REPUBLIC OF SOUTH AFRICA

National Department of Housing

DESIGN AND CONSTRUCTION OF ENGINEERING SERVICES

Project Linked Greenfield Subsidy Project Developments

Generic Specification GFSH-10
October 2002

INTRODUCTION

Specifications for services may be described as being:

i) ***Prescriptive*** *in terms of which a collection of codes and standards are used to describe how services should be designed, constructed and maintained.*

ii) ***Functional*** *in which qualitative functional statements are made but no quantitative user or technical performance criteria are prescribed.*

iii) ***Performance-based*** *in which:*

- *a) qualitative functional requirements are established;*
- *b) quantitative user and technical performance criteria are provided; and*
- *c) acceptable solutions and evaluation and design tools are offered.*

This specification is a performance specification that is driven by user requirements for a number of services. Its key objective is to satisfy user needs and requirements. This it does by identifying and capturing user needs and requirements for a number of services and translating them into functional and performance criteria and providing a framework within which such requirements and criteria may be satisfied.

The performance-based approach has a hierarchy that starts with a ***user need*** *(a general statement of requirements for an engineering service which is regarded as being satisfactory by the municipality / management body in interconnected complexes responsible for the maintenance of the service) for each service attribute, followed by a* ***performance description*** *(a statement which identifies agents that affect performance in a qualitative manner and establishes how these agents affect the state of the service) and* ***performance parameters*** *(user requirements expressed in terms of the quantitative performance of a service attribute). The means of verifying that the construction solution offered also needs to be provided so that compliance with the requirements of the specification can be readily demonstrated or predicted. (See Figure 1). Typically, the performance evaluation for prediction or the verification of performance requirements can be roughly divided into application of rules, testing, verification methods, documentary evidence and expert judgement.*

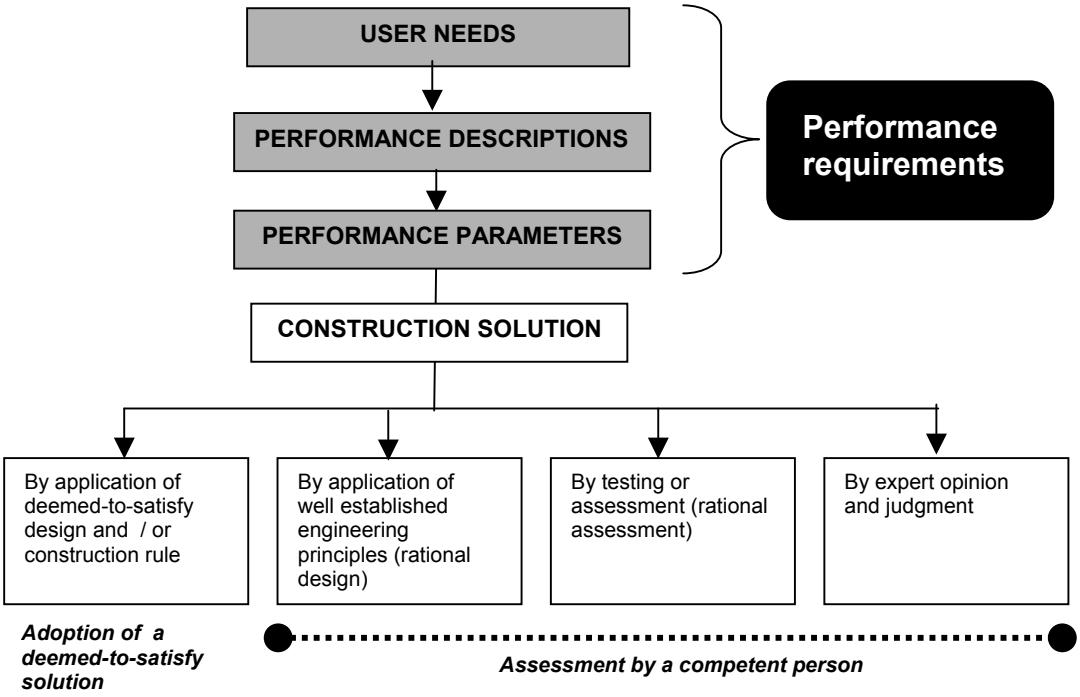

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Figure 1: The performance based approach to the procurement of engineering services

The level of service funded by the Project Linked Greenfield Subsidy Project programme, except where the geophysical conditions require a higher level, is set out in the National Housing Code. A higher level of service may be provided if other sources of funding are secured.

The National Home Builders Registration Council has technical requirements for drainage and storm water on erven. These are covered in specification GFSH-11 (Design and construction of Houses). Cognisance must be taken of these requirements when designing stormwater management systems to ensure that the NHBRC's requirements on erven can be achieved, viz "suitable means, preferably of a fail-safe nature, shall be provided for the control and disposal of stormwater in a manner which does not result in soil erosion or flooding which may detrimentally affect the structural performance of housing units."

The NHBRC has in addition specific requirements for:

- *the design and construction of township services in areas underlain by dolomites designated as D2 and D3; and*
- *drainage installation and storm water disposal systems in interconnected complexes where these services become the responsibility of the management body of such complexes*

The NHBRC's Home Building Manual also requires that:

- *particular care be taken to ensure that any impact rolling (dynamic compaction) of sites does not result in the lowering of sites to the extent that storm water drainage is impaired; and*
- *home builders are advised to assess the impact of drainage installations other than waterborne sanitation systems on ground water in accordance with the Department of Water Affairs and Forestry's Protocol to Manage the Potential of Groundwater Contamination from on site Sanitation (1997). (Full particulars of the protocol and further information in this regard may be obtained from the National Sanitation Co-ordination Office (NSCO); telephone (012) 338 - 8697; fax (012) 324 - 8257.)*

Municipalities and the management bodies in interconnected complexes are required to maintain services within the road reserves and servitudes and complexes. Accordingly, the design and construction of engineering services will have to satisfy their specific requirements.

This generic specification has been developed to facilitate the procurement of engineering services either on a traditional preplanned (design by employer)or on a turnkey basis. In the former, the specification serves as a briefing to competent persons (engineering) (see generic specification GFSH-8) appointed in terms of a services contract. In the latter, it forms part of the scope of work of the turnkey contractor.

It must be stressed that procurement can only commence once it is established what is to be procured. Municipalities need to determine their engineering service requirements in order to arrive at what is to be procured. Consideration should be given to the guidance provided in Chapters 1 to 10 of the Guidelines for Human Settlement Planning and Design (2000) with the objective of achieving sustainable and vibrant human settlements. Particular attention should be paid to the selection of appropriate and financially sustainable engineering technologies and integrating the approach to settlement planning.

This generic specification contains performance requirements for commonly encountered engineering services and nominates typical performance parameters associated with such requirements. It is anticipated that municipalities will amend these values in this base document and omit or add performance parameters to satisfy local conditions, circumstances and servicing options and their specific work procedures. Such amendments and additions should be set out in the specification data associated with a particular contract.

This generic specification was prepared by the Task Team: Implementation of National Housing Programmes to facilitate compliance with the requirements of Chapter 3 of Part 3 of the National Housing Code and the provisions of the Housing Consumers Protection Measures Act (Act 95 of 1998).

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1. SCOPE

1.1 This specification provides performance requirements for a range of commonly encountered basic engineering services in green field project linked housing developments located in servitudes and road reserves and in interconnected complexes. It provides the following in respect of each of these services:

a) user needs;
b) performance descriptions;
c) performance parameter; and
d) ways in which it can be demonstrated or predicted that solutions satisfy requirements.

1.2 This specification is confined to internal township engineering services. Bulk infrastructure and the portions of sanitation systems located within an erf are outside the scope of this specification. However, portions of sanitation systems in interconnected complexes which discharge into municipal mains within road reserves and servitudes, fall within the scope of this specification.

Note: 1 Requirements for portions of sanitation systems which fall outside the scope of this specification are addressed in the Generic Specification for the Design and Construction of Houses (GFSH-11).

2 Municipalities in determining their engineering service requirements should consider the guidance provided in Chapters 1 to 10 of the Guidelines for Human Settlement Planning and Design (2000) for sustainable and vibrant human settlements. Specific requirements may necessitate changes to this specification, typically in the form of amendments to the values stated in the performance parameters and omissions and additions to performance parameters. Such changes should be reflected in the specification data.

2. NORMATIVE REFERENCES

CSIR Building and Construction Technology. Guidelines for Human Settlement Planning and Design. 2000.

Department of Housing. Environmental Services for Housing Developments. Generic specification GFSH-4

National Housing Board. Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development. 1994.

South African Bureau of Standards. Civil engineering construction standards. SANS 1200.

South African Bureau of Standards. Sewers. SANS 1200 LD.

South African Bureau of Standards. Design of buried pipelines. SANS 10102-1: Selection of pipes for buried pipelines : Part 1 : General provisions.

South African Bureau of Standards. Design of buried pipelines. SANS 10102-2: Selection of pipes for buried pipelines : Part 2 : Rigid pipelines.

South African Bureau of Standards: Code of Practice for general procedures and loadings to be adopted in the design of buildings. SANS 10160.

3 DEFINITIONS

action: an assembly of concentrated or distributed mechanical forces acting on a structure or service (direct action) or the cause of deformations imposed on the structure or constrained in it (indirect action)

Agrément Certification: certificate confirming fitness-for-purpose of non-standardised construction products and/or the acceptability of the related non-standardised design and the conditions pertaining thereto issued by the Board of Agrément of South Africa.

engineering service: a stormwater management, roads, high mast lighting or water supply system or the sanitation system main conduits within a township or interconnected complex.

environmental impact assessment report: a report prepared in accordance with the generic specification GFSH-4.

major storm water system: a storm water system which caters for severe, infrequent storm events.

minor storm water system: a storm water system which caters for the frequent storms of a minor nature.

municipality: an organ of state within the local sphere of government exercising legislative and executive authority within an area determined in terms of the Local Government: Municipal Demarcation Act, 1998.

peak factor: a dimensionless value, indicating the relationship between peak instantaneous consumption and average consumption

performance: behaviour related to use.

performance description: a statement which identifies agents that affect performance in a qualitative manner and establishes how these agents affect the state of engineering services.

performance parameter: user needs expressed in terms of the quantitative performance of an engineering service.

Note: Performance parameters provide qualitative design criteria and as such establish constraints which impact on the solution that is adopted to satisfy the performance requirements.

rational assessment: the assessment of the adequacy of the performance of a solution in relation to requirements by a process of reasoning, calculation and consideration of accepted engineering principles, based on a combination of deductions from available information, research and data; appropriate testing and service experience.

rational design: any design involving a process of reasoning and calculation that is based on the consistent application of appropriate national or international standards or other relevant, authoritative and published technical literature.

reliability: ability of an engineering service to fulfill the specified requirements for which it has been designed.

recurrence interval: the average time interval between events.

sanitation system: an integrated series of compatible products and processes which accepts human body wastes and waste water from a household, and thereafter stores, conveys, processes and safely disposes of them or conveys them to a municipal or interconnected complex sewer main.

Note: a sanitation system comprises some, although not necessarily all of the following components:

- a superstructure or a room within a house;
- a receiving device, pan, wash trough, etc;
- a flushing device (pour-flush, sullage-flush or cistern-flush);
- a discharge duct linking the pan to the on-site storage unit or conveyancing system;
- treatment and disposal and / or re-use.

sewer main: a conduit that conveys human body wastes and waste water from a sanitation system though an interconnected complex or township to bulk sewer infrastructure.

user: the municipality, where engineering services are located in servitudes and road reserves, or the management body in the case of interconnected complexes, that is responsible for the maintenance of an engineering service.

user needs: a general statement of requirements for an engineering service that may be regarded as being satisfactory by the user.

Note: User needs can be considered to be design objectives.

4 REQUIREMENTS

The design and construction of engineering services shall:

a) satisfy the requirements of all applicable Acts and regulations, specific requirements of the municipality, the Technical Requirements of the National Home Builders Registration Council issued in terms of the Housing Consumers Protection Measures Act (Act 95 of 1998) and the National Home Builders Registration Council's requirements for areas underlain by dolomites (refer to Annexure 1); and

b) satisfy the user needs and performance descriptions as stated in Table 1 and perform within the performance parameters, if any, nominated in 5.

Table 1: User needs and performance descriptions

SERVICE (clause referring to performance parameter in brackets)	**USER NEEDS (DESIGN OBJECTIVE)**	**PERFORMANCE DESCRIPTIONS**
Storm water management systems (5.1)	The risks associated with flood hazards, which may affect the health, welfare and safety of the public, damage property or the environment, shall not exceed a level nominated by the user.	Storm water emanating from storms, which are likely to occur at different recurrence intervals, shall, with an appropriate degree of reliability and within established parameters, be controlled, safely routed and discharged from townships without unduly eroding land, unsurfaced roads or water courses, contaminating water resources or compromising environmentally sensitive areas identified in an environmental impact assessment report. Storm water structures shall, with an appropriate degree of reliability, perform within established parameters in terms of: (a) design hydraulic load; and (b) maintenance (ease of access for cleaning and self cleansing velocities);
Roads (5.2)	Roads shall accommodate the safe travel of vehicles and pedestrians and provide a means to drain storm water from properties in a manner acceptable to the user.	Roads shall, with an appropriate degree of reliability and within established parameters: (a) provide access to erven; (b) accommodate traffic; and (c) convey storm water to the major storm water system
High mast lighting (5.3)	High mast lighting shall provide at night a nominated level of lighting. The risk of collapse or other kind of severe damage to masts resulting from structural failure and the behaviour of a mast due to possible actions under normal use and condition shall not exceed a level nominated by the user.	The high light mast structure shall, with an appropriate degree of reliability: (a) maintain strength and stability under all actions likely to occur during its design working life; (b) perform, within established parameters for normal use, under all expected actions in terms of deflection; (c) fulfill its intended performance described in (a) and (b) above in the environment, which it is located when subject to normal use over its lifetime with appropriate maintenance; (d) have tamper proof connections; and (e) be protected from damage due to lightning strikes. The lights and assembly shall, with an appropriate degree of reliability: (a) provide the nominated luminance in the environment, which it is located, when subject to normal use over its lifetime with appropriate maintenance ; (b) be capable of being lowered for electrical maintenance purposes by one person at ground level; (c) be protected from damage due to lightning strikes; and (d) have tamper proof electrical connections.

SERVICE	**USER NEEDS (DESIGN OBJECTIVE)**	**PERFORMANCE DESCRIPTIONS**

Sewer mains[#] (5.4	The sewer mains shall convey sewage from the waterborne sanitation system to the bulk sewer infrastructure in a manner acceptable to the user.	The sewer main shall, with an appropriate degree of reliability and within established parameters: (a) withstand all the loads to which it is likely to be subjected to; (b) be capable of receiving sewage from the waterborne sanitation system, carrying the design hydraulic load, and discharging into the municipality's bulk sewer infrastructure; (c) be watertight (d) prevent rain water from entering the system; and (d) be easy to clean and maintain.
Water supply system (5.5)	The water supply system shall convey safe drinking water to a point within each erf, be compatible with the sanitation system that is provided and serve the fire fighting needs of the community in a manner acceptable to the user.	The water supply system shall, with an appropriate degree of reliability and within established parameters: (a) withstand all the loads to which it is likely to be subjected to; (b) be capable of supplying water to erven; (c) be watertight; and (d) be easy to operate and maintain.

[#] Sanitation systems are covered in the Generic Specification GFSH-11: Design and Construction of Houses. Only the conduit from the water borne sanitation system to the bulk sewer infrastructure (sewer main) is considered in this generic specification.

5 Performance parameters

5.1 Storm water drainage

5.1.1 Major and minor storm water systems shall be designed for design flood recurrence intervals nominated by the user. Where no such nomination is made, the design flood frequencies shall be as follows:

a) major storm water system: 50 years; and
b) minor storm water system: 2 years.

Note: Current legislation requires that flood lines for townships be determined for a 100 year recurrence interval. Flows emanating from such floods are typically 25% greater than that for the 50 year flood. Major storm systems can be designed for a 50 year flood provided that the certified 100 flood lines remain unchanged.

5.1.2 The storm water management arrangements for townships shall be such that runoff is controlled to the extent that upstream, adjacent and downstream sites on water courses are not adversely affected when the township is fully developed.

5.1.3 Terraces created for houses shall be capable of being drained by gravity.

5.1.4 Storm water shall not be concentrated so as to cause erosion.

5.1.5 In high-density housing developments (sites less than or equal to 500m² in extent), storm water shall not be directed across more than two properties before discharging into a servitude, road or access court. (See Figure 1).

5.1.6 The maximum encroachment of runoff on roads during major storms and minor storms shall be in accordance with the provisions of Table 2.

Table 2: Maximum encroachment of runoff on roads

ROAD CLASSIFICATION	MAXIMUM ENCROACHMENT
	MAJOR STORM
Local distributor or higher order road	The depth of water shall not exceed 150mm to allow emergency vehicle access.
	MINOR STORM
Residential and lower order roads	No kerb overtopping or where no kerb exists, the encroachment shall not extend over property boundaries. Flow may spread to the crown of the road.
Residential access collector	No kerb overtopping or where no kerb exists, the encroachment shall not extend over property boundaries. Flow must leave at least one traffic lane free of water.
Local distributor	No kerb overtopping or where no kerb exists, the encroachment shall not extend over property boundaries. Flow must leave at least one traffic lane free of water in each direction.
Higher-order roads	No encroachment is allowed on any traffic lane.

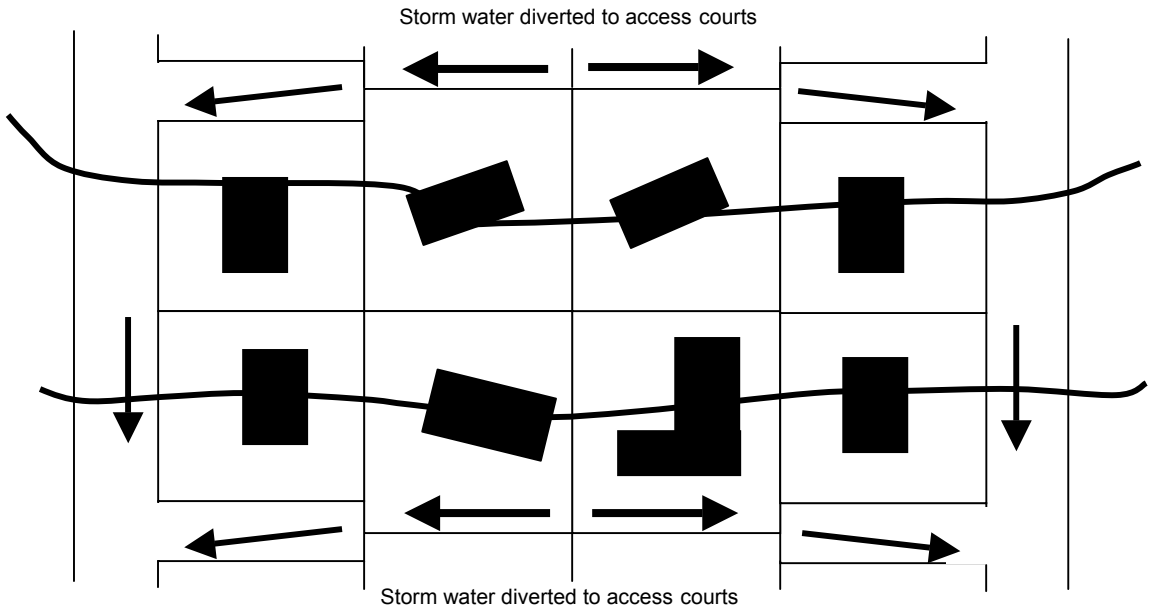

Figure 1: Illustration of storm water drainage requirements for small sites with access courts

5.1.7 The velocity of storm water flow in the road edge channels associated with a minor storm shall not exceed:

a) 3 m/s in lined channels;
b) 1,5 m/s in unlined channels comprising coarse non-colloidal gravel; and
c) 1,1 m/s in unlined channels other than those comprising non-colloidal gravel.

Note: Channels in dispersive soils need to be lined.

5.1.8 The minimums slope of road edge channels shall not be less than 0,4%.

5.1.9 The minimum slope from the road crown shall on average not be less than:

a) 2% of surfaced roads; and
b) 3% for unsurfaced roads.

5.1.10 The minimum diameter of pipes shall not be less than:

a) 300 mm in servitudes
b) 375 mm in road reserves

5.1.11 Storm water structures shall be designed to have sufficient velocity to minimize siltation and facilitate maintenance. The minimum pipe gradients shall be in accordance with Table 3.

Table 3: Minimum storm water pipe gradients

Pipe diameter (mm)	Desirable minimum gradient (1 in …)	Absolute minimum gradient (1 in …)
300	80	230
375	110	300
450	140	400
525	170	500
600	200	600
675	240	700
750	280	800
825	320	900
900	350	1000
1050	440	1250
1200	520	1500

5.2 Roads

5.2.1 Roads that carry more than 600 vehicles per day

Roads that accommodate in excess of 600 vehicles per day shall be designed to satisfy the requirements of the user.

5.2.2 Roads that carry less than 600 vehicles per day

Roads carrying less than 600 vehicles per day shall be designed in accordance with the provisions of the Guidelines for Human Settlement Panning and Design using the following parameters:

a) structural design period of 20 years where streets carry in excess of 75 vehicles per day; and
b) design speed of 40 km/hour.

5.3 High mast lighting

5.3.1 The luminaries shall, based on a grid of 4 masts at centers appropriate to the housing development, satisfy the following:

$E_{average}$ 3 Lux
$E_{minimum}$ 0,75 Lux
Uniformity $E_{average}$ / $E_{minimum}$ 0,18

5.3.2 The maximum aiming angle shall not exceed 78 degrees.

5.3.3 The design life of the high light mast shall be as follows:

a) basic structural system: 50 years;
b) replaceable components: 10 years.

5.3.4 The frequency of maintenance on the mast structure and associated components shall be at intervals of not less than 10 years

5.3.5 The representative free stream velocity pressure shall be determined and converted into a wind load in accordance with the provisions of SANS 10160.

5.3.6 The resistance of the structure under the effects of the actions shall be assessed in terms of limit state criteria or allowable stress criteria in accordance with the provisions of SANS 10160.

5.3.7 The deflection of the mast subject to wind actions shall not exceed 2,5% of the height of the mast.

5.4 Sewer mains

5.4.1 Pipelines shall be capable of accommodating an average daily flow of not less than 500 liters per day per subsidy house.

5.4.2 Pipes shall be designed to flow full at peak design flow with an allowance of 15% for storm water infiltration and other contingencies. The assumed peak factor for subsidy housing shall not be less than

2,5.

5.4.2 The materials for use in water borne sanitation systems shall be selected, taking cognisance of the municipality's existing and future maintenance equipment and capacity, experience in maintaining specific pipe systems and policy for keeping stock of pipe components.

5.4.3 Manholes shall be located at centers not exceeding 90m.

5.4.4 The pipe diameter shall not be less than 100mm.

Note: The specification data should state the minimum diameter for small bore sewers.

5.4.5 Either a full bore velocity of not be less than 0,7 m/s shall be maintained or the minimum gradient established in Table 4 shall be provided. The maximum velocity in rising mains shall be 2,5 m/s.

Table 4: Minimum gradients in sewer mains

Pipe diameter	Minimum gradient (1 in …..)
100	120
150	200
200	300
225	350
250	400
300	500

5.4.6 The minimum emergency storage capacity in sumps for pump stations shall represent a storage capacity equivalent to 4 hours flow at the average flow rate over and above the capacity available in the sump at normal top water level. Sumps shall be sized and pump controls so placed as to restrict pump starts to a maximum of six per hour.

5.4.7 The pipelines shall withstand the air and water tests described in SANS 1200 LD.

5.5 Water supply system

5.5.1 Each erf shall be provided with a metered connection acceptable to the municipality.

5.5.2 The daily water consumption or supply is not to be less than 600 litres per house per day where a water borne sanitation system is adopted and 450 litres per day where non-waterborne sanitation is provided.

Note: Although the system is to be capable of supplying the nominated litres per house per day, the flow may be restricted for free water, or other policy reasons, to a value less than this.

5.5.3 Pipes shall be designed for an average daily consumption with a minimum peak factor of:

a) 1,0 where roof tanks, ground tanks and other such semi-pressure systems are provided; and
b) 3,5 where no roof tanks, ground tanks and other such semi-pressure systems are provided.

5.5.4 The minimum head under instantaneous peak demand at any point on a erf where a house is to be, or is likely to be constructed, shall not be less than 6 metres where no roof tanks, ground tanks and other such semi-pressure systems are provided. The maximum static head, under zero flow conditions, is not to exceed 90 metres.

5.5.5 Velocities in pipes shall not exceed 1,2 m/s.

5.5.6 The number of high and low points shall be kept to a minimum. Pipes shall be laid to gradients greater than:

a) 0,3% for pipes having an internal diameter equal to or less than 200mm;
b) 0,2% for pipes having an internal diameter in excess of 200 mm.

5.5.7 A suitable means of scouring and venting pipes shall be provided at low and high points, respectively.

5.5.8 Fire hydrants, capable of replenishing trailer mounted water tanks or fire appliances capable of

carrying water, shall be located on mains having a minimum diameter of 75 mm and larger at convenient points and in the vicinity of all schools and commercial areas and public buildings

6 Construction solutions

6.1 Construction solutions, which are adopted for each engineering service, shall be such that it can be demonstrated or predicted with certainty, using one of more of the following means that the requirements of 4 are satisfied by:

a) the adoption of deemed-to-satisfy rules which are known to yield solutions that satisfy all the requirements of this specification;
b) calculation or measurement;
c) testing;
d) the preparation of a rational design; or
e) the undertaking of a rational assessment.

6.2 Observance of the appropriate design provisions of the Guidelines for Human Settlement Design and Planning, Guidelines for the Provision of Engineering Services and Amenities in Residential Township Development and SANS 10102, and construction provisions in accordance with the SANS 1200 standardised specifications for civil engineering construction, shall be considered to be sufficient to demonstrate compliance with the requirements of this specification in respect of the civil services.

6.3 Observance of the appropriate design and construction provisions of the relevant South African Bureau of Standards Specifications for highlight masts and their components shall be considered to be sufficient to demonstrate compliance with the requirements of this specification.

6.4 Testing shall incorporate, as appropriate, a realistic representation of materials, loading conditions, environmental influences, boundary conditions and construction practices.

6.5 Satisfactory performance in accordance with testing conducted by Transportek (CSIR) shall be sufficient evidence of compliance with performance requirements.

6.6 Certification of fitness for purpose by Agrément South Africa shall be sufficient evidence of compliance with performance requirements.

Annexure 1: Mandatory NHBRC requirements for the design and construction of township services in Dolomitic Areas designated as D2 and D3

The NHBRC's minimum requirements and mandatory precautionary measures, which are required in areas designated as being D2 and D3, are as follows:

General

1. The site and surrounding area shall be shaped to permit the ready drainage of surface water and to prevent ponding.

Drainage ports should be incorporated in boundary walls particularly at the lowest point of the site, to permit the passage of surface runoff.

2. Natural ponds and water courses located within 10 m of any structure shall be rendered impervious.

3. Sanitation systems shall not incorporate soak aways.

4. Backwash and other water from swimming pools, shall be discharged into either the storm water or drainage systems as required by the local authority.

The dolomitic stability over the route of any bulk water bearing service should be evaluated.

Township services

5. Underground services shall be designed and constructed so as to minimize maintenance requirements and any potential leakage points in wet services and shall, as far as possible, be designed to avoid possible disturbance of the underground environment.

6. The relevant provision of SANS 1200 DB, L, LB, LC, LD and LE shall be observed in the installation of all underground services.

7. The backfilling to service trenches and other excavations shall, except in rock, not be more permeable than the surrounding material.

8. The stormwater drainage and sewerage system shall incorporate measures to ensure watertightness of conduits and other compartments. Whenever possible, storm water should be channeled in lined, surface canals.

Concrete non-pressure pipes should be of the spigot and socket type with rubber ring seals. Joints in box culverts, channels etc. should be sealed.

9. Storm water drainage conduits shall be constructed at gradients, which will not permit the deposition of silt, or sand, of the type present in the catchment area.

10. Water mains shall be laid only in road reserves.

11. Water piping materials shall be one or more of the following:

• pipes of 75 mm and larger diameter:
- High impact PVC pipes with vitaulic joints.
- Steel pipes with internal and external corrosion protection or other flexible (as defined in SANS 10102 Part 1) water pipes with flexible, self anchoring connections.

• pipes having a diameter of less than 75 mm:
- HDPE type IV piping.
- Polypropylene piping.

The piping used in mains and communication pipes should be flexible, joints should be minimal in number and, be of the flexible, self anchoring type, i.e. not reliant on thrust blocks or friction for their anchorage.

12. Provision for future connections shall be made in order to minimize the cutting into pipes to provide such connections.

13. Provision shall be made in all water bearing pipelines to accommodate any potential differential movements without causing the pipeline or joints to leak.

14. Road surfaces shall be located sufficiently low so as to permit the drainage of erven onto them.

15. Roadways, which have a gradient of less than 1:80, shall be surfaced/sealed.

16. Where un-surfaced roads are the sole storm water system in a township, the roadways, which act as major storm water collectors, shall be surfaced.

17. The velocity of the 1 in 20 year storm water, flowing along un-surfaced roadways shall not exceed 1,5 m/s.

18. The minimum nominal diameter of water borne sewerage mains (both municipal and within inter-connected complexes) shall not be less than 150 mm.

Plumbing

19. Water pipe entries into the buildings shall be in accordance with Figure S3 of the Home Building Manual.

20. All sewer and water pipes and fittings shall be provided with flexible, watertight joints.

21. No plumbing and drainage pipes shall be placed under floor slabs, as far as is practicable.

22. The fall of the trenches shall be away from the buildings.

23. Pipes through walls shall be sleeved to permit relative movement.

24. WC pans shall be provided with a flexible connection at the junction with the outlet pipe.

25. The selection of piping materials shall take cognizance of corrosion (both external and internal).

26. Water pipes shall have a minimum cover of 500 mm.

27. Wherever practical, service trenches shall not be excavated along the length of housing units within the first 3,0 m beyond the perimeter of such units.

Site precautions

28. Down pipes, if provided, shall discharge into concrete lined drainage channels, which discharge the water at least 1,5 m away from buildings.

29. Where guttering is not provided, a 1,5 m wide impervious apron slab shall be provided.

30. The ground immediately against the buildings shall be shaped to fall in excess of 75 mm over the first 1,5 m beyond the perimeter of the building, from where it shall drain freely away from housing units. Apron slabs, where provided shall have the same fall.