Northern Territory Government

STORMWATER AND DRAINAGE

# POLICY

# STORMWATER AND DRAINAGE

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**Owner:** Department of Transport

**Manager:** Transport Infrastructure Planning Division

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## GENERAL OBJECTIVES

An adequate stormwater drainage system is required for all subdivisions and developments adjacent to, or impacting upon, Territory road reserves. The design standards outlined in these Guidelines have two principle objectives:

1. the management of stormwater run-off to or from Territory road reserves
2. the management of stormwater run-off created or concentrated by developments and subdivisions contributing to catchment flows.

In addressing these objectives the following specific requirements should be considered:

1. Management of all stormwater run-off from the development and concentrated within the development site
2. Management of all stormwater run-off entering the development site
3. Provision of an effective and appropriate outlet for all stormwater run-off from the development site into existing stormwater systems or into a natural watercourse as defined in the *Control of Waters Act* (this requirement may involve work beyond the limits of the proposed development)
4. Consideration of the impact of the proposed development drainage system on existing drains and buildings and downstream catchments
5. Ensure all drainage structures are free flowing and do not become mosquito breeding grounds
6. Provide and maintain appropriate flood immunity on access roads and properties.

In designing the stormwater drainage system, the environment, surface and sub-surface water drainage flows, infiltration characteristics, ground water quality, sedimentation and erosion shall be considered. Relevant environmental and water management legislation, and any Development Permit (issued under the provisions of the *Planning Act*) conditions for the proposed development shall also be considered.

## DESIGN CRITERIA:

## General Requirements

Any subdivision or major commercial development proposal must have a complete drainage design plan which takes account of the ultimate development density based on the zoning of the land and appropriately consider effects external to the proposed development. Where a development is to be staged, an overall drainage plan for the whole catchment is to be provided before approval will be given for individual stages.

The design of stormwater systems shall conform to the methods and criteria set out within the current versions of the following publications and this policy, whether flow is within open channel systems or underground drainage systems:

1. Australian Rainfall and Runoff
2. The collection and discharge of stormwater from the road infrastructure – (ARRB Report No ARR 368)

Where a proposed development is located within an existing local government area, the drainage design standards of the relevant local government authority shall apply.

In the absence of such an entity or applicable standards, the general requirements of this policy shall apply.

Where any drainage works (including individual property connections) is within a road that is, or will become, part of the Territory road network, the standards outlined in this policy shall apply and specific approval from the Department will be required prior to construction.

Where drainage works or outlets are proposed within a drainage easement that is, or will become, in favour of the Territory or impact on Crown land, the proposal shall be referred to the Land Administration Division of the Department of Lands, Planning and the Environment.

## Concept Design of Drainage Works

Drainage systems shall be designed to cater for both minor and major storm events.

All stormwater runoff generated in a minor storm event in urban area is to be collected via an underground drainage system

Stormwater runoff from a major storm event (usually Q100) may be contained within floodways, which may include roadways, subject to the requirements of Table 2. Unless adequate overland flow paths are incorporated in the design, the major storm flows may also have to be contained in an underground drainage system.

Drainage systems for proposed developments shall be designed with due consideration to the following:

1. Public roads are to be considered as primarily for use by vehicular and pedestrian traffic and property access. Safety of roads is a paramount consideration in stormwater drainage design.

2. Existing overland flows across a property are to be accommodated as part of the design. Diversion of such drainage off site and concentration of flows onto the road reserve will not be permitted.

3. The design for subdivisions and major developments shall take account of the potential ultimate upstream development external to the proposed development site, at a development density and form allowed for by the land zoning at the time of development. Catchment assumptions (including development densities and percentage imperviousness of catchments) are to be discussed with the Department of Transport, the Department of Land Resource Management, the Department of Lands, Planning and the Environment and relevant local governments that may have an interest in the proposed development.

   The drainage system should be designed and constructed to a standard to cater for the upstream flows to be expected when the catchment is fully developed. This may include the upgrading of existing roadway drainage structures or outfall structures that have a critical influence on level control and flooding. Any requirement for drainage infrastructure external to the site to accommodate such flows shall be undertaken by and at the Developer's cost.

4. To ensure that the relative incidence of flooding downstream of a development is not made worse, all drainage shall be designed so that the outflow characteristics of the pre-existing catchment are maintained or improved post development for all storm events up to and including the Q100.

5. It is the Developer's responsibility to examine the complete downstream drainage network and determine the maximum capacity of the existing network.

   If the existing downstream drainage system does not have sufficient capacity to carry the design flows from the development, water shall be retained on the development site (detention basin and the like) to reduce the peak flows to the capacity of the downstream drainage network. Alternatively, the existing network shall be upgraded at the Developer's cost, to the satisfaction of the Department.

6. All drainage infrastructure (including side entry pits, letterbox pits and grated inlet pits) are to be free draining and be designed to convey stormwater run-off at self-cleaning velocities to sediment collection points designed into the system. Where there is a likelihood of low flows during the dry season, grassed swale drains should have a concrete invert, or an underground low flow system should be provided to suitable end points.

7. Where lots created by a rural subdivision are less than 2 hectares in area, the Department may require the construction of a piped stormwater drainage system in lieu of open drains for part of or for the entire subdivision.

8. No longitudinal stormwater, open unlined drains or cut-off drainage structures required for new subdivisions will be permitted in Territory road reserves.

9. The Department may at any stage of a development request appropriate documentation outlining the extent of potential flooding resulting from any storm event.

## Environmental and Health Considerations

Environmental considerations are major design requirements for drainage infrastructure. Subdivisions and development drainage design must achieve Best Practice Environmental Management as required by the *Waste Management and Pollution Control Act*. To achieve this, it is expected that the design be undertaken in consultation with the Department of Land Resource Management, the Department of Health, the Department of Lands, Planning and the Environment and other relevant Agencies, and consider the following:

1. Thorough planning for stormwater management and erosion and sediment control is essential. The Developer and his Contractor shall maintain all sediment and erosion control structures throughout the whole development period, including the construction and defects liability periods.

2. Any proposed works near or impacting upon waterways as defined in the *Water Act* requires prior approval under the provisions of the *Water Act*.

3. Generally waterways as defined in the *Water Act* shall be retained in their natural state in order to maintain the existing catchment outflow characteristics and aquifer inflow characteristics as required by the Water Act. Where applicable, the requirements of the Darwin Harbour Strategy shall also be met by the drainage design.

4. Stormwater discharged from a development site must be of a suitable quality to not adversely affect the downstream catchment (also refer the Water Act). Gross pollutant traps, silt traps and other water cleansing facilities shall be incorporated within/ throughout developments and in major drains before the drain enters freshwater or tidal creek lines. These are to be designed and located to produce optimum removal of pollutants (including organic nutrients from industrial processes) and silt, to minimise ongoing maintenance costs and requirements, and provide suitable maintenance access.

5. In commercial and industrial developments, pollutant control devices should be located at the source due to the nature and volume of pollutants typically generated.

6. Groundwater levels must be taken into consideration for drainage design. Sub-soil drains are to be provided to road infrastructure to protect road pavements from the effects of groundwater seepage. Any failure of infrastructure resulting from high wet season groundwater levels shall be reinstated and additional sub-soil drainage shall be installed at the Developer's cost.

7. Generally, stormwater discharge points shall be located to avoid areas with high ground water tables, groundwater discharge areas, low lying areas of restricted flow or salt affected land. Drains through tidal areas should follow the course of existing creeks or flow lines without any impedance. Drains away from tidal areas should be directed to a defined river or free draining creek line.

8. Where drainage outlets are influenced by tidal action, an appropriate analysis shall be undertaken to ensure that major storm criteria are met and that there will be no surcharging of stormwater pits for the minor storm events. Future estimated sea level increases due to climate change and storm surge levels must also be design considerations.

9. Water sensitive urban design (WSUD) elements could be considered for incorporation in new developments to minimise the impacts of urban developments on the natural water cycle and to protect the health of aquatic ecosystems. It can also be used to reduce both the peak flow and total volume of stormwater runoff, and to integrate stormwater management into the landscape. WSUD features must comply with the current version of the Medical Entomology Development Guidelines.

10. Where constructed wetlands (dams, ponds, retention basins, etc.) are incorporated into a drainage system, a risk assessment should be conducted to determine the potential for mosquito breeding, and a Mosquito Management Plan, including a costing of maintenance, shall be developed in consultation with Medical Entomology of the Department of Health to ensure the feature can be monitored and managed appropriately. Wetlands should generally be constructed as deep, steep sided lakes with stormwater discharged to the deepest point via a silt trap. Shallow vegetated areas have to highest potential for mosquito breeding.

11. Shallow stormwater detention basins should be designed as 'dry' basins to only pond water for a period of 3-4 days, to a maximum depth of 50 millimetres, and to be completely drained within 5 days of initial water ponding. In tidal areas, the drainage system must drain within 2-3 days.

12. The effects of salinity shall also receive due consideration.

**URBAN DRAINAGE DESIGN REQUIREMENTS:**

## Subdivision Drainage

Urban subdivision stormwater drainage designs shall be based on a system of sealed roads, kerbs and guttering, entry pits, underground pipes, lined catch drains, and sub-soil drainage as required. The design is to consider the contributing catchment as fully developed when determining "run-off coefficients" and "time of concentration". The system shall also provide adequate connection points for individual medium to high density residential, industrial and commercial lot drainage along the downstream sides of the property catchments. The end of the connection pipe inside the property boundary shall be terminated in a minimum 600 millimetres by 600 millimetres surcharge/inlet pit constructed in accordance with the current version of AS/NZS 3500 *Plumbing and drainage*.

Where drains are to be extended as a result of a pavement widening, existing drainage pits will not be permitted to remain in the trafficked lane as manholes. An underground junction pit is to be constructed in such a circumstance.

The recurrence intervals in Table 1 are the minimum requirement for developments where a new road element or network is created, or works impact on an existing strategic or local road network. Stormwater spread on roads shall be managed in accordance with the provisions of Table 2.

**Table 1: Urban Design Storm Average Recurrence Intervals**

| Road or Drain Type | Minor Storm (years) | Major Storm (years) |
|---|---|---|
| Arterial/Sub-arterial crossroad culverts | 50 | 100 |
| Sub-arterial/Distributor Road [1] | 5 | 100 |
| Collector/Local Road [1] | 5 | 100 |
| Property Access | Immunity period of the road it is accessing | |
| Trunk Drain | 20 | 100 |

Note 1: For commercial and medium to high density residential developments, the ARI to be adopted for the minor storm is 10 years.

**Table 2: Limits of Stormwater Spread (Urban Area)**

| Road or Drain Type | Minor Storm (years) [2] |
|---|---|
| Sub-arterial/Distributor Road | Flow shall not overtop kerbs and shall leave at least 3 metres width of travelling lanes free of water |
| Collector Road | Flow shall not overtop kerbs and shall leave at least 3 metres width of travelling lanes free of water |
| Local Road | Flow shall not overtop crown of road or kerbs |
| Trunk Drain | Not applicable |

Note 1: For limits of stormwater spread on arterial roads refer to the current Austroads *Guide to Road Design Part 5: Drainage Design*.

Note 2: For major storms the flow may spread to the road reserve boundary, but the maximum flow depth in the roadway shall not exceed 300 millimetres, nor shall DxV exceed 0.40, where D = maximum depth of flow in the traffic lane (metres), and V = velocity (metres per second).

## Impacts on Adjoining Arterial Roads

Subdivision development adjacent to an arterial road shall not adversely impact on the flood immunity of the arterial road. Where an increase in flow is expected as a result of a subdivision development, either at the initial stage or in the ultimate, the flow capacity of the arterial road drainage system and downstream structures shall be increased in size to maintain existing immunity. Alternatively, provision shall be made to restrict flows by means of flood detention basins or other proposals within the development site.

## Individual Lot Drainage

The following matters are to be taken into consideration when designing the stormwater drainage for individual lot development:

1. stormwater drainage shall be wholly contained within the site and discharged into the local underground stormwater system to the standards and approval of the Department. Discharge of stormwater from the Lot is to be managed to prevent uncontrolled discharge to adjoining lands through the provision of kerbing and inlet pits or other appropriate measures
2. discharge of drainage through kerbs and down driveways onto the road will not be permitted

3. for drains discharging from car parks or similar locations into the underground drainage system within the road reserve, gross pollutant traps shall be installed within the private property development.
4. for commercial and industrial developments, appropriate protection/ pollutant control devices shall be provided on site to contain potential spills of waste and prevent contaminants from entering adjacent properties, roadways, and the stormwater drainage system.

## RURAL DRAINAGE DESIGN REQUIREMENTS:

Rural stormwater drainage designs shall be based on a system of gravelled or sealed roads, table drains, entry pits, culverts, lined and/ or unlined catch and trunk drains, and sub-soil drainage as required. The design is to consider the contributing catchment as fully developed consistent with its proposed ultimate land use when determining "run-off coefficients" and "time of concentration".

Rural development drainage should be designed to minimise disturbance to the environment. As far as possible, drainage patterns should be undisturbed and the concentration of runoff avoided.

Typically, roadside open drains in rural subdivisions shall be designed to accommodate run-off in accordance with Table 3. Open drains in easements or drainage reserves shall be designed and capable of conveying the 1 in 100 year storm.

Where pipes or culverts are constructed within roadside drains to accommodate driveway crossovers, these structures shall be sized so as not to restrict the design capacity of the drain and must be offset from the road carriageway to a distance outside the clear zone of that road.

The recurrence intervals in Table 3 are the minimum requirement for developments where a new road network is created, or works impact on an existing strategic or local road network.

**Table 3: Rural Design Storm Average Recurrence Interval**

| Road or Drain Type | Transverse Drains Under Road - For ARI (Years) | Trafficability of Road - For ARI (Years) | Contained in Road Reserve - For ARI (Years) [1] |
|---|---|---|---|
| Sub-arterial | 10 | 10 | 20 |
| Collector Road | 5 | 10 | 20 |
| Local Road | 5 | 10 | 20 |
| Property Access | Immunity of the road it is accessing | | |
| Trunk Drain | 20 | - | 100 |

Note 1: For major storms the flow may spread to the road reserve boundary, but the roadway is to be available for emergency vehicles (i.e. maximum flow depth shall not exceed 300 millimetres) with DxV less than 0.40, where D = maximum depth of flow (metres), and V = velocity (metres per second).

Note 2: Trafficability is defined in appropriate Austroads publications.

## DRAINAGE RESERVES AND EASEMENTS:

### General Requirements

Drainage reserves and/or easements may be created over subdivision drainage systems where the system would be handed over to the Northern Territory Government for maintenance (i.e. in areas where no local government authority exist/unincorporated areas).

Wherever practicable, drainage reserves and easements shall not sever lots. If necessary, the subdivision lot layout shall be revised so that drainage reserves/easements are adjacent to lot boundaries (other than road frontages).

Where the depth of flow for a minor storm (refer Table 1) in drains within drainage reserves is greater than 500 millimetres, the drainage reserve shall be created and fenced.

Where necessary, vehicle deflection barriers shall be provided adjacent to large drainage openings.

## Drainage Reserve and Easement Widths

All drainage infrastructure located within private land in unincorporated areas must be located centrally within an easement or reserve, vested in the Territory.

Drainage easements/reserves shall be wide enough to include a drain sufficiently sized to cater for the design criteria of Table 1, Table 2 or Table 3 as appropriate.

Drainage easements shall be a minimum of 3 metres wide for pipe diameters of 450 millimetres or less and depths up to 1.5 metres. For greater pipe diameters and depths, an increase in easement width is to be provided, as determined by the Department.

Drainage reserves shall also be wide enough to include:

1. a buffer of 2 metres between an adjacent property boundary and the edge of an underground drain, or the edge of an open drain's top of batter
2. a 5 metre wide access corridor along one side of an open or underground drain to enable access for inspection and mechanical maintenance (i.e. mowing or slashing)

Easements and reserves created within local government areas shall be vested in and meet the relevant standards of the local government entity.

## Selection of Drainage Reserve or Easement

Table 4 outlines the Department's requirements and differences in selecting either a drainage easement or drainage reserve.

**Table 4: Drainage Reserve/ Easement Requirements**

| Drain Scenario | Easement or Reserve |
|---|---|
| Man made, suitable for grazing; drain batter slopes are less than 1 in 6; or natural shallow flat drain maximum 500 mm deep | Easement |
| Man made or natural deep open lined or unlined drain; un-trafficable; unsuitable for grazing; hazardous to livestock; drain batter slopes are greater than 1 in 6; and/ or the depth exceeds 500 mm | Reserve |
| Piped drain without surface inflow or overflow structures | Easement or Reserve |
| Piped drain with surface inflow or overflow structures | Reserve |
| Perched swamps and lagoons and Natural water courses | As required by the controller of the *Water Act* |

### DRAINAGE STRUCTURES:

All drainage structures shall conform to the current version of AS 3600 *Concrete Structures*.

All drainage infrastructure must be reinforced concrete of suitable strength, manufactured, constructed and tested to relevant Australian Standards.

Structures within marine environments and areas subject to tidal influence shall be seawater resistant over the life of the structure.

## Underground Structures

To avoid silting of drainage systems, the allowable minimum size of underground drainage structures, whether used as transverse or longitudinal drainage systems within Territory road reserves, shall be as follows:

1. 375 millimetre diameter pipes, with appropriate cover for the type of pipe used; or
2. 450 x 450 millimetre reinforced concrete box culvert structures.

Underground structures shall be free from silt and debris. This will be verified through a camera inspection of the underground structures prior to handover.

## Drainage Pits and Structures

All manholes, pits and lids are to be in accordance with Northern Territory Government standard drawings and designed to withstand expected loadings for the environment. In industrial and other areas subjected to heavy vehicle and road train movements, pit structures and lids shall be of an appropriate loading class for industrial traffic (i.e. heavy duty). Where precast frames, grates and covers (e.g. heavy duty Durham or GRD industrial pits) are used, it shall be installed in accordance with manufacturer's instructions.

Side entry pits are to be located so as not to hinder the construction of driveways, and upstream of pedestrian crossings to limit the spread of flow to maximum 500 millimetre with a 20 year design storm. Spacing of side entry pits shall be designed to ensure minimum flow widths and depths as specified in Table 2.

Where catch drains discharge to a piped drain, the catch drain shall discharge to a letter box pit constructed in accordance with the Northern Territory Government standard drawing C(S)-1010.

The clearance (throat distance) between the invert and underside of side entry and letter box pit lids or lid supports shall be a minimum of 100mm. Where the inlet clearance is greater than 150 millimetres, a 12 millimetre diameter bar shall be placed across the opening for safety purposes.

Stormwater drainage manholes are to be constructed at all pipe junctions and changes in pipe direction, diameter or grade where side entry pits are not provided. Manholes are not to be placed in the road pavement.

Pipes entering manholes and inlet pits are to be finished flush with the internal wall of the manhole and shall be grouted in accordance with the specification. Cut ends of pipes are to be treated with epoxy or similar to protect exposed steel.

Grated pit covers are to be designed and constructed in accordance with the current version of AS 3996 *Access covers and grates* for heavy traffic loading and shall not present a hazard to cyclists or pedestrians.

Internal dimensions for all drainage pits shall be in accordance with the current version of AS 3500 *Plumbing and drainage*.

## Culverts

Culverts shall be designed for a minimum exposure classification of B1 in accordance with AS5100 *Bridge Design*. Culverts used for saltwater applications shall be designed for an exposure classification of C in accordance with AS 5100 *Bridge Design.*

Culvert inlets and outlets must have appropriate protection works to reduce scouring of the headwalls/endwalls.

## Open Drain Structures and Table Drains

Large open drains will only be permitted within dedicated drainage reserves in urban areas. Public safety and amenity are the main priorities in the design of these drains.

Open drainage structures are to comply with the following requirements:

1. A risk assessment of the drain and proposed mitigation measures are to be provided as part of the stormwater management plan.
2. The design of open drains shall be based on an assessment of local conditions, including the erodability of the soil, expected flow velocities and other relevant factors. In locations subject to scour erosion, appropriate drain base and batter protection shall be provided to prevent erosion.
3. Where velocities exceed 1.0 metre per second, additional scour protection shall be provided. Drain base and batter scour protection shall also be provided at all changes of direction or drop structures, and at inlets and outlets of pipe or culvert structures.
4. The design of open drains shall consider future maintenance requirements, e.g. drains are to be constructed and access provided so that mechanical maintenance by slashing or mowing is possible.
5. Side slopes (batters) of grassed drains shall not exceed 1 in 6.
6. Side slopes (batters) of table drains shall not exceed 1 in 6 as far as practicable. Where table drain side slopes exceed 1 in 6, clear zone and vehicle recovery requirements shall be considered and appropriate protection provided.
7. The maximum depth of flow shall be 750 millimetres and a minimum of 150 millimetres freeboard shall be maintained to the Q100 flows. For roadside drains, the top water level for the design storm (minimum 5 year ARI) is to be 100 millimetres below the subgrade level of the road shoulder.
8. The top water level at Q100 flows is to allow emergency access at all road crossings, and shall not be allowed to enter into any building lots.
9. The maximum DxV shall be 0.6 $m^2/s$, where D = maximum depth of flow (metres), and V = velocity (metres per second).
10. Where public access is possible, safety barriers and warning devices shall be provided (e.g. pedestrian hand rails at road crossings of a drain, or pedestrian barrier fencing with locked maintenance access). Appropriate safety measures are also to be provided to protect the public from being trapped within a drain during flash flooding.
11. Open drains with grades of 0.5 per cent or less shall, depending on the local environment, consider inclusion of an impervious lining at the base of the drain to achieve free flowing and minimise the breeding of mosquitoes.
12. Dry season low flows are to be collected within underground infrastructure in urban areas.

## Property Access Structures

Rural property accesses as defined in these Guidelines that cross roadside drainage paths shall include an appropriate drainage structure in accordance with the Northern Territory Government's standard drawing C(S)1206 and Table 3 so as not to disrupt the roadside flow path.

If a culvert structure is to be used, it shall be in accordance with Department of Transport Technical Policies. All culverts shall be provided with wing walls and aprons, not end walls, including upstream and downstream protection.

Where the depth of the flow path is too shallow to cater for the minimum sized drainage structures outlined in this policy, the Developer shall provide a bed level reinforced concrete invert structure as detailed in standard drawing C(S)1206. The invert shall match into the adjacent drain's true surface (i.e. not into a bed of silt) and include downstream protection to stop scouring.