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APPENDICES

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1 Introduction

The PWA is responsible for all public foul sewerage, surface water and ground water drainage systems in the State of Qatar.

All applications for sewerage and drainage for servicing new developments are subject to approval by the Drainage Affairs as part of the Building Permit approval procedure before such facilities can be built.

This Developer's Guide is for small developments up to 350 persons, where the peak flow does not exceed 5l/s. Larger developments should be designed in accordance with the requirements of Drainage Affairs' Vol 2 – Foul Sewerage design manual.

1.1 House Connection

A house connection is defined as the connection from a development (comprising domestic, commercial, industrial, institutional premises, etc) to transfer foul flows to the public sewerage system.

For every house connection, a terminal manhole (Manhole Number 1 – MH1), in accordance with the Standard Drawings, should be provided and should be positioned as shown on Drg no. FS 12.

The terminal manhole should normally have maximum depth 1.2m. The depth of first Inspection Chamber should be 0.45m.

All house connections should comply with the following general principles:

- They should be designed and constructed to enable foul flows to pass to the public sewer without flooding or surcharge
- They should be of 150mm minimum internal diameter
- They should be laid at minimum gradients 1:60
- They should be constructed to watertight standards in accordance with the standard drawings and specifications
- The last Inspection Chamber is known as MH1 (terminal manhole) shall be located within the property boundary but is PWA property.

The private sewerage system shall be designed and constructed as a separate system, capable of accepting foul flows only. Illegal connections allowing the entry of storm water runoff shall not be made to the foul sewerage system.

House connection to existing pipelines should be made preferably to the nearest manhole whenever possible, or failing that to a Y-junction previously incorporated into the pipeline during its construction, to facilitate future connections. Y-branches and saddles are not to be added to existing pipelines to avoid the permanent damage resulting from such modifications to the public sewer.

Y branches will only be approved by DA if manholes are impractical due to access restrictions

Sewer must be surrounded with a Grade OPC 20 Concrete in case of :

§ The pipe under the Foot path and the depth less than 0.9m

§ The pipe under the Carriageway and the depth less than 1.2m

Standard details of house connections, rider sewers, etc are shown in Standard Drawings
FS 11,12 &13.

2 Procedure for Building Permit Application

The basic procedure for application and approval of drainage facilities for developments is as follows;

- Open a building permit file at the Planning Affairs
- Produce Outline Design
- Obtain utility approvals
- Obtain DC1 approval
- Obtain DC 2 approval
- Collect building permit

The information that Drainage Affairs require to enable them to approve the development is contained in Appendix 1.

Drainage Affairs requirement vary according to the nature of the property. A list of properties and the associated requirements is provided overleaf. The list is a guide and is not limiting.

The provision of septic tanks or holding tanks will only be necessary where there is no existing sewerage system to connect to. Further information on the choice between septic tank and holding tank is provided in Section 3.5.

Table 1

Table 2.1 - Foul Sewerage Requirements

Category	Type of Development	Septic Tank	Holding Tank	Sand trap	Petrol Interceptor	Oil/ Grease trap	Chemical stabilisation / dilution	Screen	Swimming Pool Discharge Control
Residential	Single Unit	P							P
	Multiple Units /Multi Storey		P						P
Commercial	Office (small / large)	small P	large P						
	Shops (small / large)	small P	large P						
	Restaurants / Food Outlet	small P	large P			P			
	Poultry shop							P	
	Shopping Mall	P	P			P			
	Hotels		P			P			P
	Sports Clubs		P			P			P
Industrial	Garages	P			P	P			
	Car Washing	P		P					

Category	Type of Development	Septic Tank	Holding Tank	Sand trap	Petrol Interceptor	Oil/ Grease trap	Chemical stabilisation / dilution	Screen	Swimming Pool Discharge Control
	Petrol Station	P			P				
	Abattoir		P					P	
Farm	Livestock		P					P	
Public Service	Mosque		P						
	Hospital / Clinic		P				P		P
	Laboratory		P				P		
	School		P						P
	School with laboratory		P				P		P
	University / College		P				P		P
	Offices		P						

3 Foul Sewerage Design Criteria

3.1 General

Sewerage and drainage design shall generally comply with the requirements of EN 752 Drain and Sewer Systems outside Buildings. Particular requirements are detailed in the following sections.

3.1.1 Domestic Flows

Domestic flows derive from normal domestic appliances such as sinks, basins, toilets, showers, washing machines, baths, etc. and are dependent on the number of persons in a dwelling. In order to determine suitable domestic contributions to the sewerage system, it is necessary to make certain assumptions. For example, each property has to be assumed to house a certain number of persons, and this will vary from one type of property to another. For design purposes 270 litres per person per day should be used.

Peak flows from domestic properties are calculated on a Design Unit (DU) For ease of use a table of populations, design units, peak flows and average flows is provided in Appendix 2.

3.2 Sewerage System Design

The sewerage system should be designed to facilitate flows within the development by gravity, in a branched arrangement of small sewers from buildings connected to the main sewer leading to MH1.

Manholes/inspection chambers and sewers should be sited wherever possible a minimum of 1.5m from any structural building line

Building over sewers, or directly adjacent to them, causes major problems with access for maintenance and renewal. In extreme cases demolition may be required, and therefore building over sewers should not be carried out.

Foundations and basements of buildings should be designed to ensure that no building load is transferred to the sewer. The general principles of foul sewer design are:

- Pipe size should not decrease downstream.
- Sewers should be designed to convey peak flows without surcharge.
- Sewers should achieve self-cleansing velocity at least once per day.
- To allow for ventilation of the system, maximum design depth of flow should not exceed $0.75 \times$ pipe diameter.
- Inspection chambers should be provided at each junction, change of diameter, change of direction, change of gradient and at the head of each system.
- Inspection chambers should be provided where the connection from each building meets the main sewerage system of the development

- Spacing between inspection chambers should not exceed 30m.
- At inspection chambers, all pipes should be laid such that their soffits (tops) are at the same level.

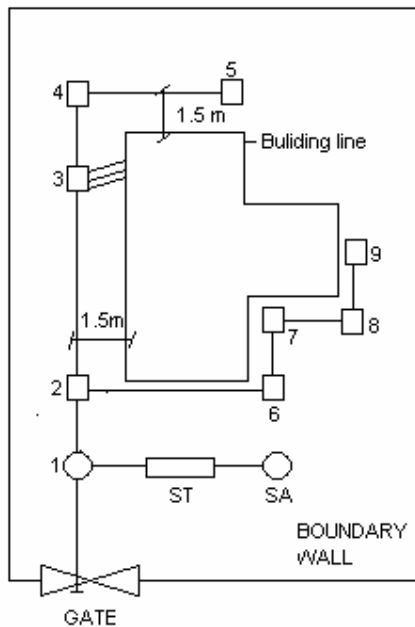
3.2.1 Minimum Pipe Sizes and Gradients

The minimum size of external sewer from each building is 150mm at a gradient of 1:60.

3.3 Manholes and Inspection Chambers

All manholes and inspection chambers within the development shall have their own unique reference number. Manholes and chambers shall be numbered in ascending order upstream from the terminal manhole MH1. Foul manholes shall be prefixed F and stormwater manholes shall be prefixed S.

Manholes and chambers at the head of each system shall include min 75mm or (1/2 x d) piped vents fixed to adjacent walls and exiting at roof level.



Layout plans for both foul and storm water systems shall contain schedules as follows:

MH Ref	Cover Level	Invert Level	Depth	MH Dia	Cover Type

All levels and dimensions are to be in metres to Qatar National Height Datum (QNHD).

Standard manhole/inspection chamber sizes are.

SCHEDULES OF INSPECTION CHAMBERS

MH. SIZE (mm)	DEPTH (m)	COVER.SIZE (mm)	COMMENTS No. of Connections from Buildings
600X600	< 1.2	600X600	Up to 3 bldg. connections each side
1200X600 1220 x675	< 1.2	1200x600 1220x675	Up to 7 bldg. connections each side
900 DIA	> 1.2	600X600	MH 1

The Cover Type for Manholes depend on the Location:

- § For foot traffic it should be Light Duty (LD)
- § For slow light vehicle traffic it should be Medium Duty (MD)

3.4 Pipework

3.4.1 Materials

The preferred material for foul sewers is extra strength vitrified clay pipes and fittings to BS EN 295 or PVC-U to EN1401-1, with flexible joints.

Material

Pipe size mm	Min Crushing Strength KN/ m ²
150	34
200	40

No concrete or asbestos cement pipes shall be used as they will be eaten away by sewer gasses.

Pumping mains may be flexibly jointed ductile iron pipes (it is recommended that these are lined internally with fusion bonded epoxy, ceramic epoxy, or polyurethane to resist sewage gases) or HDPE. uPVC should not be used as it is brittle and can fail.

3.4.2 Construction

Construction should be in accordance with the Standard Drawings provided with this document.

3.5 Building Drainage

Requirements for building drainage are applicable to domestic buildings or small non-domestic buildings. Systems are generally located within the building and above ground level, unless the building has a basement. Complex systems in larger buildings should be designed to BS EN 12056.

Building drainage of basement and ground floor shall employ a twin pipe system for separate discharge of soil and waste flows to foul sewage manholes, as shown below:

Source of Discharge	System to which Discharge is to be made
Toilet, urinals	Soil
Bidet	Soil
Wash basin, bath, shower	Waste
Kitchen	Waste

Building drainage of first floors and above shall employ a single pipe system.

Swimming Pools: To prevent flooding of the sewerage system the discharge from swimming pools shall be limited to a maximum flow rate of 10 l/s. Positive means of flow control shall be provided such as a sharp edge orifice plate (50-60mm), a locked flow control valve or a small diameter pipe (e.g 50mm x 3m long or 75mm x 10m long). As the flow control will be dependent upon the particulars of the swimming pool installation the developer shall provide calculations to demonstrate the design of the flow control device.

3.5.1 Construction

All sewerage and waste discharge pipes inside the building as far as the manhole should be PVC-U (unplasticised polyvinyl chloride) to BS 4660 and EN1401-1 with push-fit joints incorporating elastomeric sealing rings to provide flexibility at joints.

Constructing pipelines below building should be avoided where possible. Where unavoidable the design shall ensure that neither the structural integrity of the pipeline or the building is compromised.

Pipeline trenches should not be excavated lower than the foundations of the building unless concrete bedding and surround are used to the lowest level of the building foundation.

3.6 Septic Tanks, Holding Tanks and Soakaways

Septic tanks and soakaways are used to store and treat foul flows from premises, prior to future connection to the main sewerage system. They comprise an underground tank for anaerobic treatment followed by a soakaway tank or pipe system to encourage effluent flows to percolate into the surrounding ground.

Septic tank standard details are shown in dwgs FS 20 & 21; soakaways for use with septic tanks are shown in SW14.

Since septic tanks only provide partial treatment, these tanks are a major source of groundwater pollution and therefore should not be constructed where the main sewerage system is available. For existing developments, house connections from Manhole number 1 to the main sewerage system should be made at the earliest opportunity, and usage of the septic and sewage holding tank stopped.

3.6.1 Ground Conditions

Since the soakaway relies for its operation on outflows infiltrating into the surrounding ground, it is vital that the ground conditions allow such infiltration. Ground that is of low permeability or with high existing water table will prevent percolation taking place, and the septic tank system will fail.

Groundwater levels in many parts of this country have risen markedly in recent years, due to:

- § the flat and undulating topography resulting in localised depressions in the underlying impermeable layers. Such areas are without efficient drainage routes, and hence susceptible to rises in groundwater levels during heavy rainfall.
- § Urban development has increased flows soaking into the ground, due to septic tanks, water supply leakage and irrigation. The result has been significant rises in groundwater levels, due to limited permeability of the ground.
- § Ground conditions and permeability are highly variable even within very localised areas;
- § Most groundwater levels rise by between 1.0m and 1.5m during a wet period when monthly rainfall exceeds 30mm. Level rise reduces to between 0.5m and 0.6m nearer the coast;

Where soakaways do not work Holding Tanks should be provided for a period of 2 days (min) storage.

Any proposed septic tank soakaway system must demonstrate that the surrounding ground has satisfactory permeability.

3.6.2 Design Issues

The following issues require consideration when the use of soakaways is contemplated. The list is indicative only and site-specific geotechnical and hydrogeological investigation and interpretation is always required as the basis for successful design.

For the standard ring-type soakaway chamber some 3m overall depth it is recommended that:

- § The minimum (wet season) groundwater depth should be more than 3.5 m below ground level;
- § In areas where groundwater levels are rising use the groundwater depth should be more than 4 m below ground level as a precautionary measure.

The permeability of the ground has a significant influence on the ability of soakaways to function. If the permeability is attributable to sub-vertical jointing which is very variable over short distances and use of trench type soakaways may overcome this because the chances of encountering fissured zones is increased. For soakaways permeability (k) of more than 1×10^{-5} m/s required

Soakaways can become inefficient due to becoming 'clogged'. This may be due to silting up (which can occur early as the initial 'slug' of water laden with silt generated when groundwater is disturbed during construction work), and/or 'smearing' when the soakaway is drilled (i.e. the fissures are blocked off by the crushed drill cuttings). These problems may be minimised by jetting the system clean prior to its first use.

3.6.3 Siting of Septic Tanks and Soakaways

Septic tanks should be sited min 7m from any habitable parts of buildings.

The septic tank must be sited in a location where a suction tanker can get to it to empty it. The bottom of the tank should be less than 3m below the level where the vehicle will stand.

Where practical the soakaway should be located at a minimum of 5m from the septic tank or any other structure. The soakaway should not be located within 10m of potable water supplies in order to avoid possible cross-contamination.

3.6.4 Design and Construction

Septic tanks for domestic use should have a capacity below the level of the inlet of at least C litres where:

$$C = (225P + 2000)$$

C is the capacity of the tank (in litres) with a minimum value of 2900 litres.

P is the design population with a minimum value of four.

Septic Tank : Size and Type

Population	Drainage Affairs Type	Capacity (litres)
4	A	2,900
10	A	4,500
20	B	6,500
40	C	11,000
80	D	20,000
100	E	24,500
200	F	47,000
300	F	78,500
350	F	80,750

Where septic tanks are required to accept discharges from other than domestic sources, details of actual flows shall be provided.

Septic tanks are to be constructed in accordance with the Standard Details Drg. Nos. FS20 or FS21 as appropriate, or approved alternative prefabricated tanks. Tanks shall be watertight and prevent leakage of their contents and ingress of groundwater. Ventilation is to be provided with outlets distant from habitation.

The inlet and outlet of the septic tank shall be designed to prevent disturbance to the surface scum or settled sludge, and shall incorporate at least two chambers or compartments operating in series. Where the width of the tank does not exceed 1200mm the inlet should be made via a dip pipe. To minimise turbulence, provision shall be made to limit the flow rate of the incoming foul water. For incoming pipes up to 150mm diameter, the velocity shall be limited by laying the last 12m of the incoming pipe at a gradient of 1 in 50 or flatter.

The inlet and outlet pipes of the septic tank shall be provided with access for sampling and inspection.

Septic tanks shall be provided with facilities for emptying and cleaning. Access covers shall be of durable quality having regard to the corrosive nature of the tank contents. All access shall be lockable or otherwise engineered to prevent unauthorised entry.

3.6.5 Warning Notice

A notice shall be fixed within an adjacent building describing the necessary maintenance. The wording shall be in Arabic and English "The foul sewage system from this property discharges to a septic tank and soakaway. The septic tank requires monthly inspections of the outlet chamber or distribution box to observe that the effluent is free flowing and clear. The septic tank requires emptying at least once every 12 months by a licensed contractor.

The property owner is legally responsible for ensuring that the system does not cause pollution, a health hazard or a nuisance.”

3.6.6 Sewage Holding Tanks

Where soakaways cannot be permitted due to unfavourable ground conditions or the number of units delivering to the tank is high, it will be necessary to provide a sewage holding tank.

The site of the sewage holding tank should preferably be on ground sloping away from and sited lower than any existing building in the immediate vicinity.

The tank shall be sited at least 7m from any habitable parts of buildings and preferably down slope. Sewage holding tanks shall be sited such levels that they can be emptied and cleaned without hazard to the building occupants or the contents being taken through a dwelling or place of work. Access to the tank may be through a covered space, which may be lockable.

Sewage holding tanks should have a minimum capacity for the population range as shown in the Holding Tanks Capacity table.

Thereafter the size should be calculated as follows:

$$\text{Volume (m}^3\text{)} = \text{Population} \times \text{Retention} \times 0.27$$

Where the calculated volume is less than the minimum shown the minimum capacity is to be provided.

Holding Tank Capacity

Population.	Retention (days)	Size (m ³)
2 - 20	25	18 - 135
21-40	20	135 - 216
41- 80	15	216 -324
80 - 150	12	324 - 486
150- 350	10	486 - 945

Tanks should be designed as water retaining structures, and be constructed in reinforced concrete, or alternative watertight material. The design of the tank shall ensure watertightness and provide protection from external corrosion.

Sewage holding tanks should have no openings except for inlet, outlet and ventilation. Tanks should be provided with access for emptying and cleaning. Access covers shall be of durable material, having regard for the corrosive nature of the tank contents. Every access should be lockable or otherwise engineered to prevent unauthorised entry.

The developer shall be responsible for making satisfactory arrangements with the Drainage Affairs for emptying of the sewage holding tank. Details of all maintenance arrangements

will require to be approved by the Drainage Affairs prior to approval of the building permit application.

3.7 Pumping Stations and Rising Mains

Pumping stations should only be used where it is impossible to gravitate into the PWA main sewerage system. Bypassing or overflowing from pumping stations is generally not practical therefore failure of the pumping station may result in discharge of sewage to the surrounding land or within the property

Responsibility for operation and maintenance of all pumping stations and rising mains will remain with the developer. This Guide provides general information for pumping installations. It is recommended that specialist advice be sought, supported by manufacturers' recommendations.

3.7.1 Rising Mains

The desirable range of velocity should be 1m/s to 2m/s. If small pipes are (75mm) used then the pump should be able to chop up the sewage.

The roughness value used for the design of the rising main should be shown in the calculations and should be in accordance with "Tables for the Hydraulic Design of Pipes, Sewers and Channels" published by HR Wallingford. The following roughness values (ks) shall generally apply:

Mean Velocity in m/s	ks
Up to 1.1m/s	0.3mm
Between 1.1m/s and 1.5m/s	0.15mm
Over 1.5m/s	0.06mm

In the design of pressurised pipelines, thrust blocks are to be provided on flexibly jointed pipelines where any pipe movement would open up the joints in the line and cause water leakage.

Thrust blocks are also necessary near valves where a flexible joint is located to facilitate removal of the valve for maintenance purposes.

The size of block is dependent upon the deflection of the flow, the size of the pipe and the head of water inside the pipe.

3.7.2 Pumping Stations

Submersible Pumping Stations

It is expected that the maximum flows to be pumped will be less than 5l/s, for which submersible pumping stations are to be provided. Submersible pumping stations should incorporate the following features:

- Minimum of one duty and one standby pump with all pumps being of the same make and pump model number.
- Pumps and associated equipment suitable for the duty required.
- Non return and gate valve for each pump isolation.
- Operation level controls (either electrode or ultrasonic) as follows:
 - High level alarm
 - Pump start
 - Pump stop
 - Low level pump protection in addition to the method installed for pump control.
- Ultrasonic level controls should be configured to hold the last measurement in the event of a lost echo.

Design Requirements

Detailed design should incorporate the following:

- There should be sufficient space between the pumps to prevent interaction between the pump suction.
- Pump stools should be securely bolted to the structural concrete of the sump and not the benching.
- Discharge and non return valves to be in a separate easily accessible chamber adjacent to the pump sump and not located within the pump sump.
- Pump guide rails should rise close to the underside of the sump covers above the pumps.
- The covers should have a clear opening large enough to allow the removal of the pump while on the guide rails.
- Support points for the pump power cables and lifting chain should be provided under the pump covers, these should be easily accessible from the surface.

Details of the capacity, power consumption and efficiency of the proposed pumps should be submitted for approval. It would be expected that pumping stations would comply with the pump manufacturer's requirements.

Submersible Pump Requirements

Sewage pumps should have an open type impeller with a minimum passage of 100mm unless chopper pumps are being used. Impellers with smaller passages are likely to suffer from frequent blockage due to the nature of sewage debris.

Centrifugal pumps are recommended to have a maximum running speed of 1450 rpm (4 pole motor) pumps. Speeds in excess of this we cause excessive wear and premature failure.

The maximum allowable starts per hour should be as specified by the pump or motor manufacturer. In the absence of any specified figure a maximum of 15 starts/hour is acceptable.

Structure Requirements

The developer shall supply full details of general arrangement and structural drawings and supporting calculations for approval.

Package pumping stations contained in GRP or Polyethylene structures as supplied by the pump manufacturers are acceptable. The structures are to be surrounded by a minimum of 150mm of OPC20 concrete.

All other pumping stations shall be constructed of reinforced concrete, designed in accordance with BS8110 "The Structural Design of Concrete" with specific requirements for wet wells of BS8007 "Design of Concrete Structures for Retaining Aqueous Liquids". Design crack widths shall be in accordance with BS8007 and shall not exceed a maximum design surface crack width of 0.20mm from direct tension, flexure and temperature effects.

Ventilation and Odour Control

Small pumping stations generally do not require odour control. However, where odour control is required passive activated carbon unit should be sufficient.

Electrical Requirements

All electrical equipment, cabling and installations shall meet the requirements of the KAHRAMAA.

Control equipment shall be housed in dust and damp-proof, compartmentalised cubicles, complying with the relevant British Standards. Adequate anti-condensation heaters are to be provided in all compartments. All outdoor equipment shall be waterproof. All control panels shall be provided with a 13-amp single-phase power outlet and a 25-volt outlet for a portable inspection lamp.

Emergency stop, lock-off buttons shall be provided adjacent to all plant installations. Unless specifically designed for submersible operation, all electrical plant shall be located above maximum water level.

Site Requirements

Pumping stations will generally be located with the development site. Consideration should be given to the need for light vehicle access for maintenance purposes.

4 Storm Drainage

4.1 Introduction

The purpose of this guide is to advise developers of the Public Works Authority (PWA) requirements for the provision of surface water and ground water management within development sites.

The existing surface water and groundwater systems in Qatar are of limited extent. Primarily these systems manage surface water runoff and control groundwater levels for the highways. Urbanisation of the catchments increases the amount of potential runoff from development sites which would cause overload of these systems. This guide has therefore been developed to guide and assist developers in designing a managed drainage system that does not adversely affect the existing drainage network but will provide protection from flooding for the development.

This guide sets out the criteria that Drainage Affairs (DA) requires developers to follow for the provision of a Managed Drainage Systems for the disposal of surface water and groundwater.

Drainage Affairs have developed Advice Notes for four types of development which contain information on how the Managed Drainage System approach can be achieved.

The types of development specified are as follows:-

- single residential development
- residential compounds
- tower blocks
- zonal & regional development

Figure 1 indicates the decision process for the appropriate type of development.

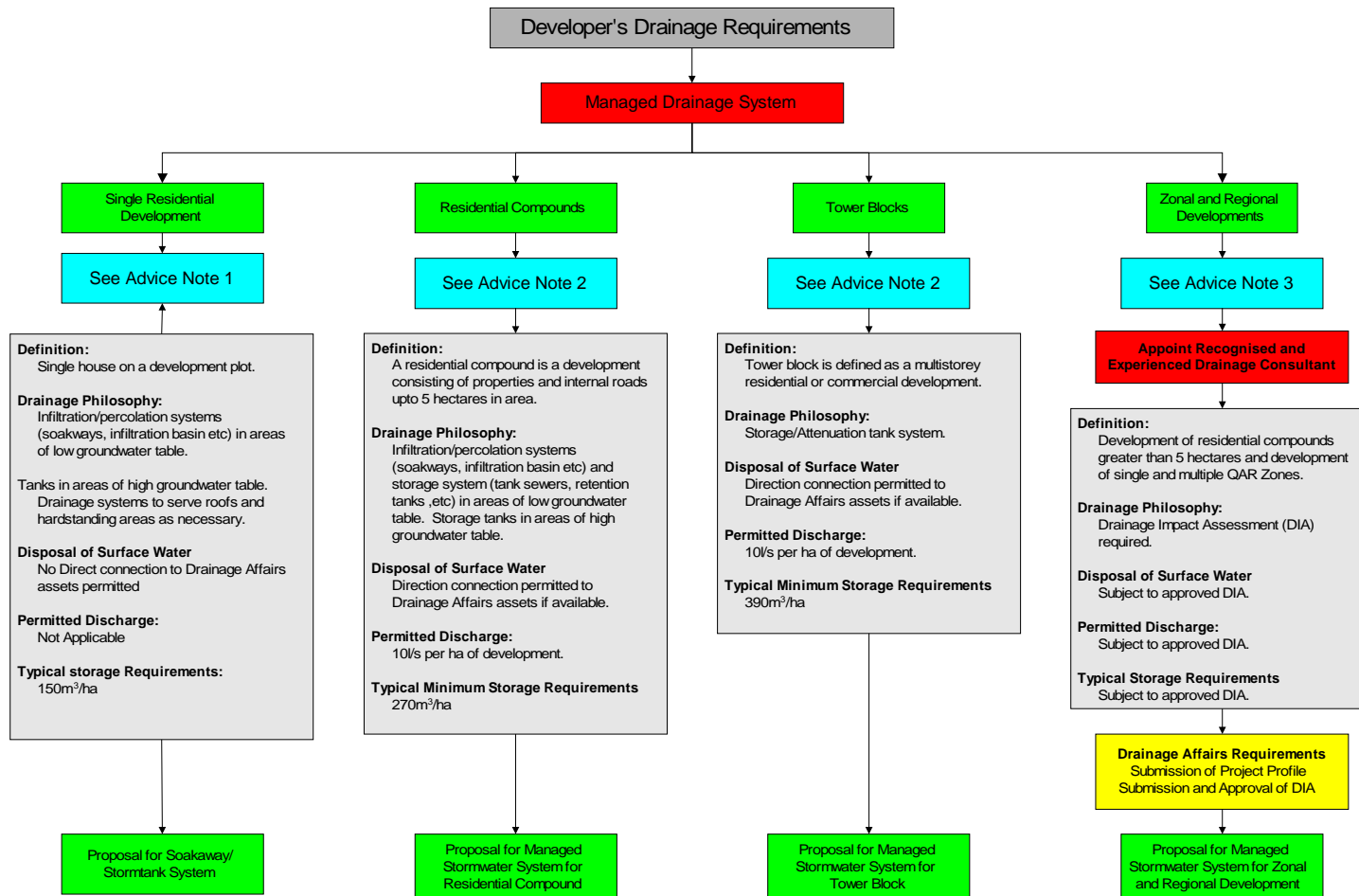


Figure 1: DEVELOPERS DRAINAGE REQUIREMENTS

4.2 Managed Drainage Systems

The Developer should consider a number of basic principles before commencing with a site layout plan as follows:-

- § Site topography with respect to site levels should be studied in detail. Development in the lowest parts of the sites should be avoided. The lowest parts of the site can be used to store and collect any stormwater runoff minimizing the construct costs of piped networks. Building on the highest part of the site may reduce amount of protection from flooding that is required.
- § High groundwater tables can cause problems not only during construction but afterwards with damage to underground structures and utilities. Drainage Affairs have information available on the areas in Qatar where high groundwater is a problem and can provide guidance as to its control. If a site is water logged filling the low lying areas does not remove the problem, it only hides it from view. A long term solution is needed which may include ground water control.
- § Drainage Affairs require surface water runoff to be managed and controlled for all developments and therefore adequate provision should be made in all developments for the storage/attenuation of stormwater runoff.
- § Ground conditions within the site should be understood, whether there is sand, fill material or massive rock will all have an influence on the type of surface water drainage systems that may be developed for the site.
- § Site grading has a considerable influence on the cost and effectiveness of the site drainage and therefore should be considered at a very early stage. A flat or level site is much more expensive to drain than a site which has some fall across it where natural drainage paths can be developed. Development site platforms adjacent to the coast should be graded to a minimum of level of 3.5m above Qatar datum. In general this will allow gravity drainage systems to be designed that could discharge to the sea, subject to SCENR approval. This proposed platform level will protect other utilities and building foundations from damage through high groundwater levels.
- § The design standards for the drainage system for the development should be established at an early stage. The degree of protection from flooding for the development needs to be established at an early stage to

Drainage Affairs philosophy is to manage to surface water and groundwater systems by the use of various techniques that are part of the stormwater management philosophy described under various names around the world such as SUDS(Sustainable Urban Development (UK)), BMP (Best Management Practice (USA)) and Stormwater Management(Australia).

The techniques that have been identified as appropriate for Qatar are:-

Preventative measures

The first stage of the Managed Approach is to reduce the runoff quantities. This may include reducing the amount of hard surfacing within a development and using soft landscaping suitable for a desert climate instead. Construction of individual tanks or soakaways for each property to store or disperse the rainfall.

Pervious surfaces

Surfaces that allow inflow of rainwater into the underlying construction or soil. This is a development of the block paving technique that is currently in extensive use in Qatar to develop its full potential by the use of geotextile filter membranes.

Filter drains

Linear drains consisting of trenches filled with a permeable material or modular plastic tank systems, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.

Swales

Swales consist of wide shallow channels with or without vegetation that conduct and retain water, and may also permit infiltration. These work well within development sites with a large proportion of landscaping where the design of the landscaping can easily incorporate these features.

Emergency Flood Areas (EFA)

The use of Emergency Flood Areas (EFA) is well established in Qatar and is a viable option for the management of surface water run off.

Infiltration devices

Sub-surface structures such as modular tanks systems that can promote the infiltration of surface water to the ground. There are a number of proprietary systems on the market for this.

Oversize Pipes and Throttles

This option is appropriate if there is a positive drainage system nearby that can take a controlled amount of runoff for the site.

All of these techniques are valid solutions to produce a Managed Drainage System, however every development site is different and will have different problems that will require different solutions.

Stormwater Drainage References

- 1 Qatar Sewerage and Drainage Design Manual
Volume 3 Surface and Groundwater Drainage
- 2 Qatar Highways Design Manual
- 3 Soakaways : BRE Digest 151
4. Scope for Control of Urban Runoff : CIRAI Report 124 1992
- 5 Interim Code of Practice for Sustainable Drainage Systems: National SUDS Working Group(UK) July 2004
- 6 Stormwater Best Management Practices in an Ultra-Urban Setting
US Department of Transport Federal Highway Administration
- 7 Statutory Instrument 1999 No. 1783
The Environmental Impact Assessment (Land Drainage Improvement Works)
Regulations 1999 : DEFRA UK

ADVICE NOTE NO 1 - SOAKAWAYS AND STORM STORAGE TANKS FOR SINGLE RESIDENTIAL DEVELOPMENT

1.0 Introduction

Soakaways and storm tanks are simple methods of managing storm water run off in situations where there is no positive stormwater system available or planned for the future.

The three determining factors for the design of a soakaway drainage system are:-

- the size of the area which relates to the volume of water to be drained
- the percolation rate of the soil/sub-soil
- the depth to the water table i.e. the upper level of the groundwater that is naturally held within the soil, sub-soil or bedrock.

Soakaways should be provided for all roof areas and hard standing areas within the building plot.

2.0 Soakaways or Storm Tanks

The choice of soakaway or storm tank for managing the surface water runoff from a site will depend upon the depth of the ground water level for the ground surface.

The method of determining whether a soakaway or storm tank is appropriate is indicated on the following flow chart.

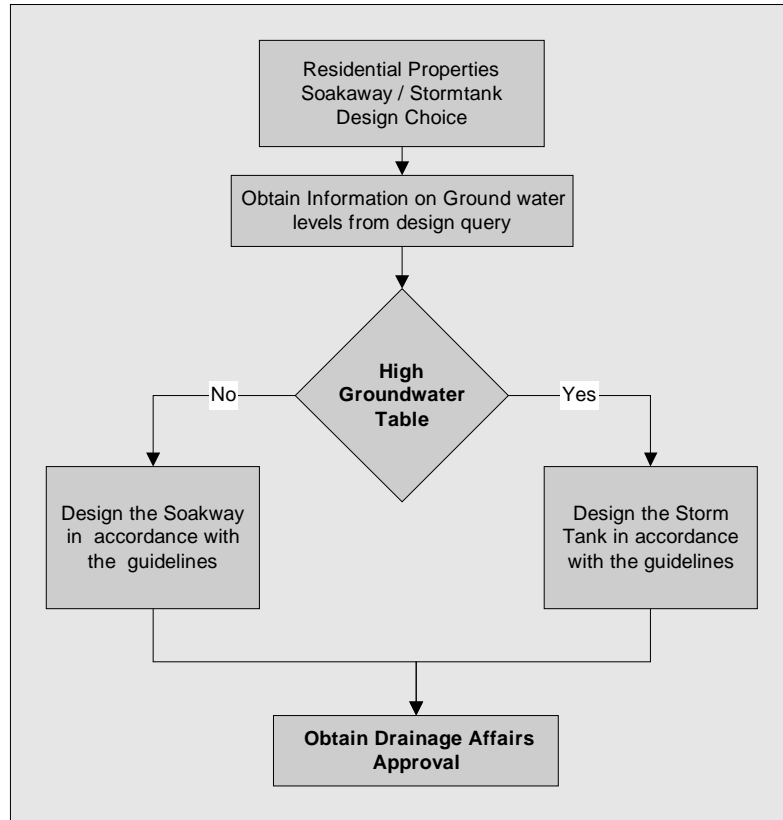


Figure 1: Choice of Soakaway or Storm Tank

3.0 Sizing of Facilities

3.1 Size of Soakaway

The following table shows the size of soakaway/tank that needs to be constructed.

Table 1: Depth of soakaway required for the design rainfall for different drainage areas

Chamber Volume Calculation				Chamber Diameter			
Roof Area to be drained m ²	Rainfall Depth for 1 in 2 year 24 Duration Mm	Runoff Coefficient	Volume of Storage m ³	1.2 m	1.5 m	1.8 m	2.1 m
100	25	0.9	2.3	1.99	1.27	0.88	0.65
200	25	0.9	4.5	3.98	2.55	1.77	1.30
300	25	0.9	6.8	X	X	2.65	1.95
400	25	0.9	9.0	X	X	3.54	2.60
500	25	0.9	11.3	X	X	4.42	3.25

Note that this is the storage volume required between the dry base or water table level of the soakaway, and the invert (inlet) level of the incoming drainage pipe, and assumes that the chamber is empty.

For example if the drainage area indicates that a 1.5metre diameter chamber with a soakaway depth of 2.55 then if the invert level of the incoming pipe is, say, 600mm below ground level, and assuming the base is above water table level, then the overall depth of the soakaway is...

$$2.55\text{m} + 0.6\text{m} = 3.15\text{m overall depth.}$$

If there is insufficient depth because of a high water table, the required volume of the soakaway can be met by increasing the plan size or placing two or more soakaways of this size side by side.

3.2 Size of Storm Tank

The sizing of the stormtankl tank should follow the procedure indicated in Table 2.

Table 2: Depth of Tank required for the design rainfall for different drainage areas

Tank Volume Calculation					Tank Diameter			
Area to be drained	Rainfall Depth for 1 in 2 year 24 hour Duration	Runoff Coefficient	Factor of Safety	Volume of Storage	1.2	1.5	1.8	2.1
m ²	mm			m ³	m	m	m	m
100	25	0.9	1.1	2.5	2.19	1.40	0.97	0.71
200	25	0.9	1.1	5.0	4.38	2.80	1.95	1.43
300	25	0.9	1.1	7.4			2.92	2.14
400	25	0.9	1.1	9.9			3.89	2.86
500	25	0.9	1.1	12.4			4.86	3.57

It should be noted that the tank will have to be pumped out after the rainfall has finished, restoring the flood protection of the property.

4.0 Construction details

4.1 Soakaway Construction

A typical standard detail drawing of a soakaway is included as Figure A1 of this advice note.

Ready-made soakaway systems are locally available in pre-cast concrete. These tend to be circular sections that can be stacked to give the required depth and storage volume, and then topped with a suitable cover.

4.2 Tank Construction

A typical standard detail drawing for a stormwater tank is included as Figure A2 of this advice note.

Pre-cast chamber rings are locally available and can be stacked to give the required depth and storage volume.

Modular plastic boxes which can be used to provide both storage and soakaway functions are available in the local market. For further information please contact Drainage Affairs.

5.0 Maintenance of Stormwater Systems

5.1 Soakaways

Soakaways do require some maintenance to keep them operating satisfactorily. Each year after the rainy season the following maintenance task should be carried out:-

- Inspect catchpit and remove any silt in the catchpit.
- Inspect soakaway and remove any silt in the chamber.

5.2 Tanks

In order to make the tank effective in the control of stormwater runoff, after each rainfall event the tank should be emptied of water and silt. The water in the tank should be tankered away or it can be used for irrigation of any garden areas. Under no circumstances should the tank be emptied to the foul sewerage system.

Each year after the rainy season the following maintenance tasks should be carried out:-

- Inspect silt trap and remove any silt in the trap.
- Inspect tank and remove any silt in the tank.
- Inspect and repair any leaks.

6.0 Safety

6.1 Excavations

Excavations can be dangerous and the following points should be noted.

- all excavations should be fenced off or covered to prevent accidents.
- deep excavations should have sufficient support provided to prevent collapse of the excavation or debris falling into the excavation.

6.1.1 Entry into Confined Spaces

Any tank buried in the ground can be dangerous. Only qualified and experienced operatives who have and are trained in the use the appropriate safety equipment for entry into confined spaces should be employed to carry out the cleaning and inspection works.

References

- 1 Qatar Sewerage and Drainage Design Manual
Volume 3 Surface and Groundwater Drainage
- 2 Qatar Highways Design Manual
- 3 Soakaways : BRE Digest 151

ADVICE NOTE NO 2 -- DRAINAGE FOR TOWER BLOCKS AND RESIDENTIAL DEVELOPMENTS

1.0 Introduction

The drainage of tower blocks and small residential compounds requires the designer of the drainage system to develop site specific solutions to protect the development from the results of flooding.

The basic requirement is that the development must deal with its runoff within the site and not export the problem to adjacent developments. Drainage affairs recommend a number of methods that could be used to manage the drainage system form tower blocks and residential developments. The designer of the proposed system should make himself aware of the concepts of managed drainage systems and choose the most appropriate system for the site in question.

It is not obligatory, but it may be useful for the developer to produce a project profile for the site drainage. The project profile provides a means to collect all relevant data for the development area which will help to produce the Managed Drainage System proposal.

2.0 Managed Drainage systems

Drainage Affairs recommend that the designer of drainage system for the development investigates the following measures and systems to manage the surface water run off.

Preventative measures

The first stage of the Managed Approach is to reduce the runoff quantities. This may include reducing the amount of hard surfacing within a development and using soft landscaping suitable for a desert climate instead. The use of individual tanks or soakaways for each property to store or disperse the surface run off is another method of reduction in surface water run-off.

Pervious surfaces

Pervious surfaces are surfaces that allow inflow of rainwater into the underlying construction or soil. In Qatar extensive use is made of block paving for footpaths and parking area. Instead of bedding the concrete blocks directly on sand bed if they are laid on a granular sub-base water can stored in the sub-base and infiltrate into the ground. Typically the sub-base consists of 300mm of 25 – 150mm grades stone overlain with a geotextile. The bedding for the block paving consists of 50 mm of 4-10 mm graded stone.

Filter drains

Linear drains consisting of trenches filled with a permeable material or modular plastic tank systems, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration.

Swales

Swales consist of wide shallow channels with or without vegetation that conduct and retain water, and may also permit infiltration. These work well within development sites with a large proportion of landscaping where the design of the landscaping can easily incorporate these features. The swales can be used for infiltration and evaporation. Areas of planting which are lower than the surround areas can be used in a similar way to a swale.

Emergency Flood Areas (EFA)

The use of Emergency Flood Areas (EFA) is well established in Qatar and is a viable option for the management of surface water run off. An area of the development site is designated as an EFA and depending on the site usage and the depth of water to be stored may need to be fenced off to prevent accidents to children and adults.

Infiltration devices

Sub-surface structures such as modular tanks systems that can promote the infiltration of surface water to the ground. There are a number of proprietary systems on the market for this. This is a growth area in the field of managed drainage systems with a number of manufacturers being able to provide plastic modular systems to build large tanks that can be installed under car parks, recreation areas etc which provide storage, attenuation and infiltration facilities for the surface water run-off.

Oversize Pipes and Throttles

This option is appropriate if there is a positive drainage system nearby that can take a controlled amount of runoff for the site. A smaller diameter pipe or orifice plate is used at the outlet to control the discharge rate.

3.0 Basic Design Principles

The basic principle of the design of the drainage system for the development is to control runoff within the development as follows:

- No Drainage Affairs stormwater system available. Drain to on site stormwater storage system as indicated on Figure 1.2 of these guidelines.
- Existing or proposed Drainage Affairs stormwater system. Connection to the Drainage Affairs system by overland flow, or direct connection via managed drainage system as indicated on Figure 1.1 of these guidelines.

4.0 Project Profile

In order that the designer can assess the requirements it is recommended but not obligatory to produce a project profile. The project profile should include all relevant information available. Information should be in note form. The checklist below is provided as a guide only, to assist in

identifying major items which should be included or considered in completing the project profile to assist in the choice of managed drainage system for the site.

1. AN OUTLINE DESCRIPTION OF THE PROJECT

Provide the following information :

- Project title
- Developer
- Contact Person (name/telephone)
- Nature and description of the project
- Location (include plans)
- Area of project site and % paved/unpaved
- Finished site platform level
- Whether planning permission application is required
- Recent and dated photographs to show a panoramic view of the site

2. AN OUTLINE OF THE PLANNING AND IMPLEMENTATION PROGRAMME

- a) Explain how the project will be planned and implemented
e.g. authorized person/consultants/contractor.
- b) Identify the project timetable for :
 - appointing consultants/authorized person
 - planning/preliminary designs
 - preparing a Drainage Impact Assessment (DIA) study (if required – see Advice Note No. 3)
 - finalizing designs
 - implementation
 - completion/commencing operation
- c) Identify any interactions with other projects which should be considered.

3. AN OUTLINE OF THE EXISTING DRAINAGE

Provide the following drainage details :

- A 1:20000 scale plan of the catchment in which the project site is located with the drainage system relevant to the proposed project highlighted.
- A detailed layout plan at 1:5000 scale or larger, of the project site with the site boundary, existing ground levels, existing drainage and existing land uses all identified both within and adjacent to the project site.
- A general description of the existing drainage including adequacy of the drainage system and flooding history.

4. OTHER INFORMATION

Provide the following information :

- Potential drainage impacts (described in broad terms) arising from the project.
- A general description of the proposed drainage impact mitigation measures (if any) to be provided.
- A general description of the proposed drainage system.
- A general statement on the flooding situation upon completion of the project.

References

- 1 Qatar Sewerage and Drainage Design Manual
Volume 3 Surface and Groundwater Drainage
- 2 Qatar Highways Design Manual
- 3 Soakaways : BRE Digest 151
4. Scope for Control of Urban Runoff : CIRAI Report 124 1992
- 5 Interim Code of Practice for Sustainable Drainage Systems: National SUDS Working Group(UK)
July 2004
- 6 Stormwater Best Management Practices in an Ultra-Urban Setting
US Department of Transport Federal Highway Administration
- 7 Statutory Instrument 1999 No. 1783
The Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999 :
DEFRA UK

ADVICE NOTE NO 3 - APPLICATION OF THE DRAINAGE IMPACT ASSESSMENT PROCESS TO
ZONAL AND DISTRICT DEVELOPMENT PROJECTS

Table 2

1. INTRODUCTION

- 1.1 This Advice Note outlines the Drainage Affairs assessment procedures for the drainage impact of zonal and district development projects. It is anticipated that the information contained in this document will assist in preparing project profiles and in addressing the project's potential drainage impacts.
- 1.2 Many private sector projects have the potential to cause adverse impacts on stormwater drainage, groundwater and flooding. These impacts need to be considered at the early stages of the project planning and designed to minimize drainage and flooding problems and to avoid expensive remedial measures.
- 1.3 The Drainage Impact Assessment (DIA) process provides for a systematic approach in addressing drainage issues associated with any project. The primary objective of the DIA process is to demonstrate that with the implementation of necessary mitigation measures, the project will not cause an unacceptable increase in the risk of flooding in areas upstream of , adjacent to, or downstream of the development.

2. ROLES AND RESPONSIBILITIES OF THE DEVELOPER

- 2.1 The developer of a zonal or district development project is responsible for :
- (a) preparing the project profile and undertaking the DIA study if required;
 - (b) implementing all measures necessary to mitigate adverse drainage impacts identified by the DIA study;
 - (c) monitoring the project's drainage performance during construction; and
 - (d) taking all measures necessary to redress unanticipated or unacceptable impacts arising during project construction.
- 2.2 The application of the DIA process to a particular project should not be separated from the other basic investigation and design processes. Thus, the developer can integrate drainage, environmental, technical and economic assessments to produce the best and most appropriate project design.

3. ROLES OF DRAINAGE AFFAIRS

- 3.1 DA is responsible for examining project profile; determining whether DIA study is required; approving DIA study report submitted under the DIA process; and advising the Planning Department drainage conditions on the project.

- 3.2 Notwithstanding that the developer may have submitted proposals in accordance with the guidelines stipulated in this Advice Note and DA may have accepted such proposals or have required such proposals to be amended prior to acceptance, DA shall have no liability to the proponent for any damage, injury, losses, claims, charges or fees which may arise from any act, omission or negligence howsoever caused by DA, its agents, servants or employees.

4. THE DRAINAGE IMPACT ASSESSMENT PROCESS

- 4.1 The DIA process comprises two principal elements, a project profile and, if necessary, a DIA study.

- 4.2 All development projects for Zonal or Regional Developments will require the preparation of a Project Profile.

The project profile and DIA study require substantial engineering input and judgement, and should be undertaken under the direction of a registered professional engineer in the Civil Engineering discipline. Any submission made as part of the DIA process should be signed and certified by the registered professional engineer in charge. Failure to submit a satisfactory project profile or DIA study report, if required, may unnecessarily delay the DIA process.

- 4.3 Development projects within urban areas served by an engineered positive stormwater drainage system will generally not require the DIA process to be completed as the project profile should contain sufficient information for approval, the exception will be those developments which are of sufficient scale to make a significant change to the drainage characteristics of a stormwater drainage system.

- 4.4 In areas not served by an engineered positive stormwater drainage system, the scale of the development, the form and location will determine the necessity of DIA process. As a general rule, if the answer to any of the following questions is positive or unknown, DIA process shall be applied to the project:

- (a) will a natural drainage path be affected by the development ?
- (b) will there be a significant increase in impervious area and therefore a significant increase in runoff from the development site ?
- (c) will reclamation or filling be required to form the site for the development ?
- (d) will the drainage system downstream of the development site require to be upgraded to convey the runoff from the site ?
- (e) will the development be situated at flood prone areas ?
- (f) will the development be situated in an area of high groundwater?
- (g) will the development have substantial area of planting which will require irrigation?
- (h) will irrigation cause a rise in groundwater levels that may cause concern for building and road foundations?

Project Profile

- 4.5 An outline of the information required for the project profile is given in Appendix I. Based on the information in the project profile, DA will decide upon the extent and scope of the DIA study that is required by considering the likely impact of the proposed project on:

- (a) the existing capacity of drainage paths;
- (b) the changes in surface runoff hydrographs and flood storage; and
- (c) the risk of flooding in other areas in the catchment.
- (d) the risk of rising groundwater levels due to development.

Drainage Impact Assessment Study

- 4.6 The scope and requirements of the DIA study shall be proposed by the developer for DA's agreement. In setting the parameters for the study, a conscious effort should be made to constrain its scope as far as practicable while ensuring that the validity of the study is maintained. The findings of the DIA study shall be documented in a report prepared by the proponent for submission to DA and the Planning Department. An outline of the information likely to be required for a DIA study report is given in Appendix II.
- 4.7 The DIA study shall be carried out in accordance with the standards set out in by DA Drainage Manual.
- 4.8 The findings of the DIA study will be used as the basis for setting any requirements on drainage provisions, flood mitigation measures and performance monitoring tasks which may be placed on the project. DA will advise the Planning Department or Lands Department of such requirements on the project as appropriate.

5. DESIGN, IMPLEMENTATION AND MONITORING OF MITIGATION MEASURES

- 5.1 The developer shall be responsible for incorporating the drainage impact mitigation measures into the design of the project to ensure that the expected drainage performance of the project is achieved. The Authorized Person in charge of the project should state in writing that necessary mitigation measures identified in the DIA study have been incorporated into the plans.
- 5.2 The developer shall be responsible for implementing the drainage impact mitigation measures and undertaking the monitoring programme during the construction stage to ensure compliance with the conditions on drainage requirements, flood mitigation measures and performance monitoring requirements as imposed by the DA.
- 5.3 DA shall recommend the Planning Department to issue a Certificate of Compliance for a development only if the imposed conditions on drainage requirements and flood mitigation measures have been fulfilled.
- 5.4 The developer shall sort out and agree with the maintenance parties on any requisite monitoring programme during the operation stage. The responsibility for undertaking such monitoring programme, if necessary, shall rest with the maintenance parties. Depending on the nature and type of the drainage works, the maintenance parties may be the developer himself, his agent, other person or DA.

References

- 1 Qatar Sewerage and Drainage Design Manual
Volume 3 Surface and Groundwater Drainage
- 2 Qatar Highways Design Manual
- 3 Soakaways : BRE Digest 151
4. Scope for Control of Urban Runoff : CIRAI Report 124 1992
- 5 Interim Code of Practice for Sustainable Drainage Systems: National SUDS Working Group(UK)
July 2004
- 6 Stormwater Best Management Practices in an Ultra-Urban Setting
US Department of Transport Federal Highway Administration
- 7 Statutory Instrument 1999 No. 1783
The Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999 :
DEFRA UK

APPENDIX SI -INFORMATION REQUIRED FOR PROJECT PROFILE

In order that the need for a DIA study can be assessed, the project profile should include all relevant information available. Information should be in note form. The checklist below is provided as a guide only, to assist in identifying major items which should be included or considered in completing the project profile.

1. 4.1.1.1 AN OUTLINE DESCRIPTION OF THE PROJECT

Provide the following information :

- Project title
- Developer
- Contact Person (name/telephone)
- Nature and description of the project
- Location (include plans)
- Area of project site and % paved/unpaved
- Finished site platform level
- Whether planning permission application is required
- Whether lease modification application is required
- Statutory land use zoning
- Recent and dated photographs to shown a panoramic view of the site

2. 4.1.1.2 AN OUTLINE OF THE PLANNING AND IMPLEMENTATION PROGRAMME

- a) Explain how the project will be planned and implemented
e.g. authorized person/consultants/contractor.
- b) Identify the project timetable for :
- appointing consultants/authorized person
 - planning/preliminary designs
 - preparing a Drainage Impact Assessment (DIA) study (if required)
 - finalizing designs
 - implementation
 - completion/commencing operation
- c) Identify any interactions with other projects which should be considered.

3. 4.1.1.3 AN OUTLINE OF THE EXISTING DRAINAGE

Provide the following drainage details :

- A 1:20000 scale plan of the catchment in which the project site is located with the drainage system relevant to the proposed project highlighted.
- A detailed layout plan at 1:5000 scale or larger, of the project site with the site boundary, existing ground levels, existing drainage and existing land uses all identified both within and adjacent to the project site.
- A general description of the existing drainage including adequacy of the drainage system and flooding history.

4. OTHER INFORMATION

Provide the following information :

- Potential drainage impacts (described in broad terms) arising from the project.
- A general description of the proposed drainage impact mitigation measures (if any) to be provided.
- A general description of the proposed drainage system.
- A general statement on the flooding situation upon completion of the project.

Any other available information relevant to Appendix II may also be submitted to facilitate DA in deciding whether a DIA study is required. Submission of sufficient information under this heading may enable DA to make an early decision on whether exemption from submission of a DIA study can be granted.

APPENDIX SII - INFORMATION REQUIRED FOR DRAINAGE IMPACT ASSESSMENT STUDY REPORT

In order that the DIA study can be completed as quickly as possible, the DIA study report should include all relevant information available. In addition to the information submitted in the project profile (Appendix I), the following information should be included in the report. The checklist below is provided as a guide only, to assist in identifying major items which should be included or considered in completing the DIA study.

The findings of the DIA study should be documented in a report prepared by the proponent which will then be used as the basis for setting any requirements on drainage provisions, flood mitigation measures and performance monitoring tasks which may be placed on the project.

1. AN OUTLINE OF THE CURRENT FLOODING SUSCEPTIBILITY AND PROPOSED DRAINAGE

Provide the following details :

- An assessment of the susceptibility of the project site to flooding, preferably with a record of any past flooding which occurred within or adjacent to the project site.
- An assessment of the groundwater levels within the project site and whether there is a record of any previous problems within the site or adjacent to the project site.
- A detailed layout plan, at an appropriate scale, of the project site with the site boundary, proposed ground levels and proposed drainage, including any necessary upgrading drainage work within the catchment, and proposed land uses, all identified. If the proponent is aware that the ground levels or drainage or land uses adjacent to, but outside the project site are likely to change, details should be provided if possible or, alternatively, attention drawn to the fact that changes are likely.

2. AN OUTLINE OF THE CHANGES TO THE DRAINAGE CHARACTERISTICS AND POTENTIAL DRAINAGE IMPACTS WHICH MIGHT ARISE FROM THE PROPOSED PROJECT

Provide the following details to quantify the changes to the drainage characteristics of the catchment arising from the proposed project :

- Changes in land use and surface runoff characteristics.
- Changes to existing groundwater levels that might be expected.
- Changes to surface runoff hydrographs for 2, 10, 25 and 50 years return period flood events for the project site, any affected natural drainage paths or existing positive or

non positive drainage system.

- Change in flood storage caused by the project.
- Assessment of timing of peak runoff from project site relative to timing of catchment peak runoff.
- Hydraulic capacity of existing drainage upstream, within and downstream of project site if applicable. This information will be made available by Drainage Affairs .
- Hydraulic capacity of proposed drainage upstream, within and downstream of project site. This will depend upon the drainage systems designed by the developer.
- Changes in peak runoff, peak flood levels and/or peak velocities for 2, 10, 25 and 50 years return period flood events at critical locations.
- Details of temporary drainage during construction including hydraulic capacities.

Provide details of all potential impacts which might arise as a result of changes to the drainage characteristics caused by the proposed project and identify land users who might be affected. Provide details of the impacts caused by the following :

- Changes in flood levels, flood frequency and/or velocities.
- Changes in timing and magnitude of runoff peaks.
- Changes to maintenance requirements and access for maintenance.
- Changes to the drainage paths and regime during construction and after completion of the project.
- Cumulative effects taking account of other concurrent developments in catchment.
- Other relevant considerations.

The potential impact should be considered on upstream, downstream and adjacent land users, and land uses should be identified (e.g. residential, commercial, institutional, industrial, infrastructure, agricultural, recreational, conservation areas).

Appendix 1
Building Permit Application

DOCUMENTS TO BE SUPPLIED TO DRAINAGE AFFAIRS FOR
BUILDING PERMIT APPLICATION

Mandatory information is shown in bold type

Information Required (2 copies)	Scale	Notes
Both copies of submission will be stamped approved by the Drainage Affairs. One copy will be returned to the Developer, the other copy will be retained by the Drainage Affairs		
<u>Developer's Programme</u> Estimated Construction Start Date		
<u>Site Location Plan (A3)</u>	1:5000	North sign, co-ordinates of corners, street names, principal landmarks
<u>Drainage Services Location Plan (A3)</u> A4- Single Property A3- Developments (Compounds, Mult)	1:1000	Existing public sewerage and drainage services adjacent to the Site to which the site will discharge
<u>Site Plan (A) showing: (Foul Sewer)</u> All levels related to Qatar National Datum Site boundary Building outline Building with descriptive label Internal Roads, Footpath Internal Sewer Layout Septic tank, soakaway, sewage holding tank Drains and manholes Schedules of foul manholes Pumping Stations Rising Mains Existing sewers and drains Road gullies/highway drains Site levels	1:1000, or 1:500, or 1:200	Manholes numbered from MH1. Diameter, length between manholes, gradient flow direction. All levels are in 'm' and Ref. To QNHD. Arch. Levels and QNHD levels.
<u>Site Plan (B) showing: (Surfacewater Sewer)</u> All levels related to Qatar National Datum Site boundary	1:1000, or	

Building with descriptive label Internal Roads, Footpath Internal Pipe Layout Soakaway Drains and manholes Schedules of storm manholes Pumping Stations Rising Mains Existing sewers and drains Road gullies/highway drains Site levels	1:500, or 1:200	Manholes numbered from MH1. Diameter, length between manholes, gradient flow direction. All levels are in 'm' and Ref. To QNHD. Arch. Levels and QNHD levels.
<u>Building Drainage (A1)</u> Floor plans Fittings and Sanitary fittings Pipeline details Discharge points Gullies	1:50	
<u>Copies of hydraulic design calculations (A4)</u> Foul water (including trade effluents) Surface water (including impermeable area plan and attenuation details) Design parameters used		
<u>Pumping Stations information showing:</u> General arrangement details Wet well capacity Rising Main Capacity		

Appendix 2
Design Unit Flows

Peak and Average Flows Using Design Units Based on 270 l/h/d

Population	Avg Flow l/s	Sewage m ³ /d	Peak flow l/s
1	0.003	0.259	1.64
5	0.016	1.382	2.53
10	0.031	2.678	2.82
15	0.047	4.061	3.09
20	0.063	5.443	3.35
25	0.078	6.739	3.51
30	0.094	8.122	3.62
40	0.125	10.8	3.83
50	0.156	13.478	4.03
60	0.188	16.243	4.22
70	0.219	18.922	4.41
80	0.250	21.6	4.59
90	0.281	24.278	4.74
100	0.313	27.043	4.86

Appendix 3

Drawings

- DG1 Inspection Chambers – Typical Details Sheet 1
- DG2 Inspection Chambers – Typical Details Sheet 2
- DG3 MH1 - Standard Details
- DG4 Typical Manhole Construction Details

DG5	Sewerage Connection to Properties - Typical Details
DG6	Typical Small Submersible Pumping Station
DG7	Sand Trap & Grease Trap – Typical Details
DG8	Septic Tank Type A&B GA Details (pops 1 – 20)
DG9	Septic Tank Type CDEF GA Details (pops 21 – 350)
DG10	Soakaway Details