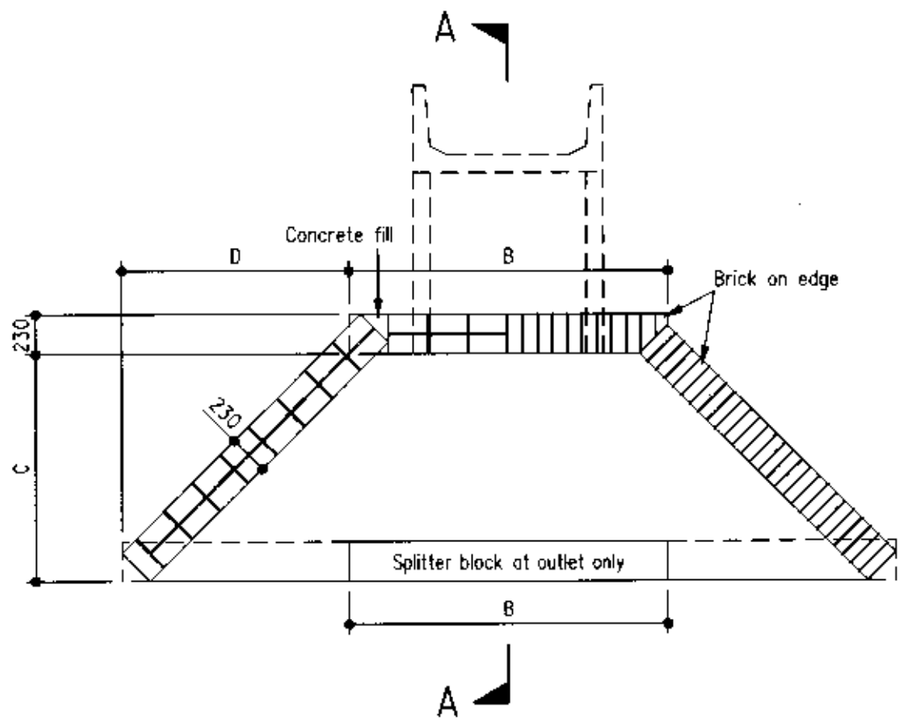
FRONT ELEVATION



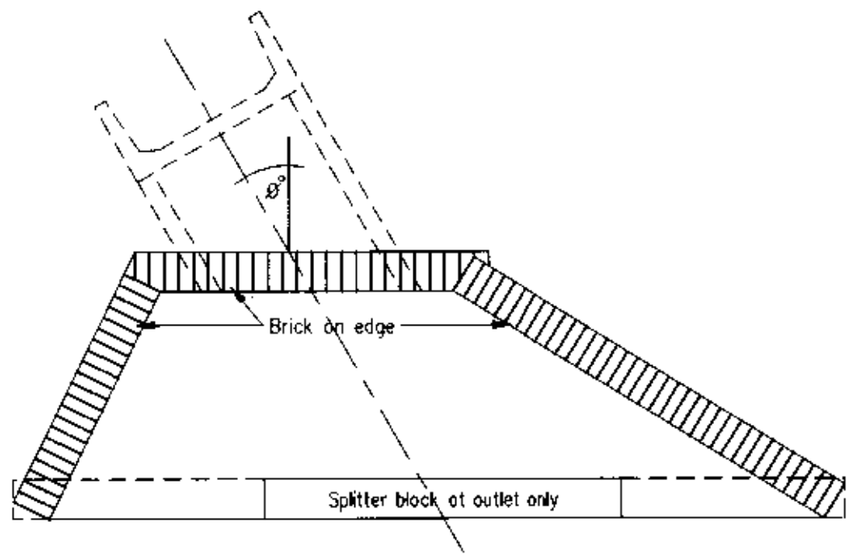
LAYOUT OF SKEW CULVERT BRICKWORK



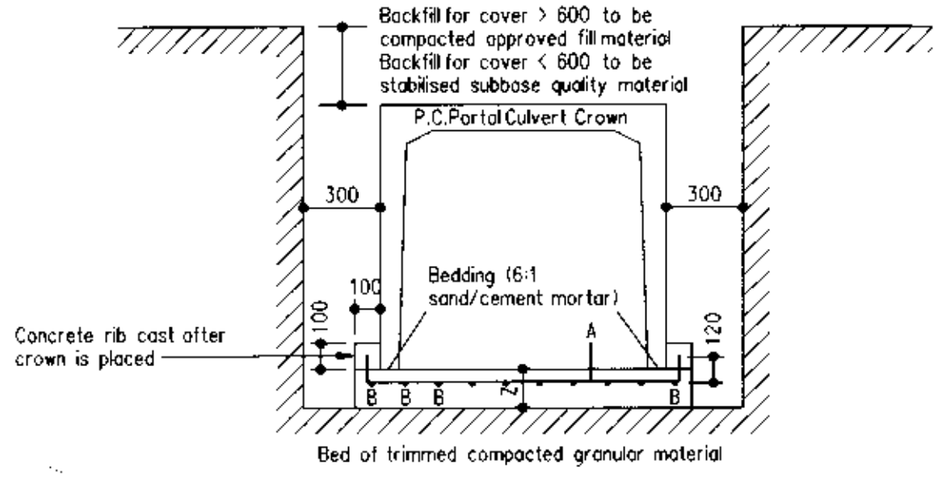
SECTION A-A



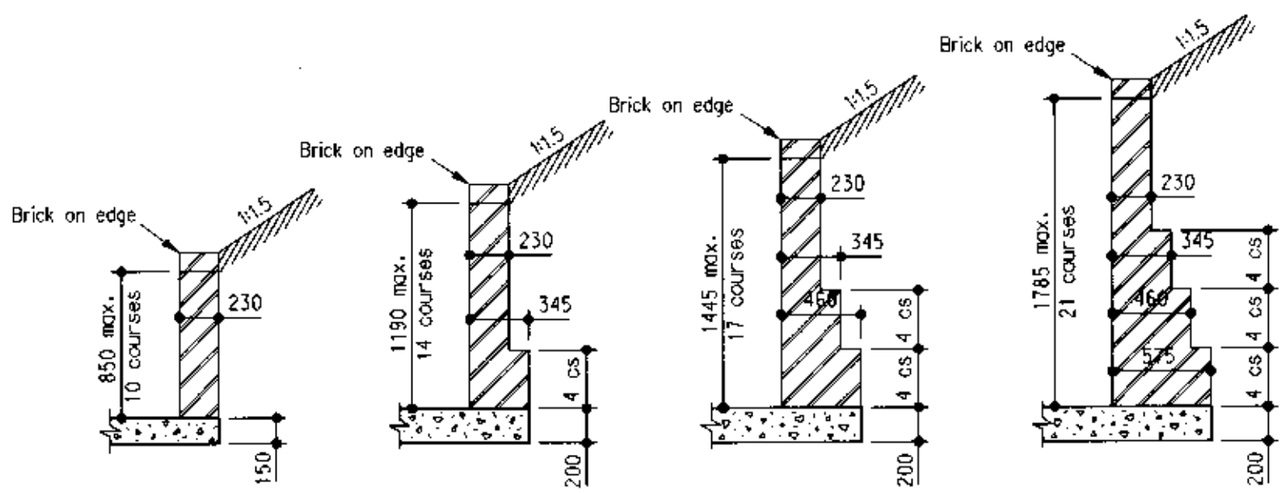
PART LAYOUT OF BRICKWORK/PART PLAN



PLAN OF SKEW CULVERT



SECTION SHOWING CAST IN-SITU BASE SLAB



TYPICAL RETAINING WALL DETAILS

Dimensions (mm) for Skew 0° - 22.5°						
S x H	A	B	C	D	E	F
600x450	680	1 495	700	700	700	150
750x600	850	1 610	900	900	900	150
900x900	1 190	1 840	1 300	1 300	1 300	230
1200x1200	1 445	2 185	1 800	1 800	1 800	230
1500x1500	1 785	2 530	2 200	2 200	2 200	230
Dimensions (mm) for Skew 23° - 45°						
S x H	A	B	C	D	E	F
600x450	680	1 725	700	350	1 050	150
750x600	850	1 840	900	450	1 350	150
900x900	1 190	2 070	1 300	650	1 950	230
1200x1200	1 445	2 415	1 800	900	2 700	230
1500x1500	1 785	2 760	2 200	1 100	3 300	230
Dimensions (mm) for Skew > 46°						
S x H	A	B	C	D	E	F
600x450	680	1 955	700	0	1 400	150
750x600	850	2 070	900	0	1 800	150
900x900	1 190	2 300	1 300	0	2 600	230
1200x1200	1 445	2 645	1 800	0	3 600	230
1500x1500	1 785	2 990	2 200	0	4 400	230

DETAILS OF CAST IN-SITU BASE					
SPAN	SLAB THICKNESS (Z)	BARS 'A'		BARS 'B'	
		DIA.	SPACING	DIA.	SPACING
600	150	Y12	150	Y10	200
750	150	Y16	150	Y10	200
900	150	Y16	150	Y10	200
1200	230	Y16	200	Y10	200
1500	230	Y16	200	Y10	200
NOTE: 1.Min. lap length for Bars 'B' = 400mm 2.Cover to reinforcement = 50mm					

MAXIMUM OVERFILL FOR PORTAL CULVERTS	
SPAN	FILL HEIGHT (m)
600	10.5
750	9.0
900	7.5
1200	6.0
1500	4.5
NOTE: Min. total cover over any portal shall be 200mm	

NOTES :

1. Splitter block and pitching to be provided at all outlets where erosion is likely to occur.
2. Splitter block may be omitted if discharge velocity is less than 0.9 m/s.
3. Cut-off walls may be omitted if structure is founded on rock.
4. Where multiples of portals are used they shall be placed 100mm apart and the spaces filled with well rammed concrete.
5. All joints between precast units shall be covered with an approved 600mm wide geofabric strip glued to the portal.
6. All portal lifting holes must be plugged to the satisfaction of the Engineer.
7. End portal units to be cut to skew.
8. For skew culverts the headwall shall be parallel to the centre line of the road.
9. All concrete is to be 20MPa.
10. Square mesh fabric (Reference S.M.F.193) is to be placed 50mm from top in all apron slabs and centrally in cut-off walls.
11. Brickwork is to consist of good quality burnt clay common bricks in accordance with SABS 227 Specification, or cement bricks in accordance with SABS 987 Specification, uniform in size and shape layed in stretcher bond style with the skins tied together with galvanised crimped wire wall ties.
12. Brickforce is to be placed every 4th course.
13. Jointing on all visible faces to be pointed.
14. No in-fill shall be larger than a half standard brick size unless 15MPa concrete is used.

Symbol	Date	Description	Dr.
Amendments			

PROVINCE OF KWAZULU-NATAL

DEPARTMENT OF TRANSPORT

Deputy Director-General: Transport

1999/05/12
Date

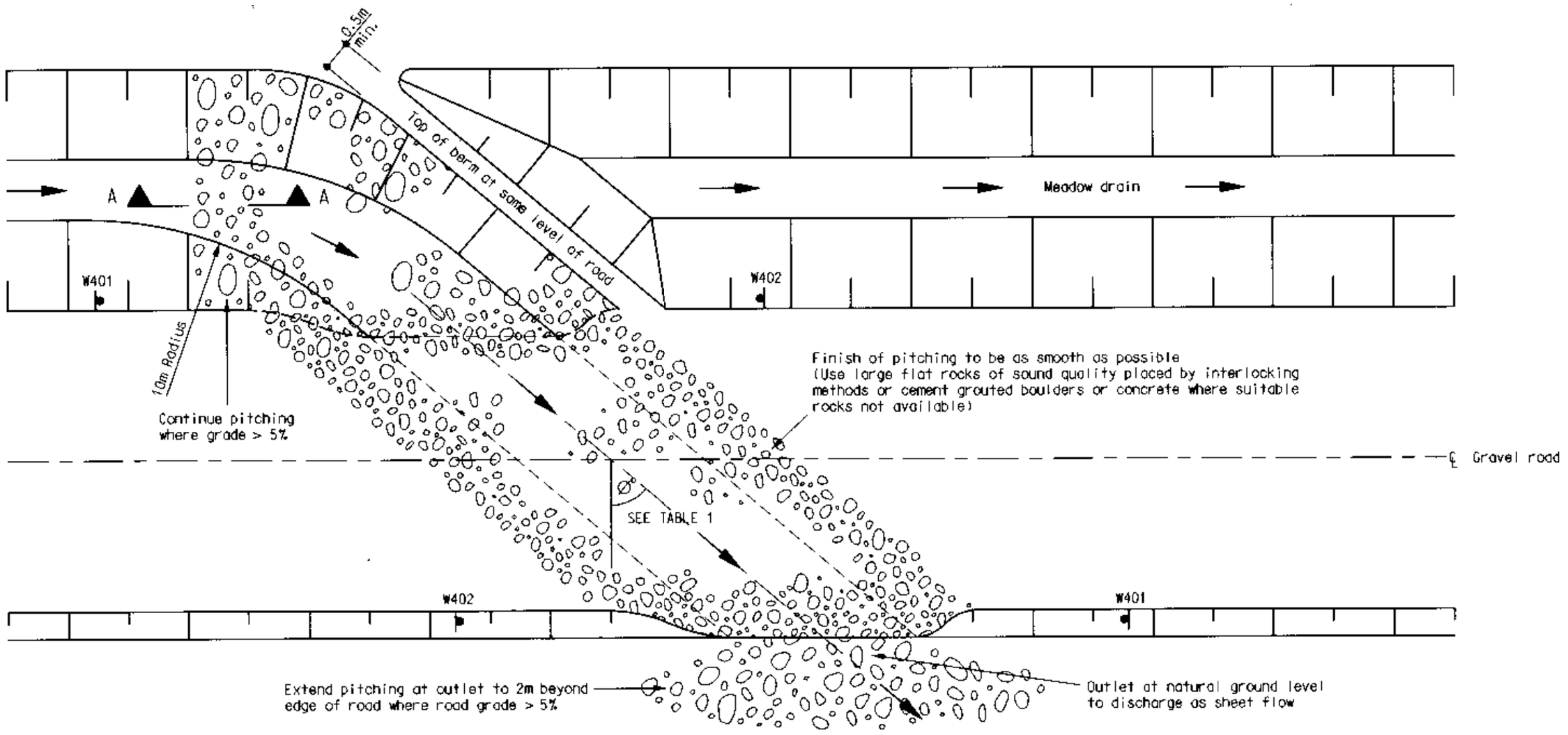
Standard Details

PRECAST CONCRETE PORTAL CULVERT
HEADWALLS (MASONRY)

Scale
N.T.S.

Drawing Number
SD 0407

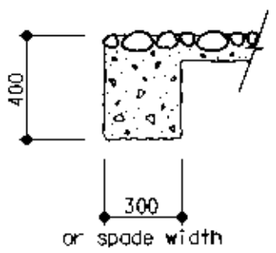
M 23222



DISH CROSSING DETAIL

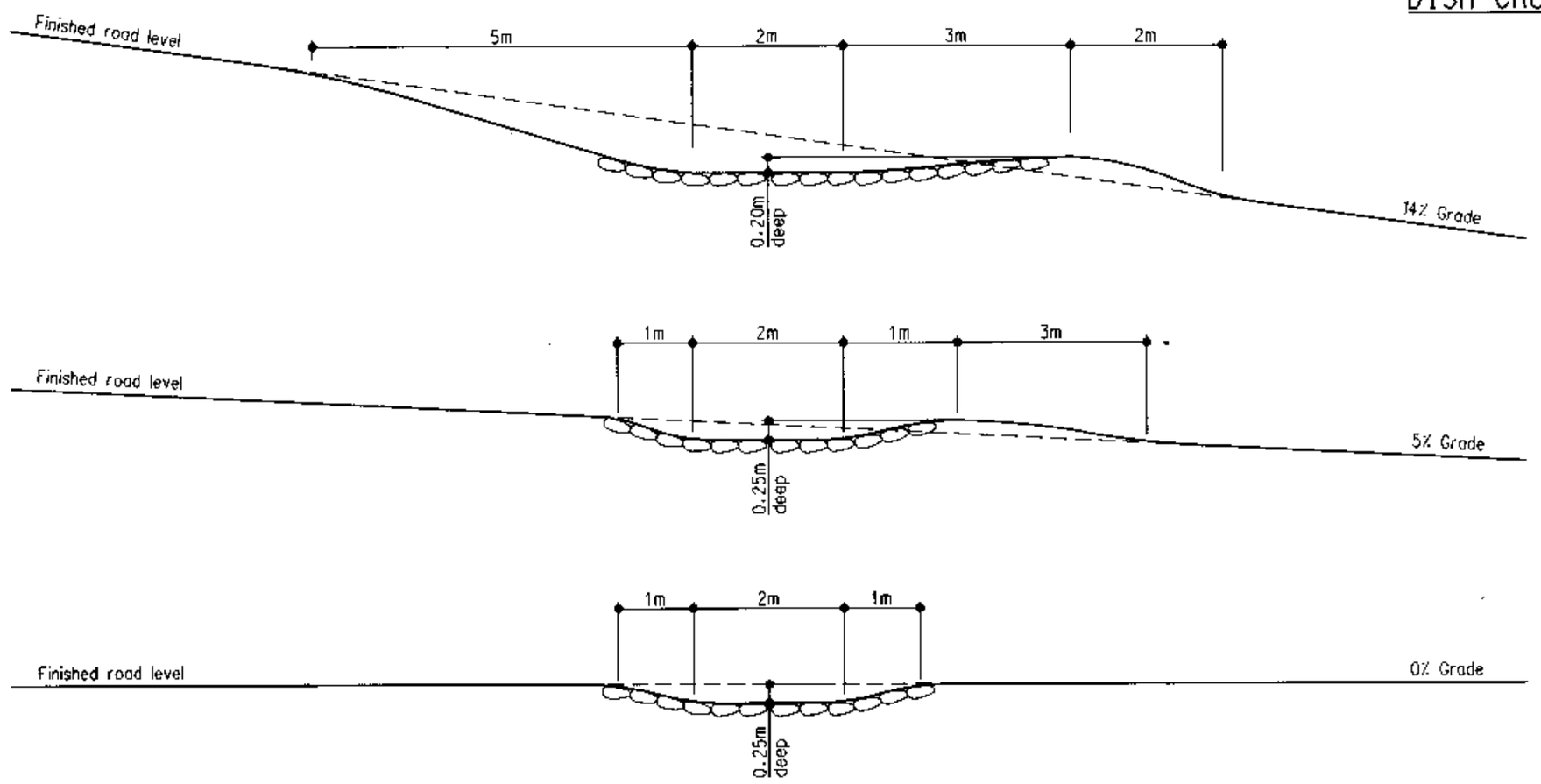
GRADIENT (%)	SKEW ANGLE (Ø°)
0-1	0°
1-3	20°
3-5	30°
5-10	40°
> 10	50°

TABLE 1 : DESIRABLE ANGLES FOR VARIOUS GRADIENTS



SECTION A-A

Concrete cut-off wall where grade > 5%



DISH CROSSING PROFILES

ROAD GRADIENT (%)	0-1	1-3	3-5	5-7	7-10	> 10
MAXIMUM DISTANCE BETWEEN CROSSINGS (m)	300	200	150	100	80	50

TABLE 2 : MAXIMUM DISTANCE BETWEEN CROSSINGS

NOTES:

1. Dish crossings are to be used for gravel roads only
2. Dish crossings to be provided for catchment areas less than 10ha.
3. W350 warning signs are to be placed 120m from dish drains in both directions.
4. W401 and W402 danger plates are to be placed on either side of dish drains in both directions.
5. Cut-off walls may be omitted where rock is encountered.

Symbol	Date	Description	Dir.
		Amendments	

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Deputy Director-General: Transport
1999/05/13
Date

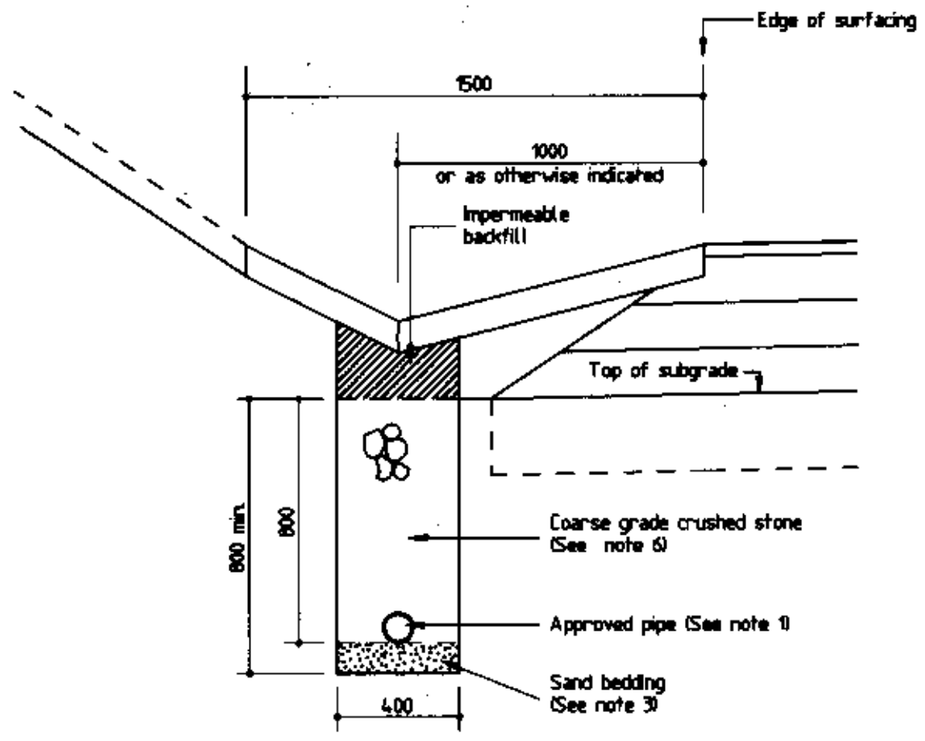
Standard Details

DISH CROSSING (PITCHED)

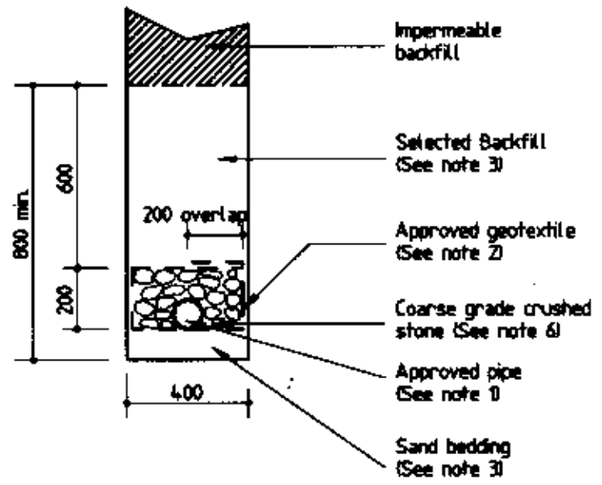
Scale
N.T.S.

Drawing Number
SD 0408

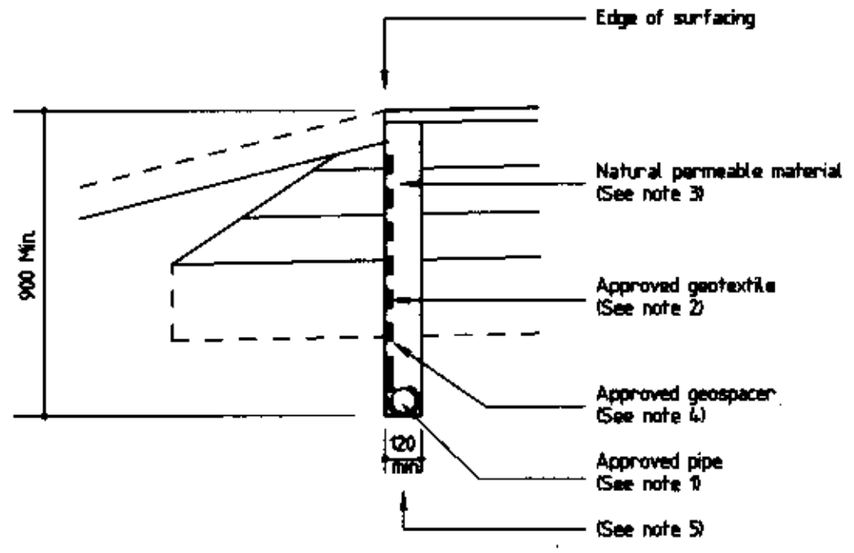
M 23223



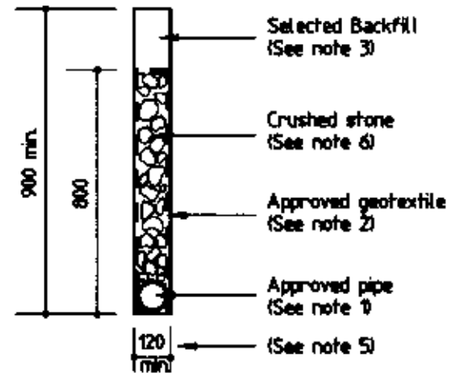
SD 0501/1 : TYPE A CONVENTIONAL DRAIN
Scale 1 : 20



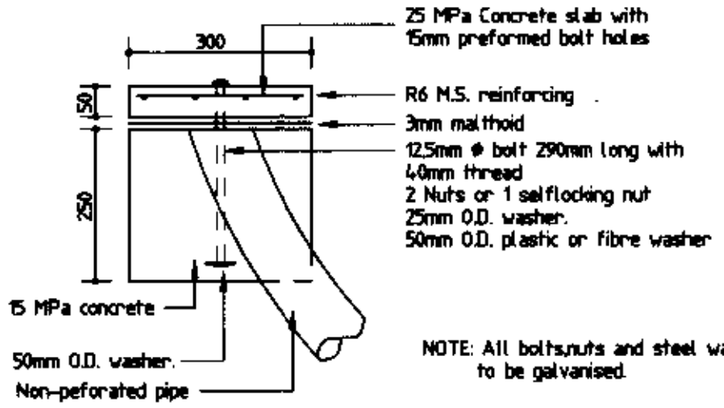
SD 0501/2 : TYPE B ALTERNATIVE DRAIN
Scale 1 : 20



SD 0501/3 : TYPE C FIN DRAIN
Scale 1 : 20

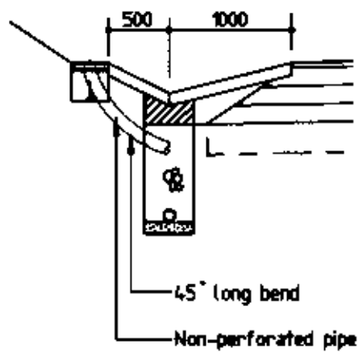


SD 0501/4 : TYPE D NARROW DRAIN
Scale 1 : 20

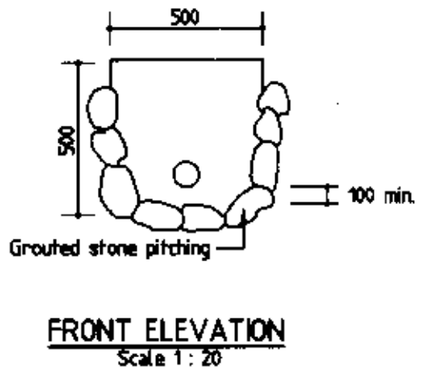


NOTE: All bolts,nuts and steel washers to be galvanised.

SECTIONAL ELEVATION
Scale 1 : 10



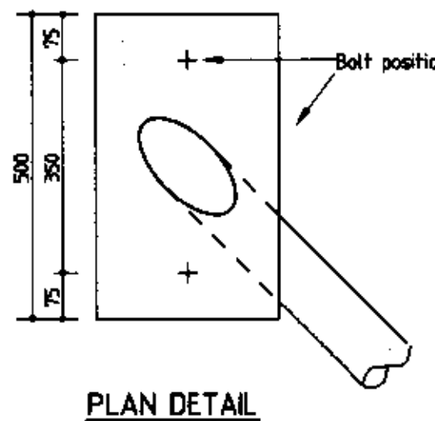
TYPICAL CROSS SECTION
Scale 1 : 50



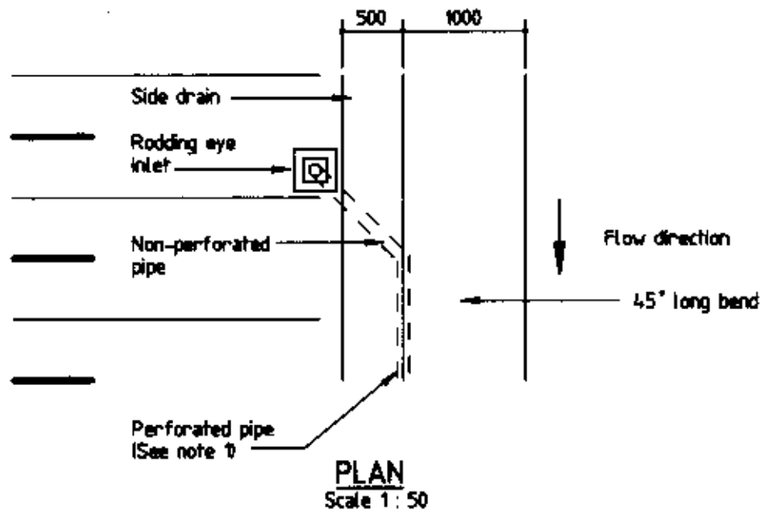
FRONT ELEVATION
Scale 1 : 20

NOTES :

1. The drainage pipe shall be not less than 100mm in diameter, perforated or slotted, and manufactured from pitch fibre,high-density polyethylene or uPVC. No openings shall be provided in the pipe invert.
2. The geotextile shall conform with grade E of Natal Roads Branch specification for Geotextiles. A stronger grade may be used at then Engineer's discretion.
3. Selected backfill and bedding shall be natural permeable material as specified in 2104 of CSRA Standard Specifications.
4. The Engineer must be satisfied that the geospacer has sufficient capacity to transmit the quantity of water discharged from the surrounding soil.
5. Trench width can vary from 120 mm to 400mm according to type of excavation equipment available and the condition of the insitu material.
6. Crushed stone shall conform with coarse-grade stone as specified in 2104 of CSRA Standard Specifications.
7. The higher end of each subsoil drain pipe shall be sealed off with a rodding eye inlet.Additional rodding eye inlets may be required as instructed by the Engineer.
8. For new works the pipe shall be at least 800mm below top of subgrade whereas for rehabilitation of existing roads it shall be at least 900mm below road surface.
9. Rodding eye inlets to be positioned at head of pipe run only.
10. In shallow cuttings it is desireable to use a 3200 wide drain as indicated on SD 0601 without a subsoil drain.



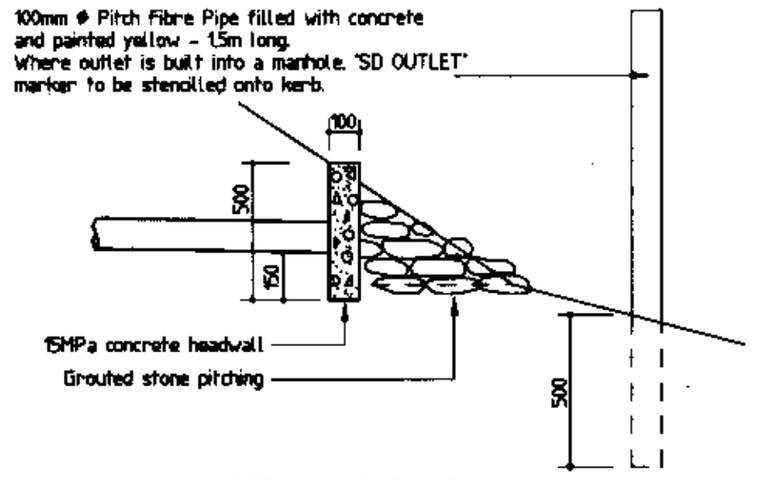
PLAN DETAIL
Scale 1 :10



PLAN
Scale 1 : 50

SD 0501/5 : RODDING EYE INLET

100mm ø Pitch Fibre Pipe filled with concrete and painted yellow – 1.5m long. Where outlet is built into a manhole, 'SD OUTLET' marker to be stencilled onto kerb.



SECTIONAL ELEVATION
Scale 1 : 20

SD 0501/6 : OUTLET HEADWALL

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary for Transport

Date 04/12/96

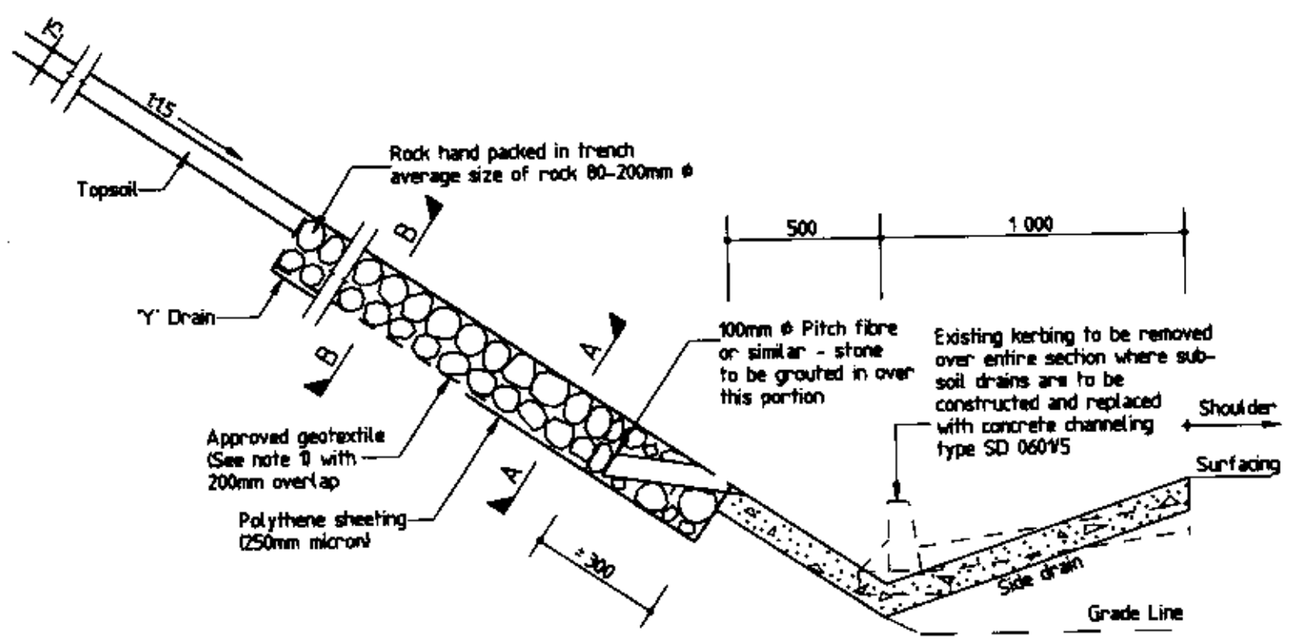
Standard Details

SUBSOIL DRAINAGE
ROAD EDGE SUBSOIL DRAINS

Scale: As shown

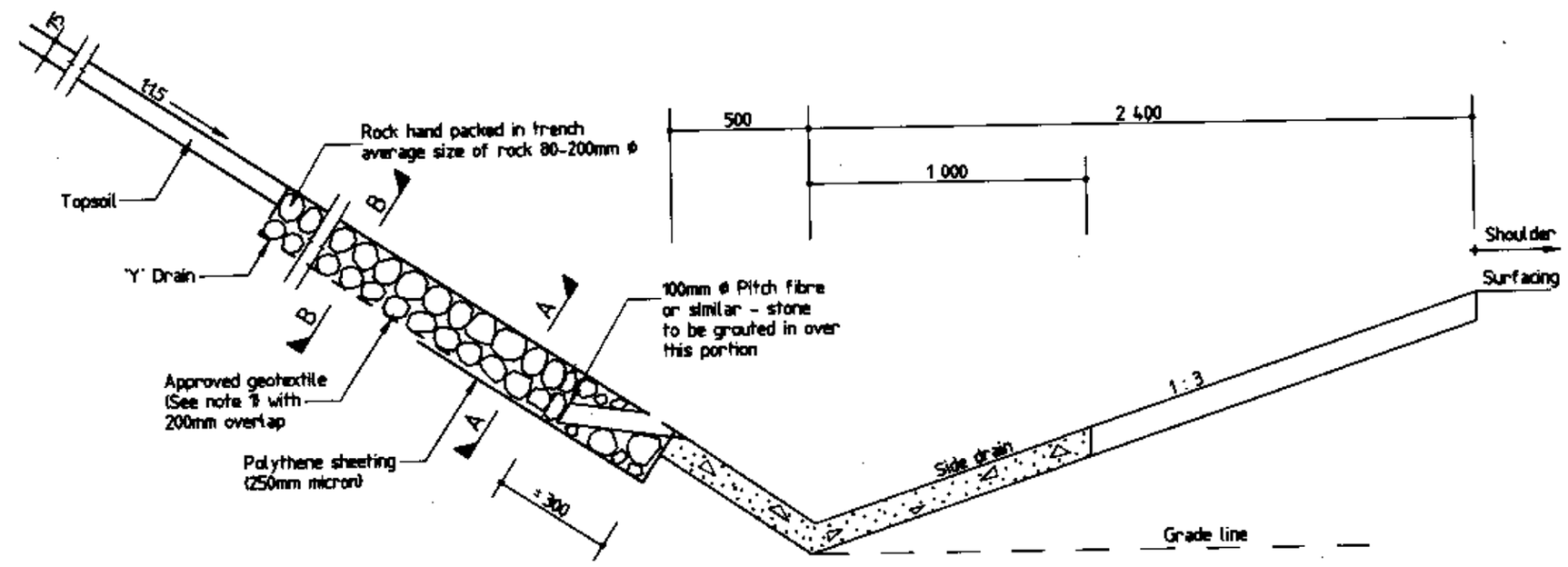
Drawing Number: SD 0501/A

M 2323



TYPICAL CROSS-SECTION USING A TYPE 1000 V-DRAIN

Scale - 1:20

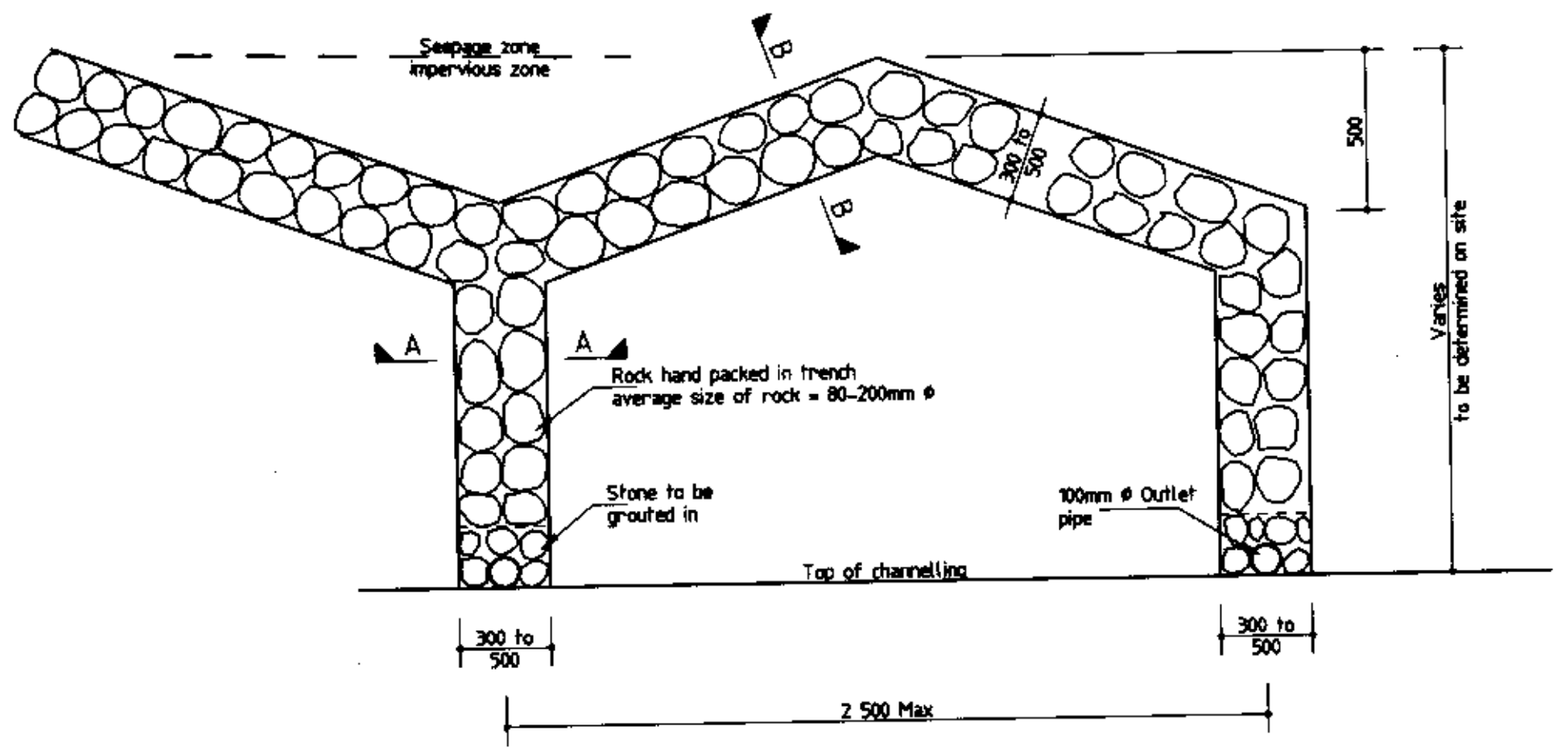


TYPICAL CROSS-SECTION USING A TYPE 2400 V-DRAIN

Scale - 1:20

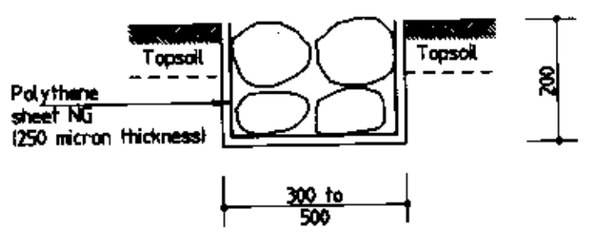
NOTE :

1. The geotextile shall conform with grade E of Natal Roads Branch specification for geotextiles. A stronger grade may be used at the Engineer's discretion.



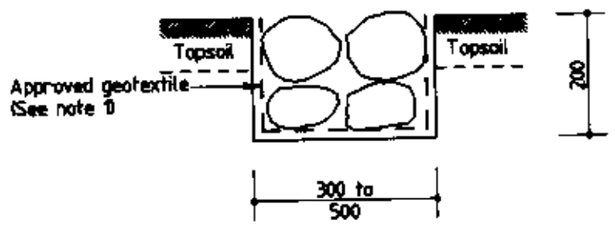
Y-DRAIN ELEVATION

Scale - 1:20



SECTION A-A

Scale - 1:10



SECTION B-B

Scale - 1:10

Symbol	Date	Description	Dir.
A	JULY 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary for Transport

Date 14/2/12

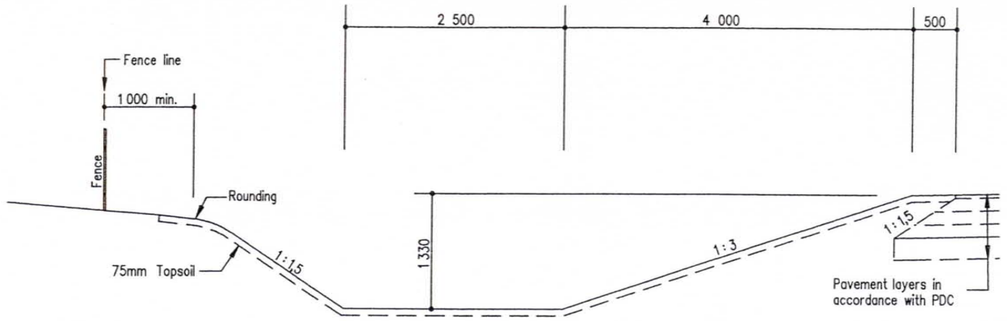
Standard Details

SUBSOIL DRAINAGE
CUT SLOPE SUBSOIL DRAIN

Scale: As shown

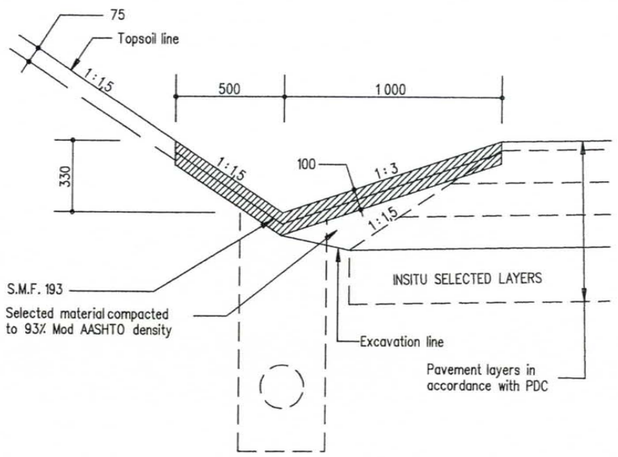
Drawing Number: SD 0502/A

M 2324



SD 0601/1 : MEADOW - DRAIN

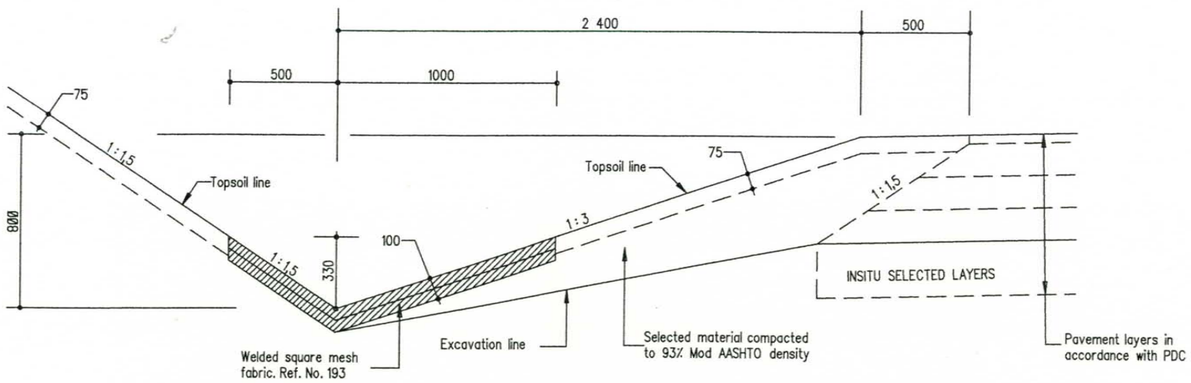
Scale 1 : 50



SD 0601/2 : GRASSED OR CONCRETE-LINED 1000 V - DRAIN

(NOTE : For use with subsoil drains in deep cuttings)

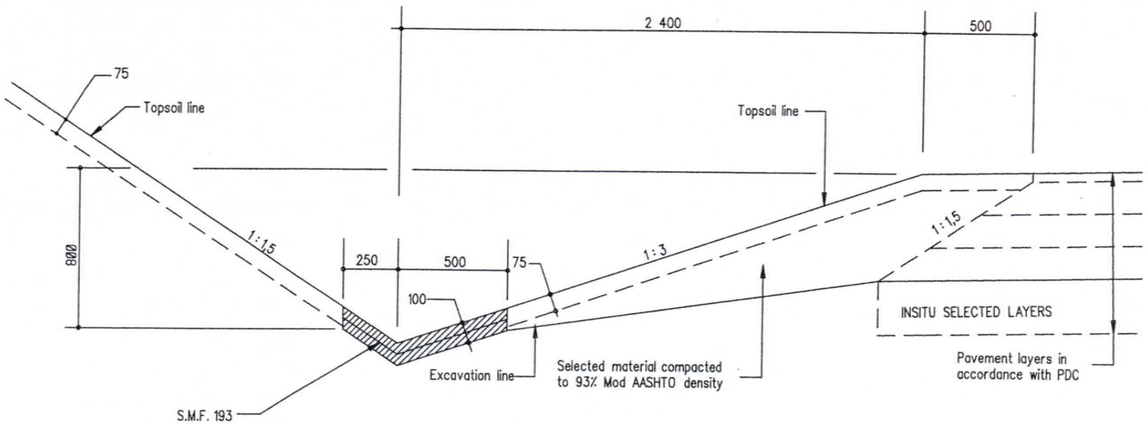
Scale 1 : 20



SD 0601/4 : CONCRETE-LINED V-DRAIN IN SHALLOW CUTTINGS.

(NOTE : 1. Subsoil drains are not required with this drain detail)
(NOTE : 2. Concrete dimensions may be increased as required)

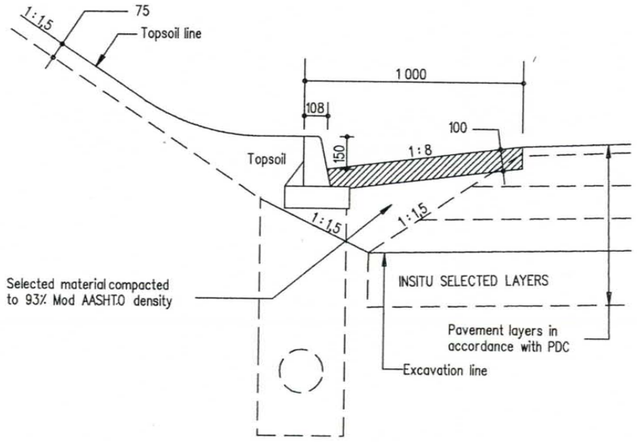
Scale 1 : 20



SD 0601/3 : GRASSED V-DRAIN IN SHALLOW CUTTINGS

(NOTE : 1. Subsoil drains are not required with this drain detail)
NOTE : 2. Where a grassed drain is used the invert must always be concreted as indicated for maintenance purposes.

Scale 1 : 20



SD 0601/5 : KERB AND CHANNEL SIDE DRAIN IN CUT

(Alternative to concrete lined 1000 V - Drain in deep cuttings)

Scale 1 : 20

NOTES :

1. A V-drain as detailed on SD 0601/3 & 4 is recommended for shallow cuttings of depth not exceeding 5,00m measured at a point 6,00m from edge of carriageway.
2. The 1000 V-drain is concrete lined and recommended for deep cuttings of depth greater than 5,00m measured at a point 6,00m from edge of carriageway.
3. Construction joints shall be provided at 4,00m intervals All panel ends shall be painted with a coat of approved bituminous emulsion containing 60% pure bitumen by mass before any adjoining panels are cast. 10mm wide expansion joints sealed with a closed cell expanded polyethylene joint filler over the full panel depth shall be provided every 12,00m
4. The meadow drain is recommended for use in flat terrain.
5. See SD 0501 for subsoil drain details.
6. See SD 0701 for kerb details.
7. Concrete to be 20MPa minimum.

Symbol	Date	Description	Dir.
		Amendments	
C	Oct 06	Unsurfaced shoulder for 2,4m v-drain & meadow-drain added	
B	Jan 96	Details of concrete lining amended	
A	July 94	General updating and revision	

PROVINCE OF KWAZULU-NATAL

DEPARTMENT OF TRANSPORT

Head: Transport

01.06.2007.
Date

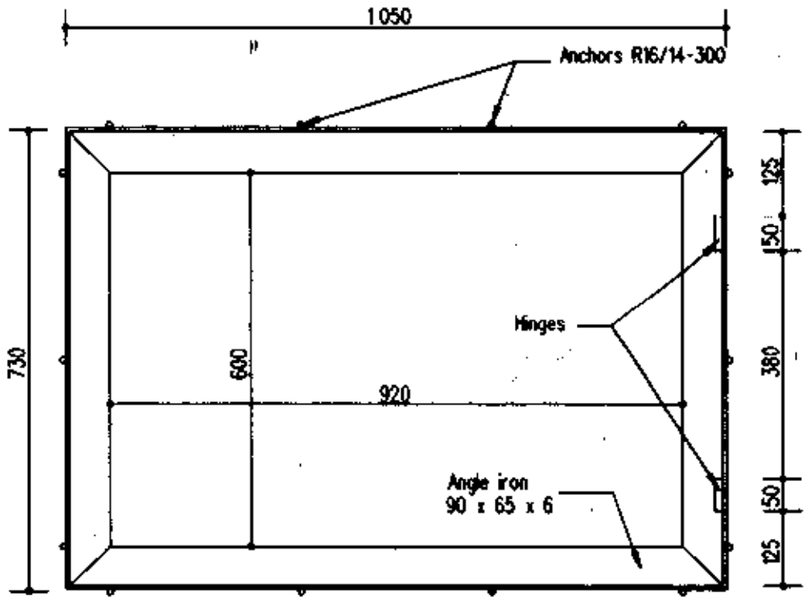
Standard Details

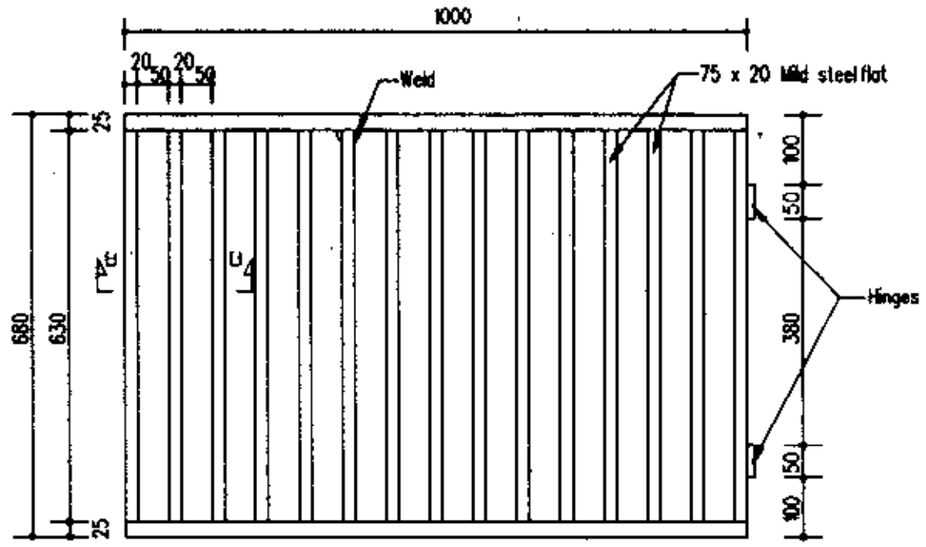
DRAINAGE IN CUTTING SIDE DRAINS

Scale: As Shown

Drawing Number: SD 0601/C

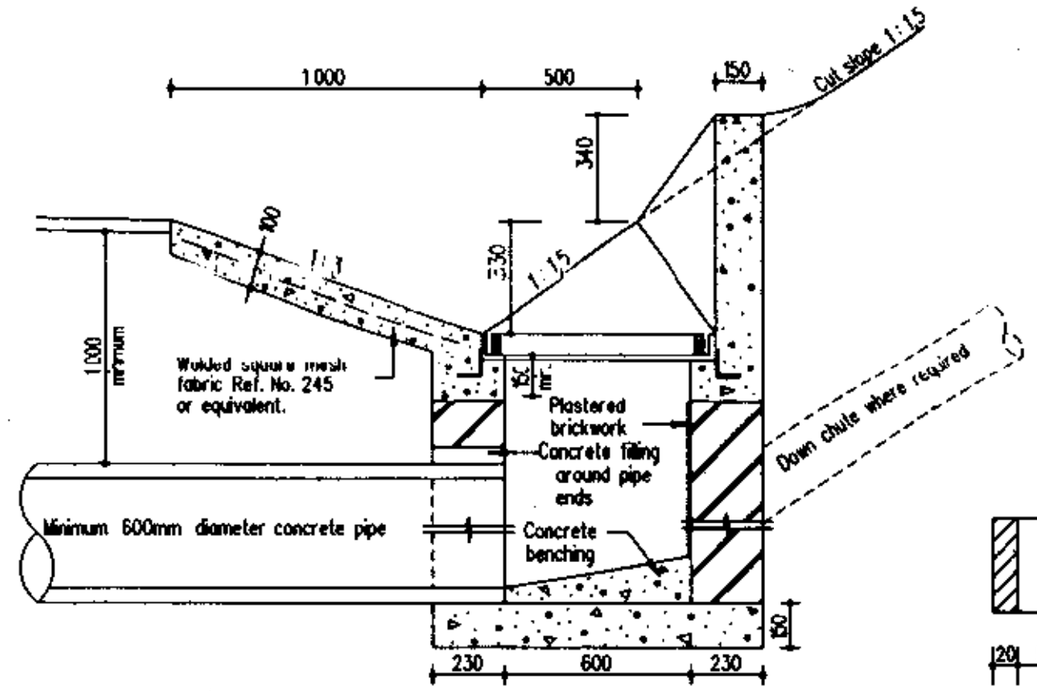
M 2325





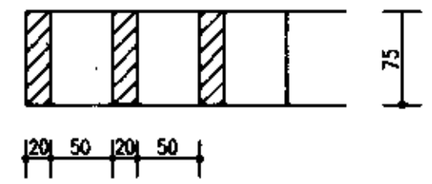
GRID AND FRAME

Scale 1 : 10



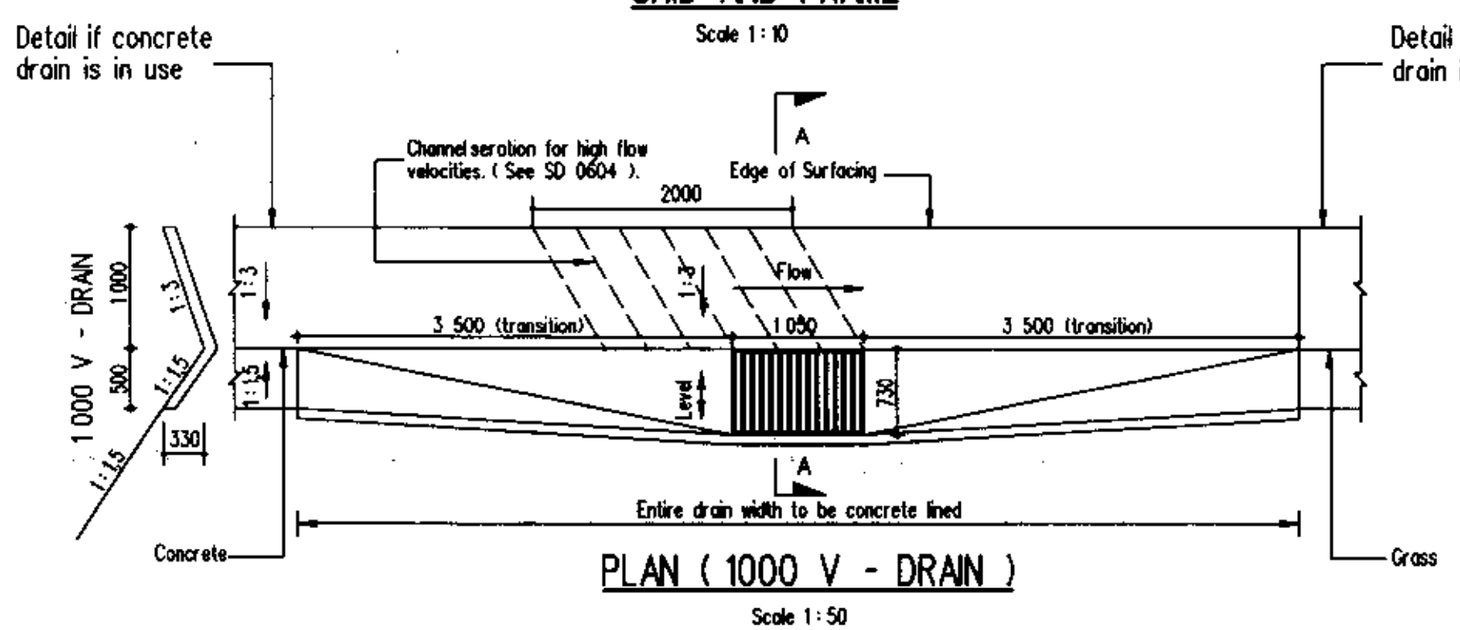
SECTION A-A

Scale 1 : 20



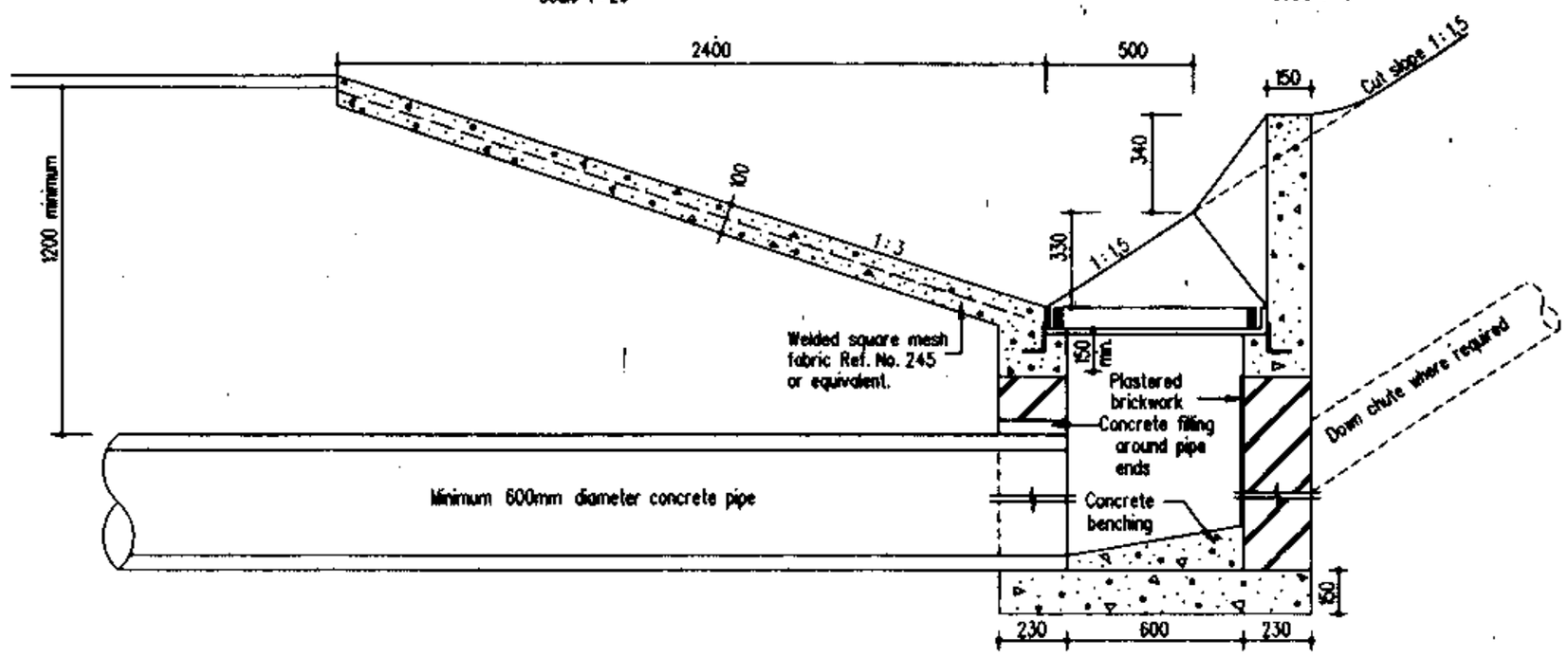
SECTION B-B

Scale 1 : 5



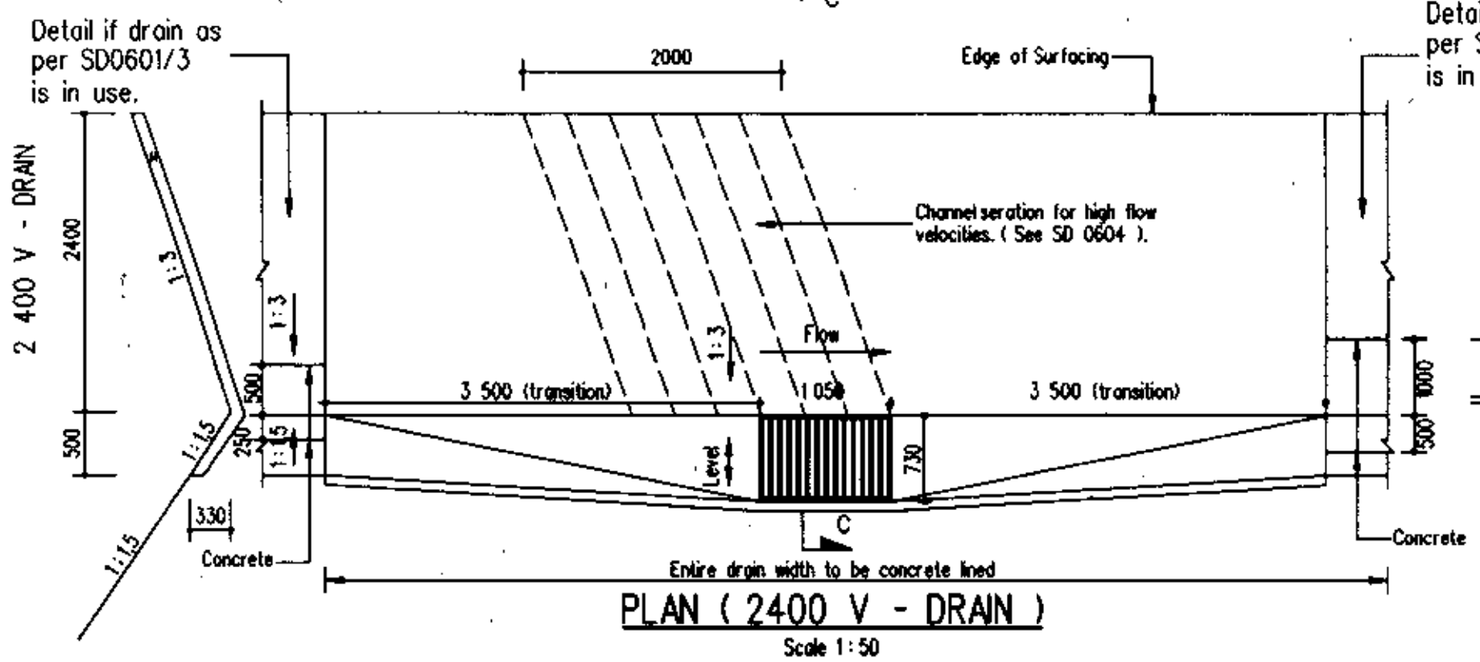
PLAN (1000 V - DRAIN)

Scale 1 : 50



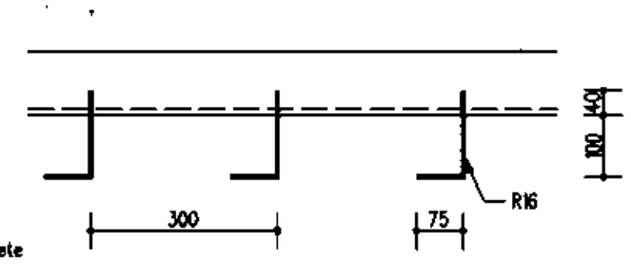
SECTION C-C

Scale 1 : 20



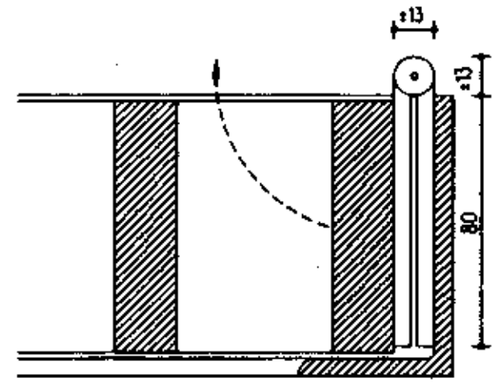
PLAN (2400 V - DRAIN)

Scale 1 : 50



ANCHOR DETAILS

Scale 1 : 10



HINGE DETAIL FOR GRID AND FRAME

Scale 1 : 2

NOTES :

1. All welding to be done prior to any galvanising.
2. Hinges to be welded to frame and grid.
3. All mild steel to be hot dip galvanised to S.A.B.S. 763.
4. All concrete to be 20Mpa minimum.

Symbol	Date	Description	Dir.
B	Jan 96	Details of concrete lining amended	
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary : Transport

Date

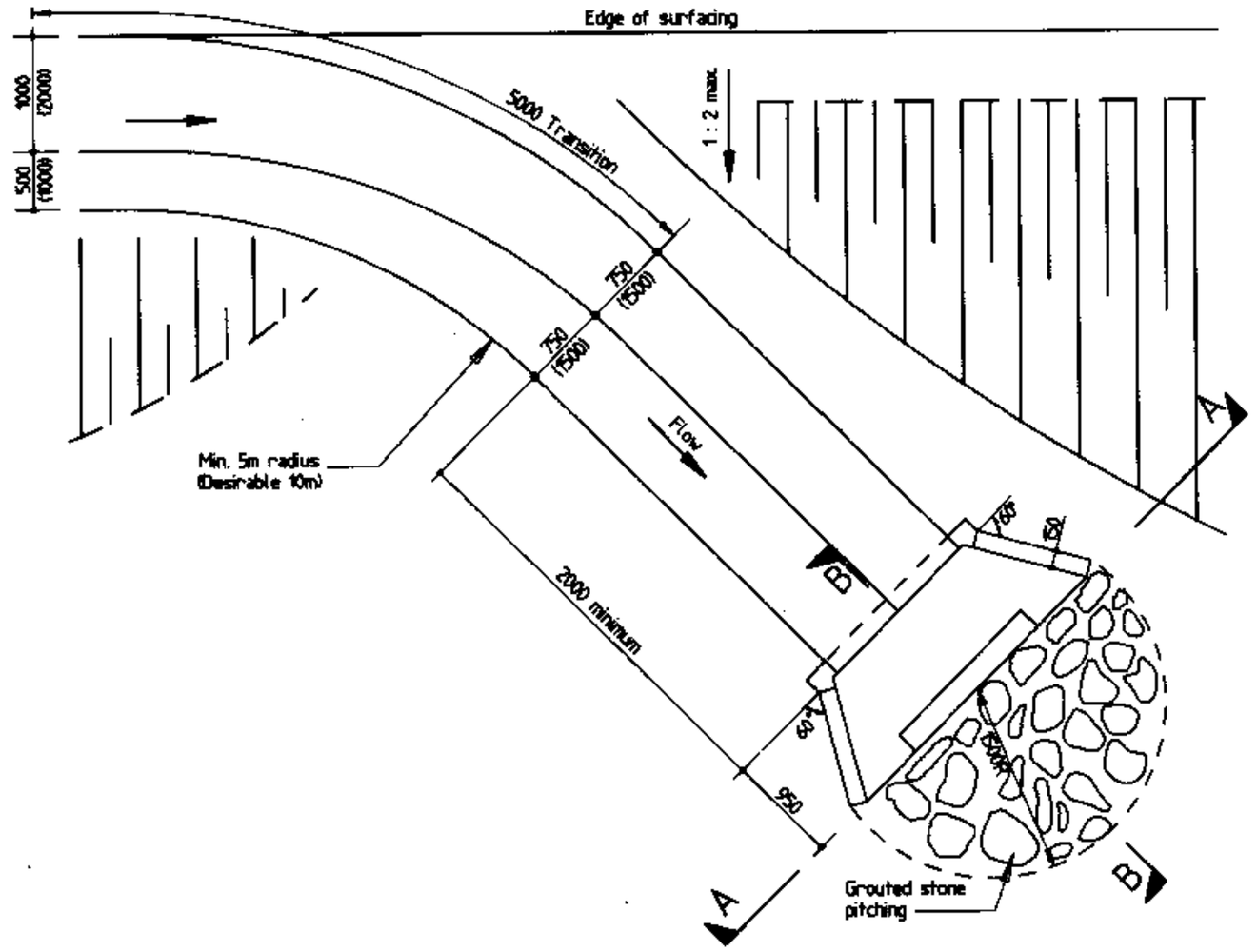
Standard Details

DRAINAGE IN CUTTINGS
SIDE DRAIN AND GRID INLET

Scale: As shown

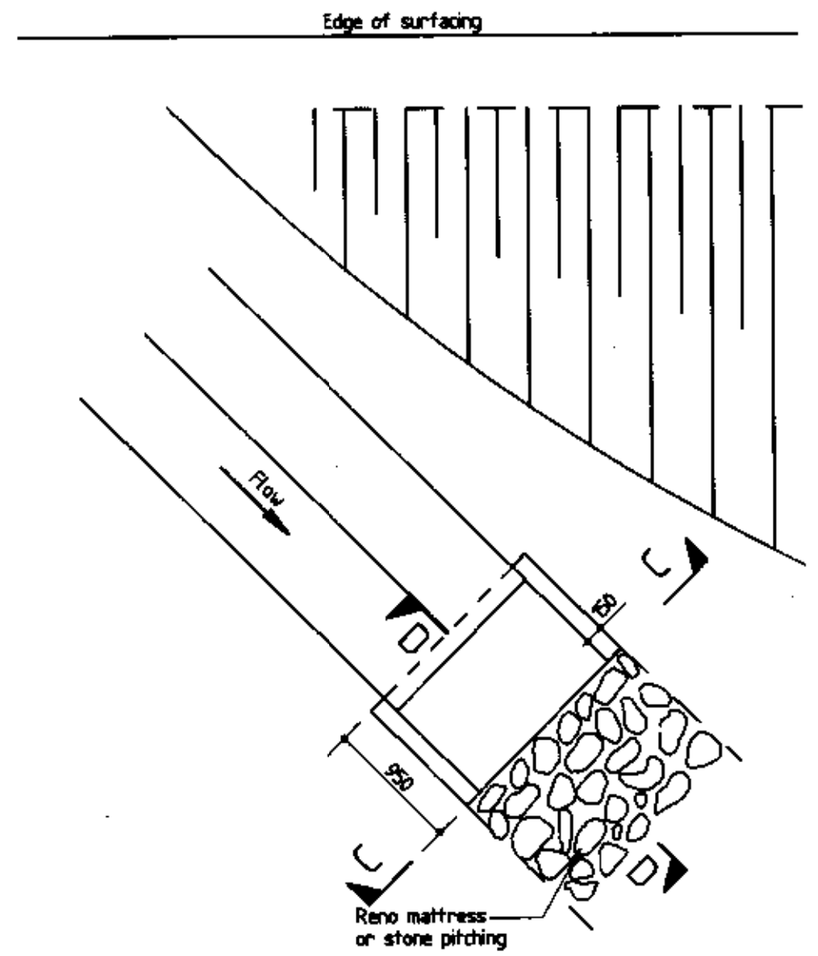
Drawing Number: SD 0602/B

M 2326



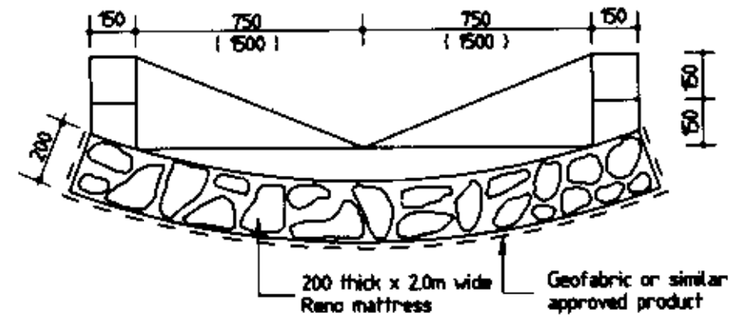
SD 0603/1 : DISCHARGE ONTO NATURAL GROUND

Scale 1 : 50



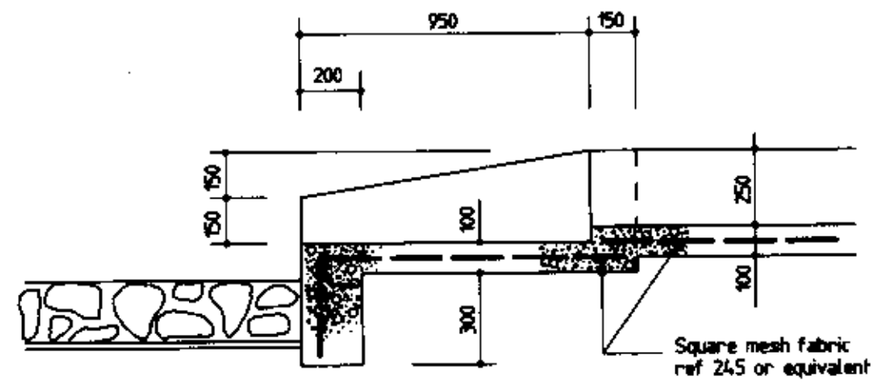
SD 0603/2 : DISCHARGE INTO LINED TOE DRAIN

Scale 1 : 50



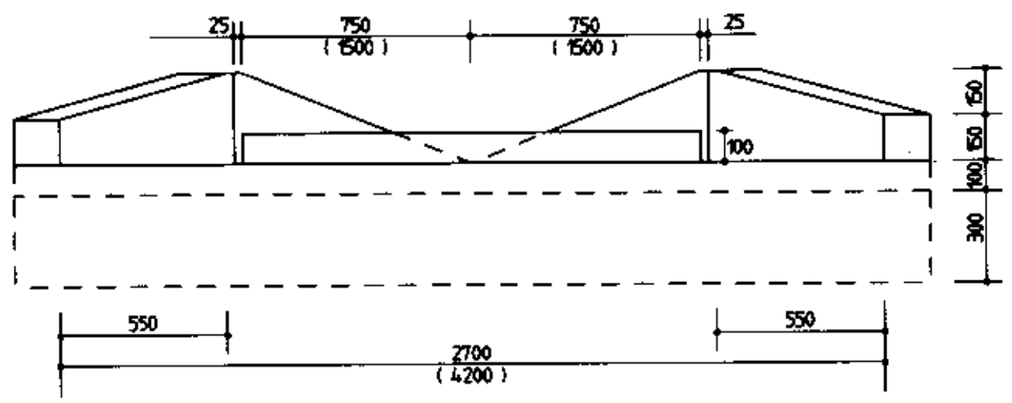
SECTION C-C

Scale 1 : 20



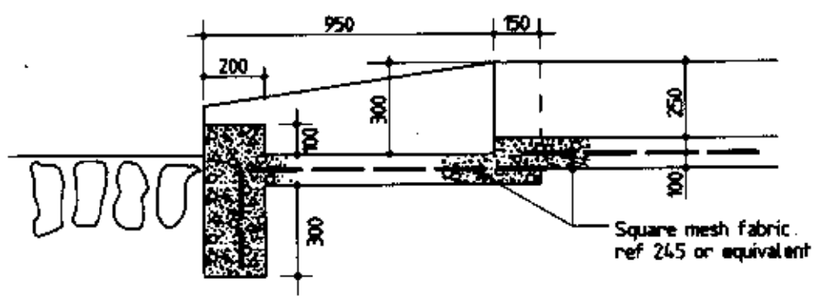
SECTION D-D

Scale 1 : 20



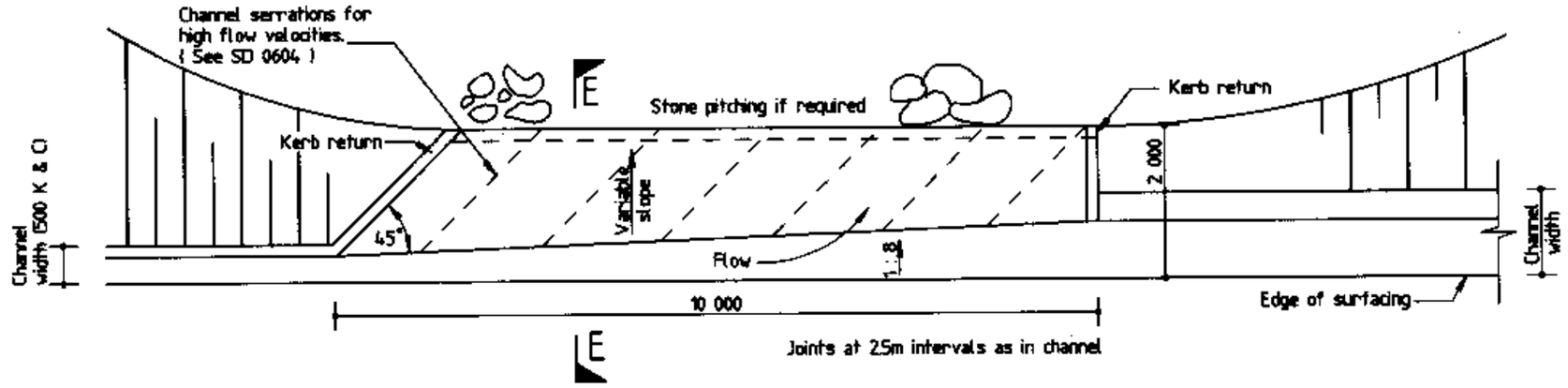
SECTION A-A

Scale 1 : 20



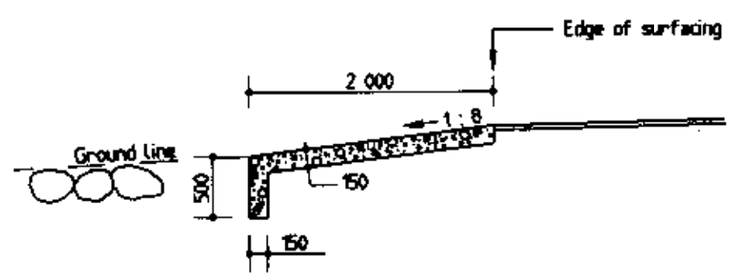
SECTION B-B

Scale 1 : 20



SD 0603/3 : SIDE SPILLING OUTLET

Scale 1 : 75



SECTION E - E

Scale 1 : 50

NOTE :

1. Bracketed dimensions are applicable to 2000 V - Drain.

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary : Transport

Date 06/12/22

Standard Details

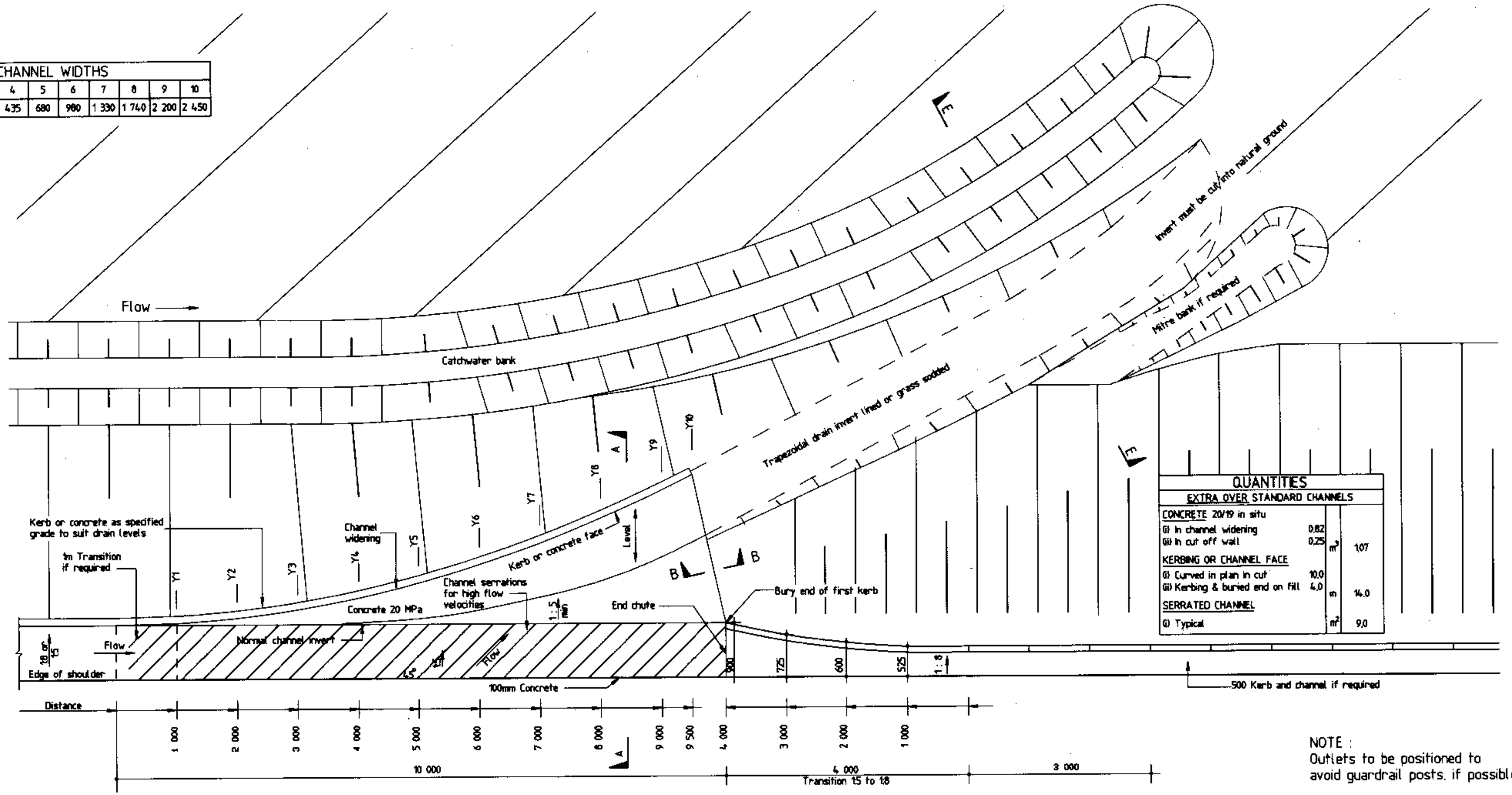
DRAINAGE IN CUTTINGS
SIDE DRAIN OUTLETS

Scale: As shown

Drawing Number: SD 0603/A

M 2327

EXTRA CHANNEL WIDTHS										
Y	1	2	3	4	5	6	7	8	9	10
mm	30	110	245	435	680	980	1 330	1 740	2 200	2 450



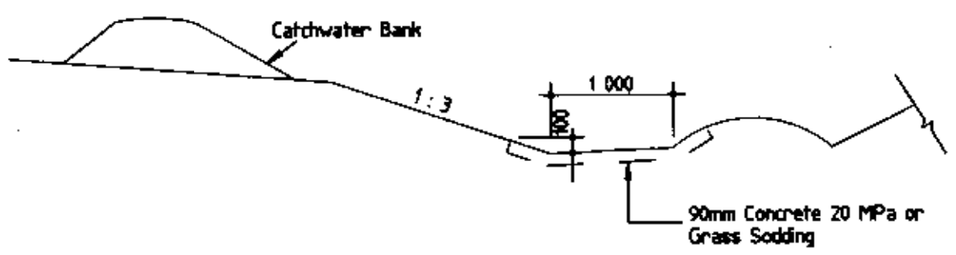
QUANTITIES

EXTRA OVER STANDARD CHANNELS

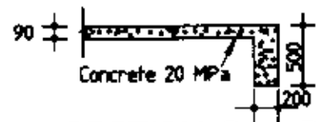
CONCRETE 20/19 in situ			
(i) In channel widening	0,82		
(ii) In cut off wall	0,25	m^3	1,07
KERBING OR CHANNEL FACE			
(i) Curved in plan in cut	10,0		
(ii) Kerbing & buried end on fill	4,0	m	14,0
SERRATED CHANNEL			
(i) Typical		m^2	9,0

NOTE :
Outlets to be positioned to avoid guardrail posts, if possible.

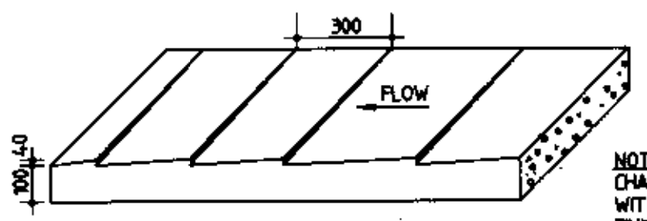
PLAN
Scale : 1:50



SECTION E - E

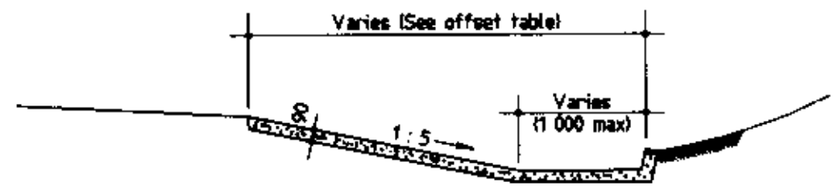


SECTION B - B



CHANNEL SERRATIONS
(AS VIEWED FROM KERB FACE)
N.T.S.

NOTE :
CHANNEL CAST IN - SITU WITH WOOD FLOATED FINISH.



SECTION A - A

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary : Transport

Date

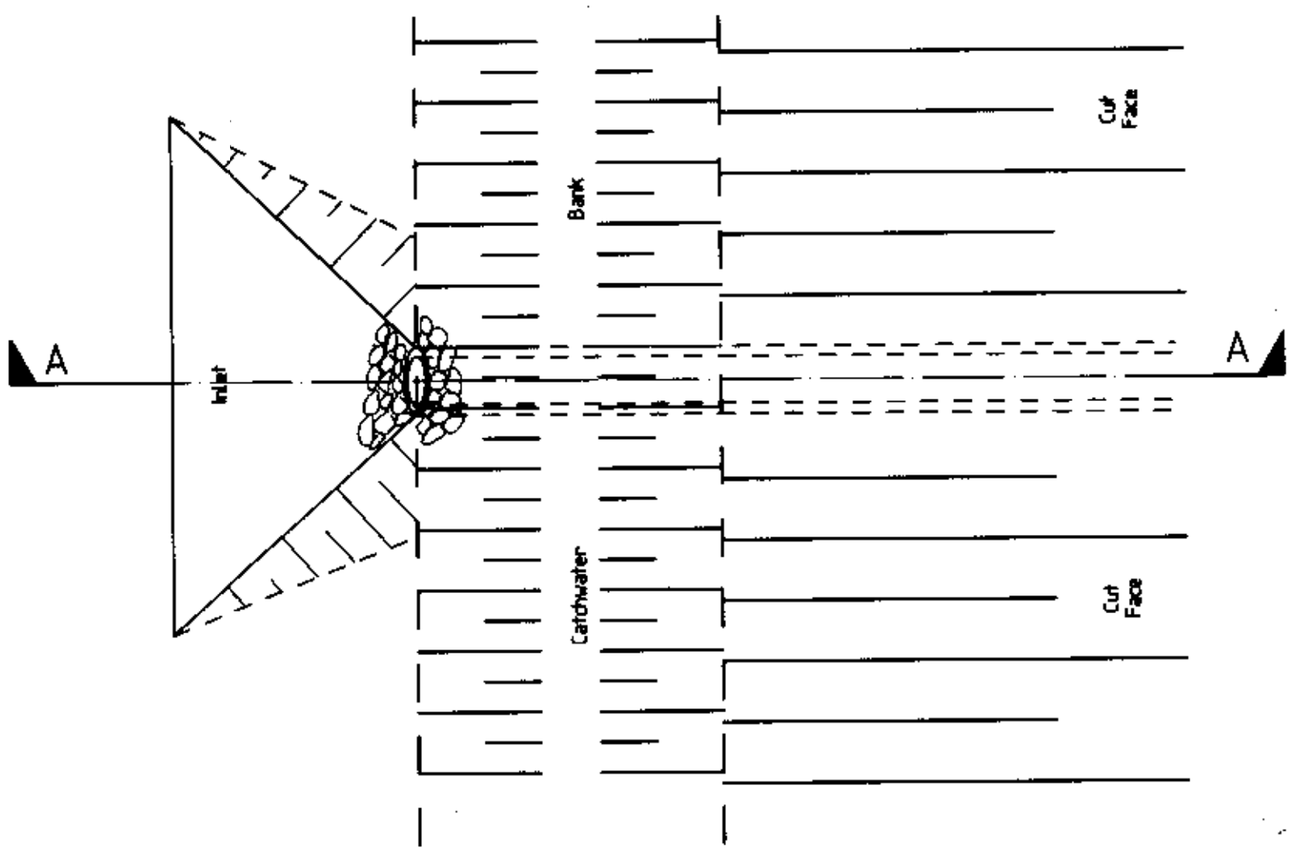
Standard Details

MITRE CHUTE

Scale
As shown

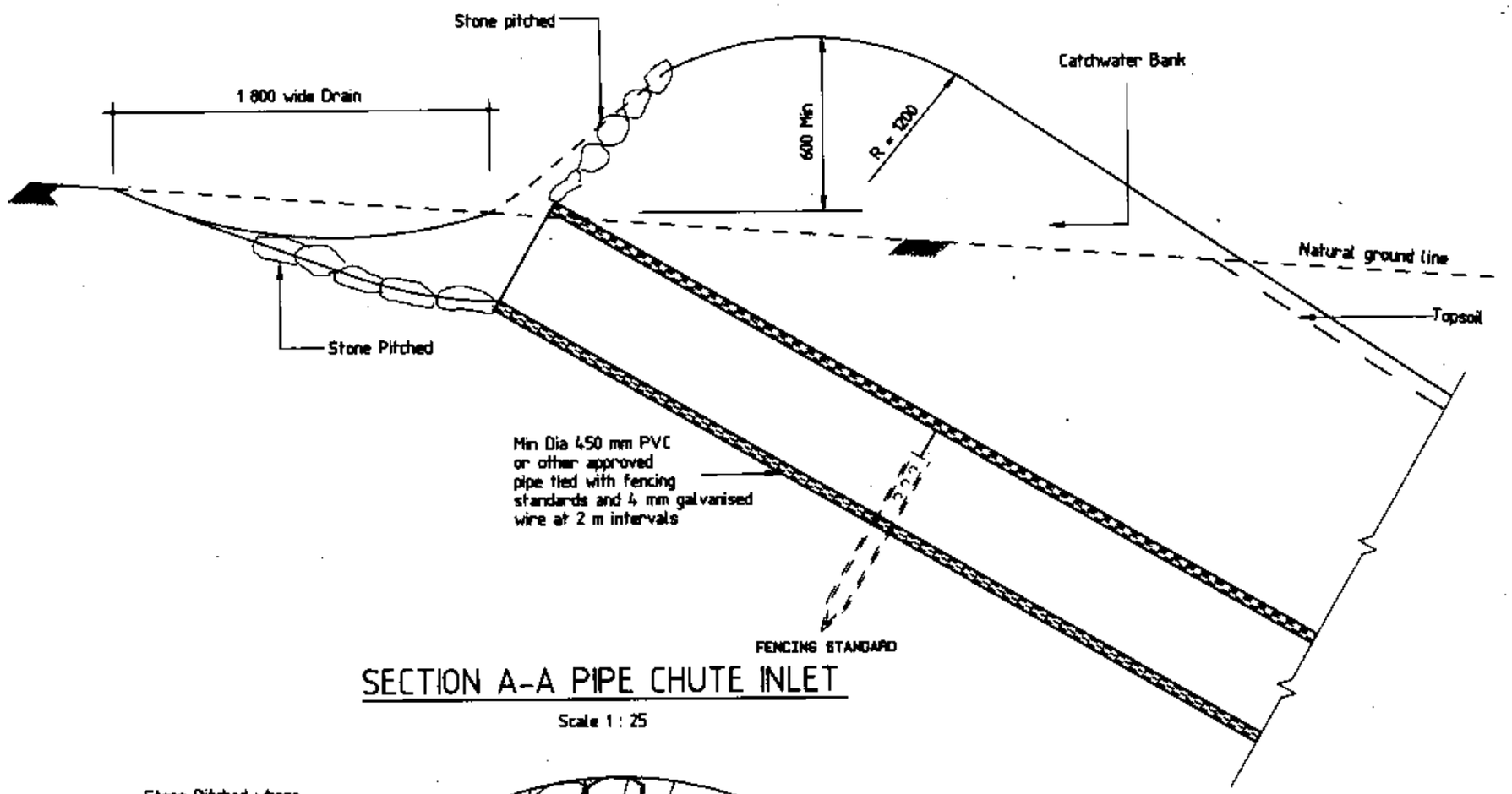
Drawing Number
SD 0604/A

M 2328



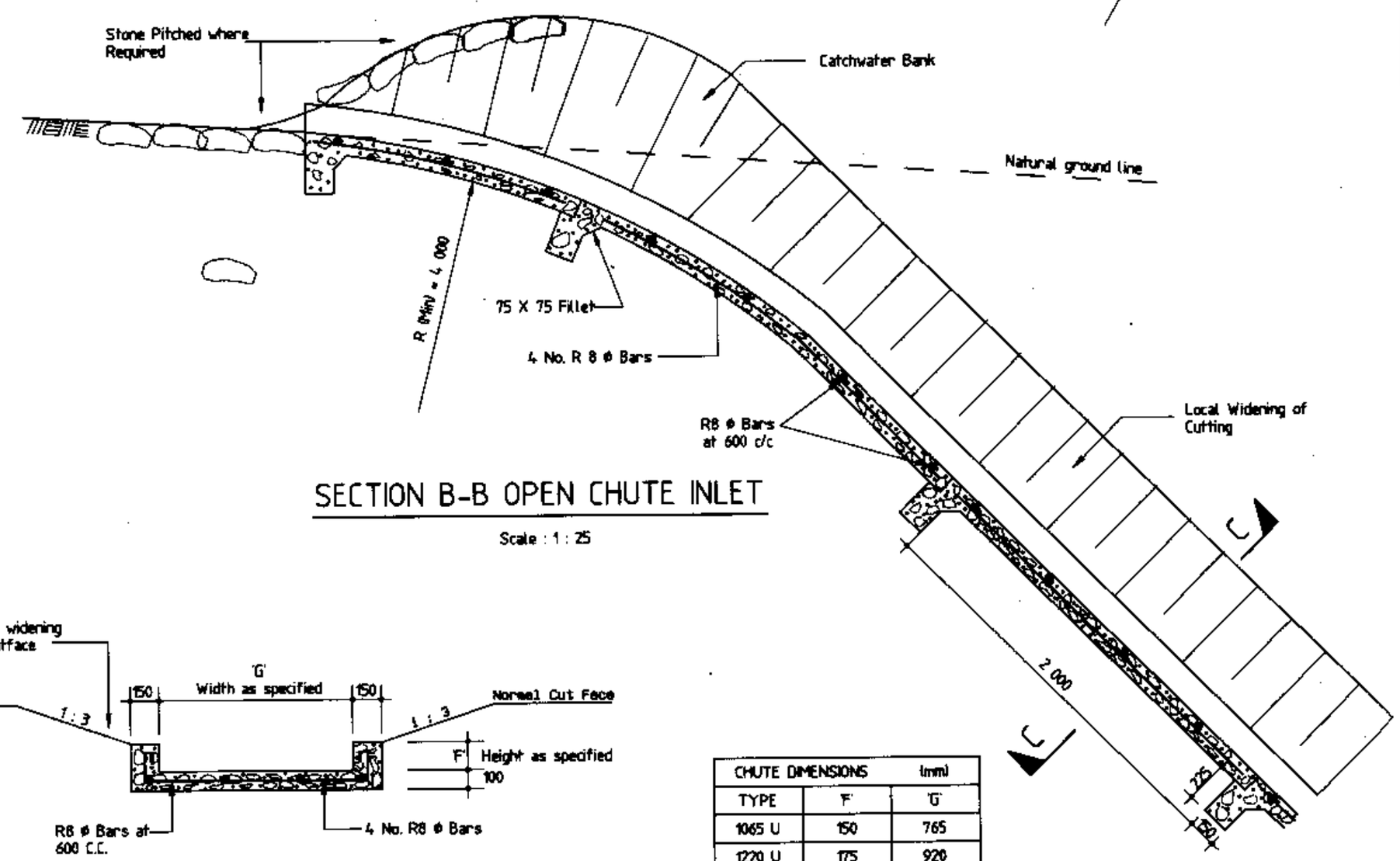
PIPE CHUTE INLET (SD 0605/1)

Scale 1 : 50



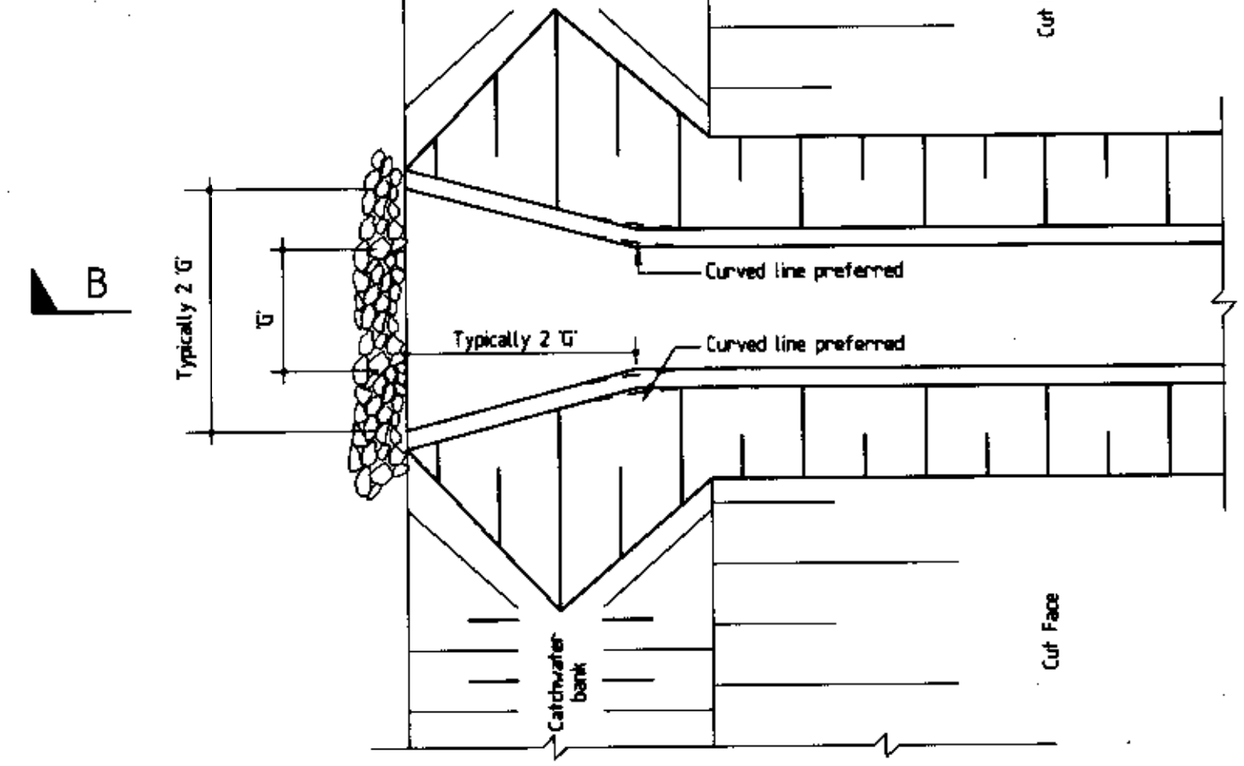
SECTION A-A PIPE CHUTE INLET

Scale 1 : 25



SECTION B-B OPEN CHUTE INLET

Scale : 1 : 25



OPEN CHUTE INLET (SD 0605/2)

Scale 1 : 50

SECTION C - C

Scale 1 : 25

CHUTE DIMENSIONS		(mm)
TYPE	'F'	'G'
1065 U	150	765
1220 U	175	920
1365 U	200	1065

NOTE :

1. Concrete strength to be 20Mpa minimum.

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary Transport

Date

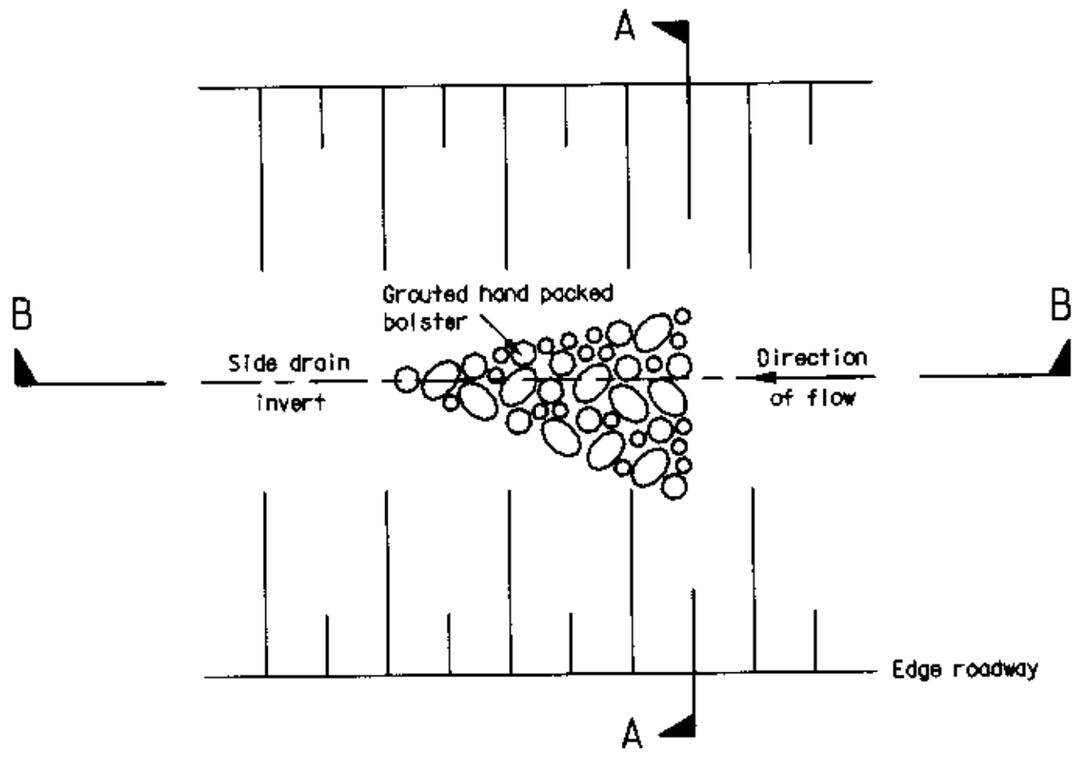
Standard Details

PIPE CHUTE, OPEN CHUTE AND CATCHWATER BANK DETAILS

Scale: As shown

Drawing Number: SD 0605/A

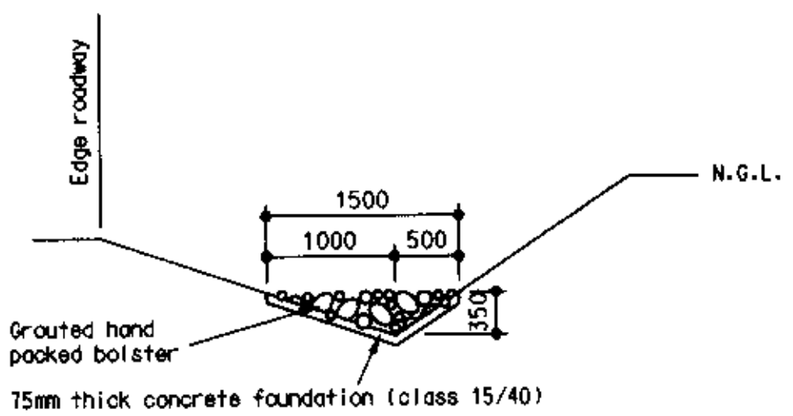
M 2329



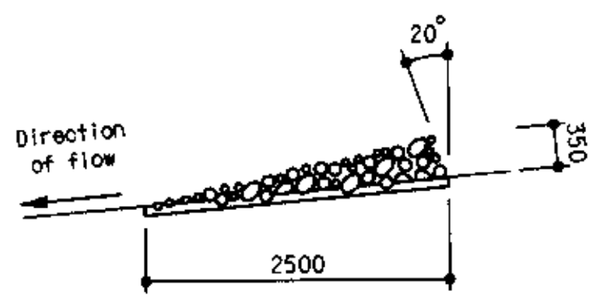
PLAN

GRADIENT (%)	SPACING (m)
0.5	120
1.0	60
1.5	40
2.0	30
2.5	24
3.0	20

DESIRABLE SPACINGS FOR VARIOUS GRADIENTS



SECTION A-A



SECTION B-B

NOTES:

1. This Standard Detail is issued as a guideline only
2. Where rock boulders are available, bolsters may be used in place of concrete weirs, or concrete lined side drains if the material in the drain is non erodable if directed by the Engineer
3. The final spacing and positions of bolsters are to be decided by the Engineer
4. Concrete lined side drains should be considered where longitudinal grades exceed 3%

Symbol	Date	Description	Dr.
Amendments			

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Transport
5/11/2002
Date

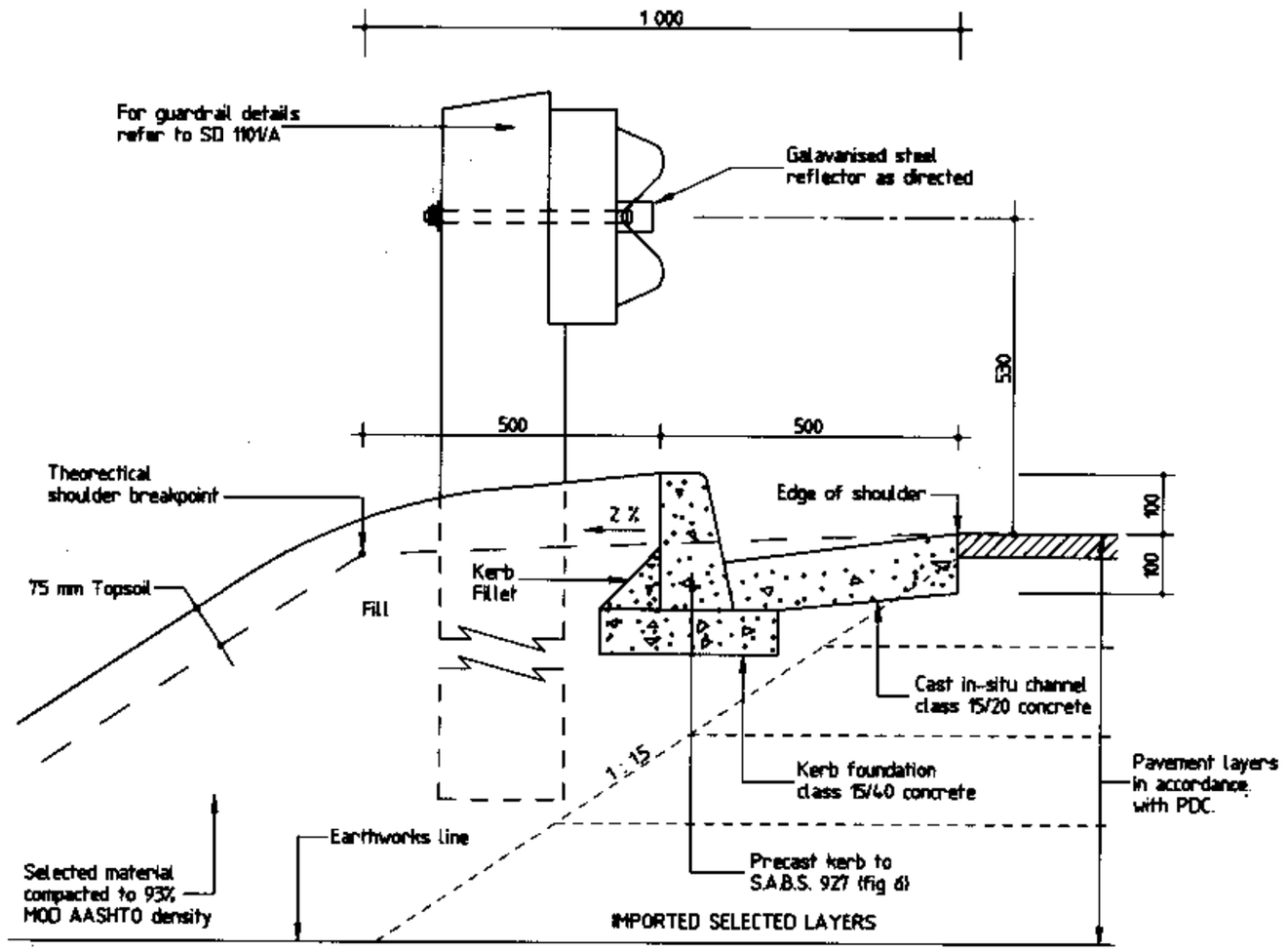
Standard Details

SIDE DRAIN BOLSTER DETAILS

Scale
N.T.S.

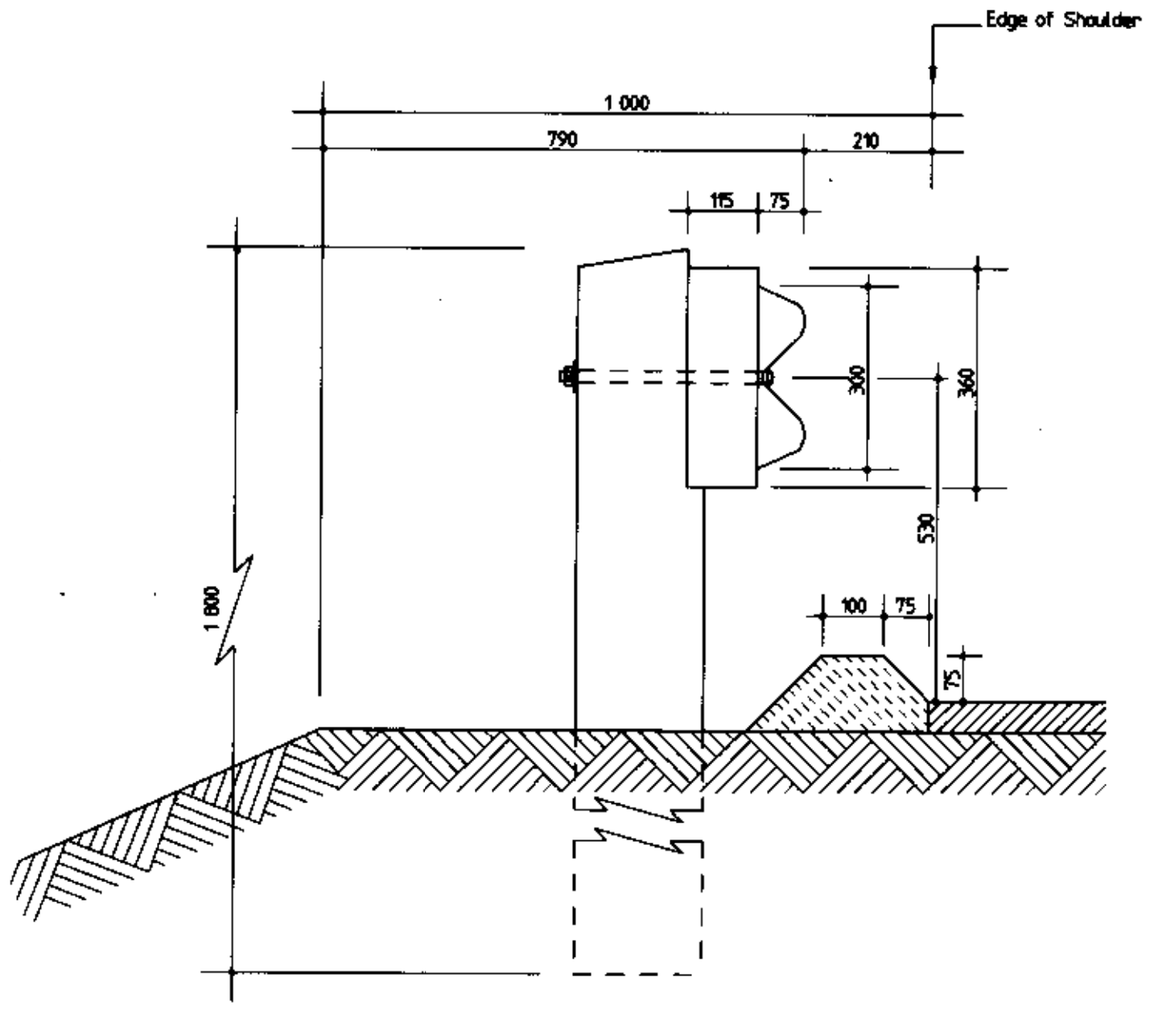
Drawing Number
SD 0606

M 23291



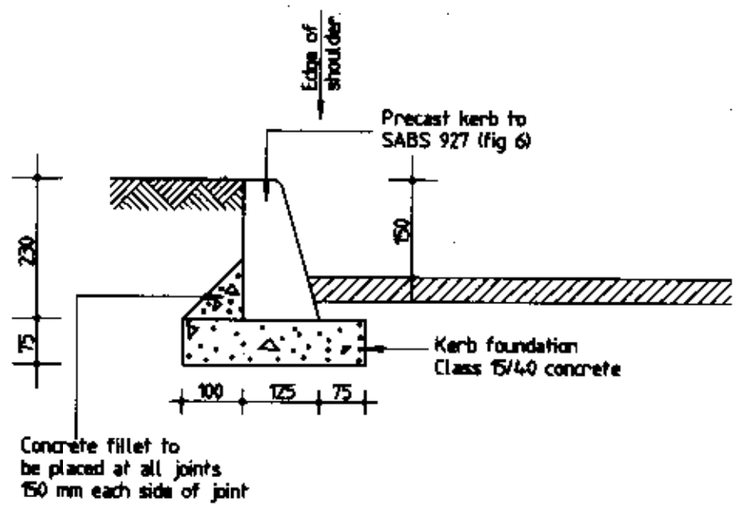
GUARDRAIL INSTALLATION WITH KERB AND CHANNEL

Scale : 1 : 10



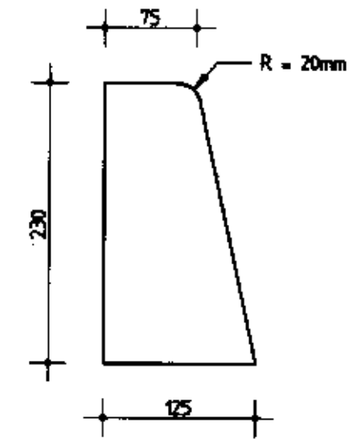
DETAIL OF ASPHALT BERM

Scale : 1 : 10



KERB ONLY

Scale : 1 : 10

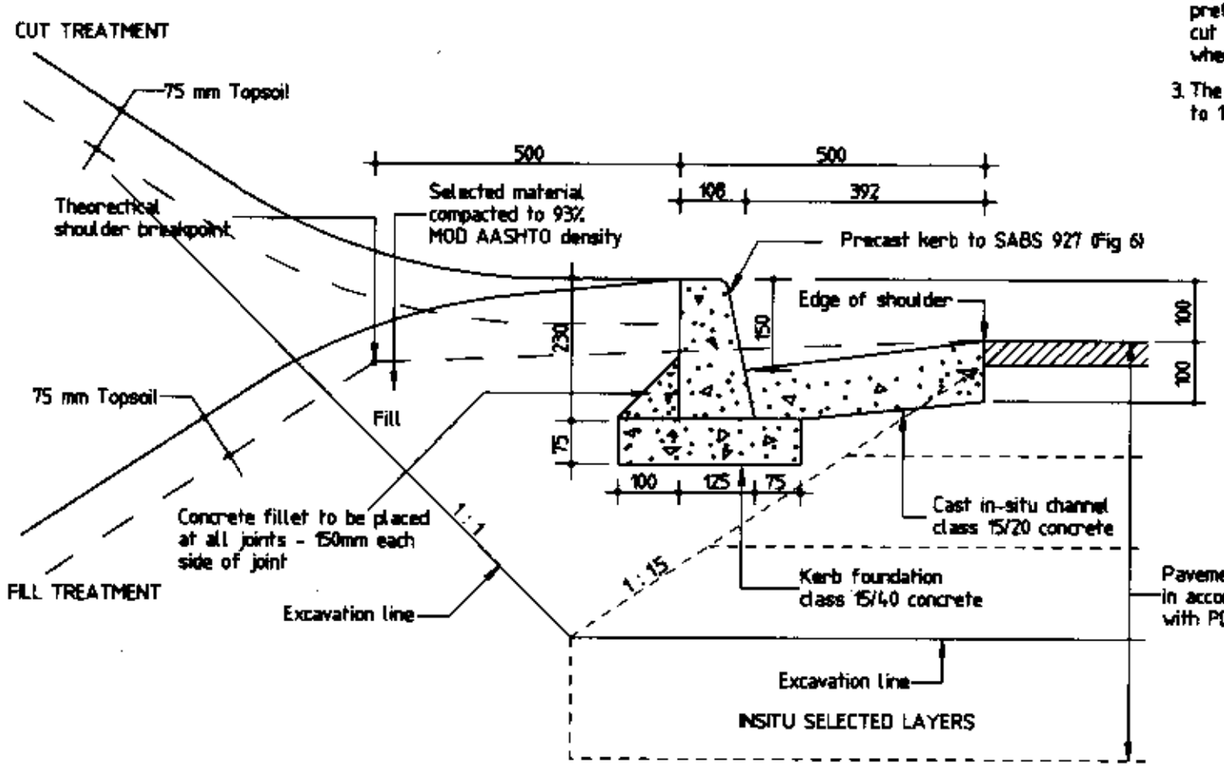


PRECAST KERB TO SABS 927 (Fig. 6)

Scale 1 : 5

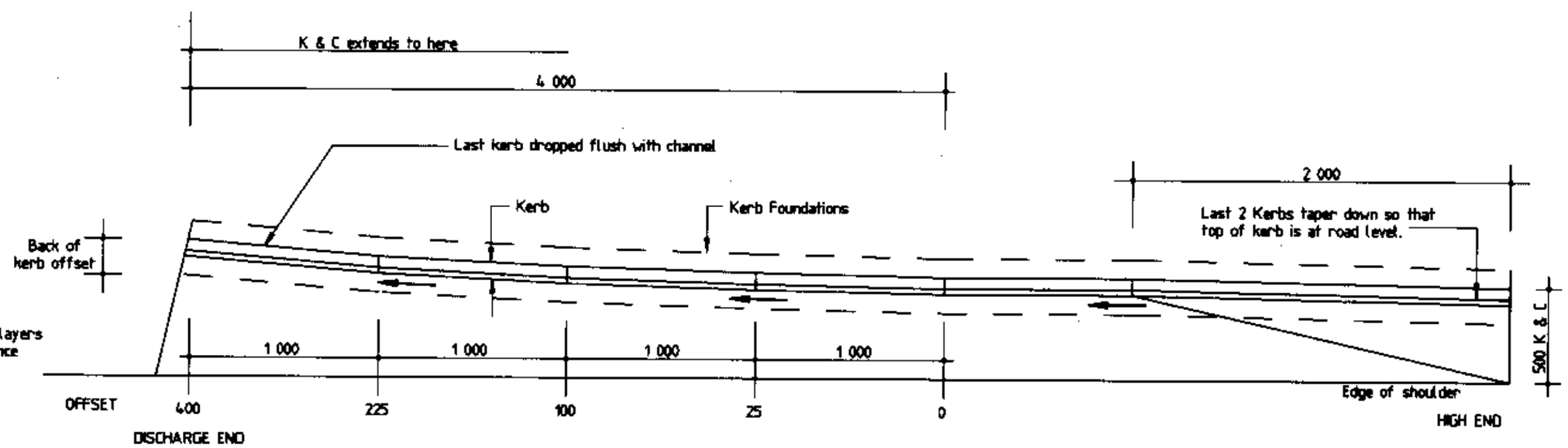
NOTES :

1. Construction joints to be provided in cast in-situ work at 2,00m intervals.
2. Expansion joints consisting of approved preformed joint filler board 13mm thick cut to required shape to be provided where indicated.
3. The 500 Kerb and Channel may be increased to 1000 Kerb and Channel where required.



KERB AND CHANNEL

Scale : 1 : 10



PLAN OF 500 KERB & CHANNEL END

Scale : 1 : 25

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary Transport

Date

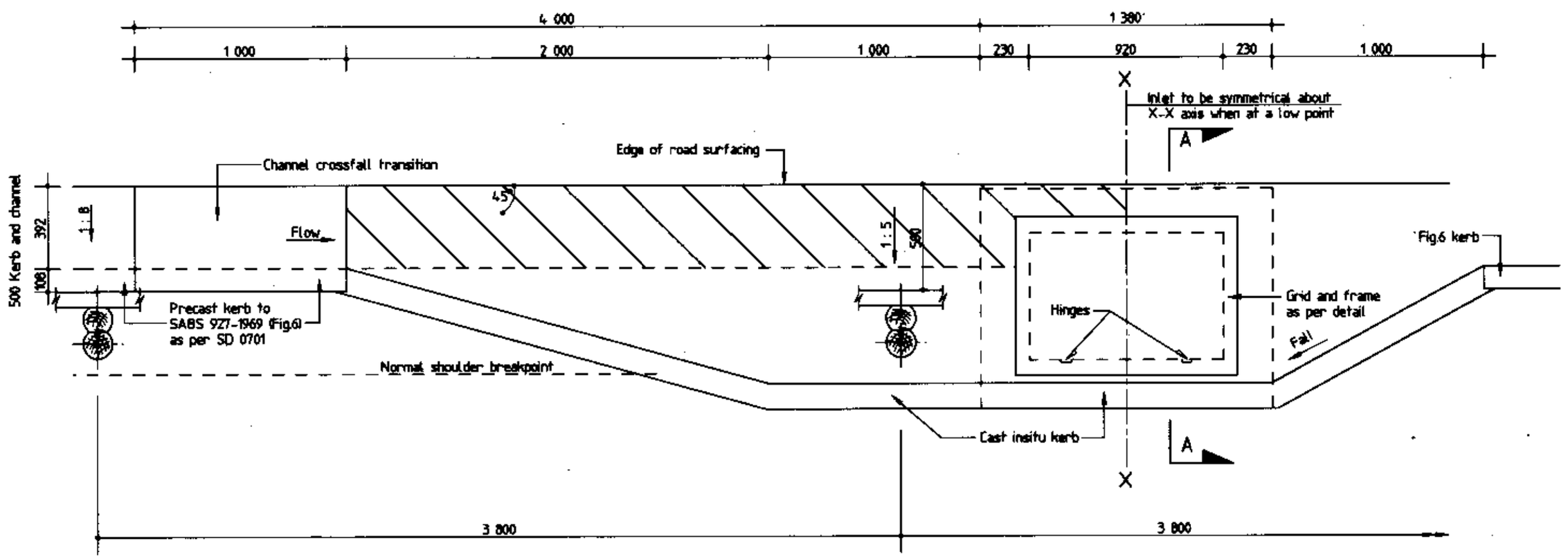
Standard Details

KERB AND CHANNEL DRAINS

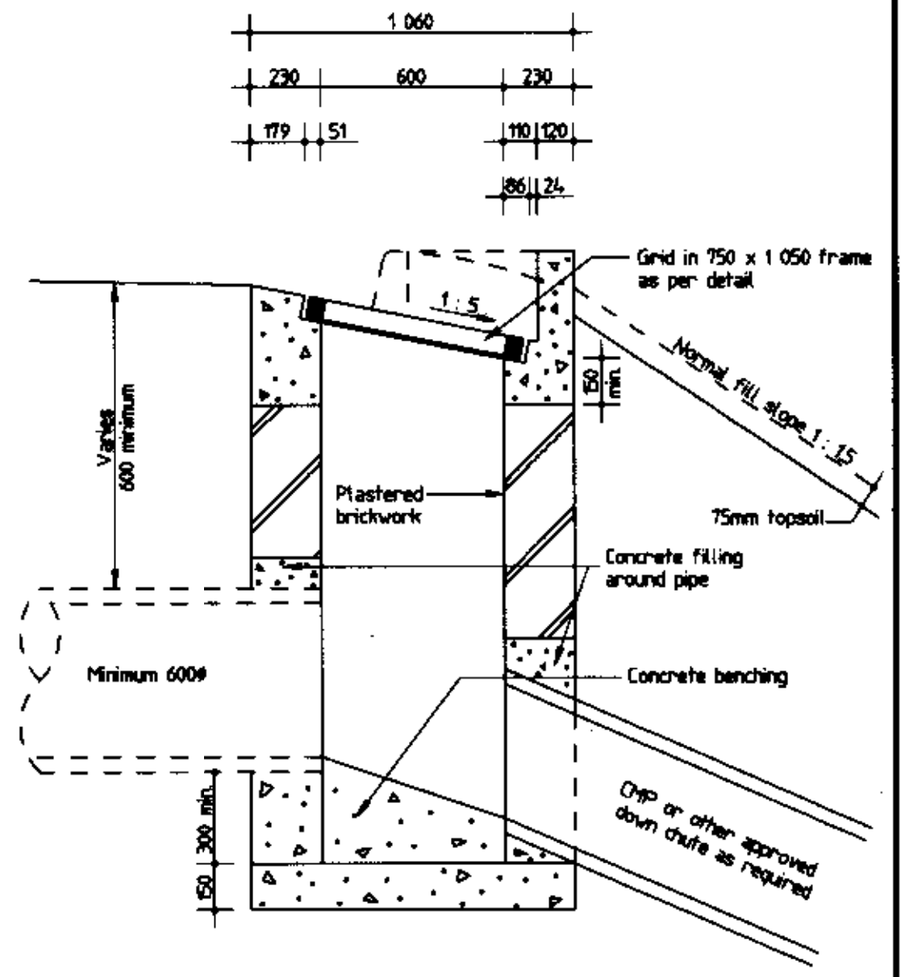
Scale: As shown

Drawing Number: SD 0701/A

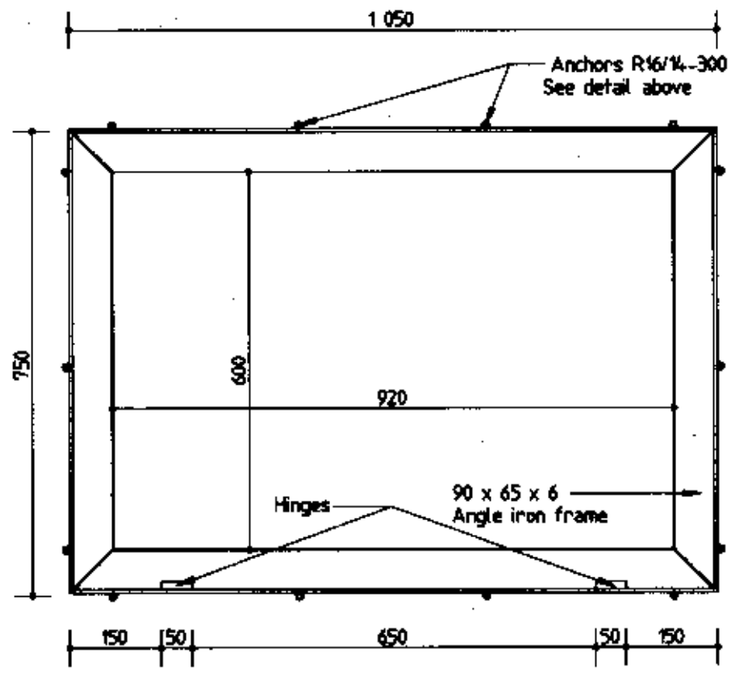
M 2330



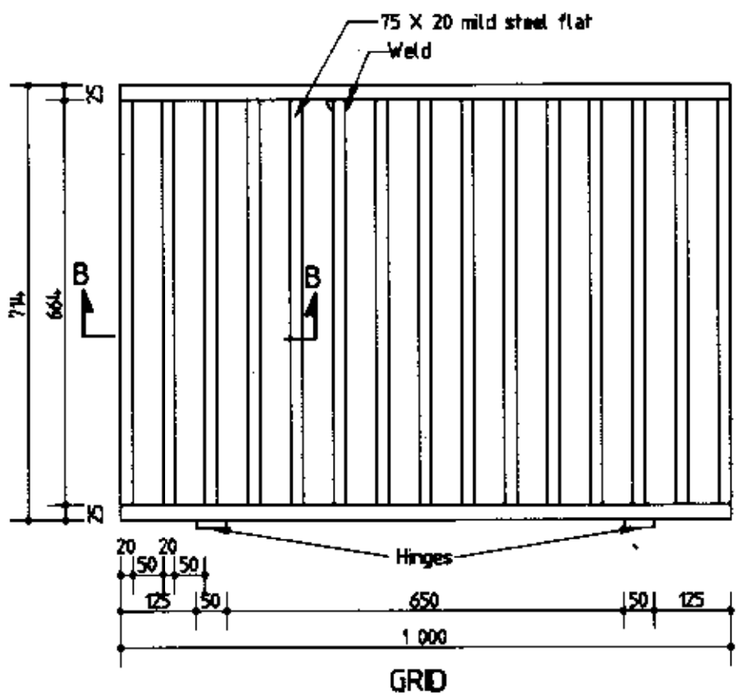
PLAN
Scale 1 : 20



SECTION A-A
Scale 1 : 20

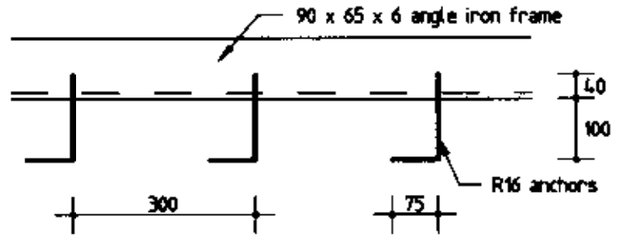


FRAME

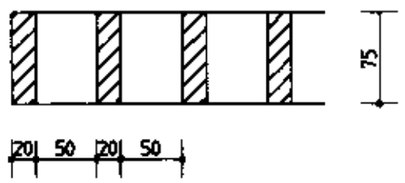


GRID

GRID AND FRAME
Scale 1 : 10

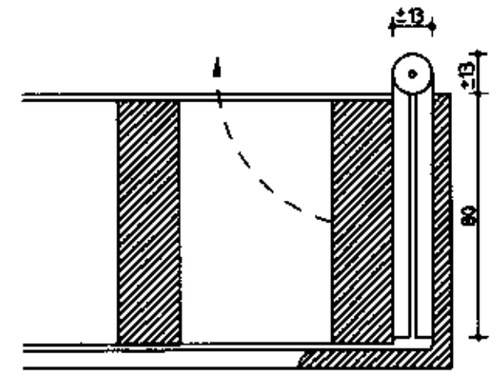


ANCHOR DETAILS
Scale 1 : 10

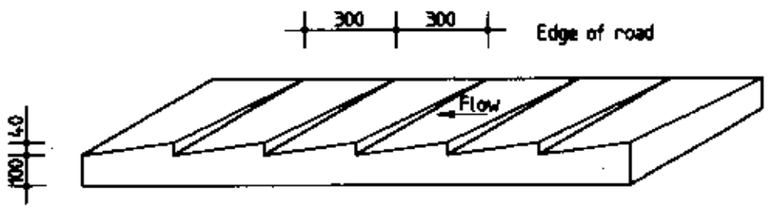


SECTION B-B
Scale 1 : 5

NOTES :
1. All welding to be done prior to any galvanising.
2. Hinges to be welded to frame and grid.
3. All mild steel to be hot dip galvanised to S.A.B.S. 763.
4. Minimum concrete strength : 20 MPa



HINGE DETAIL FOR GRID AND FRAME
Scale 1 : 2



CHANNEL SERRATIONS
Not to scale

Symbol	Date	Description	Dir.
A	July 94	General updating and revision	

Amendments

PROVINCE OF KWAZULU-NATAL
DEPARTMENT OF TRANSPORT

Secretary for Transport

Date

Standard Details

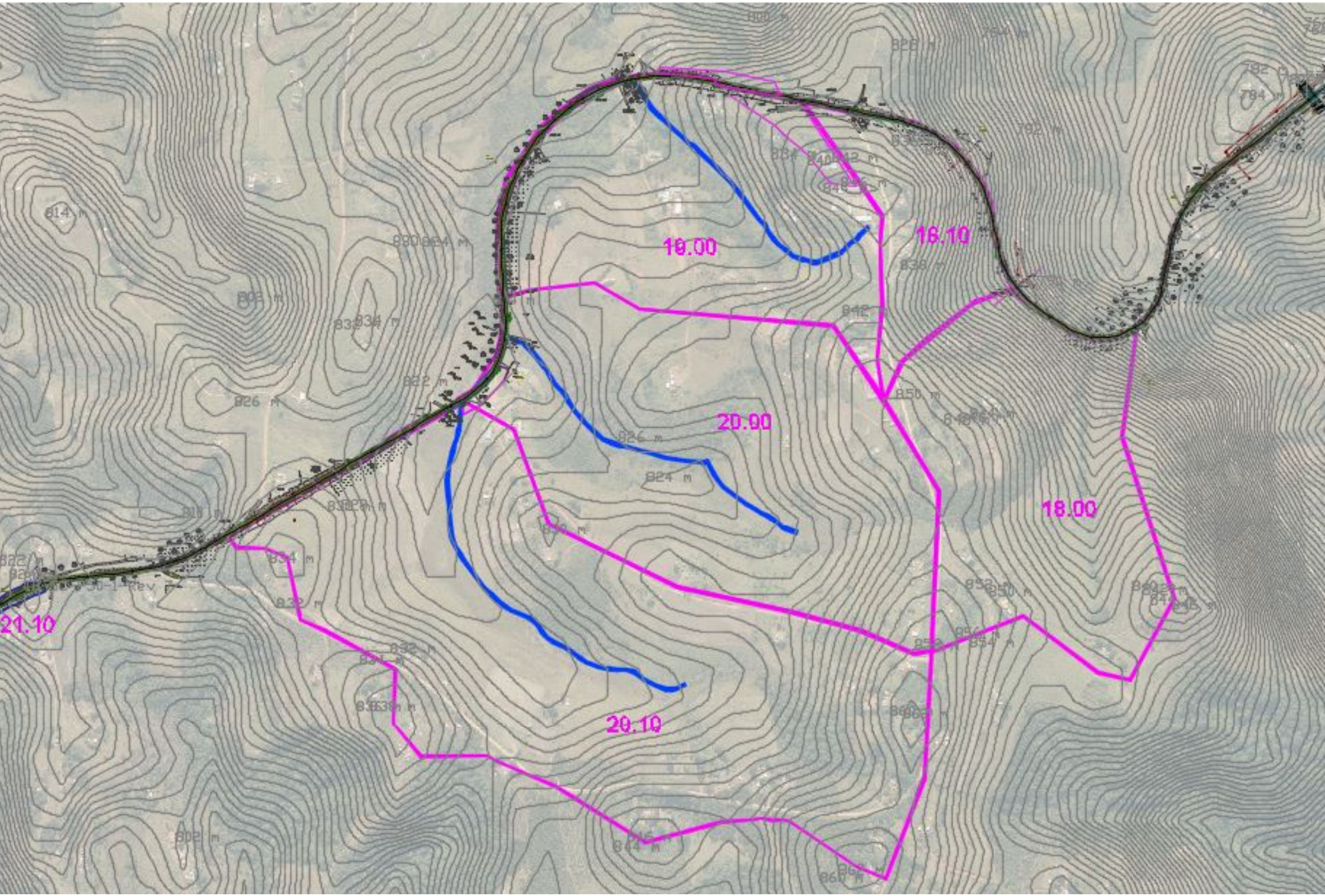
DROP INLET AND GRID INLET DETAILS

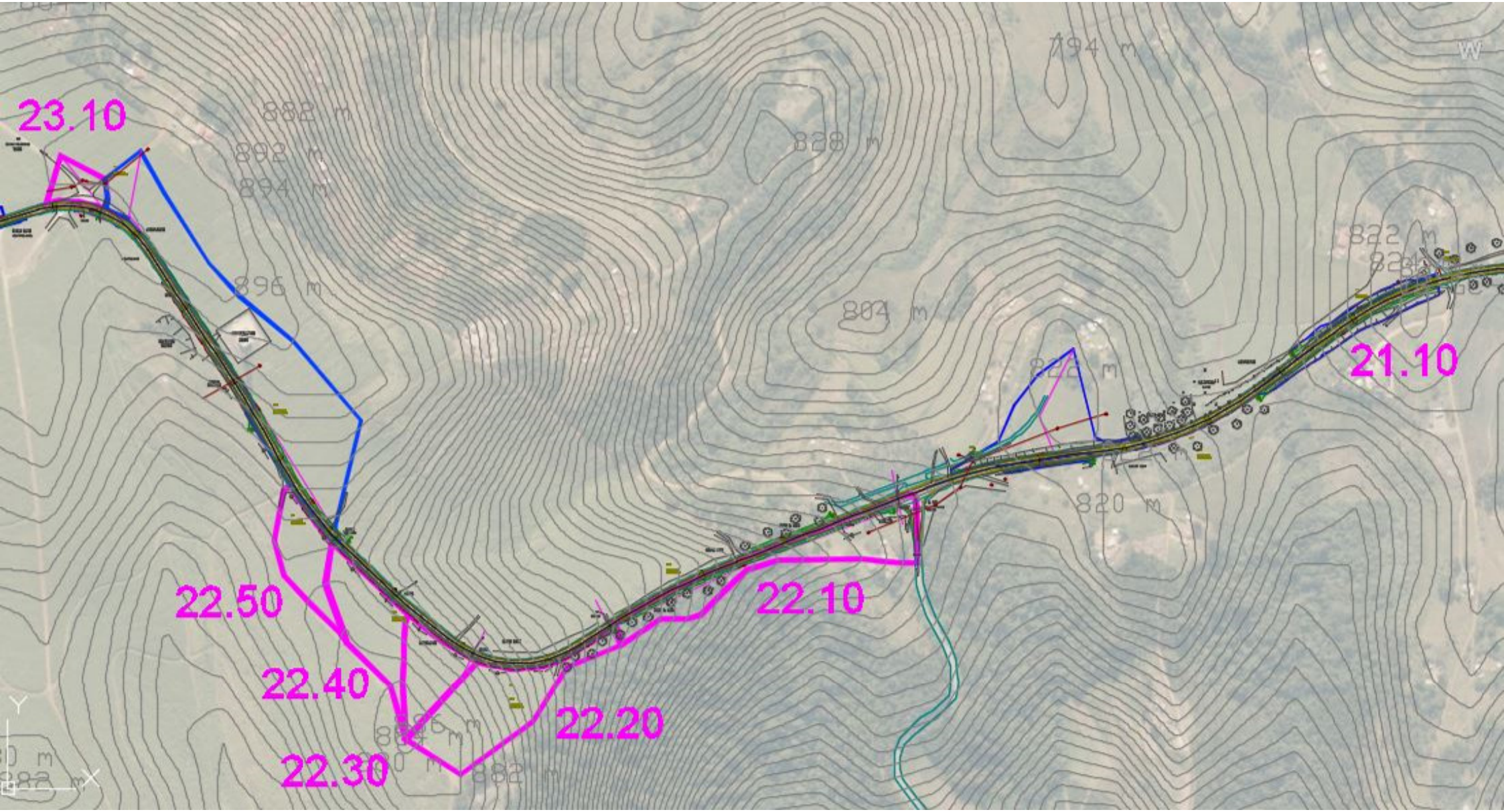
Scale: As shown

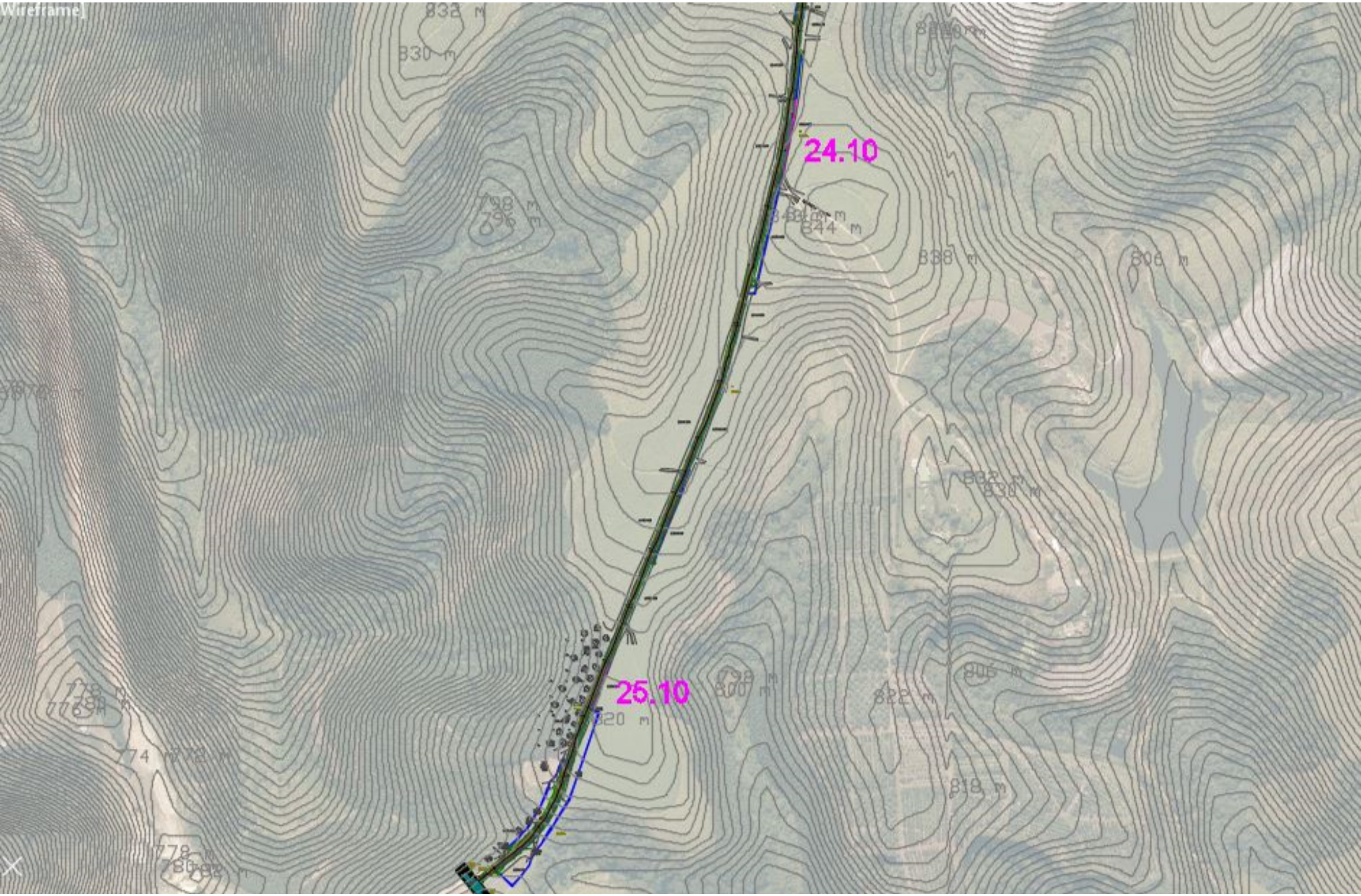
Drawing Number: SD 0702/A

M 2331

APPENDIX C: CATCHMENT MAPS


19.00
16.10
20.00
18.00
21.10
20.10


23.10
21.10
22.10
22.20
22.30
22.40
22.50
894 m
828 m
804 m
820 m
822 m
896 m
882 m


[Wireframe]
24.10
25.10
832 m
830 m
798 m
844 m
838 m
806 m
800 m
822 m
818 m

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Our connections

Innovation is a collaborative process, which is why Royal HaskoningDHV works in association with clients, project partners, universities, government agencies, NGOs and many other organisations to develop and introduce new ways of living and working to enhance society together, now and in the future.

Memberships

Royal HaskoningDHV is a member of the recognised engineering and environmental bodies in those countries where it has a permanent office base.

All Royal HaskoningDHV consultants, architects and engineers are members of their individual branch organisations in their various countries.

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