# Appendices

# APPENDIX 1
# Key Stakeholders in the Wet Tropics Region

Department of Main Roads
Environment and Technology Division
GPO Box 1412
BRISBANE QLD 4001
or
Department of Main Roads
2nd Floor
Dickens Street
SPRING HILL QLD 4000
**Telephone:** **(07) 3834 2645**
**Facsimile:** **(07) 3834 5966**

Department of Main Roads
96 Abbot Street
CAIRNS QLD 4870
**Telephone:** **(070) 505 444**
**Facsimile:** **(070) 510 168**

Department of Main Roads
PO Box 1089
TOWNSVILLE QLD 4810
**Telephone:** **(077) 207 200**
**Facsimile:** **(077) 207 211**

Queensland Transport
96 Abbot Street
CAIRNS QLD 4870
**Telephone:** **(070) 505 414**
**Facsimile:** **(070) 510 188**

Queensland Transport
146 Wills Street
TOWNSVILLE QLD 4810
**Telephone:** **(077) 810 611**
**Facsimile:** **(077) 713 350**

Department of Environment
10-12 Macleod Street
CAIRNS QLD 4870
**Telephone:** **(070) 523 092**
**Facsimile:** **(070) 314 390**

Department of Environment
PO Box 5391
TOWNSVILLE MAIL CENTRE 4810
**Telephone:** **(077) 225 211**
**Facsimile:** **(077) 225 358**

Department of Environment
Hinchinbrook District Office
PO Box 1293
INGHAM QLD 4850
**Telephone:** **(077) 761 700**
**Facsimile:** **(077) 763 770**

Department of Primary Industries
Queensland Government Offices
2nd Floor
36 Shields Street
CAIRNS QLD 4870
**Telephone:** **(070) 532 288**
**Facsimile:** **(070) 523 360**

Department of Natural Resources
PO Box 937
CAIRNS QLD 4870
**Telephone:** **(070) 523 434**
**Facsimile:** **(070) 510 851**

Department of Natural Resources
167 Walsh Street
MAREEBA QLD 4880
**Telephone:** **(070) 922 555**
**Facsimile** **(070) 923 939**

Cairns City Council
151 Abbot Street
CAIRNS QLD 4870
**Telephone:** **(070) 502 402**
**Facsimile:** **(070) 510 287**

Townsville City Council
103 Walker Street
TOWNSVILLE QLD 4810
**Telephone:** **(077) 271 235**
**Facsimile:** **(077) 256 649**

Atherton Shire Council
45 Mabel Street
ATHERTON QLD 4883
**Telephone: (070) 911 311**
**Facsimile: (070) 914 300**

Cardwell Shire Council
Civic Centre
38-48 Bryant Street
TULLY QLD 4850
**Telephone: (070) 681 033**
**Facsimile: (070) 681 772**

Douglas Shire Council
64-66 Front Street
MOSSMAN QLD 4873
**Telephone: (070) 982 599**
**Facsimile: (070) 982 902**

Eacham Shire Council
31 James Street
MALANDA QLD 4885
**Telephone: (070) 965 311**
**Facsimile: (070) 965 086**

Herberton Shire Council
6 Grace Street
HERBERTON QLD 4872
**Telephone: (070) 962 244**
**Facsimile: (070) 962 689**

Hinchinbrook Shire Council
PO Box 366
INGHAM QLD 4850
**Telephone: (077) 762 211**
**Facsimile: (077) 764 824**

Dalrymple Shire Council
14 Mossman Street
CHARTERS TOWERS QLD
**Telephone: (077) 875 600**
**Facsimile: (077) 873 903**

Johnstone Shire Council
70 Rankin Street
INNISFAIL QLD 4860
**Telephone: (070) 702 222**
**Facsimile: (070) 614 258**

Mareeba Shire Council
P O Box 154
MAREEBA QLD 4880
**Telephone: (070) 303 900**
**Facsimile: (070) 923 323**

Thuringowa City Council
86 Thuringowa Drive
TOWNSVILLE QLD 4810
**Telephone: (077) 738 411**
**Facsimile: (077) 738 499**

Wet Tropics Management Authority
PO Box 2050
CAIRNS QLD 4870
**Telephone: (070) 520 555**
**Facsimile: (070) 311 364**

CRC-Tropical Rainforest
Ecology and Management
PO Box 6811
CAIRNS QLD 4870
**Telephone: (070) 421 246**
**Facsimile: (070) 421 247**

Alliance for Sustainable Tourism
PO Box 2291
CAIRNS QLD 4870
**Telephone: (070) 550 709**
**Facsimile: (070) 550 742**

Community Committee
for Cassowary Conservation
PO Box 180
MISSION BEACH QLD 4854
**Telephone: (070) 587 248**
**Facsimile: (070) 687 298**

North Queensland Conservation Council
PO Box 364
TOWNSVILLE QLD 4810
**Telephone: (077) 716 226**
**Facsimile: (077) 716 216**

Cairns and Far North
Environment Centre
PO Box 323
NORTH CAIRNS QLD 4870
**Telephone: (070) 321 746**
**Facsimile: (070) 533 779**

# APPENDIX 2
# Road Engineering Manuals and Guidelines

| | |
|---|---|
| AustRoads Guide to Traffic Engineering Practice | Part 1 Traffic Flow |
| AustRoads Guide to Traffic Engineering Practice | Part 2 Roadway Capacity |
| AustRoads Guide to Traffic Engineering Practice | Part 3 Traffic Studies |
| AustRoads Guide to Traffic Engineering Practice | Part 4 Road Crashes |
| AustRoads Guide to Traffic Engineering Practice | Part 5 Intersections at Grade |
| AustRoads Guide to Traffic Engineering Practice | Part 6 Roundabouts |
| AustRoads Guide to Traffic Engineering Practice | Part 8 Traffic Control Devices |
| AustRoads Guide to Traffic Engineering Practice | Part 9 Arterial Road Traffic Management |
| AustRoads Guide to Traffic Engineering Practice | Part 10 Local Area Traffic Management |
| AustRoads Guide to Traffic Engineering Practice | Part 11 Parking |
| AustRoads Guide to Traffic Engineering Practice | Part 12 Roadway Lighting |
| AustRoads Guide to Traffic Engineering Practice | Part 13 Pedestrians |
| AustRoads Guide to Traffic Engineering Practice | Part 14 Bicycles |
| Queensland Transport | Cost Benefit Analysis Manual 1993 |
| Queensland Transport | Road Design References 1991 |
| AustRoads - Rural Road design | Guide to the Geometric Design of Rural Roads (1989) |
| Queensland Transport | Urban Road Design Manual, Vol. 1 (1975) |
| NAASRA | Guide Policy Geometric Design Major Urban Roads (1976) |
| NAASRA | Guide Policy Geometric Design Freeways & Expressways (1976) |
| NAASRA | Guide Design of Driveway Entrances on Major Roads in Urban Areas (1978) |
| NAASRA | Guide to the Design of Road Surface Drainage (1986) |
| ARRB | Subsurface drainage of Road Structures, SR35 (1987) |

| | |
|---|---|
| The Institution of Engineers, Aust. | Australian Rainfall and Runoff Vol. 1 (1987) |
| NAASRA | Guide to the Control of Moisture in Roads (1983) |
| NAASRA | Bridge Waterways Hydrology and Design (1989) |
| The Institution of Engineers Australian Queensland | Soil Erosion and Sediment Control (1996) |
| NAASRA | Safety Barriers (1987) |
| Queensland Transport | Pavement Design Manuals 1990 |
| Queensland Transport | Manual of Uniform Traffic Control Devices |
| AS1742.2 (1986) | Traffic Control Devices for General Use |
| AS1742.7 (1987) | Railway Crossings |
| NAASRA | Guide Provision and Signposting of Service and Tourist Facilities |
| NAASRA | Joint Code of Practice Telecom Australia Plant in Road Reserve (1980) |
| Main Roads | Road Maintenance Performance Contracts Volume 1 to 4 |

■

**Appendix 2**

# APPENDIX 3
# Relevant Legislation and Government Policies

**FEDERAL**

- World Heritage Properties Conservation Act 1983;
- Endangered Species Protection Act 1992;
- Australian Heritage Commission Act 1975;
- Environmental Protection (Impact of Proposals) Act 1974;
- Wet Tropics of Queensland World Heritage Area Conservation Act 1994;
- National Greenhouse Response Strategy;
- National Strategy for Ecologically Sustainable Development;
- National Strategy for Biological Diversity; and
- Intergovernmental Agreement on the Environment.

**STATE**

- Wet Tropics Plan Act (1997);
- Wet Tropics World Heritage Protection and Management Act 1993;
- Environmental Protection Act 1994, and subordinate legislation for Air, Water, Noise and Waste;
- Contaminated Land Act 1991;
- State Development and Public Works Organisation Act 1971;
- Nature Conservation Act 1992;
- Cultural Record (Landscapes Queensland and Queensland Estate) Act 1987;
- National Parks and Wildlife Act 1975;
- Forestry Act 1959;
- Agricultural and Chemicals (Queensland) Act 1988;
- Agricultural Chemicals Distribution Control Act 1966;
- Marine Parks Act 1992;
- Fisheries Act 1994;

- Water Resources Act 1989;
- Local Government (Planning and Environment) Act 1990;
- Queensland Heritage Act 1992;
- Transport Planning and Coordination Act 1994;
- Transport Infrastructure Act 1991;
- Transport Infrastructure (Roads) Act 1991;
- Transport Operations (Passenger Transport) Act 1994;
- Transport Operations (Marine Pollution) Act 1995;
- Carriage of Dangerous Goods by Road Act 1984;
- Transport Portfolio Environmental Framework;
- Transport Coordination Plan;
- Queensland Greenhouse Response Strategy;
- ANZECC Ozone Strategy;
- Queensland Transport Policy Directions Statement; and
- Queensland Transport Environmental Policy.

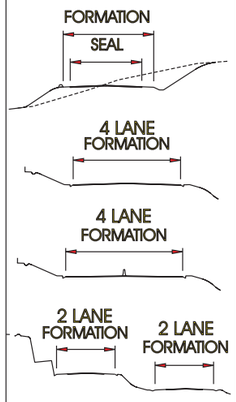
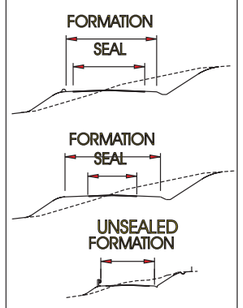
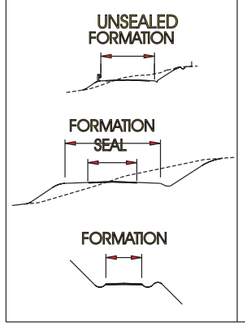
# APPENDIX 4
# Undesirable Plants Of The Wet Tropics

*NOTE: These plants are recognised as existing or potential weeds which can invade native vegetation.*

| SPECIES | FAMILY | COMMON NAME |
|---|---|---|
| all non-native species | ACANTHACEAE | |
| *Allamanda cathartica* | APOCYNACEAE | allamanda |
| *Annona glabra* | ANNONACEAE | pond apple |
| *Bambusa spp* | POACEAE | bamboo |
| *Brachiaria mutica* | POACEAE | para grass (ponded pasture) |
| *Cabomba caroliniana* | CABOMBACEAE | cabomba (aquatic weed) |
| *Calopogonium mucunoides* | FABACEAE | calopo (pasture legume) |
| *Centrosema pubescens* | FABACEAE | centro (pasture legume) |
| *Chuckrasia velutina* | MELIACEAE | East Indian mahogany |
| *Cinnamomum camphora* | LAURACEAE | camphor laurel |
| *Clitoria laurifolia* | FABACEAE | clitoria |
| *Coffea arabica* | RUBIACEAE | coffee |
| *Duranta repens* | VERBENACEAE | golden dewdrops or sky flower |
| *Eichhornia crassipes* | PONTEDERIACEAE | water hyacinth |
| *Glycine spp* | FABACEAE | glycine |
| *Harungana madagascariensis* | CLUSIACEAE | harungana |
| *Hemigraphis colorata* | ACANTHACEA | |
| *Eipomoea spp* | CONVOLVULACEAE | morning glory |
| *Lantana camara* | VERBENACEAE | lantana |
| *Ligustrum spp* | OLEACEAE | privet |
| *Melinis munutiflora* | POACEAE | molasses grass |
| *Miconia calvescens* | MELASTROMATACEAE | miconia |
| *Momordica charantia* | CUCURBITACEAE | balsam pear |
| *Montanoa hibiscifolia* | ASTERACEAE | anzac flower |
| *Panicum maximum* | POACEAE | guinea grass |
| *Passiflora spp (exotics)* | PASSIFLORACEAE | passion fruits or flowers |
| *Pennisetum purpureum* | POACEAE | elephant grass |
| *Perilepta dyeriana* | ACANTHACEAE | |
| *Pinus caribaea* | PINACEAE | caribbean pine |
| *Psidium guajava* | MYRTACEAE | guava |
| *Pueraria phaseoloides* | FABACEAE | puero (pasture legume) |
| *Salvinia molesta* | AZOLLACEAE | salvinia or water fern |
| *Saman samonea* | MIMOSACEAE | raintree |
| *Sanchezia parvibracteata* | ACANTHACEAE | sanchezia |
| *Sansevieria spp* | AGAVACEAE | mother-in-law's tongue |
| *Selaginella willdenovii* | SELAGINELLACEAE | peacock fern |
| *Spathodea campanulata* | BIGNONIACEAE | African tulip tree |
| *Stephanophysum longifolium* | ACANTHACEAE | |
| *Thaumastochloa danielii* | MARANTACEAE | prayer plant |
| *Thunbergia alata* | ACANTHACEAE | black-eyed susan |
| *Thunbergia grandiflora* | ACANTHACEAE | blue thunbergia |
| *Thunbergia laurifolia* | ACANTHACEAE | laurel clock vine |
| *Tithonia diversifolia* | ASTERACEAE | Japanese sunflower |
| *Tradescantia spp* | COMMERLINACEAE | wandering jew |
| *Turbina corymbosa* | COMMELINACEAE | turbina |
| *Wedelia tricornuta* | ASTERACEAE | Singapore daisy |
| *Zebrina spp* | COMMELINACEAE | wandering jew |

# APPENDIX 5
# Concept plans

*NOTE: These concept plans have been prepared as examples of the various measures identified throughout the manual. The concept plans have not been designed for specific applications, and their applicability to an individual circumstance must be determined as part of the planning and design processes for the particular project.*

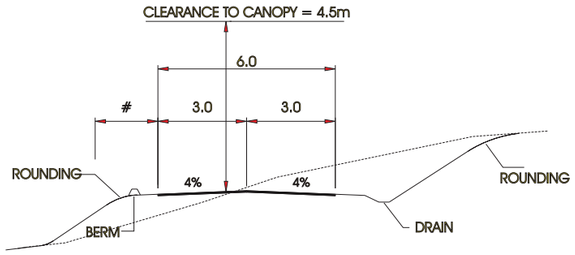
| CROSS SECTIONS | TYPE | ROAD FUNCTION | TERRAIN | DESIGN SPEED | HORIZ. RADIUS | CLEAR ZONE FROM TRAFFIC LANE | DESIRABLE MAXIMUM GRADE | DESIGN VEHICLE | HEIGHT CLEARANCE | ROAD TYPE | MINIMUM WIDTH OF CLEARING | CARRIAGEWAY WIDTH | ADVANTAGES ☒ | DISADVANTAGES ☒ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | TYPE C<br>TYPE D<br>TYPE E<br>TYPE F | MAJOR HIGHWAY & IMPORTANT REGIONAL ROAD | FLAT<br>HILLY<br>MOUNTAINOUS | 100 - 120<br>90 - 100<br>70 - 80 | > 300<br>75 - 300<br>50 - 75 | 9.0m<br>9.0m<br>6.0m | 3% - 5%<br>4% - 6%<br>6% - 8% | B-DOUBLE<br>OR<br>19m SEMI | 5.4m | 2 LANE UNDIVIDED<br>4 LANE UNDIVIDED<br>4 LANE DIVIDED NARROW MEDIAN<br>4 LANE DIVIDED WIDE MEDIAN | 12m - 15m<br>22m<br>24m<br>32m | 8.5m - 11.0m<br>18.0m<br>20.0m<br>2 x 10.0m | PROVIDE FOR SOME CANOPY CONNECTIVITY IF MINIMUM WIDTHS ADOPTED.<br>PROVIDE OVERTAKING OPPORTUNITIES.<br>PROVIDE INCREASED SAFETY CAPACITY.<br>BREAKS TOTAL WIDTH INTO TWO PARTS, MAINTAINS CANOPY CONNECTIVITY. | HIGHER VOLUME ROADS MAY REQUIRE PASSING LANES.<br>DOES NOT PREVENT HEAD ON COLLISIOINS.<br>MAY CREATE BARRIER TO FAUNA MOVEMENTS.<br>MAY BE MORE EXPENSIVE THAN UNDIVIDED ROAD. |
|  | TYPE C<br>TYPE B<br>TYPE A | TOURIST ROADS | FLAT<br>HILLY<br>MOUNTAINOUS | 80 - 100<br>70 - 90<br>25 - 60 | 75 - 300<br>70 - 300<br>25 - 70 | 9.0m<br>6.0m<br>3.0m | 3% - 6%<br>4% - 8%<br>9% - 10%<br>10%* | 40 SEATER BUS | 4.7m | 2 LANE<br>SINGLE LANE<br>UNSEALED | 9m - 11m<br>7m<br>5m - 7m | 7.0m - 9.0m<br>5.0m<br>3.0m - 5.0m | USUALLY LESS WIDTH OF DISTURBANCE THAN TWO SINGLE CARRIAGEWAYS.<br>REQUIRES MINIMUM WIDTH.<br>SUITABLE FOR LOW VOLUME ROADS. | HIGHER VOLUME ROADS MAY MAKE IT DIFFICULT FOR FAUNA TO CROSS.<br>PROVIDE AREAS FOR PASSING.<br>EROSION AND MAINTENANCE CONCERNS ON STEEP GRADES. |
|  | TYPE A<br>TYPE B<br>TYPE C | LOCAL ACCESS | FLAT<br>HILLY<br>MOUNTAINOUS | 80<br>60 - 80<br>25 - 60 | 75 - 300<br>60 - 70<br>25 - 70 | 6.0m<br>3.0m<br>3.0m | 3% - 6%<br>6% - 10%<br>9% - 15%<br>10%* | LOCAL GARBAGE TRUCK | 4.3m | 2 LANE SEALED<br>SINGLE LANE<br>UNSEALED | 9m - 11m<br>7m<br>5m - 7m | 7.0m - 9.0m<br>5.0m<br>3.0m - 5.0m | USUALLY LESS WIDTH OF DISTURBANCE THAN TWO SINGLE CARRIAGEWAYS.<br>PROVIDE MINIMUM WIDTHS.<br>SUITABLE FOR LOW VOLUME ROADS USED IN DRY SEASON. | HIGHER VOLUME ROADS MAY MAKE IT DIFFICULT FOR FAUNA TO CROSS.<br>WRONG WAY MOVEMENTS MAY BE A PROBLEM.<br>NOT SUITABLE WITH STEEP GRADES DUE TO EROSION AND MAINTENANCE REQUIREMENTS. |

* CONSIDER SEALING AT GRADES OVER 10%.

☒ REFER TABLE 7 FOR FULL DETAILS.

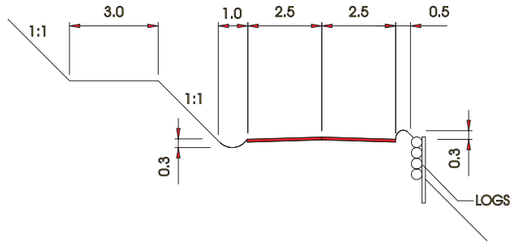
**CROSS SECTIONS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

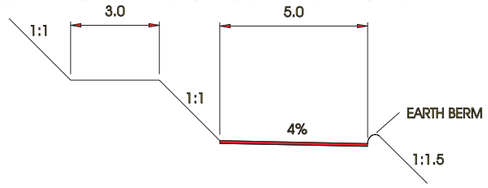



## A1. UNSEALED ROAD

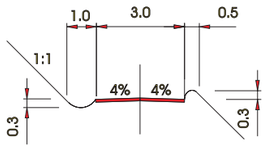
NOTE: SINGLE CROSSFALL OF 4% ON CURVES



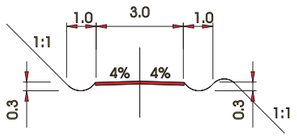

## *A2. TWO LANE UNSEALED ROAD



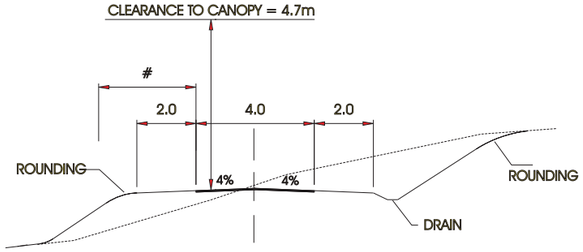

## * A3. TWO LANE UNSEALED ROAD



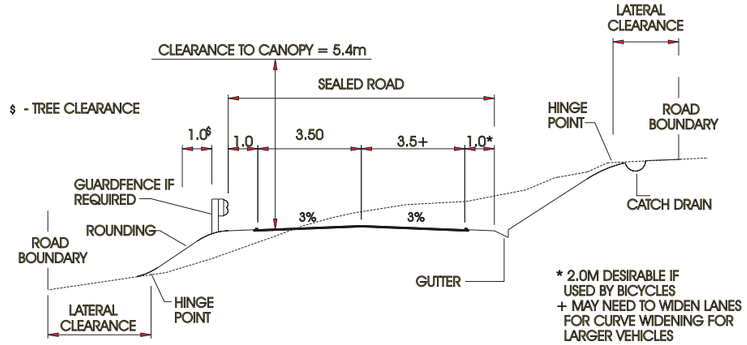

## *A4. SINGLE LANE UNSEALED ROAD



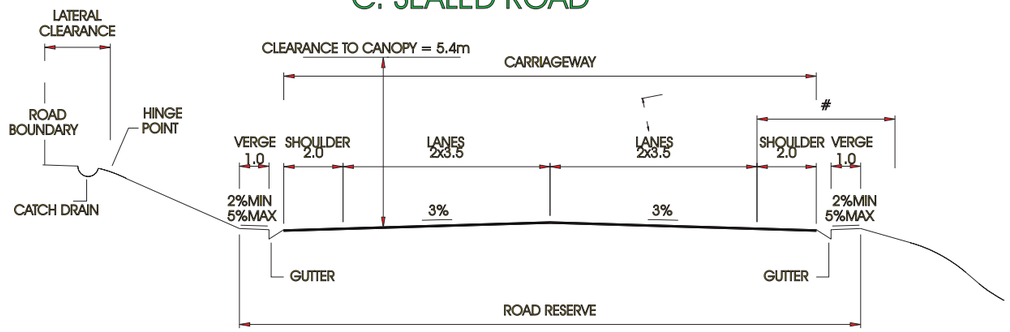

## * A5. SINGLE LANE UNSEALED ROAD



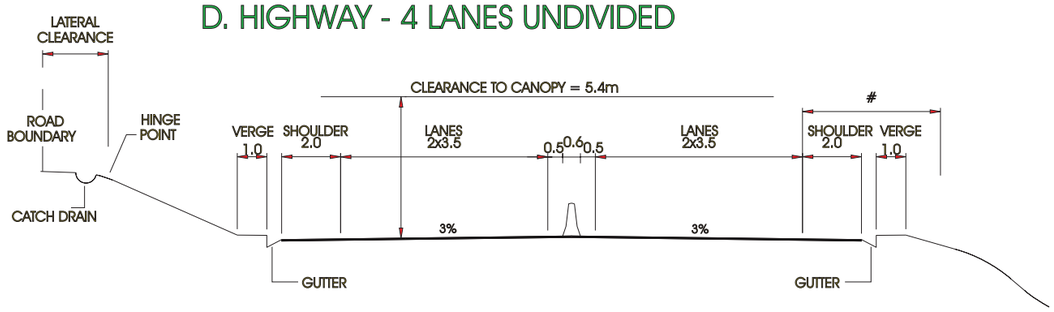

## B. SINGLE LANE SEALED



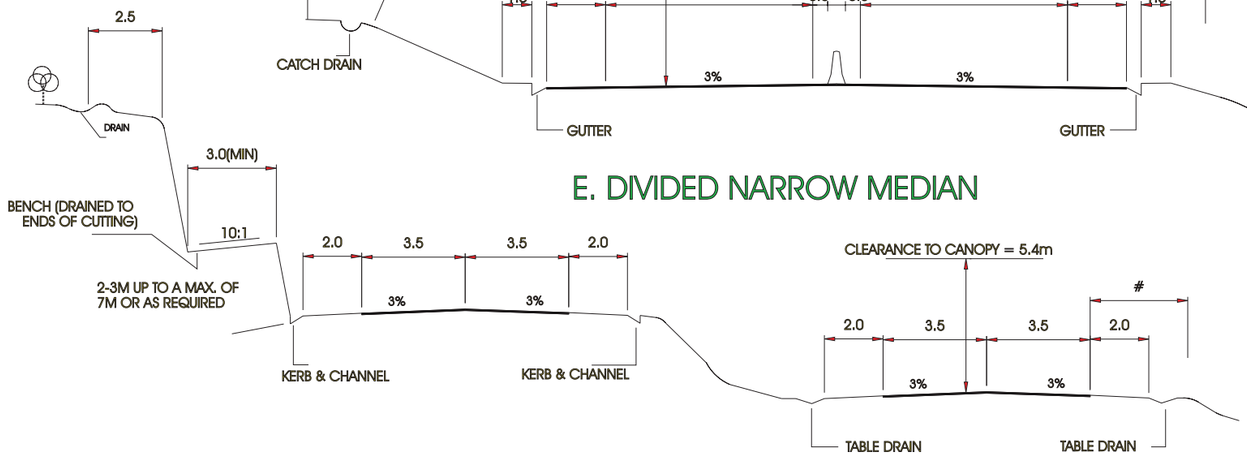

## C. SEALED ROAD




## D. HIGHWAY - 4 LANES UNDIVIDED




## E. DIVIDED NARROW MEDIAN




## F. INDEPENDENT SPLIT CARRIAGEWAY

# IN FILLS DESIRABLE CLEARANCE TO TREES GREATER THAN 75mm TRUNK DIAMETER :

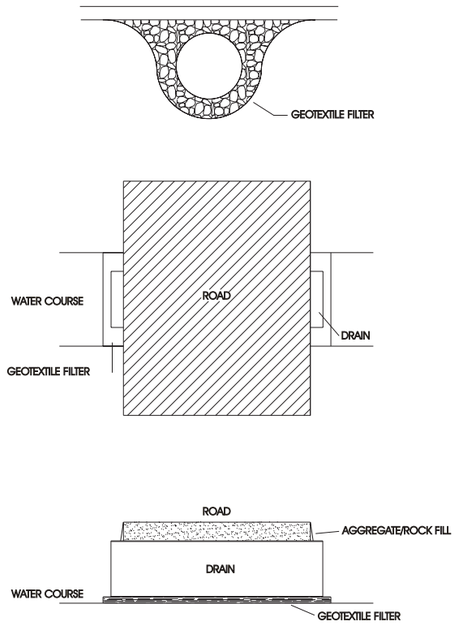
| DESIGN SPEED | CLEARANCE |
|---|---|
| 60 km/h | 3.0m |
| 80 km/h | 6.0m |
| 100 km/h | 9.0m |
| GUARDRAIL | 1.0m BEHIND RAIL |

* CROSS SECTION A2 TO A5 ARE FOR LOW SPEED LOW VOLUME ROADS.

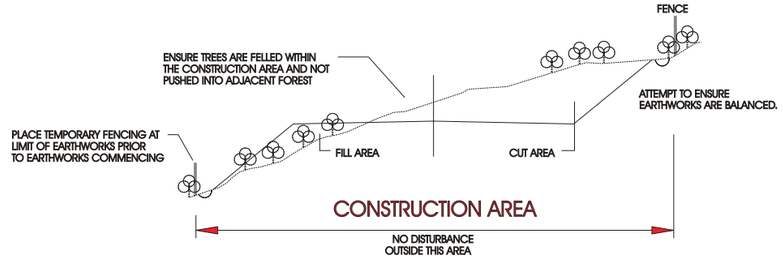
**TYPICAL CROSS SECTIONS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. TEMPORARY WATERCOURSE CROSSING

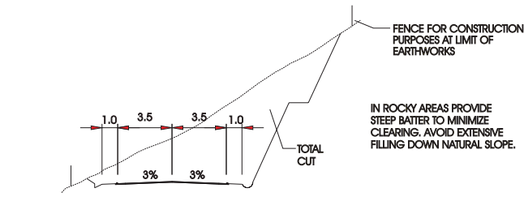


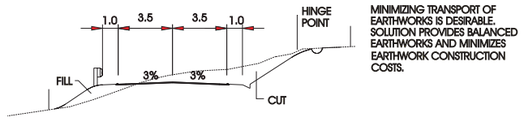

## B. CONSTRUCTION AREA CONTROLS CROSS SECTIONS

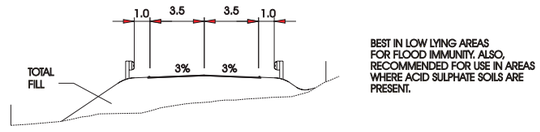


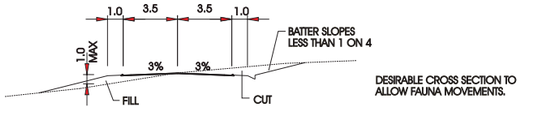

NOTE: MINIMISATION OF DISTURBANCE THROUGH DELINEATION OF THE CONSTRUCTION AREA WHICH IS BASED UPON CUT/FILL REQUIREMENTS.

## C. CUT/FILL CONTROL CROSS SECTIONS

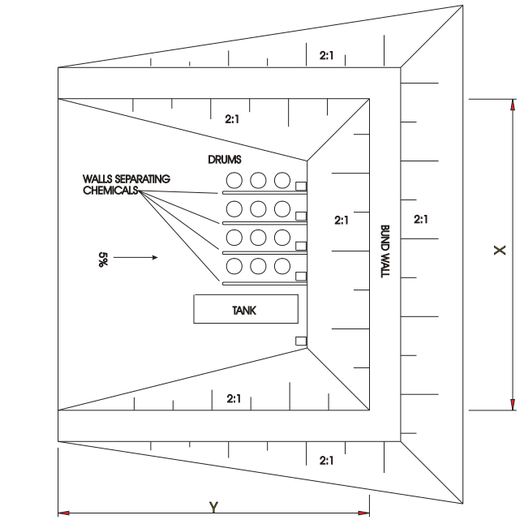


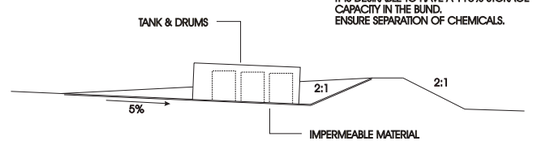



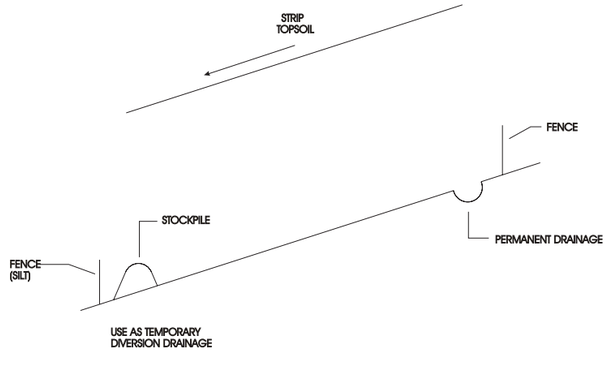

## D. CHEMICAL/FUEL STORAGE AREA BUNDING




NOTE: SIZE OR STORAGE AREA TO BE DETERMINED AS PER AS1940 AND IN WET TROPICS AREAS IT IS DESIRABLE TO HAVE A 110% STORAGE CAPACITY IN THE BUND.
ENSURE SEPARATION OF CHEMICALS.



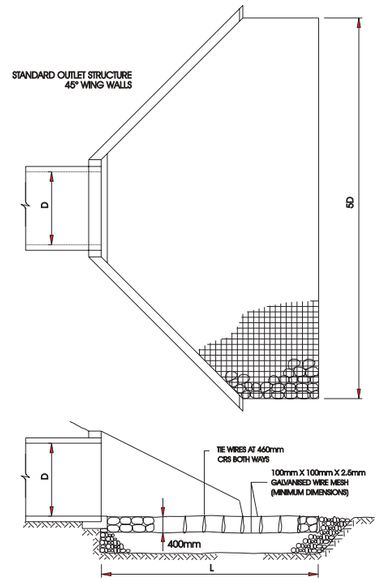

## E. TOPSOIL STRIPPING




**MISCELLANEOUS CONSTRUCTION ITEMS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. CULVERT OUTLET PROTECTION GABION







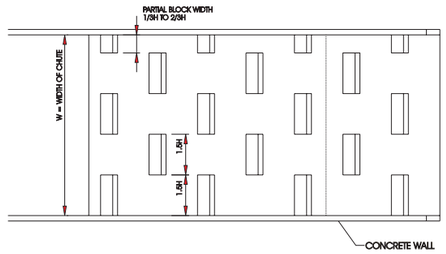
IF THE HEADWATER AND TAILWATER DEPTHS FOR THE DESIGN FLOW CAN BE ESTIMATED, THE APPROPRIATE MINIMUM DIMENSIONS CAN BE TAKEN FROM THE FOLLOWING TABLE:

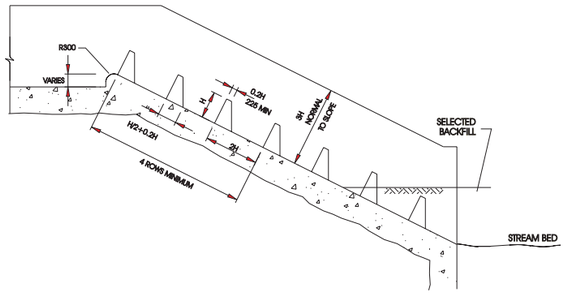
| TAILWATER DEPTH | HEADWATER DEPTH | LENGTH OF GABION | TOTAL THICKNESS OF STONE LAYER |
|---|---|---|---|
| 0.25 D | 1.5 D | 2.5 D * | 0.5 D |
| | 1.5 D - 2.5 D | 3 D * | 0.5 D ‡ |
| 0.25 D - 0.5 D | 2 D | 2.5 D | 0.5 D |
| | 2 D - 2.5 D | 3 D | 0.5 D |
| 0.5 D - 1 D | 1 D - 2.5 D | 2.5 D | 0.5 D |

* INCREASE BY 20% FOR CHANNELS OVER 10 D IN WIDTH.
‡ INCREASE BY 50% FOR CHANNELS OVER 8 D IN WIDTH.

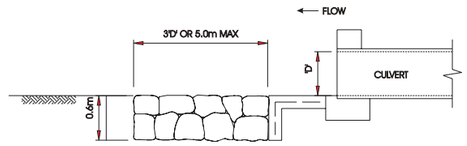
THESE DIMENSIONS ARE APPROPRIATE FOR A FINE SAND BED. FOR LESS ERODIBLE MATERIAL SOME REDUCTION IN DIMENSIONS MAY BE POSSIBLE.

## B. BASIC PROPORTIONS OF A BAFFLE CHUTE

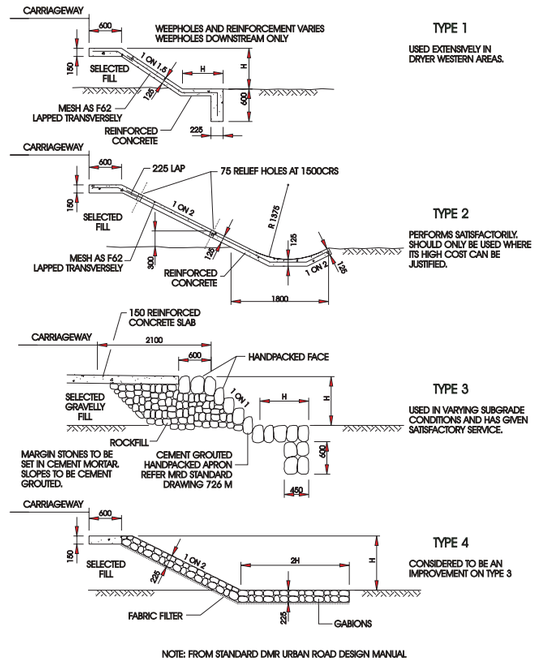



## C. RIP RAP PROTECTION

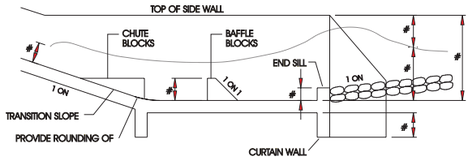


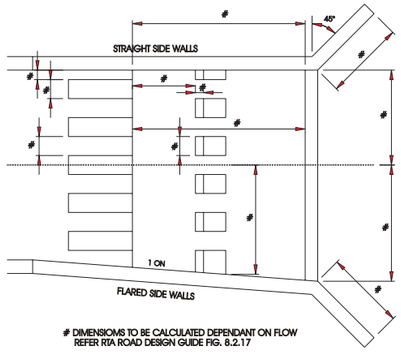

## D. DOWNSTREAM FLOODWAY PROTECTION




NOTE: FROM STANDARD DMR URBAN ROAD DESIGN MANUAL

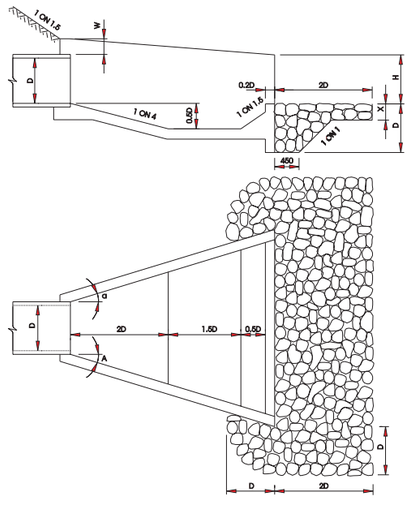
## E. TYPE C (FORCED JUMP) ENERGY DISSIPATOR




# DIMENSIONS TO BE CALCULATED DEPENDANT ON FLOW REFER RTA ROAD DESIGN GUIDE FIG. 8.2.17

## F. STILLING BASIN WITH RIP RAP

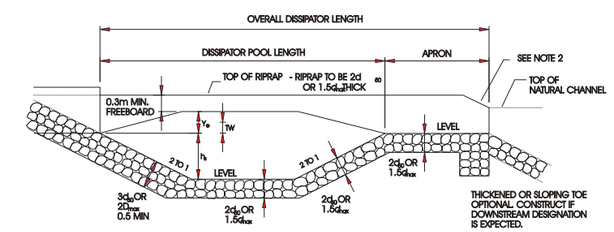


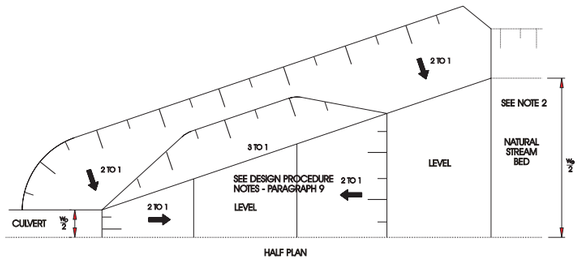

| H MAX. IN TERMS OF D | A ANGLE IN DEGREES | H IN TERMS OF D |
|---|---|---|
| 1.50 D | 22.5 | 0.70 D |
| 1.75 D | 20.0 | 0.75 D |
| 2.00 D | 19.0 | 0.80 D |
| 2.25 D | 18.5 | 0.85 D |
| 2.50 D | 18.0 | 0.90 D |
| 2.75 D | 17.5 | 0.95 D |
| 3.00 D | 17.0 | 1.00 D |

CONCRETE MINIMUM STRENGTH 30MPa

| DIAMETER D | HEIGHT W | THICKNESS OF CONCRETE | | NOMINAL ROCK SIZE FOR RIP RAP | DEPTH X |
|---|---|---|---|---|---|
| | | FLOOR | SIDE SILLS | | |
| 450 | 150 | 125 | 100 | 225 | 300 |
| 600 | 150 | 150 | 125 | 225 | 300 |
| 750 | 225 | 175 | 150 | 225 | 375 |
| 900 | 225 | 200 | 175 | 300 | 375 |
| 1050 | 225 | 225 | 200 | 300 | 450 |
| 1200 | 225 | 225 | 200 | 300 | 450 |
| 1350 | 300 | 250 | 225 | 300 | 450 |
| 1500 | 300 | 250 | 225 | 375 | 600 |
| 1650 | 300 | 250 | 225 | 375 | 600 |
| 1800 | 300 | 250 | 225 | 375 | 600 |

## G. TYPE A (RIP RAP) ENERGY DISSIPATOR



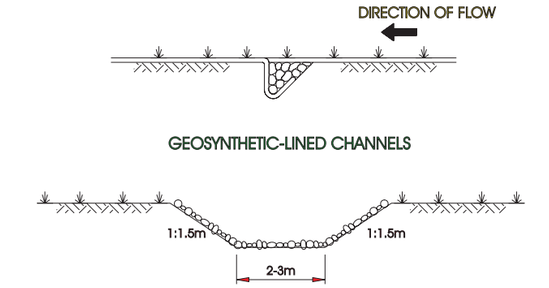

HALF PLAN

NOTE 2 : FROM ROAD DESIGN GUIDE BY RTA

**EROSION CONTROL - PERMANENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

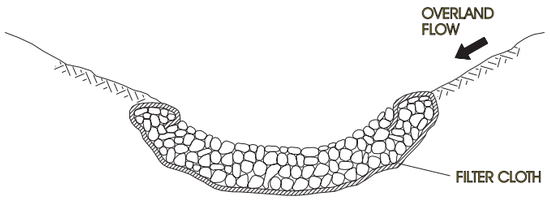
## A. CHANNEL LININGS




GEOSYNTHETIC-LINED CHANNELS

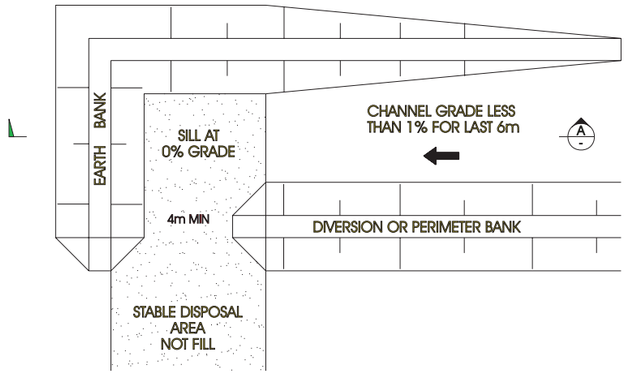


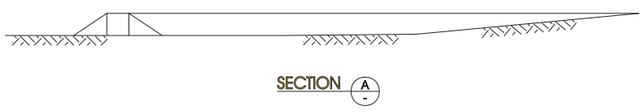

ROCK MATTRESS CHANNELS




ROCK LINED CHANNELS

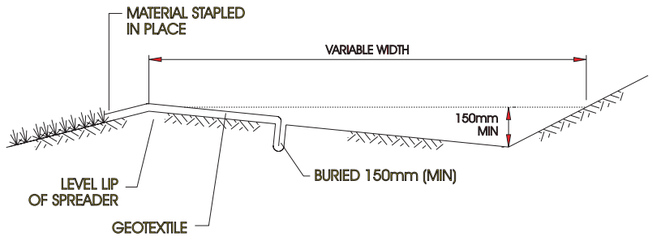
## B. LEVEL SPREADER



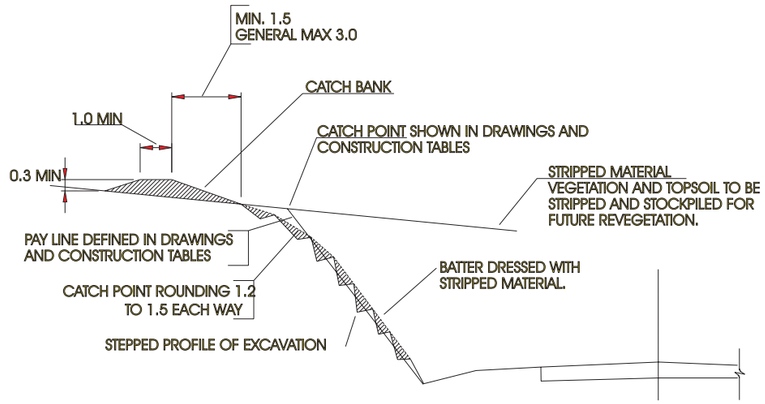



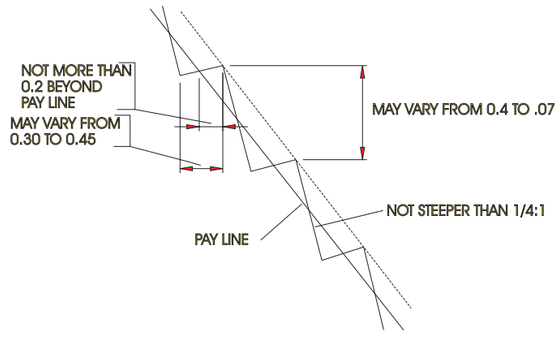
SECTION A -

LEVEL SPREADER




## C. REVEGETATION TREATMENT OF CUTTING BATTERS



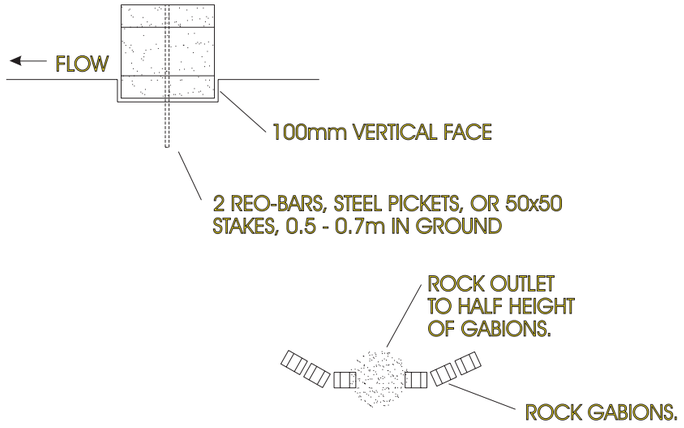




NOTE: FROM DMR STANDARD DRAWING 1045

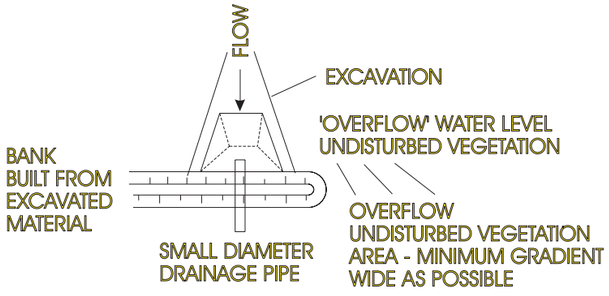
**EROSION CONTROL - PERMANENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

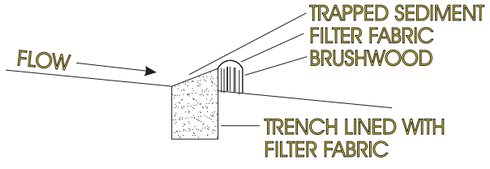
## A. IMPROVISED FROM LOCAL MATERIALS



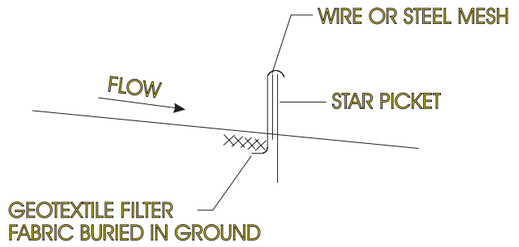

## B. SMALL EARTHWORKS




## C. BRUSHWOOD BANK




## D. SILT FENCE




## E. PORTABLE TANKS

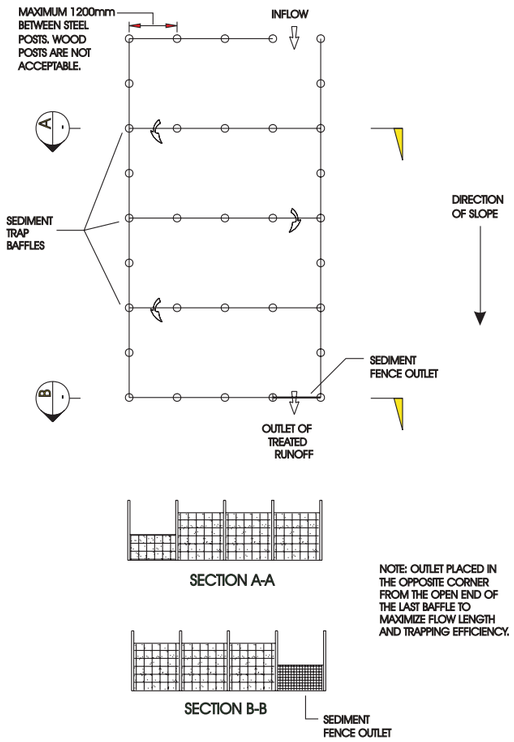



NOTE:
FOR USE IN DEWATERING SMALL EXCAVATIONS.

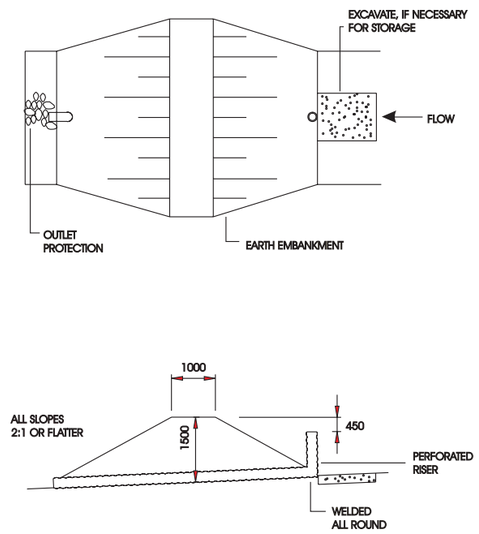
**SMALL SEDIMENT TRAPS - TEMPORARY**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

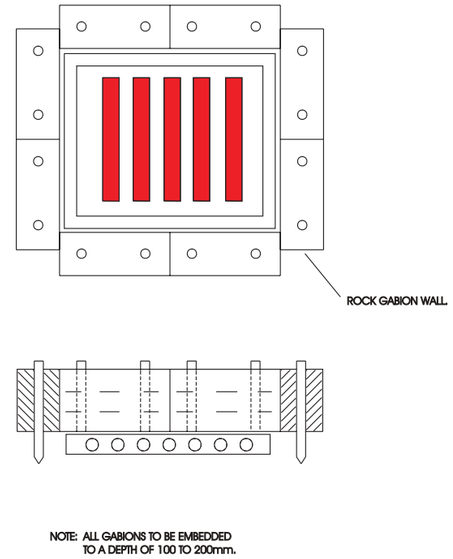
## A. SEDIMENT FENCE COARSE SEDIMENT TRAP




## B. PIPE OUTLET SEDIMENT TRAP

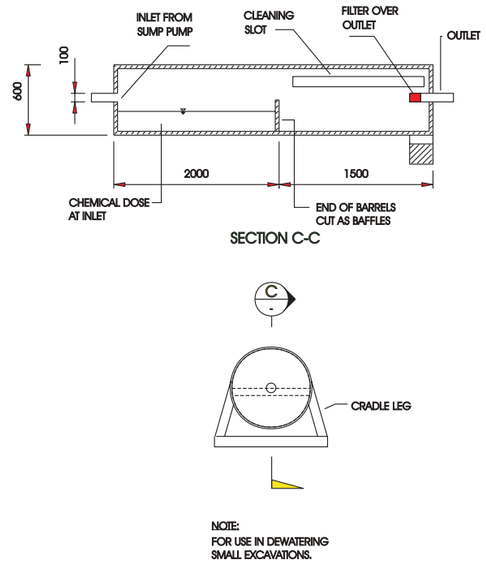



## C. DROP INLET SEDIMENT TRAP

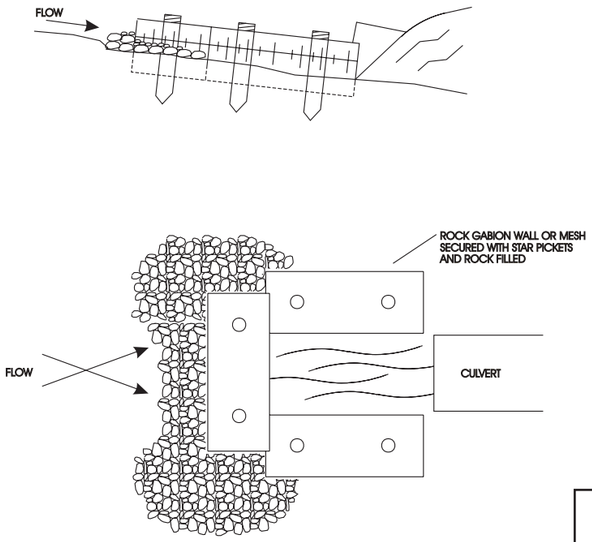



## D. PORTABLE SEDIMENT TRAP

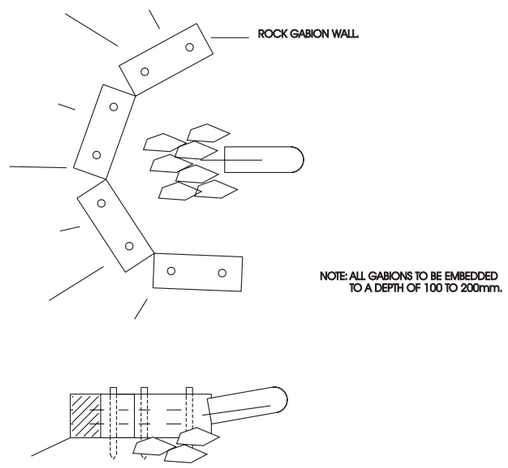
FOR PUMPED SEDIMENT FLOWS




## E. CULVERT INLET SEDIMENT TRAP



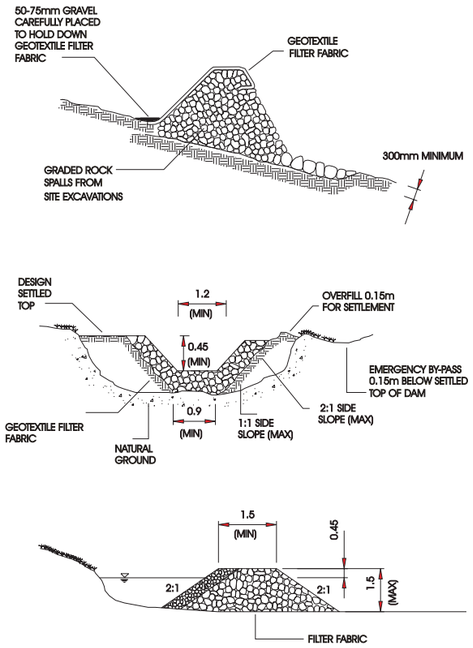

## F. CULVERT OUTLET SEDIMENT TRAP




**SEDIMENT CONTROL - TEMPORARY**

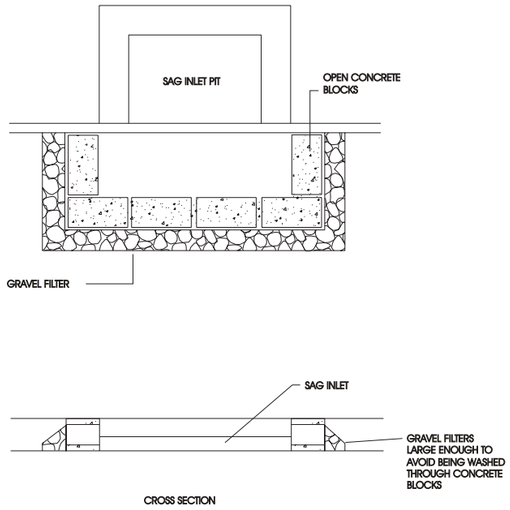
**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. ROCK FILTER DAMS



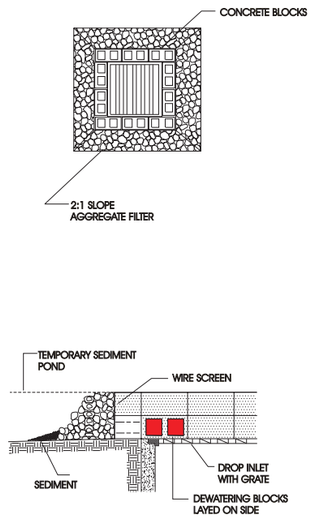

CROSS SECTION

## B. SAG GULLY INLETS

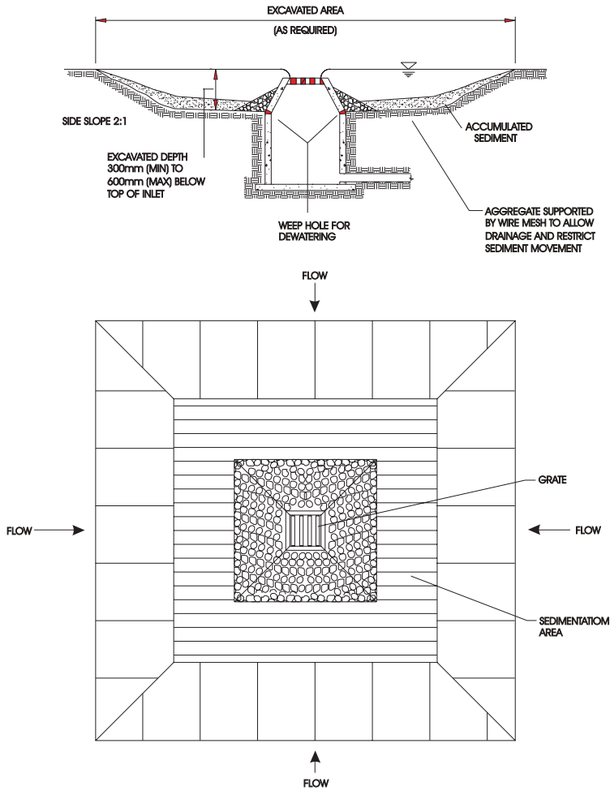



CROSS SECTION

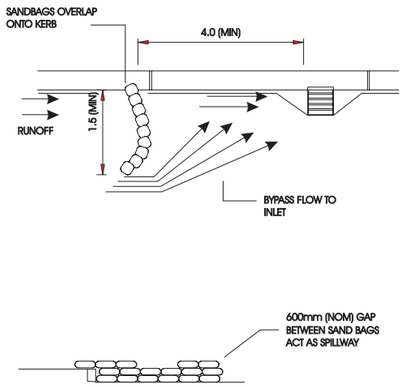
## C. BLOCK AND AGGREGATE DROP INLET PROTECTION



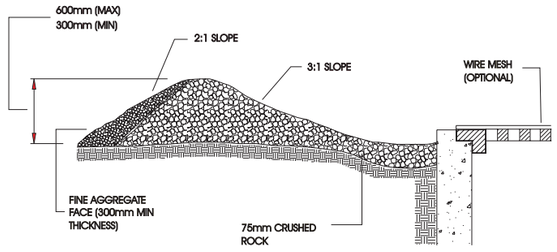

## D. EXCAVATED DROP INLET PROTECTION



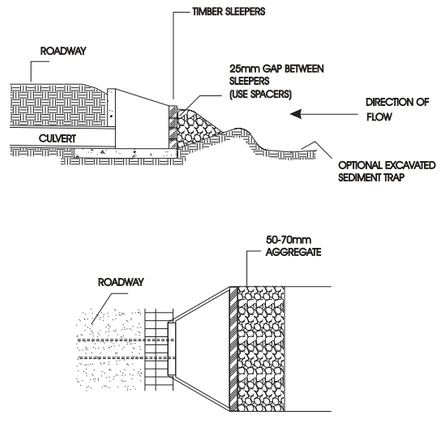

## E. ON-GRADE GULLY PITS




## F. ROCK AND AGGREGATE DROP INLET PROTECTION



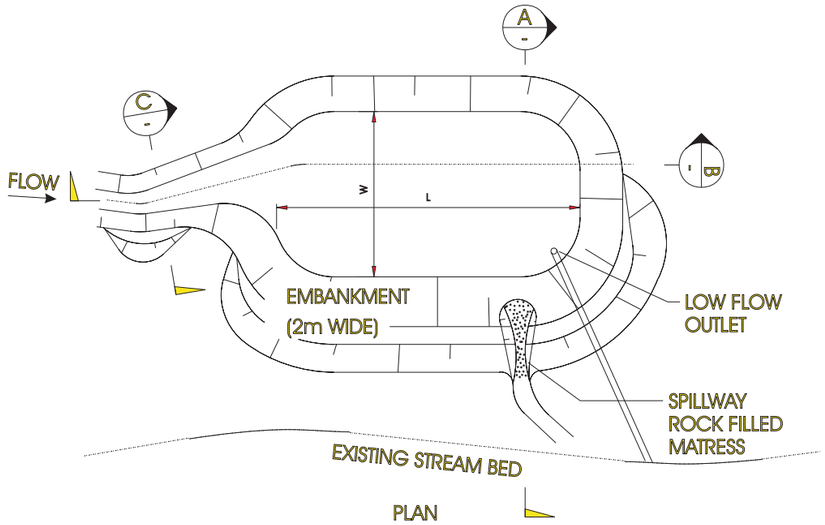

## G. PIPE INLET PROTECTION



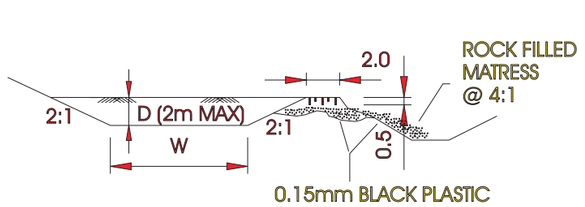

**SEDIMENT CONTROL - PERMANENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

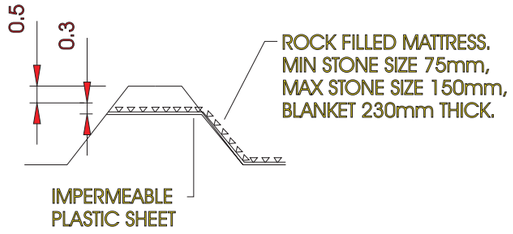
## A. SEDIMENTATION BASIN FEATURES

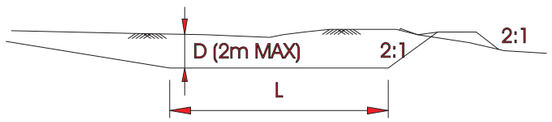



PLAN

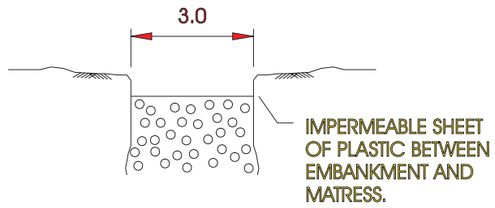



SECTION A-A

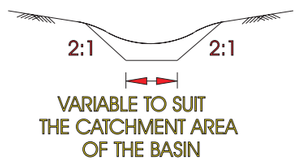


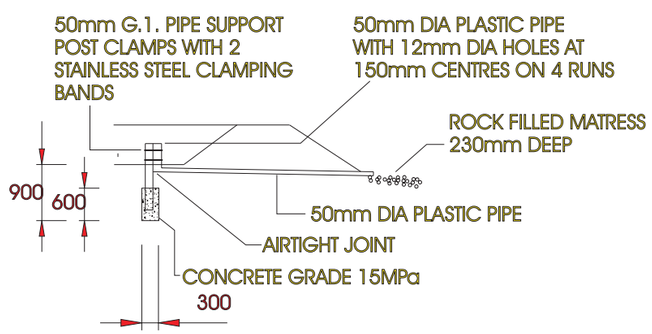

SECTION B-B




SPILLWAY DETAILS

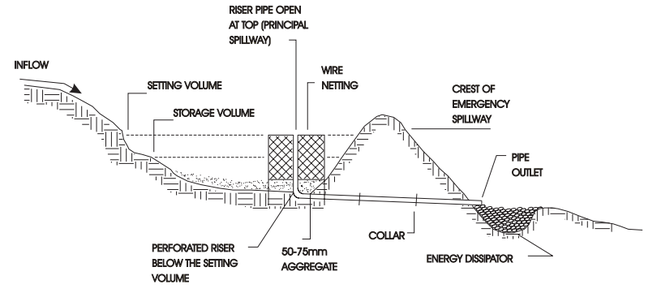



SECTION C-C

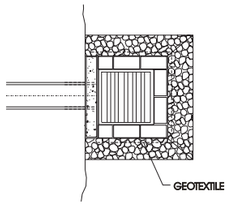


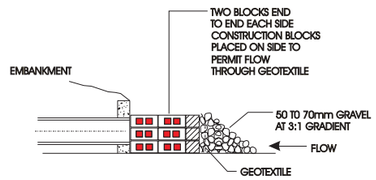

LOW FLOW OUTLET DETAIL

## B. COURSE SEDIMENT AND TURBIDITY CONTROL




## C. SEDIMENT TRAP USING ROAD EMBANKMENT AND CULVERT

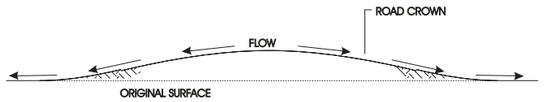


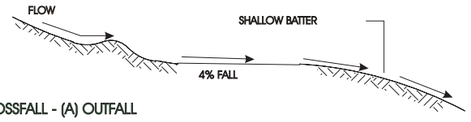

**SEDIMENT CONTROL - PERMANENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

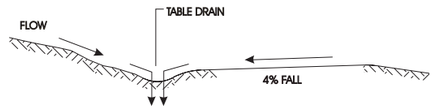
## A. ROAD CROWNING AND CROSSFALL DRAINAGE




CROWNING

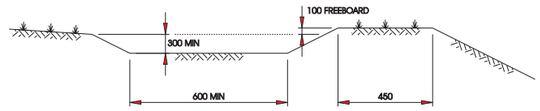



CROSSFALL - (A) OUTFALL

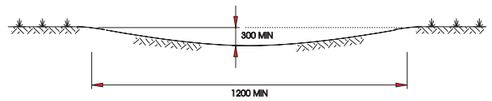



CROSSFALL - (B) INFALL

## B. DIVERSION/CATCH DRAIN

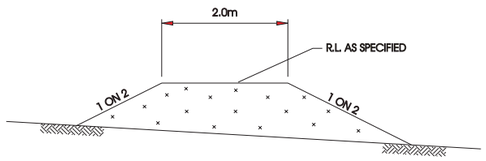



TRAPEZOIDAL CROSS SECTION

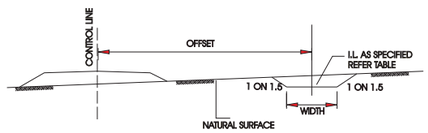



PARABOLIC CROSS SECTION

## D. LEVEE

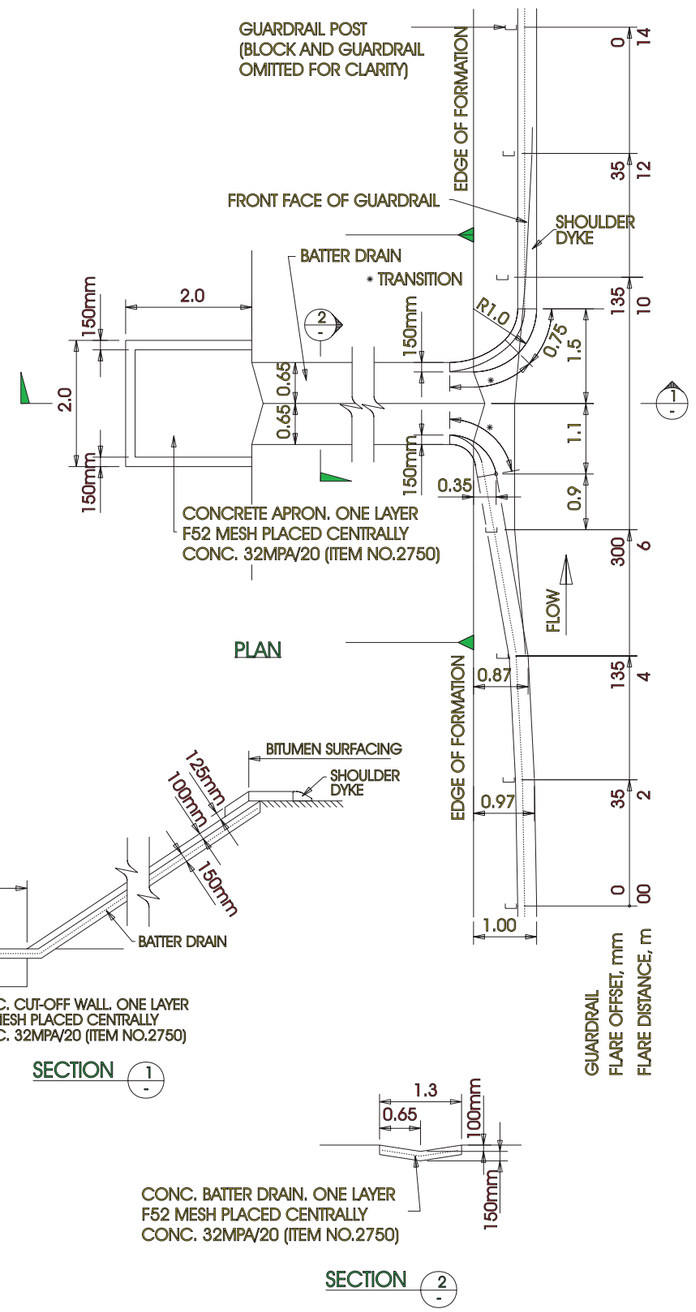



## C. DIVERSION CHANNEL




DIVERSION CHANNEL

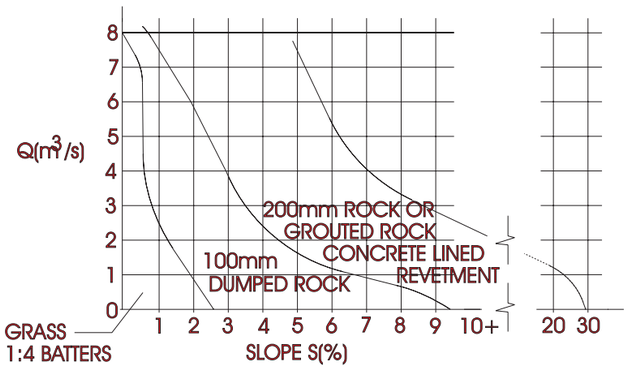
## E. SHOULDER DYKE




**DRAINAGE STRUCTURES**

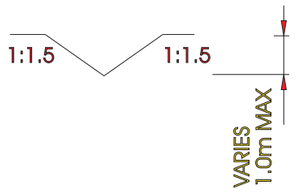
**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. TREATMENTS FOR VARIOUS FLOWS AND SLOPES GRAPHS



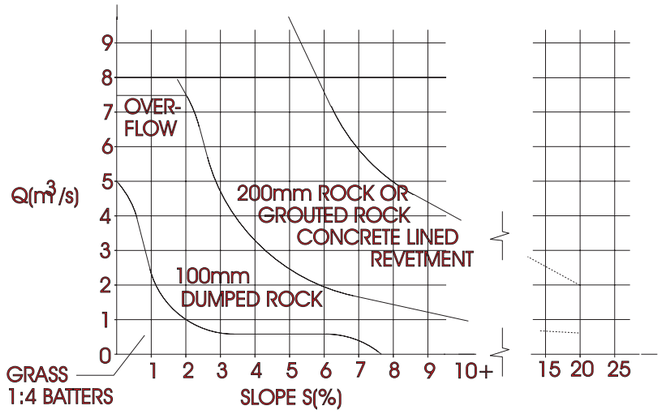

BASED ON VELOCITY OF:

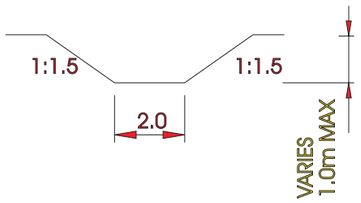
| | |
|---|---|
| GRASS | 1.5m/s |
| 100mm DUMPED ROCK | 2.9m/s |
| 200mm DUMPED ROCK | 4.1m/s |
| GROUTED ROCK | 4.1m/s+ |
| REVETMENT MATTRESS | 4.1m/s+ |
| CONCRETE LINED | 4.1m/s+ |



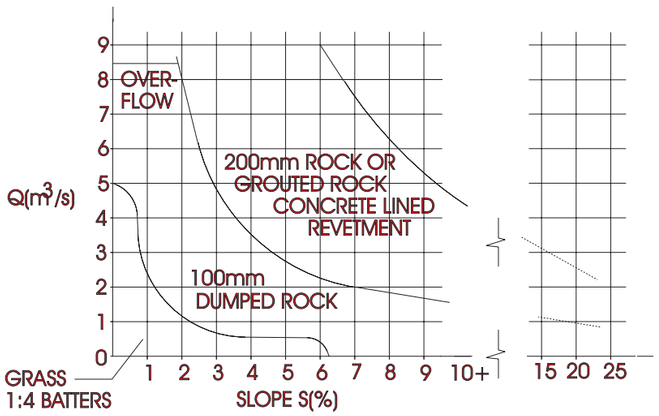

NOTE: LARGE FLOWS IN V DRAINS ARE ONLY USED WHERE THE AMOUNT OF AREA IS RESTRICTED.

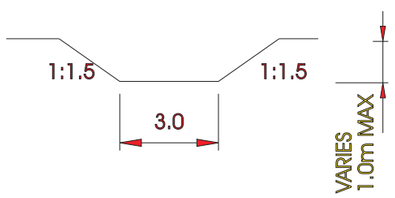
### V DRAIN




### FLAT BOTTOM DRAIN WITH 2.0m BED WIDTH

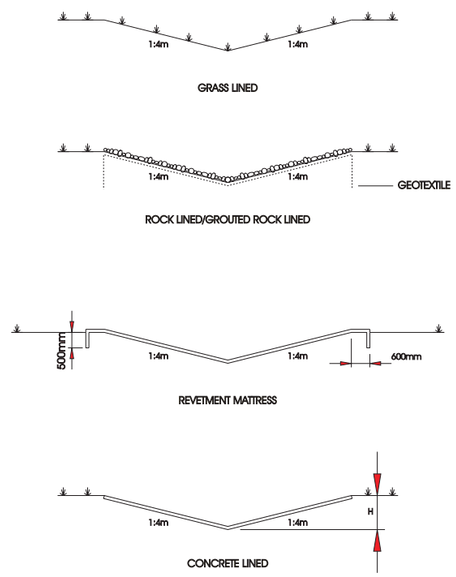


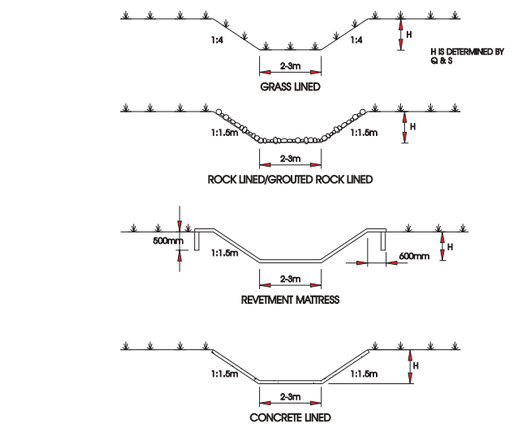

### FLAT BOTTOM DRAIN WITH 3.0m BED WIDTH

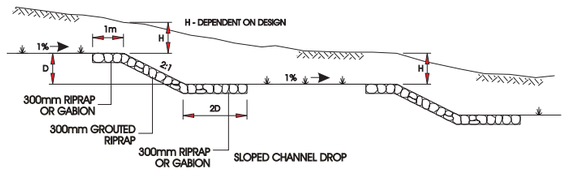
NOTE: THESE GRAPHS WERE CALCULATED FOR THE CROSS SECTIONS SHOWN AND ARE TO BE USED ONLY AS A GUIDE FOR ANY OTHER TYPE OF CROSS SECTION.

## B. TYPICAL LINED AND UNLINED V DRAINS




## C. TYPICAL LINED AND UNLINED TABLE DRAINS




OTHER ALTERNATIVE LININGS FOR DRAINS ARE AVAILABLE SUCH AS :

- AMERICAN GREEN
- JUTE MASTER
- ENKA-MAT etc.

REFERENCE SHOULD BE MADE TO TECHNICAL PRODUCT DESCRIPTIONS FOR APPROPRIATE USE.

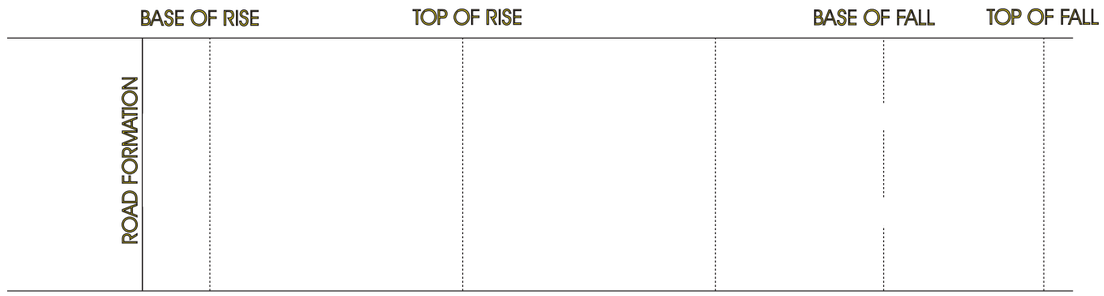
**TABLE DRAIN TREATMENTS AND GRAPHS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

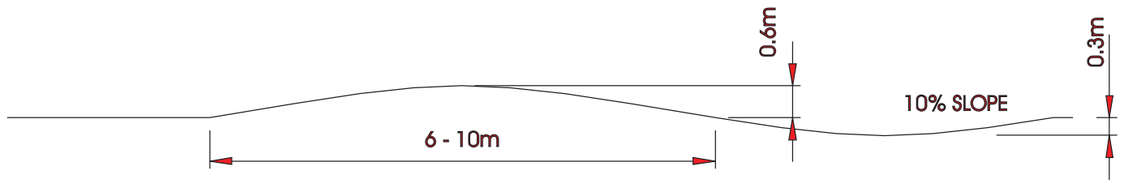


*Version 1, October 1997*

## A. CROSS BANK OR WHOA BOY




PLAN




ELEVATION

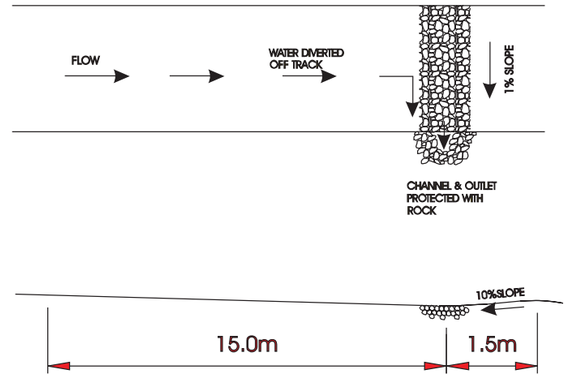
MAXIMUM SPACING OF CROSS DRAINS (WET TROPICS) (1)

| GRADE OF TRACK | MAXIMUM SPACING OF CROSS DRAINS (m) | |
|---|---|---|
| | LOW HAZARD (2) | MODERATE AND HIGH HAZARD (2) |
| <9% (5°) | 60 | 30 |
| 9-27% (5-15°) | 40 | 20 |
| 27-47% (15-25°) | 20 | 10 |
| >47% (25°) (3) | 10 | 10(3) |

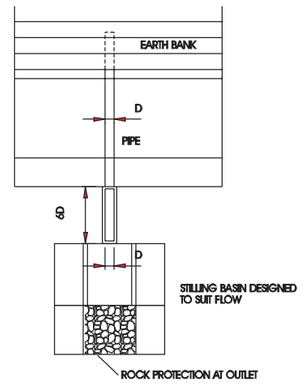
(1) FROM QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES - FOREST SERVICE, 1988
(2) SOIL ERODABILITY MAY BE RECOGNISED BY THE SOIL DESCRIPTIONS PROVIDED IN TABLE C4.2 (QDPI - FOREST SERVICE, 1988 IN THE IE AUST (QLD) ESC GUIDELINES)
(3) COVER CROP ESTABLISHMENT IN BASE AND BANKS OF ALL DRAINS IS RECOMMENDED ON SLOPES EXCEEDING 47% (25°). GRADIENTS OF THIS MAGNITUDE ARE ONLY RECOMMENDED FOR SHORT DISTANCES ON THE SOIL TYPES WITH LOW ERODABILITY ADAPTED FROM IE AUST QUEENSLAND DIVISION ENGINEERING GUIDELINES FOR QUEENSLAND CONSTRUCTION SITES 1996.

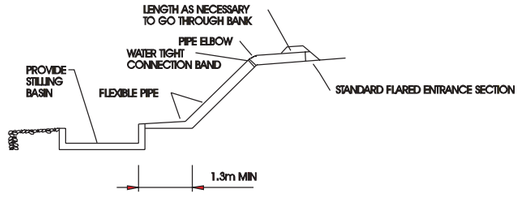
NB: FOR CROSS DRAINAGE ON UNSEALED ROADS (TEMPORARY OR PERMANENT) ON GRADE. AS GRADES BECOME STEEPER THE MORE FREQUENT THE SPACING OF THE WHOA BOY. ALSO NOTE THAT WHOA BOYS CAN BE A STAFF HAZARD AND A RISK ASSESSMENT SHOULD BE MADE BEFORE DESIGN OR CONSTRUCTION.

## B. GRADE DIPS
## WHOA BOY WITH ROCK PROTECTION



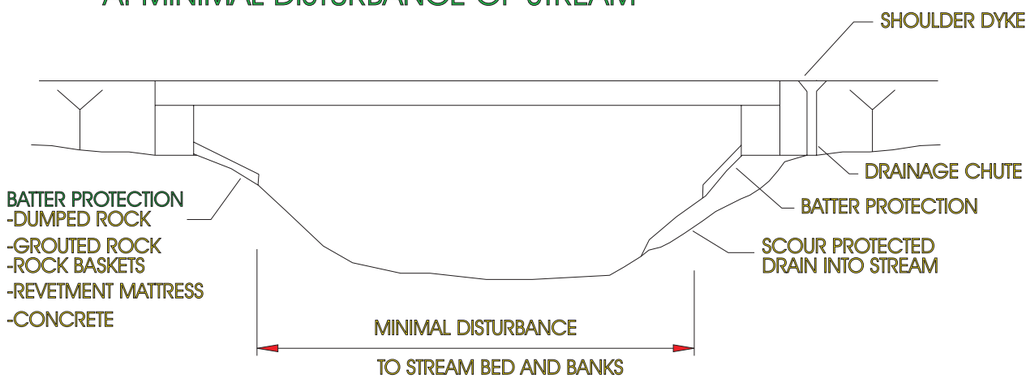

## C. DOWNDRAIN STRUCTURE



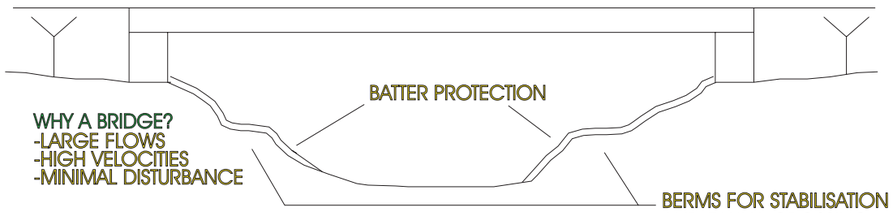




**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

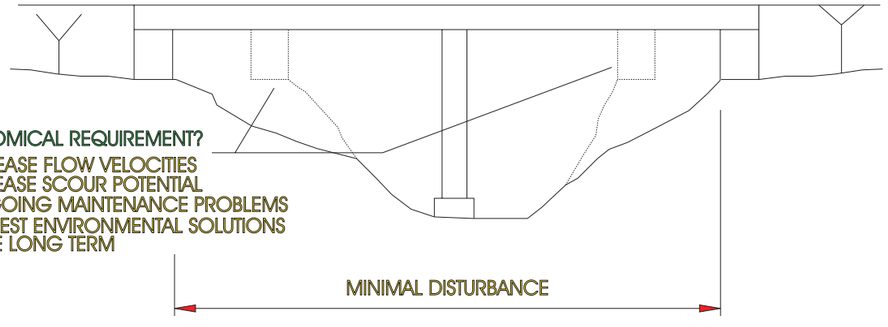
## A. MINIMAL DISTURBANCE OF STREAM




## B. BATTER PROTECTION UNDER BRIDGE

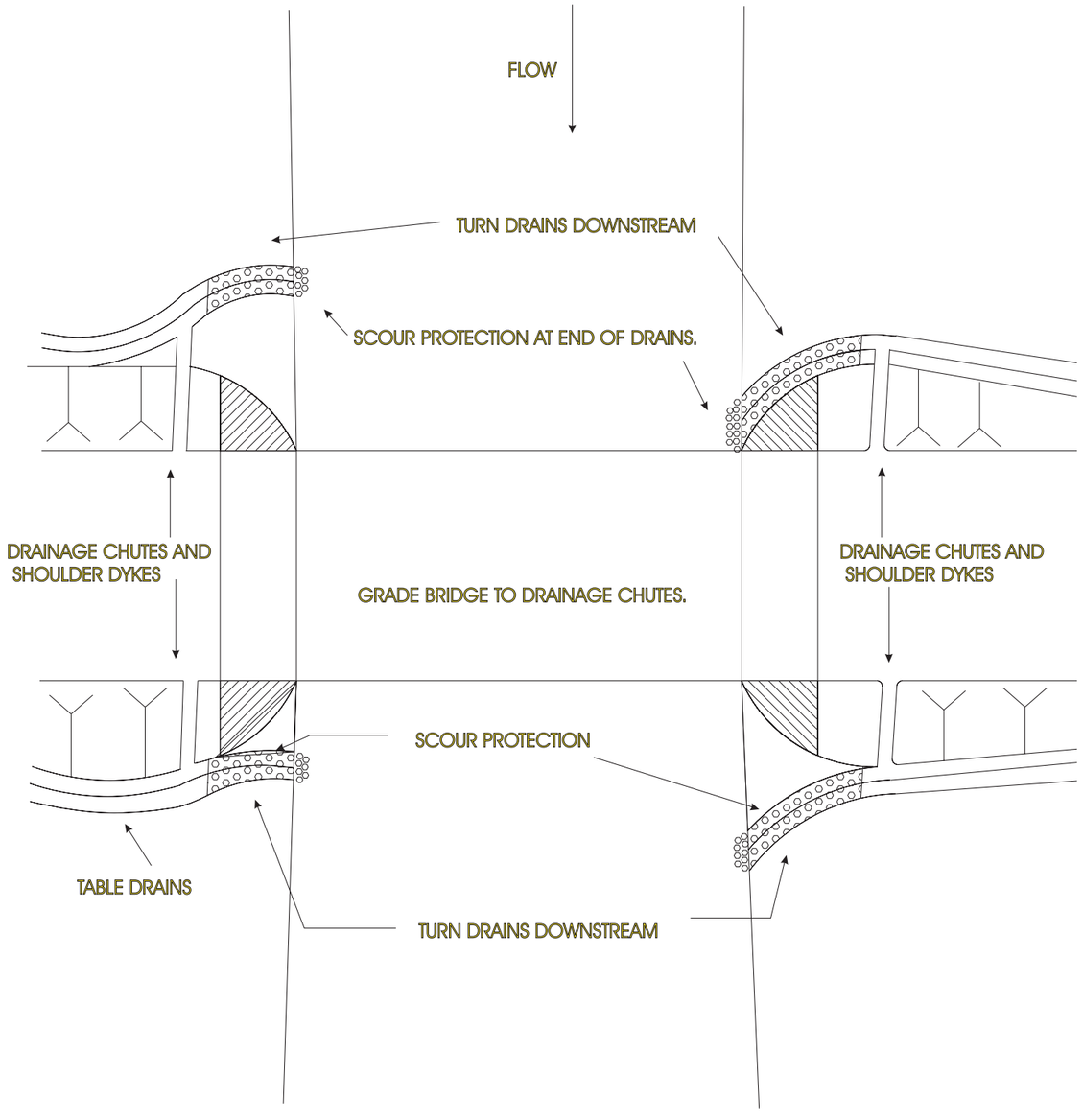



## C. IMPACT OF LONGER BRIDGE vs SHORTER BRIDGE




NOTE:
AT APPROACHES TO FAUNA CROSSING STRUCTURES MAINTAIN VEGETATION COVER FOR FAUNA AND OR LARGE ROCKS FOR PROTECTION.

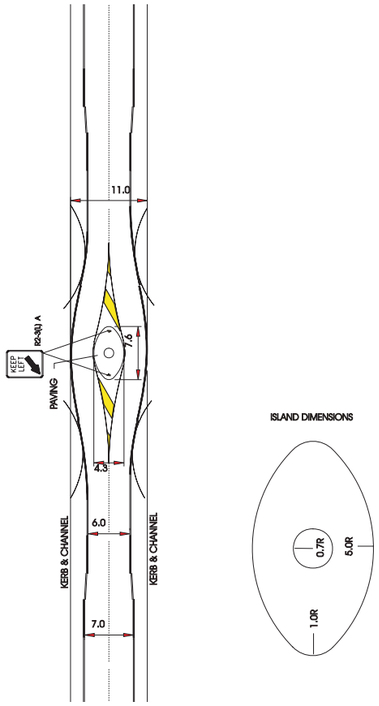
## D. TYPICAL PLAN OF BRIDGE STRUCTURE




**BRIDGE STRUCTURES - PERMANENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

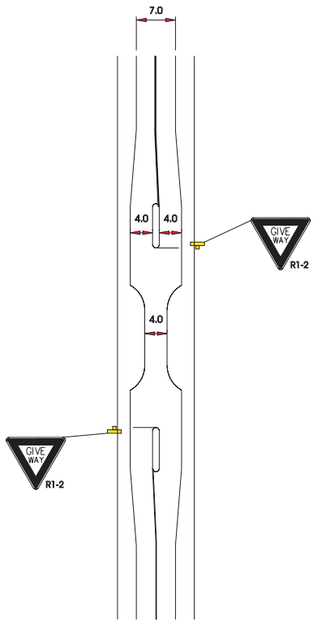
## A. MIDBLOCK HORIZONTAL DEFLECTOR - 11.0m



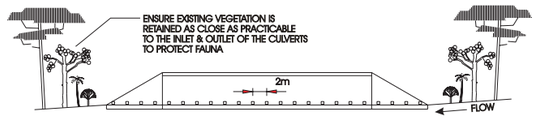




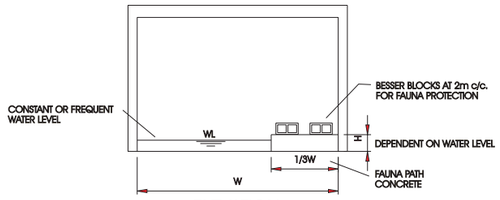
## B. TRAFFIC SLOW POINT




## C. COMBINED BOX CULVERT - FAUNA PATH

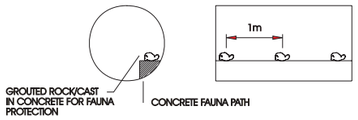



CROSS SECTION



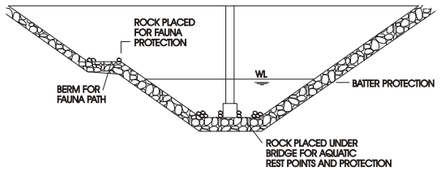

ELEVATION

## D. COMBINED PIPE CULVERT - FAUNA PATH

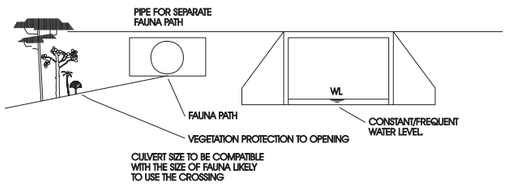



FOR PIPES D>1350mm

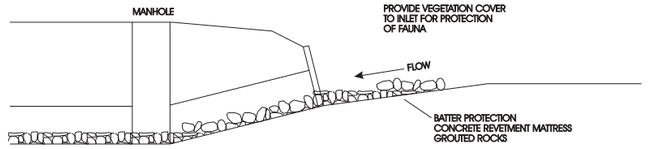
## E. BRIDGE WITH FAUNA PATH




## F. CULVERT AS FAUNA PATH ONLY

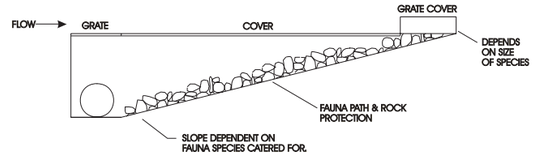



## G. ANGLE PIPE INLET AND FAUNA PATH




ALTERNATIVE TO DROP STRUCTURE USE ANGLED PIPE. MAY PLACE GROUTED ROCK IN PIPES FOR FAUNA PATH

## H. GRATED INLET FAUNA PATH DROP STRUCTURE



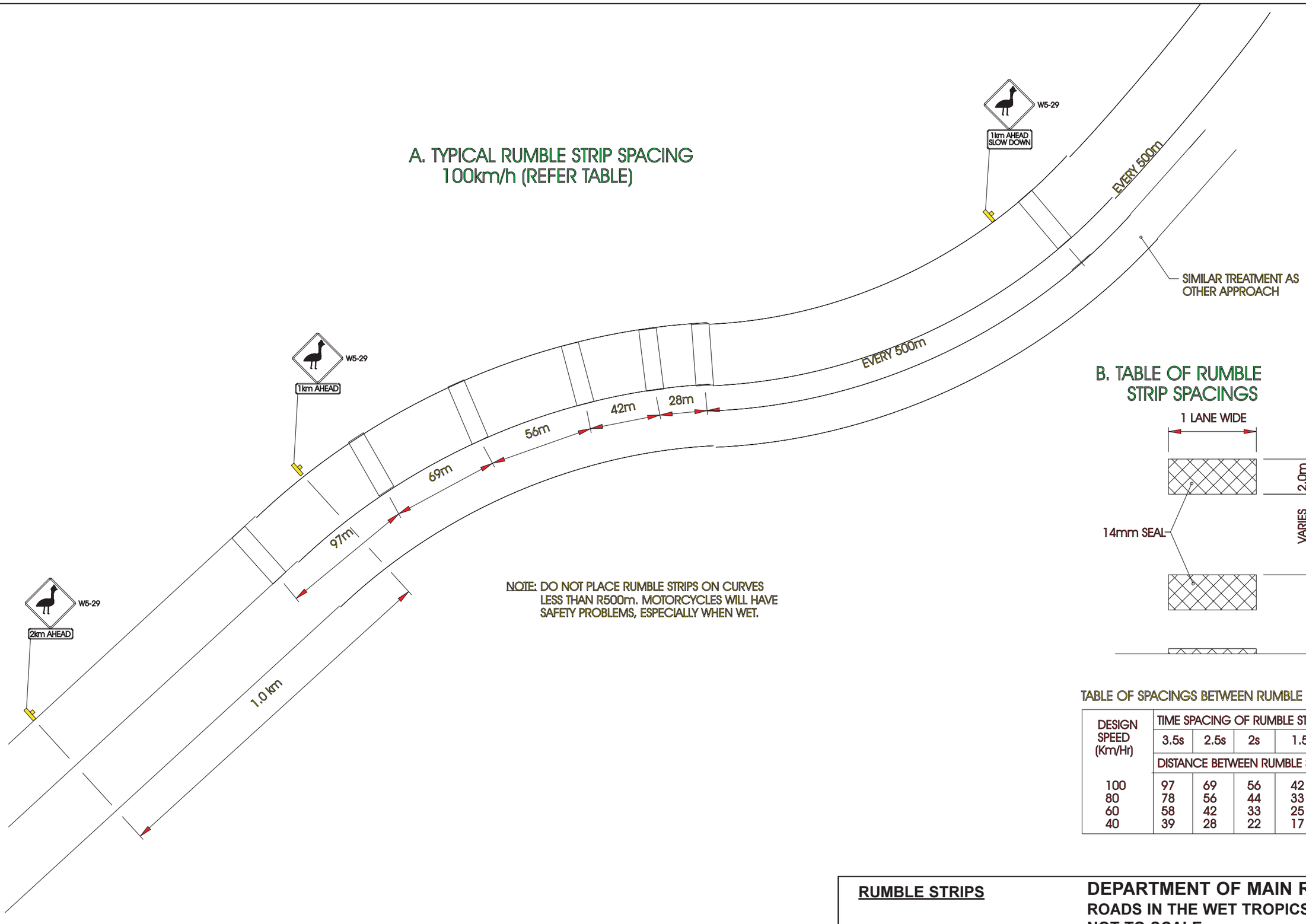




**VARIOUS TYPES OF FAUNA PATHS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. TYPICAL RUMBLE STRIP SPACING
## 100km/h (REFER TABLE)




NOTE: DO NOT PLACE RUMBLE STRIPS ON CURVES LESS THAN R500m. MOTORCYCLES WILL HAVE SAFETY PROBLEMS, ESPECIALLY WHEN WET.

## B. TABLE OF RUMBLE STRIP SPACINGS



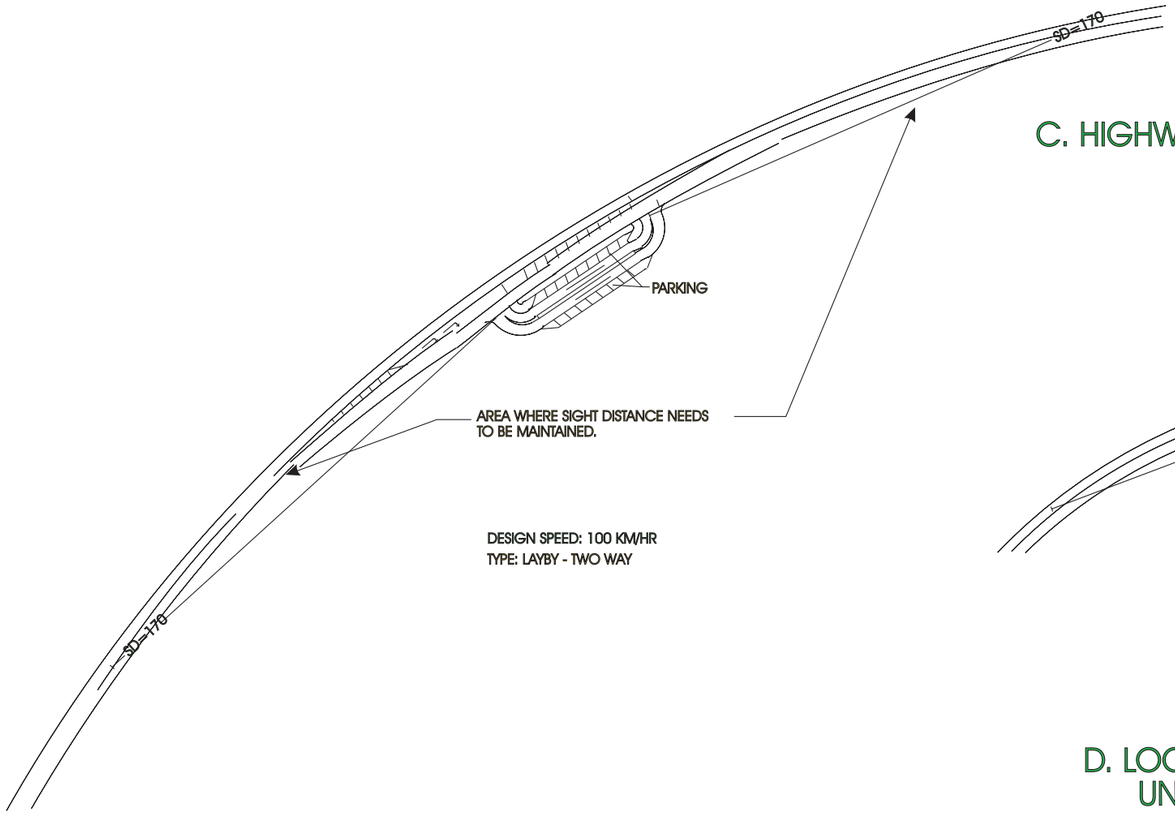

### TABLE OF SPACINGS BETWEEN RUMBLE STRIPS

| DESIGN SPEED (Km/Hr) | TIME SPACING OF RUMBLE STRIPS (sec.) | | | | |
|---|---|---|---|---|---|
| | 3.5s | 2.5s | 2s | 1.5s | 1.0s |
| | DISTANCE BETWEEN RUMBLE STRIPS (m) | | | | |
| 100 | 97 | 69 | 56 | 42 | 28 |
| 80 | 78 | 56 | 44 | 33 | 22 |
| 60 | 58 | 42 | 33 | 25 | 17 |
| 40 | 39 | 28 | 22 | 17 | 11 |

**RUMBLE STRIPS**

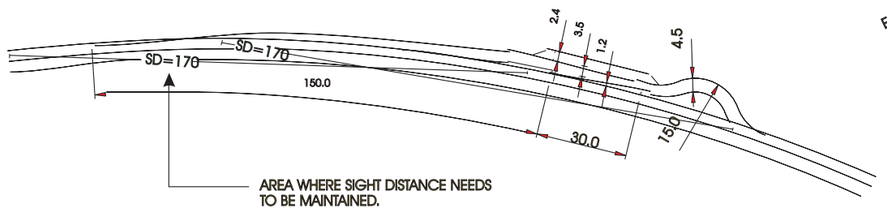
**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

## A. HIGHWAY



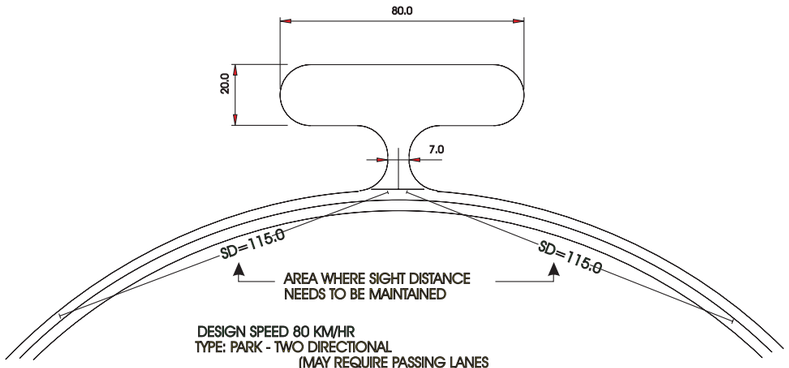

DESIGN SPEED: 100 KM/HR
TYPE: LAYBY - TWO WAY

## B. HIGHWAY



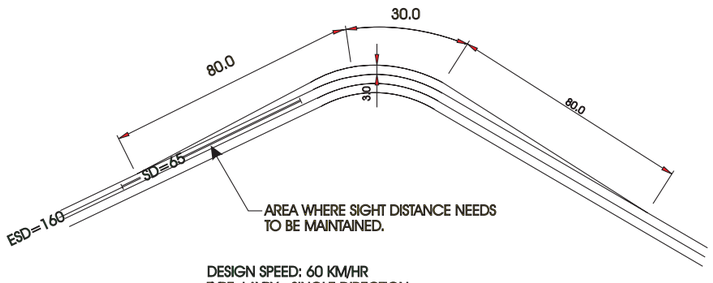

DESIGN SPEED: 100 KM/HR
TYPE: LAYBY - SINGLE DIRECTION

## C. HIGHWAY / LOCAL ROADS



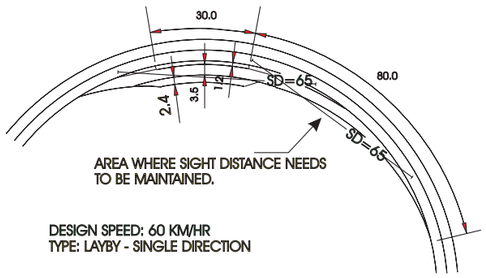

DESIGN SPEED 80 KM/HR
TYPE: PARK - TWO DIRECTIONAL
(MAY REQUIRE PASSING LANES
FOR HIGHER VOLUME ROADS)

## D. LOCAL ROADS UNSEALED



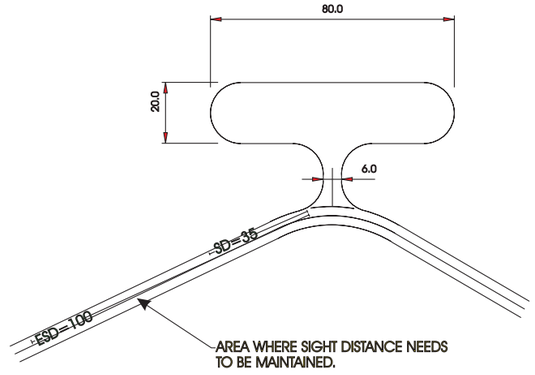

DESIGN SPEED: 60 KM/HR
TYPE: LAYBY - SINGLE DIRECTION

## E. HIGHWAY




DESIGN SPEED: 60 KM/HR
TYPE: LAYBY - SINGLE DIRECTION

## F. LOCAL ROADS UNSEALED / SEALED




DESIGN SPEED: 40 KM/HR
TYPE: PARK

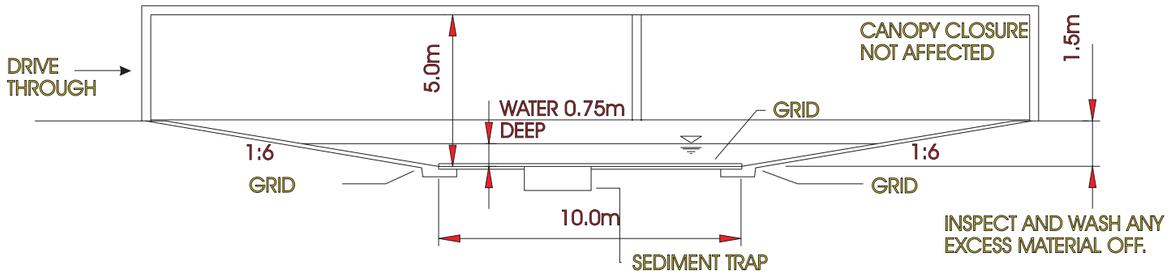
NOTE :
PREFERRED ENTRANCE POSITION IS ON A FLAT STRAIGHT LOCATION. ABOVE DIAGRAMES SHOW TYPICAL STOPPING DISTANCE REQUIREMENTS. SEE TABLES 5.1,5.2,5.3,5.6,5.7 AND 5.9 IN AUSTROADS PART 5 FOR STOPPING SIGHT DISTANCE, APPROACH SIGHT DISTANCE AND DECELERATION LANES.

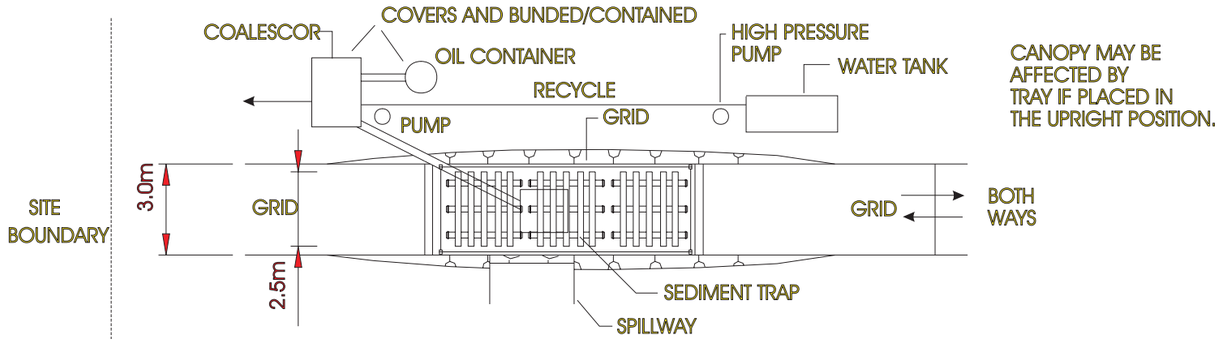
**SCENIC LOOKOUT ARRANGEMENTS PLANS**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

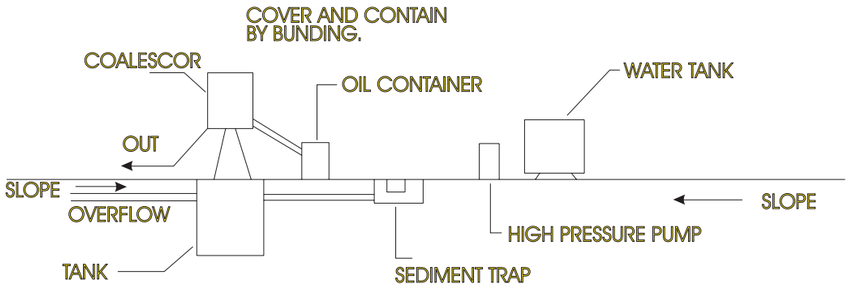
## A. ELEVATED AREAS

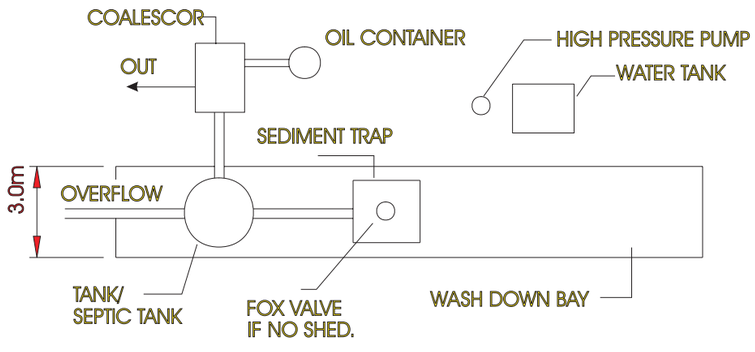
NB : OPTION 1 : CONSTRUCT A SHED TO DIVERT STORMWATER FROM OVERFLOWING THE SYSTEM INSTEAD OF A FOX VALVE.
OPTION 2 : NO SHED BUT USE A FOX VALVE AND A TANK TO CONTROL THE STORMWATER FROM OVERFLOWING THE SYSTEM.



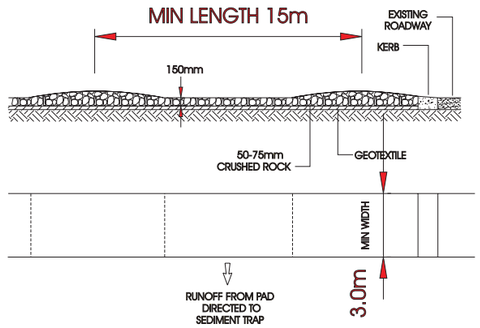



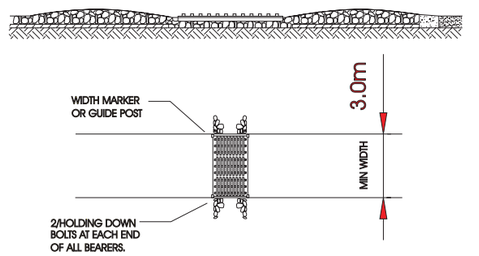

CANOPY MAY BE AFFECTED BY TRAY IF PLACED IN THE UPRIGHT POSITION.




## B. CONSTRUCTION EXITS

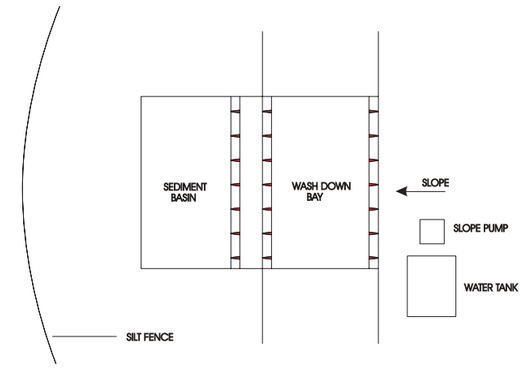


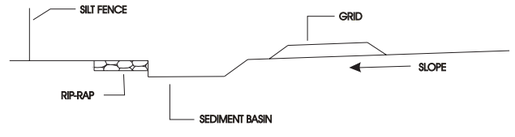




CATTLE GRID

## C. WASH DOWN BAY

NOTE:
IF PLANT PATHOGENS ARE PRESENT IN THE WASHDOWN WATER THEN TREATMENT WILL BE REQUIRED BEFORE DISCHARGE.



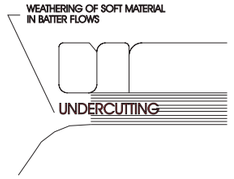

**CONSTRUCTION ENTRANCES AND EXITS WASH DOWN BAY**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

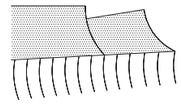
## A. SUMMARY TABLE

| FAILURE TYPE | TREATMENT | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|
| PLANE, WEDGE, TOPPLING AND RAVELLING FAILURES | ROCK BOLTING | QUICKLY INSTALLED.<br>WELL KNOWN TECHNIQUE. | EXPENSIVE. NOT SUITABLE UNLESS FRACTURE PATTERN IS WIDELY SPACED. |
| | STRUCTURAL SUPPORT BY WALLING | SOLUTION WHERE ROCK BOLTING NOT PRACTICAL. | VERY EXPENSIVE |
| | CATCH AREA TO COLLECT STONES | CAN BE PART OF CLEAR ZONE. | MAINTENANCE COSTS.<br>DOES NOT SOLVE UNDERLYING PROBLEM. |
| WEDGE, ROTATIONAL AND TRANSLATIONAL FAILURES WHERE SURFACE WATER MAKES A SIGNIFICANT CONTRIBUTION TO THE PROBLEM | BERM AT TOP OF CUTTING | DIVERTS WATER FROM THE CUTTING. COLLECTS WATER FOR SLOPE DRAINS/ PAVED DITCHES. MAY BE CONSTRUCTED BEFORE EXCAVATION IS STARTED. | ACCESS TO TOP OF CUTTING. DIFFICULT TO BUILD ON STEEP NATURAL SLOPE OR ROCK SURFACE. CONCENTRATES WATER, MAY REQUIRE CHANNEL PROTECTION OR ENERGY DISSIPATION DEVICES. CAN CAUSE WATER TO ENTER GROUND, RESULTING IN A TRANSLATIONAL SLIDE. |
| | DIVERSION DYKE | COLLECTS AND DIVERTS WATER AT A LOCATION SELECTED TO REDUCE EROSION POTENTIAL. MAY BE INCORPORATED IN THE PERMANENT PROJECT DRAINAGE. | ACCESS FOR CONSTRUCTION. MAY BE CONTINUING MAINTENANCE PROBLEM IF NOT LINED OR PROTECTED. DISTURBED MATERIAL OR BERM IS EASILY ERODED. |
| WEDGE, SLIP CIRCLE AND SLIDING FAILURES WHERE SURFACE WATER SIGNIFICANTLY CONTRIBUTES TO THE PROBLEM | SLOPE BENCHES<br>BENCH WIDTH 3m OR UNDER<br>MAX SPACING 7.5m (VERT) | SLOWS VELOCITY OF SURFACE RUNOFF.<br>COLLECTS SEDIMENT.<br>PROVIDES ACCESS TO SLOPE FOR SEEDING, MULCHING AND MAINTENANCE.<br>COLLECTS WATER FOR SLOPE DRAINS OR MAY DIVERT WATER TO NATURAL GROUND. | MAY CAUSE ADDITIONAL FAILURES IF WATER INFILTRATES.<br>REQUIRES ADDITIONAL R.O.W. NOT ALWAYS POSSIBLE DUE TO STRIKE AND DIP OF MATERIAL.<br>REQUIRES MAINTENANCE TO BE EFFECTIVE.<br>INCREASES EXCAVATION QUANTITIES.<br>WATER. |
| | SLOPE DRAINS (LINED, PIPE, ETC) | REDUCES EROSION ON THE SLOPE.<br>CAN BE TEMPORARY OR PART OF PERMANENT CONSTRUCTION.<br>CAN BE CONSTRUCTED OR EXTENDED AS EXCAVATION PROGRESSES. | REQUIRES OTHER DRAINS TO COLLECT<br>PERMANENT CONSTRUCTION IS NOT ALWAYS COMPATIBLE WITH OTHER PROJECT WORK.<br>USUALLY REQUIRES SOME TYPE OF ENERGY DISSIPATION. |
| | SEEDING/MULCHING | THE END OBJECTIVE IS TO HAVE A COMPLETELY VEGETATED SLOPE. EARLY PLACEMENT IS A STEP IN THIS DIRECTION.<br>THE MULCH PROVIDES TEMPORARY EROSION PROTECTION UNTIL GRASS IS ROOTED.<br>TEMPORARY OR PERMANENT SEEDING MAY BE USED. LARGER SLOPES CAN BE SEEDED AND MULCHED WITH SMALLER EQUIPMENT IF STAGE TECHNIQUES ARE USED. | DIFFICULT TO SCHEDULE HIGH PRODUCTION UNITS FOR SMALL INCREMENTS.<br>TIME OF YEAR MAY BE UNFAVOURABLE.<br>MAY REQUIRE WATERING. MULCH SHOULD BE ANCHORED. |
| | SODDING | PROVIDES IMMEDIATE PROTECTION.<br>CAN BE USED TO PROTECT ADJACENT PROPERTY FROM SEDIMENT. | DIFFICULT TO PLACE UNTIL CUTTING IS COMPLETE.<br>SOD NOT ALWAYS AVAILABLE.<br>MAY BE EXPENSIVE. |
| | BATTER FACING | PROVIDES IMMEDIATE PROTECTION FOR HIGH RISK AREAS AND UNDER STRUCTURES.<br>MAY BE CAST IN PLACE OR OFF SITE. | EXPENSIVE.<br>DIFFICULT TO PLACE ON HIGH SLOPES. |
| | TEMPORARY COVER | PLASTICS ARE AVAILABLE IN WIDE ROLLS AND LARGE SHEETS THAT MAY BE USED TO PROVIDE TEMPORARY PROTECTION FOR SLOPES. EASY TO PLACE AND REMOVE. USEFUL TO PROTECT HIGH RISK AREAS FROM TEMPORARY EROSION. | PROVIDES ONLY TEMPORARY PROTECTION.<br>ORIGINAL SURFACE USUALLY REQUIRES ADDITIONAL TREATMENT WHEN PLASTIC IS REMOVED. MUST BE ANCHORED TO PREVENT WIND DAMAGE. |
| | SERRATED SLOPE | LOWERS VELOCITY OF SURFACE RUN-OFF.<br>COLLECTS SEDIMENT.<br>HOLDS MOISTURE.<br>MINIMISES AMOUNT OF SEDIMENT REACHING TABLE DRAIN. | MAY CAUSE MINOR FAILURES IF WATER INFILTRATES.<br>CONSTRUCTION COMPLIANCE. |
| WEDGE, ROTATIONAL AND TRANSLATIONAL SLIDING FAILURES WHERE SUB-SURFACE WATER CONTRIBUTES SIGNIFICANTLY TO THE PROBLEM | HORIZONTAL DRAINS BORED INTO AQUIFER | CAN SUBSTANTIALLY IMPROVE THE FACTOR OF SAFETY. | LONG TERM MAINTENANCE REQUIRED.<br>SPECIAL EQUIPMENT NECESSARY. |
| | FLATTEN BATTERS | READILY CONSTRUCTED WITH CONVENTIONAL PLANT. | INCREASED CAPITAL EXPENDITURE.<br>MAY REQUIRE MORE LAND. |

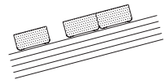
## B. FALLS AND TRANSLATIONAL SLIDES IN MIXED STRATA



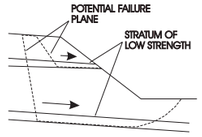

FALLS (I)
WHEN INTERBEDDED MATERIALS OCCUR IN A CUTTING, DIFFERENT WEATHERING RATES CAN CAUSE UNDERCUTTING. THIS PROBLEM OFTEN OCCURS WITH SANDSTONE CUTTINGS. (NEWCASTLE FREEWAY IS A GOOD EXAMPLE.)



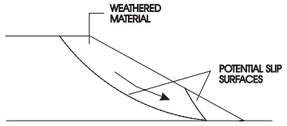
FALLS (II)
FALLS CAN ALSO BE INITIATED BY INSTABILITY HIGHER UP THE SLOPE OR WHERE THE SURCHARGE LOAD IS SUCH THAT THE STRENGTH OF THE LOWER STRATA BECOMES INSUFFICIENT.



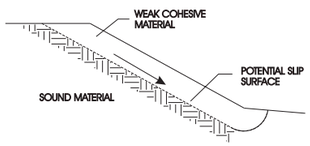
TRANSLATIONAL SLIDES (I)
INTERBEDDED MATERIALS IN A CUTTING MAY FAIL EITHER WITH A SINGLE TRANSITIONAL SLIDE (AS SHOWN) OR MULTIPLE SLIDES.




TRANSLATIONAL SLIDES (II)
WHEN THE BATTER CONSISTS OF BANDS OF STRONG AND WEAK MATERIAL, LARGE SECTIONS MAY MOVE TOWARD THE ROAD DUE TO LOSS OF SHEAR STRENGTH ON THE LOW STRENGTH STRATA.

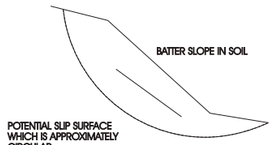



ROTATIONAL SLIDES
WEATHERED MATERIAL MAY FAIL ON A CIRCULAR PLANE DETERMINED BY THE POSITION OF THE SOIL/ ROCK INTERFACE.
THIS TYPE OF FAILURE IS OFTEN LOCALISED.

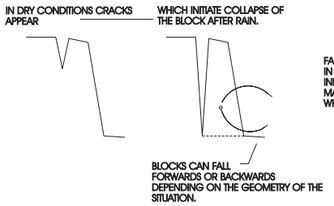



FLOWS
IF THE WEATHERED MATERIAL IS GRANULAR, SURFACE SLIDING CAN OCCUR ESPECIALLY WHERE SEEPAGE IS PRESENT. WHEN THE MATERIAL IS COHESIVE SUCH SLIPS TEND TO BE MORE DEEP SEATED. FOR BOTH SITUATIONS CAREFUL CONTROL OF SURFACE WATER CAN ASSIST STABILITY.

## C. FAILURE MECHANISMS IN SOIL




COHESIVE MATERIAL (WHICH CAN HAVE LOW SHEAR STRENGTH) IS VERY PRONE TO THIS TYPE OF FAILURE.




FALLS
IN COHESIVE MATERIAL, THESE FAILURES CAN BE INITIATED BY CRACKING CAUSED AS THE SURFACE MATERIAL DRIES DURING PERIODS OF DRY CONDITIONS; WHEN IT RAINS THE BLOCK CAN COLLAPSE

FLOWS
SOIL CAN BECOME SATURATED AND "FLOW" DOWN THE SLOPE

NB: ADAPTED FROM ROAD DESIGN GUIDE (RTA)

**SLOPE FAILURE TYPES AND VARIOUS METHODS OF TREATMENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**

DAINTREE
NATIONAL PARK
300m ON LEFT

Wet Tropics
Visitor Centre

G11-4(R)

Wet Tropics
Visitor Centre
300 m ON RIGHT

G11-2

Mission Beach
Bingil Bay
14
Tully
14

Wet Tropics
Visitor Centre

G11-3 (L)

Wet Tropics
Visitor Centre

G11-3 (R)

MISSION BEACH

EL ARISH

Mission Beach
Bingil Bay
14
El Arish

Wet Tropics
Visitor Centre

G11-3(R)

Mission Beach
Bingil Bay
14
EL Arish
Wet Tropics
Visitors Centre

TULLY

SOUTH MISSION

**COMBINED DIRECTION AND WET TROPICS SIGNING TYPICAL ARRANGEMENT**

**DEPARTMENT OF MAIN ROADS**
**ROADS IN THE WET TROPICS**
**NOT TO SCALE**