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VOLUME 2

ANNEXURES

APPROPRIATE DEVELOPMENT OF INFRASTRUCTURE ON DOLOMITE: MANUAL FOR CONSULTANTS

STANDARD SPECIFICATIONS APPLICABLE TO DOLOMITE STABILITY INVESTIGATIONS (DSI) AND THE PLANNING, ENGINEERING REQUIREMENTS AND MANAGEMENT OF DEVELOPMENT ON DOLOMITE LAND

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Annex B: The Distribution of Dolomite in South Africa

B.1 List of Provinces, Magisterial Districts, Municipalities and Towns located on Dolomite

TABLE B.1.1 List of provinces located on dolomite

Province
Limpopo
Mpumalanga
North West
Northern Cape
Gauteng
Free State

TABLE B.1.2 List of magisterial districts located on dolomite

Magisterial Districts	
Alberton	Mokerong 3
Barberton	Moutse 3
Barkly West	Naphuno 1
Benoni	Naphuno 2
Boksburg	Nelspruit
Brakpan	Nigel
Brits	Oberholzer
Britstown	Parys
Bronkhorstspruit	Pilgrim's Rest
Carolina	Phalaborwa
Delareyville	Phokwani
Delmas	Pietersburg
Ga Rankuwa	Postmasburg
Germiston	Potchefstroom
Groblersdal	Potgietersrus
Hay	Pretoria
Heidelberg	Prieska
Herbert	Randfontein
Hopetown	Rustenburg
Huhudi	Sasolburg
Johannesburg	Sekhukhuneland
Kempton Park	Springs
Kimberley	Thabamoopo
Klerksdorp	Thabazimbi
Kroonstad	Vanderbijlpark
Krugersdorp	Ventersdorp
Kudumane	Vereeniging
Kuruman	Viljoenskroon
Letaba 2	Vredefort
Lichtenburg	Vryburg
Lydenburg	Warmbad
Madikwe	Waterberg
Mankwe	Waterval-Boven
Mmabatho	Westonaria
Mokerong 2	Witrivier

TABLE B.1.3 List of municipalities located on dolomite

Municipalities	
Common Name	**New Name**
Barberton	Umjindi
Barkley West	Dikgatlong
Belfast	Emakhazeni
Benede	Siyanda
Bo Karoo	Siyathemba
Brits	Madibeng
Bronkhorstspruit	Tshwane Metropolitan
Burgersfort/Ohrigstad/Eastern Tubatse	Greater Tubatse
Bushbuckridge	Bushbuckridge
Carletonville	Merafong City
Danielskuil	Kgatelopele
Delmas	Victor Khanye
Diamondfields	Magareng
Dma Lowveld	Umjindi
East Rand	Ekurhuleni Metropolitan
Ellisras	Lephalale
Elukwatini/Carolina	Albert Luthuli
Ganyesa	Kagisano-Molopo
Griekwastad	Siyancuma
Groblersdal	Elias Motsoaledi
Heidelberg	Lesedi
Hoedspruit	Maruleng
Hopetown	Thembelihle
Johannesburg	City Of Johannesburg
Kalahari Cbdc	//Khara Hais
Kathu	Gammagara
Kgalagadi	Ga-Segonyana
Klerksdorp	City of Matlosana
Koster	Kgetlengriver
Kroonstad	Moqhaka
Krugersdorp	Mogale City
Kuruman	Ga-Segonyana
Lebowakgomo	Lepelle-Nkumpi
Lichtenburg	Ditsobotla
Mafikeng	Mahikeng
Marble Hall	Ephraim Mogale
Meyerton	Midvaal
Mogwase	Moses Kotane
Nelspruit	Mbombela
Nylstroom	Modimolle
Parys	Ngwathe
Pietersburg	Polokwane
Pomfret	Kagisano-Molopo
Postmasburg	Tsantsabane
Potchefstroom	Tlokwe City Council
Potgietersrus	Mogalakwena
Pretoria	Tshwane Metropolitan
Prieska	Siya Themba

TABLE B.1.3 (continued)

Municipalities	
Common Name	**New Name**
Randfontein	Randfontein
Reivilo	Greater Taung Local
Rustenburg	Rustenburg
Sabie	Thaba Chweu
Sasolburg	Metsimaholo
Schuinsdraai Nature Reserve	Ephraim Mogale
Sterkfontein	Mogale
Thabazimbi	Thabazimbi
Tzaneen	Greater Tzaneen
Ventersdorp	Ventersdorp
Vereeniging	Emfuleni
Vryburg	Naledi
Warmbath	Bela Bela
Westonaria	Westonaria
Zeerust	Ramotshere Moiloa

TABLE B.4.5 List of towns located on or close to dolomite

*Dolomite status: Provides an indication if the general location of the centre of a town is on dolomite land or within the buffer zone around the dolomite. Dolomite location as indicated on published geological maps.

*DOLOMITE STATUS (in terms of location)	PROVINCE	DISTRICT COUNCIL	MAGISTERIAL DISTRICT	LOCAL MUNICIPALITY (NEW NAME)	LOCAL MUNICIPALITY (COMMON NAME)	Town
2km Buffer	Free State	Fezile Dabi	Moqhaka	Moqhaka	Kroonstad	Spes Bona
On dolomite	Gauteng	Ekurhuleni Metropolitan Municipality		Ekurhuleni Metropolitan	East Rand	Kwa Thema
On dolomite	Gauteng	City of Johannesburg Metropolitan	Randfontein	City of Johannesburg Metropolitan	Randfontein	Randfontein
On dolomite	Gauteng	City Of Tshwane Metropolitan	Atteridgeville	City Of Tshwane Metropolitan	Pretoria	Atteridgeville
On dolomite	Gauteng	West Rand District	Randfontein	Randfontein	Randfontein	Bank
On dolomite	Gauteng	West Rand District	Carletonville	Merafong City	Carletonville	Carletonville
On dolomite	Gauteng	Sedibeng District	Midvaal	Midvaal	Meyerton	Daleside
On dolomite	Gauteng	City Of Johannesburg Metropolitan	Johannesburg	City Of Johannesburg Metropolitan	Johannesburg	Eldorado Park
On dolomite	Gauteng	Ekurhuleni Metropolitan	Katlehong	Ekurhuleni Metropolitan	East Rand	Katlehong
On dolomite	Gauteng	West Rand	Randfontein	Randfontein	Randfontein	Mohlakeng
On dolomite	Gauteng	Sedibeng	Randvaal	Midvaal	Meyerton	Randvaal
On dolomite	Gauteng	Ekurhuleni Metropolitan	Vosloorus	Ekurhuleni Metropolitan	East Rand	Vosloorus
On dolomite	Gauteng	West Rand	Welverdiend	Merafong City	Carletonville	Welverdiend
On dolomite	Gauteng	West Rand	Venterspost	Westonaria	Westonaria	Westonaria
4km Buffer	Gauteng	Ekurhuleni Metropolitan	Daveyton	Ekurhuleni Metropolitan	East Rand	Daveyton
4km Buffer	Gauteng	West Rand	Krugersdorp	Mogale City	Krugersdorp	Krugersdorp
4km Buffer	Gauteng	City Of Tshwane Metropolitan	Pretoria	City Of Tshwane Metropolitan	Pretoria	Pretoria
4km Buffer	Gauteng	City Of Johannesburg Metropolitan	Soweto	City Of Johannesburg Metropolitan	Johannesburg	Soweto
4km Buffer	Gauteng	Ekurhuleni Metropolitan	Springs	Ekurhuleni Metropolitan	East Rand	Springs
4km Buffer	Gauteng	Ekurhuleni Metropolitan	Tsakane	Ekurhuleni Metropolitan	East Rand	Tsakane
4km Buffer	Gauteng	Sedibeng	Vereeniging	Emfuleni Local Municipality	Vereeniging	Vereeniging
2km Buffer	Gauteng	Ekurhuleni Metropolitan	Bapsfontein	Ekurhuleni Metropolitan	East Rand	Bapsfontein
2km Buffer	Gauteng	Sedibeng	Meyerton	Midvaal	Meyerton	Meyerton
2km Buffer	Gauteng	Ekurhuleni Metropolitan	Tembisa	Ekurhuleni Metropolitan	East Rand	Tembisa
On dolomite	Gauteng	City Of Tshwane Metropolitan	Centurion	City Of Tshwane Metropolitan	Pretoria	Centurion

TABLE B.1.4 (continued)

*DOLOMITE STATUS (in terms of location)	PROVINCE	DISTRICT COUNCIL	MAGISTERIAL DISTRICT	LOCAL MUNICIPALITY (NEW NAME)	LOCAL MUNICIPALITY (COMMON NAME)	Town
1km Buffer	Gauteng	City Of Johannesburg Metropolitan	Johannesburg	City Of Johannesburg Metropolitan	Johannesburg	Lenasia
1km Buffer	Gauteng	Ekurhuleni Metropolitan	Thokoza	Ekurhuleni Metropolitan	East Rand	Tokoza
On dolomite	Limpopo	Waterberg	Thabazimbi	Thabazimbi	Thabazimbi	Ganskuil
On dolomite	Limpopo	Waterberg	Thabazimbi	Thabazimbi	Thabazimbi	Sentrum
On dolomite	Limpopo	Capricorn	Lepele-Nkumpi	Lepelle-Nkumpi	Lebowakgomo	The Downs
4km Buffer	Limpopo	Capricorn	Lebowakgomo	Lepelle-Nkumpi	Lebowakgomo	Lebowakgomo
4km Buffer	Limpopo	Waterberg	Ba-Mokopane	Mogalakwena	Potgietersrus	Mahwelereng
4km Buffer	Limpopo	Sekhukhune	Penge	Greater Tubatse	Burgersfort/Ohrigstad/Eastern Tubatse	Penge
4km Buffer	Limpopo	Capricorn	Lepele-Nkumpi	Lepelle-Nkumpi	Lebowakgomo	Zebediela
2km Buffer	Limpopo	Waterberg	Thabazimbi	Thabazimbi	Thabazimbi	Koedoeskop
2km Buffer	Limpopo	Waterberg	Thabazimbi	Thabazimbi	Thabazimbi	Middelwit
2km Buffer	Limpopo	Sekhukhune	Groblersdal	Elias Motsoaledi	Groblersdal	Groblersdal
1km Buffer	Limpopo	Capricorn	Bakgaga Ba Mphahlele	Lepelle-Nkumpi	Lebowakgomo	Chuniespoort
1km Buffer	Limpopo	Sekhukhune	Greater Tubatse	Greater Tubatse	Burgersfort/Ohrigstad/Eastern Tubatse	Branddraai
1km Buffer	Limpopo	Sekhukhune	Marble Hall	Ephraim Mogale	Marble Hall	Marble Hall
1km Buffer	Limpopo	Waterberg	Thabazimbi	Thabazimbi	Thabazimbi	Thabazimbi
On dolomite	Mpumalanga	Nkangala	Botleng	Victor Khanye	Delmas	Delmas
On dolomite	Mpumalanga	Ehlanzeni	Graskop	Thaba Chweu	Sabie	Graskop
On dolomite	Mpumalanga	Ehlanzeni	Thaba Chweu	Thaba Chweu	Sabie	Hendriksdal
On dolomite	Mpumalanga	Ehlanzeni	Thaba Chweu	Thaba Chweu	Sabie	Mauchsberg
On dolomite	Mpumalanga	Ehlanzeni	Pilgrim's Rest	Dma Lowveld	Dma Lowveld	Pilgrims Rest
On dolomite	Mpumalanga	Ehlanzeni	Sabie	Thaba Chweu	Sabie	Sabie
On dolomite	Mpumalanga	Ehlanzeni	Thaba Chweu	Thaba Chweu	Sabie	Vaalhoek
2km Buffer	Mpumalanga	Ehlanzeni	Mbombela	Mbombela	Nelspruit	Kaapsehoop
On dolomite	North West	Bojanala	Madibeng	Madibeng	Brits	Assen
On dolomite	North West	Bojanala	Madibeng	Madibeng	Brits	Atlanta
On dolomite	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Bakerville
On dolomite	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Carlsonia
On dolomite	North West	Dr Ruth Segomotsi Mompati	Naledi	Naledi	Vryburg	De Beers
On dolomite	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Elandsputte

TABLE B.1.4 (continued)

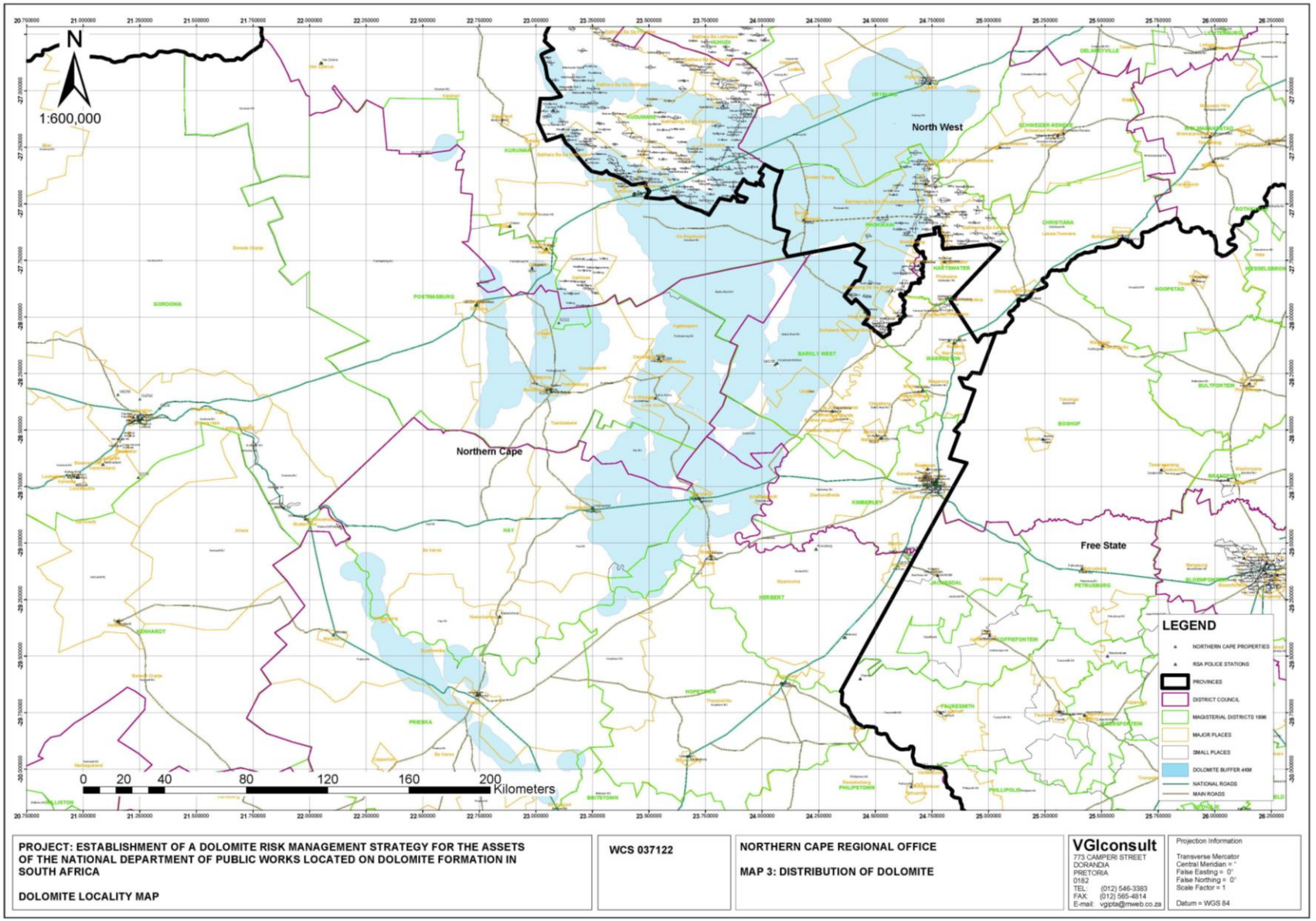
*DOLOMITE STATUS (in terms of location)	PROVINCE	DISTRICT COUNCIL	MAGISTERIAL DISTRICT	LOCAL MUNICIPALITY (NEW NAME)	LOCAL MUNICIPALITY (COMMON NAME)	Town
On dolomite	North West	Dr Ruth Segomotsi Mompati	Kagisano	Kagisano-Molopo	Ganyesa	Geluk
On dolomite	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Grootpan
On dolomite	North West	Dr Keneth Kaunda	Ventersdorp	Ventersdorp	Ventersdorp	Klerkskraal
On dolomite	North West	Dr Ruth Segomotsi Mompati	Greater Taung	Greater Taung	Reivilo	Lykso
On dolomite	North West	Dr Ruth Segomotsi Mompati	Bathlaping Ba Ga Mothibi	Greater Taung	Reivilo	Madipelesa
On dolomite	North West	Ngaka Modiri Molema	Mafikeng	Mahikeng	Mafikeng	Ottoshoop
On dolomite	North West	Dr Ruth Segomotsi Mompati	Greater Taung	Greater Taung	Reivilo	Reivilo
On dolomite	North West	Dr Ruth Segomotsi Mompati	Naledi	Naledi	Vryburg	Salpeterpan
On dolomite	North West	Dr Ruth Segomotsi Mompati	Greater Taung	Greater Taung	Reivilo	Steekdorings
On dolomite	North West	Dr Keneth Kaunda	Ventersdorp	Ventersdorp	Ventersdorp	Swartplaas
On dolomite	North West	Dr Ruth Segomotsi Mompati	Naledi	Naledi	Vryburg	Tierkloof
4km Buffer	North West	Ngaka Modiri Molema	Lichtenburg	Ditsobotla	Lichtenburg	Lichtenburg
4km Buffer	North West	Dr Keneth Kaunda	Potchefstroom	Tlokwe City Council	Potchefstroom	New Machavie
4km Buffer	North West	Dr Keneth Kaunda	Potchefstroom	Tlokwe City Council	Potchefstroom	Potchefstroom
4km Buffer	North West	Ngaka Modiri Molema	Mafikeng	Mahikeng	Mafikeng	Rooigrond
4km Buffer	North West	Ngaka Modiri Molema	Slurry	Mahikeng	Mafikeng	Slurry
4km Buffer	North West	Dr Keneth Kaunda	Ventersdorp	Ventersdorp	Ventersdorp	Ventersdorp
2km Buffer	North West	Ngaka Modiri Molema	Ga-Raphalane	Ditsobotla	Lichtenburg	Itsoseng
2km Buffer	North West	Dr Keneth Kaunda	Margaret Mine	City of Matlosana	Klerksdorp	Stilfontein
1km Buffer	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Lead Mine
1km Buffer	North West	Bojanala	Kgetlengrivier	Kgetlengriver	Koster	Merindol
1km Buffer	North West	Dr Ruth Segomotsi Mompati	Pomfret	Kagisano-Molopo	Pomfret	Pomfret
1km Buffer	North West	Ngaka Modiri Molema	Ditsobotla	Ditsobotla	Lichtenburg	Wondermere
1km Buffer	Northern Cape	John Taolo Gaetsewe	Batlharo Ba Ga Motlhware	Ga-Segonyana	Kgalagadi	Tsineng
On dolomite	Northern Cape	ZF Mgcawu	Kgatelopele	Kgatelopele	Danielskuil	Ariesfontein
4km Buffer	Northern Cape	John Taolo Gaetsewe	Kudumane	Ga-Segonyana	Kgalagadi	Bothithong
On dolomite	Northern Cape	John Taolo Gaetsewe	Ga-Segonyana	Kuruman-Mothibistad Municipality	Kuruman	Bekker
On dolomite	Northern Cape	John Taolo Gaetsewe	Kudumane	Ga-Segonyana	Kuruman	Mothibistat
On dolomite	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Bokkoppie
On dolomite	Northern Cape	Pixley Ka Seme	Campbell	Siyancuma	Griekwastad	Campbell
On dolomite	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Glosam
On dolomite	Northern Cape	John Taolo Gaetsewe	Kuruman	Ga-Segonyana	Kuruman	Kuruman
On dolomite	Northern Cape	ZF Mgcawu	Five Mission	Kgatelopele	Danielskuil	Lime Acres

TABLE B.1.4 (continued)

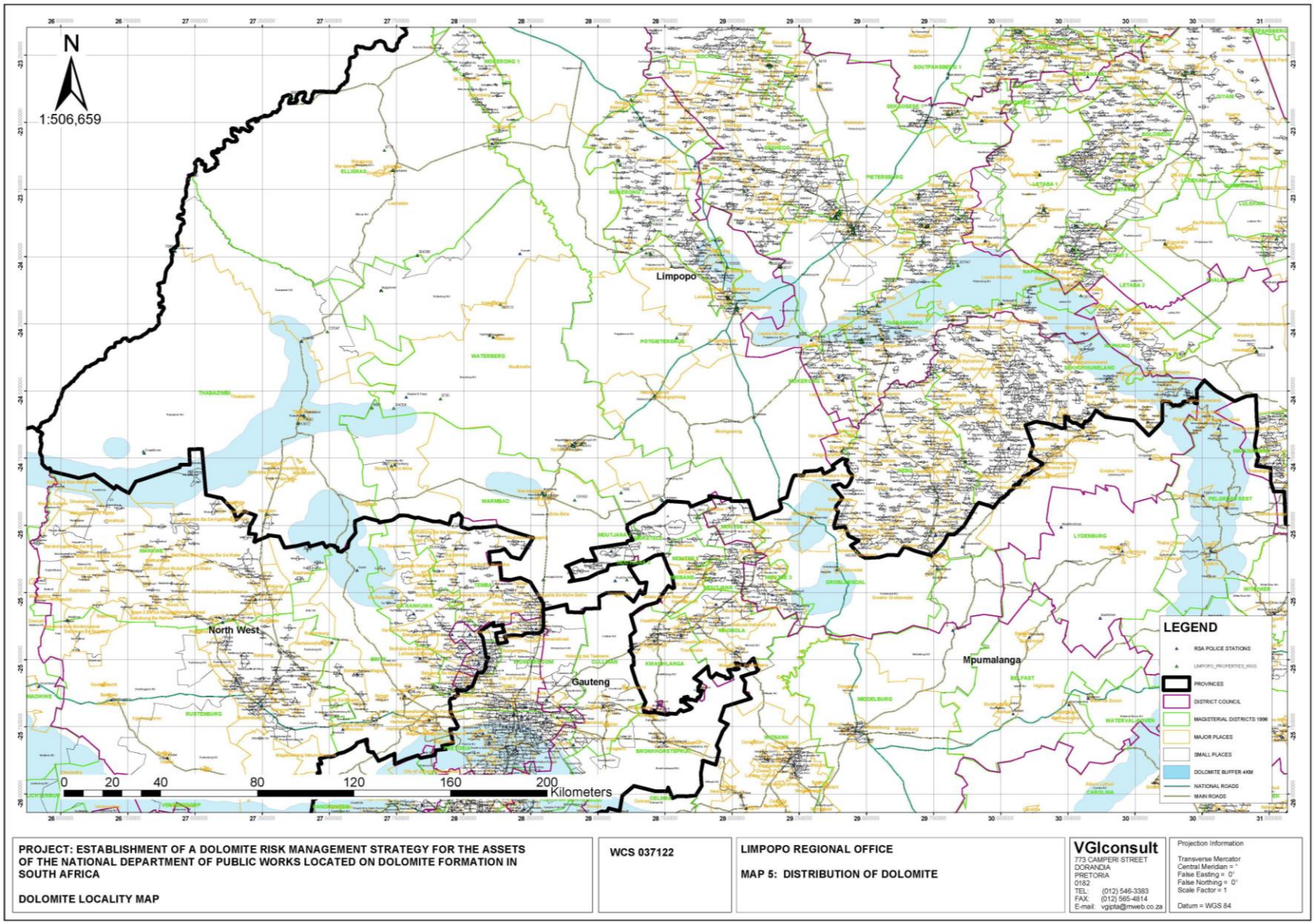
*DOLOMITE STATUS (in terms of location)	PROVINCE	DISTRICT COUNCIL	MAGISTERIAL DISTRICT	LOCAL MUNICIPALITY (NEW NAME)	LOCAL MUNICIPALITY (COMMON NAME)	Town
On dolomite	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Lohatlha
On dolomite	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Lohatlha
On dolomite	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Palingpan
4km Buffer	Northern Cape	Frances Baard	Klein Boetsap	Magareng	Diamondfields	Boetsap
4km Buffer	Northern Cape	John Taolo Gaetsewe	Gamagara	Gamagara	Kathu	Droespruit
4km Buffer	Northern Cape	Pixley Ka Seme	Bo Karoo	Siyathemba	Bo Karoo	Franzenhof
4km Buffer	Northern Cape	Pixley Ka Seme	Bo Karoo	Siyathemba	Bo Karoo	Groveput
4km Buffer	Northern Cape	Frances Baard	Diamondfields	Magareng	Diamondfields	Koopmansfontein
4km Buffer	Northern Cape	Pixley Ka Seme	Siyathemba	Siyathemba	Prieska	Shamley's Farm
4km Buffer	Northern Cape	ZF Mgcawu	Lime Acres	Kgatelopele	Danielskuil	Silver Streams
4km Buffer	Northern Cape	Frances Baard	Dikgatlong	Magareng	Barkley West	Ulco
2km Buffer	Northern Cape	ZF Mgcawu	Kgatelopele	Kgatelopele	Danielskuil	Blikfontein
2km Buffer	Northern Cape	Pixley Ka Seme	Griekwastad	Siyancuma	Griekwastad	Griquatown
2km Buffer	Northern Cape	ZF Mgcawu	Postmasburg	Tsantsabane	Postmasburg	Postmasburg
1km Buffer	Northern Cape	ZF Mgcawu	Postmasburg	Tsantsabane	Postmasburg	Beeshoek
1km Buffer	Northern Cape	ZF Mgcawu	Kgatelopele	Kgatelopele	Danielskuil	Blesmanspos
1km Buffer	Northern Cape	ZF Mgcawu	Danielskuil	Kgatelopele	Danielskuil	Danielskuil
1km Buffer	Northern Cape	ZF Mgcawu	Tsantsabane	Tsantsabane	Postmasburg	Mookaneng
1km Buffer	Northern Cape	ZF Mgcawu	Lime Acres	Kgatelopele	Danielskuil	Papkuil
1km Buffer	Northern Cape	John Taolo Gaetsewe	Gamagara	Gamagara	Kathu	Sishen
1km Buffer	Northern Cape	ZF Mgcawu	Kgatelopele	Kgatelopele	Danielskuil	Swartputs

B.2 Maps showing the distribution of dolomite land in South Africa

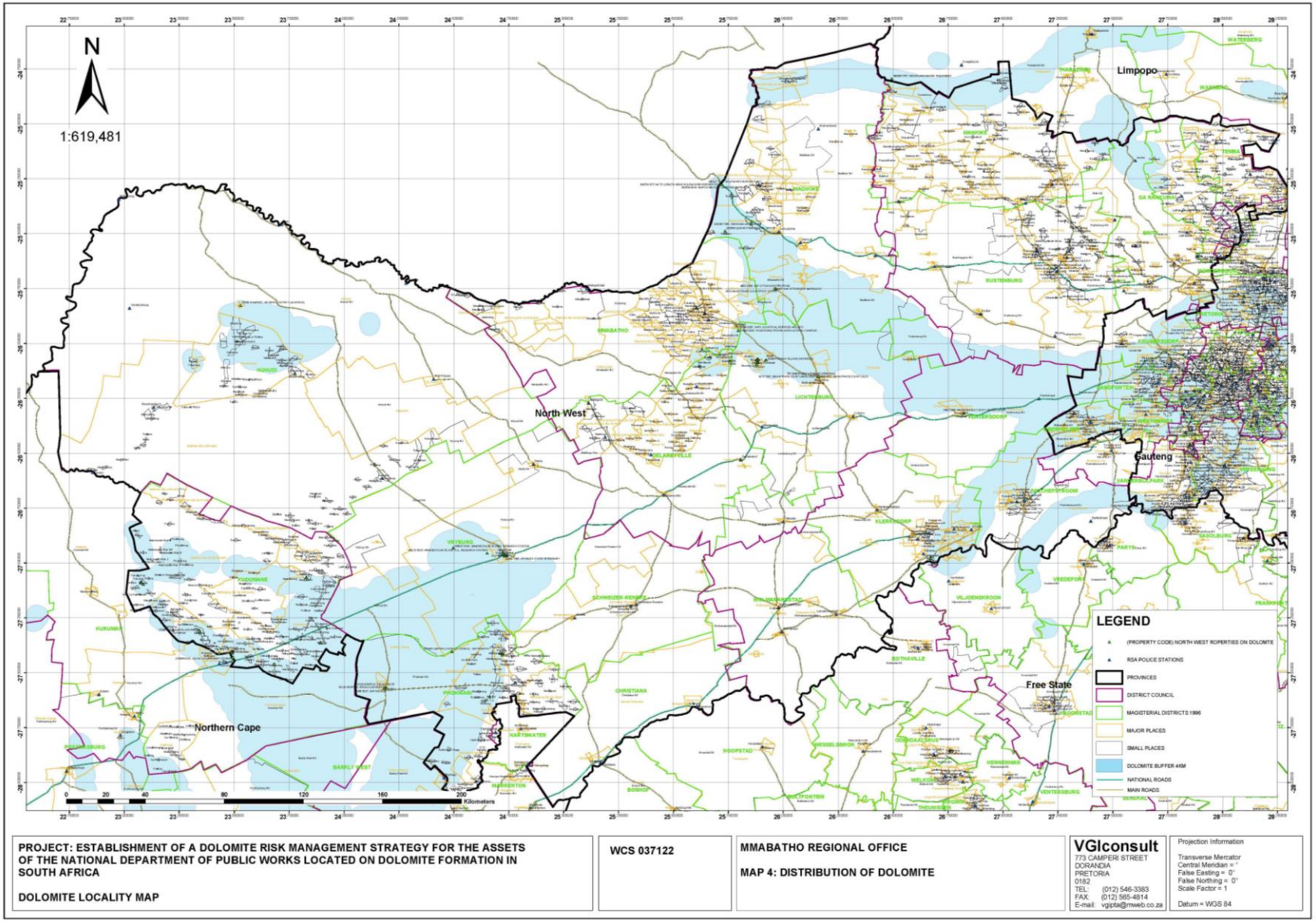
a) Distribution of dolomite: Regional Office Kimberley
b) Distribution of dolomite: Regional Office Polokwane
c) Distribution of dolomite: Regional Office Mmabatho
d) Distribution of dolomite: Regional Office Pretoria
e) Distribution of dolomite: Regional Office Johannesburg
f) Distribution of dolomite: Regional Office Nelspruit



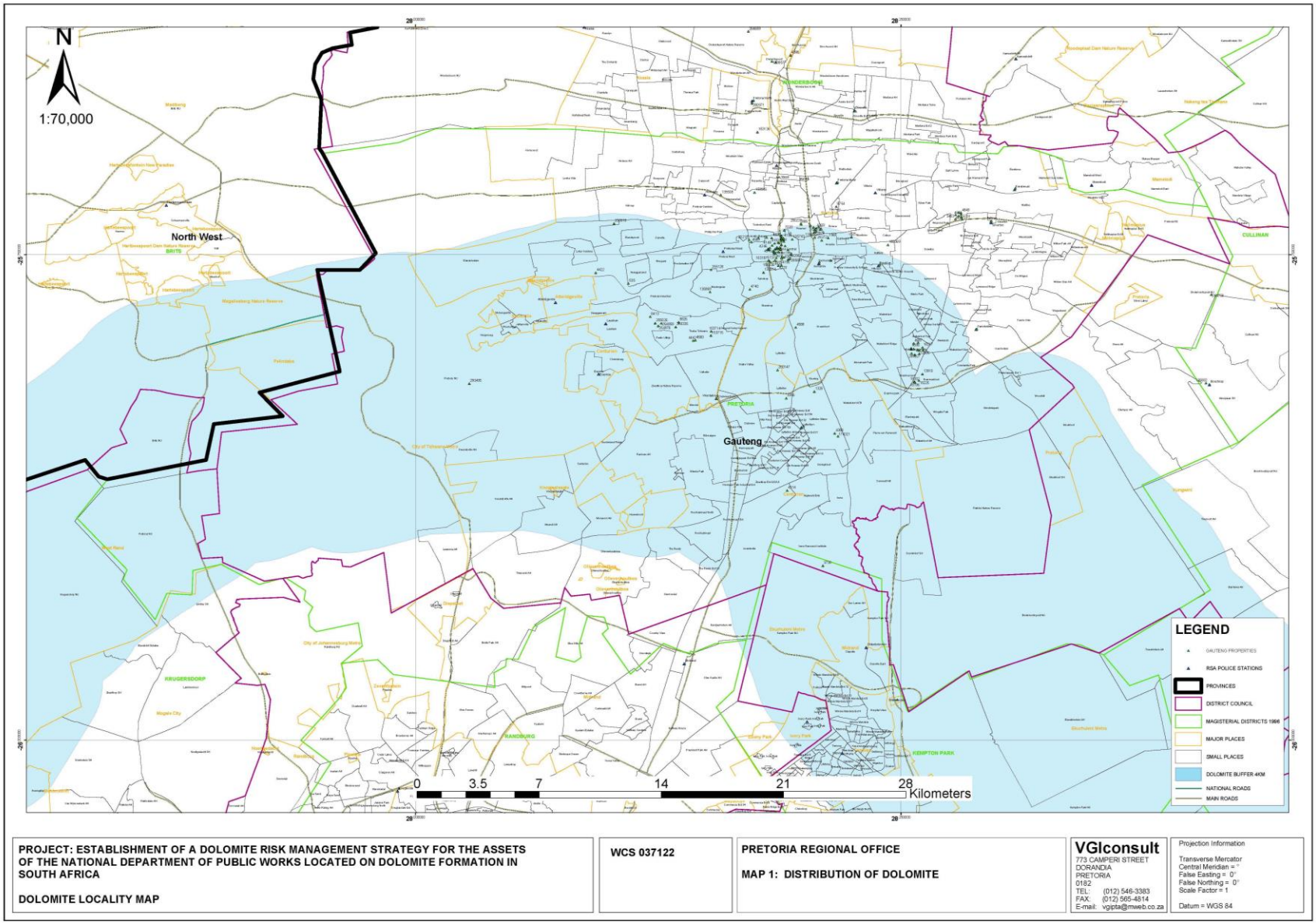
a) Distribution of dolomite: Regional Office Kimberley



b) Distribution of dolomite: Regional Office Polokwane

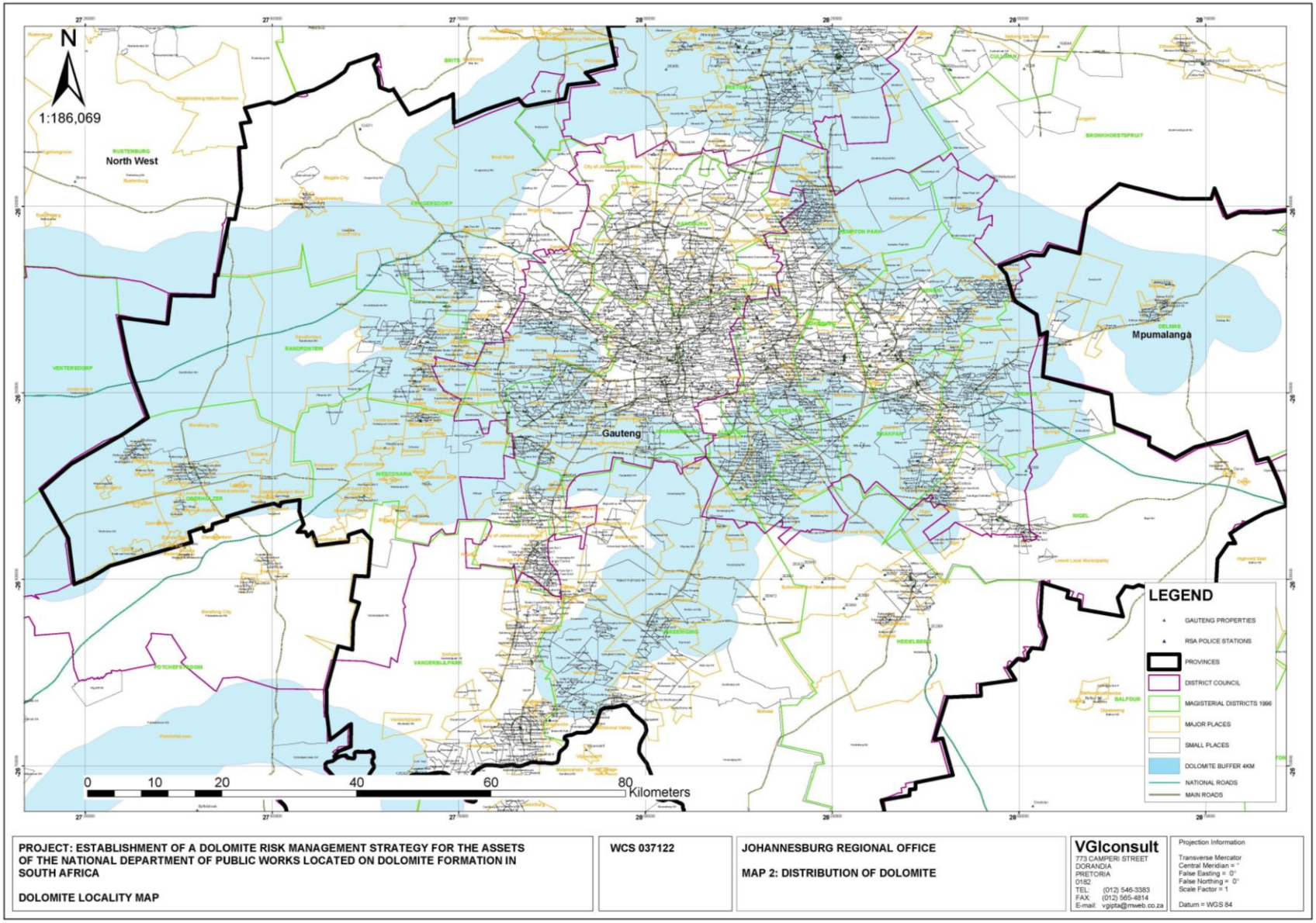


c) Distribution of dolomite: Regional Office Mmabatho



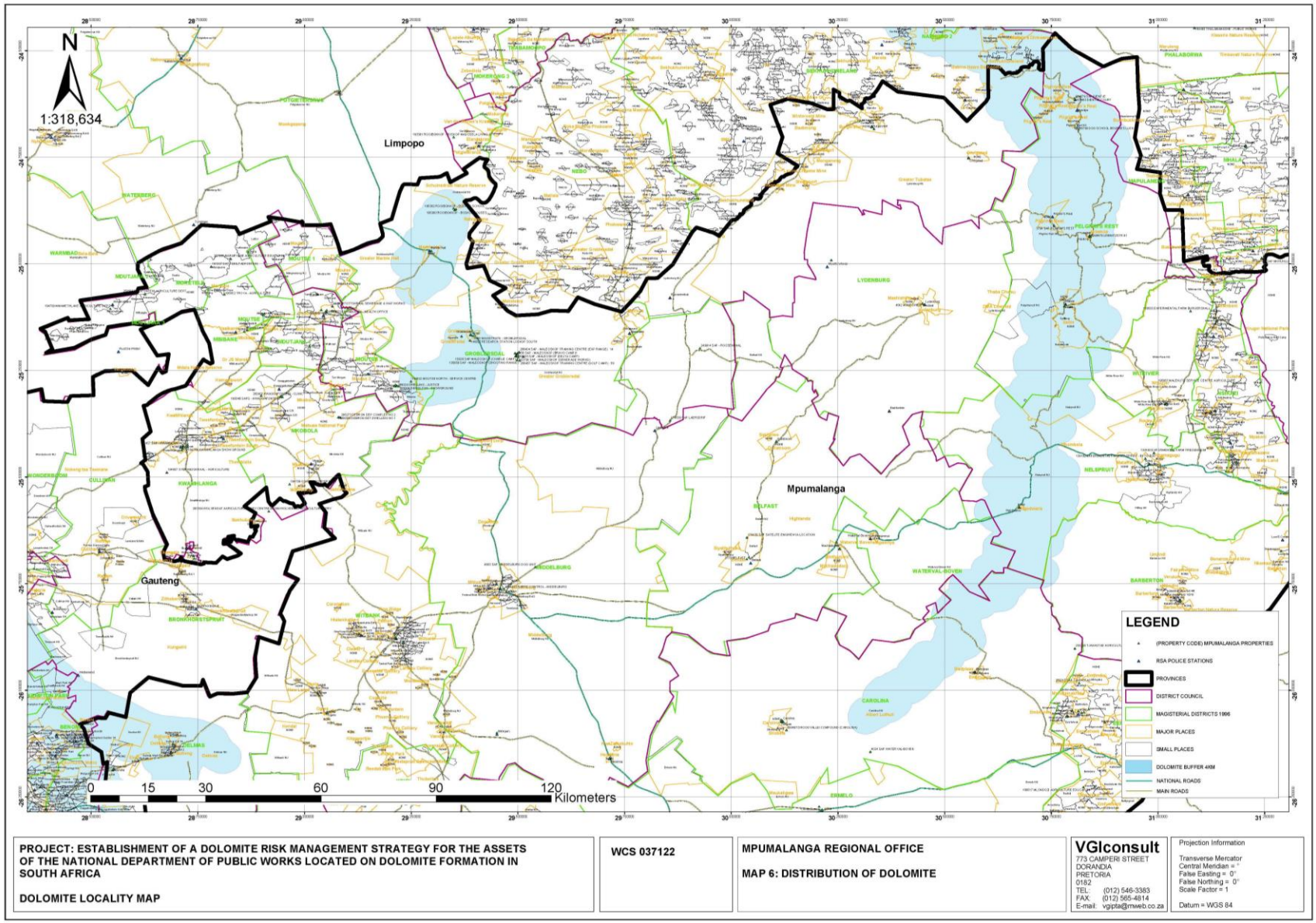
d) Distribution of dolomite: Regional Office Pretoria

Annex B: The Distribution of Dolomite in South Africa



e) Distribution of dolomite: Regional Office Johannesburg

Annex B: The Distribution of Dolomite in South Africa



f) Distribution of dolomite: Regional Office Nelspruit

Annex C: Gravity Method of Geophysical Prospecting

C.1. Gravity method of geophysical prospecting

The gravity method of geophysical prospecting has been found to be the most suitable for the identification of variations in the geology of dolomite areas. The configuration of the solid dolomitic bedrock floor and the thickness and nature of the overlying unconsolidated materials introduce variations in the geological succession that are generally discernible gravimetrically due to the density differences between the unconsolidated materials and the high density bedrock floor.

C.2. Gravity values

Gravity values are affected by all geological masses and the effects of deeper and laterally distant geology of different density need to be removed as a background or regional field to isolate the variations, which are due to the near surface geology at the site under investigation.

In this method, readings are taken with a gravimeter at each station of a grid surveyed for the site. The grid spacing is a function of the type of anomaly (variations in the gravity field) expected, the depth to the source of the anomaly, and the size of the investigated area. A Bouguer gravity contour map is produced from the data set.

C.3. Anomalies

Anomalies cannot be interpreted uniquely in terms of physical dimensions because different mass distributions and different causative effects can match a single anomaly and hence its interpretation is initially qualitative or semi quantitative. In order to constrain the possible physical models that can be produced from the gravity data, the subsurface geology needs to be probed by rotary percussion boreholes. The results are used to produce a residual gravity map which best represents dolomite bedrock variations. Areas of relatively shallow bedrock are then normally represented as gravity high anomalies, and areas of relatively deep bedrock are normally represented as gravity low anomalies. Steep gravity gradients denote rapid changes in bedrock depth over short distances, whereas gentle gravity gradients denote gradual changes in bedrock depth.

C.4. Interpretation

Interpretation of gravity data is often complex, for example gravity high anomalies might result due to causes other than near surface dolomite bedrock, for example near surface hard intrusive rock. Furthermore, where dolomite or limestone is shallow, sudden changes in bedrock topography representing grykes (solution enlarged vertical joints which form slots in the bedrock) and pinnacles are very difficult to identify and these are often not discovered although they have a significant impact on the severity of the hazard.

C.5. Other geophysical methods

Ground Penetrating Radar (GPR) has been used successfully in dolomite areas to identify localised areas of ground disturbances below paved areas, or to determine the presence of grykes in shallow dolomite. Likewise can SAWS electric resistivity survey methods also be used to determine anomalies that are possibly not detected by the gravity method. None of the other geophysical investigation methods should be seen to replace the conventional gravity surveys, but rather to supplement ground data.

Annex D: Determination of Geotechnical Properties of the Overburden

C.1 Dolomite stability assessment is an empirical science, which places great reliance on observation and past experience. The assessment of the anticipated susceptibility of the subsurface dolomite profile to sinkhole or subsidence formation is based particularly on observation of the performance of typical profiles under the influence of various mobilizing agents. Consequently, the experience of the Competent Person is critical to the correct analysis of the anticipated performance of materials constituting the blanketing layer. A range of laboratory and field tests may be considered to obtain a general perspective of the geotechnical characteristics of the various horizons constituting the blanketing layer. However, significant horizontal and vertical variation in the nature, composition and geotechnical characteristics of soil and rock materials constituting the reworked and in situ overburden, often limits the value of on site testing of materials for dolomite stability purposes. For example, over short distances, vertically and laterally in a profile, dolomite residuum may typically vary in colour, moisture content, composition (manganiferous to ferruginous), density, grading, soil fabric (in non-reworked soils varies according to the nature of the original dolomite parent rock, typically laminated or massive), etc. Geotechnical characteristics may further be complicated by the presence of chert in the residual dolomite horizons. In addition, the destructive nature of the drilling technique used during investigations of dolomite sites preclude tests on retrieved disturbed samples and compromises down-the-hole testing, due to alteration of the borehole face by shearing, smearing, fracturing, etc.

D.2. Where a broad understanding of the soil characteristics is necessary, particularly in areas of shallow dolomite bedrock, laboratory and field tests may readily be undertaken on undisturbed and disturbed samples as access in auger holes or test pits is feasible. In instances where the geological setting is such that risk class selection may prove marginal, testing may prove useful. For example, where alluvium constitutes a large proportion of the blanketing layer, testing may prove essential, to verify that the geotechnical conditions are Inherent Hazard Class 1 rather than Inherent Hazard Class 4. In such instances the drilling of large diameter auger holes is merited to obtain disturbed and undisturbed samples for testing. Of particular importance are characteristics such as the permeability and dispersiveness of the horizon. The need for the undertaking of field and laboratory tests for stability determination purposes is at the sole discretion of the Competent Person (geo-professional) performing the investigation.

D.3. Useful laboratory tests include:

a) foundation indicator test;
b) permeability test;
c) oedometer (consolidation) test;
d) shear box test;
e) triaxial test.

D.4. Useful field tests include:

a) falling or constant head, ring or pit permeability tests conducted at various depths;
b) plate load test in trial holes;
c) SPT/cone penetration test.

D.5. Appropriate testing of the surficial dolomite profile for foundation design purposes is a requirement for all geotechnical (foundation) investigations.

Annex E: Design of Foundations for Buildings on D3 Dolomite Area Designation Sites

E.1. General

Risk on class D3 dolomitic sites shall be managed as follows:

a) The site shall be classified in terms of Inherent Hazard Classes and thereafter in terms of Dolomitic Area Designations by a Competent Person (geo-professional) to ensure appropriate development will take place (refer to Chapter 3);

b) The engineering services shall be installed in accordance with the minimum specified requirements and mandatory precautionary measures to minimize concentrations of services (refer to Chapter 4);

c) Site precautions shall be implemented to ensure that water does not pond on the site when a building is constructed. Plumbing requirements shall be implemented to minimize the risk of service pipes rupturing or leaking (refer to Chapter 4);

d) A soil mattress or reinforced concrete foundation shall be provided on sites designated as D3 to allow occupants to safely evacuate buildings in the event of a sinkhole occurrence;

e) In addition or as an alternative to the above, other soil improvement techniques may be implemented as agreed to by the Competent Person (geo-professional). Such soil improvement techniques shall be project specific and are not in the ambit of PW344/2016.

NOTE 1: The requirements for dolomite area designations and general requirements for buildings in dolomitic areas are established in SANS 1936: 2012.

E.2. Performance requirements

E.2.1. The design of a building in areas underlain by dolomite with a Dolomite Area Designation of D3 shall be such that:

a) a sinkhole that has a nominal diameter of 2m on Inherent Hazard Class 5 sites and 5m on Inherent Hazard Class 3 and 4 sites, occurring anywhere on, beneath or adjacent to the building (refer to Figure E.1), will not envelop the building, or result in the toppling or sliding of the building or a portion thereof into such a hole;

b) there is sufficient time for occupants to safely escape from the structure after the occurrence of the sinkhole referred to in (a);

c) the level of expected damage associated with soil movements unrelated to sinkhole and subsidence formation in the near surface horizons is within the limits set out in Code of Practice for Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction.

E.2.2. These performance requirements may be complied with by providing an engineered soil mattress in accordance with the requirements of E.3 on Inherent Hazard Class 5 sites, or a reinforced concrete raft foundation in accordance with the requirements of E.4 on Inherent Hazard Class 3, 4 and 5 sites.

Note 1: Sinkholes can occur at any point under or adjacent to the footprint of a building (refer to Figure E.1). Apron slabs, which are commonly used to mitigate the effects of differential heave on structures and to move collapse settlements away from the footprint of the structure, have little effect on the location of a sinkhole.

Note 2: Subsidences may occur due to the premature termination of sinkhole formation or where the overburden material consolidates due to dewatering or significant seasonal fluctuations. Subsidences that are caused by the premature termination of sinkhole formation may be dealt with in the same manner as sinkholes. Subsidences may also be associated with dewatering where the original groundwater level (and fluctuations thereof) is located above the dolomite bedrock in soil material with a low dry density, high void ratio and high compression index. In such circumstances, buildings straddling the perimeter of the subsidence may be subject to differential settlement.

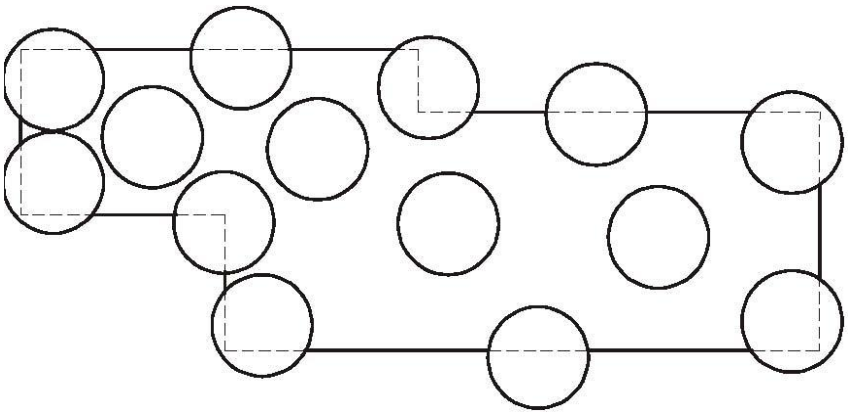


Figure E.1 — Critical locations of sinkholes under the footprint of a building

E.3. Soil mattress construction

The material on the entire plan area of the building plus a perimeter area on Inherent Hazard Class 5 sites shall be removed and backfilled with compaction, or compacted in situ, to 95% of Mod. AASHTO maximum dry density at −1% to +2% of optimum moisture content, to construct an engineered soil mattress of appropriate material, known strength and suitable thickness below the building so that:

a) the risk of sinkhole formation is reduced by reducing the permeability of the material overlying the dolomite;

b) uniform support to the foundation system is provided to reduce the differential settlement to within limits that the building may tolerate without distress;

c) an arch is formed over any cavity with a diameter of up to 2m that may develop below the building, so that in the event of sinkhole formation, the building complies with the performance requirements established in E.2.2.

Note 1: The thickness of the mattress will depend on a number of factors (refer to Figures E.2 and E.3), the most important being
a) the thickness and properties of the soil overlying pinnacles and boulders;
b) the properties of the in situ soil below the mattress;
c) the sensitivity of the proposed building to settlement.

Note 2: The mattress may be constructed using conventional equipment to excavate material and compact the fill. Alternatively, where the geotechnical conditions and the proximity of other buildings lend itself thereto, dynamic compaction (DC) may be used, provided that the safety of the operator and equipment is considered. The method of mattress construction is best determined after a number of trenches (3m to 4m deep or to bedrock, whichever is the lesser) have been excavated and profiled to determine the thickness of the soil cover over pinnacles and boulders as well as the nature of the material.

Note 3: On sites where the overburden above the pinnacle and boulder dolomite formation is less than 3m and where rockfill is available, the material is typically removed to a depth of about 1m below the tops of pinnacles and large boulders, and is backfilled with rockfill to about 200mm above the pinnacles. (Alternatively, the pinnacles may be trimmed using pneumatic tools or a blaster suitable for work in dolomitic areas.) Thereafter, the remainder of the soil mattress is constructed with selected chert gravel or other suitable granular material placed under controlled conditions. On sites where the overburden above the pinnacle and boulder dolomite formation exceeds 3m, the thickness of the mattress is typically between 1,5m and 2,5m below the foundations (refer to Figure E.3).

Note 4: Slab-on-the-ground foundations are most appropriate where mattresses are constructed as they are relatively shallow and distribute loads effectively. There is no point in providing a mattress and then excavating through it, to found the building.

Note 5: It is difficult to construct mattresses on steeply sloping sites or for a building with the ground floor on different levels, as the continuity of the mattress is compromised. In these instances consideration should be given to reinforced concrete foundations.

Note 6: Mattresses may require some tension reinforcement to span potential sinkholes or between unyielding points of support (or both).

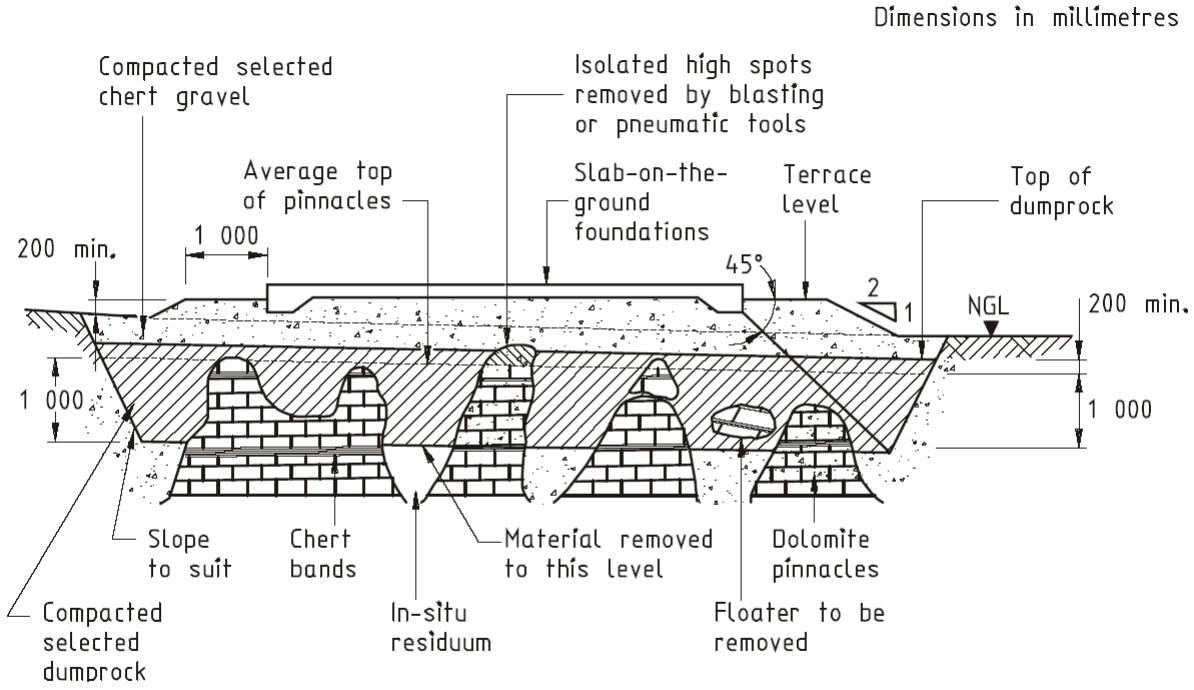


Figure E.2 — Typical mattress on a site with shallow pinnacles and boulders

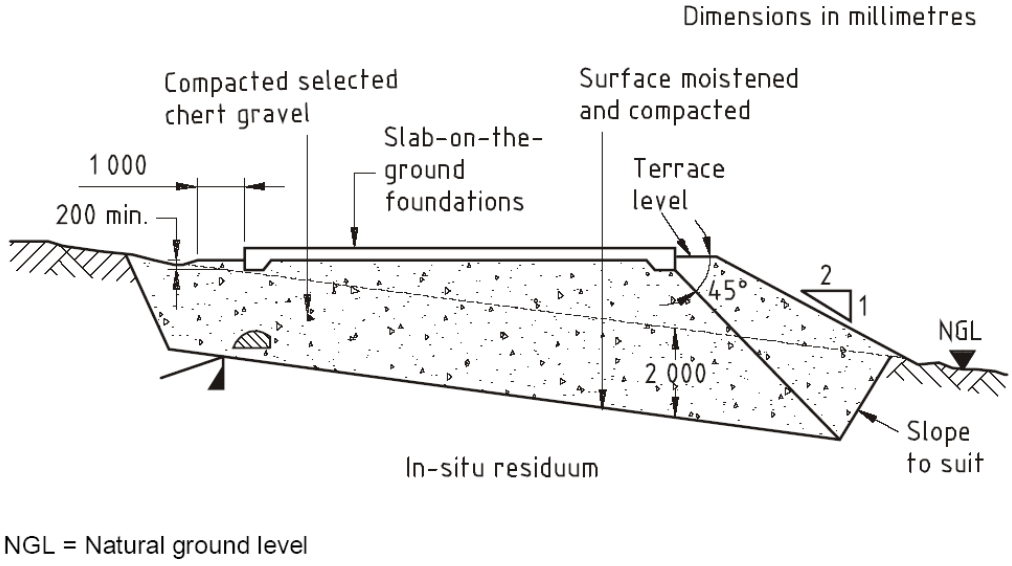


Figure E.3 — Typical mattress on sites where the overburden above the pinnacle and boulder dolomite formation exceeds 3m

E.4. Reinforced concrete foundations

E.4.1. Reinforced concrete foundations shall be designed and constructed in such a manner that the building complies with the performance requirements established in E.2.

E.4.2. The walls and floors of buildings shall withstand a loss of support without collapse into the sinkhole, occurring anywhere within the footprint of the building over an area that has a diameter of (refer to Figure E.1):

a) Inherent Hazard Class 5 sites: 2m;

b) Inherent Hazard Class 3 and 4 sites: 5m;

E.4.3. The wall foundations shall be founded:

a) within the near surface horizons;

b) on piles that have been proofdrilled for a minimum of 6m into solid rock in order to confirm that piles are socketed into pinnacles or bedrock, as opposed to floaters (boulders?);

c) on stub columns founded on bedrock; or

d) on pinnacles occurring in close proximity to the surface provided that it is confirmed that these pinnacles are part of the bedrock.

NOTE: Suitable forms of construction include:

a) stiffened raft foundations (grid of reinforced or post-tensioned (or both) concrete beams cast integrally with the floor slab (refer to plate below);

b) stiffened strip footings (reinforced concrete beams construction with interconnected floor slabs); or

c) cellular raft foundations (horizontal reinforced concrete slabs interconnected by a series of beams (refer to plate below).

Plate: Typical reinforced raft foundation

E.4.4. Beams may extend beyond the perimeter of the external walls to reduce the cantilever span or eliminate the cantilever resulting from the development of a sinkhole at the corner or perimeter of a building. Such beams shall extend beyond the assumed edge of the loss of support for a minimum length of 1,5m and have a bearing pressure of less than 50kPa.

E.4.5. Floor slabs shall be reinforced and positively connected to all edge and stiffening beams.

E.4.6. Reinforced concrete foundations, when subjected to a loss of support in accordance with the requirements of E.2 and subjected to a load combination of (1 × permanent loads) + (0,5 × imposed loads), shall have deflection limited to a maximum of 1:250.

E.4.7. Apron slabs shall be provided around the perimeter of all buildings and shall comprise 75mm thick concrete slabs, not less than 1,5m wide and cast at a slope of not less than 5% away from the

external walls. Such slabs, unless appropriately reinforced, shall be provided with control joints at centres that do not exceed 2m to minimize the effect of shrinkage cracks and the joints shall be suitably sealed.

Note 1: Building structures on raft foundations:

Depending on the engineer's design and the requirements for single-storey structures on rafts or slab-on-ground designed foundations, it is good practice to enhance the brick walls as follows:

a) External or internal double brick walls:

- add 2 x 6mm reinforcing bars on the first and second brick course;
- add 2 x 6mm reinforcing bars on the brick course or lintel above openings, windows and doors. This reinforcing shall be continuous on the entire length of the wall;

b) External or internal single brick walls – add 1 x 6mm reinforcing bar on the first and second brick course:

- add 1 x 6mm reinforcing bars on the first and second brick course;
- add 1 x 6mm reinforcing bars on the brick course or lintel above openings, windows and doors. This reinforcing shall be continuous on the entire length of the wall;

Note 2: In certain cases, it will be good practice to design the structure with a reinforced concrete ring beam directly below wall plate level.

Annex F: Concept and Viability Design (Preliminary Design) Stage Engineering

F.1 Scope

This Annex provides the basic checklist for the evaluation of Conceptual Preliminary Design Reports submitted to the Department.

F.2 Design Guidelines

The Department of Public Works has a large and diverse property portfolio. Various Departmental guidelines have been prepared to assist appointed/contracted service providers/consultants with the design and documentation of Departmental projects. These provide guidance on Departmental requirements and enable appointed/contracted service providers/consultants to efficiently prepare acceptable design solutions. These guidelines are not intended to inhibit the initiative, competence and care as expected from appointed/contracted service providers/consultants in the performance of their duties.

Appointed/contracted service providers/consultants are encouraged to carefully consider the merits of the design guidelines in the context of the requirements of individual projects. If an appointed/contracted service provider/consultant considers a guideline not to be appropriate and that a more suitable solution is available, proposals to this effect should be raised for consideration by the Department.

In the absence of express written approval for a deviation from Departmental guidelines, the Department will assume that the requirements contained in the various design guidelines for appointed/contracted service providers/consultants as published on the Department's official website www.publicworks.gov.za have been fully addressed and incorporated in the proposed design solution and specifications. Most importantly in terms of engineering services, the Civil Engineering Manual PW 347/2012 and in particular, Section C.1.3 (References) and Section C.1.4 (Stage 2: Concept and Viability (Preliminary Design), must be adhered to.

Note: All stipulations of the documents listed on the Department's official website must be applied as well as any stipulation contained in PW344/2016. Any stipulation of PW344/2016 supersedes the stipulations of the other listed documents.

F.3 Design Calculations

Design calculations and investigations shall be performed through all stages in an orderly, logical way. They should not only allow the design engineer to arrive at conclusions, which are sufficient to lead to the preparation of detailed drawings, but their final form should reflect neat and systematic thought processes to allow future verification by an external party.

The engineer must take particular care to ensure that:

a) the design processes are orderly, legible and logical so that the engineer charged with the checking should be able to follow them with ease;
b) the technical and academic quality is acceptable;
c) adequate draughting standards are complied with.

F.4 Concept Design Report (CDR)

Concept Designs and related Concept Design Reports (CDR) in terms of engineering services must comply with the general requirements of the Civil Engineering Manual PW 347/2012 and in particular Section C.1.4 (Stage 2: Concept and Viability (Preliminary Design). For projects located on dolomite all design aspects must also reflect the requirements of PW344/2016 and show the impact on normal engineering design.

a) Concept Design Reports for the development of new sites shall, as a minimum, describe the site and potential constraints by reporting on all the elements as described in Appendix A.
b) Concept Design Reports for projects related to the upgrading of existing engineering infrastructure shall report on the status quo of the existing infrastructure, as well as the proposed

upgrading, extension or replacement thereof. An indication of the expected scope of the investigation to be undertaken prior to compiling the concept design is given in Appendix B. The Department needs to know what the current status quo of services are in order to prioritise budgeting in relation to the risk of the continued use of existing infrastructure that may not be compliant to PW 344/2016.

F.5 Preliminary Design Report (PDR) Checklist

The proposed checklist contained in Table B.1 should be completed by the project manager and professional appointed/contracted service provider/consultant to ensure that the Departmental engineer has sufficient project detail to enable him to check the design proposal.

The checklist in Table B.1 is generic and some of the listed items/activities may not be applicable to the particular project under review. Items that are still in process of finalisation at the time of submission of the PDR shall be specifically highlighted and the current stage of finalisation reported. Generally, most of the aspects should be addressed in the PDR, but it may be possible that some of the processes have not been taken to conclusion (EIA for example) before submitting the PDR. An objective decision on allowable exclusions will have to be made by the Departmental Project Manager after consultation with the Departmental Civil Engineer so that the concept design approval is not delayed.

Note 1: Although not specifically related to the civil engineering, the EIA and Heritage requirements of a project as well as any interface with external utility service providers and local authorities must be addressed in detail at concept design stage as these could have a substantial impact on the cost of the works.

F.6 Civil Engineering Project

It is stated in PW347/2012, Section C.1.4.5 that in the case of a civil engineering project on an existing site, e.g. water and sewage treatment works, upgrading of water and stormwater reticulation, sewers, rehabilitation of roads and streets, etc., the Concept Design Report and Preliminary Design Report will be combined in a single report, unless instructed otherwise.

Annex F: Appendix A: Concept design site investigation of undeveloped sites for new projects located on dolomite: Scope of work for Concept Design Report (CDR)

F.A.1 General

The appointed/contracted service provider/consultant must ensure that all the requirements of PW 344/2016 that relates to the development planning and the design of all buildings, structures and infrastructure are appropriately addressed in the Concept Design Report.

The CDR for a new development on dolomite land must include an investigation of the proposed site and report as a minimum on;

a) the items as listed below;
b) the impact of the requirements of PW 344/2016 in relation thereto.

The basic information gathered for the CDR must be discussed with the Departmental Project Manager in terms of potential development constraints. The information is also required to finalise the Preliminary Design Report.

F.A.2 Cadastral Information

a) Location;
b) Property boundaries (Surveyor General diagrams and title deeds);
c) Ownership;
d) Servitudes (registered or in process of registration and ownership);
e) Right of way (registered or site conditions that may require registration thereof);
f) Occupation (illegal or legal)

F.A.3 Occupation

a) Illegal;
b) legal.

F.A.4 Topocadastral information

a) Site contours;
b) Site features that require special attention.

F.A.5 Existing structures and buildings

a) Location of existing structures and buildings;
b) Current usage;
c) Potential integration into new developments.

F.A.6 Existing engineering services

a) Ownership and purpose of existing services that traverse the site;
b) Comprehensive reporting on condition and upgrading required or relocation of existing services;
c) Agreements regarding the existing services (title deeds or other);
d) Services under construction.

F.A.7 Roads

a) Access roads (surfaced/gravel/non-existing);
b) Access (temporary and permanent and potential constraints).

F.A.8 Stormwater

a) Natural drainage features;
b) Catchment areas;
c) Natural drainage of the surrounding area;
d) Drainage properties of soil and vegetation;
e) Formalised or constructed drainage of the surrounding area;
f) Canals (lined, unlined, general condition, possible connection);
g) Stormwater pipes (size, type, possible connection).

F.A.9 Water

a) Availability and current source;
b) Current and potential future supply;
c) Current utility supply agreements;
d) Local authority connection;
e) Size;
f) Pressure;
g) Type;
h) Exact location of connection.

F.A.10 Sewer

a) Current points of discharge and/or networks;
b) Method of disposal in areas with no formal networks;
c) Current and potential future method of disposing;
d) Current agreements with utility providers;
e) Local authority connection:

    i. location;
    ii. size;
    iii. material and jointing;
    iv. manholes (type, material, joint sealing);
    v. possible connections.

F.A.11 Electricity and communication

a) Availability and current source;
b) Current and potential future supply;
c) Current supply agreements;
d) Local authority or other connections:

    i. location;
    ii. capacity.

F.A.12 Geotechnical information

a) All available geotechnical reports related to the property and/or surrounding land;
b) Dolomite Hazard Zonation (if available or from surrounding property);
c) General geological information (as published).

F.A.13 Site clearing

a) Requirements for demolitions and related activities;
b) Requirements for removal of movable items on site.

Annex F: Appendix B: Concept design site investigation of infrastructure on dolomite for upgrading projects: Scope of work for Concept Design Report (CDR)

F.B.1 General

The appointed/contracted service provider/consultant must ensure that all the requirements of PW 344/2016 that relates to the development planning and the design of all buildings, structures and infrastructure on dolomite land that are to be upgraded are appropriately addressed in the concept design report.

The CDR for upgrading projects on dolomite land must include a status quo investigation of all building structures and infrastructure on the proposed site and report as a minimum on:

a) the items as listed below;
b) the impact of the requirements of PW 344/2016 in relation thereto.

The basic information gathered for the CDR must be discussed with the Departmental Project Manager in terms of potential development constraints. The information is also required to finalise the Preliminary Design Report.

The site investigation shall include (but not be limited to):

a) Site layout drawings;
b) General investigation information;
c) General information regarding surrounding area;
d) Water;
e) Sewer;
f) Stormwater;
g) Gardening;
h) Paved areas;
i) Foundations;
j) Buildings;
k) Swimming pools and fish ponds or water features;
l) Water tanks;
m) Electricity and communication;
n) Site maintenance;
o) Boreholes for groundwater abstraction;
p) Geology.

F.B.2 Site layout drawings

Base information drawings should include the following:

a) Water (Drawing number.....)
b) Sewer (Drawing number.....)
c) Stormwater (Drawing number.....)
d) Roads (Drawing number.....)
e) Paving (Drawing number.....)
f) Building Layout (Drawing number.....)

F.B.3 General investigation information

Property description	
Building number (s)	
Responsible Client Department	
Responsible person	
Previous name (if any)	
Physical location (Province, magisterial district, town, suburb)	
Stand number	
Farm portion	
x, y co-ordinates (if known)	
Age	

General comments from site representative (with relevant dates) regarding the following:

a) Ponding of stormwater on the site;
b) Repairs to water pipes, during the last …….. years;
c) Blockages of sewer system, during the last ……. Years;
d) Cracks in buildings;
e) Known incidences of subsidences or sinkhole on the site or in the surrounding area.

Information of all Contractors that do regular maintenance on the site:

Service	**Contractor**	**Tel. no**
Water		
Sewer		
Stormwater		
General Building and structure maintenance		
General infrastructure maintenance		
Dry engineering services		

Information of occupants (date: …../…./….).

Description	**Now**	**Future**
Number of persons normally present		
Normal number of staff		
Maximum person capacity under normal conditions (including staff)		
Maximum staff capacity		
Maximum number of persons during special events (including staff)		

Information regarding services

a) Monthly water consumption for the last 12 months;
b) Municipal account number;
c) Reasons for abnormal high water consumption.

F.B.4 General information regarding surrounding area

Indicate the following on site layout drawing:

a) General drainage of surrounding area onto the site;
b) Type of roads surrounding the site;
c) Type of stormwater system surrounding the site.

F.B.5 Water

F.B.5.1 Position of water meter

Indicate on site layout (type, shut-off valve, leakages, valve box, condition, etc,)

F.B.5.2 Pressure test

Results, pressure and leakages

F.B.5.3 Flow measurement

a) Record normal consumption;
b) Record peak consumption;
c) Record consumption during “zero flow” conditions.

F.B.5.4 Approximate route of main water supply

Inspect route for:

a) Depressions;
b) Trees (5m zone);
c) Unnatural green grass patches;
d) Wet patches;
e) Excavate and report on condition of pipe.

F.B.5.5 External reticulation

a) Fire hydrants;
b) Garden taps;
c) Sports fields (size, type of irrigation, frequency of irrigation and flow rate, if metered).

F.B.5.6 Building reticulation

Indicate position of pipe distribution around buildings and inspect this route for any visible leakages, depressions, etc.

F.B.5.7 Internal fittings

Check the following for leaks, damage and general condition:

a) Washbasins;
b) Toilets;
c) Urinals;
d) Drinking fountains (excess water drainage facility);
e) Fire hose reels.

F.B.5.8 Pipes above natural ground level for entry into the buildings

a) Pipes through walls (allowance for movement);
b) All connections between flexible and rigid pipes shall be provided with flexible, self-anchoring joints;
c) Pipes under floor slabs (service ducts, inspectable);
d) The selection of pipe material and corrosion factors (both external and internal as well as between

different materials - i.e. galvanised to copper etc.).

F.B.6 Sewer

F.B.6.1 **Pit latrines**

a) Indicate position and number of;
b) Can stormwater flow into pit;
c) Type of structure;
d) Position of previous pit latrines;
e) Duration of use.

F.B.6.2 **Septic tank**

a) Describe condition and size of septic tank and indicate position;
b) Indicate position of subsurface soak-away;
c) Evidence of overflowing.

F.B.6.3 **Conservancy tank**

a) Position and size;
b) General condition;
c) Cleaning cycle;
d) Contractor currently employed to empty;
e) Evidence of overflowing.

F.B.6.4 **Sewage treatment works**

a) Type;
b) Condition;
c) Age;
d) Discharge;
e) Reed beds, maturation ponds, etc.

F.B.6.5 **Water-borne sewerage system**

a) Pipe (position, type, condition, depth);
b) Manholes (position, type, condition, depth, connection details, indicate regular overflowing, silt deposits etc.);
c) Route (type of pipe, recent modifications, inspect line for depressions or unnatural green patches and trees or vegetation on the route).

F.B.6.6 **Drains from buildings**

a) Position, accumulation route, cleaning and rodding eyes, valleys, inspect for general condition and indicate which portion is above and which below ground level, leakages, regular overflowing, general condition of surrounding area, paving, grass, etc.;
b) Pipes above natural ground level for exit from buildings;
c) Pipes through walls (allowance for movement);
d) All connections between flexible and rigid pipes shall be provided with flexible, self-anchoring joints;
e) Pipes under floor slabs (service ducts, inspection possible);
f) Area of high concentration of sewer outlets out of buildings (condition);
g) WC pans (provided with a flexible connection).

F.B.7 Stormwater

F.B.7.1 General drainage onto site

Watercourses, location, ponding against boundary, entry at driveways etc., canals, general slopes, position, etc.

F.B.7.2 Drainage system of surrounding area

The diversion of drainage onto the site, earth berms, cut-off trenches etc.

F.B.7.3 Diversions of natural watercourses on the site

Natural ponds and watercourses located within 30m of any structure - indicate type, lining material, etc.

F.B.7.4 Drainage of site and surrounding area

a) Free drainage of surface water;
b) Areas of ponding on the site;
c) Indicate any areas with gradients less than 1:100;
d) Lowest stormwater drainage point of the site.

F.B.7.5 Stormwater canals on the site, further than 10m from buildings

Gradients, type, size, position, condition, joint sealant, cracking, displacement, panel lengths, expansion joints, depositing of silt or sand.

F.B.7.6 Stormwater pipes

Gradients, type, position, size, location, age, general condition, inlet structures, jointing, condition of seals.

F.B.7.7 Stormwater drainage around buildings and up to 10m away

Detail of surfacing and open canals, joint sealants, panel dimensions cracking, displacement joint sealant and condition.

F.B.7.8 Sloping of surfaces around buildings

Drainage in passages or between buildings - indicate slope and direction of flow.

F.B.7.9 Drainage towards a structure

a) Stormwater pipes and gulleys next to, under or parallel to buildings;
b) Drainage of grassed areas such as sports fields (minimum of 1:80);
c) Water tightness of all conduits - perform tests for leakage;
d) Concrete non-pressure pipes - type, size, condition, jointing;
e) Joints in box culverts, manholes and inlet grids to subsurface systems;
f) Gutters - condition of gutters, position of down pipes and canals from downpipes;
g) Drainage away from structure - no gutters, investigate the site drainage efficiency and apron slabs (type width, position, condition).

F.B.8 Gardening

a) Indicate all gardening and flower boxes in between or around structures;
b) Inspect for type of gardening activity - excessive watering, algae, moss growth, type gardening and general condition.

F.B.9 Paved areas

Indicate on drawings all paved areas (e.g. driveways and parking areas)

a) Type and current state;
b) Accumulation of debris;
c) Gradients;
d) Purpose to facilitate drainage.

F.B.10 Foundations

a) Foundation type;
b) Exposed foundation or lowering of surrounding ground is causing exposure;
c) Termite activity.

F.B.11 Buildings

a) Building (original structure) (indicate in black ink);
b) Date of additions or alterations (indicate in red ink);
c) Comment on each structure individually and if known on the type foundation, bricks used etc.;
d) Inspect each individual structure and indicate on drawings exact positions of all cracks and magnitudes of deformation - mark origin and end of all cracks on date of inspection and give indication of width, but all cracks wider than 1mm and longer than 1m must be inspected on a regular basis and propagation thereof reported immediately;
e) Indicate all construction and expansion joints in buildings;
f) Indicate whether cracks are related to normal stress relief, foundation settlement or heave, inadequate design or originate where different material types match, etc;
g) Compile exact diagrams of crack survey.

F.B.12 Swimming pools and fish ponds/water features

a) Location, size, type, age, general condition;
b) Replenishment system;
c) Surrounding paving;
d) Waste/backwash and other water from swimming pools discharged system (piping or open drainage systems);
e) Splash drainage (impervious, brick paving, concrete paving, grass, distance, drainage canal to collect splashed water;
f) Discharge point (not closer than 20m from pool);
g) Stormwater drainage of area surrounding the swimming pool;
h) Gardening of area surrounding the swimming pool.

F.B.13 Water tanks

Type, location, condition, depth, height, etc.

F.B.14 Electircity and communication

a) Sleeve and draw box systems - condition and type (watertight?);
b) Routes;
c) Trenching, backfilling and compaction of trenches.

F.B.15 Site maintenance

a) General condition of site and building surroundings (general upkeep);
b) Presence of ash/dump pits and stormwater drainage in that area;
c) Sandpits or areas of soil removal.

F.B.16 Boreholes for groundwater abstration

a) Position;
b) Permission to sink boreholes as a control on dewatering;
c) Capacity (pump equipment).

F.B.17 Geology

a) Risk classification of the site (if known);
b) Indicate the known geological zones on the layout drawings;
c) Note site conditions (surficial soils, rock outcrop, sudden changes in soil profile, and soil consistency/type);
d) Sinkholes, subsidences or any other depression.

TABLE B.1 : Concept design (sketch plan) stage engineering

The questions/statements below require a Yes /No /Not Applicable response.

1. General	YES	NO	N/A
□ The Project Manager has briefed Departmental Civil Engineer on Client Department requirements and facility configuration.			
□ Concept Design Report (CDR). The Civil Consultant has Reported and discussed design options/details with the Departmental Civil Engineer and obtain approval for the Concept Design.			
□ Environmental Impact Assessment:			
i) Application for exemption was made.			
ii) Scoping report was compiled and submitted.			
iii) Full EIA process is required by DEAT and has been initiated.			
iv) ROD was obtained.			
□ Have the requirements of the local municipality been established and taken into consideration in the design proposal?			
□ If a services report is required by the Municipality or Service Provider has it been compiled and submitted?			
2. Preliminary Design Report (PDR)	YES	NO	N/A
□ A Preliminary Design Report (PDR) has been drafted in accordance with Clause C.1.4 of The Civil Engineering Manual 2014 and has been forwarded to Departmental Civil Engineer.			
The PDR includes the following: a). General	YES	NO	N/A
□ A Clear description of required facilities as defined by the Client Department. Definition includes function and purpose of facilities; the number and classes of occupants; periods of usage and usage patterns; all farming, abattoir or business activities listed separately.			
□ Confirmation by the Architect or Principal Agent that the description of the facility in the Engineer's PDR is accurate and complete.			
□ Append letter of confirmation to report.			
□ A summary of the Site Clearance information from the Site Clearance Report-Town Planning; problems identified at site clearance stage.			
□ Locality of project including a large scale - provincial locality map and a small scale map showing locality in town.			
□ Photos of typical or specific site characteristics – topography, access roads, vegetation, wetlands etc.			
□ Design criteria clearly referenced to Departmental or other guideline documentation. Deviations from standards clearly indicated and motivated.			
□ Recommendations and motivation for further investigations, surveys and servitudes.			

b). Water Supply		YES	NO	N/A
□	A preliminary assessment of water use as defined by the function or purpose of the facility.			
□	Water demand per category calculated and presented in tabular form.			
□	Tabled calculation of peak factors with reference to Departmental guidelines.			
□	Local Fire Authority regulations and degree of assistance available from the Authority.			
□	The facility classification in terms of fire risk. Tabled fire flow requirements with reference to Departmental or Fire Authority standard.			
□	Layout drawing with position of municipal hydrants adjacent to site.			
□	Confirmation in writing from municipality of sufficient capacity in the municipal water supply infrastructure.			
□	Results of investigations (diurnal flow and pressure readings) confirming the capacity of the municipal infrastructure. (Alternative to the written confirmation from municipality above).			
□	As-built data of Municipal water supply infrastructure.			
□	Results of surveys, investigations, methodology and assumptions if as-built data is not available.			
□	Verification of municipal water connection cost and the possibility of bulk water contribution cost.			
□	A copy of the Service Level Agreement with the Service Provider is appended to this report. (Alternative to the verification of connection and bulk costs).			
□	Special requirements of the municipality and how these requirements have been incorporated in the design proposal.			
□	Where borehole water is to be utilized, test results from yield and quality tests. Recommendations on usage and abstraction rates by Geo-hydrologist.			
□	The conceptual design of river abstraction method.			
□	A recommendation on licensing requirements to utilize borehole or river water.			
□	Proposals on water treatment, including disinfection, of borehole and river water. Results of the water quality analysis.			
□	Water Storage requirements and proposal. Specific requirements of the user-Department or requirements for fire fighting.			
□	Confirmation that elevated storage towers are listed in EIA.			
□	Proposed layout of water reticulation and placing of services. Pipe networks, ring mains etc. shown on sketch drawings.			
□	Water supply design standards i.t.o materials, hydraulic specification, velocity, pressure limits and roughness coefficients.			
□	Specifications of materials, valves, air valves, PRV's, water meters etc.			
□	Placement of water meters to monitor water usage.			
□	General arrangement and design basis for water supply pump stations, including operational control and standby capacity.			

c). Stormwater	YES	NO	N/A
□ Summary of statistical data of the nearest rainfall station.			
□ The sub-catchment areas are shown on the layout plans.			
□ Design criteria and calculation assumptions and methodology.			
□ Design storm return period and tabulated runoff per sub-catchment.			
□ A description of any specific design requirements in terms of stormwater reuse or conduit size limitations.			
□ Storm water design standards i.t.o materials, hydraulic specification, velocity, pressure limits and roughness coefficients.			
□ Flood line for the 1:100 year storm event shown on the layout plan.			
□ Routing of stormwater affecting cut and fill slopes on embankments or platforms.			
□ Concept design of flood attenuating or control devices as well as a description of storm water management plan.			
d). Sewerage	YES	NO	N/A
□ A preliminary assessment of sewer flow as defined by the function or purpose of the facility with tabulated results of calculations and design figures.			
□ Table showing criteria and results of the peak factor calculations with reference to Departmental guidelines.			
□ General arrangement and design basis for sewerage pump stations; including sump design, instrumentation and standby capacity.			
□ Description of the type and capacity of the sewerage collection system.			
□ Capacity assessment of municipal sewer or written confirmation of capacity by municipality.			
□ Location and accurate level of municipal sewer indicated on the layout drawing.			
□ Assessment of sewerage treatment options.			
□ Outcome of licensing and sewerage treatment discussions with DWAF.			
□ Does the EIA scoping report include the establishment of an on-site sewerage treatment works?			
□ If on-site treatment has been proposed with irrigation of the final effluent, is there sufficient land available within the site boundary for irrigation.			
□ Results of percolation tests if soakaways are proposed.			
□ Sewerage collection system design standards i.t.o materials, min slopes, hydraulic specification, velocity and roughness coefficients.			
□ Specifications of special materials, valves, pumps, macerators, water meters etc.			
□ Sewerage connection cost and the possibility of bulk sewer contribution cost.			

e). Roads and Parking	YES	NO	N/A
□ The information relevant to vehicular traffic to be accommodated on the site e.g. Vehicle type loading, frequency and definition of functional areas.			
□ Road classification for different functional users.			
□ Local Authority or the road owner's regulations applicable to access.			
□ Bulk contribution cost to municipality for access roads.			
□ Results or recommendation on traffic study.			
□ Applications lodged for way leaves.			
□ Road and pavement design criteria.			
f). Earthworks	YES	NO	N/A
□ Final site layout obtained from Architect.			
□ Platform elevations obtained from Architect.			
□ Retaining wall requirements communicated with Structural Engineer.			
□ Slope stability and method of stabilization detailed and motivated.			
□ Preliminary cut and fill volumes calculated and balanced.			
□ Proposed design standards for earthworks.			
□ Borrow pits and Spoil sites have been identified.			
□ Borrow pits and Spoil sites were included in EIA scoping report.			
g). Construction Specifications and Form of Contract	YES	NO	N/A
□ Construction Standard Specifications e.g. SANS 1200; COLTO.			
□ Form and Conditions of contract specified e.g. GCC 2004, JBCC.			
h). Cost Estimate	YES	NO	N/A
□ Cost estimate and comparison of the various design options.			
□ Life cycle cost where needed to motivate between options and select final design configuration.			

i). Appendices	YES	NO	N/A
□ Confirmation by the Architect or Principal agent that the description in the Engineers PDR is accurate and complete.			
□ Summary and Recommendations from Site Clearance Report.			
□ EIA – Record Of Decision (ROD).			
□ Marked up architects drawings showing concept design and layout of roads and parking; bulk water supply and water reticulation; sewerage reticulation, sewer outfall, sewerage treatment, effluent or alternative sewerage disposal; stormwater catchments, collection and conveyance systems.			
□ General arrangement of pump stations.			
□ Recommendations of geotechnical investigations.			
□ Recommendations of traffic study.			
□ Correspondence with Local Municipality including Service Level Agreement (SLA).			
□ Correspondence/ ROD - Road Owner.			
□ Way leave applications.			
□ Photos of typical or specific site characteristics. Results of water and sewerage investigation.			
□ Results of water and sewerage investigation.			
□ Explanatory drawings, typical details or typical road cross sections.			

Annex G: Dolomite Status Certificate

G.1. General

The Departmental Dolomite Risk Manager will issue a signed Dolomite Status Certificate for a particular site to the Departmental Project Manager of each upgrading, repair, maintenance or new capital project/development.

The Departmental Project Manager must ensure that all work is compliant with the requirements of the Dolomite Status Certificate.

The attached certificate is a proforma Dolomite Status Certificate as previously issued by the Department.

PRO FORMA DOLOMITE STATUS CERTIFICATE

PRM 11A

public works
Department:
Public Works
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF PUBLIC WORKS
DOLOMITE RISK MANAGEMENT SYSTEM

DOLOMITE STATUS CERTIFICATE

PROVINCE						
NDPW REGIONAL OFFICE		HO REF		FILE REF	**18/10/1**	
MAGISTERIAL DISTRICT						
DISTRICT COUNCIL						
LOCAL MUNICIPALITY						
SUBURB						
TOWN/SUBURB EXTENSION NO						
SITE DESCRIPTION/NAME AND SUB-PORTION/SUB-UNIT / STREET NAMES ETC						
BUILDING DESCRIPTION	FRN No	**N/A**	No	**N/A**	Name	**N/A**
MUNICIPAL ERF NO		PROPERTY OWNERSHIP: The undersigned herewith certifies that the property herein described is owned by the Department of Public Works:				
PROPERTY CODE (NDPW)						
SG CODE (21 DIGIT)						
FARM NAME		……. ……. Director: Town Planning Services date				
FARM NO (SG)	No		subdivision (portion)			
PROJECT NAME (NDPW WCS SYSTEM NAME)						
WCS NO						
CLIENT DEPARTMENT						
NDPW PROPERTY	Yes	No	Lease			
MAP REFERENCE	1:50 000		1:10 000			
CO-ORDINATES (dd: mm : ss)	Geographic reference	X (longitude)		Y (latitude)		
	Datum:	WGS 84		CAPE		
	Lo block	Lo X **:**		LoY:		
REPORT NO AND DATE						
Project Manager						
Date submitted						

RISK ZONE CLASS.	**DESCRIPTION**	% OF SITE *
Class 1 Low risk	Residential, light industrial and commercial development provided that appropriate water precautionary measure are applied. Other factors affecting economic viability such as excavatability, problem soils, etc. must be evaluated.	
Class 2 Medium risk	Residential development with remedial water precautionary measures. No site and service schemes. May consider for commercial or light industrial development	
Class 3 Medium risk	Selected residential development with exceptionally stringent precautionary measures and design criteria. No site and service schemes. May consider for commercial or light (dry) industrial development with appropriate precautionary measures.	

PRO FORMA DOLOMITE STATUS CERTIFICATE PRM 11A

RISK ZONE CLASS.	DESCRIPTION	% OF SITE *
Class 4 Medium risk	Selected residential development with exceptionally stringent precautionary measures and design criteria. No site and service schemes. May utilise for commercial or light (dry) industrial development with appropriate stringent precautionary measures.	
Class 5 High risk	These areas are usually not recommended for residential development but under certain circumstances selected residential development (including lower-density residential development, multi-storied complexes, etc.), may be considered, commercial and light industrial development. The risk of sinkhole and subsidence formation is adjudged to be such that precautionary measures, in addition to those pertaining to the prevention of concentrated ingress of water into the ground are required to permit the construction of housing units.	
Class 6 High risk	These areas are usually not recommended for residential development but under certain circumstances high-rise structures or gentleman's estates (stands 4 000m^2 with 500m^2 proven suitable for placing a house) may be considered, commercial or light industrial development. Expensive foundation designs may be necessary. Sealing of surfaces, earth mattresses, water in sleeves or in ducts, etc.	
Class 7 High risk	No residential development. Special types of commercial or light industrial (dry) development only (eg. bus or trucking depots, coal yards, parking areas). All surfaces sealed. Suitable for parkland.	
Class 8 High risk	No development, nature reserves or parkland.	
NO RISK	Non Dolomitic site (No risk of sinkhole and subsidence formation)	
* The proportional percentages of the site in general or the proportional percentages of the selected area of the site. Attach sketch to clarify.		
Please ensure that PRM 006, 007, 011, 012 and 016 that relates to Dolomite conditions have been completed, together with any other relevant documents, as part of the Contract Documentation list of documents.		

If any portion of a site has been classified as being on dolomite, then all infrastructure development, additions, reparations, maintenance and upgrading must comply with "PW 344/2016 APPROPRIATE DEVELOPMENT OF INFRASTRUCTURE ON DOLOMITE: GUIDELINES FOR CONSULTANTS" which can be obtained from the Departmental website.	
OTHER SPECIFIC COMMENTS	
Development potential	
Foundation design	RECOMMENDATIONS Based on the available information it is recommended that the design incorporate measures as follow:
Site works	
Monitoring	It is recommended the long-term maintenance of the completed project incorporate measures to facilitate a perpetual obligation on DOD to:

PRO FORMA DOLOMITE STATUS CERTIFICATE

PRM 11A

Departmental confirmation **The Directorate Civil and Structural Engineering (DRMS Unit) hereby confirms that the abovementioned site / buildings fall on the Risk Zone Class as specified above.**	
Signature **DRMS Unit**	Signature **D / Civil and Structural Engineering**
Date	Date

Sketch attached:	Yes		No	

Annex H: Guidelines for Infrastructure and Groundwater Monitoring on Dolomite Land

H.1 Introduction

H.1.1 Monitoring comprises three aspects:

a) infrastructure monitoring, which entails the inspection of water bearing services, buildings, roads etc.;

b) ground surface monitoring, which entails the inspection of the ground surface in its present condition;

c) groundwater monitoring, which entails the measuring and recording of the water level in boreholes together with, where appropriate, the recording of volumes of water pumped per unit measure of time for specific time periods.

H.1.2 Monitoring practices differ from site to site, but may also differ from one monitoring designation area to another within a site. Some Inherent Hazard Class areas may require the imposing of more stringent precautionary measures and may, as such, include more frequent monitoring. This could be monthly, quarterly or annually.

H.2 Infrastructure monitoring

H.2.1 Infrastructure monitoring should be undertaken at the following intervals:

a) Seasonal:

   i. visual checks for debris in open stormwater channels at the start of the rainy season and after heavy storms;

   ii. visual checks for water flowing out of stormwater manholes at the start of the rainy season and after heavy storms;

   iii. the examination of buildings for cracks at the start of the rainy season.

b) short intervals (weekly/monthly) consisting of visual checks for:

   i. outside dripping taps and pressure valves;

   ii. damp or moss grown areas;

   iii. debris in open stormwater channels;

   iv. water flowing out of sewer and stormwater manholes;

   v. cracks in buildings, paving, walls, etc.;

   vi. over wetting of gardens;

   vii. blocked drainage ports in garden walls.

c) intermediate intervals (four monthly or six monthly/annually):

   i. the activities listed in H.2.1(b);

   ii. the activities described in H.2.2 and H.2.3;

d) long intervals (every two years): inspection of wet services by camera (in pipes with a diameter greater than 100 mm).

H.2.2 In many instances visual inspections might not be sufficient. It may be necessary to undertake regular air and water tests on wet services. Consideration should also be given to the design of the infrastructure so that these tests can be easily performed.

H.2.3 Many high density residential developments have only one water meter for the entire development, which would not allow for the testing of water supply to individual units and renders identifying the location of a leak difficult. In such circumstances, the following procedure is recommended:

a) Close all taps in the buildings or stopcocks controlling the water supply to buildings, if fitted, for one hour and monitor the water meter or monitor meter late at night when residents are normally asleep. A slow increase in the water meter reading or continued operation of the meter will indicate that there is a leak between the meter and the taps or stopcocks;

b) Open all manholes on the property and observe if wastewater or stormwater flows normally.

H.3 Ground surface monitoring

H.3.1 Ground surface monitoring may be undertaken visually on a regular basis. This should be done by inspecting paved areas after rainstorms (ponding water indicates an area of differential settlement). Search for ground cracks and cracks in lined and unlined channels.

H.3.2 In many instances, visual inspections may not be sufficient. It may be necessary to undertake detailed ground surface levelling, particularly in areas that have been rehabilitated after an event. Such levelling should be undertaken by a surveyor, recorded and stored in the databank and appropriate actions should be taken when excessive settlement continues.

H.4 Groundwater level monitoring

In certain developments, a recommendation may be to equip one or more boreholes to measure the water level. The water level in such boreholes should be recorded by a designated person at predetermined intervals. The water level data should ultimately be reported to the Department of Water Affairs and the Council for Geoscience.

Annex I: Ground Hazard Incident and Monitoring Reporting

I.1 General

This annex includes the standardised Departmental forms on which:

a) Ground hazard incidents are to be reported;'
b) Monitoring feedback is to be provided of buildings and structures that sustained damage and is used subject to regular monitoring as deemed necessary by the Competent Person (geo-professional).

I.2 Requirements for Reporting

Ground hazard incident reports are to be directed to the Departmental Dolomite Risk Manager without delay, as soon as the incident occurs. The basic information can also be telephonically communicated to the Departmental Dolomite Risk Manager and then be confirmed by means of submitting the ground hazard incident report.

If required, the Departmental Dolomite Risk Manager may instruct the users of buildings, structures and infrastructure to monitor events that caused damage on a regular interval and to report such monitoring actions on a predetermined time scale. If there may be imminent danger of collapse, he may instruct evacuation of the building(s) and structure(s).

Instructions to monitor buildings, structures and infrastructure will place a legal liability on the building user.

I.3 FORMS FOR GROUND HAZARD INCIDENT AND MONITORING REPORTING

I.3.1 Ground hazard incident report

DEPARTMENT OF PUBLIC WORKS

FORWARD TO DEPARTMENTAL DOLOMITE RISK MANAGER:

Name:_____
TEL : (012) 337-2393
FAX : (012) 323-8509
FAX : 0866185990

public works
Department:
Public Works
REPUBLIC OF SOUTH AFRICA

	GHIR No		**REF NO**	
	WCS No		**DATE**	

GROUND HAZARD INCIDENT REPORT

DOLOMITE RELATED INVESTIGATIONS, REPORTS AND MANAGEMENT SYSTEMS

PROJECT NUMBER (if applicable):

REPORTING UNIT	
RESPONSIBLE CLIENT DEPARTMENT	
REPORTING MEMBER	
TEL	
DATE	
TIME	
BUILDING EFFECTED	
BUILDING NAME	
CURRENT USE	
FRN/PROPERTY/COMPLEX NO/NAME	
SITE/BASE/PROPERTY NAME	
INVENTORY HOLDER NAME	
DESCRIPTION OF HAZARD/INCIDENT	
SINKHOLE	
SUBSIDENCE	
CRACKED BUILDING	
DAMAGED SERVICE	
OTHER	
LOCATION	
MAKE DIAGRAMMATIC SKETCH OF THE LOCATION, BUILDINGS AND KNOWN UNDERGROUND SERVICES	

GHIR No	**REF NO**
WCS No	**DATE**

ACTIONS ALREADY TAKEN				
ACTION TO BE TAKEN				
CONTACT PERSONS				
NAME:				
TEL:		**CELL**		**FAX**
DISCUSSIONS				
NAME:				
TEL:		**CELL**		**FAX**
DISCUSSIONS				
NAME:				
TEL:		**CELL**		**FAX**
DISCUSSIONS				
COMMENTS:				

I.3.2 Building field inspection/investigation form

BASIC INFORMATION

Operator Name	
Facility Name	
Date	D D M M Y Y Y Y
GIS No.	
GPS Location	Latitude (Decimal Degrees) - . S
	Longitude (Decimal Degrees) . E

Type of Structure

A	Permanent
B	Semi – Permanent
C	Temporary
D	Semi - Temporary
E	Mobile
F	Demolished / Not Present

FRN Number	
Display Number	
Building Name	
No. of Floors	

Basement included

A	Yes
B	No

USE

Intended Use of Building	
Current Use	

In Use

A	Yes
B	No

METHOD OF CONSTRUCTION - STRUCTURE

Type

A	Brick
B	Concrete
C	Steel
D	Prefab
E	Timber
F	Other

If ***Other*** please specify

CONDITION - STRUCTURE

Damage

A	Serious Damage
B	Damaged
C	Minor Damage
D	No Damage

Type of damage

A	Cracked
B	Minor Movement
C	Cracked and Minor Movement
D	Major Movement
E	Cracked and Major Movement
F	None
G	Other
If ***Other*** please specify	

Attention Required

A	Urgent Attention Required
B	Attention Required
C	General Maintenance
D	None

Structure Comments

METHOD OF CONSTRUCTION - ROOF

Type

A	Corrugated Iron
B	IBR Sheets
C	Interlocked
D	Fibre Cement
E	Clay Tiles
F	Concrete Tiles
G	Timber
H	Concrete Slab
I	Other

If ***Other*** please specify

CONDITION - ROOF

Damage

A	Serious Damage
B	Damaged
C	Minor Damage
D	No Damage

Type of damage

A	Minor Rust
B	Serious Rust
C	Cracked Tiles
D	Sheets Loose
E	Sheets / Tiles Missing
F	None
G	Water Proofing
H	Other
If ***Water Proofing*** or ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Roof Comments	

GUTTERS / DOWNPIPES

System Present		
	A	Yes
	B	No

Type		
	A	Plastic
	B	Metal
	C	Concrete
	D	Fibre Cement / Asbestos
	E	Other
	If ***Other*** please specify	

Damage		
	A	Serious Damage
	B	Damaged
	C	Minor Damage
	D	No Damage

Type of damage		
	A	Minor Rust
	B	Serious Rust
	C	Gutters / Downpipes Leaking
	D	Sections Loose
	E	Vegetation
	F	Blocked
	G	None
	H	Other
	If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Gutters / Downpipes Comments	

METHOD OF CONSTRUCTION - WALLS

Exterior Type

A	Face Brick
B	Brick / Plaster
C	Metal Sheets
D	Fibre Cement
E	Hard Board
F	Timber
G	Prefab
H	None
I	Other
If ***Other*** please specify	

Interior Type

A	Brick
B	Brick / Plaster
C	Plaster
D	Fibre Cement
E	Timber
F	Partitions
G	Other
If ***Other*** please specify	

CONDITION – WALLS EXTERIOR

Damage

A	Serious Damage
B	Damaged
C	Minor Damage
D	No Damage

Type of damage

A	Cracks
B	Paint
C	Other
If ***Other*** please specify	

Attention Required

A	Urgent Attention Required
B	Attention Required
C	General Maintenance
D	None

CONDITION – WALLS INTERIOR

Damage

A	Serious Damage
B	Damaged
C	Minor Damage
D	No Damage

Type of damage

A	Cracks
B	Paint
C	Other
If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Walls Comments	

METHOD OF CONSTRUCTION - APRON

Apron Present		
	A	Yes
	B	No

Apron Slab		
	A	Only Partially
	B	Right Round
	C	None Present

Type		
	A	Cast Concrete
	B	Paving
	C	Stone
	D	Tar
	E	Gravel
	F	Flower Box
	G	Grass
	H	Natural Ground
	I	Other
	If ***Other*** please specify	

Apron Size							
	Length			.			M
	Width			.			M

CONDITION - APRON

Damage		
	A	Serious Damage
	B	Damaged
	C	Minor Damage
	D	No Damage

Type of damage		
	A	Cracked
	B	Structural Movement
	C	Cracked / Structural Movement
	D	Partially Missing
	E	Weeds / Grass
	F	Other
	If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	Remove Flower Box
	E	None

Apron Redesign / Upgrade		
	A	Redesign
	B	Upgrade
	C	None

Apron Comments	

CONDITION - PLUMBING

Water Present		
	A	Yes
	B	No

Type		
	A	HDPE
	B	PVC
	C	Galvanised
	D	Cast Iron
	E	Fibre Cement
	F	Other
	If ***Other*** please specify	

Damage		
	A	Serious Damage
	B	Damaged
	C	Minor Damage
	D	No Damage

Type of damage				
	A	Rust		
	B	Leaking		
	C	Cracked		
	D	Partially Missing		
	E	Weeds / Grass		
	F	Other	If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Plumbing Redesign / Upgrade		
	A	Redesign
	B	Upgrade
	C	None

Plumbing Comments	

Waste Water		
	A	Yes
	B	No

Soil (Sewer) Water

A	Yes
B	No

Sewer Inlet

A	French Drain
B	Concrete Tank
C	Sewer Reticulation
D	Other
If ***Other*** please specify	

Sewer Type

A	HDPE
B	PVC
C	Galvanised
D	Cast Iron
E	Fibre Cement
F	GEWP (Clay)
G	Other
If ***Other*** please specify	

METHOD OF CONSTRUCTION – STORMWATER CHANNEL

Stormwater Channel Present

A	Yes
B	No

Stormwater Channel

A	Only Partially
B	Right Round
C	None

Type

A	Concrete
B	Paving
C	Other
If ***Other*** please specify	

Stormwater Channel Size

Length			**.**			M
Width			**.**			M

CONDITION – STORMWATER CHANNEL

Silt

A	0 %
B	1 – 25%
C	26 – 50%
D	51 – 75%
E	>75%

Damage

A	Serious Damage
B	Damaged
C	Minor Damage
D	No Damage

Type of damage		
	A	Cracked
	B	Structural movement
	C	Cracked / Structural Movement
	D	Partially Missing
	E	Weeds / Grass
	F	Other
	If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Stormwater Redesign / Upgrade		
	A	Redesign
	B	Upgrade
	C	None

Stormwater Comments	

CONDITION – SITE DRAINAGE

Site Drainage		
	A	Seriously Problematic
	B	General Upgrade required
	C	Fine

Type of Damage		
	A	Standing Water Next to Building
	B	Insufficient Runoff
	C	Ground Subsiding
	D	All of the Above
	E	None
	F	Other
	If ***Other*** please specify	

Attention Required		
	A	Urgent Attention Required
	B	Attention Required
	C	General Maintenance
	D	None

Site Drainage Redesign / Upgrade		
	A	Redesign
	B	Upgrade
	C	None

Site Drainage Comments	

GENERAL

Building Term		
	A	Special
	B	Long Term
	C	Medium Term
	D	Short Term

Building Condition		
	A	Good
	B	Fair
	C	Poor
	D	Very Poor
	E	Demolish

Number of Taps		SPRINKLER SYSTEM	Y	N
Number of Toilets		FIRE HOSE	Y	N
Number of Urinals				
Number of Showers				
Number of Baths				
Number of Wash Basins				
Number of Sinks				
Number of Washing Troughs				
General Comments				
Photo Reference		No. of Photos		

I.3.3 Engineering services field inspection/investigation form

BASIC INFORMATION

Operator Name

Facility Name

Date D D M M Y Y Y Y

Manhole Number

Accessibility

A	Yes
B	No

If ***NO*** please specify

GPS Location

Latitude (Decimal Degrees) - . S

Longitude (Decimal Degrees) . E

Type of Service

A	Water
B	Sewer
C	Storm water
D	Electrical
E	Fuel

If ***A, B or C*** please specify type of service

No. of Floors (pump station)

Basement included

A	Yes
B	No

SLAB

Slab Level to Ground Level

A	Level
B	Below
C	Above

If ***B or C*** give depth / height in MM MM

Type

A	Round
B	Square
C	Rectangular
D	Other
E	None

If ***Other*** please specify

Condition

A	Good
B	Fair
C	Poor

If ***C – Poor*** please motivate

COVER

Type

A	Round
B	Square
C	Rectangular
D	Inlet Grid
E	Other

If ***Other*** please specify

Material

A	Concrete
B	Cast Iron
C	Steel
D	Plastic
E	None
F	Other

If ***Other*** please specify

Duty

A	Light
B	Heavy

Condition

A	Good
B	Fair
C	Poor

If ***C – Poor*** please motivate

Size in MM

MM

SHAFT

General Impression

A	Good
B	Fair
C	Poor

If C – Poor please Motivate

In Use

A	Yes
B	No

If ***No*** please motivate

Type

A	Round
B	Square
C	Rectangular
D	Other

If ***Other*** please specify

Size in MM

MM

Invert Depth in MM

MM

Material

A	Brick
B	Brick / Concrete
C	Concrete
D	Pre-cast Concrete
E	HDPE
F	PVC
G	Steel
H	Other

If ***Other*** please specify

Condition

A	Good
B	Fair
C	Poor

If ***C – Poor*** please Motivate

CHANNELS

Material

A	Clay
B	Concrete
C	PVC
D	Asbestos
E	HDPE
F	Steel
G	Other

If ***Other*** please specify

Number of Connections

A	1
B	2
C	3
D	4
E	5
F	6
G	More than 6

Pipe size in MM

Size 1		MM
Size 2		MM
Size 3		MM
Size 4		MM

Condition

A	Good
B	Fair
C	Poor
D	Misaligned

If ***C – Poor or D – Misaligned*** please motivate

Benching

A	Proper
B	Flat

Benching Condition

A	Good
B	Fair
C	Poor

If ***C – Poor*** please motivate

Silt

A	0 %
B	25 %
C	50 %
D	75 %
E	100 %

Blockages (Manhole)

A	Wet Regularly
B	Dry Regularly
C	Wet Currently
D	Dry Currently
E	None

Blockage Percentage

A	0 %
B	25 %
C	50 %
D	75 %
E	100 %

If B, C, D or E please motivate

Roots / Vegetation	A	Yes	If ***Yes*** please motivate	
	B	No		

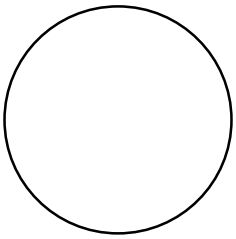
Distance to Nearest Building in Meters ____ M

Nearest Building GIS No ____

LOCATION SKETCH IN RELATION TO BUILDING (MINIMUM OF 2 DISTANCES INDICATED)

GIS NO.

CHANNEL LAYOUT AND FLOW INDICATION WITH PIPE SIZES INDICATED



PHOTOS

Photo folder ____

Number of Photos ____

Annex J: Dolomite Risk Management Plans

J.1. Scope

This annex provides the generic format for Dolomite Risk Management plans and can be extended by the site specific requirements as deemed necessary to ensure that the plan can be executed to the requirements of the Department.

J.2. General

Each new development and the upgrading of existing development require the compilation of a risk management strategy and plan in terms of PW 344/2016, Chapter 5. The risk management plan shall include all the information as required in terms of Chapter 5 (in structure and content) to ensure that the various appointed/contracted service providers/consultants and in-house divisions/sections provide the required site data in a predetermined/formalised format and sequence to the Department.

The completed dolomite risk management plan must be lodged at:

a) Departmental Dolomite Risk Management Unit (DRMU);
b) KAM of each Client Department;
c) Client Department Facility Management division (Accounting officer);
d) State Asset Register division of the Department.

J.3. Risk Management plan format

The investigator/competent person (geo-professional) shall document and report all findings and opinions of the risk management plan in a written report using the standard headings, subheadings and requirements as indicated below.

J.3.1 Report title

All reports shall be specific in title as follows:

a) *First line in Title*:
Report number assigned by Competent Person (geo-professional) as well as the Departmental Dolomite Risk Manager: Client Department abbreviation: Province: Town: Site name: Type of investigation;
b) *Second line in Title*:
Departmental Project Name: WCS Number

Example:

First line in title:
1234: DEPARTMENT OF (NAME of CLIENT): GAUTENG: PRETORIA: SITE (NAME): DOLOMITE RISK MANAGEMENT PLAN
Second line in title:
PROJECT TITLE: WCS NUMBER

J.3.2 Introduction

Provide a brief outline of risk management and the method by which risk may be managed on dolomite land. Refer to the hazards related to dolomitic land and the impact of the particular site development.

The document must emphasise that dolomite risk management is a an essential concept and that all owners and users are legally bound to implement and execute the proposed risk management plan to ensure/enhance safety of people and assets.

J.3.3 Terms of reference and scope of work

The terms of reference shall specifically state the instructions issued by the Department as well as any related documentation.

J.3.4 Existing information pertaining to the site

The reference to existing information shall include all documents related to dolomite risk management available to the author.

Basic background sources/information and geotechnical data may include:

a) Basic geology;
b) Groundwater information;
c) Aerial photographic coverage and cadastral and topocadastral data;
d) Relevant existing dolomite stability investigation reports pertaining to the site;
e) Report of previous events of instability;
f) Data concerning sinkholes and subsidences;

J.3.5 Buildings, structures and infrastructure that sustained damage in the past

Quantify the risk to buildings, structures and infrastructure which had sustained damage in the past by applying the requirements of one or more of the following documents:

a) Method for dolomite land hazard and risk assessment (PW344/2016 and related documentation);
b) Generic Specification GFSH-2, National Department of Housing: “Geotechnical site investigations for housing development”;
c) NHBRC Home Building Manual, Parts 1 and 2;
d) South African National Standard SANS 1936 Parts 1 to 4;
e) Guideline for engineering/geological characterisation and development of dolomitic land, Council for Geoscience Publication.

J.3.6 Description of the study area

An exact description of the study area shall include the correct Surveyor General diagrams and details of the registered owner(s) at the time the dolomite risk management plan was compiled. It includes the identification of all owners of registered servitudes that contain wet services transversing the site.

J.3.7 Procedures used in the compilation of the dolomite risk management plan

The procedures and methodology used in compiling the dolomite risk management plan as well as the various drawings and databases that are to be compiled as result of the risk management plan shall be adequately described to allow correct current and future referencing of all documentation and data. The various items to be described shall include, but are not limited to, information indicated below.

J.3.7.1 Co-ordinate system

All information shall be in printed and electronic format and relate to the same co-ordinate system.

The report shall:
a) Describe the co-ordinate system that was used for all data collation;
b) Map production procedures (projection, co-ordinate system and datum).

J.3.7.2 Hazard characterisation procedure

Describe the methodology and reference documents that was used in the hazard characterisation procedure and provide detailed background on the meaning of:

a) Inherent hazard classes;
b) Land usage type;
c) Dolomite area designations;

d) Land usage permitted;
e) Deemed-to-satisfy requirements.

J.3.7.3 Terminology

Provide a description of all terminology that may have a particular impact or reference from a technical perspective. Typically the following shall be described in common terms:

a) Dolomite land;
b) Hazard;
c) The hazard characterisation procedure;
d) Inherent hazard;
e) Inherent hazard class;
f) Hazard rating;
g) Tolerable hazard rating;
h) Return period;
i) Subsidence;
j) Sinkhole;
k) Event;

J.3.8 Background information

Background information and report drawings required to compile the requisite risk management plan and associated monitoring areas and to define the elements of the development to be included in the monitoring activities include:

a) Site layout (including delineation of servitudes and development restrictions);
b) Ground topography drawings;
c) Base geological information;
d) Simplified geohydrology;
e) Sinkhole and subsidence data base;
f) Dolomite hazard zonation of the site;
g) Permissible land usages;
h) Dolomite area designations;
i) Buildings, structures and infrastructure (wet and dry engineering infrastructure) - all elements of the development;
j) Building, structures and infrastructure (demolished, to be demolished or that sustained damage).

J.3.9 Dolomite Risk Management Strategy

J.3.9.1 Roles and responsibilities

Define the land owner, custodian and user and explain the functions and responsibilities of the parties in terms of the risk management strategy. Generically the following needs to be elaborated on:

Functions of the Department	**Functions of the Client Department**
General activities	
Custodian of data pertaining to the site	Assist in gathering information
Responsible for maintaining and updating data	“Eyes and ears” on behalf of both parties
Responsible for management of facility	Management of use
Setting standards and principles for development and use.	Responsible for complying with set standards
New facilities and additions	
Ensure compliance with standards, procedures and policy. Hazard characterisation, planning, design, water and other precautionary measures shall comply with DPW344/2016	Client Department identifies needs.
Monitoring	
Undertake monitoring programme in accordance with monitoring designations for each unit or sector of the site. To provide standard forms.	Client to undertake visual inspections as specified by the Department of Public Works.

Functions of the Department	Functions of the Client Department
Create a reporting desk.	Submit information to reporting desk. Inspections will be indicated on a facility/site/prporty or building basis depending on level of requirements. Inspections will be specified as daily, weekly, monthly or over longer periods.
Testing of services as prescribed.	No action required other than reporting extraordinary events.
Monitoring of ground water level as specified.	No action required.
Identify both generic and specific tasks per sitre or area.	Execute monitoring tasks as per schedule.
Maintenance	
Undertake scheduled maintenance	Report maintenance lapses or areas requiring special attention.
Undertake unscheduled maintenance as and when requested/reported.	Report areas requiring special attention
Emergency repairs	
Respond efficiently to requests for emergency repairs.	Vigilance and reporting of leaking services critical. Report to Help Desk at Department of Public Works.
Emergency Reaction Plan	
Set down procedures in case of an emergency	User Department to immediately evacuate any problem area and contact the Department of Public Works. Apply prescribed guidelines
Vigilance	
Provide awareness programmes highlighting need for vigilance	Ensure education of all occupants (awareness to all levels of personnel)
Integrity assessment (audit)	
Every five years an external audit is required in terms of PW344/2016. Arrange audit	Execution process of tasks outlined above will be scrutinised by external independent audit

J.3.10 Monitoring activities

J.3.10.1 Monitoring areas

Provide manageable monitoring areas and identify the monitoring activities in each area. A map of monitoring areas shall include:

a) the overall, composite monitoring designation for each area;
b) a list of normal site specific monitoring activities per area;
c) site specific monitoring activities listed for special attention (i.e, specific problems identified where stormwater drainage has in the past proven to be problematical, inappropriate wet services prone to leaking, etc.);
d) delineation of priority monitoring areas within a monitoring area.

J.3.10.2 Priority monitoring areas

Identify priority monitoring areas and associated monitoring activities within the monitoring areas where extremely sensitive conditions or problems are anticipated from a stability perspective. Particular attention is to be given to all areas with:

a) metastable subsurface conditions or latent sinkhole formation;
b) high Inherent Hazard conditions;
c) poor subsurface conditions (e.g. cavities, cavernous conditions);
d) previous sinkhole or subsidence formation;
e) palaeo-sinkhole or palaeo-subsidence structures;
f) geological contact areas;
g) fault zones;
h) shallow groundwater above dolomite bedrock;
i) anticipated ground settlement;
j) ponding of water, etc.

J.3.10.3 Restricted movement areas

Define all areas that should have restricted movement (limited or none) allowed as result of metastable geotechnical conditions (i.e. high Inherent Hazard areas or existing or latent sinkholes).

J.3.10.4 Monitoring designations

Provide the monitoring designations which describe the level and type of monitoring activities (risk reduction factor) required in each monitoring area in for:

a) infrastructure monitoring;
b) ground surface monitoring;
c) groundwater monitoring.

The monitoring designations shall describe the:

a) reaction required;
b) the purpose of the activity;
c) the frequency with which each activity is to be performed.

Note: According to PW344/2016 the monitoring designations should be identified and delineated according to the Inherent Hazard characterisation of a site and knowledge of problems which could impact on the infrastructure on the site.

The generic monitoring activities considered appropriate for dolomite land are given below.

Annotation	**Activity**	**Reaction**	**Purpose**
A	Visual inspections of ground, structures and above ground infrastructure (e.g. buildings, taps, gardens, private and public open space etc.): Examine buildings for cracks. Visual checks for outside dripping taps and pressure valves. Visual checks for damp or moss grown areas. Visual check for over-wetting of gardens. Visual check for blocked drainage ports in garden walls. Visual check for cracks in the ground.	Any evidence of cracking or ground settlement should immediately be reported and investigated. Any evidence of blockages should be reported and cleared immediately.	Monitor, control and prevention of concentrated ingress of water.
B	Visual inspection of storm water systems: Visual checks for debris in open storm water channels at, for example, the start of the rainy season and after heavy storms. Visual checks for water flowing out of storm water manholes at the start of the rainy season and after heavy storms. Search for ground cracks and cracks in lined and unlined channels.		
C	Testing of wet services for leaks: regular air and water tests on wet services. In waste water and stormwater pipes with a diameter greater than 100mm wet services to be inspected by camera.	Any leaks to be reported and repaired immediately.	To prevent damage due to subsidence or sinkhole formation.
D	Monitoring of structures and ground levels: In many instances visual inspections may not be sufficient and it may be necessary to undertake precision ground surface levelling, particularly in areas that have been rehabilitated after a ground movement event. Such levelling must be undertaken by a surveyor, recorded and stored in the databank and appropriate actions taken when excessive settlement continues.	Any evidence of movement must be reported and investigated.	Monitor the effects of concentrated ingress of water or groundwater level drawdown.

Annotation	Activity	Reaction	Purpose
E	Monitoring of the groundwater level: this activity not only entails the measuring and recording of the groundwater level, but also the analysis and understanding of groundwater level trends over time and the control of excessive (beyond seasonal fluctuations) groundwater level drawdown. Drill and equip strategic boreholes with the necessary equipment to measure the groundwater level. Record groundwater level, monitoring well number, date and other relevant observations. Analyse groundwater level trend over time on a regular basis. Report artificial/excessive groundwater level drawdown to Council and the Department of Water Affairs. Investigate cause of artificial/excessive groundwater level drawdown. Arrest artificial/excessive groundwater level drawdown.	Evidence of lowering must be reported to Council and the Department of Water Affairs.	Monitor, control and prevention of groundwater level drawdown.

The frequency of each activity is to be indicated in the following time categories:

Annotation	Frequency
()DAILY	Activities to be undertaken daily.
()WEEKLY	Activities to be undertaken weekly.
()1	Activities to be undertaken once a month.
()3	Activities to be undertaken quarterly.
()6	Activities to be undertaken bi-annually.
()12	Activities to be undertaken annually.
()24	Activities to be undertaken once every two years.
()NA	No action required
()tbd	To be determined

J.3.10.5 Precautionary measures

Describe the precautionary measures required to support development for the designated, current and potential future land uses. State the methodology and the requirements that shall be applied to all activities related to:

a) new development;
b) maintenance of existing development;
c) upgrading of infrastructure;
d) emergency repairs;

J.3.11 Pro-active maintenance of water bearing services and other infrastructure

Provide requirements of pro-active maintenance of all liquid bearing infrastructure in particular. These requirements must take account of short, medium and long-term maintenance activities in relation to the nature, age and type of services and structures. It shall also prioritise maintenance tasks according to monitoring area designations and establishes the work and procedures associated with the following:

a) routine service maintenance and replacement;
b) repair of service after damage;
c) repair of service after instability;
d) responsibilities for undertaking repairs and the like.

J.3.12 Audit of liquid bearing infrastructure

Provide the requirements for audit of all liquid conveying systems that compare the statistical mean design demands/consumption with actual recorded.

J.3.13 Dolomite risk awareness programme

Provide guidance to the identification of personnel responsible for the monitoring of particular demarcated areas. State the requirements regarding:

a) briefing on the dolomite issue;
b) importance of vigilance;
c) monitoring activities and methodology to keep records;
d) reporting on monitoring activities.

J.3.14 Emergency Reaction Plan

J.3.14.1 General

Provide a detailed description of the activities and responsibilities that will be required in the event of a subsidence or sinkhole. These requirements for dolomite related instability shall include:

a) emergency reaction procedures;
b) timeous reporting;
c) investigation of incident;
d) rehabilitation;
e) ongoing monitoring.

J.3.14.2 Sinkhole and subsidence event procedures

Describe the methodology and the procedures to be followed in the event of a sinkhole or subsidence manifestation. Typically procedures for the following are required:

a) safety precautions and potential evacuation orders;
b) termination of wet services that may impact on the event;
c) reporting to the Dolomite Risk Management Unit in the National Department of Public Works Head Office;
d) tasking of a Competent Person to inspect, make preliminary determinations and to fully investigate the event;
e) requirements for reporting;
f) requirements for rehabilitation;
g) ongoing monitoring and maintenance.

J.3.14.3 Recording of incidents sinkhole or subsidence formation, damage and actions taken

Provide reference to the methodology and the information to be gathered for each event of instability as well as the reporting procedures and compilation of a historic database for each property.

J.3.14.4 Emergency Services

Provide the requirements of information to be supplied to officials tasked with the duty of executing emergency services on the property. As a minimum, information must include:

a) the contents of Dolomite Risk Management Plan;
b) the recommendations concerning no go areas, high risk areas for sinkhole formation;
c) monitoring requirements;
d) areas of priority monitoring;
e) the distribution of inherent hazard classes.

J.3.15 Database of ground movement events and structural damage

Provide the procedures to be followed to ensure that an accurate database of ground movement events are continuously updated and used to adjust the Dolomite Risk Management plan. These detailed records must include sinkholes, subsidences, structural damage to structures or infrastructure and buildings demolished.

J.3.16 Dolomite stability investigations (general requirements)

Provide guidance and describe the procedures and related dolomite stability investigations to be followed by the Department for work related to the upgrading of existing development as well as the creation of new development. Officials tasked to execute the Dolomite Risk Management plan must receive appropriate guidance regarding all the requirements of the Department in this regard. The information must include all Departmental procedures to be followed for work related to

a) existing development;
b) minor extensions to existing development;
c) major extensions to existing development;
d) new developments;
e) new buildings.

J.3.17 Designs not compliant with PW 344/2016

Notes on any designs that are not compliant with the general requirements of PW344/2016.

J.3.18 Report drawings

Drawings shall be to a common and appropriate scale, legible and easily reviewed. All drawings shall be correctly referenced with a clear indication of coordinates.

Annex K: Servitude Requirements

K.1 General

The attached Appendix A contains a typical servitude agreement document between the Department and other land owners or entities requiring a servitude over Departmental land or vice versa.

The servitude agreement needs to be extended with:

a) the standard legal requirements of the Department;

b) the particular requirements as deemed appropriate for the particular Land Usage of the servitude;

c) The general requirements for a servitude from a dolomite risk management perspective according to Chapter 1.

The Departmental Dolomite Risk Manager must approve the servitude conditions pertaining to Land Usage, development and management prior to negotiations with other parties.

K.2 Additional documentation that may be required

a) Dolomite Stability Investigation Report pertaining to the servitude and/or adjacent land;

b) Dolomite Risk Management Plan;

c) Dolomite Status Certificate.

Annex K: Appendix A: Servitude Agreement

1. PARTIES

1.1.1.1. _____
_

(Registration number: _____

(hereinafter referred to as the SERVITUDE HOLDER)

and

THE NATIONAL GOVERNMENT OF THE REPUBLIC OF SOUTH AFRICA in its **DEPARTMENT OF PUBLIC WORKS**

herein represented by _____

in his/her capacity as _____

(hereinafter referred to as the LAND OWNER)

2. RECORDAL

2.1. The SERVITUDE HOLDER is desirous of acquiring a servitude over the PROPERTY for the purposes of construction, maintenance and use of the SERVICE and WORKS;

2.2. The LAND OWNER, as registered owner of the PROPERTY, is prepared to grant the required servitude over the PROPERTY in favour of the SERVITUDE HOLDER subject to the terms set out hereinafter.

3. DEFINITIONS

In this AGREEMENT, the following expressions, unless it appears otherwise from the context, have the meaning respectively set opposite them and cognate expressions bear corresponding meanings;

- "AGREEMENT" means the servitude agreement as recorded herein and any annexures hereto;
- “DOLINE” means shallow, enclosed depressions in the ground surface;
- “DOLOMITE” means rock composed of the mineral dolomite, which is a carbonate of calcium and magnesium;
- “DOLOMITIC LAND” means land underlain directly, or at a depth of less than one hundred (100) meters, by DOLOMITE or LIMESTONE ROCK.
- “DOLOMITE RISK MANAGEMENT” refers to the process of determining risk characterization by means of using different best practice methods utilising scientific and engineering procedures and measures to manage an environmental HAZARD and encompasses the current scientific and industry acceptable policies and procedures set in place to reduce the likelihood of SINKHOLES and DOLINES occurring;
- “HAZARD”, without derogating from the ordinary meaning, includes all geohazards, including problem soils, such as active clays, collapsing soils,

landslip, collapse of undermined areas, seismicity, DOLOMITE or LIMESTONE related features (SINKHOLE or DOLINE);

- “LIMESTONE ROCK” means a rock comprising of greater then fifty (50) percent calcium carbonate;
- "PARTIES" means the SERVITUDE HOLDER and the LAND OWNER;
- "PROPERTY" means the Property known as:

Measuring: ……..……

Province: ……

Held by the LAND OWNER by virtue of ……..……..
(Title Deed number must be indicated);

- “RISK”, without derogating from its ordinary meaning, also means the possibility of meeting danger or the possibility of incurring misfortune or loss and the possibility of the hazard happening;
- "SERVICE" means a SERVICE or SERVICES which may be used for the conveyance of electrical power, electronic/optical communication signals, solids, gases and/or liquids. The design, construction and maintenance of the service will be done in the best professional and risk averse manner in due compliance with all relevant legislations and best practices of the relevant industries;
- "SERVITUDE AREA" means an area which does not exceed ……..

  meters in width along a route or an area in extent approximately ……..

  square meters, as approximately indicated by the letters ……..…… on the attached diagram marked “A” within which the SERVICE and WORKS will be accommodated. The boundaries of such area will be determined by a land surveyor to be appointed by the SERVITUDE HOLDER, after construction of the SERVICE over the PROPERTY. The said land surveyor shall frame a servitude diagram of such area with co-ordinates and will have such diagram approved by the Surveyor-General;
- "SERVICE MARKERS" means markers at intervals sufficient to indicate visually the exact location of the SERVICE;
- “SINKHOLE” means subsidence which occurs suddenly, having steep sides and being of limited lateral extent;
- "TEST POSTS" means testing apparatus above natural ground level located along the route of the SERVICE;
- "WORKS" means all power, communication or other cables, piping, channels, transformer units, cathodic protection equipment, TEST POSTS, SERVICE MARKERS, valve boxes, and any other appliance, construction, appurtenance, addition or fitting which in the SERVITUDE HOLDER's discretion may be necessary or convenient for the purpose of the SERVICE and which are installed or erected by the SERVITUDE HOLDER on or above the surface or underground.

4. SERVITUDE

4.1. The LAND OWNER hereby gives and grants to the SERVITUDE HOLDER, against compensation in clause 8, a non-exclusive servitude over the PROPERTY within the SERVITUDE AREA for the installation, maintenance and use of the SERVICE and WORKS and the right to patrol, inspect, maintain, repair, renew, remove and/or re-lay

the SERVICE and/or WORKS, subject to the terms and conditions of this AGREEMENT.

5. ACCESS TO PROPERTY

5.1. The LAND OWNER hereby agrees to allow the SERVITUDE HOLDER reasonable access over the PROPERTY for the duration of the construction of the SERVICE and WORKS within the SERVITUDE AREA.

5.2. If the SERVITUDE HOLDER requires land for the establishment of a construction camp, the SERVITUDE HOLDER will, in writing, notify the LAND OWNER in advance of his intention to lease portion of the PROPERTY and the terms and conditions thereof will form the subject of a separate agreement between the PARTIES.

5.3. Once the SERVITUDE HOLDER has appointed the construction contractor who will undertake the construction of the SERVICE and WORKS, the LAND OWNER, the SERVITUDE HOLDER, and the construction contractor shall meet with a view to agree on the manner in which, and the schedule according to which, the construction of the SERVICE and WORKS over the PROPERTY will be undertaken. The SERVITUDE HOLDER shall in accordance with such construction schedule notify the LAND OWNER in writing of the date on which the construction is to commence on the PROPERTY, which written notice shall be submitted to the LAND OWNER by no later than four (4) weeks prior to the date on which the construction is to commence on the PROPERTY. The SERVITUDE HOLDER shall notify the LAND OWNER timeously, in writing, if construction, in accordance with the construction schedule, is to be delayed due to any reason beyond the SERVITUDE HOLDER's control.

5.4. The SERVITUDE HOLDER, its contractors, or agents, or its or their servants, together with all necessary vehicles and equipment shall have such right of ingress to and egress from the PROPERTY as may be necessary for the exercise of any or all of the rights granted to the SERVITUDE HOLDER in terms of this AGREEMENT.

5.5. For the purpose of ingress to and egress from the SERVICE and WORKS by the SERVITUDE HOLDER, its contractors, or agents, or its or their servants, for the exercise by the SERVITUDE HOLDER of its rights in terms of this AGREEMENT, the LAND OWNER, tenant or occupier shall not erect any buildings, fences or other structures, or plant any trees, or deposit any materials in the SERVITUDE AREA, or reduce, disturb, or interfere with any soil deposit over the SERVICE and WORKS, or elsewhere in the SERVITUDE AREA without the written consent of the SERVITUDE HOLDER.

5.6 The SERVITUDE HOLDER shall, prior to installing suitable gates at places where existing fences cross the SERVITUDE AREA, or where access to the SERVITUDE AREA is hindered by existing fences, obtain written approval from the LAND OWNER. The SERVITUDE HOLDER shall not damage or interfere with existing servitudes, fences, gates, services or structures. The SERVITUDE HOLDER undertakes to install, at his own cost, suitable gates for the LAND OWNER's use, if fences are hereafter erected on or over or adjacent to the SERVITUDE AREA. All the aforementioned gates shall be locked by the SERVITUDE HOLDER and if the LAND OWNER shall also require the said gates to be locked, this shall be done in a manner agreed to between the PARTIES. The SERVITUDE HOLDER shall be responsible to maintain all such fences and/or gates used by him in good order, and he shall be responsible to repair any damage caused by its contractors, or agents, or its or their servants.

6. MINING RIGHTS

The Minister of Minerals and Energy may decide that mining shall take place on the land in which event:

6.1. each PARTY, shall do what is necessary to protect their respective rights;

6.2. if practicable, a new servitude will be granted to the SERVITUDE HOLDER;

6.3 all costs for and incidental to the removal, rehabilitation and relocation of the SERVICE and/or WORKS, including the cost of obtaining and registering servitudes to protect the SERVICE, will be for the SERVITUDE HOLDER's account.

7. SERVITUDE REGISTRATION

7.1. The provisions of this AGREEMENT shall be registered in notarial form against the Title Deed of the PROPERTY.

7.2. In the event that the LAND OWNER decides not to instruct a notary at the Office of the State Attorney to register the servitude, then the LAND OWNER undertakes to deliver to the SERVITUDE HOLDER, on written demand, the Title Deed and diagrams relating to the PROPERTY and to sign such other documents and consents as may be necessary for the registration of the notarial deeds.

7.3. The LAND OWNER nominates, constitutes and appoints a notary at the State Attorney as agent with the power of substitution to sign all documentation that may be required to execute and register notarial servitudes which have been drafted according to the conditions set out in this AGREEMENT and to make all necessary alterations for registration purposes; and generally for effecting the purposes aforesaid, to do or cause to be done whatsoever shall be requisite, as fully and effectually, for all intents and purposes, as the LAND OWNER might or could do if personally present and acting herein. The LAND OWNER therefore ratifies everything his agent shall lawfully do, or cause to do.

7.4. The SERVITUDE HOLDER shall, at its own cost, ensure the execution and registration of such notarial agreements. The costs aforementioned shall include the cost of the preparation of notarial agreements and all attendances, documents and papers which may be necessary for preparation and registration thereof, the transfer duty and stamp duty payable, including the cost of survey, preparation and approval of diagrams and in general any cost whatsoever to obtain execution and registration of the notarial deeds.

7.5 The SERVITUDE HOLDER shall at its own risk be entitled to exercise all the rights granted in terms of this AGREEMENT notwithstanding that registration of the notarial deeds have not been effected.

8. COMPENSATION

8.1. As compensation for the rights granted in clause 4.1 above, the SERVITUDE HOLDER shall pay the LAND OWNER the Servitude Compensation. The PARTIES agree that the Servitude Compensation payable by the SERVITUDE HOLDER to the LAND OWNER shall be determined as follows:

8.1.1. The SERVITUDE HOLDER shall within thirty (30) days of signature of this AGREEMENT submit to the LAND OWNER a fully motivated comprehensive valuation report setting out the valuation of the SURVITUDE AREA by an independent valuer who is a member of the South African Council for the Property Valuers Profession.

8.1.2. Within fourteen (14) days of receipt of the valuation report submitted by the SERVITUDE HOLDER in terms of clause 8.1.1, the LAND OWNER shall submit such valuation report to the Land Affairs Board for review and recommendation as contemplated in section 6(2) of the Land Affairs Act, 1987 (Act 110 of 1987).

8.1.3. The LAND OWNER and the SERVITUDE HOLDER agree that the SERVITUDE HOLDER shall pay to the LAND OWNER the Servitude Compensation in accordance with the recommendation of the Land Affairs Board as set out in clause 8.1.2, within thirty (30) days of receiving notification thereof from the LAND OWNER.

8.2. As compensation for the rights granted in clause 5.1 above, the SERVITUDE HOLDER shall pay to the LAND OWNER an amount equal to the LAND OWNER's actual financial

loss caused by or resulting from the granting of the rights in clause 5.1 above, which amount will be agreed upon by the SERVITUDE HOLDER and the LAND OWNER within three (3) months after the SERVICE and WORKS have been completed to such an extent that in the opinion of the SERVITUDE HOLDER the extent of the damages suffered by the LAND OWNER can be ascertained and in the absence of an agreement on the amount of such compensation, an amount has to be determined in accordance with Clause 13 hereof. The SERVITUDE HOLDER shall pay to the LAND OWNER the amount agreed to or determined in accordance with this clause within thirty (30) days of such agreement or determination.

8.3 The SERVITUDE HOLDER shall pay reasonable compensation for all damage caused on the PROPERTY, outside the SERVITUDE AREA by the SERVITUDE HOLDER (its contractors, agents or its or their servants acting as such), arising from the exercise of any of the rights granted in terms of this AGREEMENT during the construction of the SERVICE and/or WORKS.

8.4 The compensation excludes Value Added Tax and should such tax be payable, the SERVITUDE HOLDER shall pay the amount of such tax on submission of an acceptable tax invoice.

8.5 Any and all payments by the SERVITUDE HOLDER to the LAND OWNER in terms of this AGREEMENT shall be made by way of Electronic Funds Transfer and the SERVITUDE HOLDER shall within ten (10) days of payment, deliver proof of such payment, to the LAND OWNER.

8.6 Interest shall accrue on all late payments due in terms of this AGREEMENT. Interest shall be calculated on such amounts, from its due date to date of payment, at the rate determined from time to time by the Minister of Finance in terms of section 80(1)(b) of the Public Finance Management Act, 1999 (Act 1 of 1999).

9. EXERCISE OF SERVITUDE RIGHTS

9.1. To the extent that the rights of the SERVITUDE HOLDER granted in terms of this AGREEMENT may conflict with the rights of another servitude holder, the rights of the holder of the servitude which first registered its rights shall prevail. The SERVITUDE HOLDER shall, in advance, determine whether there are other servitudes, regardless of whether it is registered or unregistered, on the PROPERTY, obtain such other servitude holder's written consent in so far as may be necessary and exercise his rights under this servitude with due cognisance of such other servitude.

9.2. In exercising its rights in terms of this AGREEMENT, the SERVITUDE HOLDER shall exercise its rights *civiliter modo* and in such a manner that any other servitude holder is able to exercise its rights meaningfully and on an equitable basis.

9.3. The SERVITUDE HOLDER shall furthermore maintain the SERVITUDE AREA in good condition, safe from any material, liquid, gas, excavation, hole, structure or situation that can be dangerous, or harmful to people, animals or the environment in general.

9.4 In the event that the SERVITUDE AREA overlaps or partly covers any area close to any boundary of the LAND OWNER's property the SERVITUDE HOLDER shall be solely responsible for all the legal obligations and liabilities that the LAND OWNER may have or become encumbered with including for fire breaks, prevention of fires or the spreading of fires in the SERVITUDE AREA. The SERVITUDE HOLDER shall fulfill all the LAND OWNER's legal obligations in that regard at its own cost.

10. GENERAL CONDITIONS APPLICABLE TO THE LAND OWNER AND SERVITUDE HOLDER

10.1. The conditions and provisions of this AGREEMENT shall be binding on the LAND OWNER, or its successors in title.

10.2. The SERVITUDE HOLDER shall, in advance, determine the geological conditions underlying the PROPERTY and the SERVITUDE AREA. Should the SERVITUDE AREA and PROPERTY be underlain by DOLOMITE or other geological soil conditions, which may be susceptible to HAZARDS occurring, including DOLINE and SINKHOLE

formation, which may in turn place the construction and ongoing utilisation of the SERVICE and/or the WORKS within the SERVITUDE AREA at risk of damage or loss, the SERVITUDE HOLDER shall take this risk into account in the design and construction of the SERVICE and WORKS in the SERVITUDE AREA as well as its activities and procedures relating to the operation and maintenance of the SERVICE and WORKS situated in the SERVITUDE AREA. The SERVITUDE HOLDER shall specifically take this risk into account as part of the periodic risk assessments which it conducts in respect of the SERVICE and/or WORKS in terms of, inter alia, the Major Hazardous Installation Regulations promulgated under the Occupational Health and Safety Act, 1993 (Act 85 of 1993).

10.3 In light of the risk highlighted in 10.2, the SERVITUDE HOLDER:

10.3.1 hereby waives any and all claims against the LAND OWNER and/or its legal entities, office bearers, employees and/or consultants, and further

10.3.2 hereby indemnifies and holds harmless the LAND OWNER and the persons and entities mentioned in clause 10.3.1 against any and/or all loss or damage which the SERVITUDE HOLDER or any third party may sustain pursuant to loss or damage occasioned to the SERVICE and/or WORKS.

10.3.3 undertakes to consult the LAND OWNER at regular intervals and as often as circumstances, or the PARTIES, may require in order to take all reasonable steps as far as possible to:

10.3.3.1 exchange information regarding the conditions of the SERVITUDE AREA with specific reference to the risk of subsidence and SINKHOLE formation; and

10.3.3.2 to liaise and exchange information, to assist the SERVITUDE HOLDER in the implementation of appropriate prevention and rehabilitation measures including on the risk of ground subsidence, DOLINE and SINKHOLE formation in the SERVITUDE AREA. However, the SERVITUDE HOLDER is solely responsible for any and all risks, as well as for DOLOMITE RISK MANAGEMENT within the SERVITUDE AREA and for any related costs.

10.3.4 shall undertake the adequate geotechnical investigations appropriate to the geological conditions anticipated along the servitude and determine appropriate precautionary measures for identified HAZARDS. In addition to the afore, those areas underlain by DOLOMITE shall be subjected to a DOLOMITE stability assessment according to current best practice in order to determine the risk characterisation of the SERVITUDE AREA and apply appropriate precautionary measures with respect to the design of the SERVICE and/or WORKS within the SERVITUDE AREA to reduce the likelihood of HAZARDS occurring.

10.3.5 shall, in DOLOMITE areas, compile and implement a DOLOMITE RISK MANAGEMENT STRATEGY on the SERVICE and/or WORKS and related structures in accordance with current best practice. The SERVITUDE HOLDER shall in any event be responsible for the investigation, rehabilitation and all other related cost of all DOLINES and SINKHOLES or any other ground subsidence incident generated within and adjoining the SERVITUDE AREA. Where necessary, the SERVITUDE HOLDER shall apply appropriate risk management to manage and mitigate other identified geo-hazards.

11. INSPECTIONS

11.1 The LAND OWNER may, without any obligations in that regard, inspect, or cause to be inspected, the SERVITUDE AREA and adjacent areas to review whether the SERVITUDE AREA has been and is being maintained by the SERVITUDE HOLDER in accordance with its obligations under this AGREEMENT.

11.2 The LAND OWNER shall use reasonable endeavors to minimize any disruptions caused to the SERVICE by the inspection. The cost of the inspection shall be borne by the LAND OWNER. The SERVITUDE HOLDER shall give the LAND OWNER, free of charge, any reasonable assistance required by the LAND OWNER during the execution of the inspection.

11.3 If the results of the inspection show that the SERVITUDE HOLDER has not complied or is not complying with its maintenance or other obligation then the LAND OWNER may notify the SERVITUDE HOLDER of the results of such inspection.

11.4 The conduct of the inspection shall not relieve the SERVITUDE HOLDER from the performance of any of its obligations under this AGREEMENT and any amendment to the SERVITUDE HOLDER's maintenance programme resulting from the inspection shall be at the sole risk and responsibility of the SERVITUDE HOLDER.

12. SERVITUDE HOLDER INDEMNITIES TO THE LAND OWNER

The SERVITUDE HOLDER shall indemnify and keep the LAND OWENR indemnified at all times from and against all losses or damages by the LAND OWNER in consequence of:-

12.1 Any claim for or in respect of the death and all personal injuries of any employee of or person engaged by the SERVITUDE HOLDER or its employees, agents or contractors;

12.2 Any claim for or in respect of the death and/or personal injuries of any third party arising out of the SERVICES or WORKS, save to the extent caused by the gross negligent or with the wilful misconduct of the LAND OWNER;

12.3 Any loss or damage to any LAND OWNER property or assets arising by reason of any act or omission of the SERVITUDE HOLDER, its employees, agents or contractors;

12.4 Any loss or damage to the property or assets of any third party arising by reason of any act or omission of the SERVITUDE HOLDER, its employees, agents or contractors, save to the extent caused by the wilful misconduct of the LAND OWNER;

12.5 Any breach by the SERVITUDER HOLDER of any of its statutory duties arising under applicable law; and

12.6 Any breach by the SERVITUDE HOLDER of any of its obligations or warranties under this AGREEMENT.

13 DISPUTE RESOLUTION

13.1 If any dispute or difference arises between the PARTIES out of or in relation to or in connection with this Agreement, or the interpretation thereof, or any breach thereof, or its termination, both while in force and after its termination, the PARTY claiming such dispute or difference, shall forthwith advise the other in writing thereof. Within ten (10) working days of receipt of such notice, the SERVITUDE HOLDER and the LAND OWNER shall meet and negotiate in good faith in order to resolve such dispute or difference.

13.2 Should the representatives of the PARTIES fail to resolve such dispute or difference within twenty one (21) working days of the matter having been referred to them or such longer period as the PARTIES may agree in writing, either PARTY may, only with the written consent of the other PARTY, refer such dispute or difference to arbitration by a single Arbitrator (hereinafter referred to as the Arbitrator). In the event of the PARTIES failing or refusing to consent to arbitration such dispute or difference will be referred to litigation.

13.3 In the event of a dispute or difference as contemplated clause 13.2 hereof being referred to arbitration, such dispute or difference will be referred to a person as agreed upon, in writing, by the PARTIES and failing such an agreement within fourteen (14) days after the date upon which the period referred to in clause 13.2 has elapsed, the dispute or difference will be referred to a practising senior advocate of the Pretoria Bar

or a practising attorney of Pretoria with at least fifteen (15) years practical experience and appointed by the then President of the Law Society of the Northern Provinces.

13.4 Any person appointed in terms of the agreement as set out above ("the Arbitrator") shall always act as an arbitrator.

13.5 The procedure and method to be followed in the hearing of the dispute or difference and the hearing of expert evidence and anything which is necessary to be done to reach a decision, shall remain in the full discretion of the Arbitrator.

13.6 The PARTIES shall use their best endeavours to procure a decision by the Arbitrator within twenty-one (21) days or as soon as possible thereafter, after the dispute or difference was referred to the Arbitrator.

13.7 The decision of the Arbitrator will be final and binding upon the disputing parties and may be made an order of any court of competent jurisdiction upon the application of a PARTY to the dispute or difference.

13.8 The provisions of this clause 13:

13.8.1 serve as an irrevocable consent by all the PARTIES to any of the proceedings in terms hereof and the PARTIES shall not be entitled to withdraw from the proceedings or to maintain that they are not bound by such provisions; and

13.8.2 be divisible from the rest of this agreement and will remain of full force and effect notwithstanding termination of this agreement for any reason whatsoever.

13.9 In respect of the costs in the arbitration proceedings, the PARTIES agree as follows:

13.9.1 The Arbitrator shall be empowered to make such award or awards in respect of costs as he in his discretion may deem fit in respect of the following:

13.9.1.1 interim awards in respect of wasted costs;

13.9.1.2 on request of any PARTY determine whether a particular item or items claimed by any PARTY in terms of an order to costs made by the Arbitrator, should be allowed or disallowed against the other PARTY.

13.9.2 Costs shall be allowed as between party and party in accordance with the provisions of the tariff applicable in the High Court of South Africa.

14 GENERAL

14.1 This AGREEMENT constitutes the sole record of the agreement between the PARTIES in regard to the subject matter thereof.

14.2 Neither PARTY shall be bound by any representation, express nor implied term, warranty, promise or the like not recorded herein or reduced to writing and signed by the PARTIES.

14.3 No addition to, variation, or agreed cancellation of this AGREEMENT shall be of any force or effect unless in writing and signed by or on behalf of the PARTIES. Any waiver of this requirement must be in writing.

14.4 No indulgence which either PARTY may grant to the other shall constitute a waiver of any of the rights of the grantor.

14.5 If any provision of this AGREEMENT should be wholly or partly invalid, unenforceable or unlawful, then this AGREEMENT shall be severable in respect of this provision in question (to the extent that it is valid, unenforceable or unlawful) and the remaining provisions of this AGREEMENT shall remain in full force and effect.

15 TERMINATION

The SERVITUDE HOLDER shall be entitled to, at any time prior to the commencement of construction of the first SERVICE, terminate this AGREEMENT should it appear that the route of the SERVICE is diverted not to effect the PROPERTY. On such termination, this AGREEMENT will lapse and neither of the PARTIES will have any claim against the other as a result of such termination.

SIGNED AT .....…..... ON THE ……..... DAY OF ……..……..... 2007.

WITNESSES:

1 ----------

2 ---------- ----------

LAND OWNER
who warrants that he is duly authorised thereto

Name: _____

Designation: _____

SIGNED AT .....…..... ON THE ……..... DAY OF ……..……..... 2007.

WITNESSES:

1 ----------

2 ---------- ----------

SERVITUDE HOLDER
who warrants that he is duly authorised thereto

Name: _____

Designation: _____

Annex L: Submission of Record Data

L.1 Scope

This section contains the Departmental requirements for:

a) Submission of drawings in hard copy format for centralised drawing archive.

b) Submission of drawings in electronic format for centralised drawing archive.

c) Submission of drawings in electronic format for integration into Departmental geographical information system (GIS).

L.2 Reference documents

All engineering and related drawings must comply with the standards as set out in Civil Engineering Manual PW347.

L.3 Submission of drawings for centralised drawing archive

L.3.1 Hard copy

Hard copies of drawings submitted to the Department must conform to the following:

a) Polyester film of minimum 0,08mm thickness;
b) "A" size format sheets;
c) Drawings are to be to scale;
d) Information is to be clear and legible;
e) Each sheet to be clearly marked "as-built";
f) Each sheet to be signed by the respective competent person with the professional registration number clearly indicated thereon;
g) All relevant information on title blocks to be fully and correctly completed i.e. Date, WCS no, title, service etc;
h) Include a locality plan where applicable.

L.3.2 Electronic copy

a) All drawings are to be stored onto standard size compact disks;
b) Drawings to be stored in normal CAD format and in addition are required in .dwg, dxf, pdf, and tiff format to facilitate use in various software applications;
c) The following information is to be clearly printed on the printable side of each compact disk in strict accordance with manufacture's specifications:
    i. Facility name;
    ii. Service/project name;
    iii. Appointed/contracted service provider/consultant, firm name, telephone number, address and name of contact person;
    iv. WCS and/or reference number;
    v. The number of the disk (e.g. disk 01 of 02);
    vi. The type of discipline e.g. architectural, civil, etc;
    vii. The name and version of the CAD program used to produce drawings (e.g. Caddie / Autocad, etc.;
d) The disk is to be presented in a suitable cover;
e) The cover must contain a clearly printed list of the drawings saved on the specific compact disk.

L.4 Submission of drawings in electronic format for integration into Departmental geographical information system (GIS)

L.4.1 General

The Department incorporates all “as-built” drawings into a single Geographical Information System (GIS) and as such requires that drawings shall be submitted in a format that is compatible with the currently adopted system in ArcGIS suite of programmes.

The ArcGIS suit format of drawings are filename.shp (shape) files and the programme is compatible to incorporate “filename.dxf” formats. As such it will thus be a requirement that all electronic drawings be submitted as follows:

a) Format normally used by appointed/contracted service providers/consultants (i.e. Caddie, AutoCad, MicroStation, etc. – refer to Manual PW347;
b) dxf.format;
c) pdf (portable document format) format at 300dpi (dots per inch) minimum (complete drawing as used for construction).

L.4.2 Primary drawing layer system

The current Departmental drawing layer system contains the primary layer groups according to L.1.

All existing work must be shown on layers with names as currently assigned.

All new work (only new work) must be placed on layers created by the appointed/contracted service provider/consultant.

L.4.3 Layers created by appointed/contracted service providers/ consultants

The appointed/contracted service provider/consultant needs to create new layers for all new work with the WCS number as prefix to the layer description (e.g. “WCS3365_20mm HDPE WATER LINE”)

Only new work shall be on layers with the “WCS” number prefix. All existing work shall be indicated on defined layers with an “existing” prefix (e.g. “existing_20mm HDPE WATER LINE”)

L.4.4 Electronic compatibility of drawings

The GIS software uses lines, circles, polygons and points to define all drawing elements. As such must all “filename.dxf” drawings only contain lines, circles, polygons (closed drawing elements) or points to be compatible for integration into the GIS program. Drawings submitted for incorporation into the GIS must be as simplified as possible.

All lines, circles, points or polygons must be drawn spatially (X, Y position) and dimension wise correct.

L.4.4.1 In preparing CAD drawings the placing of drawing element attributes (text to describe the element) in addition to the drawing layer name must conform to the following:

a) Lines - text origin on line;
b) Circles - text origin on the centre of circle;
c) Polygons - text origin in polygon;
d) Points - text origin on point.

All circles or polygons must be closed elements. Circles must consist of one single line. (Test: must be able to delete entire circle as one function.) The hatch function for the majority of cad programmes can be used to ensure polygons are closed entities. Do not submit drawings with hatching. Closing of line ends or T-junctions in lines are best extended by CAD programme “snap to” functions.

If only the layer with the particular item is switch on in the CAD drawing it must only show that element and attributes as a line, closed circle, point or closed polygon.

Any element with a common boundary with another element must be drawn as a closed polygon

separate form such other element.

The converting of “filename.dxf” files to “filename.shp” files requires the separate transfer of each layer in the CAD environment to a layer in the GIS environment.

Polygons (similar in nature) with a common boundary on the same drawing layer (e.g. stands in township development, geotechnical zoning, land use demarcations etc.) can be drawn with a common boundary provided that each polygon is closed and defined by text attributes with origin of such text inside the polygon.

Polygons that demarcate areas such as geotechnical zones, land use demarcation, pressure zones etc. must be closed entities demarcating the area covered by such zoning. A zone with one open side is not defined as a zone.

L.4.4.2 In preparing drawings, only the dimensions wise correct outline (plan view) of a particular entity must be on the drawing, for example:

a) Building - footprint of building must be defined by a single polygon with no internal lines or connections to other buildings;

b) Walkway between buildings – footprint of walkway defined by a polygon separate from building;

c) Storm water canal around building – dimension correct polygon drawn separate from building even if it shares a common boundary with the building wall;

d) Roads – outline of entire road surface, with similar design (e.g. one polygon to define a bituminous surfaced road and another to define a road with concrete interlocking brick paving even if the one is an extension of the other. The same for parking adjacent to a road;

e) Kerbs – closed polygon with width exactly the same as the kerbs (e.g. 200mm) for the area of a particular kerb type. The transition to another kerb shall be defined by another polygon;

f) Stormwater inlet or manhole – closed polygon or circle exactly to external dimensions of the manhole to be constructed. No covers, cover slabs etc. must be within the polygon that defines the structure. Items such as lids or grids must be drawn on a separate layer that exactly describes such element;

g) Sewer manholes – same as storm water above;

h) Sewer gulleys, rodding eyes, inspection eyes, etc. – circular elements with 200mm diameter. All different elements on different layers;

i) Water valve boxes – same as storm water manholes;

j) Water valves – circular element not exceeding the diameter of the pipe. Different sizes and types to be on different layers;

k) Pumps – polygon that shows extent of plinth;

l) Sewer valves, flow meters, etc. – same as water valves;

m) Dams (concrete) – Same as buildings;

n) Dams (earth) – to be defined by two polygons. The internal polygon must show the maximum water level surface area. The external polygon must define the toe of the earthworks on the outside slope;

o) Pipes – all pipes or circular conduits for water, sewer, fuel, stormwater, cables etc. shall be defined as a single line. All lines that define a network such as a water or sewer system shall be on different layers to define various diameters or types but must be drawn with the “snap to end point” function to show a continuous line if all drawing layers are displayed. If a straight pipe of similar diameter enters and exit from a manhole, valve or valve chamber or similar structure shall the line be ended and again be continued at the origin (centre point) of such structure. Similarly shall lines that join other lines at an angle be joined by means of “snap to middle of line” or “snap to end point” functions. It also applies to lines that converge in a manhole or chamber. No breaks may exist in lines that defines a network;

p) Cables – the same as for pipes;

q) Rectangular or square service ducts – must be drawn as a polygon with exact dimensions as the plan view of the duct. Various shapes and sizes to be drawn in different layers;

r) Stormwater canal – draw as polygon with dimensions same as plan view of canal. Various types, shapes and lining material to be drawn as separate layers.

L.4.4.3 The following may not be used:

a) Hatching (solid or line);
b) Double lines for conduits;
c) Text boxes with arrows;
d) Standard drawing symbols such as valves, manholes etc. These symbols can only be placed on drawings other than those submitted for GIS incorporation;
e) Leaders or arrows;
f) Text to show dimensions (element must be drawn exactly to scale);
g) Dimensioning text - only applicable to drawings not submitted for GIS integration.

L.4.4.4 Text to describe line elements shall be with text origin on line and be as follows:

a) Water pipes (gravity and rising mains);
   - Pipe number or mark;
   - Internal diameter in mm;
   - Type;
   - Pressure class;
   - Type material;
   - Design flow per second;

   Text attribute notation e.g.
   14 :50mm:HDPE:PN12,5:PE100:D 3 ℓ/s.

b) Sewer pipes (gravity and rising mains);
   - Pipe number;
   - Internal diameter in mm;
   - Type;
   - Class;
   - Material type;
   - Slope;
   - Design flow in ℓ/s or m/s;
   - Text attribute notation e.g.

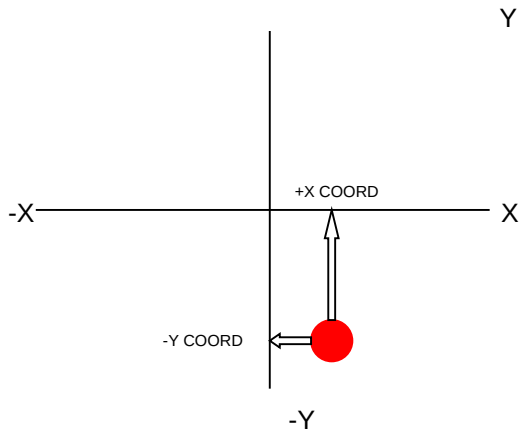
   12 :100mm:HDPE:PN10:PE100:1in50:DQ2 ℓ/s:DF 1,2m/s:FQ 10,6 ℓ/s.

c) Stormwater pipes (Same as sewer pipes).

L.4.5 GIS - geographic coordinate system

In preparing drawings the following are important:

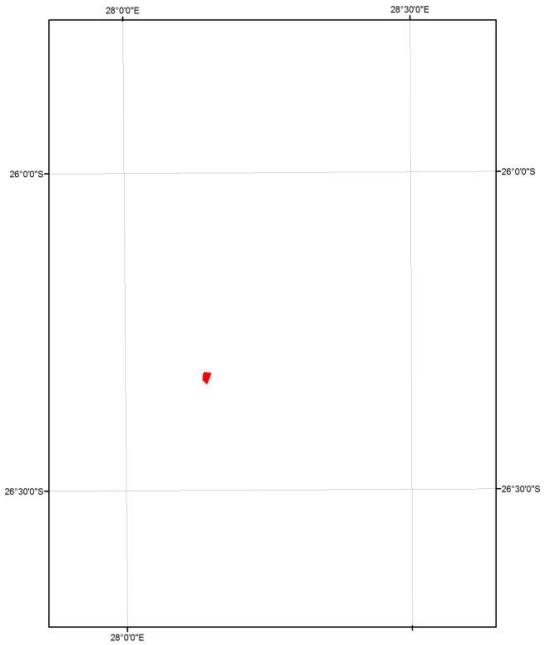
a) The way surveyors and the GIS describe co-ordinates differ;
b) The x co-ordinate supplied by surveyors are the y co-ordinate in the GIS and the y co-ordinate supplied by surveyors are the x co-ordinate in the GIS;
c) the GIS defines co-ordinates as follows:



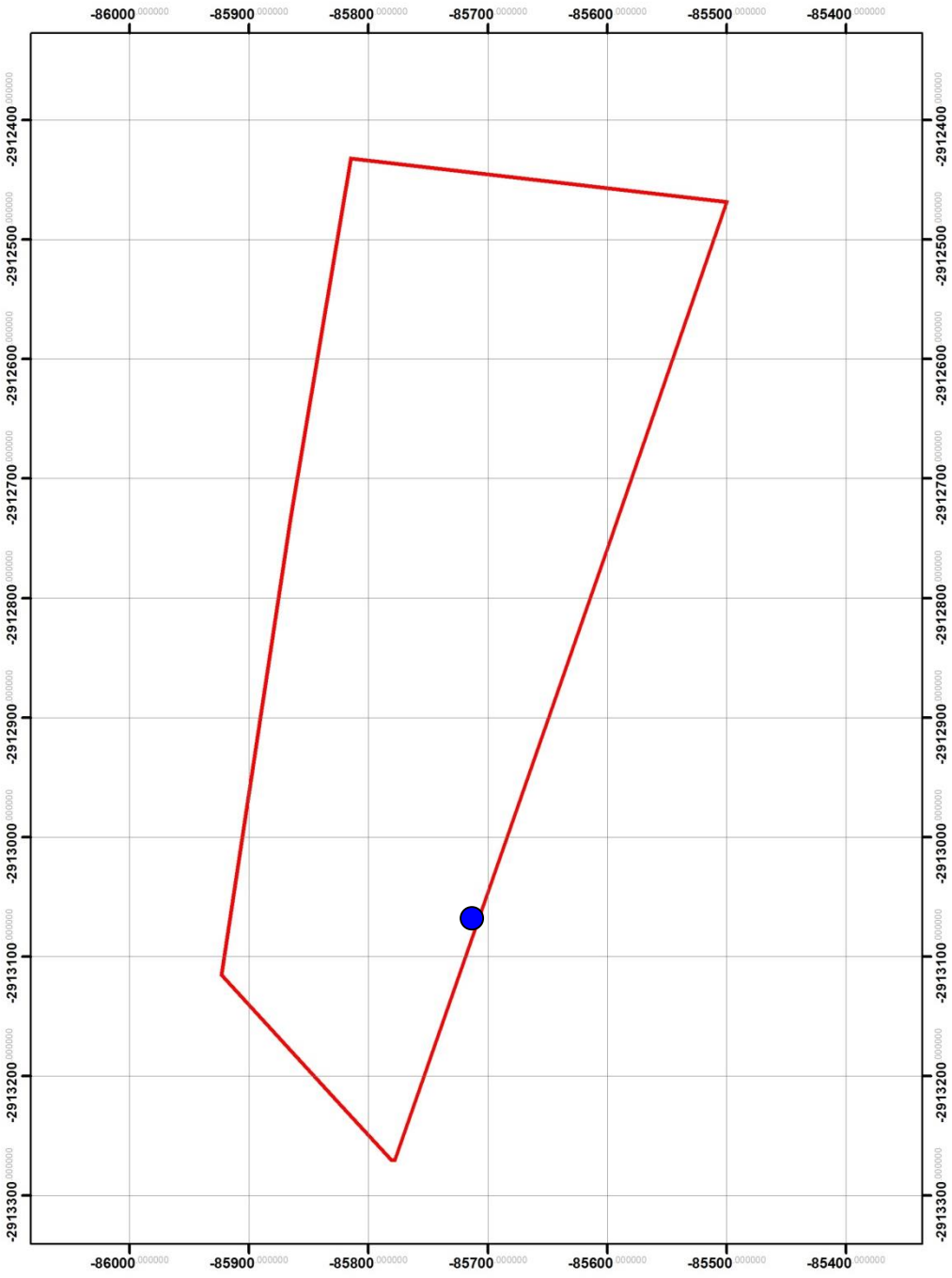
- The dot represents South Africa;
- The x-axis represents the equator and the y-axis the Greenwich meridian;
- Vertical lines crossing the x axis are lines of longitude and horizontal lines crossing the y axis are lines of latitude;
- Because South Africa is east of the Greenwich meridian the x co-ordinate (longitude) is positive;
- Because South Africa is south of the equator the y co-ordinate (latitude) is negative.

L.4.6 GIS - projected co-ordinate system

The co-ordinate notation that defines a site in Transverse Mercator – Central Meridian 29° (lo 29) can be described as follows:



a) The site is located west of 29° longitude and south of the equator, therefore the x and y co-ordinates will be negative in the Transverse Mercator projection;
b) If the site was located east of 29° longitude the x co-ordinate would be positive.



- an example of a co-ordinate from the picture above would be

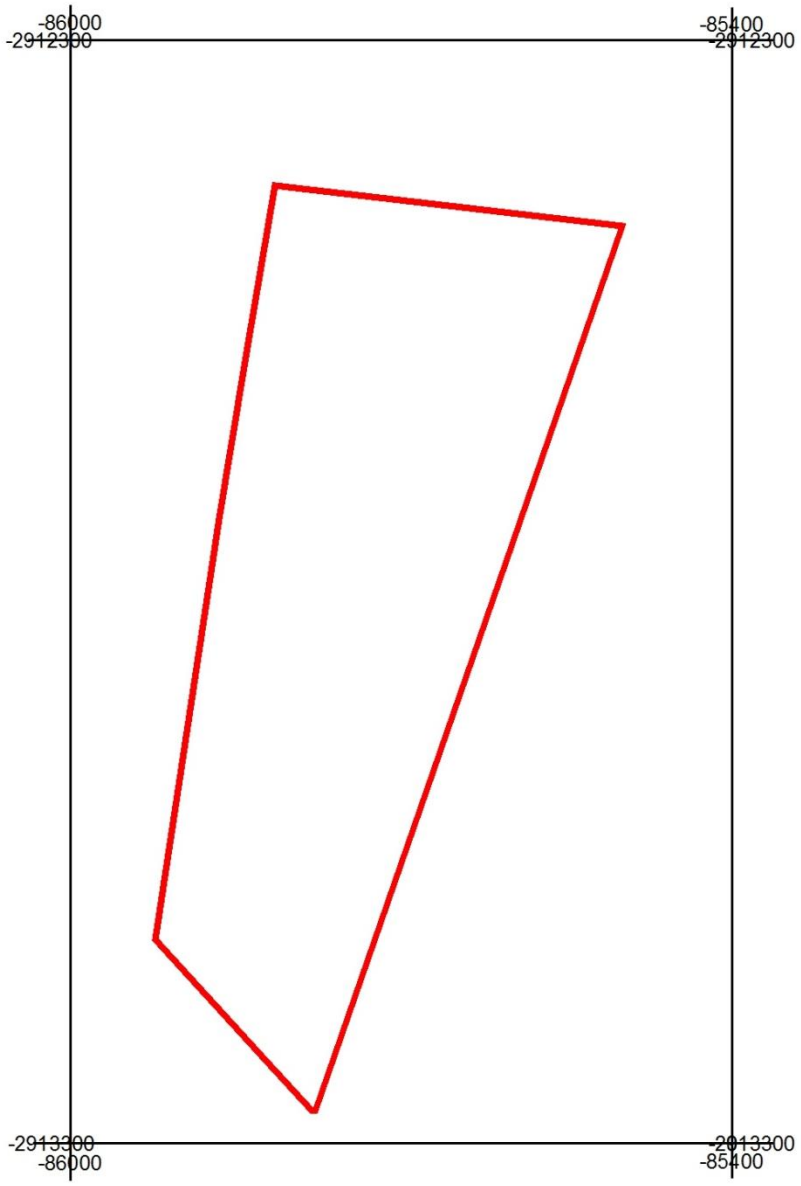
    - X co-ordinate = - 85 800;
    - Y co-ordinate = - 2 913 000

L.4.7 Grid and general rules for drawings to be imported into GIS

All drawings submitted by the appointed/contracted service provider/consultant must be referenced as follows:

a) All drawings must be done in a grid block as shown below;

b) The grid block must be in a Transverse Mercator (gauss) projection in WGS 84 datum;



c) The x and y (co-ordinate) values must be given on the drawing;

d) The drawing must not exceed the grid block;

e) The drawing must be supplied as a “dxf” file format;

f) Drawing units must be meters;

g) Only the actual drawing (points, lines and polygons) must be exported to “dxf” format (no title block etc);

h) North must always be on the top of the page (no rotation are allowed to make drawing fit on landscape page);

i) All drawings must be done on the layer system supplied by NDPW;

j) If a layer does not exist for the feature being drawn it must be added as a new layer with a descriptive layer name as previously explained;

k) Only one feature per layer allowed (e.g. only 20mm HDPE pipes are allowed on a specific layer. 25mm HDPE pipes must be drawn on a different layer;

l) All features drawn must be described by means of text attributes that clearly define the feature. Length of text depends on CAD program capability (generally less than 250 characters);

m) Points, lines and polygons (closed line features) are allowed;

n) Line features should be drawn as single lines e.g. only one line must represent a feature i.e. centre line of a pipe;

o) The text origin for line features must be placed on the line;

p) Polygon features should be checked to ensure that they are closed;
q) No hatching must be used to symbolise polygons – no fill to be used, only the border line of polygon;
r) Annotation (text) must be placed in the centre of the polygon with the text origin in centre of polygon;
s) Point features can be drawn as points or circles such as manholes. If circles are used the text origin must be placed in the centre of the circle. For point features the text origin must be placed on the point;
t) Circles must be completely closed with no hatching;
u) The projection parameters used for the drawing must be supplied as a text document with the "dxf" file.

L.4.8 Field data collected by global positioning system (GPS) or surveys

In collecting field data with a GPS the following are important:

a) Make sure the GPS is set to WGS84 datum before collection of data;
b) Collected data to be supplied in "dbf" file format, tab or comma delimited "txt" file;
c) Latitude and longitude must be converted to decimal degrees;
d) Formula for conversion is as follows:

degrees + [((minutes*60) + seconds)/3600]

e) Table columns should contain at least the following fields:

id : unique identifier
x co-ord : longitude in decimal degrees
y co-ord : latitude in decimal degrees

f) Data to be supplied in a geographic co-ordinate system (latitude, longitude) in WGS84 datum or in a Transverse Mercator (gauss) projection in WGS84 datum;

g) If a projection is used all projection parameters must be supplied e.g.;

Projection: Transverse Mercator
Central meridian : 29°
Scale factor : 1
False easting : 0
False northing : 0
Datum : Hartebeeshoek 1994 (WGS84)

L.4.9 Drawing file names

The file name of a drawing must correspond exactly with the drawing number as well as the WCS number of the project. The file name shall be as follows:

WCS NUMBER_project drawing number_drawing number_Additional drawing notation
e.g.: WCS03215_C3365_25_ PRELIM1. dxf

Please note that all "/,\.(,) or- " in drawing number must be replaced by an underscore "_" in the file name.

The drawings in the appointed/contracted service providers/consultants CAD format, "dxf" format as well as the "pdf" format with the same information must have exactly the same name.

L.4.10 Digital submission

Drawings must be submitted on CD (compact disk) with the following requirements:

Cover label of disk (not case) shall contain the following information:

a) WCS no.;
b) Project name;

c) Date;
d) Appointed/contracted service provider/consultant 's name;
e) Regional office;
f) Town;
g) General name of site;
h) Property code of site.

L.4.11 Drawing and text file list

Drawing lists shall be compiled in Excel ("xls")format with the following headings:

WCS NO	PROJECT TITLE	DISCIPLINE	DRAWING NUMBER	DRAWING TITLE	CAD FILE NAME	REGIONAL OFFICE	TOWN	DATE ON DRAWING
WCS NO	**PROJECT TITLE**	**DISCIPLINE**	**DRAWING NUMBER**	**DRAWING TITLE**	**TEXT FILE NAME**	**DESCRIPTION OF CONTENT**	**COMPILER NAME**	**DATE**

(Please note the table must not include any merged cells. All cells must be filled irrespective if a column or row has repeatedly the same entry. All "txt" files that give information regarding particular drawing must also be included in the drawing list and shall have the same name as the drawing file.

TABLE L.1: Primary Drawing Layer Groups

DRAWING ELEMENT REFERENCE TYPE GROUPS
TITLE BLOCKS
SITE IDENTIFICATION
DRAWING ORIENTATION
SURVEY
CADASTRAL
TOPO CADASTRAL
TOWNSHIP PLANNING
TOWN PLANNING FLOOD LINES
CONSTRUCTION NOTES
WATER RETICULATION
WATER SOURCE
WATER TREATMENT
WATER MANAGEMENT
SEWER DISPOSAL
SEWER RETICULATION
SEWER TREATMENT
STORMWATER RETICULATION
ROAD DESIGN
ROAD MANAGEMENT
ROAD MARKING
ROAD PAVING
ROAD SIGNS
RUNWAY
WASTE DISPOSAL
ELECTRICAL RETICULATION
ELECTRICAL SUPPLY
COMMUNICATION
FENCING
EARTH WORKS
MECHANICAL
PNEUMATIC
STEAM
RAIL
BUILDING DEMOLISHED
BUILDING ELEMENTS
BUILDING MOBILE
BUILDING REFERENCE
BUILDINGS
BUILDINGS RECREATIONAL
BUILDINGS TEMPORARY
BUILDINGS UTILITY
SPORT FACILITY
GEOTECHNICAL INVESTIGATIONS
ENVIRONMENTAL IMPACT ASSESSMENT

Annex M: Specification for the Repair of Sinkholes and Subsidences

M.1 Scope

This specification covers

a) the repair of sinkholes and subsidences on dolomite land using the inverted filter or dynamic compaction methods of repair; and

b) the subsurface grouting of cavities.

NOTE 1: Annex A provides guidance to those responsible for compiling procurement documents which make reference to this specification.

NOTE 2: Annex B identifies items that might need to be considered when preparing the scope of work for a particular project

NOTE 3: The repair of the sinkholes and subsidences might impact negatively on the stability of the in situ soils and might jeopardise the safety of existing works and personnel and in certain instances nearby infrastructure. Therefore site specific geotechnical investigations should be undertaken around the sinkhole or subsidence. These investigations might involve a drilling programme and might also include a gravity survey or other appropriate remote sensing techniques, prior to determining the best method of rehabilitation. Such investigations should be undertaken in accordance with the requirements of PW344/2014.

M.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies

a) PW344/2014 Appropriate Development of Infrastructure On Dolomite: Manual for Consultants ;

b) SANS 1200, *Civil Engineering Construction – Part G: Concrete (Structural).* (SANS 2001CC1, *Construction works – Part CC1: Concrete works (Structural).);*

c) SANS 1200, *Civil Engineering Construction – Part GA: Concrete (small works).* (SANS 2001CC2, *Construction works – Part CC2: Concrete works (minor works).);*

d) SANS 10403, *Formatting and compilation of construction procurement documents;*

e) SANS 50197-1/EN 1971, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*;

f) SANS 50197-2/EN 1972, *Cement – Part 2: Conformity evaluation*;

g) SANS 3001PR5, Civil engineering test methods Part PR5: Computation of soil mortar percentages, coarse sand ratio, grading modulus and fineness modulus;

h) SANS 3001GR10:2008**,** Civil engineering test methods Part GR10: Determination of the one point liquid limit, plastic limit, plasticity index and linear shrinkage;

i) TMH1A10(a), *Standard methods of testing road construction materials – Method A10(a): The determination of the in place dry density of soil or gravel by the sand replacement method;*

j) TMH1A10(b), *Standard methods of testing road construction materials – Method A10(b): Tentative method for determining the inplace density and moisture content of soils and gravels by nuclear methods.*

M.3 Definitions

For the purposes of this specification, the definitions given in SANS 10403 and the following definitions apply.

backfill: material placed in an excavation in a certain manner after specified operations have been performed

Competent Person (geo-professional/engineer) : person named in the scope of work and appointed in terms of SANS 1936-1: 2012, Annex A

deviation: difference between the actual (i.e. measured) dimension or position and the specified dimension or position

subsidences: shallow, enclosed depressions in the ground surface.

dolomite: rock composed of the mineral dolomite, which is a carbonate of calcium and magnesium.

dolomite land: land underlain by dolomite or limestone rock directly or at a shallow depth

grading modulus (GM): sum of the cumulative percentages retained on the 2mm, 425m and 75m sieves divided by a hundred

linear shrinkage (LS): percentage reduction in length of an oven dried bar of material

permissible deviation (pd): specified limit(s) of deviation within which a dimension or position lies

liquid limit: empirically established moisture content at the boundary between the liquid and the plastic states

modified AASHTO maximum dry density: highest density obtainable when compaction is carried out on soil at varied moisture contents at the modified AASHTO compaction effort in accordance with the requirements of TMH1-A7

optimum moisture content (OMC): moisture content at which the maximum dry density of a soil is obtained for a specific compaction effort

permissible deviation (pd): specified limit(s) of deviation within which a dimension or position lies

plasticity index (PI): difference between the liquid limit and the plastic limit

plastic limit: empirically established moisture content at the boundary between the plastic and semisolid states

specification data: data, provisions and variations that make this specification applicable to a particular contract or works (refer to Appendix A)

NOTE Specification data are included in the scope of work of a contract. Appendix B outlines additional items that might be considered when preparing the scope of work for a particular project.

specified density: ratio of field density to laboratory determined maximum dry density

sinkhole: subsidence which occurs suddenly and manifests itself as a large hole in the ground.

suitable: capable of fulfilling or having fulfilled the intended function, or fit for its intended purpose

M.4 Requirements

M.4.1 Materials

M.4.1.1 Fill

M.4.1.1.1 Bulk Fill

Unless otherwise specified in the specification data, bulk fill shall comprise:

a) material having 0,75 ≤ GM ≤ 2,75 and PI < 12% or a value equal to 3 times the GM plus 10, whichever is the higher value, provided that in the case of calcrete the PI shall not exceed 17% subject to the LS not exceeding 7%; or

b) coarse material including crushed or blasted rock and building rubble from demolished buildings, but excluding metal, wood, or other degradable materials and maximum size of 400mm (measured in any direction) with a fines content not exceeding 30% of the total volume.

M.4.1.1.2 Capping Layer

The capping layer shall comprise one of more of the following, unless otherwise specified in the specification data:

a) material with a CBR >3% at the specified density (compacted at OMC), a PI ≤ 12% and a maximum particle dimension of 53mm; or

b) silty sand or clay or a mixture thereof with a maximum particle size of 1,55mm.

M.4.1.2 Grout

Grout shall comprise any of the following:

a) Self-compacting concrete: pumpable concrete mix that requires no external vibration to achieve consolidation, with 13,2mm maximum aggregate size and 2MPa cube strength at 28 days;

b) Soil-cement: the soil-mix shall contain the following materials:

- Soil complying with the following:

Grading:	100%	passing 10mm sieve size
	80% to 100%	passing 2mm sieve size
	50% to 60%	passing 0,425mm sieve size
	20% to 30%	passing 0,075mm sieve size
	<5%	finer than 0,002mm
Plasticity Index:	<8%	

- Ordinary Portland Cement (OPC)
- Water
- Additives such as plasticiser may be used with approval by the Engineer.

The soil shall be thoroughly mixed with the addition of 6% to 10% of OPC (by weight) before adding water. Only enough water shall be added to achieve a slump of between 100m and 150mm. The minimum 28 day cube strength of the grout shall be 2MPa.

Trial mixes shall be performed to determine the most applicable mix proportions for the specific materials that will be used.

M.4.2 Dynamic compaction

Dynamic compaction (DC) shall be undertaken using a mobile crane fitted with a boom and suitable cable, clutch and braking system to handle a free falling square tamper or ball type tamper and an

ironing tamper having the parameters specified in the specification data. Such a crane shall remain stable when the tamper is accidentally dropped into a cavity having a depth specified in the specification data beyond its normal cable and braking configuration.

Note: Compaction is carried out in areas of highly compressible material in which subsurface cavities do exist. Accordingly, there may be a possibility of losing the tamper.

M.4.2.1 Compaction of Large Subsidence Areas

The compaction footprint spacing (refer to Figure 1) shall be specified in the specification data if a large area of subsidence has to be compacted, but it is not required for the rehabilitation of a sinkhole.

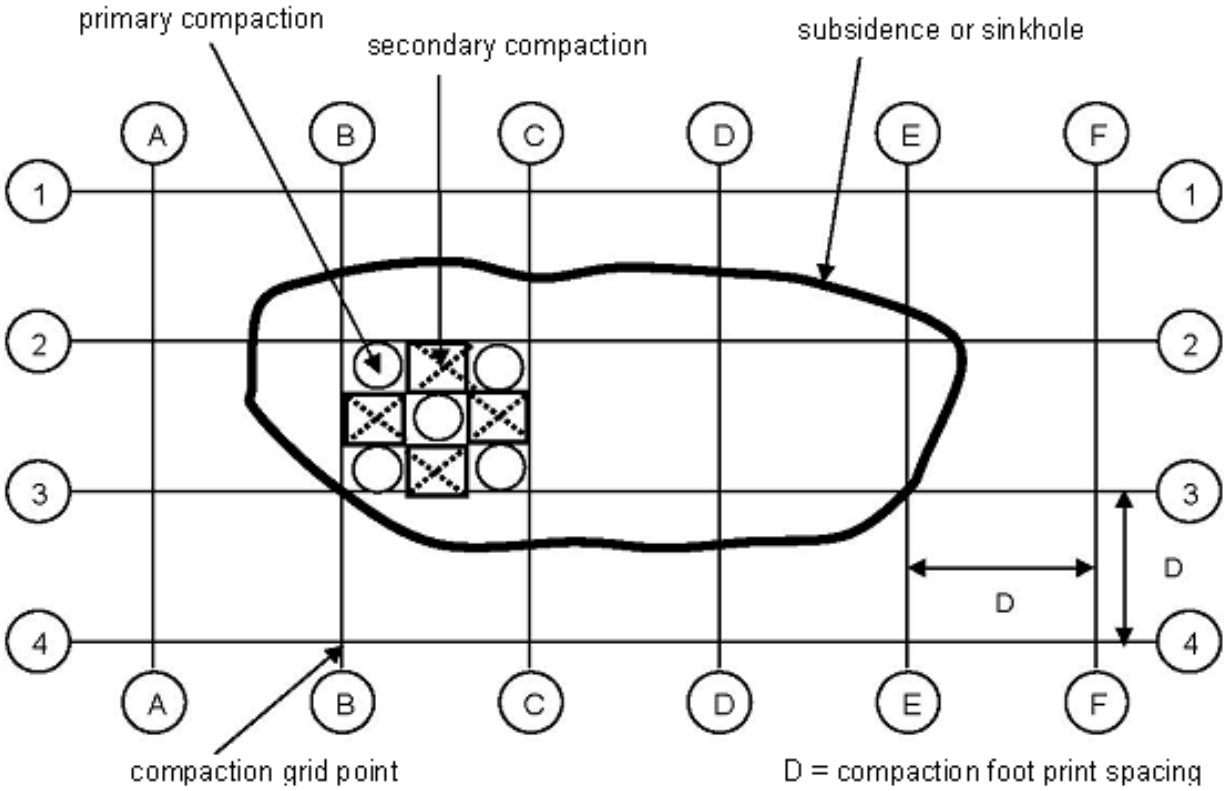


Figure 1: Setting out grid for dynamic compaction of large subsidence area

The grid for dynamic compaction of a large subsidence shall be set out prior to any compaction taking place.

The base of the excavated area shall, if necessary, be levelled off using the excavator bucket.

Compaction shall, unless otherwise specified in the scope of work, be executed by dropping the weight from an 18 metre height in the desired premarked pattern to result in an even distribution of:

a) primary compaction: 15 blows per 25m²

b) secondary compaction: 15 blows per 25m²

c) ironing (finishing) compaction: 2 blows per m²

The compaction imprints shall be filled once it exceeds 700mm in depth and between each compaction phase.

The settlement of each blow and the number of blows, as appropriate shall be recorded on marked drawings showing the location of premarked grids (refer to Figure 2).

Field report for each block					
Grid block reference number	Primary compaction		Secondary compaction		Finishing compaction
	No of blows	Average depth	No of blows	Average depth	No of blows
Drop height					
Drop height					
Drop height					

Figure 2: Field report

M.4.2.2 Compaction of sinkholes

A sinkhole affects a confined area, which does not require a specified compaction grid spacing and the DC contractor is required to cover the sinkhole area by DC compaction to ensure a uniformly compacted area. Initially a reduced pounderdrop height shall be used to expose the sinkhole throat, where it is not visible.

The sinkhole shall be backfilled and compacted in 4m maximum layer thicknesses to the invert level of the capping layer. Final ironing compaction shall be performed before the capping layer is constructed. A large diameter (1m) plate load test to at least 300kPa load shall be performed after completionof the DC to verify the integrity of the sinkhole backfill.

M.4.3 Repair of sinkholes

M.4.3.1 Preparation

The topsoil shall be removed to a depth of 150 mm and the area around the sinkhole excavated to the relevant dimensions shown in Figure 3.

The sidewalls of the sinkhole shall be excavated at approximately 60 degrees to the horizontal to a depth indicated in the specification data. The surface perimeter of the sinkhole shall thereafter be prepared to the dimensions indicted in Figure 3.

NOTE: Sinkholes shall only be repaired under the direction of a Competent Person (geo-professional/engineer) . The Competent Person (geo-professional/engineer) should provide the precise dimensions for the repair.

Where necessary, level off the base of excavation using the excavator bucket.

M.4.3.2 Choking of sinkhole throat

Where the specification data specifies dynamic compaction for the rehabilitation of the sinkhole, the sinkhole floor shall be compacted by means of dynamic compaction before being chocked.

The sinkhole throat shall be choked using one of the following methods specified in the specification data:

a) the placement of boulders of 500 mm and larger, suitably compacted by dynamic compaction (DC);

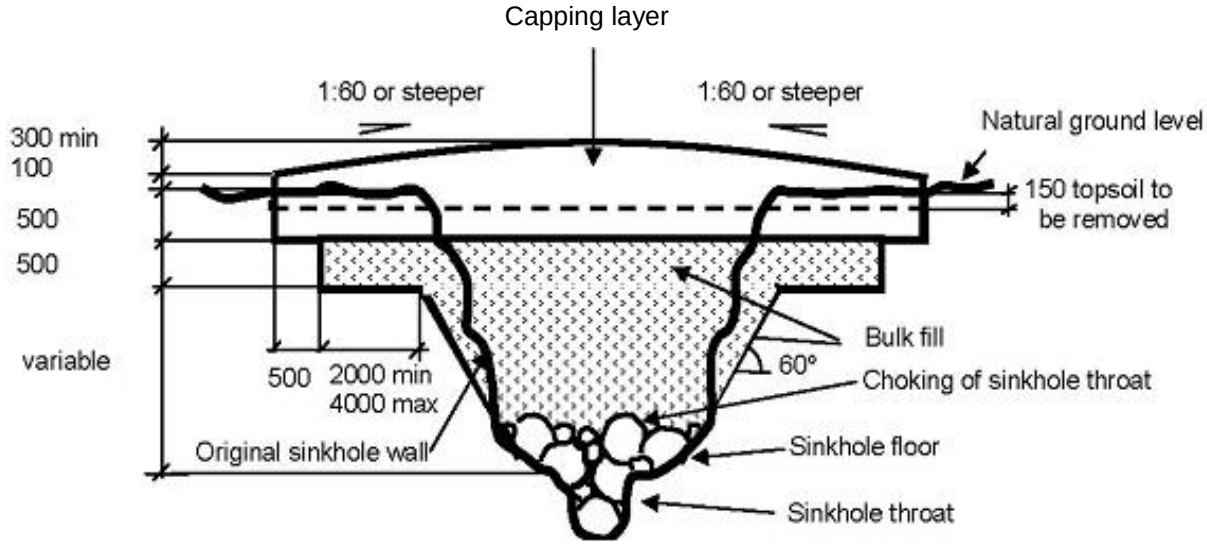
b) the placement of boulders and/or building rubble having a dimension not exceeding 400 mixed

with soil such that the soil content is approximately 30% compacted by dynamic compaction (DC);

c) the pumping in of soil cement mix;

d) the casting of self-compacting concrete.

Note: The type of choking is usually determined by a Competent Person (geo-professional/engineer) after the sinkhole floor has been excavated.



Note: 1) All dimensions in millimetres
2) Not to scale

Figure 3 Stabilisation of a sinkhole using the inverted filter method

M.4.3.3 Method of repair

The contractor shall prepare a detail methodology statement for approval by the Competent Person before commencement of any sinkhole repair.

The sinkhole shall, with reference to Figure 3, be repaired using one of the following methods as specified in the specification data:

a) Dynamic Compaction

1) Fill the sinkhole with material complying with the requirements of M.4.1.1.1 in layers not exceeding 4m thickness, level off with the excavator bucket and compact using dynamic compaction in accordance with the requirements of M.4.2.2;

2) Place material complying with the requirements of M.4.1.1.2 in the capping layer in layers not exceeding 150mm and compact to 95% of Modified AASHTO maximum dry density at optimum moisture content and shape the surface in accordance with the requirements of Figure 3 to prevent the ponding of surface water.

b) Using compaction equipment other than DC

1) Place material that complies with the requirements of M.4.1.1.1 in the bulk fill (refer to Figure 3) in layers not exceeding 200mm in thickness and compact with suitable mechanical compactors to 93% of Modified AASHTO maximum dry density at optimum moisture content. The maximum particle size in the backfill material shall be limited to two-thirds of the compacted layer thickness;

2) Place material complying with the requirements of M.4.1.1.2 in the capping layer in layers not exceeding 150mm thickness and compact to 95% of Modified AASHTO maximum dry

density at optimum moisture content and shape the surface in accordance with the requirements of Figure 3b in a manner that prevents the ponding of surface water.

Low lying areas within 30m of the repaired sinkhole shall be backfilled to prevent the ponding of water by:

a) Removal of the surface material to a depth of 150mm to 0,5m beyond the extremity of the depression;

b) backfill the depression according to M.4.3.3 (a)(2);

c) finish off the surface in such a manner that water drains and does not pond on the finished surface.

M.4.3.4 Prevention of damage to surrounding properties

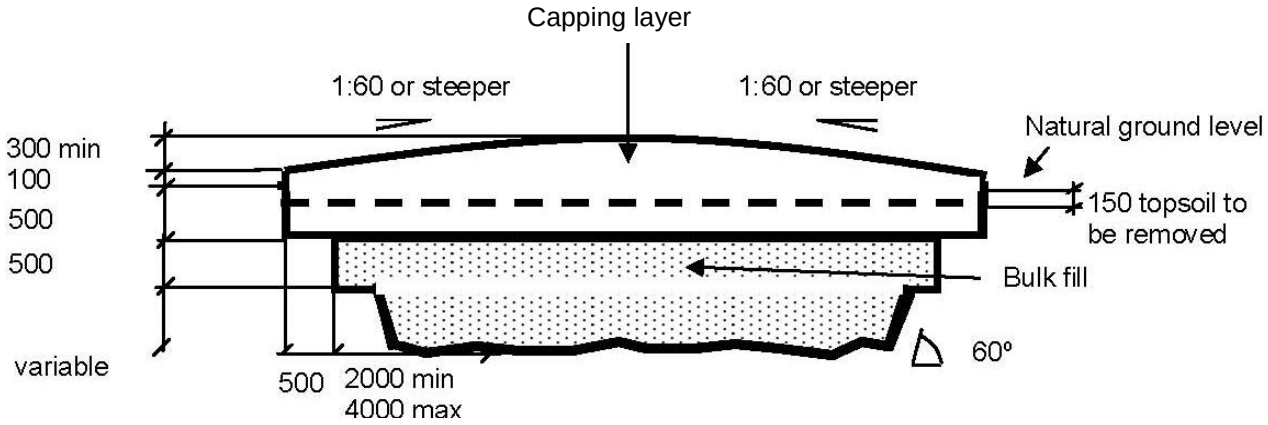
The DC contractor shall apply appropriate measures to prevent damage to surrounding properties. DC shall not be performed closer than 1m to any adjacent property and a photographic record of the interior and exterior of all surrounding properties shall be compiled and presented to the Competent Person before commencement of DC. Vibration measurements (peak particle velocity) shall be recorded at a minimum of three positions around the sinkhole to ensure that the vibrations caused by DC operations are less than 12mm/s for frequencies of between 3 Hertz and 20 Hertz.

M.4.4 Repair of subsidences

M.4.4.1 Preparation

The topsoil shall be removed to a depth of 150mm and the area around the subsidence excavated to the relevant dimensions shown in Figure 4.

The sidewalls of the subsidence shall be excavated at approximately 60° to the horizontal to a depth indicated in the specification data. The surface perimeter of the subsidence shall thereafter be extended by not less than 2m to a depth of 1m (refer to Figure 4).



Note: 1) All dimensions in millimetres
2) Not to scale

Figure 4 – Repair of subsidence

M.4.4.2 Method of repair

The subsidence shall, with reference to Figure 4, be repaired using one of the following methods as specified in the scope of work:

a) Using Compaction Equipment other than DC

1) Place material that complies with the requirements of M4.1.1.1 in the bulk fill to the base of the capping layer (refer to Figure 4) in layers not exceeding 200mm in thickness and compact with suitable mechanical compactors to 93% of Modified AASHTO maximum dry density at optimum moisture content. The maximum particle size of the backfill material shall be limited to two-thirds of the compacted layer thickness;

2) Place material complying with the requirements of M.4.1.1.2 in the capping layer (refer to Figure 4).

b) Using Dynamic compaction

1) Fill the subsidence with material complying with the requirements of M.4.1.1.1, level off with the excavator bucket and compact using dynamic compaction in accordance with the requirements of M.4.2.2;

2) Place material complying with the requirements of M4.1.1.2 in the capping layer (refer to Figure 4) in layers not exceeding 150mm and compact to 95% of Modified AASHTO maximum dry density at optimum moisture content and shape the surface in accordance with the requirements of Figure 4 to prevent the ponding of surface water.

Low lying areas within 15m of the repaired subsidence shall be backfilled to prevent the ponding of water by:

a) Removal of the surface material to a depth of 150mm and to 0,5m beyond the extremity of the depression;

b) backfill the depression according to M.4.3.3 (a)(2);

c) finish off the surface in such a manner that water drains and does not pond on the finished surface.

M.4.5 Grouting of subsurface cavities

The purpose of the grouting will be to fill wad/low density zones and/or cavities with low mobility grout under low pressure.

Grouting of subsurface cavities shall be undertaken using the grout type specified in the specification data.

The grouting equipment used shall:

a) be capable of pumping 20m³ of grout per hour at pressures of up to 1MPa to a depth of at least 60m;

b) be fitted with a calibrated pressure gauge and flow meter;

c) require less than 4h down time for minor repairs in every 40h of grouting.

The consistency of the grout shall be recorded for every 12m³ of grout that is supplied. Where necessary, the consistency of the grout may be corrected by adding water only after permission is granted by the Competent Person.

Grout holes shall be drilled to the diameters, depths and positions as specified in the specification data.

Grouting shall be undertaken in accordance with the sequence and to the depth ranges specified by the Competent Person (geo-professional/engineer) and specified in the specification data.

The grout pressure shall not exceed 15% of the calculated overburden pressure at the grouting depth, on the assumption that the material has the properties of loose sand.

Grouting shall commence at a pressure of less than 500kPa (measured at the surface). The grout pipe shall have a minimum diameter of 50mm and grouting shall be performed upwards from the bottom of the hole until no grout is injected for a period of 5 minutes. After at least 12h all holes shall be regrouted.

After completion of grouting at a particular borehole all grout spilled on the surface shall be removed.

When any ground movement in the vicinity of the grout hole is noticed, the grout pressure shall be released immediately and grout injection stopped at the particular hole. Grouting shall then continue in the next grout hole. Grouting shall be continued at that hole at a reduced pressure.

A field report shall be made available to the Competent Person (geo-professional/engineer) after completion of the grouting operation. Such report shall contain particulars of the grout mix, consistency measurements, injected grout volumes for each hole, depth of grout holes, and method of grouting and grout pressures for each hole.

M.5 Compliance with the requirements

M.5.1 Material properties of backfill

The material properties of fill and backfill shall, where relevant, be determined in accordance with The relevant requirements of SANS 3001PR5 and SANS 3001PR5

M.5.1.1 In place dry density and moisture content

The in place dry density of the backfill shall be determined in accordance with the requirements of TMH1 Method -A10(9) by means of the sand replacement method, or where appropriate, by nuclear methods in accordance with the requirements of TMH1 Method -A10(9).

The moisture content shall be determined in accordance with the requirements of TMH1-A7 where the sand replacement method is used and TMH1-A10(b) where nuclear methods are used.

M.5.2 Moisture content and density

Moisture content and density during compaction shall be within the limits of Table 1, appropriate to the degree of accuracy required in terms of the specification data.

Table 1: Permissible deviation in respect of moisture content and density

Item	Permissible deviation (PD)		
	Degree of accuracy		
	III	II	I
	%	%	%
Moisture content PD in moisture content in field during compaction from OMC	± 2	+ 2 - 1	+ 2 0
Maximum dry density PD in density from specified density	no upper limit 0	no upper limit 0	no upper limit 0

Annex M: Appendix A: Preparation of specification data associated with this specification for inclusion in the scope of work

Specification data form an essential part of this part of this specification; without such data, requirements are incomplete.

The format for the specification data has been developed to be compatible with the requirements in Table D.1 of SANS 10403:2003. The specification data shall be incorporated in the scope of work as shown in Table A.1.

NOTE In the development of a scope of work, it might be necessary to address the items discussed in Annex B as these are not covered in this specification.

Table A.1 — Incorporating this specification in the scope of work

TOPIC	**ASPECT**	**COMMENTARY**	
DESCRIPTION OF THE WORKS			
CONSTRUCTION			
Works specifications	Particular/generic specifications	The specification for the repair of sinkholes and subsidences as published in Appendix 1 of the National Department of Public Works Manual for the Development of Dolomite Land applies with the following specification data:	
		Clause	**Specification data**

Develop the specification data based on the contents of Table A.2.

Table A.2 — Specification data associated with this specification

Specification data associated with this specification	Guidance notes	
	Clause number	**Consideration**
Essential data		
Bulk fill shall comprise …	M.4.1.1.1	State requirements if standard requirements are not suitable
Capping layer shall comprise …	M.4.1.1.2	State requirements
The boom configuration shall allow a drop height of ...m measured from normal ground level whilst the closest portion of the crane is a minimum of ...m away from point of impact. Furthest point of impact to be possible shall be a minimum of ...m.	M.4.2.1	Typically the boom configuration allows a drop height of 18m at a minimum distance from the crane of 13m. The furthest point of impact is typically 20m.
Cable shall allow for accidental dropping to a depth of ... m below ground level.	M.4.2.1	State depth of cavity in which tamper may be accidentally dropped into. (Typically, this depth is 20m)
The compaction foot print spacing shall be...	M.4.2.1	State requirements if not specified else where
The compaction shall be as follows:	M.4.2.1	State requirements if standard requirements are not appropriate and if not stated elsewhere.
The sinkhole shall be choked in accordance with the requirements of M.4.3.2...	M.4.3.2	State if means of choking is not specified elsewhere i.e. a, b, c or d.
The method for repairing the sinkhole is M.4.3.3...	M.4.3.3	State which repair method is to be used if not stated elsewhere, i.e. a or b
The method for repairing the subsidence is M.4.4.2…	M.4.4.2	State which repair method is to be used if not stated elsewhere, i.e. a or b
The grout type shall be type M.1.4.2…	M.1.4.2	State the grout type if not stated elsewhere, i.e. a or b
Variations		
		State variations, if any.
Additional clauses		
		State additional clauses, if any.

Annex M: Appendix B: Items that may need to be considered when preparing the scope of work for a particular project

M.B.1. The scope of work for a particular project, prepared in accordance with the requirements in Annex D of SANS 10403:2003, should commence with a description of the works and thereafter describe items relating to general project management practice, namely Engineering, Procurement, Construction or Management. In many instances it may be necessary to include clauses in each of these sections to establish design responsibilities, management procedures, constraints to construction, etc. which are pertinent to the works executed in accordance with this specification.

M.B.2. The health and safety aspects of work around subsidences and sinkholes should be addressed in the scope of work. The following issues should be considered.

a) requirements for personnel executing work in or around sinkholes to be strapped into harnesses and safety ropes secured away from the sinkhole or suspended from crane or excavator parked at a safe position;

b) the safe parking distance for equipment and the zone where personnel are to be strapped into safety harnesses attached to safety ropes (see Figure B.1);

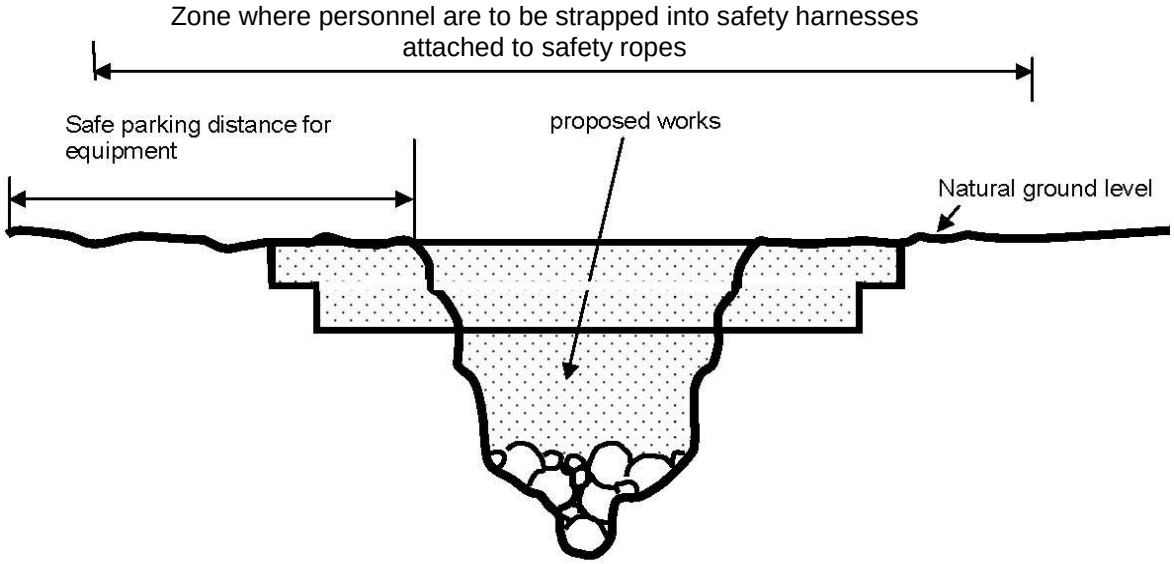


Figure M.B.1 - Safety distances

c) all precautionary measures that the contractor should take prior to and during the repair of the sinkhole;

d) the manner in which personnel are to be informed of the hazardous conditions pertaining to working in or around sinkholes;

e) the reporting requirements for the reporting of any:

i. surface cracks;

ii. cavities (irrespective of size);

iii. any ground movement;

iv. any sudden variation in soil profiles; and

f) requirements, in the event of the items listed in c) being observed, for the immediate stopping of the work and evacuation of all personnel from the area until the Competent Person (geo-professional/engineer) has inspected the site and determined the course of action to be employed;

g) the appointment of a suitable contractor's representative to oversee the safety of the works;

h) requirements for the locating and protection of existing services;

i) requirements for the reporting and repair of damage to existing services .e.g. damage reported to the Competent Person (geo-professional/engineer) within one hour of occurrence and full damage report submitted within 24h; and

j) requirements for obtaining approval from the Competent Person (geo-professional/engineer) prior to commencing operations.

NOTE: Other issues such as special risk insurance should be considered in the contract data.

Annex N: Specification for Below Ground Surface Installations for Buildings - Dolomite Area Designation D1

N.1 Scope

This specification provides minimum requirements regarding areas with a Dolomite Area Designation of D1 as well as the requirements to make emergency repairs and maintain existing infrastructure until such time that upgradings or replacements to the requirements of PW344/2016 can be executed on areas with a Dolomite Area Designation of D2, D3 and D4.

This specification covers the construction of water pipelines having a diameter of up to 160 mm from a water reticulation main to the boundaries of individual erven or other specified points on erven. It covers the installation of pipework and associated specials which provide water, meters and fire hydrants.

Below ground installations involving pipes having a diameter exceeding 160mm shall be constructed in accordance with the requirements of SANS 1200-L (SANS 2001-DP2).

NOTE: 1 Appendix A provides guidance to those responsible for compiling procurement documents which make reference to this standard.

NOTE 2: This standard is suitable for constructing of fire installations designed in accordance with the design rules provided in SANS 10400W, Fire installations.

NOTE 3: Pipework installed in accordance with the standard requirements of this standard will satisfy the minimum pressure rating requirements for fire installations specified in SANS 10400W and will accommodate the maximum water pressure in the municipal supply.

N.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard: All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below.

a) SANS 62-1, *Steel pipes: Part 1 Pipes suitable for threading and of nominal size not exceeding 150mm;*

b) SANS 62-2, *Steel pipes: Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150mm;*

c) SANS 191, *Cast steel gate valves;*

d) SANS 226, *Water taps (metallic);*

e) SANS 370*, Steel mesh reinforced polyethylene (PE) pipes for water supply;*

f) SANS 460, *Copper and copper alloy tubing;*

g) SANS 533, *Black polyethylene pipes for the conveyance of liquids;*

h) SANS 664, *Cast iron valves for waterworks;*

i) SANS 776, *Copper alloy valves – heavy duty;*

j) SANS 966-1, *Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems;*

k) SANS 1128-1, *Fire fighting equipment Part 1: Components of underground and above ground hydrant systems;*

l) SANS 1223, *Fibrecement pressure pipes and couplings ;*

m) SANS 1294, *Precast concrete manhole sections and slabs;*

n) SANS 1671-1, *Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding;*

o) SANS 1671-2*, Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding;*

p) SANS 1671-3, *Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding;*

q) SANS 1808-13, *Water supply and distribution system components Part 13: Diaphragm valves;*

r) SANS 1808-15, *Water supply and distribution system components Part 15: Mechanical backflow prevention devices;*

s) SANS 1808-31*, Water supply and distribution system components Part 31: Automatic control valves;*

t) SANS 1808-32*, Water supply and distribution system components Part 32: Float valves (equilibrium type);*

u) SANS 1808-44, *Water supply and distribution system components Part 44: Pipe saddles;*

v) SANS 1808-45*, Water supply and distribution system components Part 45: Pipe repair clamps;*

w) SANS 1882, *Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames;*

x) SABS 1200, *Civil Engineering Construction – Part L: Medium - pressure pipelines. (*SANS 2001DP2, *Construction works – Part DP2: Medium pressure pipelines.);*

y) SANS 10112, *The installation of polypropylene and poly(vinyl chloride)(UPV-C and PVC-M) pipes;*

z) SANS 10265-1*, Welding of thermoplastics – Welding processes Part 1: Heated tool welding;*

aa) SANS 10265-2*, Welding of thermoplastics – Welding processes Part 2: Electrofusion welding;*

bb) SANS 10265-5*, Welding of thermoplastics – Welding processes Part 5: Solvent welding;*

cc) SANS 10265-10*, Welding of thermoplastics – Welding processes Part 10: Weld defects;*

dd) *SANS 10269, Welding of thermoplastics – testing and approval of welders;*

ee) SANS 10403, *Formatting and compilation of procurement documents*;

ff) SANS 14 / ISO 49, *Malleable cast iron fittings threaded to ISO 71;*

gg) SANS 4427 / ISO 4277, *Polyethylene (PE) pipes for water supply specifications;*

hh) SANS 14236 / ISO 14236, *Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems;*

ii) SANS 50545 EN545, *Ductile iron pipe, fittings, accessories and their joints for water pipelines-Requirements and test methods*.

N.3 Definitions and abbreviations

For the purposes of this standard the definitions given in SANS 10403 and the following definitions apply:

Agrément certificate: certificate confirming fitness for purpose of a non-standardised product, material or component or the acceptability of the related non-standardised design and the conditions pertaining

thereto (or both) issued by the Board of Agrément of South Africa

backfill: material placed and compacted on top of the bedding material to reinstate the excavated trench to the original level

bedding: the operation of placing and compacting bedding material around or over the pipe or prefabricated culvert in the manner specified

Board of Agrément of South Africa: body operating under the delegation of authority of the Minister of Public Works

ductile iron: cast iron used for pipes, fittings and accessories in which graphite is present in substantially spheroid form

ferrule: a short metal tube that is screwed or plugged into the wall of a pipe or into a saddle to form a connection.

fire installation: any water installation which conveys water for the purposes of firefighting

leading connection (or service connection or stand connection): a short pipeline used for conveying water from a reticulation main to a consumer's meter.

nominal pressure (*PN*):specified maximum allowable operating pressure of the pipe at 20° C

polymer concrete: reinforced plastic mortar mixture of synthetic thermosetting resin (polymer, polyester or vinyl ester or epoxy and others), aggregates (commonly graded silica sand and stone, or both of the same size and shape or different sizes and shapes), glass fibre strands or fibres, polypropylene fibres and a reactive catalyst

saddle: a metal ring split into two semicircular halves that are clamped round a pipe and used with a ferrule to form a connection.

specification data: data, provisions and variations that make this specification applicable to a particular contract or works (see Annex A)

stop tap (stop valve): a shutoff device installed in a pipeline to control the flow of water.

suitable: capable of fulfilling or having fulfilled the intended function or fit for its intended purpose

N.4 Requirements

N.4.1 Materials

N.4.1.1 Earthworks materials

N.4.1.1.1 Backfill material

Backfill material shall:

a) Comply with the requirements as per Chapter 4;

b) contain no organic material (material produced by animal or plant activities);

c) exclude gravel and rock fragments of maximum dimension larger than 53mm;

d) not contain more than 10% rock or hard fragments of material retained in a sieve of nominal aperture size 53mm;

e) not contain large clay lumps that do not break down under the action of compaction.

N.4.1.1.2 Bedding material

Bedding material shall:

a) Comply with the requirements as per Chapter 4;

b) not be a predominantly clayey material (PI<12%);

c) contain no organic material (material produced by animal or plant activities);

d) not contain any material retained on a sieve of nominal aperture size 5,6mm;

e) not contain large clay lumps that do not break up under the action of compaction.

N.4.1.2 Pipes and Fittings

N.4.1.2.1 General

Pipes and fittings shall be of the types and sizes specified in the scope of work.

Unless otherwise stated in the scope of work, pipes, fittings and specials shall either comply with the requirements of N.4.1.3 to N.4.1.18 or be the subject of an Agrément certificate.

Pipes shall be handled and stored in accordance with the manufacturer's instructions.

Screwended pipes shall comply with the relevant requirements of SANS 11091. Male ends shall be taper screwed and female ends shall have parallel threads.

Pipe repair clamps shall, where relevant, comply with the requirements of SANS 180845 and have a pressure rating not less than that of the pipes which are repaired.

N.4.1.2.2 Steel pipes, fittings and specials

Steel pipes shall comply with the requirements of SANS 62-1 for a medium duty pipe which is galvanized inside and outside with, unless otherwise stated in the specification data, a silicon range in the range 0,135 % to 0,30 %. Such pipes shall be supplied in a galvanized condition with plastic caps.

Screwed pieces and fittings shall be medium fittings complying with the requirement of SANS 62-2 and shall be galvanized inside and outside. Alternatively, fittings shall satisfy the requirements of SANS 14 / ISO 49.

A certificate stating that each consignment complies with the requirements of SANS 62-1 or SANS 62-2 shall be provided where specified in the specification data.

Fabricated flanged steel pipes shall comply with the requirements of SANS 1476 and, unless otherwise stated in the specification data, have flanges complying with the requirements of SANS 1123, be fabricated from pipes complying with the requirements of SANS 62-2 and be hot dip galvanized.

N.4.1.2.3 Fibre cement (FC) pipes and couplings

Fibre-cement (FC) pipes and couplings shall comply with the requirements of SANS 1223 and, unless otherwise specified in the specification data, have a constant outside diameter and be a class B pipe.

Fibre-cement pipes shall be bitumen dipped where so required in terms of the scope of work.

N.4.1.2.4 Glass fibre reinforced thermosetting plastic (GRP) pipes

Glass fibre reinforced thermosetting plastic (GRP) pipes and jointing systems shall comply with the requirements of SANS 1748-1 and, unless otherwise specified in the specification data, have a nominal pressure (PN) class of 12, a pipe stiffness (SN) class of 630 and be evaluated and certified for conveying potable water.

N.4.1.2.5 Polyethylene (PE) pipes and fittings

N.4.1.2.5.1 Polyethylene (PE) pipes

Polyethylene (PE) pipes shall comply with the requirements of SANS 4427 / ISO 4427 and, unless otherwise stated in the specification data, be a designation PE 100 and PN rating as described in Chapter 4.

Pipes shall preferably be joined by means of butt welding as per the requirements of SANS 4427 but mechanical joint compression fittings complying with the requirements of SANS 14236 / ISO 14236 can

also be used. Where permitted in terms of the specification data, pipes may be joined together by means of suitable push fit, heated tool socket weld or electro fusion fittings recommended by the pipe manufacturer or butt fusion.

Polyethylene pipes may be supplied and stored in coils provided that the diameter of the coil is at least 24 times the pipe diameter or 600mm.

N.4.1.2.5.2 Steel mesh reinforced polyethylene (PE) pipes

Steel mesh reinforced polyethylene (PE) pipes shall comply with the requirements of SANS 370 and, unless otherwise specified in the specification data, have a PN 16 nominal pressure rating. Such pipes shall be joined by means of either an electrofusion coupling or flanged fitting complying with the requirements of SANS 371, unless otherwise specified in the specification data

N.4.1.2.6 Polypropylene

Polypropylene pipes shall comply with the requirements of SANS 15874 and, unless otherwise specified in the specification data, shall be class PN10 pipes.

Polypropylene pipes shall be joined together by means of mechanical joint compression fittings complying with the requirements of SANS 10268. Where permitted in terms of the specification data, pipes may be joined together by means of suitable heated tool socket weld fittings recommended by the pipe manufacturer or butt fusion.

N.4.1.2.7 Polyvinyl chloride pipes (PVC) pipe systems

N.4.1.2.7.1 Unplasticized poly(vinyl chloride) (PVC-U) pipes

PVC pipes shall be stored, handled and transported in accordance with the requirements of SANS 10112.
Unplasticized poly(vinyl chloride) (PVC-U) pipes and fittings shall comply with the requirements of SANS 966-1 and, unless otherwise specified in the specification data, shall be a pressure class of 12. Unless otherwise specified in the specification data, pipes may be joined by means of rubber ring joints or solvent weld joints.

N.4.1.2.7.2 Modified poly(vinyl chloride) (PVC-M) pipes

Modified poly (vinyl chloride) (PVC-M) pipes and fittings shall comply with the requirements of SANS 966-2 or SANS 1283 and, unless otherwise stated in the specification data, shall be a pressure class 12.

N.4.1.2.7.3 Oriented polyvinyl chloride pipes (PVC-O)

Oriented polyvinyl chloride pipes shall comply with the requirements of SANS 1808-85, and, unless otherwise stated in the specification data, shall have an overall an overall service (design) coefficient of 1,4 and be a pressure class 12.

N.4.1.2.8 Copper pipes and fittings

Copper pipes shall comply with the relevant requirements of SANS 460, and fittings shall be mechanical joint compression fittings complying with the requirements of SANS 1067-1.

N.4.1.2.9 Metallic compression type pipe couplings

Metallic compression type pipe couplings shall comply with the requirements of SANS 1808-2 and, unless otherwise specified in the specification data, have a working pressure rating of 1600kPa, have a corrosion resistant coating and be designed for the situation where one side of the pipe is not restrained against longitudinal movement.

N.4.1.2.10 Ferrules

Ferrules shall be manufactured from leaded gunmetal and shall be of a standard pattern

a) screw-in type; or
b) plug-in type,

The outlets of ferrules shall be such that they are compatible with the pipes used for the stand or building connections.

N.4.1.2.11 Saddles

Saddles shall comply with the requirements of SANS 1808-44 and have a suitable corrosion resistant finish.

N.4.1.2.12 Valves

Pipes and fittings shall be of the types and sizes specified in the scope of work.

Diaphragm valves shall comply with the requirements of SANS 1808-13 and, unless otherwise specified in the specification data, have a nominal pressure class of PN 16, flange dimensions complying with SANS 1123 and hand wheels fitted.

Float valves (equilibrium type) shall comply with the requirements of SANS 1808-32 and, unless otherwise specified in the specification data, have a working pressure rating of 1600kPa.

Automatic control valves shall comply with the requirements of SANS 1808-31 and, unless otherwise specified in the specification data, have a working pressure rating of 1600kPa.

Cast steel gate vales shall comply with the requirements of SANS 191.

Cast iron gate vales shall comply with the requirements of SANS 664, and, unless otherwise specified in the specification data, shall be a class PN 16 valve.

Copper alloy gate valves comply with the requirements of SANS 776, and, unless otherwise specified in the specification data, shall be a class PN 16 valve.

N.4.1.2.13 Inline strainers

Inline strainers shall comply with the requirements of SANS 1808-58 and have the parameters as specified in the scope of work.

N.4.1.2.14 Mechanical backflow prevention devices

Mechanical backflow prevention devices shall comply with the requirements of SANS 1808-15 and have the parameters as specified in the scope of work.

N.4.1.2.15 Fire hydrants

Underground ground fire hydrants shall comply with the requirements of SANS 1128-1 and have the parameters as specified in the scope of work.

N.4.1.2.16 Manholes, surface boxes, anchor blocks, concrete casing, etc.

N.4.1.2.16.1 Masonry and plaster

Masonry units, unless otherwise stated in the scope of work shall have the following attributes:

a) burnt clay units: FIBS or NAP with a nominal compressive strength of 14MPa or FIBS without frogs and perforations;

b) Concrete units: solid units with a nominal compressive strength of 14MPa.

Mortar shall be a type II mortar in accordance with the requirements of SANS 2001CM1.

Plaster shall be an external plaster in accordance with the requirements of SANS 2001EM1.

N.4.1.2.16.2 Prefabricated cylinders

Suitable prefabricated cylinders may be of spun concrete, fibre cement, glass reinforced polyester, HDPE or PVC, except where particular materials are required in terms of the scope of work. Precast concrete cylinders shall comply with the applicable requirements of SANS 1294.

Sectional spun concrete cylinders shall comply with the requirements for pipes of SC type, Class A, of SANS 677. Jointing between cylinders shall be of the interlocking self centering type suitable for sealing.

N.4.1.2.16.3 Concrete

Unless otherwise specified, concrete shall be grade 20 or higher and comply with the requirements of SANS 1200-G (SANS 2001-CC1) or SANS 1200-GA (SANS 2001-CC2), as applicable.

N.4.1.2.16.4 Step irons

Step irons shall be of malleable cast iron complying with the applicable requirements of EN 1301 and of length suitable for fixing in brick, in situ concrete, or precast concrete, as applicable.

N.4.1.2.16.5 Cast iron manhole covers and frames

Unless otherwise required in terms of the specification data, cast iron covers and frames for manholes shall comply with the requirements of SANS 558 for Type 2B in the case of manholes in roads and other areas subject to road traffic loads, and Type 4 in the case of manholes in areas not subject to such loads.

Covers and frames for manholes shall be supplied in matching sets. The cover and frame of each set shall each bear a serial number (applied by means of an oil paint) to enable the sets to be identified.

When installed, the covers and frames shall still comply with the requirements of SANS 558 for freedom from warp and evenness of seating.

N.4.1.2.16.6 Polymer concrete manhole covers and frames

Polymer concrete manhole and inspection covers and frames shall comply with the requirements of SANS 1882. Unless otherwise specified in the scope of work, the covers shall be:

a) light duty class where wheeled vehicles have no access; and

b) medium duty class where heavy commercial vehicles have no access;

c) heavy duty class where heavy commercial vehicles have access.

N.4.1.2.16.7 Surface boxes

Surface boxes shall, unless otherwise stated in the scope of work, be:

a) cast iron boxes complying with the requirements of SANS 558 for Type 3A in the cases of surface boxes for gate and scour valves, and Type 5 in the cases of surface boxes for hydrants and air valves;

b) polymer concrete boxes complying with the relevant requirements of SANS 1882; or

c) made from any suitable material that comply with the applicable requirements of N.4.1.17, provided that they conform to the relevant shapes and internal dimensions given in SANS 558.

All cast iron surface boxes shall be hot dipped in a bituminous compound before dispatch from the manufacturer's works.

N.4.1.2.17 Stop taps and meters

N.4.1.2.17.1 Stop taps

Stop taps shall be of screw down pattern, clockwise closing, and shall comply with the relevant requirements for Class 1 water taps of SANS 226. Each stop tap shall be fitted with a crutch for hand operation.

N.4.1.2.17.2 Meters

a) Meters shall be of the type and size indicated in the scope of work. The meters shall be suitable for installation in horizontal, vertical, or inclined pipelines without their accuracy being affected, and shall be supplied with couplings suitable for connecting them to pipes of the type and class to be used.

b) Each meter shall be capable of registering the volumes of water stated in the scope of work under the conditions indicated.

N.4.1.2.18 Markings and marker posts

Markings and marker posts shall comply with the applicable requirements of the scope of work.

N.4.2 Trenches

Trenches shall, as far as is practicable, not be excavated parallel to buildings within 1,5m of a building and shall not extend below a line drawn at 45° to the horizontal, as measured from the bottom edge of the foundation (refer to Figure 1) unless suitable precautions are taken to ensure the stability of the adjacent foundations.

Where a water pipe is to be laid underground horizontally next to a sewer or other service, it should be at least 500mm away. If the water pipe crosses another service it shall be laid at least 100mm above or below it. No water pipe shall be installed within 100mm of any other service pipe or cable.

The sides of trenches shall be vertical for at least the height of the bedding. For trenches deeper than 1,5m the sides shall be flattened or supported to maintain safe working conditions in the trench.

Trench depths shall be such that not less than 100mm and not more than 200mm of bedding material may be placed below pipes. (refer to Figure 2)

Where the trench floor has been loosened or over excavated during excavations, it shall be well compacted with bedding material and raised to the correct level prior to the placing of bedding and pipe laying.

Soft spots in the trench floor shall be removed and backfilled and compacted with bedding material.

Trenches shall not be less than 450mm wide.

The trench floor shall be sufficiently straight to enable pipes to be laid without significant reduction in trench side space.

Trenches shall be kept sufficiently dry to allow proper and safe bedding, laying, and jointing of pipes and kept dry until the pipeline has passed the required tests and construction of the selected fill blanket over the pipes has been completed.

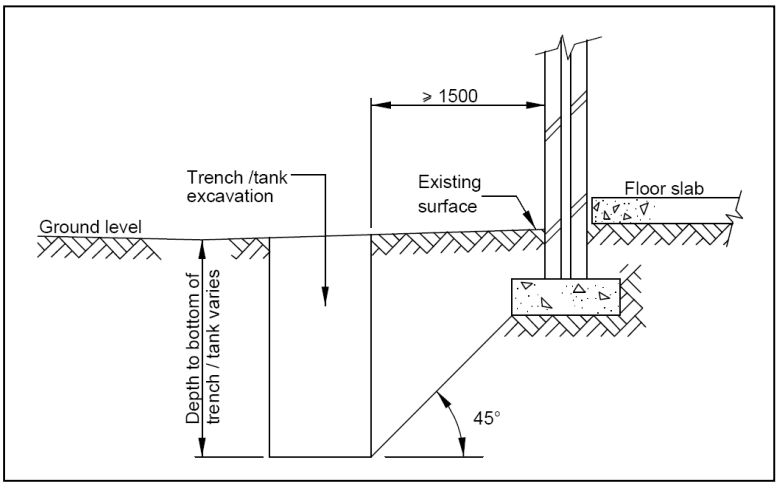


Figure 1 : Typical trench setting out details

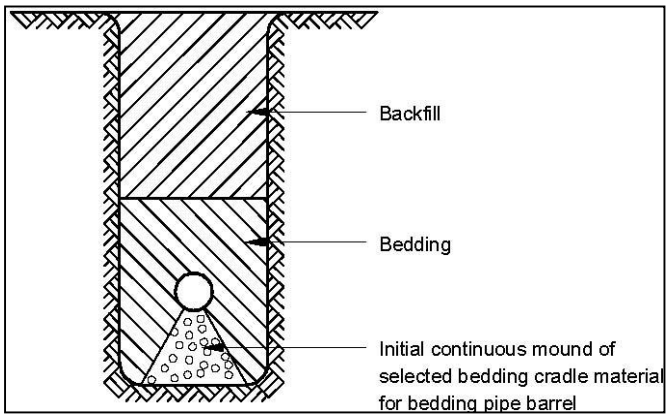


Figure 2 : Pipe bedding details

N.4.3 Pipe bedding and backfilling

Backfilling and bedding shall be placed in layers not exceeding 100 mm. Each layer shall be compacted to the specified compaction standard before additional fill material is added.

Pipes shall be bedded on a continuous bed of bedding material and protected so that the bedding extends from between 100mm to 200mm beneath the pipe bottom to 200mm above the pipe and not less than 150mm on each side of the pipes (refer to Figure 3).

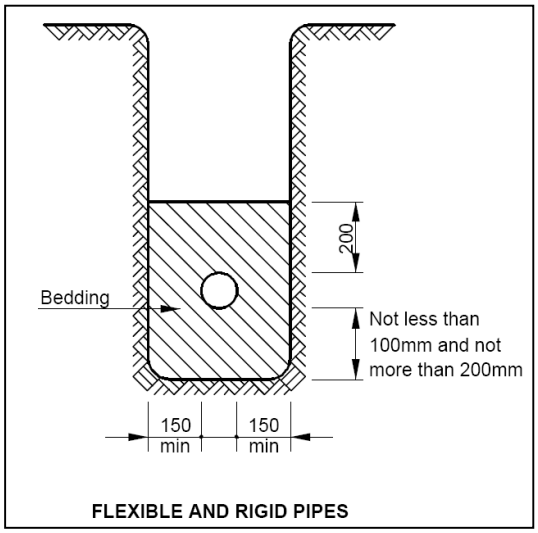


Figure 3 : Pipe supported on bedding

When placing bedding, all voids under the pipes shall be filled. Compaction shall be carried out simultaneously and uniformly on both sides of the pipe so as not to cause any lateral or vertical displacement of the pipe. Bedding shall be carried out as pipe laying proceeds and shall be completed before any acceptance test is carried out.

Under no circumstances shall pipes be laid on supporting masonry units or other hard materials as uneven deflection of the pipes or pipe damage may occur.

Backfill shall be placed and compacted once the pipe has been laid and firmly bedded in accordance with requirements.

Pipes shall, unless otherwise specified in the scope of work, have a minimum top cover of 300mm.

N.4.4 Laying of pipes in trenches

Pipes and pipe fittings shall have the nominal diameter stated in the scope of work. Pipes and pipe fittings shall not be dropped or thrown onto the ground. Pipes that are the subject of an Agrément certificate shall be installed in accordance with the provisions of that certificate.

Solvent cemented pipes shall be provided with rubber ring joints at intervals not exceeding 9m to provide for expansion and contraction.

All solvent cement joints shall be made in a dry area outside the trench. Rubber ring jointing may be carried out in the trench.

Pipes shall be laid and bedded to even grades. The pipe gradient may be varied gradually by deflection at pipe joints, but the deflection shall not exceed the deflections recommended by the manufacturer of the joints.

The method of laying shall be such that the barrels of the pipes bear evenly over their full lengths and no packing is used under the barrels. Each pipe and fitting shall be thoroughly cleaned out and carefully examined for damage immediately before laying. Agrément certified pipes shall be laid within the scope, conditions and limitations prescribed in the certificate.

Precautions shall be taken to prevent the entry of foreign matter and water into pipelines. At the close of each day's work, or when work is suspended for a significant period, the open ends of uncompleted pipelines shall be plugged, capped, or otherwise closed until laying is recommenced.

A pipeline feeding a fire hydrant shall be laid at such a level that the top of the threaded outlet to the hydrant is not more than 400mm below the level at which the top of the hydrant cover is to be set. Valves shall be set upright.

Unless otherwise specified in the specification data, pipes shall not be hot bent to achieve a change of direction.

NOTE: SANS 10112 provides recommendations for the introduction of bends in PE, PVC-U and PVC-M pipes with heat treatment which may be carried out off site in a suitable hot liquid or hot air oven.

N.4.5 Jointing methods and operations

N.4.5.1 Detachable couplings (FC and PVC pipelines)

Each end of FC and PVC pipes shall be thoroughly cleaned by brushing and wiping immediately before being jointed. All rubber rings and seals shall be carefully inspected after being placed in position and before the joint is closed, to ensure that they have not suffered any cuts, tears, or other damage, and are not in any other way defective. Only the lubricant recommended by the manufacturer shall be used for sleeve type couplings and rubber insertion rings of FC pipes. Polyurethane joints for PVC pipes shall be lubricated with soft soap or similar material approved by the manufacturer. Grease derived from petroleum products shall not be used in PVC pipe joints.

PVC pipelines shall be jointed in accordance with the manufacturer's instructions.

FC pipelines shall be jointed in accordance with the manufacturer's instructions. Joints in such pipelines

with ductile iron detachable couplings shall have gaps, after laying and jointing, of approximately 10mm between the ends of the pipes and central to the collar, to allow for expansion when the pipes are filled and have absorbed moisture.

N.4.5.2 Flanges (steel pipelines)

In the jointing of steel pipes with flanges, care shall be taken to align, grade, and level the pipes, specials, and valves to avoid straining of the flanges. All bitumen and paint shall be removed from the mating face of each flange immediately before jointing. Insertion pieces that have accurately cut holes for bolts shall be placed to form a continuous one-piece ring between the flanges. Bolts shall be tightened up evenly in opposite pairs to ensure uniform bearing on the insertion. Care shall be taken to avoid damage to the internal surfaces of the pipes during assembly of the pipeline.

Wherever loose flanges are welded onto pipelines, the pipe linings shall be restored to the thickness specified and the new linings shall be soundly jointed to the existing linings.

N.4.5.3 Jointing of PE, PP, PVC-U and PVC-M pipes

N.4.5.3.1 Welding of thermoplastics

The welding of polypropylene homopolymer, polypropylene block copolymer, polypropylene random copolymer, polyvinylidene fluoride and highdensity polyethylene using the heated tool butt welding and heated tool socket welding processes shall be undertaken in accordance with the requirements of SANS 10268-1 using equipment that satisfies the requirements of SANS 1671-1.

The welding of polyethylene and polypropylene pipes by means of electro fusion shall be in accordance with the requirements of SANS 10268-2. The acceptability of the weld shall be assessed in accordance with the assessment table contained in SANS 10268-10.

The joining of unplasticized polyvinyl chloride (PVC-U) and chlorinated polyvinyl chloride (PVC-C) using the solvent welding process shall be in accordance with the requirements of SANS 10268-5.

Welders shall, where specified in the specification data, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate.

N.4.5.3.2 Thermofusion of polypropylene pipes

Buttfusion welding and electrofusion of polypropylene pipes shall be carried out by suitably trained and skilled operators using equipment that satisfies the requirements of SANS 1671-1 or SANS 1671-2. Electrofusion control units and butt fusion welding machines shall be used strictly in accordance with the supplier’s instructions and the provisions of SANS 10268-1.

Before use, metal heating plates shall be cleaned of all traces of polyethylene remaining from previous operations to avoid inclusion of oxidized polyethylene in the weld.

The pipe ends of all pipes jointed by means of an electrofusion fitting shall be prepared prior to jointing by scraping off any surface oxide and being thoroughly cleaned with a suitable cleaner.

The two elements that are to be jointed in the buttwelding process shall be not be under tension or lateral stress during the welding operation.

Welders shall, where specified in the specification data, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate.

NOTE: Unskilled application of the thermofusion process is likely to produce joints which appear satisfactory on inspection but which may contain stresses and brittle areas which might result in the eventual failure of the joint.

N.4.5.3.3 Hot welding of PVC-U piping

Hot welding shall be carried out by suitably trained and skilled operators in accordance with the requirements of SANS 10112 using equipment that satisfies the requirements of SANS 1671-3.

Welders shall, where specified in the specification data, be tested and certified in accordance with the

requirements of SANS 10269 and be in possession of a valid test certificate.

N.4.5.3.4 Compression fittings

The end of the pipe shall be inserted into the fitting past the rubber sealing ring. The nut that compresses the sealing ring shall then be hand tightened and thereafter turned with a suitable spanner a further 1¼ turns to compress the grip ring onto the pipe. Care shall be taken to:

a) not overtighten the elastic ring which is in contact with the PVC pipe as the tightness of the joint may be impaired under pressure;

b) ensure that if the other end of piece of pipe is already jointed to another pipe, such pipe does not turn during the screwing process and stress the existing fittings.

NOTE: Sealing is obtained with a light compression of the elastomeric sealing ring due to the smooth surface of the pipe.

N.4.5.3.5 Screwed joints on polyethylene pipes

Screw threads may, unless otherwise stated in the specification data, be cut on PE 63, PE40 and PE 32 pipes polyethylene pipes, provided that a clean sharp suitable die is used.

The die shall be washed in petrol and wiped clean and dry to ensure that no oil is applied to the pipe during the cutting of the thread.

The end of the pipe shall be cut off square before the die is run on, and a mandrel shall be inserted in the end of the pipe to support it against the die. The thread shall be cut in one pass without endpressure on the die. The length threaded shall be such that all the threads will enter the joint, so that no threads will be left exposed.

Metal sockets or injection moulded plastics sockets (or elbows, tees, crosses reducers, etc.) may be used to complete the joint after wrapping the thread with PTFE tape and hand tightening. Care shall be taken in screwing up the joint to not overstress the screw thread by applying excessive torque to the socket or to the pipe. Only strap wrenches which grip the pipe with a strap fabric shall be used to finally tighten the joint if necessary.

NOTE 1: A set of dies should be kept specifically for use with polyethylene pipes. Special dies for threading polyethylene pipes are available and should be used in preference to the dies normally used on metal pipes.

NOTE 2: The use of ordinary jointing compound and hemp in the joint might damage the joint.

N.4.5.3.6 Rubber ring type integral pipe and sockets

The groove which houses any rubber ring where such ring is supplied separately shall be thoroughly cleaned prior to the location of the rubber ring in such groove.

The spigot end shall be square to the axis of the pipeline and suitably chamfered. Both the spigot and the rubber ring shall be lubricated with a suitable lubricant recommended by the pipe manufacturer prior to insertion into the socket. As soon as the spigot and sealing ring have been lubricated, the pipe shall be introduced into the socket, after it has been correctly aligned, so as to prevent any risk of contamination by sand or particles of grit.

The spigot shall be inserted into the socket up to the reference (depth of entry) mark made by the manufacturer or a mark measured by the installer to ensure the correct penetration of the pipe into the sealing element of the joint and guarantees sealing under pressure.

N.4.6 Concrete casing, anchor and thrust blocks

Where required in terms of the scope of work pipes shall be encased in grade 15 concrete, unless otherwise indicated. No part of the concrete casing shall be closer than 150mm to any flexible joint of a concrete encased pipeline. No earth filling over the concrete shall be commenced until at least two days after the concrete has been placed.

Anchor and thrust blocks shall, unless otherwise specified in the scope of work, be constructed to dimensions shown on Figure 4 at tees, bends, terminal valves, end caps where the joint between the pipe and such fittings is not of the self-anchoring type or is not a welded connection.

Anchor or thrust blocks and pedestals shall be constructed of grade 15 concrete unless otherwise stated in the scope of work.

The concrete shall be well punned round the pipe and, if in trenches, against the undisturbed faces and bottom of the trench. Backfilling may not be placed behind or under thrust faces. Excess excavation shall be replaced with the concrete as used for anchor or thrust blocks. Care shall be taken to leave the joints accessible.

N.4.7 Valve and hydrant chambers

Valve and hydrant chambers shall unless otherwise specified in the scope of work, be constructed in accordance with the relevant requirements of SANS 1200-L (SANS 2001-DP2).

N.4.8 Laying from main to erf

N.4.8.1 Access to properties in built-up areas

Where specified in the specification data, a printed notice shall be delivered to the owner or occupier, as appropriate, of each house or building, before operations are commenced, informing him that any existing water supply may be interrupted at short notice. When an erf connection is to be disconnected or shut off, reasonable warning shall be given to the consumer.

Where any part of an erf connection is to be installed within the boundaries of an erf, the work shall be arranged in such a way as to cause the least inconvenience to the consumer and the least possible damage to private property. After backfilling, those portions of lawns, flower beds, driveways, and pathways (gravel, tar, paving, or concrete), etc., that have been disturbed shall be made good.

N.4.8.2 Service connections

N.4.8.2.1 General

Holes for ferrules shall be drilled, not punched. On pipes in which ferrules are intended to be fitted while the pipes are under pressure, a suitable special drilling and tapping machine shall be used.

Any connection showing leakage when tested under the test pressure specified for the water supply main shall be regarded as defective and the pipe length with the defective connection shall be replaced and retested.

N.4.8.2.2 FC pipes

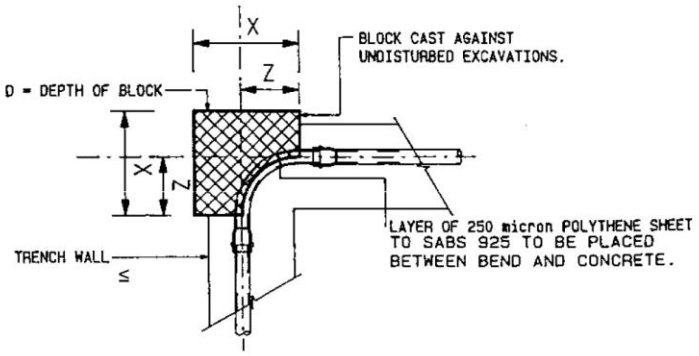
Except where plug-in type (expanding) ferrules are specified in the scope of work, and except where the water main is of Class 18 (CID) or Class C (COD) or better and has a wall thick enough for direct tapping, saddles shall be used for service connections to FC pipes. The nominal diameter of ferrules used for direct tappings in FC pipes shall not exceed 20mm for pipes of nominal diameter 100mm and 150mm, and shall not exceed 25mm for pipes of nominal diameter greater than 150mm.

A service connection to an AC pipeline may be made

a) at a joint by using:

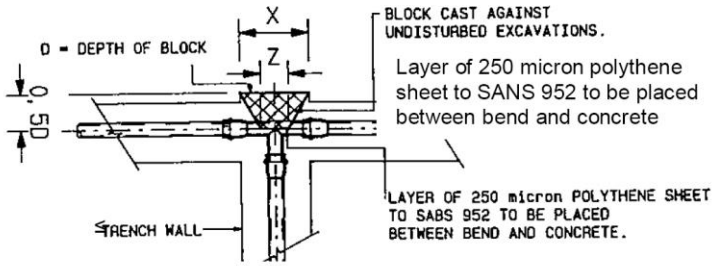
   1) a long collar detachable joint; or

   2) a CI detachable coupling that is longer than the standard sleeve and incorporates a platform with a tapped hole to which a service connection can be attached, or



PIPE Ø	X	D	Z	VOLUME M3
90	700	200	350	0, 08
110	800	300	450	0, 14
160	1 000	400	650	0, 27

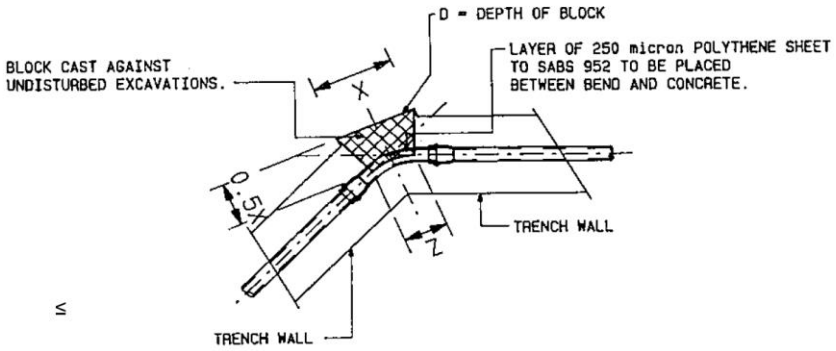
c: Thrust block for 90º bend



b: Thrust block for tee /end cap

PIPE Ø	X	D	Z	VOLUME M3
90	500	300	150	0, 01
110	500	400	200	0, 03
160	650	600	275	0, 08
200	850	700	350	0, 16

THRUST BLOCK FOR TEE/END CAP uPVC BEND



PIPE Ø	45˚ BEND			VOLUME M3	22, 5˚ AND 11, 25˚ BEND			VOLUME M3
	X	D	Z		X	D	Z	
90	500	200	250	0, 02	400	150	200	0, 01
110	600	250	350	0, 03	500	200	250	0, 02
160	700	400	450	0, 08	600	250	350	0, 03
200	900	500	600	0, 16	700	350	450	0, 06

a: Thrust block for 11,25º, 22.5 º and 45 º bends

Figure 4: Anchor and thrust blocks

b) on a pipe section at a position not less than 300mm from the end of the pipe by one of the following methods;

1) The pipe shall be drilled at the takeoff point to a diameter greater than that of the threaded portion of the ferrule. A suitable saddle complete with rubber washer having a hole that has been clearly punched to the size of the ferrule beforehand, shall then be accurately centred over the hole, and bolted round the pipe, the boss being drilled and tapped to the size required for the ferrule. A ferrule of the appropriate size shall then be installed;

2) A saddle complete with rubber washer shall be bolted round the pipe at the take-off point. The hole for the connection shall then be drilled and tapped through the saddle, washer, and pipe and a ferrule of the appropriate size installed;

3) Where plug-in type ferrules for AC pipes are to be used, the pipe shall be drilled to the correct size, and a ferrule of the type and dimensions appropriate to the wall thickness of the pipe shall be installed in accordance with the ferrule manufacturer's instructions.

In each method given in (b)(1), (2), and (3) the ferrule shall be so installed that, when the connection is tested, there is no sign of visible leakage.

N.4.8.2.3 Ductile iron pipes

On ductile iron pipes a service connection shall be made by drilling and tapping the pipe at the take-off point and then fitting a ferrule of the required size in the manner specified in 4.7.2.2.2 b(2).

N.4.8.2.4 Steel pipes

Where a service connection is required to be taken off a steel pipe, suitable precautions shall be taken to ensure that any pipe lining or coating is not damaged.

N.4.8.2.5 GRP, PE, PP and PVC pipes

On GRP, PE, PP and PVC, the service connections shall be made using suitable saddles in strict accordance with the method recommended by the pipe manufacturer. Pipes shall be cut in such a way that each cut end is smooth and clean.

N.4.8.2.6 Pipes of different materials

Pipes and fittings of different materials shall be jointed only with special adaptors recommended by the pipe manufacturer(s).

N.4.8.2.7 Recording of locations

Where required in terms of the specification data, the following data shall be recorded in respect of each connection:

a) The name of the street;

b) The number of the plot or erf;

c) The location measurements of the stop tap in relation to the nearest erf peg(s);

d) The position of the connection on the supply main relative to lateral erf boundaries;

e) The size of the connection.

N.4.9 Installation of water meters, stop taps and surface boxes

N.4.9.1 Meters

Each meter shall be installed in the position shown on the drawings and in such a manner that the meter can be removed easily after unscrewing the couplings and slightly springing the pipes apart. PTFE

sealing tape shall be used to joint threaded couplings. The inlet and outlet of each meter shall be kept securely covered until the meter is installed. Before being installed, each meter shall be blown through carefully in the direction of the arrow on the meter to ensure that it works freely. The meter shall then be set in position with the arrow pointing in the correct direction.

N.4.9.2 Stop taps

Each stop tap shall be installed with the arrow on the body of the tap pointing in the direction of flow.

N.4.9.3 Installation of surface boxes

Each surface box shall be set according to the ground slope, clear of, and in such a way as to afford adequate protection for the meter and stop tap. The inside of the box shall be backfilled to the underside of the meter.

N.4.9.4 Commissioning of meters

When turning on the water at each erf connection, all air shall be expelled from the meter by opening the highest tap on the premises and then slowly opening the stop tap.

N.4.9.5 Recording of meter installations

Where required in terms of the specification data, the following data shall be recorded in respect of each connection:

a) The meter type and number;

b) The number of the plot or erf;

c) The date of installation;

d) Any other data specified in the specification data

N.4.10 Freestanding and wall mounted taps

Freestanding and wall mounted external taps shall be supported in such a manner that they are capable of supporting a 50kg weight hung from the spout of the tap.

N.5 Compliance with requirements

N.5.1 Tolerances

No deviation will be permitted from the minimum cover above the pipe specified or shown on the drawings.

N.5.2 Materials testing

Materials for pipelines shall be tested in accordance with the relevant requirements of the standards applicable to such materials.

N.5.3 Hydraulic pipeline test

Water installations which incorporate fire hydrants shall be hydraulically tested in accordance with the requirements of SANS 1200-L (SANS 2001-DP2) at a field test pressure of 1500kPa.

Water installations which do not incorporate fire hydrants shall, unless otherwise specified in the specification data, be tested at the working pressure in the supply mains. All visible leaks shall be made good and any pipe, special, or fitting found to be defective shall be removed and replaced and such replacement material shall, after installation, be tested.

Annex N: Appendix A: Preparation of specification data associated with this specification for inclusion in the scope of work

Specification form an essential part of this specification; without such data, requirements are incomplete.

The format for the specification data has been developed to be compatible with the requirements of table D.1 of SANS 10403:2003. The specification data should be incorporated in the scope of work as illustrated in table A.1.

Table A.1 : Incorporating this specification in the scope of work

<table>
<tr><th>Topic</th><th>Aspect</th><th colspan="2">Text</th></tr>
<tr><td colspan="4">CONSTRUCTION</td></tr>
<tr><td>Works specifications</td><td>Particular/generic specifications</td><td colspan="2">The specification for below ground water installations for buildings as published in Appendix 4 of the National Department of Public Works Manual for the Development of Dolomite Land applies with the following specification data:</td></tr>
<tr><td></td><td></td><td>Clause</td><td>Specification data</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

Develop the specification data based on the contents of table A.2.

Table A.2 : Specification data associated with this specification

Specification data pertaining to this specification	Guidance Notes	
	Clause number	**Consideration**
Essential data		
The following types of pipes and associated fittings may be used:	4.1.11	State the type of pipes and fittings that are to be used and if alternatives are permitted. (If particular types of pipes are specified, they should be specified on the drawings. Where they are not shown on the drawings, the permitted types of pipes should be stated) The specifier should confirm with manufacturers that the pipes in the required diameter are available
The silicon range of pipes complying with the requirements of SANS 62-1 shall not exceed 0,040%;	4.1.2.1	Omit if default silicon range is acceptable
A certificate certifying compliance with the requirements of SANS 62-1 and SANS 62-2, as relevant, is required for each consignment of pipes and fittings.	4.1.2.3	Omit if not a requirement.
Fabricated flanged steel pipe work shall ...	4.1.2.4	State requirements for flanges if default requirements are not suitable (See Annex B of SANS 1476)
FC pipes shall... FC pipes shall be bitumen dipped in accordance with the provision of Annex B of SANS 1223	4.1.3	State requirements if default requirements are not suitable. (See Annex A of SANS 1223). State if pipes are to be bitumen dipped. (See Annex B of SANS 1223)
Glass fibre reinforced thermosetting plastics (GRP) pipes shall ...	4.1.4	State requirements if default requirements are not suitable.(See Annex A of SANS 1748-1)
Polyethylene (PE) pipes shall... PE pipes may be joined by butt fusion / electrofusion fittings / push fit fittings / heated tool socket weld	4.1.5.1	State requirements if default requirements are not suitable. (refer to SANS ISO 4427) State alternative means of jointing pipes together, if relevant.

Specification data pertaining to this specification	Guidance Notes	
	Clause number	**Consideration**
Essential data		
Steel mesh reinforced polyethylene (PE) pipes shall... Steel mesh reinforced polyethylene (PE) pipes shall only be joined by means of a flanged connection / electrofusion connection	4.1.5.2	State requirements if default requirements are not suitable. (refer to SANS 370) State which of the two methods is permitted.
Polypropylene (PP) pipes shall... PP pipes shall be jointed by butt fusion / heated tool socket weld	4.1.6	State requirements if default requirements are not suitable (refer to Appendix B of SANS 15874) State alternative means of jointing pipes together, if relevant.
PVC-U pipes and fittings shall...: Pipes shall not be joined by means of solvent weld joints	4.1.7.2	State requirements if default requirements are not suitable. (refer to Annex A of SANS 966-1) Omit if solventweld joints are permitted.
PVC-M pipes shall comply with the requirements of SANS 966-2 / SANS 1283	4.1.7.3	State which standard applies to MPV-C pipes. Omit if there are no preferences.
PVC-M pipes complying with SANS 9662 shall...	4.1.7.3	State requirements if default requirements are not suitable. (refer to Annex A of SANS 966-2)
PVC-M pipes complying with the requirements of SANS 1283 shall...	4.1.7.3	State requirements if default requirements are not suitable. (refer to Annex A of SANS 1283)
PVC-O pipes shall ...	4.1.7.4	State requirements if default requirements are not suitable. (refer to Annex A of SANS 1808-85)
Copper pipes shall ...	4.1.8	State requirements if default requirements are not suitable. (refer to Annex A of SANS 460)
Metallic compression type pipe couplings shall be ...	4.1.9	State requirements if default requirements are not suitable. (refer to Annex A of SANS 1808-2)
Diaphragm valves shall ...:	4.1.12.2	State requirements if default requirements are not suitable.
Float valves (equilibrium type) shall...	4.1.12.3	State requirements if default requirements are not suitable (refer to Annex A of SANS 1808-32)
Automatic control valves shall ...	4.1.12.4	State requirements if default requirements are not suitable (refer to Annex A of SANS 1808-31)
Cast steel gate valves shall ...	4.1.12.5	State requirements if default requirements are not suitable (refer to Annex A of SANS 191)
Cast iron gate valves shall ...	4.1.12.6	State requirements if default requirements are not suitable (refer to Annex A of SANS 664)
Copper alloy gate valves shall ...	4.1.12.7.	State requirements if default requirements are not suitable (refer to Annex A of SANS 776)
Inline strainers shall: a) have a working pressure rating of 1000/1200/1600/2500kPa b) have a filter element of an acceptable plastics material c) an aperture area of 30/90mm² d) have a head loss across the filter element of ... and a maximum flow rate of ...	4.1.14	State requirements for inlet strainers (refer to Annex A of SANS 1808-58)
Mechanical backflow-prevention devices shall: a) be a type 1 / 2 / 3 device b) a working pressure rating of 1000/1600kPa	4.1.15	State requirements for mechanical backflow-prevention devices (refer to Annex A of SANS 1808-15)

Specification data pertaining to this specification	Guidance Notes	
	Clause number	**Consideration**
Essential data		
Underground hydrant valves shall open anticlockwise. The inlet of the outlet connection of underground hydrant valve outlet connections shall be furnished with a fixed / valve The outlet of underground hydrant valve outlet connections shall be of the bayonet / vthread / round thread type.	4.1.16	State direction of opening if default direction (clockwise) is not required.
Portable standpipes shall have an inlet of the bayonet / screw type. The inlets of portable standpipes of the bayonet type shall have mating surfaces ... Screw type portable standpipes shall have a 2/5tpi Witworth thread. The portable standpipe outlet connection shall comprise one / two instantaneous connections Above ground hydrant valves shall open anticlockwise. Above ground hydrant valves shall have a) a flanged / threaded valve inlet b) upwards oblique / downwards oblique / right angle / straight through pattern valve outlet. c) an outlet furnished with an instantaneous connection integrally cast with the body / instantaneous coupling or connection screwed onto the body d) a gland with packing / "O" rings e) an operating device of the tamperproof key type having an open / shielded sheath / fixed wheel type / f) an outlet coupling and outlet adaptor comprising ... Blank caps shall be furnished for each outlet		State requirements if default provisions are not suitable. State direction of opening if default direction (clockwise) is not required. State requirements if a 65mm instantaneous outlet connection is not suitable (refer to Appendix B of SANS 1128-1)
Masonry units shall have the following attributes:....	4.1.17.1	Omit if default attributes are suitable or state what attributes should be.
Precast cylinders shall be of ...	4.1.17.2	If precast cylinders are to be of a specific material, indicate this
State the grade of concrete	4.1.17.3	Omit if default grade is suitable or state what grade should be.
Manhole covers and frames shall ...	4.1.17.5 4.1.17.6	Omit if default requirements are suitable or state what requirements should be.
Surface boxes, valve chambers and covers and frames shall be ...colour-pigmented	4.1.17.6 4.1.17.7	State colour pigment (see Annex A of SANS 1882)

Specification data pertaining to this specification	Guidance Notes	
	Clause number	**Consideration**
Essential data		
Surface boxes shall be cast iron / polymer concrete	4.1.17.7	Omit if alternatives are permitted or requirements are established on construction drawings.
Polymer concrete valve chambers and fire hydrant boxes shall be heavy duty / medium duty class The additional marking information is required...	4.1.17.7	State duty class if default duty class are not appropriate. State requirements for special lettering or other markings.
Meters shall ...	4.1.18.2	Specify requirements for meters.
Markings and marker posts shall ...	4.1.19	State requirements for markings and marker posts.
Pipes shall have a minimum top cover of ...mm.	4.3.2.7	State minimum cover if default value is not suitable.
Pipes may be hot bent on site.	4.3.3.8	Omit if not permitted.
Welders shall be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate.	4.4.3.1.4 4.4.3.2.5 4.4.3.3.2	Omit where not a requirement
Screw threads may not be cut on polyethylene pipes	4.4.3.5.1	Omit if screw cut threads are permitted in terms of the default provision or state which types of PE pipes may be threaded
The concrete used in the casing of pipes shall be grade ...	4.5.1	Omit if default grade of 15 is acceptable or state grade.
The concrete used in anchor or thrust blocks shall be grade ...	4.5.3	Omit if default grade of 15 is acceptable or state grade.
The provisions of 4.7.1 shall apply	4.7.1	Omit if printed notices are not to be provided.
The recording of location is required. The recording of ... is also required.	4.7.2.2.7	Omit if not a requirement State additional requirements e.g. coordinates
The recording of meter locations is required. The ... shall also be recorded.	4.8.5	Omit if not a requirement.
The water installation shall be tested in accordance with the requirements of SANS 1200-L (SANS 2001-DP2).	5.3.2	Omit if the default test provisions are suitable.
Variations:		
		State variations, if any
Additional clauses:		
		State additional clauses, if any

Annex O: Specification for Sewers for Buildings - Dolomite Area Designation D1

O.1. Scope

This specification provides minimum requirements regarding areas with a Dolomite Area Designation of D1 as well as the requirements to make emergency repairs and maintain existing infrastructure until such time that upgrading or replacements to the requirements of PW344/2016 can be executed in areas with a Dolomite Area Designation of D2, D3 and D4.

This specification covers in relation to a building, the construction of:

a) surface mounted sewers having a nominal diameter of 200mm or less; and

b) below ground sewers having a nominal diameter of 160mm or less including manholes and the like which discharge into a connecting sewer, conservancy tank, french drain or septic tank in areas with a Dolomite Area Designation of D1 as well as the requirements to make repairs and maintain existing infrastructure until such time that upgradings or replacements to the requirements of PW344/2016 can be executed.

This specification does not cover the construction of municipal sewers and is not necessarily suitable for the construction of the sewers in large interconnected complexes.

NOTE 1 SANS 1200-LD (SANS 2001-DP4), *Sewers,* covers the construction of sewer systems within servitudes, road reserves and interconnected complexes and is suitable for the construction of below ground sewers having a diameter greater than 160mm.

NOTE 2 This specification is suitable for constructing sewers designed in accordance with the design rules provided in SANS 10400P, *Drainage*.

O.2. Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard: All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below.

a) EN 13101, *Steps for underground main entry chambers;*

b) BS 1247, *Manhole step irons;*

c) SANS 227, *Burnt clay masonry units;*

d) SANS 558, *Cast iron surface boxes and manhole and inspection covers and frames;*

e) SANS 559, *Vitrified clay sewer pipes and fittings;*

f) SANS 677, *Concrete nonpressure pipes;*

g) SANS 746, *Castiron pipe and pipe fittings for use above ground in drainage installations;*

h) SANS 791, *Unplasticized polyvinyl chloride (uPVC) sewer and drain pipes and pipe fittings;*

i) SANS 819, *Fibrecement pipes coupling sand fittings for sewerage, drainage and low pressure irrigation;*

j) SANS 921, *Pitch impregnated fibre pipes and couplings;*

k) SANS 967, *Unplasticized poly(vinyl chloride)(PVC-U) soil, waste and vent pipes and pipe fittings;*

l) SANS 974-1, Rubber joint rings (noncellular) *Part I : Joint rings for use in gas, water, sewer, and drainage systems;*

m) SANS 1294, Precast concrete manhole sections and slabs;

n) SANS 1601, *Structured wall pipes and fittings of unplasticized poly (vinyl) chloride (PVC-U) for buried drainage and sewerage systems;*

o) SANS 1748-1, *Glass fibre reinforced thermosetting plastics (GRP) pipes Part 1:Pipes for water supply , sewerage and drainage;*

p) SANS 1882, *Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames;*

q) SANS 1200, *Civil Engineering Construction – Part G: Concrete (Structural).* (SANS 2001CC1, *Construction works – Part CC1: Concrete works (Structural).);*

r) SANS 1200, *Civil Engineering Construction – Part GA: Concrete (small works).* (SANS 2001CC2, *Construction works – Part CC2: Concrete works (minor works).);*

s) SANS 2001CM1, *Masonry walling;*

t) SANS 1200, *Civil Engineering Construction – Part LD: Sewers. (*SANS 2001DP4, *Construction works – Part DP4: Sewers.);*

u) SANS 2001EM1, *Cement plaster;*

v) SANS 10403, *Formatting and compilation of construction procurement documents;*

w) SANS 50295/EN 2951, *Vitrified clay pipes and fittings and pipe joints for drains and sewers;*

x) SANS 50598/EN 598, *Ductile iron pipes, fittings, accessories and their joints for sewerage application - Requirements and test methods;*

y) SANS 8773/ISO 8773, Plastics piping systems for non-pressure underground drainage and sewerage - *Polypropylene (PP).*

O.3. Definitions

For the purposes of this standard the definitions given in SANS 10403 and the following definitions apply:

Agrément certificate: a certificate confirming fitness for purpose of a non standardised product, material or component and/or the acceptability of the related non standardised design and the conditions pertaining thereto issued by the Board of Agrément of South Africa

backfill: material placed and compacted on top of the bedding material to reinstate the excavated trench to the original level

bedding: the operation of placing and compacting bedding material around or over the pipe or prefabricated culvert in the manner specified

Board of Agrément of South Africa: a body operating under the delegation of authority of the Minister of Public Works

connecting sewer: a pipe vested in the local authority which connects a sewer form a building

to a sewer owned by a local authority

ductile iron: cast iron used for pipes, fittings and accessories in which graphite is present in substantially spheroid form

flexible pipe: a pipe which is not a rigid pipe

manhole: a chamber of a depth greater than 750mm and of such dimension that allows entry of a person into such chamber for the purpose of providing access to a sewer

permissible deviations: the specified limit(s) of deviation within which a size or position must lie

pipe: straight cylinder of uniform diameter and uniform wall thickness throughout the length, through one end may have a socket

pipe fitting: component used to so connect pipes as to form a sewer

polymer concrete: reinforced plastic mortar mixture of synthetic thermosetting resin (polymer, polyester or vinyl ester or epoxy and others), aggregates (commonly graded silica sand and stone, or both of the same size and shape or different sizes and shapes), glass fibre strands or fibres, polypropylene fibres and a reactive catalyst

rigid pipes: cast iron, ductile iron, fibre cement and vitrified clay and concrete pipes

rodding eye: an access opening in a sewer provided for the purposes of gaining full-bore access to the interior of a sewer for internal cleaning, and which remains permanently accessible after completion of the installation, but does not include an inspection chamber or manhole

specification data: data, provisions and variations that make this specification applicable to a particular contract or works (refer to Appendix A)

suitable: capable of fulfilling or having fulfilled the intended function or fit for its intended purpose

structured wall: the wall of a product made of PVC-U, the design of which has been optimized with regard to maximum stiffness of the product, relative to material usage

unplasticized poly(vinyl chloride) (PVC-U): a material based on a homopolymer of vinyl chloride or on a copolymer of vinyl chloride such that the principal ingredient is vinyl chloride

O.4. Requirements

O.4.1. Materials

O.4.1.1. Earthworks Materials

O.4.1.1.1. Backfill Material

Backfill material shall:

a) Comply with the requirements as per Chapter 4;

b) contain no organic material (material produced by animal or plant activities);

c) exclude gravel and rock fragments of maximum dimension larger than 53mm;

d) not contain more than 10% of gravel or material fragments retained on a sieve of nominal 53mm aperture size;

e) not contain large clay lumps that do not break down under the action of compaction.

O.4.1.1.2. Bedding material

Bedding material shall:

a) Comply with the requirements as per Chapter 4

b) not be a predominantly clayey material PI<12%;

c) contain no organic material (material produced by animal or plant activities);

d) not contain any material retained on a sieve of nominal 5,6mm aperture size;

e) not contain large clay lumps that do not break down under the action of compaction.

O.4.1.2. Pipes and fittings

O.4.1.2.1. General

Pipes and fittings shall be of the diameter specified in the scope of work or determined from the requirements of SANS 10400P.

Pipes and fittings shall either comply with the requirements of O.4.1.2 or be the subject of an Agrément Certificate.

NOTE: SANS 10400P requires that the joints between pipes and pipes and fittings

a) be appropriate to the materials of which such pipes and fittings are made;
b) remain watertight when air tested or where there may be any differential movement between such pipes and any building or ground or other construction forming part of the drainage installation; and
c) be able to withstand an internal water pressure of 50kPa and an external water pressure of 30kPa without leaking.

Pipes shall be handled and stored in accordance with the manufacturer's instructions

Solvent cements, lubricants and solvent cleaners shall comply with the recommendations of the pipe or fitting manufacturer.

Pipes and fittings shall be stored and handled in accordance with the recommendations of the pipe or fitting manufacturer.

O.4.1.2.2. Cast iron pipes

Above ground cast iron pipes shall unless otherwise specified in the specification data, comply with the requirements of SANS 746 for a type A, B or C pipe.

O.4.1.2.3. Ductile iron pipes

Above and below ground ductile iron pipes, fittings, accessories and their joints shall comply with the requirements of SANS 50598 EN 598. Unless otherwise specified in the specification data, pipes shall be supplied with flanged joints and grey in colour,

O.4.1.2.4. Fibre cement pipes

Below ground fibre cement pipes, couplings and fittings shall comply with the requirements of SANS 819 and unless otherwise specified in the scope of work, be a series 4 pipe.

Fibre cement pipes shall be bitumen dipped in accordance with the provisions of Annex D of SANS 819 where so required in terms of the scope of work.

O.4.1.2.5. Unplasticized poly(vinyl chloride) (PVC-U) pipes

Below ground PVC-U pipes and fittings shall comply with the relevant requirements of SANS 791 and unless otherwise specified in the scope of work, be a normal duty pipe with one end plain and the other one socketed, the plain end chamfered, and an integral socket of the rubber ring type.

Above ground pipes and fittings shall comply with the relevant requirements of SANS 967 and unless otherwise specified in the scope of work have plain ends,

O.4.1.2.6. Structured wall unplasticized poly(vinyl chloride)(PVC-U) pipes and fittings

Structured wall PVC-U pipes and fittings shall comply with the relevant requirements of SANS 1601, and unless otherwise specified in the scope of work be a type 1 pipe with a stiffness class of 100 or higher one end plain and the other one socketed, and the plain end chamfered.

O.4.1.2.7. Polypropylene (PP) pipes and fittings

Polypropylene (PP) pipes and fittings shall comply with the requirements of SANS 8773 ISO 8773. The pipe series shall, unless otherwise specified in the scope of work be a pipe series S20 and joined together with elastomeric sealing ring socket joints.

O.4.1.2.8. Glass fibre reinforced thermosetting plastics (GRP) pipes and jointing systems

Glass fibre reinforced thermosetting plastics (GRP) pipes and jointing systems shall comply with the requirements of SANS 17481 and have a pressure class of 2 or higher and a pipe stiffness of 630 or higher.

O.4.1.2.9. Pitch impregnated fibre pipes and fittings

Pitch impregnated fibre pipes and fittings shall comply with the requirement of SANS 921 for a solid wall pipe and unless otherwise specified in the scope of work, be a class 3 or higher pipe with the pipes and couplings being tapered.

Couplings shall be made from a suitable polypropylene or polyethylene material.

O.4.1.2.10. Vitrified clay pipes and fittings

Vitrified clay pipes and fittings shall comply with the requirements of either SANS 50295 EN 2951 or SANS 559 and unless otherwise specified in the scope of work be a class 1 pipe and be supplied without sockets.

O.4.1.2.11. Reinforced concrete pipes and fittings

Concrete pipes shall comply with the requirements of SANS 677 for an SI pipe, have the properties stated in the scope of work and be supplied with suitable joints.

Where specified in the specification data that such joints are to be flexible joints, such joints shall be capable of permitting a relative displacement between pipes of 0,04mm/m of the pipe diameter in a plane normal to the axis of the pipe when subjected to an internal water pressure of 60kPa for 5 minutes without leaking.

O.4.2. Above ground installations

Pipes and pipe fittings shall have the nominal diameter stated in the scope of work. Pipes and pipes fittings shall not be dropped or thrown onto the ground. Solvent cemented pipes shall be provided with rubber ring joints at intervals not exceeding 3m to provide for expansion.

Ducts shall be cleaned of rubble and combustible material before pipes are installed.

Suitable holderbats recommended by a pipe manufacturer and supplied from the same

supplier shall be used to support pipes and fittings. These supports shall be fixed to a surface corresponding to those that are to be occupied by fittings and pipe end sockets. Additional pipe supports shall be fixed at a surface to support long lengths of pipe at centres not exceeding:

a) vertical pipe runs: 2m;
b) horizontal pipe runs: 1,2m.

Pipe supports for vertical pipe runs shall be positioned by means of a plumb line. All pipes, fittings and supports shall be accurately aligned before the supports are fully tightened.

NOTE: The requirement for using pipe supports being supplied by the same supplier ensures that the supports are the same and give a visually acceptable appearance.

All bends, and sets shall be achieved by means of fittings.

O.4.3. Below ground installations

O.4.3.1. Excavation for sewers

Trenches shall, as far as is practicable, not be excavated parallel to buildings within 1,5m of a building and shall not extend below a line drawn at 45° to the horizontal, as measured from the bottom edge of the foundation (refer to Figure 1) unless suitable precautions are taken to ensure the stability of the adjacent foundations.

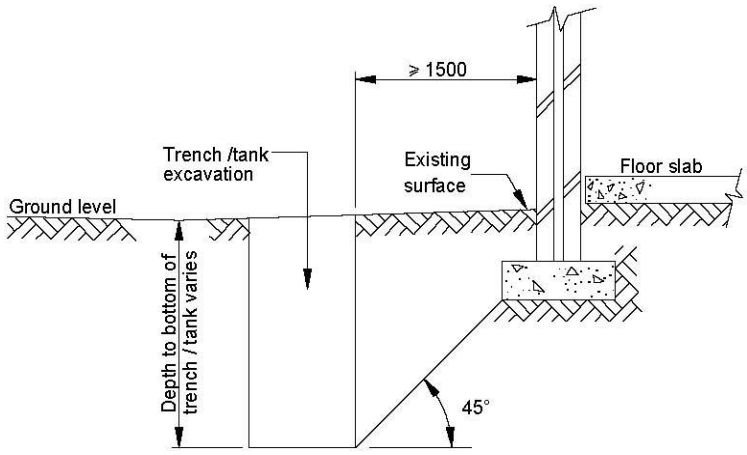


Figure 1 : Typical trench setting out details

Where a sewer is to be laid underground horizontally next to a water pipe, it should be at least 500mm away from the water pipe. If the sewer pipe crosses another pipe, it shall be laid at least 100mm below it. No sewer pipe shall be installed within 100mm of any other service pipe or cable.

The sides and trenches shall be vertical for at least the height of the bedding. For trenches deeper than 1,5m, the sides shall be flattened or supported to maintain safe working conditions in the trench.

Trench depths shall be such that not less than 100 mm and not more than 200mm of bedding material may be placed below pipes, except in cases where rigid pipes are placed directly on the trench bottom (refer to Figure 2).

Where rigid pipes are to be laid directly on the trench floor, the fjloor shall be hand-trimmed to ensure that each pipe will be fully supported throughout the length of its barrel. Joint holes shall be formed in the trench floor for pipe sockets and couplings.

The trimming and grading of the trench floor shall be such that the barrel of each length of pipe can be uniformly supported on the bedding over its full length at the correct grades and levels. Except where the trench is in rock, hard objects and boulders that may adversely affect the

uniformity of the foundation shall be removed to a depth of 100mm below the trench floor.

Where the trench floor has been disturbed or over excavated, it shall be backfilled with bedding material to the correct level and compacted to the specified compaction standard prior to the placing of bedding and pipe laying.

Soft spots in the trench floor shall be removed and backfilled and compacted with a bedding material.

Trenches shall not be less than 450mm wide.

The trench floor shall be sufficiently straight to enable pipes to be laid without significant reduction in trench side space.

Trenches shall be kept sufficiently dry to allow proper and safe bedding, laying, and jointing of pipes and kept dry until the pipeline has passed the required tests and construction of the selected fill blanket over the pipes has been completed.

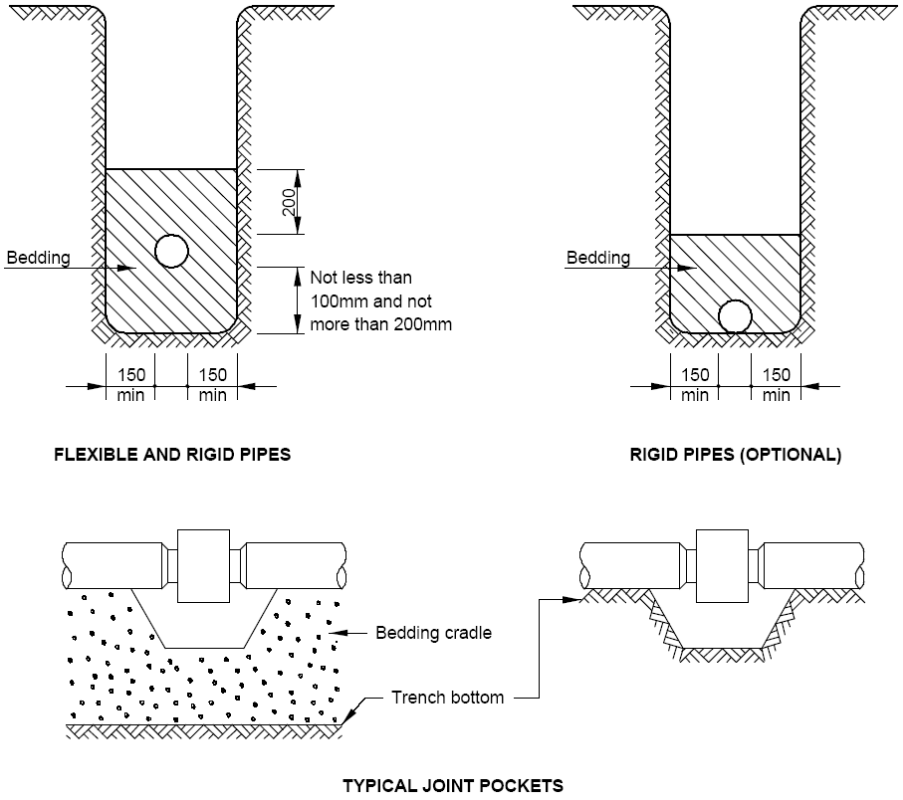


Figure 2 : Pipe bedding details

O.4.3.2. Pipe bedding and backfilling

Backfilling and bedding shall be placed in layers not exceeding 100 mm. Each layer shall be compacted to the specified compaction standard before additional fill material is added.

Rigid pipes shall either be bedded in accordance with the provisions of O.4.3.3 or be bedded directly on a trench floor prepared in accordance with O.4.3.1 as shown in Figure 2.

Pipes, which are not laid directly on the trench floor, shall be bedded on a continuous bed of bedding material (refer to Figure 3) and protected so that the bedding extends from between 100mm to 200mm beneath the pipe bottom to 200mm above the pipe and not less than 150mm

on each side of the pipes. (refer to Figure 2).

The joint holes beneath rigid pipes which are laid directly on the trench floor shall be refilled with fine granular material and lightly compacted to prevent the migration of adjacent pipe bedding material into the holes.

When placing bedding, all voids under the pipes shall be filled. Compaction shall be carried out simultaneously and uniformly on both sides of the pipe so as not to cause any lateral or vertical displacement of the pipe. Bedding shall be carried out as pipe laying proceeds and shall be completed before any acceptance test is carried out.

Under no circumstances must sewers be laid on supporting masonry units or other hard materials as deflection of the pipes or pipe damage may occur.

Backfill shall be placed and compacted once the pipe has been laid and firmly bedded in accordance with the requirements.

Pipes shall have minimum top cover of 300mm. Where such a cover cannot be provided, a concrete slab in accordance with the details of Figure 4 shall be cast or installed above such pipes.

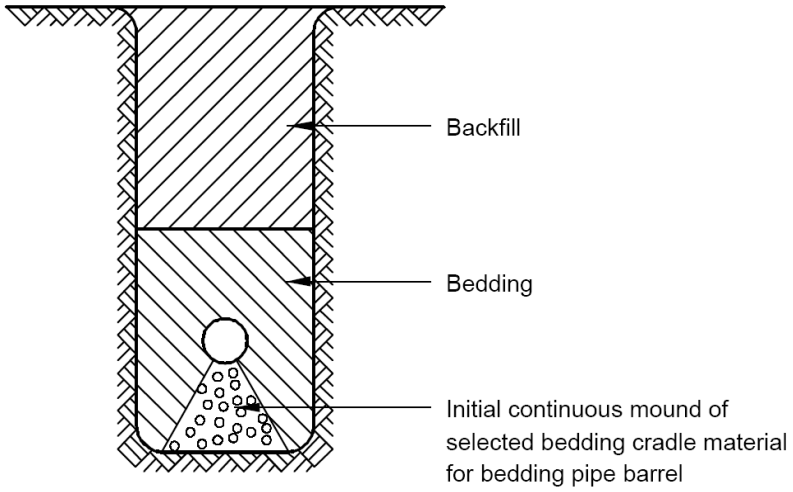


Figure 3 - Pipe supported on bedding

O.4.3.3. Laying of pipes in trenches

Pipes and pipe fittings shall have the nominal diameter stated in the scope of work. Pipes and pipe fittings shall not be dropped or thrown onto the ground. Pipes that are the subject of an Agrément certificate shall be installed in accordance with the provisions of that certificate

Solvent cemented pipes shall be provided with rubber ring joints at intervals not exceeding 9m to provide for expansion and contraction.

All solvent cement joints shall be made in a dry area outside the trench. Rubber ring jointing may be carried out in the trench.

Pipes shall be laid to in a straight line between points of change in gradient, either true to designated line and level or to a minimum gradient specified in the scope of work

The method of laying shall be such that the barrels of the pipes bear evenly over their full lengths; no packing is used under the barrels; and no sockets or couplings bear on the bedding. Each pipe and fitting shall be thoroughly cleaned out and carefully examined for damage

immediately before laying. Agrément certified pipes shall be laid within the scope, conditions and limitations prescribed in the certificate.

All pipeline openings shall be sealed to ensure that no water, stones or other foreign matter can enter the system during or after laying.

Rodding eyes shall, unless otherwise specified in the scope of work, be provided:

a) where there is a change in direction exceeding 45º, provided that where any bend with a radius of not less than 600mm is installed, such rodding eye may be omitted for not more than two such direction changes of up to 90º between any two rodding eyes;

b) at any point within 1,5m of the connection of the sewer to a connecting sewer, septic tank or conservancy tank, provided that an inspection eye shall be installed immediately downstream of such point;

c) at the highest point of the sewer;

d) at such intervals along the sewer that no rodding distance exceeds 25m measured, along the line of such sewer from a rodding eye or other permanent means of access to such sewer.

Grade 15 concrete anchor blocks shall be provided in accordance with the provisions of SANS 1200-G (SANS 2001-CC1) or SANS 1200-GA (SANS 2001-CC2) and Figure 5 where the pipe gradient exceeds 1 in 10.

Steep drops in sewers shall as far as is practicable be avoided. Where unavoidable, the connection between two sections of sewers at different levels shall be executed in accordance with the details shown on Figure 5.

O.4.3.4. Protection of below ground pipework

Where rigid pipes pass underneath buildings, they shall be encased in concrete with the casing at least the width of the diameter of the pipe. Movement joints shall be provided at each pipe joint or at not more than 5m intervals in accordance with the details in Figure 4.

Flexible pipes should not be encased in concrete but be protected from overload by means of a concrete slab laid over the pipe in accordance with Figure 5.

Anchor blocks shall be provided where pipes have gradients steeper than 1:10 and at steep drops in accordance with Figure 6. Where pipes pass through structural walls they must be protected by lintels or arches and, in order to accommodate movement, shall (refer to Figure 7):

a) have a 50mm clearance all around or be sleeved;

b) be built in;

c) be connected on both sides of the wall to pipes with flexible joints, made in accordance with the pipe manufacturer’s recommendations and positioned not more than 150mm from the face of the wall.

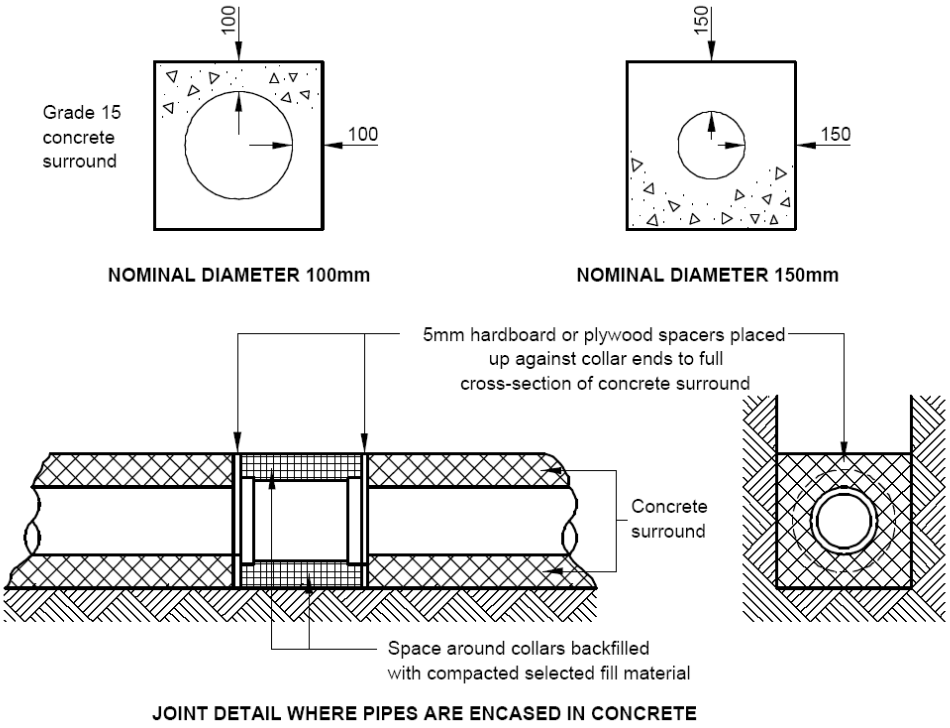
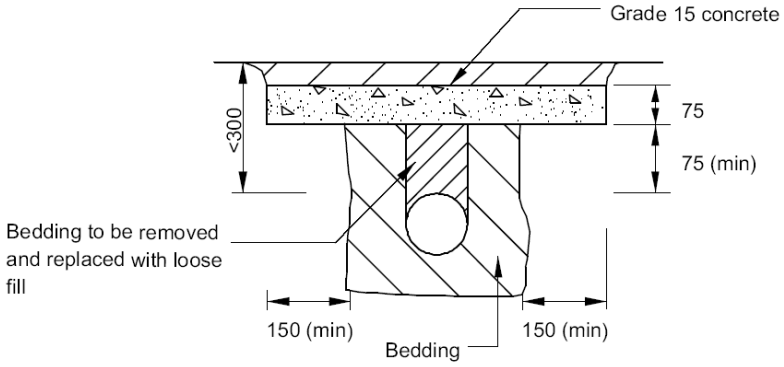
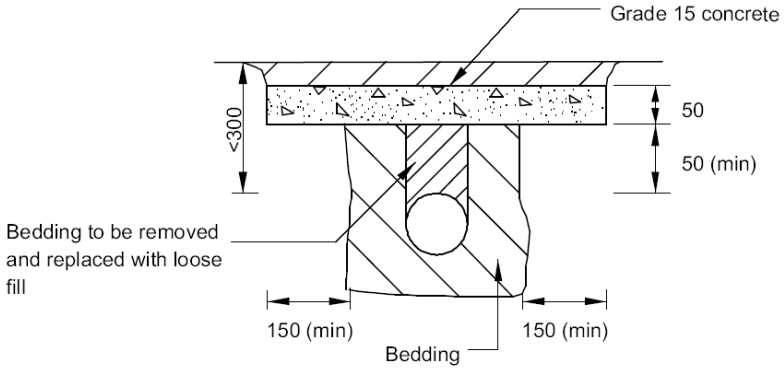


Figure 4 : Concrete encasing of rigid pipes

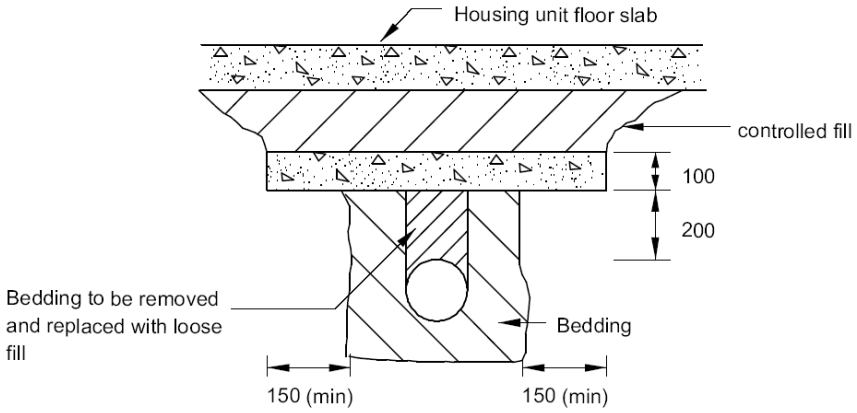
Dimensions in millimetres



VEHICLE TRAFFIC OVER
(Cover to top of drain less than 300 mm)



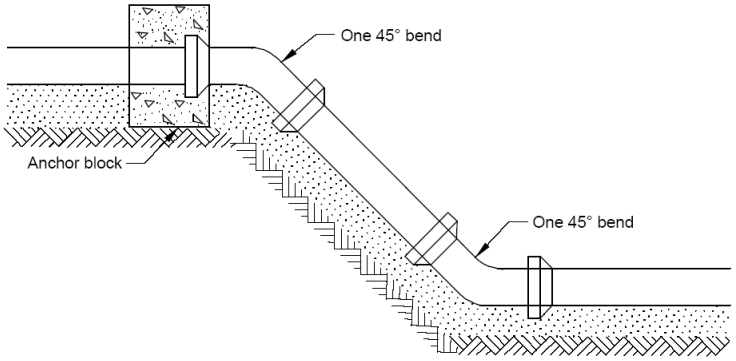
PEDESTRIAN TRAFFIC OVER
(Cover to top of drain less than 300 mm)



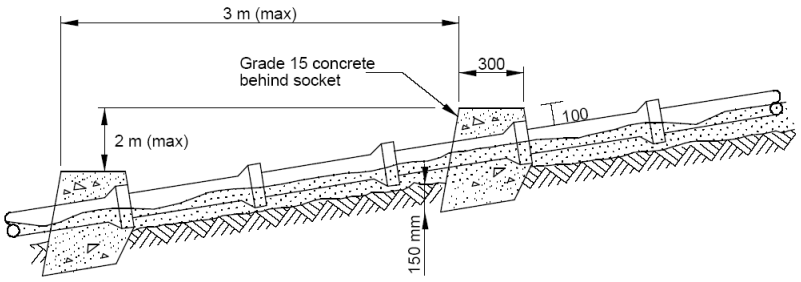
drawing 11037h

FLEXIBLE PIPE CONSTRUCTED BENEATH HOUSING UNITS

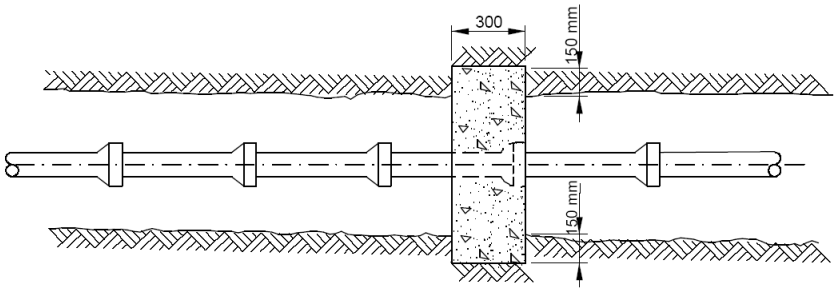
Figure 5 - Concrete slabs over drains



STEEP DROPS IN DRAINS



SPACING OF ANCHOR BLOCKS



PLAN

Figure 6 : Anchor blocks on slopes steeper than 1:10 and at steep drops in sewers

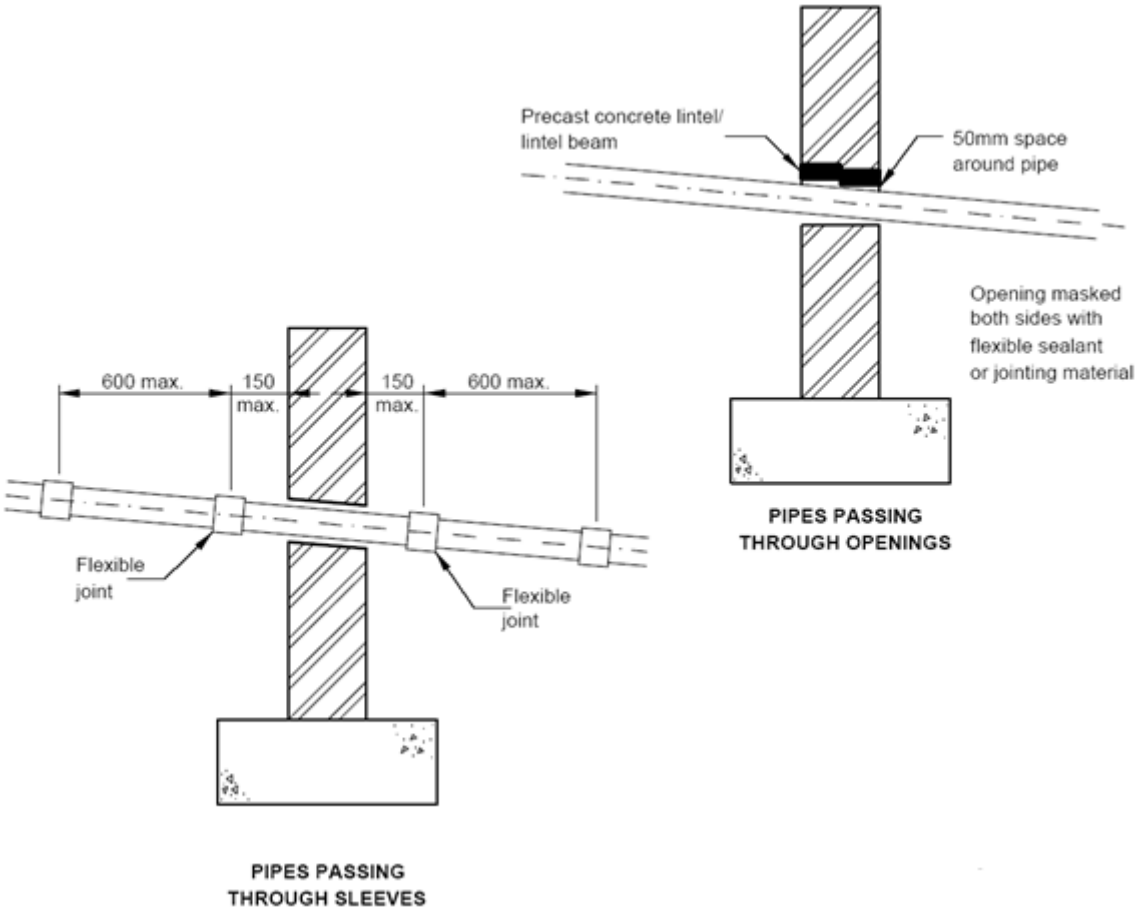


Figure 7: Pipes passing through walls

O.4.4. Joining of pipes and fittings

Pipes shall be cut with suitable tools so as to obtain neat, square ends. The outer edge of such cuts shall be evenly chamfered and shall be free from swarf, burrs, channels and loose material. Allowance shall be made for movement of at least 6mm in any rubber ring socket into which a pipe is to be inserted.

All pipes and fittings shall be joined together strictly in accordance with the manufacturer's instructions or, if applicable, the requirements of an Agrément certificate in such a manner that the continuity of bore is maintained and the flow in the interior of the sewer is not obstructed.

Solvent cements, lubricants and solvent cleaners shall be used in accordance with the manufacturer's instructions. Solvent cleaners shall not be used as adhesive thinners.

The surfaces of all areas to be bonded by means of solvent cement shall be dry and shall be cleaned with a solvent cleaner, a fresh piece of absorbent material being used to clean each joint. The joint shall be made while the cement is still wet by pushing the prepared parts squarely together (without twisting or tilting). Excess solvent shall be wiped off and the components of the joint held together firmly until the solvent cement has set. The joint shall not be moved for a period of 30 minutes and shall not be stressed for at least 24 hours.

All sockets and spigots shall be cleaned with a clean, dry cloth, immediately before the application of a thin film of lubricant to each rubber ring and socket. The joint shall then be made by pushing the spigot squarely into the socket until it bottoms. Care shall be taken to not displace the rubber ring. The spigot shall thereafter be withdrawn approximately 6 mm to allow

for longitudinal movement.

Suitable adaptors and joints shall be provided where types of different materials are joined to each other.

Pipes shall be connected to toilet pans by means of a suitable moulded fitting incorporating a rubber sealing ring manufactured specifically for this purpose.

The welding of polyethylene and unplasticized poly(vinyl chloride) pipes, the thermo fusion of polypropylene pipes and the hot welding of unplasticized poly(vinyl chloride) shall be in accordance with the requirements of SANS 1200-LD (SANS 2001-DP4) and all other relevant SANS standards.

O.4.5. Manholes and Chambers

The materials for and construction of manholes and chambers shall be in accordance with the relevant provisions of SANS 1200-LD (SANS 2001DP4).

O.5. Compliance with requirements

O.5.1. Tolerances

The permissible maximum deviation in plan of the centre line of the sewer from the designated location shall be 300mm. This location will be treated as the control point for the purpose of locating intersections whether for manholes or inspection chambers. Such manholes or chambers shall be constructed at the meeting points of intersecting pipelines subject only to such deviation as can be tolerated by the junction channels or specials.

The permissible deviation in location along the centre line for manholes and chambers not situated at control points shall be plus or minus half a pipe length.

The permissible maximum deviation from the designated level of the invert at each manhole shall be 50mm but, should the fall between any two successive manholes be less than 90% of that specified, the said permissible deviation shall be reduced to a value such that the fall is at least 90% of the specified fall.

Subject to the permitted manufacturing tolerances applicable to the pipes being laid, the following shall be applicable:

a) the line of the pipe invert shall at no place between control points at successive manholes:

   i. deviate from a straight line between the said control points by more than 5% of the nominal diameter of the pipe;

   ii. be lower than at any other place closer to the lower manhole.

b) there shall be no steps at the junctions between successive pipes, except where pipes of different diameters are joined together.

O.5.2. Materials testing

Materials for pipes shall be tested in accordance with the relevant requirements of the standards applicable to such materials.

O.5.3. Air test

After bedding and backfilling operations have been completed, all traps shall be filled with

water and the outlets of ventilating pipes shall be plugged. Air shall be pumped into such underground sewers under a gauge pressure of not less than 0,35kPa. Sewers shall be deemed to be acceptable if the pressure after 3 minutes is not less than a gauge pressure of 0,25kPa.

Annex O: Appendix A: Preparation of specification data associated with this specification for inclusion in the scope of work

Specification data form an essential part of this specification, without such data, requirements are incomplete.

The format for the specification data has been developed to be compatible with the requirements in Table D.1 of SANS 10403:2003. The specification data should be incorporated in the scope of work as illustrated in Table A.1.

Table A.1 : Incorporating this specification in the scope of work

<table>
<tr><th>Topic</th><th>Aspect</th><th colspan="2">Text</th></tr>
<tr><td colspan="4">CONSTRUCTION</td></tr>
<tr><td rowspan="3">Works specifications</td><td rowspan="3">Particular/generic specifications</td><td colspan="2">The specification for the Sewers for Buildings as published in Annex O of the National Department of Public Works Manual for the Development of Dolomite Land (PW344/2016) applies with the following specification data:</td></tr>
<tr><td>Clause</td><td>Specification data</td></tr>
<tr><td></td><td></td></tr>
</table>

Develop the specification data based on the contents of Table A.2.

Table A.2 : Specification data associated with this part of SABS 1200 (SANS 2001)

Specification data pertaining to this specification	Guidance notes	
	Clause number	Consideration
Essential Data		
Sewers shall be constructed using the following types of pipes: ... or Sewers shall be constructed only using .... pipes.	4.1.3	State the types of pipes that may be used. The specifier should confirm with manufacturers that the pipes are available in the required diameter
Above ground cast iron pipes shall: a) be type A / B / C; b) have a nominal length of 3,0 / 2,0 / 1,75 m; c) not be coated.	4.1.4	State specific requirements if default requirements are not suitable or omit. (Refer to Appendix B of SANS 746)
Ductile iron pipes shall be supplied: a) with flexible / flanged joints. b) in ... m lengths. c) with a zinc rich paint coating with finishing layer / thicker metallic zinc coating with finishing layer / polyethylene sleeving (as a supplement to the zinc coating with finishing layer) / polyethylene / polypropylene / polyurethane / epoxy resin / fibre cement mortar /adhesive tapes external coating;	4.1.5	State specific requirements if default requirements are not suitable or omit. (Refer to SANS 50598 EN 598)

Specification data pertaining to this specification	Guidance notes	
	Clause number	Consideration
d) with polyurethane / polyethylene / epoxy resin / bituminous paint / thicker cement mortar lining / cement mortar lining with seal coat internal coat; e) red / brown / grey colour. The coatings for fittings and accessories shall be as follows: a) external: zinc coating with finishing layer / polyethylene sleeving (as a supplement to the bituminous paint or to the zinc coating with finishing layer) /polymeric /adhesive tapes. b) internal: polyethylene / polyurethane / polymeric / thicker cement mortar lining / cement mortar lining with seal coat.		
Fibre cement (FC) pipes shall: a) be series LPI; b) have a length of 4m / 5m / 6m / ..m; The following optional tests shall apply: a) straightness of pipe b) permeability of pipe c) crushing strength of fittings d) unit flexural strength of pipes e) acid resistance	4.1.6	State specific requirements if default requirements are not suitable or omit. (Refer to Annex B of SANS 819).
FC pipes shall be bitumen dipped	4.1.6	State if pipes are to be bitumen dipped.
PVC-U below ground pipes shall: a) be of the heavy duty type; b) have plain ends c) have the plain ends chamfered d) have an injection moulded solvent – cemented socket e) have sockets of the solvent cement type PVC-U fittings shall be of the solvent cement type	4.1.7	State specific requirements if default requirements are not suitable or omit. (Refer to Annex A of SANS 791).
PVC-U above ground pipes shall: a) have chamfered plain ends b) have sockets of the rubber ring type / solvent cement type c) have a length of ...m	4.1.7	State specific requirements if default requirements are not suitable or omit. (Refer to Annex B of SANS 967).
Structured wall PVC-U pipes shall: a) be of a stiffness class 200 / 400; b) be a type 2 pipe c) supplied in ... m lengths d) plain ends / one plain and one socketed end / one socketed and one spigoted e) chamfered plain ends PVC-U fittings shall be of the solvent cement type	4.1.8	State specific requirements if default requirements are not suitable or omit. (Refer to Annex A of SANS 1601).
Polypropylene (PP) shall: a) be a pipe series S16 / S14 / S12,5 / S10; b) be supplied in . m lengths;	4.1.9	State specific requirements if default requirements are not suitable or omit. (Refer to SANS 8773 ISO 8773).

Specification data pertaining to this specification	Guidance notes	
	Clause number	Consideration
PP pipes shall be joined together by means of buttwelded joints / flanged joints / mechanical / socket fusion / ring seal compression / electrowelded sockets.		
Glass fibre reinforced thermosetting plastics (GRP) pipes shall: a) have a nominal pressure (PN) class of 5 / 6 / 8 / 10 / 12,5 / 16 / 20 / 25 / 32 / 40. b) have pipe stiffness (SN) class of 1 250 / 2 500 / 5 000. c) be supplied in 3 / 6 / 9 / 12 / 18 m lengths The following optional test shall apply: a) the beam strength is to be determined; b) the additional 48 hour test for hydraulic leaks Unrestrained joints shall comprise a coupling or bell and spigot gasket joint / mechanical coupling with an elastomeric seal. Restrained joints shall comprise a coupling or bell and spigot gasket joint / butt joint with laminated overlay /a bell and spigot joint with laminated overlay / a bell and spigot joint, that is adhesive bonded / a flanged joint, integral or loose ring. The tolerance on the planarity of the flange faces in flanged joints shall be ... The elastomeric gaskets shall comply with the requirements of ASTM F 477 / SANS 974-1 The additional marking shall be ...	4.1.10	State specific requirements if default requirements are not suitable or omit. (Refer to Annex A of SANS 1748-1).
Pitch impregnated fibre pipes shall: a) be class 1 / 2 pipe; and b) not have tapered ends	4.11	State requirements, if any, for the material of couplings and fittings, whether the ends are to be tapered and the lengths of pipes. (Refer to Annex A of SANS 921)
Vitrified clay pipes shall comply with the requirements of SANS 559 / SANS 50295 EN 295	4.1.12	State which of the two standards applies.
Vitrified clay pipes complying with SANS 559 shall: a) be supplied with / without sockets b) be a class 1 / 2 pipe c) have a nominal length of ... M	4.1.12	State requirements if not stated on the drawings (Refer to Annex A of SANS 559)
Vitrified clay pipes complying with SANS EN 295 shall: a) have a crushing strength (FN) of 22 /28 / 34 kN/m where the pipe diameter does not exceed 150mm b) be a class L / 95 / 120 / 160 / 200 pipe where the diameter equals or exceeds 200mm	4.1.12	State pipe crushing strength if 150mm diameter or less and class of pipe if 200mm diameter or greater, if not stated on the drawings. State preferred length of pipe and joint type. (Refer to Appendix A of SANS 559)f

Specification data pertaining to this specification	Guidance notes	
	Clause number	**Consideration**
c) be supplied in ... m lengths; The pipes shall have a spigot on one end and a socket on the other and shall be supplied with rubber sealing elements / polyurethane sealing elements The pipes shall be plain ended and joined by means of polypropylene sleeve couplings		
Concrete pipes shall: a) be reinforced / unreinforced b) be provided with spigot and sockets with rolling rubber rings / spigot and socket with sliding rubber ring / in the-wall with rolling rubber rings / in the-wall with sliding rubber ring/ ogee / butt joints c) be provided with an effective length of m d) a nonstandard cover of mm; e) a D-load designation of 25D/ 50D/ 75D / 100D f) have a low content of material insoluble in hydrochloric acid g) be made using dolomitic aggregate / sulphate resisting cement … i) have a . mm sacrificial layer	4.13	Omit if default requirements are suitable. State type or pipe and type of joint, the D load designation and other relevant attributes. State preferred lengths of pipes. (Refer to Appendix B of SANS 677)
Above ground pipes shall have a nominal diameter of ...	4.2.1	State pipe diameter. Omit if pipe diameter is shown on construction drawings.
Below ground pipes shall have a nominal diameter of ...	4.3.3.1	State pipe diameter. Omit if pipe diameter is shown on construction drawings.
The gradient of the pipes shall be such that they are not less than 1: ...	4.3.3.4	State gradient if not shown on the drawings. (SANS 10400P requires that such gradient be not flatter than 1:120 for 100mm diameter pipes and 1:200 for 150mm pipes. The hydraulic load determines the minimum grade of the pipe – refer to SANS 10400P))
Variations:		
		State variations, if any
Additional clauses:		
		State additional clauses, if any

Annex P: Specification for HDPE Product Supply, Installation and Quality Control

P.1. Scope

This material specification outlines the requirements for the manufacture of HDPE (High Density Polyethylene) Pipes & Fittings.

P.2. Quality assurance

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of quality control procedures, which shall ensure that the product will meet the requirements of this specification. The manufacturer/supplier shall maintain a quality system that conforms to the requirements of the SANS 9001/ISO 9001:2000 or national equivalent. The applicable standard for manufacture of pipes shall be SANS 4427/ISO 4427.

It is the responsibility of the design Engineer to ensure that all material and manufacturing details of all pipes, fittings and structures are appropriately specified in terms of the relevant SANS (or equivalent) specifications in the tender documents and that the contractor supply and install all material to the required SANS standards on site. Tender documentation must include or refer to all relevant requirements, certification or testing that may be necessary for quality assurance of raw material supply, manufacturing standards, equipment used in manufacturing or tests to ensure standards are met. Refer to SANS 4427/ISO 4427, SANS 10268, SANS 10269, SANS 10270, SANS 1655, SANS 1671, SANS 21138, SANS 674, ISO 9969 and relevant specifications. Tender documentation must allow for relevant quality control testing either by means of an appropriate clause (stating type of test and quantity) or by inclusion (specific stipulation of test requirements) in the price of the manufactured/installed item.

P.3. Inspection of manufacturing process

The design engineer must ensure that pre-delivery tests are conducted at the manufacturer's/supplier's works.

Tender documentation must stipulate that the Contractor will arrange with the supplier access to his works for the purpose of inspecting either during the course of manufacturing or when completed and shall permit the design engineer all reasonable access to conduct such inspections.

Copies of all test schedules and manufacturer's quality control records as called for in the relevant SANS (or similar) specifications and tender specifications shall be submitted by the contractor for examination by the design engineer.

P.3.1. HDPE manufacturing inspections

It is required that an inspection be conducted of the manufacturing facility of potential suppliers of HDPE products prior to accepting products from such suppliers. Such inspections may be an unannounced or announced evaluation of the everyday manufacturing procedure of manufacturers requesting to be accepted as approved suppliers of structured wall HDPE pipe for the use in dolomite areas.

The objective of such evaluation is to conduct a manufacturing and quality inspection against the manufacturers own in-house standards as well as acceptable good manufacturing practice and specifications, e.g. SANS standards and/or Licensor guidelines.

P.3.2. Validation of information

An inspection report must validate the following in detail:

a) Manufacturer's own in-house standards and guidelines;
b) NDPW guidelines for the design for dolomite conditions;
c) SANS and or other references

The inspection report shall comment on, but are not limited to, the following:

1. Quality management system: SANS 9001 (or approved equivalent);
2. PE100 raw material supplies: compliance with SANS ISO 4427 raw materials PE100;
3. SANS Permit applicable to technology, e.g. SANS 21138:1-3 whichever is applicable, SANS 674 and/or direct technology link to Licensor;
4. PE100 raw materials shall be subject to compounds that conform to EN1555-1 and ISO4437 or EN12201-1 and ISO4427 as well as ISO12162. Manufacturer of products with a PE100+ rating must comply with ISO9000 Standards for acceptance;
5. Certificates of conformance as well as certificates of analysis to be submitted and/or be available per batch of raw material (no in-house regrind, non-virgin base raw material may be utilized);
6. In-house records of piping quality recording sheets to be inspected and stored in accordance with SANS 9001 Quality management system;
7. Validation of frequencies and execution of destructive and non-destructive tests in line with permit conditions and or Licensor;
8. Calibration certification of testing equipment, MFI (Melt flow index) OIT (Induction oxidation time) etc.;
9. Validation of staff competency to achieve accurate results Gauge R-R certification of item measured, method of measure, and persons measuring;
10. Validation of finished product against Permit and or Licensor dimensions requirements and/or geometry;
11. Weld seam testing qualitative / quantitively if and when available;
12. Joint spigot and socket compliance testing circumferential and angular deflection with appropriate jointing method;
13. Pipe to pipe and or pipe to sheet and or sheet to sheet extrusion welding design (geometry and application) to be validated to “Design calculations for containers and apparatus made from thermoplastics characteristic values DVS 2205-1”;
14. Fabricator and/or welder to comply with SANS welder requirements in so far as welding discipline (butt welding or extrusion welding) / welder competence / welding equipment / welding materials and/or components (welding rod) / weld procedure (method) and weld compliance vs design / weld visual inspections (non-destructive) and property testing;
15. Preparation and storage of batch certificates;
16. Marking and trackability of welds and piping.

The above are generic guidelines for inspections and can be extended with specific requirements.

P.3.3. Report

The final report shall list all criteria that were used during the evaluation and it shall specifically comment on:

a) Compliance with National, International Standards and Licensor requirements;
b) Compliance with criteria specified by the Department;
c) Possible risks with respect to inspection findings;
d) General recommendations;
e) Specific recommendations regarding the acceptability of the supplier.

P.4. General product requirements

The finished product shall be free from cracks, voids, foreign inclusions and other defects, which would impair the overall performance. It shall be smooth walled on inside and outside and shall conform to the requirements (characteristics) outlined below.

P.4.1. HDPE pipe quality control

The Department requires that the following must be complied with in terms of HDPE products.

1. National product specification: ISO 4427/SANS 4427;
2. Product and installation identification: In addition to the standard markings all HDPE products must carry the logo or name of the manufacturer;
3. Designation of material: All elements to be conform to specification of PE 100;
4. Nominal pressure and wall thickness of pipes: ISO 4427/SANS 4427-2, Table 2;
5. Raw Material: the HDPE manufacturing substance shall be 100% SANS ISO 4427 PE100 High Stress Crack Resistance certified virgin material (i.e. with ZERO inhouse/buy-in reworked materials or scrapings or foreign material), which material shall have been tested in accordance with the ISO13479 Notched Pipe Test by an independent 3rd party laboratory and the time to failure shall have been ≥8,760 hours. HDPE structured wall manufacturing substance shall be 100% SANS ISO 4427 PE100 certified material (i.e. with ZERO in-house/buy-in reworked materials or scrapings or foreign material), which material shall be subjected and proved to be conforming to testing means and methods specified in SANS 4427.
6. Raw material declaration: the HDPE product manufacturer must declare in the tender documents the origin (supplier) of the raw material that will be used to manufacture the pipes for the contract;
7. Ash content: To be in accordance with SABS 533 part 1,2 and 3 clause 6.3 maximum not to exceed 0,1%(m/m).

P.4.2. Characteristics

Raw material composition for pipes, fittings (e.g. stubs) and other elements (e.g. sheeting for benching) shall be PE 100 pre-compounded black.

P.4.2.1. Technical considerations for raw material and finished product

Physical/Chemical Property	**Standard**	**Value**	**Unit**
Density	ISO 1183	0,949-0,960	g/cm^3
Melt Flow Index (190°C/5Kg)	ISO 1133	0,25-0,35	g/10min.
Vicat Softening Point	ISO 306	64-68	°C
Crystalline Melting Range	ISO 3146-85	130-135	°C
Viscosity Number	ISO 1628-3	390	cm^3/g

Mechanical Property	**Standard**	**Value**	**Unit**
Shore D, Hardness	ISO 868	61	-
Elastic Modulus	ISO 527	900	MPa
Tensile Yield strength	ISO 527 / ISO 6259	24	MPa
Ultimate Tensile	ISO 527 / ISO 6259	35	MPa
Ultimate Elongation	ISO 527 / ISO 6259	>600	%
Flexural Stress (3.5% Deflection)	ISO 178	19	MPa
Thermal Stability (OIT @ 210°C)	ISO 10837	>40	Minutes
Carbon Black Content	ASTM D 1603 / ISO 6964	2,25 +/- 0,25	%

P.4.2.2. Pipe characteristics

Characteristics	Applicable Standard
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness at any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

P.4.2.3. Welding requirements

HDPE pipes and fittings welders to be certified under the Thermoplastics Welding Institute of South Africa (TWISA)

The following standards shall apply:

SANS 10268 Part 1	Welding of thermoplastics - Welding processes - Heated tool welding
SANS 10268 Part 2	Welding of thermoplastics - Welding processes - Electro fusion welding
SANS 10268 Part 3	Welding of thermoplastics - Welding processes - Hot gas welding
SANS 10268 Part 4	Welding of thermoplastics - Welding processes - Hot-gas extrusion welding
SANS 10268 Part 10	Welding of thermoplastics - Welding processes - Weld defects
SANS 10269	Welding of thermoplastics - Testing & approval of welders
SANS 10270	Welding of thermoplastics - Approval of welding procedures and welds
SABS method 1269	Welding of thermoplastics – Test methods for welded joints
SANS 1655	Welding of thermoplastics – Welding rods, fillers and solvents
SANS 1671 Part 1	Welding of thermoplastics – Machines and equipment – Heated tool welding
SANS 1671 Part 2	Welding of thermoplastics – Machines and equipment – Electro fusion welding
SANS 1671 Part 3	Welding of thermoplastics – Machines and equipment – Hot-gas welding
SANS 1671 Part 4	Welding of thermoplastics – Machines and equipment – Hot-gas extrusion welding

WELDING OF THERMOPLASTICS STANDARDS		
SANS No	**(New Numbers)**	**TITLE**
10268-1	Processes- Pt.1:	Heated tool
10268-2	Processes- Pt.2:	Electrofusion wldg
10268-3	Processes- Pt.3:	Hot-gas welding
10268-4	Processes- Pt.4:	Hot-gas extrusion
10268-5	Processes- Pt.5:	Solvent welding
10268-6	Processes- Pt.6:	Ultrasonic welding
10268-7	Processes- Pt.7:	Infra-red welding
10268-8	Processes- Pt.8:	Bead & crevice free
10268-9	Processes- Pt.9:	Spin & friction wlg
10268-10	Processes- Pt.10:	Weld defects
1671-1	Machines- Pt.1:	**I.1.1** Heated tool wlding
1671-2	Machines- Pt.2:	Electrofusion wldg
1671-3	Machines- Pt.3:	Hot-gas welding
1671-4	Machines- Pt.4:	Hot-gas extrusion
1671-5	Machines- Pt.5:	Solvent welding
1671-6	Machines- Pt.6:	Ultrasonic welding
1671-7	Machines- Pt.7:	Infra-red welding
1671-8	Machines- Pt.8:	Bead & crevice free

WELDING OF THERMOPLASTICS STANDARDS		
SANS No	**(New Numbers)**	**TITLE**
1671-9	Machines- Pt.9:	Spin or friction
6269		Test methods for welded joints
1655		Welding rods, fillers and solvents
10269		Testing and approval of welders
10270		Approval of welding procedures

P.4.2.4. Raw material acceptance tests

The material used for the manufacture of the pipes and fittings and ancillary elements shall be a high-density polyethylene (HDPE) PE 100. To ascertain the quality of this product the following tests shall be performed:

a) Density;
b) Melt Flow Index;
c) Carbon Black Content;
d) Thermal Stability

Only virgin materials (raw materials as received from the polymer producers, with no additives) shall be used for the manufacture of the pipes and fittings.

The pipe supplier shall accommodate regular visits by NDPW and/or appointed/contracted service providers/consultant representatives to their factory as and when required to inspect/check the manufacturing process and be permitted to take samples of final products to an independent certified laboratory for acceptance tests as mentioned above.

No recycled material may be used in the manufacturing of the pipes. The supplier will be required to provide documented proof, as and when requested, that the material used conforms to the requirements of this specification.

P.4.2.5. Testing of pipes

Testing as described in ISO 4427/SANS 4427 shall apply. Independent tests shall also be conducted ad-hoc by a registered and authorised testing body as determined by the Department of Public Works.

Documents to be submitted by the pipe manufacturer:

a) Certificate of Registration –ISO 9001/SANS 9001 or National Equivalent;

b) Permit Certification –ISO 4427/SANS 4427 for PE 100;

c) Quality Control Plan (QCP) shall include Raw Material and Product Test Certificates;

d) SANS or National Equivalent Quality Systems Audit Reports – last 2 Audits;

e) Certificate of Conformity and Certificate of Analysis - certificate for the raw materials used for each batch. Documentation shall be kept/filed separately by the pipe manufacturer for all pipes ordered per each contract.

P.4.2.6. Pipe marking

All HDPE pipes shall be indelibly marked at 1m intervals with the following details:

Reference item	Mark printed
Trade name	Manufacturer/Supplier Name
Specification	ISO 4427/SANS 4427
Pipe OD	e.g. 160
Pipe OD tolerance	Grade B
Wall thickness	e.g. 7.7
Nominal pressure	e.g. PN 10
Material designation	PE 100

Batch no.	Manufacturer/Supplier Traceability
Application	SEWER or WATER or STORMWATER or "SLEEVE – WATER" or any other application

Typical example:

XXX SET OF SANS MARK XXX

SUPPLIER A - ISO 4427 – 160 - B - X 7.7 - PN 10 - PE 100 - BATCH NO. 123456 – SEWER (Important note: This number should always be on top of the pipe after installation)

P.4.2.7. Material guarantee / product life expectancy

The manufacturer must unconditionally guarantee all HDPE products for a period of 100 years against any form of chemical decomposition or mechanical failure as a result of normal use in a 100-year lifecycle of expected pressures.

P.5. Construction and on site requirements

P.5.1. Offloading of HDPE pipes

The manufacturer's instructions regarding the offloading of all HDPE pipes, fittings and manufactured items must be strictly adhered to. The specification of such procedures must be in the office of the contractor at all times. The engineer must be provided with a copy of such procedures. The pipes must be offloaded by hand or mechanical crane.

During site establishment of the contractor the engineer must instruct the contractor to clear an area specifically for the purpose of offloading HDPE/ PVC products. This area must be free of rocks, boulders or any other foreign objects that may puncture, cut or scar the HDPE/PVC fittings, pipes and other manufactured items. The area must also be relatively level in one direction and the ponding of stormwater must not be permitted. The area must be kept in such condition for the duration of material being on site.

P.5.2. Handling of HDPE pipes on site

The manufacturer's specification for the handling and transporting of pipes on site must be strictly enforced. The engineer shall write a specific instruction regarding this in the absence of such a manufacturer's specification.

The site instruction must include: "Under no circumstances shall the dragging of pipes on site be allowed. Dragging of the pipe will result in cuts, scratches and puncture marks that may result in weakening of the pipe. Welded pipes shall be transported to the point of installation in accordance with the manufacturer's specification."

P.5.3. HDPE pipes - visual inspection for defects

The engineer shall inspect all HDPE pipes for any visual defects such as cracks, deformation, wall thinning etc. This in no means constitute approval of the pipes. It merely serves as an additional quality control feature to ensure that pipes with obvious defects are rejected.

Pipes found to have such defects must be brought under the attention of the contractor in writing. The contractor must respond in writing. Copies of such cases must be forwarded to the Departmental Project Manager for submission to the Dolomite Risk Management.

P.5.4. Engineer's inspection of installed pipes

The engineer shall inspect all HDPE pipes and fittings prior to backfilling of trenches.

All pipes with cut, scratch, punctures marks or signs of deforming must be rejected from a quality control perspective. In such cases the contractor must submit a certificate of approval from the pipe supplier.

This document must clearly state that the supplier approves the integrity of the pipes irrespective of the noted damages.

If such an approval certificate is not supplied the engineer shall reserve the right to reject such pipes as he/she sees fit.

Any dispute in this regard must be referred to both the Departmental Project Manager and Dolomite Risk Manager.

All welds must also be inspected for obvious visual defects.

P.5.5. Pressure testing:

Contracts shall provide for quick testing of all pipe sizes delivered to site with at least:

a) One test per 500 m of pipes having a diameter less than 75m(OD)
b) Two test per 500 m for all pipes having a diameter in excess of 75mm (OD)

P.5.5.1. The pressure testing in laboratory

Selection of 3 samples, at random by the independent test laboratory, of pipes having a minimum length of 1m with all relevant pipe markings and free of scratches and defects. These sections shall be tested as follows:

a) The condition of pipe or fitting in water for 12 hours at 20ºC;
b) Standard pressure test procedures according to ISO 4427/SANS 4427;
c) Failure test: apply internal pressure at 5 bar/min until failure - PE100 pipes must reach a pressure of at least twice the minimum required strength according to ISO 4427/SANS 4427;
d) The Engineer shall also allow for quick testing as stated above to ISO 4427/SANS 4427 as follows:

   Quick tests:
   - MFI: Melt Flow Index
   - OIT: Oxygen Induction Time
   - Screen: Polymer identification
   - Pressure Test: Regression Curve
   - Notch Sensitivity Test: Polymer
   - Technological Bend Test: welds
   - Technological Tensile Test: welds
   - Demand feed stock information: certificate
   - Check polymer with manufacturer

P.5.5.2. Hydraulic field testing of water supply pipes

All completed pipelines shall be satisfactorily tested hydrostatically and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Hydrostatic tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of hydrostatic testing and for the supply of all equipment, materials and labour required.

The test pressure for field testing shall be 1,5 times the maximum working pressure.

The test pressure applied over any section under test, taking any differences in elevation along the pipeline into account shall be such that the pressure at any point along the section is not more than 1,5 times the maximum working pressure of the pipe.

The test procedure shall be as follows:

- Fill the pipe section with potable water and leave overnight;

- Gradually increase the pressure over a period of 3 hours to 100% of the maximum working pressure;
- Inspect the pipe for visual leaks and should leaks be observed, gradually decrease the pressure to zero and repair the leaks;
- Repeat the last two steps until no visual leaks occur;
- Then increase the pressure to 150% of the maximum working pressure and close the valve to maintain the pressure. After one hour measure the pressure. To pass the test, zero leakage (i.e. zero pressure drop) shall be recorded;
- Upon successful completion of the test, gradually decrease the pressure to zero over a period of 3 hours;
- If the test fails, find the leak(s) and repair it before repeating the test until a successful result is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

P.5.5.3. Testing of large diameter sewer and stormwater pipes

All completed sewer lines shall be satisfactorily tested and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Air tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of air testing and for the supply of all equipment, materials and labour required.

The maximum air test pressure for field testing shall be 100kPa.

The air test procedure shall be as follows:

- Isolate the section of pipe to be tested by inserting airtight packers, one of which is connected to the air testing machine;
- Gradually raise the gauge pressure in the pipe in 10kPa steps, with a 2 minute stabilisation period between steps, to 100kPa and ensure that there is no air leakage at the packers;
- Switch off the machine and keep the pressure in the pipe for 1 hour. After 1 hour, the gauge reading shall remain constant to indicate zero air leakage;
- If the gauge reading reduces by more than 1% over 1 hour, the pipe shall be deemed to have failed the air test and the pipe test section rejected;
- Upon completion of the air test, gradually decrease the pressure to zero over a period of 20 minutes;
- After rejection of a pipe section that has failed the air test, the Contractor may apply a water test to locate the source of failure, rectify the pipe section and re-apply the air test. The pipe section will be accepted if zero leakage is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

The water test procedure shall be as follows:

- Fill the pipe section with water to such a depth that every portion of the pipeline is subjected to a pressure of at least 100kPa.;

- After an initial period of 30 minutes, accurately measure and mark the water level and keep filled for 1 hour;
- Check (or measure) the water level after 1 hour to record the water level;
- The test is successful if the recorded water levels are the same to indicate zero leakage.

P.5.6. Welding

P.5.6.1. Special notes on HDPE welding work

The following general site procedures need to be implemented

For welds other than prepared butt welds, the following practical issues must be observed and implemented:

a) The adjoining faces of plastic are scraped with a chisel to roughen up the surface and remove any oxidization of the surfaces to be welded;

b) Angle grinders must not be used for this process, as it burns the plastic and also leaves a powder film, which is detrimental to welding;

c) Cleaning agents (i.e. XYLENE) must be used prior to the performing of any extrusion weld, especially on all site works and repair work on dirty items;

d) In winter conditions, preheating of the parent plastic along the prepared weld surface is sometimes necessary. This prevents heat sink (i.e. the parent plastic chills and thus removes the heat from the extruded welding filler);

e) The welder's registration number must be imprinted on each weld prior to cooling. This number should always be on top of the pipe after installation.

P.5.6.2. Removal of welding beads from HDPE pipes

After butt-welding of HDPE pipes the internal welding bead must be removed from all solid wall sewer pipes (all diameters) and stormwater pipes smaller than 200mm diameter.

The engineer must inspect the contractor's equipment for this work and instruct the contractor to weld and remove beads from the various pipe sizes to be used on site. These examples of the removed beads, as well as the welded pipe sections must be kept on site for the duration of the project.

The removed beads must show no signs of cracking (cut too cold) or extreme deformation (cut too hot).

All welding beads removed from the installed pipes shall be marked sequentially with the same number as the weld. All welded joints must be sequentially numbered with white weatherproof paint. These weld positions must be transferred to an as-built drawing.

The contractor must store the removed welding beads to the end of the retention period.

It is important to note that:

a) The cut direction is the same as the liquid flow direction;

b) The bead cutter must be fitted with equipment to extract the bead after cutting;

c) The equipment must be able to cut the bead in one operation. Multiple cuts may lead to uneven or sharp burr ends on the pipe surface.

Note that the internal welding beads of water pipes must not be removed. Typical equipment is shown below.

PLATE 17: TYPICAL EXAMPLE OF INDUSTRIAL BEAD REMOVER

P.5.6.3. Removal of HDPE pipe shavings

During the preparation phase of welding surfaces all care must be taken to ensure that pipe shavings are not left behind in pipes. This is of particular importance in terms of the preparation of water pipes. No system with a diameter smaller than 32mm may be connected to the main reticulation unless the main reticulation is thoroughly flushed. The same applies to the entire smaller systems prior to the installation of water meters. The portion of pipe work to individual buildings must also be flushed in reverse from pressure sustaining valves towards the meter prior to connection of the meter. All strainers must be cleaned and checked by the engineer prior to handing over the system.

The entire system should be monitored for blockages after installation and the Principal Agent must introduce measurements to ensure that blockages are the responsibility of the Contractor for the duration of the contract up to final delivery.

Annex Q: Specification for Demolition of Buildings

Q.1. Scope

This specification covers the basic principles for the deconstruction of buildings.

Note1: The deconstruction of buildings may jeopardise the safety of existing works and personnel and in certain instances nearby infrastructure. Great care has to be taken when specifying the demolition of buildings to ensure the safety of the surrounding existing infrastructure and all people.

Q.2. Normative references

All work shall be specified in terms of:

a) Manual PW344/2016 Appropriate Development of Infrastructure On Dolomite;

b) SANS 1200, *Civil Engineering Construction – Parts as applicable.* (alternative: SANS 2001CC1, *Construction works – Parts as applicable – if approved by the Department).*

Q.3. Tenderer's experience

The tenderer needs to indicate his appropriate experience regarding demolishing of buildings of this magnitude in the tender.

Q.4. Inspection of structure

The tenderer needs to inspect the structure prior to tendering to aquant him/herself with the task.

Q.5. Geological conditions at the building site

Engineer is to provide detail descriptions of the geological conditions, as well as the safest areas for movement of equipment and personnel.

Q.6. Legislation

The contractor shall comply with the following legislation:

a) Explosives Act 2003 (Act 15 of 2003);

b) Atmospheric Pollution Prevention Act, 1965 (Act 45 of 1965);

c) Environmental Conservation Act, 1989 (Act 73 of 1989);

d) Occupational Health and Safety Act, 1993 (Act 85 of 1993) in general and in particular with reference to the Construction Regulation Notice R.84 dated 7 February 2014;

e) National Building Regulations and Standards Act, 1996 (Act 29 of 1996);

f) Electricity Act, 1996 (Act 88 of 1996);

g) National Water Act, 1998 (Act 36 of 1998);

h) National Environmental Management Act, 1998 (Act 107 of 1998);

i) Post Office Act, 1998 (Act 124 of 1998) (telephone installations);

j) National Heritage Resources Act, 1999 (Act 25 of 1999);

k) Fire Brigade Services Act, 2000 (Act 14 of 2000);

l) Local Government Ordinance 1939 (Ordinance 17 of 1939);

m) Latest issue of SABS 0142: “Code of Practice for the Wiring of Premises”;

n) Regulations of the local Gas Board, where applicable.

Q.7. Use of explosives

The use of explosives shall be limited due to the possible metastable subsurface conditions. Demolition methods using explosives shall be subject to the requirements of SANS 1936-3: 2012, Section 4.84.

Ground vibrations of both the blasting operation and the collapsing structural elements shall conform to the requirements of SANS 1936-3: 2012, Section 4.84. The tenderer’s method statement must reflect conformance to these requirements.

If explosive demolition is used, the following shall be covered extensively in the tender’s method statement:

a) Steps to be taken to avoid injuring the public and causing damage to existing property in the area;

b) Tender’s extensive experience in explosive demolition of large structures;

c) Experience in blasting in dolomitic areas;

d) Plans and safety measures to avoid damage to possible subsurface cavities and metastable ground conditions in the area.

Q.8. Proposed demolition methods

The proposed demolition work generally includes the demolition of structures, termination of engineering services at main connections, removal of service lines to the perimeter of works and reroute, if required, and general earthworks to enhance site drainage.

Q.8.1. Normal single-storey brick structures and foundation slabs/plinths

Use normal demolition methods (no explosives).

Payment: The rate shall include the complete demolition and removal of the super structure, foundations and foundation slabs to 300mm below natural ground level and disposing of materials at commercial dump sites. Compacted filling 300mm proud of natural ground level (to enhance drainage) on footprint of demolished building to be measured elsewhere as earth works. The earthworks (fill and compaction) will be measured elsewhere as earthworks.

Unit rate: Sum

Q.8.2. Normal steel structures, carports and temporary structures

Use normal demolition methods (no explosives)

Payment: Rate shall include the complete demolition and removal of the super structure, foundations and foundation slabs to 300mm below natural ground level and dispose of material at commercial dumpssites. Fill of areas after demolishing to be measured elsewhere. Dismantling and recovery of material as well as future re-erection, if required, will be indicated in bill of quantities. Compacted filling 300 mm proud of natural ground level (to enhance drainage) on footprint of demolished building to be measured elsewhere as earthworks.

Unit rate: Sum

Q.8.3. Aircraft hangers

All steel elements inclusive of side cladding and windows need to be dismantled for later re-erection.

Structural elements are to be dismantled to sizes suitable for road transport. Floor slabs shall not be removed or damaged.

All columns and elements cast into floor slabs shall be demolished to 100mm below the surrounding floor slab level. Finish such areas flush with surrounding floor slab by means of 20MPa concrete.

Payment: The rate includes the dismantling of the entire structure and relocation to an indicated site. Transportation of materials measured separately. Measurement and payment for dismantling various elements of the structure will be as per the description in the bills of quantity and drawings. Compacted filling 300mm proud of natural ground level (to enhance drainage) on footprint of demolished building to be measured elsewhere as earthworks.

Unit rate: Sum

Q.8.4. Mobile structures

Mobile structures are to be removed from current location to another area.

Payment: The rates include loading, transportation for indicated distance and unloading at a new location.

Unit rate: Sum

Q.8.5. Multi-storey residential buildings

The lump sum tendered shall include full compensation for all preparatory work required, demolition of structures, excavation and removal of foundations, levelling of the site and for the loading, transportation and disposal of the products of the demolition, including overhaul and commercial dumping site fees. The tendered rate shall also include full compensation for all measures to protect the surrounding structures, roads, engineering services, as well as for surveying and protection of adjoining buildings and all other items of work related to the demolition of the structures as called for in Local, Provincial and National regulations and legislation and Codes of Practice.

Demolish structures and all improvements to the site to 1m below natural ground level (including equipment, walkways, slabs, steps, terraces, services, etc.) and remove rubble to a commercial dump site. Following demolition, reshape area and compact all disturbed soil to 93% of Mod. AASHTO maximum dry density at optimum moisture content. Additional ground works to facilitate stormwater drainage are measured and paid for separately.

Payment: The rate includes the complete removal of the entire building complex and related site services and paving. Compacted fill 300mm proud of natural ground level (to enhance drainage) on footprint of demolished building to be measured elsewhere as earthworks.

Unit rate: Sum

Q.9. Safety

The contractor needs to provide proper barricades, security and safety signs around the building to prevent any person from entering, whilst demolition activities are in progress. The same shall apply for after hours and over weekends.

Payment: The rate includes all measures to prevent persons from entering the site.

Unit rate: Sum

Q.10. Material from the demolition

All material from the demolition shall become the property of the contractor, except if specifically indicated that structures are to be dismantled or re-erected (i.e. aircraft hangers, some carports and other steel structures).

Q.11. Disposal of debris

The contractor shall make his own arrangements for disposal of the rubble or surplus material in collaboration with the engineer. All costs related to such disposal shall be deemed to be included in the rates tendered for the demolition or cleaning up of the buildings.

The contractor shall submit written consent from the proper authorities for the dumping of material on sites provided by him. Under no circumstances shall a contractor be allowed to dump material on these provided sites without written consent.

Should the contractor be required or wish to spoil any of the excavated or other material resulting from the contract on a site to be arranged by the contractor, he shall provide the following fully signed documents to the engineer before spoiling commences:

a) An indemnity signed by the contractor and the owner on whose property the material is to be spoiled. This indemnity must completely indemnify the Department and the engineer against all claims whatsoever arising from the spoil of material on this particular property.

b) The agreement or conditions under which spoiling would be performed.

Q.12. Method statement

The tenderer must submit a Method Statement for the demolition of the various structures.

The proposed submission shall include full details (in the absence of which the tender will not be considered) of the following:

a) Full detail of the methods that the tenderer propose to use to carry out the work as specified, together with the time for completion tendered;

b) Commencement and completion dates and a detailed daily program to be implemented;

c) Specifically include detailed reference to the geological conditions and dolomite hazard and the tenderer's experience in similar geological conditions;

d) Preliminary calculations and all relevant data shall be submitted with the tender;

e) A full description of the assumptions and codes of practice used shall accompany the calculations;

f) Specify fence / hoarding to secure the site and protect the public, as well as other safety measures to be introduced;

g) Method of notifying adjoining owners / residents;

h) Evacuation procedures of surrounding buildings and areas during demolition;

i) Safeguarding of the existing and adjoining properties;

j) Subsurface geotechnical conditions and the impact that the proposed method may have as well as ground vibration measuring methods;

k) Meeting of requirements of legislation pertaining to the work to be executed (submit relevant documentation).

The engineer reserves the right to request the tenderer to submit additional method statements, calculations or information regarding the proposed demolition to be implemented. Such further details are to be submitted within seven days of the request to do so.

Annex R: Specification for Water Meters

R.1 Scope

This specification provides a generic description of the requirements of the Department regarding water meters and associated equipment. It is a particular requirement to provide specific specifications that detail the requirements of water meters and associated equipment allowed for in the schedule of quantities. Each installation shall be approved by the Department, prior to construction. Design engineers must ensure that installations are compatible to the Department's current requirements for mechanical and electronic on-site and/or remote sensing logging capabilities.

The general requirements for the following items are included:

a) Data logger and software specification:

   The specification provides a generic scope of the system requirements as well as the potential operational functions for on-site logging as well as remote sensing by means of GSM modules;

b) Requirements for plastic (composite) bodied, semi-positive rotary type, protected dial, domestic water meters.

   The specification covers the requirements for basic 15mm water meters for connections to single buildings and residential developments. The engineer must ensure that the consumption demand does not exceed the flow and accurate measuring capabilities of the meters.

c) Requirements for ultra high performance Woltman type, mechanical, turbine, flanged bulk water meters.

   The specification covers the requirements for basic 40mm to 150mm mechanical water meters with electronic logging capability. The requirements for mechanical meters larger than 150mm diameter requires a specific submission and approval by the Departmental engineer.

d) Electromagnetic flow meter specifications.

   The specification is specifically targeting the installation of water meters larger than 150mm in diameter. Electromagnetic flow meters smaller than 150mm must only be considered based on the financial viability and consistency with the remainder of the installation, should it form part of a network with multiple large water meters.

R.2 Data logger and software specification

All data loggers supplied to the Department shall be accompanied by the appropriate software, as well as training appropriately appointed Departmental staff.

R.2.1 Loggers

R.2.1.1 Options for single channel, two channel or four channel loggers must be available. Logger channels must be easily user-configurable for logging flows (digital inputs) and/or pressures (analogue inputs) in any permutation. All ports on the logger must be fitted with durable, military type connectors and sealing caps for watertight closure of the port, when not in use.

R.2.1.2 The minimum memory requirements are as follows:

a) For single channel loggers : 128kB
b) For twin channel loggers : 256kB
c) For four channel loggers : 512kB

Efficient memory utilisation is a prerequisite and under no circumstances must any event (pulse or pressure reading) take up more than 3 bytes of the logger's memory.

R.2.1.3 Loggers must provide both time and event based data storage. In order to provide quick

access to the stored data, the memory should be allocated to three unique and distinct memory banks as follows:

a) Record detailed event logging, i.e. all events must be stored in this memory bank;
b) Record time-based hourly values;
c) Record time-based daily values.

The event based data and the time-based hourly and daily data must provide true (not averaged!) maximum, minimum and average flow values. The software will automatically draw data from the memory bank best suited for the type of graphical representation required by the user.

R.2.1.4 Loggers must be capable of communication speeds of equal to or better than 19.6k Baud.

R.2.1.5 The loggers are to be programmed and interrogated via a RS232 interface. It must furthermore have hardware and software capability for GSM communication.

R.2.1.6 The internal electronics should incorporate rigid, solid state, surface mounted technology (SMT).

R.2.1.7 Loggers should be completely waterproof to IP68 insulation standard. A separate battery compartment must be user accessible, without having to disturb the insulation seal on the main logger. The logger and batteries should be housed in a lightweight, durable aluminium enclosure, with a solid metal carry handle, which may be used for securing the unit by lock and chain.

R.2.1.8 The logger should be powered by standard, commercially available leak-proof, alkaline batteries, size “AA” or similar. It must be possible to change the batteries without having to return the logger to the manufacturer. Power consumption of the logger must be such that useful battery life of 1 to 2 years can be achieved under normal operating conditions.

R.2.1.9 Each logger must be equipped with a robust, alphanumeric LC-display window from which on-site information can be easily obtained via a cascading menu, without having to connect the logger to a PC. On-site information available via the LCD display must include at least the following:

a) Channel parameters as programmed for each channel;

b) Logger parameters as programmed:
- Starting date and time;
- Ending date and time;

c) Status of the logger:
- Battery voltage;
- Memory used;
- Current date and time;
- Logger self-diagnostic errors;
- Logger serial number;

d) Logged values for each flow (digital) channel:
- Channel ID;
- Instantaneous flow rate reading;
- Built-in totaliser reading;
- Date and time when maximum flow rate occurred and maximum flow rate;
- Option to reset the above date, time and maximum flow rate;
- Date and time when minimum flow rate occurred and minimum flow rate;
- Option to reset the above date, time and minimum flow rate;

e) Logged values for each pressure (analogue) channel:
- Channel ID;
- Instantaneous pressure reading;
- Date and time when maximum pressure occurred and maximum pressure;
- Option to reset the above date, time and maximum pressure reading;
- Date and time when minimum pressure occurred and minimum pressure;

- Option to reset the above date, time and minimum pressure reading.

R.2.1.10 The loggers will accept a 2-wire, voltage free, reed-switch type pulse input as well as a high frequency, opto-type pulse input for logging to high resolution. It must be possible to log forward and reverse flows using opto-type pulsers. All pulsers must be fitted with the appropriate military type plugs, for connecting to the data logger.

R.2.1.11 Pressure transducers for logging pressures must be available as a separate item. Built-in pressure transducers will not be acceptable, as this type renders the entire logger useless when the accuracy of the transducer drifts. Transducers offered must be capable of logging pressures up to 2000 kPa to accuracy equal to or better than ±1% of FS at constant temperature. All pressure transducers must be fitted with the appropriate military type plugs, for connecting to the data logger.

R.2.1.12 0mA to 20mA or 4mA to 20mA Analogue interfaces with data logger connector plugs must be available from the supplier in the event of a requirement to log from analogue 24V loop-powered sources.

R.2.1.13 Loggers must have a built-in, real time clock, accurate to better than or equal to the following specification:

$$deviation < 10^{-4} \text{ at } 10°C \leq T \leq 30°C$$

The only method of setting the date and time must be through the transfer of the PC's system time to the built-in real time clock.

R.2.2 Logger software

R.2.2.1 User-friendly, purpose-written, Windows®-based software must be available for the programming and interrogation of the loggers, for file management and evaluation of the logged files, as well as for the computer system configuration.

R.2.2.2 The software must be user configurable for upgrade to programming and readout of loggers via the cell-phone (GSM) network.

R.2.2.3 The software must provide the option for the user to either create a new data file when doing the download, or to string the data onto a previously downloaded file, without having to resort to conversion into ASCII-format or importing into commercially available software packages, such as Excel®, for that purpose. Conversion of logged files into ASCII-format must however be available as a standard option.

R.2.2.4 It must be possible to do on-site monitoring of a logger connected to a water meter, via a laptop PC, for real time graphical and/or tabular display of flow and/or pressure. The system must allow for this type of monitoring through the use of the RS232 interface and via the GSM cell phone network.

R.2.2.5 It must be possible to generate line graphs of flows and/or pressures and bar graphs of minimums, maximums and average flows and/or pressures as well as bar or pie charts of daily, hourly (or shorter periods) volumes.

R.2.2.6 It must be possible to superimpose graphs and to add or subtract graphs for generating a graph reflecting a net result. It must be possible to combine graphs logged from a combination water meter for instance, to reflect a single graph of total consumption to a consumer.

R.2.2.7 It must be possible to change the resolution of any generated graph between course, fine and all values logged.

R.2.2.8 The software must have a well-developed statistical function.

R.2.2.9 Zooming and panning of any generated graph must be performed with ease.

R.3 Requirements for plastic (composite) bodied, semi-positive rotary type, protected dial, domestic water meters

R.3.1 Meters installed under this category must be a plastic (composite) bodied, semi-positive rotary type, protected dial, domestic water meters, for the measurement of cold, clean potable water and must conform to the following dimensions and specifications:

Nominal Bore (mm)	Body Length (Excluding connectors) (mm)	Minimum Metrological Class	Maximum Working pressure (kPa)	Maximum Temperature (°C)
15	115	"C"	1600	40

R.3.2 Meters must conform to the specifications of SANS1529-1, it must be tested and sealed in compliance with SANS 10378 in a SANS approved laboratory in South Africa.

R.3.3 The meters must be suitable for horizontal or vertical installation, whichever installation position must not affect metrological performance.

R.3.4 The design of the meter must be very compact and robust and constructed of a high-performance glass-fibre reinforced polyamide polymer (PPA), which provides exceptional structural strength. In addition, the threaded connections of the meter must be positioned against the meter body in such a manner that the possibility of it breaking off is minimized.

R.3.5 These meters shall perform to an accuracy of better than ±2% error over the meter's operating range; i.e. between Qt and Qp (Qn), and must meet or exceed Metrological Class "C".

R.3.6 The design of the meter dictates that the piston axis of the meter be positioned in the vertical plane (when the meter is installed horizontally) to ensure superior starting flow and low flow measuring characteristics.

R.3.7 Meters must be fitted with registers, which comprise four digit cyclometer type totalisers, registering in kiloliters (kℓ) or cubic meters (m^3), and another four digits on a red background to indicate submultiples of m^3 or kℓ. The registers must be protected from the water being measured, must be lubricant filled to prevent condensation from forming under the register lens and to ensure ease of reading.

R.3.8 The register lenses must be made from a thick, transparent polycarbonate material to prevent cracking or discolouring, designed to withstand harsh environmental conditions and to facilitate ease of reading.

R.3.9 Non-return valves must be fitted to prevent reverse flow through the meters.

R.3.10 The serial number of the meter must be clearly visible from the position that the meters are normally read.

R.3.11 Meters must have a pulse output facility, which will accept an optional reed switch, which provides a potential free pulse equal to 2 pulses per 1 litre (or 1 pulse per 0,5 litre).

R.3.12 Meters must have the facility to accept an optional inductive type High Resolution Impulse (HRI) pulser unit for providing pulses, or a radio transmission unit for Automatic Meter Reading (AMR).

R.3.13 Meters shall not be affected by outside magnetic influences.

R.3.14 Meters should offer very low friction loss characteristics at Qp (Qn).

R.3.15 The manufacturer must have a proven track record for the supply of plastic bodied, domestic meters in Southern Africa.

R.3.16 In addition to the requirements of SANS1529-1, the following test in the presence of the engineer is also required:

Witness testing of a random sample of five meters in the SANS accredited test laboratory, on the test rig normally used for the testing and calibration of these meters. Special attention will be given by the engineer to the actual performances of the meters offered, rather than the minimum performance as laid down by SANS1529-1 for Class C specifications.

R.4 Requirements for ultra high performance Woltman type, mechanical, turbine, flanged bulk water meters

R.4.1 Water meters tendered for under this category, for sizes NB 40mm up to and including NB 150mm, must be, in-line through-flow Woltman type, mechanical turbine flanged bulk water meters and must conform to the following dimensions and specifications:

Nominal Bore (mm)	Body Length (mm)	Flange Specification	Working Pressure Maximum (kPa)	Maximum Temperature (°C)
40	220	BS4504 Table 16*	1600	50
50	200	BS4504 Table 16*	1600	50
80	225	BS4504 Table 16*	1600	50
100	250	BS4504 Table 16*	1600	50
150	300	BS4504 Table 16*	1600	50

*BS4504 Table 16 is equivalent to SANS1123 Table 1600/3

R.4.2 Dual-drilled or multi-drilled flanges will not be acceptable to the engineer as this practice may weaken the flanges.

R.4.3 All Woltman type mechanical meters supplied in terms of this contract shall perform to an accuracy of better than ±2% error over the meter's operating range; i.e. between Qt and Qp (Qn). The performance characteristics of the meters offered, when installed horizontally, must be equal to or better than the values listed below:

Size DN (mm)	Qstart (m^3/h)	Qmin (m^3/h)	Qt (m^3/h)	Qn (Qp) (m^3/h)	Qmax (Qs) (m^3/h)
40	0,05	0,2	0,32	40	60
50	0,05	0,15	0,4	50	90
80	0,1	0,2	0,51	120	200
100	0,11	0,3	0,81	230	300
150	0,3	0,8	1,6	450	600

R.4.4 Meters must be fitted with dry dial registers, which comprise six digit cyclometer-type totalisers, registering in kiloliters (kℓ) or m^3. These registers must be hermetically sealed to prevent ingress of dirt or moisture. The registers, which are to be fitted as standard, must be able to provide one high frequency opto-type pulse output function and one HRI (High Resolution Impulse) function. All meters shall be fitted with a HRI and opto-type pulsers, normally associated with data logging,

R.4.5 It is required that the meter be upgradeable to AMR (Automatic Meter Reading), which facilitates the fitment of "intelligent" registers, or the fitment of HRI and/or Radio Transmitters at a later stage. Tenderers are to provide full details of their capabilities in this regard.

R.4.6 The manufacturer must have a proven track record for the supply of plastic bodied, domestic meters in Southern Africa if not supplied as a metal body.

R.4.7 Cover bolts must be of stainless steel material to facilitate easy removal of mechanisms. Meter bodies must be coated with a high quality sintered epoxy powder coating, both internally and externally, to provide maximum protection against corrosion.

R.4.8 Although most of the meters will be installed horizontally, it must be possible to install the meters vertically (with flow in the upward direction) or in an inclined position (with flow in the upward direction), should site conditions make this necessary.

R.4.9 Manufactures must provide full details of the minimum lengths of straight pipe required upstream and downstream for each size of meter offered, to ensure that the accuracy of the meters remain within the stated limits, under normal operating conditions.

R.4.10 The performance of the meters offered shall not be affected by outside magnetic influences.

R.4.11 A suitable place must be provided for on the meter body, which may optionally be drilled and tapped for a pressure connection, for connecting a pressure transducer, for data logging.

R.4.12 The manufacturer must provide details of any approvals which they may have from any authority, locally or overseas, permitting them to exchange meter mechanisms or to fit new, calibrated mechanisms into used or existing meter bodies, without loss of measuring accuracy.

R.4.13 Details of head loss across the meters offered must be provided.

R.4.14 The manufacturer must provide details of meter-compatible strainers (if required), which can be offered to protect the meters against possible damage as a result of foreign matter in the water.

R.5 Electromagnetic flow meter specifications

Electromagnetic Flow Meter Specifications can be specified in terms of the following criteria:

R.5.1 Sensor tube

The electromagnetic flow meter sensor tube for sizes 25mm to 300mm shall conform to the following specification:

a) Utilize Faraday's law as a measuring principal with electrically conductive fluids;

b) Have an aluminum alloy measuring insert featuring a rectangular measuring port for conditioning of the flow within the meter body;

c) The internal protection coating shall not exceed a 0.3mm thickness and must withstand operating temperatures of -5°C to 70°C and pressures of 1kPa to 4000kPa;

d) The manufacturer must guarantee that the internal coating has a lifespan similar to the entire sensor tube;

e) Body pressure rated 16bar;

f) Nominal flange pressure will be PN16;

g) The tube should have a corrosion resistant coating with a minimum thickness of 150μm;

h) Electrical conductivity ≥20μS/cm;

i) The tube should be able to accommodate flow velocity in sensor of 18m/sec;

j) Installation requirements for inlet and outlet runs can be zero pipe diameters;

k) Process connections for DN 25 – 300mm can be PN 10 or PN16;

l) Measuring electrodes will be stainless steel 1.4301 / AISI 304;

m) Grounding Electrode stainless steel 1.4301 / AISI 304;

n) Electromagnetic approvals and standards to conform as follows;
Electromagnetic compatibility – Directive 89/336/EEC, Harmonised standard WEN 61326-1:2006.

o) Low voltage Directive 2006/95/EC, Harmonised standard : EN 61010: 2001;

p) Custody transfer to MI-001 and OIML R-49;

q) Tube must be available with a direct burial option if required;

r) Requires zero straight pipe lengths on inlet or outlet side of meter

R.5.2 Calibration certificate

A manufacturer's calibration certificate, showing calibration twice at two calibration points, shall be supplied with each flow sensor.

The measuring uncertainty of the meters will be equal to or better than ±0.5% of actual flow for flow velocities >0.5m/s.

R.5.3 Signal convertor - IP68 compact mount

The battery powered convertor should conform to the following.

a) Offer a battery life of 15 years with no external battery packs;
b) The display shall be a high contrast high resolution type;
c) Display to consist of 8 digits, display of positive and negative counter, sum counter, flow rate. Will also give status indication for battery, flow/ counter direction and empty pipe condition;
d) Settable units will be cubic meters, while flow rate will be cubic meters per hour;
e) Repeatability will be ± 0.1%(v>0.5m/s/1.5ft/sec);
f) Operate within following temperature ranges (-40 deg C to +65 deg C);
g) Handle a conductivity of ≥ 20 µS/cm;
h) In sensor flow velocity of 18m/sec;
i) Powered by lithium cells that provides for a 15 year battery life;
j) Have pre alarm 1 year before battery depletion and final alarm;
k) Battery replacement will be possible without loss of totalizer data;
l) Outputs will be 2 x passive pulse outputs for remote totalizing f≤500 Hz;I≤10 mA; U: 5 to 24 VDC (P≤100mW), also 2 passive status outputs (I≤10mA; U: 5 to 24VDC (P≤100mW));
m) Have facility for external communication to a data logger / GSM protocol/ SMS protocol to SCADA system;
n) Housing to be IP68/67 (NEMA 4/4X/6P);
o) Convertor manufactured from Polycarbonate material with IP68 Mil Spec connector for plug and play data logging;
p) Shock and vibration resistance to IEC 68-2-3;
q) For custody transfer be in accordance to MI-001 and OIML R-49;
r) Double safety with double O Ring construction;
s) Hermetically sealed against water ingress or condensation.

R.5.4 Leakage detection capability

The meter must be able to monitoring the lowest flow or volume during selected time window within 24 hours. Leakage detection must be configurable over a selectable period where monitored if value exceeds the possible leakage level. The minimum and maximum values must be stored with date registration. Last stored value visible on the display.

Annex S: Specification for Precise Levelling

S.1. Scope

This specification deals with the installation of permanent survey base stations, control beacons and survey points for precise levelling purposes.

S.2. Contract scope of works

The contract scope of works includes the installation of permanent survey base stations, control beacons and survey points for precise levelling purposes. The survey points are primarily on buildings, roads, services and related structures.

All surveys are of precise levelling nature to record any vertical or horizontal movement of installed beacons with an accuracy of **(*)** 0,1mm.

Note: (*) Indicates values or data to be changed or inserted by the engineer to suit the project specification.

Surveys will be divided into three categories namely:

S.2.1. Installation of survey beacons and levelling points

Initial installation of survey/levelling points include:

a) Installation of fixed concrete survey base stations;
b) Installation of fixed concrete survey control beacons;
c) Installation of permanent precise levelling survey points;
d) Levelling of installed survey points (3 cycles of levelling) of the entire installation to determine precise levels.

S.2.2. Scheduled surveys

Levelling points are predefined for levelling on a 1, 3 and 6 month levelling cycle for the duration of the contract or alternatively on cycles as required by the engineer.

S.2.3. Emergency ad-hoc call-outs

This includes levelling of points as indicated by the Department on an ad-hoc basis.

This description of the scope of works is not necessarily complete and shall not limit the work to be carried out by the contractor.

Approximate quantities of each type of work are given in the schedule of quantities.

NOTE: The drilling of boreholes for control beacon installations shall be measured and paid for as per the tendered rates.

S.3. Construction programme

The contractor needs to program the installation of all predetermined survey points, survey base stations and control beacons within the first two months of the month contract. Other survey points installation are at the discretion of the engineer on an ad-hoc basis as may be required during the execution of the contract.

The approval by the engineer of a programme shall have no contractual significance other than that the engineer will be satisfied that the work is carried out according to the programme. The said approval shall not limit the right of the engineer to instruct the contractor to vary the programme if necessary.

NOTE: The contractor shall organise his work to cause the minimum inconvenience to the Department/Client Department's personnel and operations.

S.4. Equipment specifications

All surveys are to be executed by means of calibrated equipment that conforms to the specifications below. Calibration certificates of all equipment need to be submitted to the Departmental Project Manager prior to commencement of work.

Specifications applicable to differential levelling equipment for deformation monitoring surveys are as follows:

S.4.1. Instruments

Instrumentation used shall meet the requirements for precise geodetic levelling, employing either compensator levels with micrometers or bar code digital levels.

The instrument will be an automatic level with telescope magnification of 40 times or better, a compensator and a parallel plate micrometer capable of 0,1mm readings.

The digital level compensator must be 0,3 seconds or better and a working range of ±15 minutes or better.

Instrument accuracy for a double run must be 0,4mm or better.

S.4.2. Staves

Levelling staves shall be an invar, double scale rod, with graduations equal to the range of the parallel plate micrometer or bar coded invar stave for the digital level.

S.4.3. Change points

Only heavy-duty precise level change points are to be used, not normal change points.

S.4.4. Tripods

Use sturdy, heavy-duty tripods.

S.4.5. Calibration requirements

Prior to conducting levelling operations the following calibrations will be performed:

a) Precise level staves and survey instruments must have a valid laboratory calibration certificate;

b) Collimation error shall be determined each day before commencing with measurements.

S.4.6. Equipment testing and quality control

The contractor shall engage the services of an approved independent laboratory or other institution as applicable for quality testing, to ensure that his work complies with the Specifications.

No separate payment will be made for such testing, the cost of which will be deemed to be included in the contractor's tendered rates for the items of work that require testing in accordance with the Specifications.

This in particular also refers to the calibration of all survey equipment to be used on site.

S.5. Levelling procedures

When determining elevation by precise levelling, the following guidelines must be followed:

S.5.1. Sections

Sections shall not exceed one kilometre in length. Level lines will be run in two directions, preferably by two different observers (observer A – forward run; observer B – reverse run).

S.5.2. Rod index error

An even number of set ups will be made for all differential level section runs in order to eliminate possible rod index errors.

Each section shall start and end with the same stave (e.g. stave A) on the Benchmark or reference point. The instrument shall be levelled with the telescope pointing towards stave A, thus alternating towards the back sight and foresight at alternate instrument stations.

S.5.3. Stave readings

Observing and recording are similar to conventional levelling procedures. The readings will be recorded manually in the field book or electronically to **(*)** 0,01mm. Level sketches and abstracts shall also be prepared.

S.5.4. Line of sight

The maximum length of the line of sight should not be more than **(*)** 50m. Foresight and hindsight distances should be balanced.

S.5.5. Stave settlement

If using one level stave, it must be moved from hindsight to foresight as quickly as possible to minimize the effects of stave and instrument settlement.

S.5.6. Ground refraction

The line of sight will not be less than **(*)** 0,5m above the ground to minimize line-of-sight refraction due to higher temperature gradients near ground level.

S.5.7. Misclosure tolerance

The allowable misclosure for a double run is as follows:

Survey in general:

a) Primary lines: $3 \text{ x } (\text{km})^{\frac{1}{2}}$
b) Secondary lines: $7{,}5 \text{ x } (\text{km})^{\frac{1}{2}}$

Deflection surveys

a) Tarred and concrete surfaces = 0.2x√set ups: $0{,}2 \text{ x } (\text{no. of set ups})^{\frac{1}{2}}$
b) Other: $0{,}3 \text{ x } (\text{no. of set ups})^{\frac{1}{2}}$

S.5.8. Levelling recordings

All surveys are to be recorded in the format as attached in Appendix A or as per a format agreed upon by the Departmental Project Manager. The original field information from survey cycles must be submitted to the Departmental Project Manager after each survey.

S.5.9. Reporting

The levels of all points must be provided in printed and digital format to the engineer after each recording cycle.

The level of each point shall be indicated on a single A4 sheet with height on the horizontal axis and date on the vertical axis.

The time axis must provide subdivision suitable for the complete duration of a 36 months monitoring period. Subdivisions on both the level and time axes are to be in accordance with a predefined constant

height or time scale for all points. The vertical axis must indicate the initial height of the levelling point as the zero line and any positive or negative movement must be indicated on a scale of 1:10 (1mm movement = **(*)**10mm on graph).

Each report shall indicate the complete list of points with a notation of (S) for points surveyed and (NS) for points not surveyed.

The report shall also indicate:

a) Date of survey;
b) Temperature;
c) Reason (normal cycle or ad-hoc call out);
d) List of points surveyed;
e) Level graph for all surveyed points;
f) Tabulated result of all previous and current surveys;
g) Summary report of findings.

The contractor must provide a pro-forma report to the engineer for acceptance.

S.6. List of points and survey cycle

The engineer shall provide list of the survey stations, control beacons and survey points to be installed.

Each survey point as determined for precise levelling shall be provided with a predetermined/proposed time schedule of levelling frequency.

NOTE: The initial schedule of three survey cycles are at the beginning of any precise levelling project, which must be completed within the first 14 days after the installation of the points. Each cycle is to be executed on a different day. This control survey is inclusive of the cost of the installation of the survey points.

S.7. Workmanship and quality control

The onus to produce work that conforms in quality and accuracy to the requirements of the specifications and drawings rests with the contractor, and the contractor shall, at his own expense, institute a quality/control system and provide experienced surveyors and other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times.

The cost of supervision and process control, including testing carried out by the contractor, will be deemed to be included in the rates tendered for the related items of work.

S.8. Measurement and payment

All project payments shall be monthly and based on the data as captured in submitted reports.

The installation of all beacons are payable after installation and submission of the first three cycle control survey reports.

S.8.1. Survey base stations

Payment: Install complete survey base station as per Detail Type DT 05/SB. The price shall include the installation of 8 x 180mm diameter, 1200mm long concrete bollards around the station (similar to Detail Type DT 02/SB).

Unit rate: no

S.8.2. Control beacons

Payment: Install complete control beacon on rock as per Detail Type DT 02/SB, Drilling of the borehole measured elsewhere. Price to include the concrete and steel bottom rod to a depth of 6m down the hole as well as the 4 x 180mm diameter, 1200mm long concrete bollards around the station.

Unit rate: no

S.8.3. Installation of survey points

S.8.3.1. Survey points in road/runway

Payment: Install complete survey point in road/runway surface as per Detail Type DT 01/SB.

Unit rate: no

S.8.3.2. Survey points in concrete

Payment: Install complete survey point in concrete as per Detail Type DT 06/SB.

Unit rate: no

S.8.3.3. Levelling pins against building

Payment: Install complete levelling pin against building as per Detail Type DT 04/SB.

Unit rate: no

S.8.3.4. Survey points in open cield

Payment: Install complete survey point in open field as per Detail Type DT 03/SB.

Unit rate: no

S.8.4. Site establishment for each measuring cycle

Payment: Site establishment include all control surveys to ensure integrity of survey base stations as well as control beacons. Site establishment cost must cover all overhead, transport, consumable and related cost and is independent of the number of points included in the survey cycle.

Unit rate: no

S.8.5. Survey of points

Each survey cycle will include points as indicated below. The rate for surveying of each point includes the updating and printing of a time-height graph as well as the printed and electronic submission of the levelling data. A preliminary schedule of points for each survey cycle is included in the Technical Specifications but is subject to change by the Department.

S.8.5.1. Survey points in road/runway

Payment: Survey of point in road surface as per DT 01/SB.

Unit rate: no

S.8.5.2. Survey points in concrete

Payment: Survey of point in concrete as per DT 06/SB

Unit rate: no

S.8.5.3. Levelling pins against building

Payment: Survey of levelling pin against building as per DT 04/SB

Unit rate: no

S.8.5.4. Survey points in open field

Payment: Survey of point in open field as per DT 03/SB

Unit rate: no

S.8.6. Report of survey cycle

Payment: Provide a written report of the findings of the survey and indicate the relative movement (if any) of all points in a tabulated manner. Report must also include the time - height graphs as required

Unit rate: sum

S.8.7. Emergency / ad-hoc call outs

The ad-hoc call outs will be initiated by the engineer. The engineer will indicate the points to be surveyed during each call out.

S.8.7.1. Land surveyor and support staff travelling and site survey time

Payment: The rate shall include all professional and technical costs related to travelling and site work for a survey as requested by the engineer. It is expected that the contractor responds to such call outs within three hours. A maximum of three hours will be allowed for on-site controlee surveys (not the points indicated by the engineer).

Unit rate: R/hour

S.8.7.2. All-inclusive travelling cost of personnel and equipment to site

Payment: The travelling distance shall be measured from the contractor's official business premises (maximum travel distance allowed is 30km).

Unit rate: km

S.8.7.3. Report of ad-hoc call out

Payment: Provide a written report of the findings of the survey and indicate the relative movement (if any) of all points in a tabulated manner. Report must also include the time - height graphs for all points surveyed.

Unit rate: hour

Annex S: Appendix A: Details and Forms

The acceptable details for machine base plates are shown in Plates 1 to 3, as follows:

PLATE 1 UNIVERSAL 5/8” MACHINE BASE PLATE (TOP VIEW)
PLATE 2 UNIVERSAL 5/8” MACHINE BASE PLATE (BOTTOM VIEW)
PLATE 3 UNIVERSAL 5/8” MACHINE BASE PLATE (SECTION VIEW)

The proposed format for the recording of surveys is given as:

Field form: Precise Levelling
Table 1: Schedule of Proposed Survey Base Stations
Table 2: Schedule of Proposed Control Beacons
Table 3: Schedule of Proposed Levelling Points and Levelling Cycle

The following typical drawings are contained in Volume 3 of ManualPW344/2016 and shall be issued as part of the tender documentation (if applicable). Where applicable, drawings may be re-issued to the contractor at the commencement of the contract.

TYPE DT 01/SB - SURVEY POINT IN ROADS SURFACE
TYPE DT 02/SB - CONTROL BEACON ON ROCK
TYPE DT 03/SB - SURVEY POINT IN OPEN FIELD
TYPE DT 04/SB - LEVELLING PIN AGAINST BUILDING
TYPE DT 05/SB - SURVEY BASE STATION
TYPE DT 06/SB - SURVEY POINT IN CONCRETE

PLATE 1: UNIVERSAL 5/8” MACHINE BASE PLATE (TOP VIEW)

PLATE 2: UNIVERSAL 5/8” MACHINE BASE PLATE (BOTTOM VIEW)

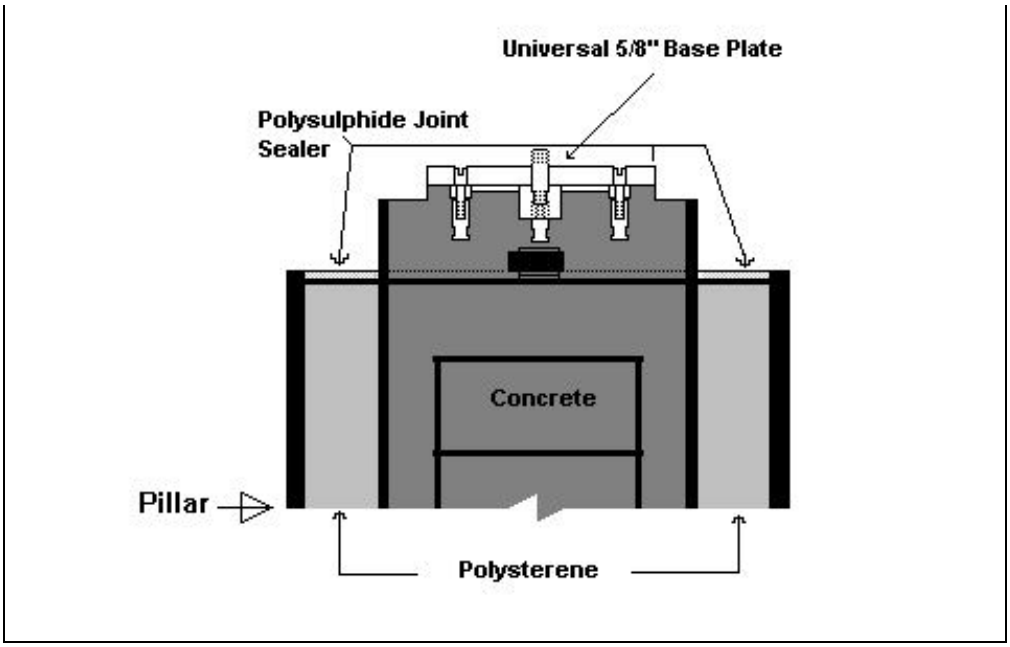


PLATE 3: UNIVERSAL 5/8” MACHINE BASE PLATE (SECTION VIEW)

DEPARTMENT OF PUBLIC WORKS

PRECISE LEVELLING

SITE .... **MEAS:** .... **ROUTE:** ....

POINT	RECORD NUM	FORWARD Meter	REVERSE Meter	RECORD NUM	DIFF mm	RECORD NUM	RE-LEV 1 Meter	RE-LEV 2 Meter	RECORD NUM
TOTAL:									

OBSERVER: ....

DATE: ....

INSTRUMENT Nr: ....

STAVE	Nr	CONST
ALT		

Page: ....

TABLE 1: SCHEDULE OF PROPOSED SURVEY BASE STATIONS

SURVEY POINT NUMBER	LOCATION	X CO-ORDINATE	Y CO-ORDINATE	ELEVATION	SURVEY FREQUENCY

TABLE 2: SCHEDULE OF PROPOSED CONTROL BEACONS

SURVEY POINT NUMBER	LOCATION	X CO-ORDINATE	Y CO-ORDINATE	ELEVATION	SURVEY FREQUENCY

TABLE 3: SCHEDULE OF PROPOSED LEVELLING POINTS AND SURVEY FREQUENCY

SURVEY POINT NUMBER	LOCATION	X CO-ORDINATE	Y CO-ORDINATE	ELEVATION	SURVEY FREQUENCY

Annex T: Amendments to Standard Specifications SANS 1200 L, LB, LD, LE

AMENDMENTS TO STANDARD SPECIFICATION SANS 1200 L : MEDIUM-PRESSURE PIPELINES

PSL: MEDIUM-PRESSURE PIPELINES

PSLC1. INTERPRETATION

PSLC1.1 Definitions (Sub-Clause 2.3)

Substitute item b) with:

Any process of jointing, including butt and fusion welding of HDPE plain ended pipes to one another and to specials, valves and hydrants.

PSLC1.2 Abbreviations (Sub-Clause 2.4)

For "AC : Asbestos Cement" in third line read "FC : Fibre Cement" and read "FC" for "AC" wherever the latter appears throughout the Standardised Specification.

Add the following:

GRP : Glass fibre reinforced thermosetting plastic

HDPE : High density polyethylene

PE : Polyethylene

PSLC2. MATERIALS

PSLC2.1 General (Sub-Clause 3.1)

Add:

Pipes shall be handled and stored in accordance with the manufacturer's instructions.

PSLC2.2 FC Pipes and Specials (Sub-Clause 3.2)

In the first and second lines delete the words SABS 286 for COD pipes or SABS 946 for CID pipes and substitute SANS 1223.

PSLC2.3 Steel Pipes, Fittings and Specials (Sub-Clause 3.4)

PSLC2.3.1 Pipes of Nominal Bore up to 150mm (Sub-Clause 3.4.2)

Substitute Sub-Clause 3.4.2 with:

Steel pipes shall comply with the requirements of SANS 62-1 for a medium duty pipe which is galvanized inside and outside with a silicon content in the range 0,135 % to 0,30 %. Such pipes shall be supplied in a galvanized condition with plastic caps.

Screwed pieces and fittings shall be medium fittings complying with the requirement of SANS 62-2 and shall be galvanized inside and outside. Alternatively, fittings shall satisfy the requirements of SANS 14 / ISO 49.

A certificate stating that each consignment complies with the requirements of SANS 62-1 or SANS 62-2 shall be provided.

Fabricated flanged steel pipes shall comply with the requirements of SANS 1476 and have flanges complying with the requirements of SANS 1123, be fabricated from pipes complying with the requirements of SANS 62-2 and be hot dip galvanized.

PSLC2.4 Other Types of Pipes (Sub-Clause 3.7)

Delete Sub-Clauses 3.7.1 and 3.7.2 and replace with:

PSLC2.4.1 HDPE pipes (new Sub-Clause 3.7.1)

PSLC2.4.1.1 General Requirements (New Clause 3.7.1.1)

HDPE pipes shall comply with the requirements of SANS 4427 / ISO 4427. Pipes shall preferably be joined by means of butt welding as per the requirements of SANS 4427 but mechanical joint compression fittings complying with the requirements of SANS 14236 / ISO 14236 may also be used where permitted. Where permitted in terms of the specification data, pipes may be joined together by means of suitable push fit, heated tool socket weld or electro fusion fittings recommended by the pipe manufacturer or butt fusion.

HDPE pipes may be supplied and stored in coils provided that the diameter of the coil is at least 24 times the pipe diameter or 600mm.

PSLC2.4.1.2 Quality Assurance (New Sub-Clause 3.7.1.2)

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of quality control procedures, which shall ensure that the product will meet the requirements of this specification. The manufacturer/supplier shall maintain a quality system that conforms to the requirements of SANS 9001 / ISO 9001:2000 or national equivalent. Applicable standard for manufacture of pipe shall be SANS 4427 / ISO 4427.

For all relevant requirements, certification or testing that may be necessary for quality assurance of raw material supply, manufacturing standards, equipment used in manufacturing or tests to ensure standards are met, refer to SANS 4427 / ISO 4427, SANS 10268, SANS 10269, SANS 10270, SANS 1655, SANS 1671, SANS 21138, SANS 674, ISO 9969 and relevant specifications.

The manufacturer/supplier shall submit the following documents prior to delivery of material to site:

- Certificate of Registration - SANS 9001/SANS ISO 9001 or National equivalent;
- Permit Certification - SANS 4427/SANS ISO 4427 for PE100;
- Quality Control Plan (QCP shall include Raw Material and Product Test Certificates);
- Last two audit reports according to SANS or National equivalent.

The manufacturer must unconditionally guarantee all HDPE products for a period of 100 years against any form of chemical decomposition or mechanical failure as a result of normal use in a 100-year lifecycle of expected pressures.

PSLC2.4.1.3 General Product Requirements (New Sub-Clause 3.7.1.3)

PSLC2.4.1.3.1 General (New Sub-Clause 3.7.1.3.1)

All finished HDPE products shall be free from cracks, voids, foreign inclusions and other defects, which would impair the overall performance. It shall be smooth walled on inside and outside and shall conform to the requirements (characteristics) outlined below.

PSLC2.4.1.3.2 Characteristics of Raw Material (New Sub-Clause 3.7.1.3.2)

Raw material composition for pipes, fittings (e.g. stubs) and other elements (e.g. sheeting for benching) shall be PE 100 pre-compounded black.

PSLC2.4.1.3.3 Technical Specification for Raw Material and Finished Product (New Sub-Clause 3.7.1.3.3)

Physical/Chemical Property	Standard	Value	Unit
Density	ISO 1183	0,949 – 0,960	g/cm³
Melt Flow Index (190°C/5kg)	ISO 1133	0,25 – 0,35	g/10min
Vicat Softening Point	ISO 306	64 – 68	°C
Crystalline Melting Range	ISO 3146-85	130 – 135	°C
Viscosity Number	ISO 1628-3	390	cm³/g

Mechanical Property	Standard	Value	Unit
Shore D, Hardness	ISO 868	61	–
Elastic Modulus	ISO 527	900	MPa
Tensile Yield	ISO 527 / ISO 6259	24	MPa
Ultimate Tensile Strength	ISO 527 / ISO 6259	35	MPa
Ultimate Elongation	ISO 527 / ISO 6259	>600	%
Flexural Stress (3.5% Deflection)	ISO 178	19	MPa
Thermal Stability (OIT @ 210°C)	ISO 10837	≥20	minutes
Carbon Black Content	ASTM D 1603 / ISO 6964	2,25 +/- 0,25	%

PSLC2.4.1.3.4 Pipe Characteristics (New Sub-Clause 3.7.1.3.4)

Characteristics	Applicable Standard
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness @ any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

PSLC2.4.1.4 Fittings and Specials (New Sub-Clause 3.7.2)

All HDPE fittings and specials shall be fabricated from pipe complying with the requirements of PSL2.4.1.1. In addition, all pipe fittings and specials shall be free of weld spatter and all sharp corners and edges shall be chamfered smooth.

Welders who are competent in terms of the relevant procedure approval test shall carry out all welding and proof of such competency may be required by the Engineer.

PSLC2.4.2 GRP Pipes (new Clause 3.7.3)

GRP pipes and jointing systems shall comply with the requirements of SANS 1748-1 and, unless otherwise specified in the specification data, have a nominal pressure (PN) class of 12, a pipe stiffness (SN) class of 630 and be certified for conveying potable water.

PSLC2.4.3 Steel mesh reinforced PE pipes (New Clause 3.7.4)

Steel mesh reinforced polyethylene (PE) pipes shall comply with the requirements of SANS 370 and a have a PN 16 nominal pressure rating for pipes with a diameter of up to 160mm. Such pipes shall be joined by means of either an electrofusion coupling or flanged fitting complying with the requirements of SANS 371.

PSLC2.4.4 Polypropylene (New Clause 3.7.5)

Polypropylene pipes shall comply with the requirements of SANS 15874 and shall be class PN10 for pipes with a diameter of up to 160mm.

Polypropylene pipes shall be joined together by means of mechanical joint compression fittings complying with the requirements of SANS 10268. Pipes may be joined together by means of suitable heated tool socket weld fittings recommended by the pipe manufacturer or butt fusion.

PSLC2.4.5 uPVC pipes (New Clause 3.7.6)

uPVC pipes shall be stored, handled and transported in accordance with the requirements of SANS 10112.

uPVC pipes and fittings shall comply with the requirements of SANS 966-1 and, in the case of pipes with a diameter up to 160mm shall be Class PN10. Pipes may be joined by means of rubber ring joints or solvent weld joints.

PSLC2.4.6 Copper pipes and fittings (New Clause 3.7.7)

Copper pipes shall comply with the relevant requirements of SANS 460, and fittings shall be mechanical joint compression fittings complying with the requirements of SANS 1067-1.

PSLC2.5 Jointing Materials (Sub-Clause 3.8)

PSLC2.5.1 Pipe Joints (New Sub-Clause 3.8.8)

All properties of pipe joints designed by the manufacturer must always exceed or be equivalent to the base parent pipe (i.e. joints shall not decrease the tensile strength properties of the overall pipeline.)

PSLC2.6 Manholes and Surface Covers (Sub-Clause 3.11)

PSLC2.6.1 Precast Cylinders (Sub-Clause 3.11.2)

Change the title to “Prefabricated Cylinders” and add the following:

For dolomite underlain land manholes, inspection chambers and surface boxes shall preferably be manufactured from structured or solid wall HDPE or steel-reinforced spirally wound HDPE pipes and shall be watertight.

HDPE structured wall pipes shall be manufactured according to SANS 21138 or SANS 674 in terms of profile, pipe fittings and pipe endings, but with stainless steel stiffeners and 5mm minimum wall thickness.

HDPE solid wall pipes shall be manufactured according to SANS 4427. Ring stiffness shall be tested according to ISO 9969 with:

i. 8,0kN/m² ring stiffness for all depths
ii. 4,0kN/m² ring stiffness for depths ≤1,5m where approved.

HDPE pipes to be extrusion welded to the manhole.

Benching shall consist of HDPE (PE100 to SANS 4427) flat sheet and pipe of minimum 12mm thickness.

PSLC2.6.2 Step Irons (Sub-Clause 3.11.4)

Add “or HDPE, as appropriate” at end of sub-clause.

PSLC2.6.3 Manhole Covers and Frames (Sub-Clause 3.11.5)

PSLC2.6.3.1 Covers for HDPE Manholes, Chambers and Surface Boxes (New Sub-Clause 3.11.5.3)

For HDPE manholes, inspection chambers and surface boxes, the manhole roof shall be an integral part of the chamber wall to form a watertight chamber. The cover (lid) shall be lockable and manufactured from a material that has no monitory value (i.e. steel and CI lids are not acceptable).

PSLC3. CONSTRUCTION

PSLC3.1 Depths and Cover (New Sub-Clause 5.1.4.6)

For HDPE, GRP and PVC pipes the minimum soil cover shall be:

Average	:	750mm
Outside traffic areas	:	600mm
Inside traffic areas	:	1000mm

Where these minimum thicknesses cannot be met appropriately designed concrete slabs shall be used as protection or if imposed loads necessitates protection.

PSLC3.2 Jointing Methods

PSLC3.2.1 **Jointing of HDPE pipes (New Sub-Clause 5.2.5)**

PSLC3.2.1.1 Welding of HDPE (New Sub-Clause 5.2.5.1)

The welding of HDPE using the heated tool butt welding and heated tool socket welding processes shall be undertaken in accordance with the requirements of SANS 10268-1 using equipment that satisfies the requirements of SANS 1671-1.

The welding of polyethylene and polypropylene pipes by means of electro fusion shall be in accordance with the requirements of SANS 10268-2. The acceptability of the weld shall be assessed in accordance with the assessment table contained in SANS 10268-10.

Welders shall, where specified, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate. Welders shall be certified by the Thermoplastics Welding Institute of SA (TWISA).

Before use, metal heating plates shall be cleaned of all traces of polyethylene remaining from previous operations to avoid inclusion of oxidized polyethylene in the weld.

The pipe ends of all pipes jointed by means of an electrofusion fitting shall be prepared prior to jointing by scraping off any surface oxide and being thoroughly cleaned with a suitable cleaner. Angle grinders shall not be used for preparing surfaces.

The two elements that are to be jointed in the butt welding process shall not be under tension or lateral stress during the welding operation.

PSLC3.2.1.2 Removal of HDPE Pipe Shavings (New Sub-Clause 5.2.5.2)

During the preparation phase of welding surfaces all care must be taken to ensure that pipe shavings are not left behind in pipes. This is of particular importance in terms of the preparation of water pipes. No system with a diameter smaller than 32mm may be connected to the main reticulation unless the main reticulation is thoroughly flushed. The same applies to the entire smaller systems prior to the installation of water meters. The portion of pipe work to individual buildings must also be flushed in reverse from pressure sustaining valves towards the meter prior to connection of the meter.

The entire system should be monitored for blockages after installation and the Engineer shall introduce measures to ensure that the rectification of blockages remains the responsibility of the Contractor for the duration of the contract up to final delivery.

PSLC3.3 HDPE Product Supply, Installation and Quality Control (New Sub-Clause 5.11)

PSLC3.3.1 Off-loading of Pipes and Fittings (New Sub-Clause 5.11.1)

The manufacturer's instructions regarding the off-loading of all HDPE pipes, fittings and manufactured items must be strictly adhered to. The specifications of such procedures must be in the site office of the contractor at all times. The Engineer must be provided with a copy of such procedures.

The Contractor must clear an area specifically for the purpose of off-loading HDPE products. This area must be free of rocks, boulders or any other foreign objects that may puncture, cut or scar the HDPE fittings, pipes and other manufactured items. The area must also be relatively level in one direction and the ponding of stormwater must not be permitted. The area must be kept in such condition for the duration of material being on site.

PSLC3.3.2 Handling of Pipes on Site (New Sub-Clause 5.11.2)

The manufacturer's specification for the handling and transporting of material on site must be strictly adhered to. The Engineer shall write a specific instruction regarding this in the absence of such a manufacturer's instruction.

Under no circumstances shall the dragging of pipes on site be allowed. Dragging of the pipe will result in cuts, scratches and puncture marks that may result in weakening of the pipe.

Welded pipes shall be transported to the point of installation in accordance with the manufacturer's specification.

PSLC3.3.3 Visual Inspection of Pipes for Defects (New Sub-Clause 5.11.3)

The Engineer will inspect all HDPE pipes for any visual defects such as cracks, deformation, wall thinning, etc. This in no means constitute approval of the pipes. It merely serves as an additional quality control feature to ensure that pipes with obvious defects are rejected from the beginning.

Pipes found to have such defects must also be brought under the attention of the supplier in writing. The suppliers must respond in writing. Copies of such cases must be forwarded to the Engineer. In the event of not resolving such cases the matter must be referred to the Technical Committee of the South African Plastic Pipe Manufacturing Association (SAPPMA) for comments in terms of SABS ISO 4427: 1996.

PSLC3.3.4 Pipe Marking (New Sub-Clause 5.11.4)

All HDPE Pipes shall be indelibly marked at 1 meter intervals with the following details:

Reference Item	Mark Printed
Trade name	Manufacturer/Supplier Name
Specification	ISO 4427 / SANS 4427
Pipe OD	e.g. 160
Pipe OD tolerance	Grade B
Wall thickness	e.g. 7.7
Nominal pressure	e.g. PN 10
Material designation	PE 100
Batch no.	Manufacturer/Supplier Trace ability
Application	SEWER or WATER or STORMWATER or "SLEEVE-WATER" or any other application

PSLC3.3.5 Inspection of Installed HDPE Pipes by Engineer (New Sub-Clause 5.11.5)

The Engineer shall be notified to inspect all HDPE pipes and fittings 24 hours prior to backfilling of trenches.

All pipes with cut, scratch, puncture marks or signs of deforming will be rejected from a quality control perspective. In such cases the Contractor must submit a certificate of approval from the pipe supplier. This document must clearly state that the supplier approves the integrity of the pipes irrespective of the noted damages. If such an approval certificate is not supplied, the Engineer reserves the right to reject such parts of the installation as he/she sees fit.

Any dispute in this regard must be referred to the Departmental Project Manager.

PSLC3.3.6 Temporary Connections (New Sub-Clause 5.11.6)

All temporary connections to water systems shall not be backfilled unless with the express instruction, in writing, of the Engineer. The installation shall, as a rule, be left open and barricaded as per the contractual standards until the permanent connections are made.

PSLC4. TESTING

PSLC4.1 Testing of HDPE Pipes (New Sub-Clause 7.3.4)

PSLC4.1.1 General (New Sub-Clause 7.3.4.1)

Testing as contained in ISO 4427 / SANS 4427 shall apply. Tests shall also be conducted ad-hoc by a registered and authorised testing body as approved by the Department of Public Works.

PSLC4.1.2 Raw Material Acceptance Tests (New Sub-Clause 7.3.4.2)

The material used for the production of the pipes and fittings or structures shall be high-density polyethylene (HDPE) PE 100. To confirm the quality of this product, the following tests shall be performed:

- Density
- Melt Flow Index
- Carbon Black content
- Carbon Black distribution

PSLC4.1.3 Testing of HDPE welding (New Sub-Clause 7.3.4.3)

For weld joint evaluation, water pipes are classified as Assessment Class I, according to SANS 10268-10. Tests on welds shall be performed according to the requirements of SANS 6269 and all pipe system weld factors shall be ≥1.

The Contractor shall submit to the Engineer the results of tensile, bend and peel tests performed according to SANS 6269 by the manufacturer on each batch of HDPE pipe delivered to site.

The Engineer shall visually inspect all welds on site, including welding rod property evaluation as required.

The Engineer shall have 1% of all welds performed removed (sampled) and tested for tensile strength according to SANS 6269 by an approved independent and accredited testing facility.

PSLC4.1.4 Pressure testing of HDPE pipes in Laboratory (New Sub-Clause 7.3.4.4)

The Contractor shall provide for quick pressure testing of all pipe sizes delivered to site with at least:

- One test per 500m of pipe having a diameter less than 75mm (OD).
- One test per 250m for all pipes having a diameter exceeding 75mm (OD).

  The pressure test involves:

  - Selection of 3 samples, at random by the independent test laboratory, of pipes having a minimum length of 1,0m with all relevant pipe markings on and free of scratches and defects.
  - Conditioning of the pipe or fitting in water for 12 hours at 20°C.
  - Standard pressure test procedures according to ISO 4427.
  - Failure test: apply internal pressure at 5bar/min until failure - PE 100 pipes must reach a pressure of at least twice the Minimum Required Strength (MRS) as per ISO 4427 / SANS 4427.
  - Upon failure of the test procedure as described above, standard pressure test procedures as per SABS ISO 4427 must be applied.

PSLC4.1.5 Permissible Leakage Rates (New Sub-Clause 7.3.4.5)

The permissible leakage rate shall be zero.

PSLC4.1.6 Testing of HDPE pipe sections (New Sub-Clause 7.3.4.6)

All completed pipelines shall be satisfactorily tested hydrostatically and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Hydrostatic tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of hydrostatic testing and for the supply of all equipment, materials and labour required.

The test pressure for field testing shall be 1,5 times the maximum working pressure.

The test pressure applied over any section under test, taking any differences in elevation along the pipeline into account shall be such that the pressure at any point along the section is not more than 1,5 times the maximum working pressure of the pipe.

The test procedure shall be as follows:

- Fill the pipe section with potable water and leave overnight;
- Gradually increase the pressure over a period of 3 hours to 100% of the maximum working pressure;
- Inspect the pipe for visual leaks and should leaks be observed, gradually decrease the pressure to zero and repair the leaks;
- Repeat the last two steps until no visual leaks occur;
- Then increase the pressure to 150% of the maximum working pressure and close the valve to maintain the pressure. After one hour measure the pressure. To pass the test, zero leakage (i.e. zero pressure drop) shall be recorded;
- Upon successful completion of the test, gradually decrease the pressure to zero over a period of 3 hours;
- If the test fails, find the leak(s) and repair it before repeating the test until a successful result is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

PSLC5. MEASUREMENT AND PAYMENT

PSLC5.1 Scheduled Items (Sub-Clause 8.2)

PSLC5.1.1 Quality assurance of HDPE welded joints (New Sub-Clause 8.2.16)

(a) Independent quality control testing of HDPE welded joints .....Unit : Prov Sum

(b) Percentage charges and profit on (a) ..... Unit : Percentage

The stated provisional sum shall cover the cost for the independent quality control of the welding operations, quality control systems and testing as ordered by the Engineer. The expenditure of this scheduled item is at the discretion of the Engineer and does not relieve the contractor of his obligation to do normal quality control as stipulated.

PSLC5.1.2 Special Tests Requested by the Engineer (New Sub-Clause 8.2.17)

a) Pipeline acceptance control and testing by an independent

inspectorate.....Unit: Prov. Sum

b) Percentage charges and profit on a)..... Unit: Percentage

The stated provisional sum shall allow for conducting factory and on site inspections and adjudication of test records that are relevant to the construction of the pipeline (e.g. welds, lining, coating and repairs, etc.) by an independent inspectorate appointed by the Engineer to act on his behalf.

APPENDIX A: APPLICABLE STANDARDS

Add the following:

SANS 14 / ISO 49	*Malleable cast iron fittings threaded to ISO 71*
SANS 62-1	*Steel pipes: Part 1 Pipes suitable for threading and of nominal size not exceeding 150mm*
SANS 62-2	*Steel pipes: Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150mm*
SANS 191	*Cast steel gate valves*
SANS 226	*Water taps (metallic)*
SANS 370	*Steel mesh reinforced polyethylene (PE) pipes for water supply*
SANS 371	*Steel mesh reinforced polyethylene (PE) pipe fittings for water supply*
SANS 460	*Copper and copper alloy tubing*
SANS 533	*Black polyethylene pipes for the conveyance of liquids*
SANS 664	*Cast iron valves for waterworks*
SANS 674	*Steel-reinforced spirally wound PE drainage and sewer pipes*
SANS 776	*Copper alloy valves – heavy duty*
SANS 966-1	*Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems*
SANS 1067	*Copper-based fittings for copper tubes*
SANS 1123	*Pipe Flanges*
SANS 1128-1	*Fire-fighting equipment Part 1: Components of underground and above ground hydrant systems*
SANS 1223	*Fibrecement pressure pipes and couplings*
SANS 1294	*Precast concrete manhole sections and slabs*
SANS 1476	*Fabricated flanged steel pipework*
SANS 1655	*Welding of thermoplastics - Welding rods, fillers and solvents*
SANS 1671-1	*Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding*
SANS 1671-2	*Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding*
SANS 1671-3	*Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding*
SANS 1671-4	*Welding of thermoplastics - Machines and equipment Part 4: Hog gas extrusion welding*
SANS 1748	*Glass-fibre-reinforced thermosetting plastic (GRP) pipes*
SANS 1808-13	*Water supply and distribution system components Part 13: Diaphragm valves*
SANS 1808-15	*Water supply and distribution system components Part 15: Mechanical backflow prevention devices*
SANS 1808-31	*Water supply and distribution system components Part 31: Automatic control valves*
SANS 1808-32	*Water supply and distribution system components Part 32: Float valves (equilibrium type)*
SANS 1808-44	*Water supply and distribution system components Part 44: Pipe saddles*
SANS 1808-45	*Water supply and distribution system components Part 45: Pipe repair clamps*
SANS 1882	*Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames*
SANS 10112	*The installation of polypropylene and polyvinyl chloride (UPV-C and PVC-M) pipes*
SANS 10268-1	*Welding of thermoplastics – Welding processes Part 1: Heated tool welding*

SANS 10268-2	*Welding of thermoplastics – Welding processes Part 2: Electrofusion welding*	
SANS 10268-3	*Welding of thermoplastics - Welding processes Part 3: Hot gas welding*	
SANS 10268-4	*Welding of thermoplastics – Welding processes Part 4: Hot gas extrusion welding*	
SANS 10268-10	*Welding of thermoplastics – Welding processes Part 10: Weld defects*	
SANS 10269	*Welding of thermoplastics – Testing and approval of welders*	
SANS 10270	*Welding of thermoplastics - Approval of welding procedures and welds*	
SANS 10403	*Formatting and compilation of procurement documents*	
SANS 4427 / ISO 4277	*Polyethylene (PE) pipes for water supply specifications*	
SANS 14236 / ISO 14236	*Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems*	
SANS 15874	*Plastic piping systems for hot and cold water*	
SANS 21138	*Plastics piping systems for non-pressure underground drainage and sewerage*	
SANS 50545 EN545	*Ductile iron pipe, fittings, accessories and their joints for water pipelines Requirements and test methods*	
SANS 1200 A	*Civil engineering construction:*	*General*
SANS 1200 AA	*Civil engineering construction:*	*General (small works)*
SANS 1200 D	*Civil engineering construction:*	*Earthworks*
SANS 1200 DA	*Civil engineering construction:*	*Earthworks (small works)*
SANS 1200 DB	*Civil engineering construction:*	*Earthworks (pipe trenches)*
SANS 1200 G	*Civil engineering construction:*	*Concrete (structural)*
SANS 1200 GA	*Civil engineering construction:*	*Concrete (small works)*
SANS 1200 LB	*Civil engineering construction:*	*Bedding (pipes)*
SANS 1200 LK	*Civil engineering construction:*	*Valves (medium-pressure)*
SANS 2001 DP2	*Construction works 9 Part Dp2:*	*Medium Pressure pipelines*

AMENDMENTS TO STANDARD SPECIFICATION
SANS 1200 LB : BEDDING (PIPES)

PSLB: BEDDING (PIPES)

PSLB1. INTERPRETATION

PSLB1.1 Supporting Specifications (Sub-Clause 2.1.1 and 2.1.2)

Change all references to "SABS 1200 …" to "SANS 1200 …". This shall also apply throughout the Standardised Specification.

Any process of jointing, including butt and fusion welding of HDPE plain ended pipes to one another and to specials, valves and hydrants.

PSLB2. MATERIALS

PSLB2.1 Selected Granular Material (Sub-Clause 3.1)

Add:

In the case of dolomite underlain land the use of non-cohesive singularly graded sand or crusher sand shall not be used for bedding, selected fill blanket and backfill of the trench to ensure that the bedding and fil blankets shall not allow free draining. The material used for bedding, selected fill blanket and backfill shall have a maximum particle size of 6mm and permeability that is lower than that of the surrounding in situ soil.

PSLB3. CONSTRUCTION

PSLB3.1 General (Sub-Clause 5.1)

PSLB3.1.1 **Placing (Sub-Clause 5.1.3)**

Add to Sub-Clause 5.1.3.2:

In the case of dolomite underlain land joint holes shall not be filled with granular material, but only with material conforming with the requirements of PSL2.1.

PSLB3.1.2 **Compacting (Sub-Clause 5.1.4)**

Add:

In the case of dolomite underlain land the required compaction shall be at least 93% of modified AASHTO maximum dry density at optimum moisture content or the density of the surrounding in situ soil, whichever is higher.

PSLB4. APPENDIX A: APPLICABLE STANDARDS

PSLB4.1 Change all references from "SABS 1200 …" to "SANS 1200 …" and add:

SANS 1936 Development of Dolomite Land, Parts 1, 2, 3 and 4.

APPENDIX A: APPLICABLE STANDARDS

Add the following:

SANS 14 / ISO 49	*Malleable cast iron fittings threaded to ISO 71*
SANS 62-1	*Steel pipes: Part 1 Pipes suitable for threading and of nominal size not exceeding 150mm*
SANS 62-2	*Steel pipes: Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150mm*
SANS 191	*Cast steel gate valves*
SANS 226	*Water taps (metallic)*
SANS 370	*Steel mesh reinforced polyethylene (PE) pipes for water supply*
SANS 371	*Steel mesh reinforced polyethylene (PE) pipe fittings for water supply*
SANS 460	*Copper and copper alloy tubing*
SANS 533	*Black polyethylene pipes for the conveyance of liquids*
SANS 664	*Cast iron valves for waterworks*
SANS 674	*Steel-reinforced spirally wound PE drainage and sewer pipes*
SANS 776	*Copper alloy valves – heavy duty*
SANS 966-1	*Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems*
SANS 1067	*Copper-based fittings for copper tubes*
SANS 1123	*Pipe Flanges*
SANS 1128-1	*Fire-fighting equipment Part 1: Components of underground and above ground hydrant systems*
SANS 1223	*Fibrecement pressure pipes and couplings*
SANS 1294	*Precast concrete manhole sections and slabs*
SANS 1476	*Fabricated flanged steel pipework*
SANS 1655	*Welding of thermoplastics - Welding rods, fillers and solvents*
SANS 1671-1	*Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding*
SANS 1671-2	*Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding*
SANS 1671-3	*Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding*
SANS 1671-4	*Welding of thermoplastics - Machines and equipment Part 4: Hog gas extrusion welding*
SANS 1748	*Glass-fibre-reinforced thermosetting plastic (GRP) pipes*
SANS 1808-13	*Water supply and distribution system components Part 13: Diaphragm valves*
SANS 1808-15	*Water supply and distribution system components Part 15: Mechanical backflow prevention devices*
SANS 1808-31	*Water supply and distribution system components Part 31: Automatic control valves*
SANS 1808-32	*Water supply and distribution system components Part 32: Float valves (equilibrium type)*
SANS 1808-44	*Water supply and distribution system components Part 44: Pipe saddles*
SANS 1808-45	*Water supply and distribution system components Part 45: Pipe repair clamps*
SANS 1882	*Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames*
SANS 10112	*The installation of polypropylene and polyvinyl chloride (UPV-C and PVC-M) pipes*
SANS 10268-1	*Welding of thermoplastics – Welding processes Part 1: Heated tool welding*

SANS 10268-2	*Welding of thermoplastics – Welding processes Part 2: Electrofusion welding*	
SANS 10268-3	*Welding of thermoplastics - Welding processes Part 3: Hot gas welding*	
SANS 10268-4	*Welding of thermoplastics – Welding processes Part 4: Hot gas extrusion welding*	
SANS 10268-10	*Welding of thermoplastics – Welding processes Part 10: Weld defects*	
SANS 10269	*Welding of thermoplastics – Testing and approval of welders*	
SANS 10270	*Welding of thermoplastics - Approval of welding procedures and welds*	
SANS 10403	*Formatting and compilation of procurement documents*	
SANS 4427 / ISO 4277	*Polyethylene (PE) pipes for water supply specifications*	
SANS 14236 / ISO 14236	*Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems*	
SANS 15874	*Plastic piping systems for hot and cold water*	
SANS 21138	*Plastics piping systems for non-pressure underground drainage and sewerage*	
SANS 50545 EN545	*Ductile iron pipe, fittings, accessories and their joints for water pipelines Requirements and test methods*	
SANS 1200 A	*Civil engineering construction:*	*General*
SANS 1200 AA	*Civil engineering construction:*	*General (small works)*
SANS 1200 D	*Civil engineering construction:*	*Earthworks*
SANS 1200 DA	*Civil engineering construction:*	*Earthworks (small works)*
SANS 1200 DB	*Civil engineering construction:*	*Earthworks (pipe trenches)*
SANS 1200 G	*Civil engineering construction:*	*Concrete (structural)*
SANS 1200 GA	*Civil engineering construction:*	*Concrete (small works)*
SANS 1200 LB	*Civil engineering construction:*	*Bedding (pipes)*
SANS 1200 LK	*Civil engineering construction:*	*Valves (medium-pressure)*
SANS 2001 DP2	*Construction works 9 Part Dp2:*	*Medium Pressure pipelines*

AMENDMENTS TO STANDARD SPECIFICATION
SANS 1200 LC : CABLE DUCTS

PSLC: CABLE DUCTS

PSLC1. INTERPRETATION

PSLC1.1 Supporting Specifications (Sub-Clause 2.1)

Change all references to “SABS 1200 …” to “SANS 1200 …”. This shall also apply throughout the Standardised Specification.

PSLC1.2 Abbreviations (Sub-Clause 2.4)

Add the following:

HDPE: High density polyethylene
PE: Polyethylene

PSLC2. MATERIALS

PSLC2.1 Alternative Materials for Pipes and Joints (Sub-Clause 3.5)

PSLC2.1.1 HDPE Pipes (New Sub-Clause 3.5.1)

PSLC2.1.1.1 General Requirements (New Sub-Clause 3.5.1.1)

HDPE pipes shall comply with the requirements of SANS 4427 / ISO 4427. Pipes shall preferably be joined by means of butt welding as per the requirements of SANS 4427. Where permitted in terms of the specification data, pipes may be joined together by means of suitable push fit, heated tool socket weld or electro fusion fittings recommended by the pipe manufacturer or butt fusion.

PSLC2.1.1.2 Quality Assurance (New Sub-Clause 3.2.5.2)

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of quality control procedures, which shall ensure that the product will meet the requirements of this specification. The manufacturer/supplier shall maintain a quality system that conforms to the requirements of SANS 9001 / ISO 9001:20000 or national equivalent. Applicable standard for manufacture of pipe shall be SANS 4427 / ISO 4427.

For all relevant requirements, certification or testing that may be necessary for quality assurance of raw material supply, manufacturing standards, equipment used in manufacturing or tests to ensure standards are met, refer to SANS 4427 / ISO 4427, SANS 10268, SANS 10269, SANS 10270, Sans 1655, SANS 1671, SANS 21138, SANS 674, ISO 9969 and relevant specifications.

The manufacture/supplier shall submit the following documents prior to delivery of material to site:

- Certificate of Registration – SANS 9001/SANS ISO 9001 or National equivalent;
- Permit Certification – SANS 4427/SANS ISO 4427 for PE100;
- Quality Control Plan (QCP shall include Raw Material and Product Test Certificates);
- Last two audit reports according to SANS or National equivalent.

The manufacturer must unconditionally guarantee all HDPE products for a period of 100 years against any form of chemical decomposition or mechanical failure as a result of normal use in a 100-year lifecycle of expected pressures.

PSLC2.1.1.3 General Product Requirements (New Sub-Clause 3.5.1.3)

PSLC2.1.1.3.1 General (New Sub-Clause 3.5.1.3.1)

All finished HDPE products shall be free from cracks, voids, foreign inclusions and other defects, which would impair the overall performance. It shall be smooth walled on inside and outside and shall conform to the requirements (characteristics) outlined below.

PSLC2.1.1.3.2 Characteristics of Raw Material (New Sub-Clause 3.5.1.3.2)

Raw material composition for pipes, fittings (e.g. stubs) and other elements (e.g. sheeting for benching) shall be PE100 pre-compounded black.

PSLC2.1.1.3.3 Technical Specification for Raw Material and Finished Product (New Sub-Clause 3.2.1.3.3)

Physical/Chemical Property	Standard	Value	Unit
Density	ISO 1183	0.949 – 0.960	g/cm³
Melt Flow Index (190°C/5kg)	ISO 1133	0.25 – 0,35	g/10min
Vicat Softening Point (5kg)	ISO 306	64 – 68	°C
Crystalline Melting Range	ISO 3146-85	130 – 135	°C
Viscosity Number	ISO 1628-3	390	cm³/g

Mechanical Property	Standard	Value	Unit
Shore D, Hardness	ISO 868	61	–
Elastic Modulus	ISO 527	900 – 1000	MPa
Tensile Yield	ISO 527 / ISO 6259	24	MPa
Ultimate Tensile Strength	ISO 527 / ISO 6259	35	MPa
Ultimate Elongation	ISO 527 / ISO 6259	>600	%
Flexural Stress (3.5% Deflection)	ISO 178	19	MPa
Thermal Stability (OIT @ 210°C)	ISO 10837	≥20	minutes
Carbon Black Content	ASTM D 1603 / ISO 6964	2.25 +/- 0.25	%

PSLC2.1.1.3.4 Pipe Characteristics (New Sub-Clause 3.5.1.3.4)

Characteristics	Applicable Standard
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness @ any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

PSLC2.1.2 HDPE Pipe Joints (New Sub-Clause 3.5.2)

All properties of pipe joints designed by the manufacturer must always exceed or be equivalent to the base parent pipe (i.e. joints shall not decrease the tensile strength properties of the overall pipeline).

PSLC3. BEDDING AND COMPACTION OF BEDDING

PSLC3.1 Bedding for Dolomite Underlain land (New Sub-Clause 5.2.5)

Bedding for ducts on dolomite underlain ground shall be according to the requirements of PSLB: Bedding (Pipes).

PSLC4. DUCT LAYING

PSLC4.1 Manholes, Chambers and Draw Pits on Dolomite Land (New Sub-Clause 5.3.5)

For dolomite underlain land manholes and inspection chambers shall preferably be manufactured from structured or solid wall HDPE or steel-reinforced spirally wound HDPE pipes and shall be watertight.

HDPE structured wall pipes shall be manufactured according to SANS 21138 or SANS 674 in terms of profile, pipe fittings and pipe endings, but with stainless steel stiffeners and 5mm minimum wall thickness.

HDPE solid wall pipes shall be manufactured according to SANS 4427. Ring stiffness shall be tested according to ISO 9969 with:

i. 8,0kN/m² ring stiffness for all depths
ii. 4,0kN/m² ring stiffness for depths ≤1,5m where approved.

HDPE pipes to be extrusion welded to the manhole.

Benching shall consist of HDPE (PE100 to SANS 4427) flat sheet and pipe of minimum 12mm thickness.

PSLC4.2 Covers for HDPE Manholes, Chambers and Draw Pits (New Sub-Clause 5.3.6)

For HDPE manholes, chambers and draw pits the manhole roof shall be an integral part of the chamber wall to form a watertight chamber. The cover (lid) shall be lockable (if required) and manufactured from a material that has no monitoring value (i.e. steel and cast iron lids are not acceptable).

PSLC5. CONSTRUCTION OF HDPE PIPES, MANHOLES AND CHAMBERS (New Sub-Clause 5.12)

PSLC5.1 HDPE Pipes, Manholes and Chambers (New Sub-Clause 5.12.1)

PSLC5.1.1 Off-loading of Pipes and Fittings (New Sub-Clause 5.12.1.1)

The manufacturer's instructions regarding the off-loading of all HDPE pipes, fittings and manufactured items must be strictly adhered to. The specifications of such procedures must be in the site office of the contractor at all times. The Engineer must be provided with a copy of such procedures.

The Contractor must clear an area specifically for the purpose of off-loading HDPE products. This area must be free of rocks, boulders or any other foreign objects that may puncture, cut or scar the HDPE fittings, pipes and other manufactured items. The area must also be relatively level in one direction and the ponding of stormwater must not be permitted. The area must be kept in such condition for the duration of material being on site.

PSLC5.1.2 Handling of Pipes on Site (New Sub-Clause 5.12.1.2)

The manufacturer's specification for the handling and transporting of material on site must be strictly adhered to. The Engineer shall write a specific instruction regarding this in the absence of such a manufacturer's instruction.

Under no circumstances shall the dragging of pipes on site be allowed. Dragging of the pipe will result in cuts, scratches and puncture marks that may result in weakening of the pipe.

Welded pipes shall be transported to the point of installation in accordance with the manufacturer's specification.

PSLC5.1.3 Visual Inspection of Pipes for Defects (New Sub-Clause 5.12.1.3)

The Engineer will inspect all HDPE pipes for any visual defects such as cracks, deformation, wall thinning, etc. This in no means constitute approval of the pipes. It merely serves as an additional quality control feature to ensure that pipes with obvious defects are rejected from the beginning.

Pipes found to have such defects, must also be brought under the attention of the supplier in writing. The suppliers must respond in writing. Copies of such cases must be forwarded to the Engineer. In the event of not resolving such cases, the matter must be referred to the Technical Committee of the South African Plastic Pipe Manufacturing Association (SAPPMA) for comments in terms of SANS ISO 4427: 1996.

PSLC5.1.4 Pipe Marking (New Sub-Clause 5.12.1.4)

All HDPE Pipes shall be indelibly marked at 1 meter intervals with the following details:

Reference Item	**Mark Printed**
Trade name	Manufacturer/Supplier Name
Specification	ISO 4427 / SANS 4427
Pipe OD	e.g. 160
Pipe OD tolerance	Grade B
Wall thickness	e.g. 7.7
Nominal pressure	e.g. PN 10
Material designation	PE 100
Batch No.	Manufacturer/Supplier Trace ability
Application	SEWER or WATER or STORMWATER or "SLEEVE-WATER" or any other application

PSLC5.1.5 Inspection of Installed HDPE Pipes by Engineer (New Sub-Clause 5.12.1.5)

The Engineer shall be notified to inspect all HDPE pipes and fittings 24 hours prior to backfilling of trenches.

All pipes with cut, scratch, puncture marks or signs of deforming will be rejected from a quality control perspective. In such cases, the Contractor must submit a certificate of approval from the pipe supplier. This document must clearly state that the supplier approved the integrity of the pipes, irrespective of the noted damages. If such an approval certificate is not supplied, the Engineer reserves the right to reject such parts of the installation as he/she sees fit.

Any dispute in this regard must be referred to the Department of Public Works Project Manager.

PSLC5.2 Cover (New Sub-Clause 5.12.2)

For HDPE pipes the minimum soil cover shall be:

Average	:	750mm
Outside traffic areas	:	600mm
Inside traffic areas	:	1000mm

Where these minimum thicknesses cannot be met, appropriately designed concrete slabs shall be used as protection or if imposed loads necessitates protection.

PSLC5.3 Jointing Methods (New Sub-Clause 5.12.3

PSLC5.3.1 *Welding of HDPE (New Sub-Clause 5.12.3.1)*

The welding of HDPE using the heated tool butt welding and heated tool socket welding processes shall be undertaken in accordance with the requirements of SANS 10268-1 using equipment that satisfies the requirements of SANS 1671-1.

The welding of HDPE pipes by means of electro fusion shall be in accordance with the requirements of SANS 10268-2. The acceptability of the weld shall be assessed in accordance with the assessment table contains in SANS 10268-10.

Welders shall, where specified, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate. Welders shall be certified by the Thermoplastics Welding Institute of SA (TWISA).

Before use, metal heating plates shall be cleaned of all traces of polyethylene remaining from previous operations to avoid inclusion of oxidized polyethylene in the weld.

The end of all pipes jointed by means of an electrofusion fitting, shall be prepared prior to jointing by scraping off any surface oxide and being thoroughly cleaned with a suitable cleaner. Angle grinders shall not be used for preparing surfaces.

The two elements that are to be jointed in the butt welding process, shall not be under tension or lateral stress during the welding operation.

PSLC6. TESTING

PSLC6.1 Testing of HDPE Pipes (New Sub-Clause 7.4)

PSLC6.1.1 General (New Sub-Clause 7.4.1)

Testing as contained in ISO 4427 / SANS 4427 shall apply. Tests shall also be conducted ad-hoc by a registered and authorised testing body as approved by the Department of Public Works.

PSLC6.1.2 Raw Material Acceptance Tests (New Sub-Clause 7.4.2)

The material used for the production of the pipes and fittings or structures, shall be high-density polyethylene (HDPE) PE 100. To confirm the quality of this product, the following test shall be performed.

- Density
- Melt Flow Index
- Carbon Black content
- Carbon Black distribution

PSLC6.1.3 Testing of HDPE welding (New Sub-Clause 7.4.3)

For weld joint evaluation, water pipes are classified as Assessment Class 1, according to SANS 10268-10. Tests on welds shall be performed according to the requirements of SANS 6269 and all pipe system weld factors shall be ≥1.

The Contractor shall submit to the Engineer the results of tensile, bend and peel tests performed according to SANS 6269 by the manufacturer on each batch of HDPE pipe delivered to site.

The Engineer shall visually inspect all welds on site, including welding rod property evaluation as required.

The Engineer shall have 1% of all welds performed removed (sampled) and tested for tensile strength according to SANS 6269 by an approved independent and accredited testing facility.

PSLC6.1.4 Pressure testing of HDPE pipes in Laboratory (New Sub-Clause 7.4.4)

The Contractor shall provide for quick pressure testing of all pipe sizes delivered to site with at least one test per 250m of sewer pipe.

The pressure test involves:

- Selection of 3 samples, at random by the independent test laboratory, of pipes having a minimum length of 1m with all relevant pipe markings on and free of scratches and defects;
- Conditioning of the pipe or fitting in water for 12 hours at 20°C;
- Standard pressure test procedures according to ISO 4427;
- Failure test: apply internal pressure at 5bar/min until failure – PE 100 pipes must reach a pressure of at least twice the Minimum Required Strength (MRS) as per ISO 4427 / SANS 4427;
- Upon failure to pass the test procedure as described above, standard pressure test procedures as per SABS ISO 4427 must be applied.

PSLC6.1.5 Permissible Leakage Rates (New Sub-Clause 7.4.5)

The permissible leakage rate for HDPE pipes, manholes and inspection chambers shall be zero.

PSLC6.1.6 Testing of HDPE pipe sections (New Sub-Clause 7.4.6)

All completed ducts shall be satisfactorily tested and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Air tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of air testing and for the supply of all equipment, materials and labour required.

The maximum air test pressure for field testing shall be 100kPa.

The air test procedure shall be as follows:

- Isolate the section of pipe to be tested by inserting airtight packers, one of which is connected to the air testing machine;

- Gradually raise the gauge pressure in the pipe in 10kPa steps, with a 2-minute stabilisation period between steps, to 100kPa and ensure that there is no air leakage at the packers;
- Switch off the machine and keep the pressure in the pipe for 1 hour. After 1 hour, the gauge reading shall remain constant to indicate zero air leakage;
- If the gauge reading reduces by more than 1% over 1 hour, the pipe shall be deemed to have failed the air test and the pipe test section rejected;
- Upon completion of the air test, gradually decrease the pressure to zero over a period of 20 minutes;
- After rejection of a pipe section that has failed the air test, the Contractor may apply a water test to locate the source of failure, rectify the pipe section and re-apply the air test. The pipe section will be accepted if zero leakage is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

The water test procedure shall be as follows:

- Fill the pipe section with water to such a depth that every portion of the pipeline is subjected to a pressure of at least 100kPa.;
- After an initial period of 30 minutes, accurately measure and mark the water level and keep filled for 1 hour;
- Check (or measure) the water level after 1 hour to record the water level;
- The test is successful if the recorded water levels are the same to indicate zero leakage.

PSLC7. MEASUREMENT AND PAYMENT

PSLC7.1 Scheduled Items (Sub-Clause 8.2)

PSLC7.1.1 Quality assurance of HDPE welded joints (New Sub-Clause 8.2.10)

(a) Independent quality control testing of HDPE welded joints ..... Unit : Prov Sum

(b) Percentage charges and profit on (a) .....Unit : Percentage

The stated provisional sum shall cover the cost for the independent quality control of the welding operations, quality control systems and testing as ordered by the Engineer. The expenditure of this scheduled item is at the discretion of the Engineer and does not relieve the contractor of his obligation to do normal quality control as stipulated.

PSLC7.1.2 Special Tests Requested by the Engineer (New Sub-Clause 8.2.11)

a) Pipeline acceptance control and testing by an independent inspectorate ..... Unit: Prov. Sum

b) Percentage charges and profit on a) .....Unit: Percentage

The stated provisional sum shall allow for conducting factory and on-site inspections and adjudication of test records that are relevant to the construction of the pipeline (e.g. welds, lining, coating and repairs, etc.) by an independent inspectorate appointed by the Engineer to act on his behalf.

PSLC7.1.3 Supply, lay, bed, test and prove HDPE ducts (New Sub-Clause 8.2.12)

Separate items will be scheduled for each diameter of duct.

The rates shall cover the cost of supply, lay, joint, bed, weld to chambers, test pipe and joints, prove draw wire as specified ..... Unit: m

PSLC7.1.4 Supply and install HDPE Manholes and Draw Pits (New Sub-Clause 8.2.13)

Separate items will be scheduled for each diameter and depth of manhole/draw pit.

The rates shall cover the cost of supply, install, welding of ducts to chamber, test of welds and chamber for watertightness .....Unit: No.

APPENDIX A: APPLICABLE STANDARDS

Add the following:

SANS 370	*Steel mesh reinforced polyethylene (PE) pipes for water supply*	
SANS 371	*Steel mesh reinforced polyethylene (PE) pipe fittings for water supply*	
SANS 533	*Black polyethylene pipes for the conveyance of liquids*	
SANS 674	*Steel-reinforced spirally wound PE drainage and sewer pipes*	
SANS 966-1	*Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems*	
SANS 1223	*Fibrecement pressure pipes and couplings*	
SANS 1655	*Welding of thermoplastics - Welding rods, fillers and solvents*	
SANS 1671-1	*Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding*	
SANS 1671-2	*Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding*	
SANS 1671-3	*Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding*	
SANS 1671-4	*Welding of thermoplastics - Machines and equipment Part 4: Hog gas extrusion welding*	
SANS 1748	*Glass-fibre-reinforced thermosetting plastic (GRP) pipes*	
SANS 1882	*Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames*	
SANS 10112	*The installation of polypropylene and polyvinyl chloride (UPV-C and PVC-M) pipes*	
SANS 10268-1	*Welding of thermoplastics – Welding processes Part 1: Heated tool welding*	
SANS 10268-2	*Welding of thermoplastics – Welding processes Part 2: Electrofusion welding*	
SANS 10268-3	*Welding of thermoplastics - Welding processes Part 3: Hot gas welding*	
SANS 10268-4	*Welding of thermoplastics – Welding processes Part 4: Hot gas extrusion welding*	
SANS 10268-10	*Welding of thermoplastics – Welding processes Part 10: Weld defects*	
SANS 10269	*Welding of thermoplastics – Testing and approval of welders*	
SANS 10270	*Welding of thermoplastics - Approval of welding procedures and welds*	
SANS 10403	*Formatting and compilation of procurement documents*	
SANS 4427 / ISO 4277	*Polyethylene (PE) pipes for water supply specifications*	
SANS 14236 / ISO 14236	*Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems*	
SANS 15874	*Plastic piping systems for hot and cold water*	
SANS 21138	*Plastics piping systems for non-pressure underground drainage and sewerage*	
SANS 1200 A	*Civil engineering construction:*	*General*
SANS 1200 AA	*Civil engineering construction:*	*General (small works)*
SANS 1200 D	*Civil engineering construction:*	*Earthworks*
SANS 1200 DA	*Civil engineering construction:*	*Earthworks (small works)*
SANS 1200 DB	*Civil engineering construction:*	*Earthworks (pipe trenches)*
SANS 1200 G	*Civil engineering construction:*	*Concrete (structural)*
SANS 1200 GA	*Civil engineering construction:*	*Concrete (small works)*
SANS 1200 LB	*Civil engineering construction:*	*Bedding (pipes)*
SANS 2001 DP2	*Construction works 9 Part Dp2:*	*Medium Pressure pipelines*

AMENDMENTS TO STANDARD SPECIFICATION
SANS 1200 LD : SEWERS

PSLD: SEWERS

PSLD1. INTERPRETATION

PSLD1.1 Supporting Specifications (Sub-Clause 2.1)

Change all references to “SABS 1200 …” to “SANS 1200 …”. This shall also apply throughout the Standardised Specification.

PSLD1.2 Additional Abbreviations (Sub-Clause 2.4)

For “AC: Asbestos cement” read “FC: Fibre cement” and read “FC” for “AC” wherever the latter appears throughout the Standardised Specification.

Add the following:

HDPE: High density polyethylene
PE: Polyethylene

PSLD2. MATERIALS

PSLD2.1 Alternative Materials for Pipes, Fittings and Joints (Sub-Clause 3.2)

PSLD2.1.1 HDPE Pipes (New Sub-Clause 3.2.1)

PSLD2.1.1.1 General Requirements (New Sub-Clause 3.2.1.1)

HDPE pipes shall comply with the requirements of SANS 4427 / ISO 4427. Pipes shall preferably be joined by means of butt welding as per the requirements of SANS 4427. Where permitted in terms of the specification data, pipes may be joined together by means of suitable push fit, heated tool socket weld or electro fusion fittings recommended by the pipe manufacturer or butt fusion.

PSLD2.1.1.2 Quality Assurance (New Sub-Clause 3.2.1.2)

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of quality control procedures, which shall ensure that the product will meet the requirements of this specification. The manufacturer/supplier shall maintain a quality system that conforms to the requirements of SANS 9001 / ISO 9001:20000 or national equivalent. Applicable standard for manufacture of pipe shall be SANS 4427 / ISO 4427.

For all relevant requirements, certification or testing that may be necessary for quality assurance of raw material supply, manufacturing standards, equipment used in manufacturing or tests to ensure standards are met, refer to SANS 4427 / ISO 4427, SANS 10268, SANS 10269, SANS 10270, Sans 1655, SANS 1671, SANS 21138, SANS 674, ISO 9969 and relevant specifications.

The manufacture/supplier shall submit the following documents prior to delivery of material to site:

- Certificate of Registration – SANS 9001/SANS ISO 9001 or National equivalent;
- Permit Certification – SANS 4427/SANS ISO 4427 for PE100;

- Quality Control Plan (QCP shall include Raw Material and Product Test Certificates);
- Last two audit reports according to SANS or National equivalent.

The manufacturer must unconditionally guarantee all HDPE products for a period of 100 years against any form of chemical decomposition or mechanical failure as a result of normal use in a 100-year lifecycle of expected pressures.

PSLD2.1.1.3 General Product Requirements (New Sub-Clause 3.2.1.3)

PSLD2.1.1.3.1 General (New Sub-Clause 3.2.1.3.1)

All finished HDPE products shall be free from cracks, voids, foreign inclusions and other defects, which would impair the overall performance. It shall be smooth walled on inside and outside and shall conform to the requirements (characteristics) outlined below.

PSLD2.1.1.3.2 Characteristics of Raw Material (New Sub-Clause 3.2.1.3.2)

Raw material composition for pipes, fittings (e.g. stubs) and other elements (e.g. sheeting for benching) shall be PE100 pre-compounded black.

PSLD2.1.1.3.3 Technical Specification for Raw Material and Finished Product (New Sub-Clause 3.2.1.3.3)

Physical/Chemical Property	Standard	Value	Unit
Density	ISO 1183	0.949 – 0.960	g/cm³
Melt Flow Index (190°C/5kg)	ISO 1133	0.25 – 0,35	g/10min
Vicat Softening Point (5kg)	ISO 306	64 – 68	°C
Crystalline Melting Range	ISO 3146-85	130 – 135	°C
Viscosity Number	ISO 1628-3	390	cm³/g

Mechanical Property	Standard	Value	Unit
Shore D, Hardness	ISO 868	61	–
Elastic Modulus	ISO 527	900 – 1000	MPa
Tensile Yield	ISO 527 / ISO 6259	24	MPa
Ultimate Tensile Strength	ISO 527 / ISO 6259	35	MPa
Ultimate Elongation	ISO 527 / ISO 6259	>600	%
Flexural Stress (3.5% Deflection)	ISO 178	19	MPa
Thermal Stability (OIT @ 210°C)	ISO 10837	≥20	minutes
Carbon Black Content	ASTM D 1603 / ISO 6964	2.25 +/- 0.25	%

PSLD2.1.1.3.4 Pipe Characteristics (New Sub-Clause 3.2.1.3.4)

Characteristics	Applicable Standard
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness @ any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

PSLD2.1.2 HDPE Fittings and Specials (New Sub-Clause 3.2.2)

All HDPE fittings and specials shall be fabricated from pipe complying with the requirements given in PSL2.1.1.1. In addition, all pipe fittings and specials shall be free of weld spatter and all sharp corners and edges shall be chamfered smooth.

Welders who are competent in terms of the relevant procedure approval test shall carry out all welding and proof of such competency may be required by the Engineer.

PSLD2.1.3 Steel mesh reinforced PE pipes (New Clause 3.2.3)

Steel mesh reinforced polyethylene (PE) pipes shall comply with the requirements of SANS 370 and have a PN 16 nominal pressure rating for pipes with a diameter of up to 160mm. Such pipes shall be joined by means of either an electrofusion coupling or flanged fitting complying with the requirements of SANS 371.

PSLD2.1.4 HDPE Pipe Joints (New Sub-Clause 3.2.4)

All properties of pipe joints designed by the manufacturer must always exceed or be equivalent to the base parent pipe (i.e. joints shall not decrease the tensile strength properties of the overall pipeline).

PSLD3. MANHOLES, CHAMBERS, ETC

PSLD3.1 Step Irons (Sub-Clause 3.5.7)

Add “or HDPE, as appropriate” at end of sub-clause.

PSLD3.2 Manholes and Chambers on Dolomite Land (New Sub-Clause 3.5.9)

For dolomite underlain land manholes and inspection chambers shall preferably be manufactured from structured or solid wall HDPE or steel-reinforced spirally wound HDPE pipes and shall be watertight.

HDPE structured wall pipes shall be manufactured according to SANS 21138 or SANS 674 in terms of profile, pipe fittings and pipe endings, but with stainless steel stiffeners and 5mm minimum wall thickness.

HDPE solid wall pipes shall be manufactured according to SANS 4427. Ring stiffness shall be tested according to ISO 9969 with:

i. 8,0kN/m² ring stiffness for all depths
ii. 4,0kN/m² ring stiffness for depths ≤1,5m where approved.

HDPE pipes to be extrusion welded to the manhole.

Benching shall consist of HDPE (PE100 to SANS 4427) flat sheet and pipe of minimum 12mm thickness.

PSLD3.3 Covers for HDPE Manholes, Chambers and Surface Boxes (New Sub-Clause 3.5.10)

For HDPE manholes and inspection chambers, the manhole roof shall be an integral part of the chamber wall to form a watertight chamber. The cover (lid) shall be lockable and manufactured from a material that has no monitory value (i.e. steel and CI lids are not acceptable).

PSLD4. CONSTRUCTION

PSLD4.1 HDPE Pipes, Manholes and Chambers (New Sub-Clause 5.11)

PSLD4.1.1 HDPE Product Supply, Installation and Quality Control (New Sub-Clause 5.11.1)

PSLD4.1.1.1 Off-loading of Pipes and Fittings (New Sub-Clause 5.11.1.1)

The manufacturer's instructions regarding the off-loading of all HDPE pipes, fittings and manufactured items must be strictly adhered to. The specifications of such procedures must be in the site office of the contractor at all times. The Engineer must be provided with a copy of such procedures.

The Contractor must clear an area specifically for the purpose of off-loading HDPE products. This area must be free of rocks, boulders or any other foreign objects that may puncture, cut or scar the HDPE fittings, pipes and other manufactured items. The area must also be relatively level in one direction and the ponding of stormwater must not be permitted. The area must be kept in such condition for the duration of material being on site.

PSLD4.1.1.2 Handling of Pipes on Site (New Sub-Clause 5.11.1.2)

The manufacturer's specification for the handling and transporting of material on site must be strictly adhered to. The Engineer shall write a specific instruction regarding this in the absence of such a manufacturer's instruction.

Under no circumstances shall the dragging of pipes on site be allowed. Dragging of the pipe will result in cuts, scratches and puncture marks that may result in weakening of the pipe.

Welded pipes shall be transported to the point of installation in accordance with the manufacturer's specification.

PSLD4.1.1.3 Visual Inspection of Pipes for Defects (New Sub-Clause 5.11.1.3)

The Engineer will inspect all HDPE pipes for any visual defects such as cracks, deformation, wall thinning, etc. This in no means constitute approval of the pipes. It merely serves as an additional quality control feature to ensure that pipes with obvious defects are rejected from the beginning.

Pipes found to have such defects, must also be brought under the attention of the supplier in writing. The suppliers must respond in writing. Copies of such cases must be forwarded to the Engineer. In the event of not resolving such cases, the matter must be referred to the Technical Committee of the South African Plastic Pipe Manufacturing Association (SAPPMA) for comments in terms of SANS ISO 4427: 1996.

PSLD4.1.1.4 Pipe Marking (New Sub-Clause 5.11.1.4)

All HDPE Pipes shall be indelibly marked at 1 meter intervals with the following details:

Reference Item	**Mark Printed**
Trade name	Manufacturer/Supplier Name
Specification	ISO 4427 / SANS 4427
Pipe OD	e.g. 160
Pipe OD tolerance	Grade B
Wall thickness	e.g. 7.7
Nominal pressure	e.g. PN 10
Material designation	PE 100
Batch No.	Manufacturer/Supplier Trace ability

Reference Item	Mark Printed
Application	SEWER or WATER or STORMWATER or "SLEEVE-WATER" or any other application

PSLD4.1.1.5 Inspection of Installed HDPE Pipes by Engineer (New Sub-Clause 5.11.1.5)

The Engineer shall be notified to inspect all HDPE pipes and fittings 24 hours prior to backfilling of trenches.

All pipes with cut, scratch, puncture marks or signs of deforming will be rejected from a quality control perspective. In such cases, the Contractor must submit a certificate of approval from the pipe supplier. This document must clearly state that the supplier approved the integrity of the pipes, irrespective of the noted damages. If such an approval certificate is not supplied, the Engineer reserves the right to reject such parts of the installation as he/she sees fit.

Any dispute in this regard must be referred to the Department of Public Works Project Manager.

PSLD4.1.1.6 Temporary Connections (New Sub-Clause 5.11.1.6)

All temporary connections to water systems shall not be backfilled unless with the express written instruction of the Engineer. The installation shall, as a rule, be left open and barricaded as per the contractual standards until the permanent connections are made.

PSLD4.1.2 Cover (New Sub-Clause 5.11.2)

For HDPE pipes the minimum soil cover shall be:

Average	:	750mm
Outside traffic areas	:	600mm
Inside traffic areas	:	1000mm

Where these minimum thicknesses cannot be met, appropriately designed concrete slabs shall be used as protection or if imposed loads necessitates protection.

PSLD4.1.3 Jointing Methods (New Sub-Clause 5.11.3

PSLD4.1.3.1 Welding of HDPE (New Sub-Clause 5.11.3.1)

The welding of HDPE using the heated tool butt welding and heated tool socket welding processes shall be undertaken in accordance with the requirements of SANS 10268-1 using equipment that satisfies the requirements of SANS 1671-1.

The welding of HDPE pipes by means of electro fusion shall be in accordance with the requirements of SANS 10268-2. The acceptability of the weld shall be assessed in accordance with the assessment table contains in SANS 10268-10.

Welders shall, where specified, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate. Welders shall be certified by the Thermoplastics Welding Institute of SA (TWISA).

Before use, metal heating plates shall be cleaned of all traces of polyethylene remaining from previous operations to avoid inclusion of oxidized polyethylene in the weld.

The end of all pipes jointed by means of an electrofusion fitting, shall be prepared prior to jointing by scraping off any surface oxide and being thoroughly cleaned with a suitable cleaner. Angle grinders shall not be used for preparing surfaces.

The two elements that are to be jointed in the butt welding process, shall not be under tension or lateral stress during the welding operation.

PSLD4.1.3.2 Removal of HDPE Pipe Shavings (New Sub-Clause 5.11.3.2)

During the preparation phase of welding surfaces, all care must be taken to ensure that pipe shavings are not left behind in pipes.

The entire system should be monitored for blockages after installation and the Engineer shall introduce measures to ensure that the rectification of blockages remains the responsibility of the Contractor for the duration of the contract up to final delivery.

PSLD4.1.3.3 Removal of Welding Beads from HDPE Pipes (New Sub-Clause 5.11.3.3)

After butt-welding of HDPE sewer pipes, the internal welding bead must be removed from all solid wall pipes (all diameters).

The engineer must inspect the contractor's equipment for this work and instruct the contractor to weld test pieces of the various pipe sizes to be used on site and remove the beads. These examples of the removed beads, as well as the welded pipe sections, must be kept on site for the duration of the project.

The removed beads must show no signs of cracking (cut too cold) or extreme deformation (cut too hot).

All welding beads removed from the installed pipes shall be marked sequentially with the same number as the weld. All welded joints must be sequentially numbered with white weatherproof paint. These weld positions must be transferred to an as-built drawing.

The contractor must store the removed welding beads to the end of the retention period.

It is important when removing weld beads that:

a) The cut direction is the same as the liquid flow direction;

b) The bead cutter must be fitted with equipment to extract the bead after cutting;

c) The equipment must be able to cut the bead in one operation. Multiple cuts may lead to uneven or sharp burr ends on the pipe surface.

PSLD4.1.3.4 Rising Mains (New Sub-Clause 5.11.3.4)

HDPE pipes used as rising mains shall be similar to the HDPE pipes as specified in PSLD2.1.1, but the pressure class shall be as required by the specific design.

PSLD5. TESTING

PSLD5.1 Testing of HDPE Pipes (New Sub-Clause 7.3)

PSLD5.1.1 General (New Sub-Clause 7.3.1)

Testing as contained in ISO 4427 / SANS 4427 shall apply. Tests shall also be conducted ad-hoc by a registered and authorised testing body as approved by the Department of Public Works.

PSLD5.1.2 Raw Material Acceptance Tests (New Sub-Clause 7.3.2)

The material used for the production of the pipes and fittings or structures, shall be high-density polyethylene (HDPE) PE 100. To confirm the quality of this product, the following test shall be performed.

- Density
- Melt Flow Index

- Carbon Black content
- Carbon Black distribution

PSLD5.1.3 Testing of HDPE welding (New Sub-Clause 7.3.3)

For weld joint evaluation, water pipes are classified as Assessment Class 1, according to SANS 10268-10. Tests on welds shall be performed according to the requirements of SANS 6269 and all pipe system weld factors shall be ≥1.

The Contractor shall submit to the Engineer the results of tensile, bend and peel tests performed according to SANS 6269 by the manufacturer on each batch of HDPE pipe delivered to site.

The Engineer shall visually inspect all welds on site, including welding rod property evaluation as required.

The Engineer shall have 1% of all welds performed removed (sampled) and tested for tensile strength according to SANS 6269 by an approved independent and accredited testing facility.

PSLD5.1.4 Pressure testing of HDPE pipes in Laboratory (New Sub-Clause 7.3.4)

The Contractor shall provide for quick pressure testing of all pipe sizes delivered to site with at least one test per 250m of sewer pipe.

The pressure test involves:

- Selection of 3 samples, at random by the independent test laboratory, of pipes having a minimum length of 1m with all relevant pipe markings on and free of scratches and defects;
- Conditioning of the pipe or fitting in water for 12 hours at 20°C;
- Standard pressure test procedures according to ISO 4427;
- Failure test: apply internal pressure at 5bar/min until failure – PE 100 pipes must reach a pressure of at least twice the Minimum Required Strength (MRS) as per ISO 4427 / SANS 4427;
- Upon failure to pass the test procedure as described above, standard pressure test procedures as per SABS ISO 4427 must be applied.

PSLD5.1.5 Permissible Leakage Rates (New Sub-Clause 7.3.5)

The permissible leakage rate for HDPE pipes, manholes and inspection chambers shall be zero.

PSLD5.1.6 Testing of HDPE pipe sections (New Sub-Clause 7.3.6)

All completed sewer lines shall be satisfactorily tested and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Air tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of air testing and for the supply of all equipment, materials and labour required.

The maximum air test pressure for field testing shall be 100kPa.

The air test procedure shall be as follows:

- Isolate the section of pipe to be tested by inserting airtight packers, one of which is connected to the air testing machine;
- Gradually raise the gauge pressure in the pipe in 10kPa steps, with a 2 minute stabilisation period between steps, to 100kPa and ensure that there is no air leakage at the packers;
- Switch off the machine and keep the pressure in the pipe for 1 hour. After 1 hour, the gauge reading shall remain constant to indicate zero air leakage;
- If the gauge reading reduces by more than 1% over 1 hour, the pipe shall be deemed to have failed the air test and the pipe test section rejected;
- Upon completion of the air test, gradually decrease the pressure to zero over a period of 20 minutes;
- After rejection of a pipe section that has failed the air test, the Contractor may apply a water test to locate the source of failure, rectify the pipe section and re-apply the air test. The pipe section will be accepted if zero leakage is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

The water test procedure shall be as follows:

- Fill the pipe section with water to such a depth that every portion of the pipeline is subjected to a pressure of at least 100kPa.;
- After an initial period of 30 minutes, accurately measure and mark the water level and keep filled for 1 hour;
- Check (or measure) the water level after 1 hour to record the water level;
- The test is successful if the recorded water levels are the same to indicate zero leakage.

PSLD6. MEASUREMENT AND PAYMENT

PSLD6.1 Scheduled Items (Sub-Clause 8.2)

PSLD6.1.1 Quality assurance of HDPE welded joints (New Sub-Clause 8.2.16)

(a) Independent quality control testing of HDPE welded joints ..... Unit : Prov Sum

(b) Percentage charges and profit on (a) .....Unit : Percentage

The stated provisional sum shall cover the cost for the independent quality control of the welding operations, quality control systems and testing as ordered by the Engineer. The expenditure of this scheduled item is at the discretion of the Engineer and does not relieve the contractor of his obligation to do normal quality control as stipulated.

PSLD6.1.2 Special Tests Requested by the Engineer (New Sub-Clause 8.2.17)

a) Pipeline acceptance control and testing by an independent inspectorate ..... Unit: Prov. Sum

b) Percentage charges and profit on a) .....Unit: Percentage

The stated provisional sum shall allow for conducting factory and on-site inspections and adjudication of test records that are relevant to the construction of the pipeline (e.g. welds, lining, coating and repairs, etc.) by an independent inspectorate appointed by the Engineer to act on his behalf.

APPENDIX A: APPLICABLE STANDARDS

Add the following:

SANS 370	*Steel mesh reinforced polyethylene (PE) pipes for water supply*	
SANS 371	*Steel mesh reinforced polyethylene (PE) pipe fittings for water supply*	
SANS 533	*Black polyethylene pipes for the conveyance of liquids*	
SANS 674	*Steel-reinforced spirally wound PE drainage and sewer pipes*	
SANS 966-1	*Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems*	
SANS 1223	*Fibrecement pressure pipes and couplings*	
SANS 1655	*Welding of thermoplastics - Welding rods, fillers and solvents*	
SANS 1671-1	*Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding*	
SANS 1671-2	*Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding*	
SANS 1671-3	*Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding*	
SANS 1671-4	*Welding of thermoplastics - Machines and equipment Part 4: Hog gas extrusion welding*	
SANS 1748	*Glass-fibre-reinforced thermosetting plastic (GRP) pipes*	
SANS 1882	*Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames*	
SANS 10112	*The installation of polypropylene and polyvinyl chloride (UPV-C and PVC-M) pipes*	
SANS 10268-1	*Welding of thermoplastics – Welding processes Part 1: Heated tool welding*	
SANS 10268-2	*Welding of thermoplastics – Welding processes Part 2: Electrofusion welding*	
SANS 10268-3	*Welding of thermoplastics - Welding processes Part 3: Hot gas welding*	
SANS 10268-4	*Welding of thermoplastics – Welding processes Part 4: Hot gas extrusion welding*	
SANS 10268-10	*Welding of thermoplastics – Welding processes Part 10: Weld defects*	
SANS 10269	*Welding of thermoplastics – Testing and approval of welders*	
SANS 10270	*Welding of thermoplastics - Approval of welding procedures and welds*	
SANS 10403	*Formatting and compilation of procurement documents*	
SANS 4427 / ISO 4277	*Polyethylene (PE) pipes for water supply specifications*	
SANS 14236 / ISO 14236	*Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems*	
SANS 15874	*Plastic piping systems for hot and cold water*	
SANS 21138	*Plastics piping systems for non-pressure underground drainage and sewerage*	
SANS 1200 A	*Civil engineering construction:*	*General*
SANS 1200 AA	*Civil engineering construction:*	*General (small works)*
SANS 1200 D	*Civil engineering construction:*	*Earthworks*
SANS 1200 DA	*Civil engineering construction:*	*Earthworks (small works)*
SANS 1200 DB	*Civil engineering construction:*	*Earthworks (pipe trenches)*
SANS 1200 G	*Civil engineering construction:*	*Concrete (structural)*
SANS 1200 GA	*Civil engineering construction:*	*Concrete (small works)*
SANS 1200 LB	*Civil engineering construction:*	*Bedding (pipes)*
SANS 2001 DP2	*Construction works 9 Part Dp2:*	*Medium Pressure pipelines*

AMENDMENTS TO STANDARD SPECIFICATION SANS 1200 LE : STORMWATER DRAINAGE

PSLE: STORMWATER DRAINAGE

PSLE1. INTERPRETATION

PSLE1.1 Supporting Specifications (Sub-Clause 2.1)

Change all references to "SABS 1200 …" to "SANS 1200 …". This shall also apply throughout the Standardised Specification.

PSLE1.2 Additional Abbreviations (Sub-Clause 2.4)

For "AC: Asbestos cement" read "FC: Fibre cement" and read "FC" for "AC" wherever the latter appears throughout the Standardised Specification.

Add the following:

HDPE: High density polyethylene
PE: Polyethylene

PSLE2. MATERIALS

PSLE2.1 Culvert Units and Pipes (Sub-Clause 3.1)

PSLE2.1.1 a) Precast concrete pipes

Add the following:

For concrete pipes on dolomite underlain land, spigot and socket pipe joints with rolling rubber rings or sliding rubber joints shall be used.

PSLE2.1.2 Alternative Materials for Pipes, Fittings and Joints (New Sub-Clause 3.1.1)

PSLE2.1.2.1 HDPE Pipes (New Sub-Clause 3.1.1.1)

PSLE2.1.2.1.1 General Requirements (New Sub-Clause 3.1.1.1a)

HDPE pipes shall be either solid wall HDPE or structured wall HDPE pipes.

HDPE pipes shall be PE100 and comply with the requirements of SANS 4427 / ISO 4427. Pipes shall preferably be joined by means of butt welding as per the requirements of SANS 4427. Where permitted in terms of the specification data, pipes may be joined together by means of electro fusion fittings recommended by the pipe manufacturer or butt fusion or hot gas extrusion welding.

PSLE2.1.2.1.2 Quality Assurance (New Sub-Clause 3.1.1.1b)

It is the responsibility of the manufacturer/supplier to establish Quality Assurance by means of quality control procedures, which shall ensure that the product will meet the requirements of this specification. The manufacturer/supplier shall maintain a quality system that conforms to the requirements of SANS 9001 / ISO 9001:20000 or national equivalent. Applicable standard for manufacture of pipe shall be SANS 4427 / ISO 4427.

For all relevant requirements, certification or testing that may be necessary for quality assurance of raw material supply, manufacturing standards, equipment used in manufacturing or tests to ensure standards are met, refer to SANS 4427 / ISO 4427, SANS 10268, SANS 10269, SANS 10270, Sans 1655, SANS 1671, SANS 21138, SANS 674, ISO 9969 and relevant specifications.

The manufacture/supplier shall submit the following documents prior to delivery of material to site:

- Certificate of Registration – SANS 9001/SANS ISO 9001 or National equivalent;
- Permit Certification – SANS 4427/SANS ISO 4427 for PE100;
- Quality Control Plan (QCP shall include Raw Material and Product Test Certificates);
- Last two audit reports according to SANS or National equivalent.

The manufacturer must unconditionally guarantee all HDPE products for a period of 100 years against any form of chemical decomposition or mechanical failure as a result of normal use in a 100-year lifecycle of expected pressures.

PSLE2.1.2.1.3 General Product Requirements (New Sub-Clause 3.1.1.1c)

PSLE2.1.2.1.3.1 General (New Sub-Clause 3.1.1.1c1)

All finished HDPE products shall be free from cracks, voids, foreign inclusions and other defects, which would impair the overall performance. It shall be smooth walled on inside and outside and shall conform to the requirements (characteristics) outlined below.

PSLE2.1.2.1.3.2 Characteristics of Raw Material (New Sub-Clause 3.1.1.1c2)

Raw material composition for pipes, fittings (e.g. stubs) and other elements (e.g. sheeting for benching) shall be PE100 pre-compounded black.

PSLE2.1.2.1.3.3 Technical Specification for Raw Material and Finished Product (New Sub-Clause 3.1.1.1c3)

Physical/Chemical Property	Standard	Value	Unit
Density	ISO 1183	0.949 – 0.960	g/cm³
Melt Flow Index (190°C/5kg)	ISO 1133	0.25 – 0,35	g/10min
Vicat Softening Point (5kg)	ISO 306	64 – 68	°C
Crystalline Melting Range	ISO 3146-85	130 – 135	°C
Viscosity Number	ISO 1628-3	390	cm³/g

Mechanical Property	Standard	Value	Unit
Shore D, Hardness	ISO 868	61	–
Elastic Modulus	ISO 527	900 – 1000	MPa
Tensile Yield	ISO 527 / ISO 6259	24	MPa
Ultimate Tensile Strength	ISO 527 / ISO 6259	35	MPa
Ultimate Elongation	ISO 527 / ISO 6259	>600	%
Flexural Stress (3.5% Deflection)	ISO 178	19	MPa
Thermal Stability (OIT @ 210°C)	ISO 10837	≥20	minutes
Carbon Black Content	ASTM D 1603 / ISO 6964	2.25 +/- 0.25	%

PSLE2.1.2.1.3.4 Pipe Characteristics (New Sub-Clause 3.1.1.1c4)

Characteristics	**Applicable Standard**
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness @ any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

PSLE2.1.2.2 HDPE Pipes and Specials (New Sub-Clause 3.1.1.2)

All HDPE fittings and specials shall be fabricated from pipe complying with the requirements given in PSL2.1.2.1.1. In addition, all pipe fittings and specials shall be free of weld spatter and all sharp corners and edges shall be chamfered smooth.

Welders who are competent in terms of the relevant procedure approval test shall carry out all welding and proof of such competency may be required by the Engineer.

PSLE2.1.2.3 Pipe Joints (New Sub-Clause 3.1.1.3)

All properties of pipe joints designed by the manufacturer must always exceed or be equivalent to the base parent pipe (i.e. joints shall not decrease the tensile strength properties of the overall pipeline).

PSLE2.2 Bedding Materials

PSLE2.2.1 Concrete (Sub-Clause 3.3.2)

Add the following:

For concrete pipes on dolomite underlain land the bedding conditions shall ensure that the deflection tolerances are not exceeded as a result of consolidation settlement to ensure zero leakage from pipes.

PSLE2.3 Manholes, Catchpits and Accessories

PSLE2.3.1 Manholes and Chambers on Dolomite Land (New Sub-Clause 3.6)

For dolomite underlain land manholes and chambers shall preferably be manufactured from structured or solid wall HDPE or steel-reinforced spirally wound HDPE pipes and shall be watertight.

HDPE solid wall pipes shall be manufactured according to SANS 4427.

HDPE structured wall pipes shall be manufactured according to SANS 21138 or SANS 674 in terms of profile, pipe fittings and pipe endings, but with stainless steel stiffeners and 5mm minimum wall thickness.

Ring stiffness shall be tested according to ISO 9969 with 8,0kN/m² ring stiffness for all depths.

HDPE pipes to be extrusion welded to the manhole.

Benching shall consist of HDPE (PE100 to SANS 4427) flat sheet and pipe of minimum 12mm thickness.

PSLE2.3.2 Covers for HDPE Manholes and Chambers (New Sub-Clause 3.5.10)

For HDPE manholes and chambers, the manhole roof shall be an integral part of the chamber wall to form a watertight chamber. The cover (lid) shall be lockable and manufactured from a material that has no monitory value (i.e. steel and CI lids are not acceptable).

PSLE3. CONSTRUCTION

PSLE3.1 Catchpits, Manholes, Inlets and Outlet Structures (Sub-Clause 5.5)

PSLE3.1.1 General (Sub-Clause 5.5.1)

Add the following:

Masonry and concrete manholes and inlets on dolomite underlain land and shall be designed as water-retaining structures and tested for watertightness (zero leakage) using the test procedure in SANS 2001-CC1.

PSLE3.2 HDPE Pipes, Manholes and Chambers (New Sub-Clause 5.8)

PSLE3.2.1 HDPE Product Supply, Installation and Quality Control (New Sub-Clause 5.8.1)

PSLE3.2.1.1 Off-loading of Pipes and Fittings (New Sub-Clause 5.8.1.1)

The manufacturer's instructions regarding the off-loading of all HDPE pipes, fittings and manufactured items must be strictly adhered to. The specifications of such procedures must be in the site office of the contractor at all times. The Engineer must be provided with a copy of such procedures.

The Contractor must clear an area specifically for the purpose of off-loading HDPE products. This area must be free of rocks, boulders or any other foreign objects that may puncture, cut or scar the HDPE fittings, pipes and other manufactured items. The area must also be relatively level in one direction and the ponding of stormwater must not be permitted. The area must be kept in such condition for the duration of material being on site.

PSLE3.2.1.2 Handling of Pipes on Site (New Sub-Clause 5.8.1.2)

The manufacturer's specification for the handling and transporting of material on site must be strictly adhered to. The Engineer shall write a specific instruction regarding this in the absence of such a manufacturer's instruction.

Under no circumstances shall the dragging of pipes on site be allowed. Dragging of the pipe will result in cuts, scratches and puncture marks that may result in weakening of the pipe.

Welded pipes shall be transported to the point of installation in accordance with the manufacturer's specification.

PSLE3.2.1.3 Visual Inspection of Pipes for Defects (New Sub-Clause 5.8.1.3)

The Engineer will inspect all HDPE pipes for any visual defects such as cracks, deformation, wall thinning, etc. This in no means constitute approval of the pipes. It merely serves as an additional quality control feature to ensure that pipes with obvious defects are rejected from the beginning.

Pipes found to have such defects, must also be brought under the attention of the supplier in writing. The suppliers must respond in writing. Copies of such cases must be forwarded to the Engineer. In the event of not resolving such cases, the matter must be referred to the Technical Committee of the South African Plastic Pipe Manufacturing Association (SAPPMA) for comments in terms of SANS ISO 4427: 1996.

PSLE3.2.1.4 Pipe Marking (New Sub-Clause 5.8.1.4)

All HDPE Pipes shall be indelibly marked at 1m intervals with the following details:

Reference Item	**Mark Printed**
Trade name	Manufacturer/Supplier Name
Specification	ISO 4427 / SANS 4427
Pipe OD	e.g. 160
Pipe OD tolerance	Grade B
Wall thickness	e.g. 7,7
Nominal pressure	e.g. PN 10
Material designation	PE 100
Batch No.	Manufacturer/Supplier Trace ability
Application	SEWER or WATER or STORMWATER or "SLEEVE-WATER" or any other application

PSLE3.2.1.5 Inspection of Installed HDPE Pipes by Engineer (New Sub-Clause 5.8.1.5)

The Engineer shall be notified to inspect all HDPE pipes and fittings 24 hours prior to backfilling of trenches.

All pipes with cut, scratch, puncture marks or signs of deforming will be rejected from a quality control perspective. In such cases, the Contractor must submit a certificate of approval from the pipe supplier. This document must clearly state that the supplier approved the integrity of the pipes, irrespective of the noted damages. If such an approval certificate is not supplied, the Engineer reserves the right to reject such parts of the installation as he/she sees fit.

Any dispute in this regard must be referred to the Department of Public Works Project Manager.

PSLE3.2.1.6 Cover (New Sub-Clause 5.8.1.6)

For HDPE pipes the minimum soil cover shall be:

Average	:	750mm
Outside traffic areas	:	600mm
Inside traffic areas	:	1000mm

Where these minimum thicknesses cannot be met, appropriately designed concrete slabs shall be used as protection or if imposed loads necessitates protection.

PSLE3.2.2 Jointing Methods (New Sub-Clause 5.8.2

PSLE3.2.2.1 Welding of HDPE (New Sub-Clause 5.8.2.1)

The welding of HDPE using the heated tool butt welding and heated tool socket welding processes shall be undertaken in accordance with the requirements of SANS 10268-1 using equipment that satisfies the requirements of SANS 1671-1.

The welding of HDPE pipes by means of electro fusion shall be in accordance with the requirements of SANS 10268-2. The acceptability of the weld shall be assessed in accordance with the assessment table contains in SANS 10268-10.

Welders shall, where specified, be tested and certified in accordance with the requirements of SANS 10269 and be in possession of a valid test certificate. Welders shall be certified by the Thermoplastics Welding Institute of SA (TWISA).

Before use, metal heating plates shall be cleaned of all traces of polyethylene remaining from previous operations to avoid inclusion of oxidized polyethylene in the weld.

The end of all pipes jointed by means of an electrofusion fitting, shall be prepared prior to jointing by scraping off any surface oxide and being thoroughly cleaned with a suitable cleaner. Angle grinders shall not be used for preparing surfaces.

The two elements that are to be jointed in the butt welding process, shall not be under tension or lateral stress during the welding operation.

PSLE3.2.2.2 Removal of HDPE Pipe Shavings (New Sub-Clause 5.8.2.2)

During the preparation phase of welding surfaces, all care must be taken to ensure that pipe shavings are not left behind in pipes.

The entire system should be monitored for blockages after installation and the Engineer shall introduce measures to ensure that the rectification of blockages remains the responsibility of the Contractor for the duration of the contract up to final delivery.

PSLE4. TESTING FOR LEAKAGE

PSLE4.1 Testing of HDPE Pipes (New Sub-Clause 7.2)

PSLE4.1.1 General (New Sub-Clause 7.2.1)

Testing as contained in ISO 4427 / SANS 4427 shall apply. Tests shall also be conducted ad-hoc by a registered and authorised testing body as approved by the Department of Public Works.

PSLE4.1.2 Raw Material Acceptance Tests (New Sub-Clause 7.2.2)

The material used for the production of the pipes and fittings or structures, shall be high-density polyethylene (HDPE) PE 100. To confirm the quality of this product, the following test shall be performed.

- Density
- Melt Flow Index
- Carbon Black content
- Carbon Black distribution

PSLE4.1.3 Testing of HDPE welding (New Sub-Clause 7.2.3)

For weld joint evaluation, water pipes are classified as Assessment Class 1, according to SANS 10268-10. Tests on welds shall be performed according to the requirements of SANS 6269 and all pipe system weld factors shall be ≥1.

The Contractor shall submit to the Engineer the results of tensile, bend and peel tests performed according to SANS 6269 by the manufacturer on each batch of HDPE pipe delivered to site.

The Engineer shall visually inspect all welds on site, including welding rod property evaluation as required.

The Engineer shall have 1% of all welds performed removed (sampled) and tested for tensile strength according to SANS 6269 by an approved independent and accredited testing facility.

PSLE4.1.4 Pressure testing of HDPE pipes in Laboratory (New Sub-Clause 7.2.4)

The Contractor shall provide for quick pressure testing of all pipe sizes delivered to site with at least one test per 250m of sewer pipe.

The pressure test involves:

- Selection of 3 samples, at random by the independent test laboratory, of pipes having a minimum length of 1m with all relevant pipe markings on and free of scratches and defects;
- Conditioning of the pipe or fitting in water for 12 hours at 20°C;
- Standard pressure test procedures according to ISO 4427;
- Failure test: apply internal pressure at 5bar/min until failure – PE 100 pipes must reach a pressure of at least twice the Minimum Required Strength (MRS) as per ISO 4427 / SANS 4427;
- Upon failure to pass the test as described above, standard pressure test procedures as per SABS ISO 4427 must be applied.

PSLE4.1.5 Permissible Leakage Rates (New Sub-Clause 7.2.5)

The permissible leakage rate for HDPE pipes, manholes and chambers shall be zero.

PSLE4.1.6 Testing of HDPE pipe sections (New Sub-Clause 7.2.6)

All completed stormwater lines shall be satisfactorily tested and no payment in respect of pipe laying or the supply of pipes and fittings on any section of pipeline shall be made until such tests have been completed successfully.

Air tests shall be carried out on approved completed pipe sections with suitable length as approved by the Engineer.

The Contractor shall be responsible for arranging all aspects of air testing and for the supply of all equipment, materials and labour required.

The maximum air test pressure for field testing shall be 100kPa.

The air test procedure shall be as follows:

- Isolate the section of pipe to be tested by inserting airtight packers, one of which is connected to the air testing machine;
- Gradually raise the gauge pressure in the pipe in 10kPa steps, with a 2-minute stabilisation period between steps, to 100kPa and ensure that there is no air leakage at the packers;
- Switch off the machine and keep the pressure in the pipe for 1 hour. After 1 hour, the gauge reading shall remain constant to indicate zero air leakage;
- If the gauge reading reduces by more than 1% over 1 hour, the pipe shall be deemed to have failed the air test and the pipe test section rejected;
- Upon completion of the air test, gradually decrease the pressure to zero over a period of 20 minutes;
- After rejection of a pipe section that has failed the air test, the Contractor may apply a water test to locate the source of failure, rectify the pipe section and re-apply the air test. The pipe section will be accepted if zero leakage is achieved.

Water used for hydrostatic testing shall be disposed of in an approved manner without causing damage, nuisance or injury.

The water test procedure shall be as follows:

- Fill the pipe section with water to such a depth that every portion of the pipeline is subjected to a pressure of at least 100kPa;
- After an initial period of 30 minutes, accurately measure and mark the water level and keep filled for 1 hour;
- Check (or measure) the water level after 1 hour to record the water level;
- The test is successful if the recorded water levels are the same to indicate zero leakage.

PSLE5. MEASUREMENT AND PAYMENT

PSLE5.1 Scheduled Items (Sub-Clause 8.2)

PSLE5.1.1 Quality assurance of HDPE welded joints (New Sub-Clause 8.2.14)

(a) Independent quality control testing of HDPE welded joints..... Unit: Prov Sum

(b) Percentage charges and profit on (a) .....Unit: Percentage

The stated provisional sum shall cover the cost for the independent quality control of the welding operations, quality control systems and testing as ordered by the Engineer. The expenditure of this scheduled item is at the discretion of the Engineer and does not relieve the contractor of his obligation to do normal quality control as stipulated.

PSLE5.1.2 Special Tests Requested by the Engineer (New Sub-Clause 8.2.15)

a) Pipeline acceptance control and testing by an independent

inspectorate ..... Unit: Prov. Sum

b) Percentage charges and profit on a) .....Unit: Percentage

The stated provisional sum shall allow for conducting factory and on-site inspections and adjudication of test records that are relevant to the construction of the pipeline (e.g. welds, lining, coating and repairs, etc.) by an independent inspectorate appointed by the Engineer to act on his behalf.

PSLE5.1.3 Supply and Lay HDPE pipes

On Class ….. bedding (type, class and nominal diameter of pipes),

butt welding of pipes and all testing of welds .....Unit: Prov. m

PSLE5.1.4 Supply and Install Manholes, Catchpits and the Like (Sub-Clause 8.2.8)

Add:

d) HDPE Manholes (type and depth stated). The rate shall include the cost of welding of pipes to the manhole, testing of welds and manhole ..... Unit: Prov. No.

APPENDIX A: APPLICABLE STANDARDS

Add the following:

SANS 370	*Steel mesh reinforced polyethylene (PE) pipes for water supply*	
SANS 371	*Steel mesh reinforced polyethylene (PE) pipe fittings for water supply*	
SANS 533	*Black polyethylene pipes for the conveyance of liquids*	
SANS 674	*Steel-reinforced spirally wound PE drainage and sewer pipes*	
SANS 966-1	*Components of unplasticized polyvinylchloride (uPVC) pressure pipe systems*	
SANS 1223	*Fibrecement pressure pipes and couplings*	
SANS 1655	*Welding of thermoplastics - Welding rods, fillers and solvents*	
SANS 1671-1	*Welding of thermoplastics — Machines and equipment Part 1: Heated tool welding*	
SANS 1671-2	*Welding of thermoplastics — Machines and equipment Part 2: Electrofusion welding*	
SANS 1671-3	*Welding of thermoplastics — Machines and equipment Part 3: Hot gas welding*	
SANS 1671-4	*Welding of thermoplastics - Machines and equipment Part 4: Hog gas extrusion welding*	
SANS 1748	*Glass-fibre-reinforced thermosetting plastic (GRP) pipes*	
SANS 1882	*Polymer concrete surface boxes, manhole and inspection covers, gully grating and frames*	
SANS 10112	*The installation of polypropylene and polyvinyl chloride (UPV-C and PVC-M) pipes*	
SANS 10268-1	*Welding of thermoplastics – Welding processes Part 1: Heated tool welding*	
SANS 10268-2	*Welding of thermoplastics – Welding processes Part 2: Electrofusion welding*	
SANS 10268-3	*Welding of thermoplastics - Welding processes Part 3: Hot gas welding*	
SANS 10268-4	*Welding of thermoplastics – Welding processes Part 4: Hot gas extrusion welding*	
SANS 10268-10	*Welding of thermoplastics – Welding processes Part 10: Weld defects*	
SANS 10269	*Welding of thermoplastics – Testing and approval of welders*	
SANS 10270	*Welding of thermoplastics - Approval of welding procedures and welds*	
SANS 10403	*Formatting and compilation of procurement documents*	
SANS 4427 / ISO 4277	*Polyethylene (PE) pipes for water supply specifications*	
SANS 14236 / ISO 14236	*Plastics pipes and fittings Mechanical joint compression fittings for use with polyethylene pressure pipes in water supply systems*	
SANS 15874	*Plastic piping systems for hot and cold water*	
SANS 21138	*Plastics piping systems for non-pressure underground drainage and sewerage*	
SANS 1200 A	*Civil engineering construction:*	*General*
SANS 1200 AA	*Civil engineering construction:*	*General (small works)*
SANS 1200 D	*Civil engineering construction:*	*Earthworks*
SANS 1200 DA	*Civil engineering construction:*	*Earthworks (small works)*
SANS 1200 DB	*Civil engineering construction:*	*Earthworks (pipe trenches)*
SANS 1200 G	*Civil engineering construction:*	*Concrete (structural)*
SANS 1200 GA	*Civil engineering construction:*	*Concrete (small works)*
SANS 1200 LB	*Civil engineering construction:*	*Bedding (pipes)*
SANS 2001 DP2	*Construction works 9 Part Dp2:*	*Medium Pressure pipelines*

Annex U: Example of Typical Bill of Quantities for Construction in Dolomite Areas

NOTE: The items contained in this example of a typical BOQ are typical general items only and it is the responsibility of the consultant to adapt these items and add additional items to suit the requirements of each contract.

PROJECT NAME: MANUAL FOR CONSULTANTS: STANDARD SPECIFICATIONS APPLICABLE TO DOLOMITE STABILITY INVESTIGATIONS (DSI) AND THE PLANNING, ENGINEERING REQUIREMENTS AND MANAGEMENT OF DEVELOPMENT ON DOLOMITE LAND APPROPRIATE DEVELOPMENT OF INFRASTRUCTURE ON DOLOMITE

SERVICE: WCS NO

BILL OF QUANTITIES

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 A	**SECTION1: PRELIMINARY AND GENERAL**				
	8.3	**FIXED-CHARGE AND VALUE-RATED ITEMS**				
1.1	8.3.1	**Contractual Requirements** Contractor to notice requirements regarding high risk insurance to cover plant and personnel working in or around sinkholes and trench excavations in a dolomitic High Risk area. Contractor to execute work with safety requirements as per General and Particular Specification of this document. The Occupational Health and Safety Act compliance for all parts of the work is the responsibility of the contractor.	sum			
1.2	8.3.2	**Provision of Facilities on Site**				
	8.3.2.1	Facilities for Engineer				
1.2.1	8.3.2.1(a)	Site office and ablution (1 room plus store) with telephone and facsimile facility.	sum			
1.2.2	8.3.2.1(c)	Name board (no 2)	sum			
	8.3.2.2	Facilities for Contractor				
1.2.3	8.3.2.2 (a to i)	All Facilities, tools, laboratory and services as per own requirements. (Additional: Telephone and facsimile facility must be provided). Special plant are covered in respective bills.	sum			
1.2.4	8.3.3	General responsibilities and other fixed charged obligations.	sum			
1.2.5	8.3.3	Site safety regarding demolishing of structures, drilling, grouting, repair of sinkholes (see Particular Specification). Refer also to Occupational Health and Safety Act and other legislation as indicated.	sum			
1.2.6	8.3.4	Removal of site establishment.	sum			
	8.4	**TIME-RELATED ITEMS**				
1.3	8.4.1	**Contractual Requirements**	sum			
1.4	8.4.2	**Operate and Maintain Facilities on Site**				
1.4.1	8.4.2.1	Facilities for Engineer	sum			
1.4.2	8.4.2.2	Facilities for Contractor				
	8.4.2.2 (a to j)	All facilities as per own requirements	sum			
	8.4.3. Additional	Direct Supervision of Works Special requirement: The contractor is to provide full time construction supervision by a written appointed senior construction supervisor for work in and around sinkholes and dolines.	sum			
1.4.3	8.4.4	Company and Head Office overheads.	sum			
1.4.4	8.4.5	General responsibilities and other time related obligations.	sum			
1.4.5		General safety obligations (see Particular Specifications).	sum			
	8.5	**PROVISIONAL SUMS**				
1.5	8.5.b.1	Surveys and reference beacons set out by Professional Land Surveyor.	hour			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
1.6	8.5.b.1	Machinery - Supply and operation of excavator (minimum weight of 32 ton, minimum boom reach of 6m) for excavations as directed by the Engineer.	prov			
1.7	1200 L PSL 5.1.1 (8.2.16)	Quality assurance of HDPE welded joints				
1.7.1		a) Independent quality control testing of HDPE welded joints	prov. Sum			
1.7.2		b) Percentage charges and profit on a)	%			
	PSL 5.1.2	Special tests requested by the Engineer				
1.7.3		a) Pipeline acceptance control and testing by an independent inspectorate	prov. Sum			
1.7.4		b) Percentage charges and profit on a)	%			
	8.8	**TEMPORARY WORKS**				
1.8	8.8.2.0	Dealing with pedestrians: The Contractor shall provide barricading to prevent pedestrians from entering the Works where excavations are open to public movement.	sum			
1.9	8.8.2.1	Dealing with traffic: Allow for dealing with traffic, as well as providing applicable signs for working next to or in roads.	sum			
1.10	8.8.4(a,b)	Supply and operate specialized equipment to detect underground services as directed by Engineer.	hour			
1.11	8.8.4(c)	Excavate by hand in all material to expose existing services as directed by Engineer.	m^3			
1.12	8.8.6	Special water control: The contractor to ensure that no water shall flood any portion of his works by providing necessary earth berms from excavated material or placing excavated material on suitable locations. Typical earth berm height min. 400mm and width at base 1000mm.	sum			
TOTAL SECTION 1: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 C	**SECTION 2: SITE CLEARANCE AND DEMOLISHING OF STRUCTURES** **GENERAL** **Refer to Particular Specification PF: PARTICULAR SPECIFICATION: DEMOLISHING OF STRUCTURES prior to completion of this Section of the Bill of Quantities.** All rates hereunder shall include the loading, transport, offloading and levelling of dumpsite where material is dumped. All material to be transported to commercial dumpsites.				
	8.2.1	**CLEAR AND GRUB**				
2.1	8.2.1	Clear and grub areas between buildings and structures.	m²			
2.2	8.2.2	**Remove and Grub Large Trees of Girth** Contractor to remove complete stump and spoil at commercial dump site.				
2.2.1	8.2.2(a)	Over 1,0m and up to 2,0m	no			
2.2.2	8.2.2(b)	Over 2,0m and up to 3,0m	no			
2.3	8.2.5	**Take down Fence**				
2.3.1	8.2.5	Take down 1,5m to 2,4m high precast, panel type, concrete wall and columns. Store materials on site for re-use.	m			
2.3.2	8.2.5	Take down 1,2m high wire fence and erect again.	m			
2.4	8.2.7	**Dismantle Steel Pipes**				
2.4.1	8.2.7	Cut, dismantle and remove <32mm pipe Cut, dismantle and remove 32mm to 100mm pipe Cut, dismantle and remove 100mm to 200mm pipe Cut, dismantle and remove 200mm to 300mm pipe	m m m m			
2.4.2	8.2.7	Remove <20mm diameter communication or electrical cable from sleeve pipes. Coil for re-use.	m			
2.4.3	8.2.7	Remove 20mm to 70mm diameter communication or electrical cable from sleeve pipes. Coil for re-use.	m			
2.5		**DEMOLISHING OF STRUCTURES** All material from demolishing to be transported to commercial dumpsite. Demolish the following:				
2.5.1	8.2.8	a) Load, transport and off load soil, trees and rubble from any site	m³.km			
2.5.2	8.2.8	b) Floor slabs, foundations and building rubble	m³.km			
2.5.3	8.2.8	c) Rip up and remove kerbs (up to 350mm high and 800mm wide)and concrete edge restraints of similar size	m			
	8.2.7	d) Rip up and remove water, sewer and stormwater pipe. Excavation and backfilling to be measured under trench excavations. For pipe dimensions:				
2.5.4		80mm to 160mm all types of pipe	m			
2.5.5		160mm to 250mm steel pipes	m			
2.5.6		160mm to 250mm concrete or clay pipes	m			
2.5.7		250mm to 400mm concrete pipes	m			
2.5.8		400mm to 800mm concrete pipes	m			
2.5.9		800mm to 1200mm concrete pipes	m			
2.5.10		800mm to 1400mm Armco steel pipe	m			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	8.2.8	e) Reinforced concrete paving or floor and wall of canal sections of thickness:				
2.5.11		<150mm	m²			
2.5.12		151mm to 200mm	m²			
2.5.13		201mm to 250mm	m²			
2.5.14		251mm to 300mm	m²			
	8.2.8	f) Unreinforced concrete paving or floor and wall of canal sections of thickness:				
2.5.15		<150mm	m²			
2.5.16		151mm to 200mm	m²			
2.5.17		201mm to 250mm	m²			
2.5.18		251mm to 300mm	m²			
2.5.19	8.2.8	g) Expose, demolish and dispose of reinforced column foundations.	m³			
2.5.20		h) Reinforced concrete walls and floors of service ducts and other large subsurface chambers up to 250mm thick.	m²			
		i) Walls, floor and roof of manholes, valve chambers and stormwater inlet structures:				
2.5.21		Brick walls 110mm thick	m²			
2.5.22		Brick walls 220mm thick	m²			
2.5.23		Concrete 200mm thick	m²			
2.5.24		Reinforced concrete 110mm to 200mm thick	m²			
		j) Brick walls				
2.5.25		110mm thick	m²			
2.5.26		220mm thick	m²			
		TOPSOIL				
	8.2.10	Remove topsoil to 150mm, stockpile, maintain and redress and compact designated area after completion of work. Item refer to areas other than sinkholes for:				
2.5.27		a) Confined areas between buildings where hand excavation is required	m³			
2.5.28		b) Areas suitable for machine excavation	m³			
		GRASS				
2.6	8.2.10	Remove in blocks and replant, within 300m, grass on road shoulder	m²			
TOTAL SECTION 2: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 D	**SECTION 3: EARTHWORKS** **NOTE 1**: Amendment to clause 5.2.5.1 - All haul within the site area shall be free. **NOTE 2**: Earthworks measured here would be general earthworks to improve stormwater drainage, rehabilitation of borrow areas and limited over-excavation and backfilling of potentially dangerous sinkholes and dolines. The Engineer shall be called to site before commencing excavation at each site and will discuss the geological conditions with the Contractor in full as to ensure safe working areas.				
3.1	8.3.1	**SITE PREPARATION**				
	8.3.1.2	Remove topsoil to depth of 150mm, stockpile, maintain and redress and compact area after completion of filling.	m³			
3.2	8.3.4 8.3.4	**IMPORTING OF MATERIALS** Import (G6) material from commercial off-site sources. The imported materials are to be used for filling of areas where buildings are removed / demolished, sinkholes and dolines are to be filled or any area that requires filling to enhance drainage. Work shall include excavation, selecting, transporting, off loading, placing and compaction for:				
3.2.1		a) 150mm layers compacted to 93% Mod AASHTO density (using small walk behind compactors) within the sinkhole, doline or other areas requiring filling (max particle size 63mm).	m³			
3.2.2		b) 150mm layers compacted to 93% Mod AASHTO density (using medium to large compaction equipment) within the sinkhole, doline or other areas requiring filling.	m³			
3.2.3		c) filling of any sinkhole, doline or other areas with poor drainage in 150mm layers compacted to 95% Mod AASHTO density (using medium to large compaction equipment) (max particle size 63mm).	m³			
3.3	8.3.2 8.3.2(a)	**BULK EXCAVATIONS** Excavate in all material from a designated borrow area, for backfilling of sinkholes or dolines within 2 km from point of excavation. Work shall include excavation, selecting, transporting, off loading, placing and compaction for:				
3.3.1		a) 150mm layers compacted to 93% Mod AASHTO density (using small walk behind compactors) within the sinkhole, doline or other areas requiring filling (max particle size 63mm).	m³			
3.3.2		b) 150mm layers compacted to 93% Mod AASHTO density (using medium to large compaction equipment) within the sinkhole, doline or other areas requiring filling.	m³			
3.3.3		c) filling of any areas with poor drainage in 150mm layers compacted to 95% Mod AASHTO density (using medium to large compaction equipment) (max particle size 63mm).	m³			
3.3.4		d) Excavate rock boulders in borrow area (within 2km from site) of diameter >500mm to place in sinkhole throat before normal backfilling commences. Work shall include excavation, selection, transport off-loading and placing.	m³			
	8.3.2(b)	Extra over 3.3.2.0 for:				
3.3.5	8.3.2(b)	a) Intermediate excavation	m³			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
3.4	8.3.3	**RESTRICTED EXCAVATIONS**				
3.4.1	8.3.3	Excavate and backfill in all material to open up areas in or around sinkholes or dolines for preparation of backfill in imported layers. Excavation walls shall be trimmed to 60 degrees to the horizontal. (Machine to use: minimum of 6m reach on boom of excavator). Refer to Drawing Detail Type No. DT 01/SH, DT 02/SH, DT 05/SH, DT 06/SH and DT 08/SH. Rate includes backfilling and compaction to 95% Mod AASHTO density. Excavate for stormwater canals and other related structures. Excavated materials to be levelled, compacted and generally disposed of within 1km of excavation.	m^3			
3.4.2	8.3.3(b)1	Extra over 3.5.1 and 3.5.2 for:				
3.4.3	8.3.3(b)2	Intermediate excavation	m^3			
3.4.4	8.3.3(b)3	Hard rock excavation (refer to restrictions on blasting)	m^3			
3.4.5	8.3.2(b)4	Boulder excavation Class A	m^3			
		DEALING WITH OVERBURDEN				
3.5	8.3.4(c)	Push material on side of dumpsite into the dump.	m^3			
3.6		**OVERHAUL**				
3.6.1	8.3.6(a)	limited overhaul	km			
3.6.2	8.3.6(b)	long overhaul	km			
		TOPSOIL				
	8.3.10	Topsoil in 100mm layer provided from:				
3.8		Stockpile	m^3			
		GRASSING				
3.9	8.3.11	Grassing of area with “roll on lawn” applicable for recreation areas, planted without gaps or areas to be covered later. Samples to be approved by Engineer.	m^2			
TOTAL SECTION 3: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 DB	**SECTION 4: EARTHWORKS (PIPE TRENCHES)**				
		NOTE: All unsuitable material from trench excavations to be disposed of in designated dumpsite. The extra over rates for intermediate and hard rock excavation shall include the cost of disposing of such material not suitable for backfill in this dumpsite.				
4.1	8.3.1	**SITE CLEARANCE**				
4.1.1	8.3.1.a	Clear trees and vegetation (trees with girth <1m included)	m			
4.1.2	8.3.1.b	Clear trees with girth over 1m	no			
4.1.3	8.3.1.c	Remove topsoil to 150mm depth, stockpile, maintain and replace and compact at completion of work.	m²			
	8.3.1.d additional	Remove surfacing on areas by square cutting and disposal of:				
4.1.4		a) Asphalt sections on pipe routes by means of cutting with a diamond tip pavement cutter. The rate shall cover all trench excavation routes up to 1,2m wide:				
4.1.4.1		30mm thick	m²			
4.1.4.2		70mm thick	m²			
4.1.4.3		100mm thick	m²			
4.1.4.4		150mm thick	m²			
4.1.5		b) Concrete:				
4.1.5.1		0 - 125mm	m²			
4.1.5.2		125mm - 200mm	m²			
4.1.5.3		200mm - 300mm	m²			
4.1.6		c) Brick Paving (stockpile for re-use)	m²			
4.1.7		Cut single line in asphalt or concrete with diamond tip pavement cutter. The rate shall cover the cost of plant labour and consumables. For depths:				
4.1.7.1		30mm thick	m			
4.1.7.2		70mm thick	m			
4.1.7.3		100mm thick	m			
4.1.7.4		150mm thick	m			
	8.3.2	**EXCAVATION FOR ALL PIPES / DUCTS**				
		NOTE: Excavations are preliminary along tarred roads and the vehicle movement areas of hangers and offices. The contractor needs to provide sufficient warning and danger signs as well as barricading tape around excavations to prevent pedestrians and vehicles from entering the work area. Shoring of deep excavations are included in the rates for the items below. Excavation safety is the responsibility of the Contractor.				
4.2	8.3.2(a)	Excavate in all material for pipe trenches with inclusion of backfilling and compaction to 93% Mod AASHTO density and dispose of surplus material to designated dumpsite. No material from hard or intermediate excavations exceeding 100mm in diameter shall be used for backfilling of pipe trenches. Excavate for pipes of nominal diameter:				
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.2.1		a) 25mm - 125mm diameter and depth:				
4.2.1.1		0,0 - 1,0m	m³			
4.2.1.2		1,0m - 2,0m	m³			
4.2.1.3		2,0m - 3,0m	m³			
4.2.2		b) 125mm - 700mm diameter and depth:				
4.2.2.1		0,0 - 1,0m	m³			
4.2.2.2		1,0m - 2,0m	m³			
4.2.2.3		2,0m - 3,0m	m³			
4.2.2.4		3,0m - 4,0m	m³			
4.2.3		a) 700mm - 1000mm diameter and depth:				
4.2.3.1		0,0 - 1,0m	m³			
4.2.3.2		1,0m - 2,0m	m³			
4.2.3.3		2,0m - 3,0m	m³			
4.2.3.4		3,0m - 4,0m	m³			
4.2.4		b) 1000 - 2000mm diameter and depth				
4.2.4.1		0,0 - 1,0m	m³			
4.2.4.2		1,0m - 2,0m	m³			
4.2.4.3		2,0m - 3,0m	m³			
4.2.4.4		3,0m - 4,0m	m³			
4.3	8.3.2(b)	**Extra-over** 4.2 for:				
4.3.1	8.3.2(b)1	Intermediate excavation (rate includes the cost to dispose of unsuitable material at commercial dumpsite).	m³			
4.3.2	8.3.2(b)2	Hard rock excavation NOTE: Blasting requirements as per Particular Specification PB.	m³			
4.3.3		Tunnelling under fence or to 1,0m measured horizontally under foundations.	m³			
4.4	8.3.2(b)	**Extra-over** trench and manhole or related excavations to allow for work in confined areas such as between buildings and other structures where access is limited to the use of a TLB only and blasting is prohibited. These excavation rates are subject to written approval by engineer. Extra over for:				
4.4.1	8.3.2(b)	Soft excavation	m³			
4.4.2	8.3.2(b)1	Intermediate excavation	m³			
4.4.3	8.3.2(b)2	Hard rock excavation	m³			
4.5	8.3.2(b)	**Extra-over** trench and manhole or related excavations to allow for work in confined areas such as between buildings and other structures or close to foundations and in between existing services where access is limited to the use of manual labour only and blasting is prohibited. Rate shall also apply to the location of services specifically called for by the engineer. These excavation rates are subject to written approval by engineer. Extra over for:				
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
4.5.1	8.3.2(b)	Soft excavation	m^3			
4.5.2	8.3.2(b)1	Intermediate excavation	m^3			
4.5.3	8.3.2(b)2	Hard rock excavation	m^3			
4.6	8.3.2(c)	Excavate and dispose of unsuitable material from trench bottom in dumpsite	m^3			
4.7	8.3.3	**EXCAVATION ANCILLARIES**				
4.7.1	8.3.3.1(b)	Make up deficiency in backfilling by importing material from designated eastern dump site. Rate shall include excavation, loading, carting, placing and compaction.	m^3			
4.7.2	8.3.3.3	Compaction in road reserve as per 5.7.2. Compaction to 95% Mod AASHTO density.	m^3			
4.8	8.3.4	**PARTICULAR ITEMS**				
	8.3.4.a	Shore trench opposite structure or service for depth:				
4.8.1		0 to 1m	m			
4.8.2		1m to 2m	m			
4.8.3		2m to 3m	m			
4.8.4	8.3.4.b	Provide 10 l/s sludge pump and 150m of 75mm diameter flexible hose for temporary sewer diversions.	day			
4.9	8.3.5	**EXISTING SERVICES**				
4.9.1	8.3.5(a)	Services intersecting trench (drawings of all services are available)	no			
4.9.2	8.3.5(b)	Services adjoining trench	m			
4.10	8.3.6	**FINISHING**				
	8.3.6.1	Reinstate surfaces of trenched areas with:				
4.10.1		Asphalt 30mm thick	m^2			
4.10.2		Concrete: 15MPa/19mm 100mm thick, wood floated finish to match existing	m^2			
4.10.3		Brick paving previously removed	m^2			
4.11	8.3.7	**ACCOMMODATION OF TRAFFIC**				
4.11.1		Set up and maintain road deviation signs (6 road crossings).	Sum			
4.11.2		Provide 4 sets of trench bridges for vehicle access to span trench width of 2m. Bridges must accommodate trucks up to 15 ton (wheel base width up to 2,3m).				
TOTAL SECTION 4: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 LB	**SECTION 5: BEDDING**				
5.1	8.2.1	Provide class B bedding selected from trench excavation and compacted to 93% Mod AASHTO density (material PI between 12% and 16%).				
5.1.1	8.2.1(a)	Selected granular material with max. particle size not exceeding 6mm diameter.	m^3			
5.1.2	8.2.1(b)	Selected fill (compacted in 150mm layers).	m^3			
5.1.3	8.2.1(b)	Selected fill (compacted in 150mm layers). First 150mm above HDPE pipes to be filled with material of particle size not exceeding 10mm diameter.	m^3			
5.2	8.2.2.2	Provide class B bedding imported from designated borrow area for fine-grained soils and compact to 93% Mod AASHTO density. Rate includes loading, haul (3km), off loading and placing for:				
5.2.1	8.2.2.1(a)	Selected granular material with max. particle size not exceeding 6mm diameter.	m^3			
5.2.2	8.2.2.1(b)	Selected fill (compacted in 150mm layers). First 150mm above HDPE pipes to be filled with material of particle size not exceeding 10mm diameter.	m^3			
5.3	8.2.3	Provide class A bedding of (1:12) soilcrete cradle to 50% of pipe diameter. Note that soilcrete will be paid according the limitation of excavation width for the particular pipe size as per SANS 1200 DB or the actual trench width whatever is the smaller.	m^3			
5.4	8.2.4	Provide 5MPa crusher sand “Trench fill concrete” in cradle or complete encasing of any type or diameter of pipe. Note that trench fill will be paid according the limitation of excavation width for the particular pipe size as per SANS 1200 DB or the actual trench width whatever is the smaller.	m^3			
5.5	8.2.4	Encasing of water and sewer pipes up to a nominal diameter of 300mm in 15MPa/13mm concrete of minimum 150mm thickness.				
TOTAL SECTION 5: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 L	**SECTION 6: MEDIUM PRESSURE PIPELINES**				
6.1	8.2.1	**PIPES - HDPE**				
6.1.1	8.2.1	Supply, lay, butt weld jointing and bed complete approved solid wall HDPE (high density polyethylene), PE100, PN16 pipe to SANS 4427, supplied in 12m lengths, test to specification and remove internal welding beads for pipes of nominal diameter:				
6.1.1.1		110mm	m			
6.1.1.2		125mm	m			
6.1.1.3		160mm	m			
6.1.1.4		180mm	m			
6.1.1.5		200mm	m			
6.1.1.6		225mm	m			
6.1.1.7		250mm	m			
6.1.1.8		280mm	m			
6.1.1.9		315mm	m			
6.1.1.10		355mm	m			
6.1.1.11		400mm	m			
6.1.1.12		450mm	m			
6.1.2	8.2.1	Supply, lay, join, and bed complete approved solid wall HDPE (high density polyethylene) PE100, PN16 pipe to SANS 4427 , supplied in 100m lengths (no welding) and test to specification for pipes of nominal diameter:				
6.1.2.1		20mm	m			
6.1.2.2		25mm	m			
6.1.2.3		32mm	m			
6.1.2.4		63mm	m			
6.1.2.5		75mm	m			
6.1.2.6		90mm	m			
6.2		**PIPES - Galvanised mild steel**				
6.2.1	8.2.5	Supply, fit (or lay and bed) complete with couplings, approved hot dipped galvanised to SANS 121, Mild Steel, Class Medium pipes and fittings to SANS 62-1.				
6.2.2		a) Pipes, mounted with holder batts, spaced at (min.)1000mm horizontally or vertically to external or internal walls or in roofs, for diameters:				
6.2.2.1		15mm	m			
6.2.2.2		20mm	m			
6.2.2.3		25mm	m			
6.2.2.4		32mm	m			
6.2.2.5		40mm	m			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.2.2.6		50mm	m			
6.2.2.7		65mm	m			
6.2.2.8		80mm	m			
6.2.2.9		100mm	m			
6.2.2.10		125mm	m			
6.2.2.11		150mm	m			
6.2.3	8.2.5	b) Pipes, mounted on columns 1,0m to 2,7m high as per Drawing Detail Type Number DT 07/W. Columns measured elsewhere. For diameters:				
6.2.3.1		15mm	m			
6.2.3.2		20mm	m			
6.2.3.3		25mm	m			
6.2.3.4		32mm	m			
6.2.3.5		40mm	m			
6.2.3.6		50mm	m			
6.2.3.7		65mm	m			
6.2.3.8		80mm	m			
6.2.3.9		100mm	m			
6.2.3.10		125mm	m			
6.2.3.11		150mm	m			
6.3	8.2.2	**FITTINGS - HDPE** Supply, butt weld jointing and lay approved solid wall HDPE (high density polyethylene), type PE 100, Class PN 16 fittings to SANS 4427. All fittings to be butt welded to HDPE pipes. Each fitting must be supplied with stubs welded on the outside for securing fitting into concrete anchor blocks. Stubs (Partial puddle flange) to be designed by fitting manufacturer for pipe size and maximum pressure rating as well as fitting configuration. Each fitting shall be supplied with a minimum of two HDPE stubs (25mm thick by 0,25 x diameter of fitting high by 0,75 x diameter of fitting long), welded to the outside. For fittings:				
6.3.1	8.2.2	HDPE EQUAL T-PIECE				
6.3.1.1		110mm	no			
6.3.1.2		160mm	no			
6.3.1.3		180mm	no			
6.3.1.4		200mm	no			
6.3.1.5		250mm	no			
6.3.1.6		280mm	no			
6.3.1.7		300mm	no			
6.3.1.8		315mm	no			
6.3.1.9		355mm	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.3.1.10		400mm	no			
6.3.1.11		450mm	no			
6.3.2	8.2.2	HDPE LONG RADIUS 90 DEGREE BEND (SEAMLESS)				
6.3.2.1		110mm	no			
6.3.2.2		160mm	no			
6.3.2.3		180mm	no			
6.3.2.4		200mm	no			
6.3.2.5		250mm	no			
6.3.2.6		280mm	no			
6.3.2.7		300mm	no			
6.3.2.8		315mm	no			
6.3.2.9		355mm	no			
6.3.2.10		400mm	no			
6.3.2.11		450mm	no			
6.3.3	8.2.2	HDPE LONG RADIUS 45 DEGREE BEND (SEAMLESS)				
6.3.3.1		110mm	no			
6.3.3.2		160mm	no			
6.3.3.3		180mm	no			
6.3.3.4		200mm	no			
6.3.3.5		250mm	no			
6.3.3.6		280mm	no			
6.3.3.7		300mm	no			
6.3.3.8		315mm	no			
6.3.3.9		355mm	no			
6.3.3.10		400mm	no			
6.3.3.11		450mm	no			
6.3.4	8.2.2	HDPE LONG RADIUS 11 to 22 DEGREE BEND (SEAMLESS)				
6.3.4.1		110mm	no			
6.3.4.2		160mm	no			
6.3.4.3		180mm	no			
6.3.4.4		200mm	no			
6.3.4.5		250mm	no			
6.3.4.6		280mm	no			
6.3.4.7		300mm	no			
6.3.4.8		315mm	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.3.4.9		355mm	no			
6.3.4.10		400mm	no			
6.3.4.11		450mm	no			
6.3.5	8.2.2	HDPE REDUCING T-PIECE				
6.3.5.1		450mm x 250mm	no			
6.3.5.2		400mm x 250mm	no			
6.3.5.3		355mm x 250mm	no			
6.3.5.4		315mm x 250mm	no			
6.3.5.5		300mm x 250mm	no			
6.3.5.6		280mm x 250mm	no			
6.3.5.7		355mm x 315mm	no			
6.3.6	8.2.2	HDPE REDUCER (CONCENTRIC)				
6.3.6.1		450mm x 400mm	no			
6.3.6.2		450mm x 250mm	no			
6.3.6.3		400mm x 355mm	no			
6.3.6.4		450mm x 315mm	no			
6.3.6.5		400mm x 315mm	no			
6.3.6.6		355mm x 315mm	no			
6.3.6.7		355mm x 280mm	no			
6.3.6.8		315mm x 250mm	no			
6.3.6.9		280mm x 250mm	no			
6.3.6.10		250mm x 180mm	no			
6.3.7	8.2.2	Extra-over any fitting or pipe to supply and weld on, in factory, A HDPE stub and steel flange drilled to BS 4504 table 16. Rate include supply lay, installation and fixing as well as all bolts and nuts. For HDPE pipe or fitting diameters:				
6.3.7.1		110mm	no			
6.3.7.2		160mm	no			
6.3.7.3		180mm	no			
6.3.7.4		200mm	no			
6.3.7.5		250mm	no			
6.3.7.6		280mm	no			
6.3.7.7		300mm	no			
6.3.7.8		355mm	no			
6.3.7.9		400mm	no			
6.3.7.10		450mm	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.3.8	8.2.2	Extra-over any fitting or pipe to supply and weld on, at site, A HDPE stub and steel flange drilled to BS 4504 table 16. Rate include supply lay, installation and fixing as well as all bolts and nuts. For HDPE pipe or fitting diameters:				
6.3.8.1		110mm	no			
6.3.8.2		160mm	no			
6.3.8.3		180mm	no			
6.3.8.4		200mm	no			
6.3.8.5		250mm	no			
6.3.8.6		280mm	no			
6.3.8.7		300mm	no			
6.3.8.8		315mm	no			
6.3.8.9		355mm	no			
6.3.8.10		400mm	no			
6.3.8.11		450mm	no			
6.4	8.2.2	**FITTINGS - CAST IRON** All fittings to SANS 1564 class 18, CID, covered with three coats epoxy tar to SANS 801 and thickness 300-micron minimum. All flanges drilled to BS 4504, table 16. Rate includes supply, lay and all packing and bolts. Bolts to be high tensile and heavy duty hot dipped galvanised to SANS 121. Cover complete fitting again after installation with epoxy tar.				
6.4.1		200mm flange adaptor	no			
6.4.2		250mm flange adaptor	no			
6.4.3		150mm blank flange	no			
6.4.4		200mm blank flange	no			
6.4.5		250mm blank flange	no			
6.4.6		VJ-COUPLINGS				
6.4.6.1		200mm CI to CI	no			
6.4.6.2		250mm CI to CI	no			
6.4.6.3		250mm CI to FC	no			
6.5	8.2.2	**FITTINGS - STEEL** Fittings coated with epoxy Coupon EP2300 and bolts and washers hot dipped galvanised.				
6.5.1		VJ-COUPLINGS				
6.5.1.1		100mm steel to 110 HDPE	no			
6.5.1.2		100mm steel to 160mm HDPE	no			
6.5.1.3		80mm steel to steel	no			
6.5.1.4		100mm steel to steel	no			
6.5.1.5		150mm steel to steel	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.5.1.6		200mm steel with locking ring welded onto pipe	no			
6.5.1.7		250mm steel with locking ring welded onto pipe	no			
6.5.1.8		80 x 100mm universal adaptor	no			
6.5.1.9		100 x 150mm universal adaptor	no			
6.6	8.2.3	**VALVES**				
6.6.1		GATE VALVES - STEEL Supply and install complete waterworks type SANS 664 approved, non-rising spindle, right hand closing, flanged, resilient seal, hand wheel and ball thrust collar, cast iron, gate valve of nominal diameter (drilled to BS 4504 table 16). All valves in and outside coated with epoxy Copon EP2300. For diameter:				
6.6.1.1		80mm	no			
6.6.1.2		100mm	no			
6.6.1.3		150mm	no			
6.6.1.4		200mm	no			
6.6.1.5		250mm	no			
6.6.1.6		300mm	no			
6.6.1.7		350mm	no			
6.6.1.8		400mm	no			
6.6.2		GATE VALVES - BRASS Approved brass, full way gate valve tested to 2500kPa for diameter				
6.6.2.1		15mm	no			
6.6.2.2		20mm	no			
6.6.2.3		25mm	no			
6.6.2.4		32mm	no			
6.6.2.5		40mm	no			
6.6.2.6		50mm	no			
6.6.2.7		65mm	no			
6.6.2.8		80mm	no			
6.6.2.9		100mm	no			
6.6.3		PRESSURE REDUCING VALVE 100mm Pressure reducing valve capable of reducing pressure from 2400kPa to 650kPa. Reducer to be fitted with V port to accommodate near zero flow volumes effectively. All valves in and outside coated with 250 micron fusion bonded Epoxy resin coating Electrostatically applied (DIN 30677) (Valve type tendered ....)				
6.6.4		CHECK VALVES Swing Type Check valve for high flow application on water network. Working pressure 1600kPa. All valves in and outside coated with 250 micron fusion bonded Epoxy resin coating Electrostatically applied (DIN 30677). Flanges to BS 4504 Table 16. (Valve type tendered .....) For nominal diameter:				
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.6.4.1		150mm	no			
6.6.4.2		200mm	no			
6.6.4.3		250mm	no			
6.6.5		AIR RELEASE VALVE				
		80mm Nominal diameter Combination air valve for high flow no slam application on water network. Working pressure 1600kPa. All valves in and outside coated with 250 micron fusion bonded Epoxy resin coating Electrostatically applied (DIN 30677). Flanges to BS 4504 Table 16. (Valve type tendered .....)	no			
6.6.6		STRAINERS				
		Cast iron horizontally mounted strainer with stainless steel inner. Working pressure 2400kPa. In and outside coated with 250 micron fusion bonded Epoxy resin coating Electrostatically applied (DIN 30677). Flanges to BS 4504 Table 23. (Strainer type tendered .....) For diameter:				
6.6.6.1		200mm	no			
6.6.6.2		250mm	no			
6.7		**WATER METER**				
		200mm Nominal diameter in line through flow Water Meter rated for working pressure 16 bar, continuous flow rate 800m³/h (1200m³/h) max.). Meter to be fitted with mechanical turbine. Meters to be flanged with drilling to BS 4504 Table 16, and fitted with electronic logger port (logger not to be supplied). Registers, 6 digit cyclometer-type totalisers, registering in kL, must be hermetically sealed. Main valve body to be cast iron. Install meter horizontally. Meter also to be fitted with "intelligent" automatic data register. Accuracy better than 2% (Meter Type tendered ....)	no			
6.8		**FIRE HYDRANT**				
		Supply and install complete fire hydrant next to main line. Fire hydrants are to be above ground, tamper proof, right angled and in accordance with SANS 1128. Rate includes all fittings from main line according to detail:				
6.8.1		Drawing Number DT01/W	no			
6.8.2		Drawing Number DT02/W	no			
6.8.3		Drawing Number DT03/W	no			
6.9	8.2.1	**20mPa CONCRETE BLOCKS**				
		Thrust block	m³			
6.10	8.2.4	**PERMANENT PRESSURE/LEAK TEST FACILITY**				
		Supply silicone filled pressure gauge rated at 1500KPa with base shut and bleed valves, 1 x 15mm horizontal wet dial water meter with 2 brass gate valves and 2 x 25mm quick coupling units to suit 15mm hose connection.	unit			
6.11	8.2.11	**OVERHEAD WATER PIPE SUPPORT STANDS**				
6.11.1		Supply pipe holder bracket as per Drawing Detail Type No. DT 07/W for pipe sizes:				
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.11.1.1		25mm to 50mm	no			
6.11.1.2		50mm to 80mm	no			
6.11.1.3		80mm to 150mm	no			
6.11.2		Supply steel pipe column as per Drawing Detail Type No. DT 07/W. Rate per metre length for pipe sizes:				
6.11.2.1		50mm	m			
6.11.2.2		80mm	m			
6.11.2.3		100mm	m			
6.11.3		Supply steel pipe bracket as per Drawing Detail Type No. DT 08/W.	no			
6.12		**VALVE BOX LID**				
6.12.1		Valve Box Lid complete as per Drawing Detail Type No. DT 18/W – Type 1.	no			
6.12.2		Valve Box Lid complete as per Drawing Detail Type No. DT 18/W – Type 2.	no			
6.13		**PAINT**				
6.13.1		Paint GMS pipes and fittings in accordance with OWG 371, section 18.1.3 with 1 coat of self etching primer (SANS 723) and two coats high gloss enamel for exterior use. For colours:				
6.13.1.1		yellow	m²			
6.13.1.2		red	m²			
6.13.1.3		blue	m²			
6.14		**CONNECT TO EXISTING PLUMBING**				
		Rate include the cutting, dismantling of existing fittings next to buildings and connection of new GMS pipes and fittings. For existing connection to building of diameter:				
6.14.1		15mm	no			
6.14.2		20mm	no			
6.14.3		25mm	no			
6.14.4		32mm	no			
6.14.5		40mm	no			
6.14.6		50mm	no			
6.14.7		65mm	no			
6.14.8		80mm	no			
6.14.9		100mm	no			
6.15		**DRILLING THROUGH WALLS**				
		Drill hole through 230mm brick wall to insert new GMS pipes. For holes of diameter:				
6.15.1		20mm	no			
6.15.2		30mm	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
6.15.3		40mm	no			
6.15.4		60mm	no			
6.16		**QUICK REPAIR CLAMP COUPLINGS**				
		Full circle single band stainless steel repair clamp with rubber lining. For pipe diameters:				
6.16.1		20mm	no			
6.16.2		25mm	no			
6.16.3		40mm	no			
6.16.4		50mm	no			
6.16.5		80mm	no			
6.16.6		100mm	no			
6.16.7		150mm	no			
6.16.8		200mm	no			
TOTAL SECTION 6: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 LD	**SECTION 7: SEWERS**				
7.1	8.2.1	**PIPES - HDPE** Supply, lay, butt weld jointing and bed complete as per type PE100, PN8, SANS 4427 approved solid wall HDPE (high density polyethylene) - (in 12m lengths), test to specification and remove internal welding bead and inspect with camera for pipes of nominal diameter:				
7.1.1		110mm	m			
7.1.2		160mm	m			
7.1.3		200mm	m			
7.1.4		250mm	m			
7.1.5		300mm	m			
7.2	8.2.1	**PIPES - PVC** Supply and fix to outer/inner walls in short lengths to toilet outlets, basins, etc. Unplasticised Polyvinyl Chloride pipes (SANS 791) with diameter:				
7.2.1		32mm	m			
7.2.2		40mm	m			
7.2.3		50mm	m			
7.2.4		75mm	m			
7.2.5		110mm	m			
7.3	8.2.1	**PVC FITTINGS** Supply and fix outer/inner walls to toilet outlets, basins, etc. Unplasticised Polyvinal Chloride fittings with spigot and socket joints and O-ring seals (SANS 967 & 791) with diameter:				
7.3.1		40mm bend with inspection eye	no			
7.3.2		50mm bend with inspection eye	no			
7.3.3		110mm bend with inspection eye	no			
7.3.4		110mm bend with 50mm vent horn	no			
7.3.5		110mm Kimberley socket	no			
7.3.6		50mm Kimberley socket	no			
7.3.7		40mm Kimberley socket	no			
7.3.8		110mm x 110mm single junction with inspection eye	no			
7.3.9		50mm x 50mm single junction with inspection eye	no			
7.3.10		110mm x 50mm single reducing junction with inspection eye	no			
7.3.11		110mm x 110mm x 110mm double junction with inspection eye	no			
7.3.12		110mm x 50mm x 50mm double reducing junction	no			
7.3.13		110m inspection pipe	no			
7.3.14		110mm x 50mm reducer	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
7.4	8.2.3	**MANHOLES - PRE-MANUFACTURED - HDPE** Construct manhole complete from a single length 1000mm diameter HDPE (Type PE100 to SANS ISO 4427) structured wall (8kN/m² ring stiffness) pipe with inclusion of factory fitted benching. Cover slab and lid to be heavy-duty with lockable lid, which is manufactured from a material that has no monetary value (i.e. not steel/cast iron) on concrete slab for type 1A units all as per Drawing Detail Type No. DT 04/D, DT 09/D, DT 10/D, DT 11/D and DT 12/D. For depths:				
7.4.1		0000 - 1000mm	no			
7.4.2		1000mm -1500mm	no			
7.4.3		1500mm - 2000mm	no			
7.4.4		2000mm - 2500mm	no			
7.4.5		2500mm - 3000mm	no			
7.4.6		3000mm - 3500mm	no			
7.4.7		3500mm - 4000mm	no			
7.4.8		4000mm - 4500mm	no			
7.5		**FACTORY FITTED BENCHING - HDPE MANHOLES** Extra over 7.2.1.0 to 7.2.8.0 to factory fit HDPE manholes with connections, channels and benching for site welding on (not rubber socket ends) of HDPE pipes and removal of welding bead as well as testing for pipes of nominal diameter and configuration as follows:				
7.5.1		100mm straight channel	no			
7.5.2		160mm straight channel	no			
7.5.3		200mm straight channel	no			
7.5.4		250mm straight channel	no			
7.5.5		100mm 45 to 90 degree bend	no			
7.5.6		160mm 45 to 90 degree bend	no			
7.5.7		200mm 45 to 90 degree bend	no			
7.5.8		250mm 45 - 90 degree bend	no			
7.5.9		160mm x 100mm junction	no			
7.5.10		200mm x 160mm junction	no			
7.5.11		250mm x 200mm junction	no			
7.6		**CONNECTION TO EXISTING MANHOLES** Cut into existing manhole, remove benching, replace benching and new clay channels and provide flexible connection joint for:				
7.6.1		100mm HDPE pipe	no			
7.6.2		160mm HDPE pipe	no			
7.6.3		200mm HDPE pipe	no			
7.7	8.2.3	**MANHOLES - PRE-MANUFACTURED/HDPE** Install complete small diameter pre-manufactured manhole with factory fitted benching as per Drawing Detail Type No. DT 03/D, DT 05/D and concrete ring beam, cover slab and lid as per Drawing Detail Type No. DT 08/D. Price includes for complete manhole with benching, concrete base and ringbeam at top. Manhole covers are measured separately. For diameter:				
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
7.7.1		350mm and 1,0m deep	no			
7.7.2		500mm and 1.0m deep	no			
7.7.3		700mm and 1,0m deep	no			
7.7.4		Extra over 7.7.2 to raise manhole by 0,5m	no			
7.7.5		Extra over 7.7 3 to raise manhole by 0,5m	no			
7.8		**REPLACEMENT OF CAST IRON PIPES**				
7.8.1		Chase into wall and replace complete cast iron waste pipe with PVC from toilet to outlet bend. Rate includes fixing of wall and paint.	no			
7.8.2		Replace complete water closet	no			
7.9		**TERMINATE EXISTING SEWER**				
		Terminate existing sewer pipes with concrete plug 500mm long for diameters:				
7.9.1		90mm to 160mm	no			
7.9.2		160mm to 250mm	no			
7.9.3		250mm to 300mm	no			
TOTAL SECTION 7: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 LE	**SECTION 8: STORMWATER DRAINAGE**				
8.1	8.2.1	**PIPES - CONCRETE**				
	8.2.1	Supply, handle and lay class 100 D SANS 677 concrete pipe with rubber ring. Nominal diameter:				
8.1.1		450mm	m			
8.1.2		600mm	m			
8.1.3		825mm	m			
8.1.4		900mm	m			
8.1.5		1200mm	m			
8.2		**PIPES - HDPE**				
	8.2.1	Supply, handle and lay 8kN/m² hoop stiffness HDPE (high density polyethylene structured wall - pipe (in 12 metre lengths – material type PE100: SANS 4427) with welded joints on Class B bedding and test. Rate includes the removal of all internal welding beads. Nominal diameter of pipes:				
8.2.1		350mm in trenches				
8.2.2		450mm in trenches	m			
8.2.3		500mm in trenches	m			
8.2.4		600mm in trenches	m			
8.2.5		900mm in trenches	m			
8.2.6		1000mm in trenches	m			
8.2.7		1200mm in trenches	m			
8.3	8.2.8	**INLET / OUTLET STRUCTURES**				
8.3.1		Construct steel inlet grid as per Drawing Detail Type No. DT 19/ST	no			
8.4	8.2.8	**MANHOLES - PRE-MANUFACTURED HDPE**				
		Construct manhole complete from a single length diameter 1000mm diameter HDPE type PE 100 to SANS 4427 structured wall (8kN/m² ring stiffness) pipe with inclusion of factory fitted benching (separate item scheduled for types of benching), step irons and cover slab as per Detail type DT 20/ST.				
8.4.1		0000 - 1000mm	no			
8.4.2		1000mm - 1500mm	no			
8.4.3		1500mm - 2000mm	no			
8.4.4		2000mm - 2500mm	no			
8.5	8.2.8	**FACTORY FITTED BENCHING - HDPE MANHOLES**				
		Extra over 8.4 to factory fit HDPE manholes with connections, channels and benching for HDPE pipes of nominal diameter and configuration as follows:				
8.5.1		450mm straight channel	no			
8.5.2		450mm channel bend at 45 degrees	no			
8.5.3		500mm straight channel, one end to fit 300mm pipe	no			
8.5.4		600mm straight channel	no			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
8.6		**CONNECTING TO EXISTING MANHOLES** Cut into existing concrete inlet structure with concrete wall 300mm thick and join pipe, repair concrete and remove and replace benching for pipes of diameter:				
8.6.1		300mm - 600mm	no			
8.6.2		600mm - 900mm	no			
8.6.3		1000mm - 1200mm	no			
TOTAL SECTION 8: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 LG	**SECTION 9: PIPE JACKING**				
9.1	8.2.6	Horizontal auger drilling or pneumatic hammer jacking and install 600mm Class 100D (SANS 677) concrete pipe with interlocking joints under road. Distance from thrust to reception station is 20m with no intermediate stations. Rate includes the full cost of site establishment, drilling, pipe insertion, supervision, labour, material and plant.	m			
9.2	8.9.9	Grout space between 500mm HDPE and 600mm concrete pipe with 400mm wide 20MPa/13mm concrete band at entry and exit from sleeve pipe.	no			
TOTAL SECTION 9: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 MK	**SECTION 10: KERBING AND CHANNELLING**				
10.1	8.2.1	**CONCRETE KERBING** 30MPa kerbing, inclusive of all excavation, bedding, joint sealing and pointing, concrete at back of joints as well as backfilling and compaction of soil to 1000mm beyond kerb as per Drawing Detail Type No. DT 01/R, DT 03/R and DT04/R.				
	8.2.1(b)	a) Precast Semi-mountable: Type - Fig 7 (SANS 927)				
10.1.1		1000mm sections	m			
10.1.2		300mm sections on curves	m			
	8.2.1(b)	b) Precast mountable: Type - Fig 8 (SANS 927)				
10.1.3		1000mm sections	m			
10.1.4		300mm sections on curves	m			
10.1.5	8.2.1(c)	c) 300 x 250mm In situ cast flat kerb as per Drawing Detail Type No. DT 03/R and DT 01/R	m			
10.1.6	8.2.1.(c)	d) 150 x 150mm edge restraint for concrete pavements as per Drawing Detail Type No. DT 04/P	m			
10.2		**STORMWATER CHANNELLING**				
		Stormwater channelling next to buildings as per Drawing Detail Type No. DT 06/ST. For canal width:				
		a) 300mm				
10.2.1		1000mm sections	m			
10.2.2		90 degree Corner unit	no			
10.2.3		Gully entrance	no			
10.2.4		T- junction	no			
		b) 400mm				
10.2.5		1000mm sections	m			
10.2.6		90 degree Corner unit	no			
10.2.7		Gully entrance	no			
10.2.8		T- junction	no			
		c) 500mm				
10.2.9		1000mm sections	m			
10.2.10		90 degree Corner unit	no			
10.2.11		Gully entrance	no			
10.2.12		T- junction	no			
10.3	8.2.4	Depressed kerbing, extra over normal kerbing straight or curved	m			
10.4		**SERVICE DUCTS IN ROADS**				
10.4.1		Type R 450 x 450mm rectangular portal culvert Class C to SANS 986 installed with roof to bottom for service ducts in paved areas. Place on 100mm 25MPa/19mm concrete foundation and seal all joints with Polysulphide or similar approved sealant.	m			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
10.4.2		Steel grid to fit culvert of 10.4.1.0 manufactured in 3m lengths consisting of a 60 x 60 x 8mm angel iron welded onto sides of 500mm wide Catwalk Type grating (same as on Drawing Detail Type No. DT 01/ST) to fit into and rest on culvert edge. All joints be 5mm filet welds on all sides. Grid to be heavy duty hot dipped galvanized to SANS 121.	m			
10.4.3		Cast in situ service duct with grating over as per Drawing Detail Type No. DT 01/ST	m			
10.5		**EXCAVATION**				
	8.2.7	Trimming of excavations for channels in:				
10.5.1		Soft material	m³			
10.5.2		Intermediate material	m³			
10.5.3		Hard material	m³			
10.6	8.2.8	**CAST IN SITU CONCRETE OPEN DRAINS**				
10.6.1		Construct a 2,8 metre wide, 300mm deep V - shaped 25MPa/19mm concrete drain. Thickness of concrete - 150mm. Reinforcing - Ref 617 (SANS 1024) welded mesh continuous over alternating slabs (Steel - Y 10mm diameter at 200 h/h in both directions). Reinforcing to overlap by 400mm. Cannel to be cast in 3 metre alternating panels with construction joints as per Drawing Detail Type No. DT 12/ST without sealed tie bar / expansion joint at every 18 metres as per Drawing Detail Type No. DT04/ST. Joint filler Polysulphide. Surface finish - wood floated (SANS 1200 G). Accuracy of concrete surface - Degree II. Also provide 250 micron Polyethylene sheeting to base. Base preparation - Compact to 95 % Mod AASHTO density. Rate shall include all preparation, material and form work. Construct complete as per Drawing Detail Type No. DT 02/ST Excavations measured separately.	m²			
10.6.2		as above 1,2 metre wide 150mm deep	m²			
10.6.3		as above 1,5 metre wide 150mm deep	m²			
10.6.4		as above 2,0 metre wide 200mm deep	m²			
10.7		**CONCRETE PAVING SLABS**				
10.7.1		Cast concrete paving slabs as per as per Drawing Detail Type No. DT 04/P	m²			
10.7.2		Extra over 10.7.1 to cast edge thickening as shown in Drawing Detail Type No. DT 06/P	m			
10.8	8.2.13	**POLYETHYLENE SHEETING**				
10.8.1		Provide, lay and join 250 micron polyethylene sheeting on prepared surface beds for channelling	m²			
10.9	SANS 1200 DA	**EXCAVATION FOR STORMWATER DRAIN**				
	8.3.2(a)	Excavate in all material, including trimming for dished concrete stormwater drains and dispose of surplus material to designated dump site, for depths:				
10.9.1		0 - 0,5m	m³			
10.9.2		0,5m -1,0m	m³			
TOTAL SECTION 10: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 DM	**SECTION 11: EARTHWORKS (ROADS, SUBGRADE)**				
11.1	8.3.2	**PREPARATION**				
11.1.1	8.3.2(b)	Remove existing bitumen surface to a maximum depth of 70mm and dispose of at dumpsite within free haul distance.	m²			
11.2		**EXISTING BASE/SUBBASE TO WINDROW**				
11.2.1	8.3.10	Rip, remove to stockpile or windrow and maintain existing base to a depth of 150mm from area to be reconstructed.	m³			
11.2.2	8.3.10	Rip, remove to stockpile or windrow and maintain subbase to a depth of 150mm from area to be reconstructed.	m³			
11.3		**CUT TO SPOIL**				
11.3.1	8.3.7(b)	Rip, remove and dispose, at nearest sinkhole repair site, of first selected layer to a depth of 150mm from area to be reconstructed.	m³			
11.4	8.3.3	**ROADBED TREATMENT**				
11.4.1	8.3.3(b)1	Rip to 150mm depth the in situ material of area to be reconstructed and recompact to 93 % Mod AASHTO density.	m³			
11.4.2	8.3.3(b)2	Blasting of hard rock in road bed	m³			
11.5		**SELECTED LAYER**				
	8.3.5	Construct 150mm selected layers from excavation stockpile (in terms of 11.2.1 and 11.2.2) and compact to 93% Mod AASHTO density for type (ref TRH4):				
11.5.1		G7	m³			
TOTAL SECTION 11: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 ME	**SECTION 12: SUBBASE**				
12.1	8.3.2(a)	Construct 150mm thick subbase and shoulders from selected material excavated from road prism and stockpiled or windrowed next to road (previous excavated base see Section 11) Compact to 95% Mod AASHTO density.	m^3			
12.2	8.3.3	Construct 200mm thick subbase from material from commercial off-site sources. Compact to 95% MOD AASHTO density.	m^3			
		Extra over 12.1 and 12 2 for:				
12.3		areas $2m^2$ and smaller (i.e. potholes)	m^3			
12.4		areas less than $100m^2$	m^3			
12.5	8.3.5(d)	Stabilization	m^3			
12.6	8.3.8(b)	Stabilizing agent: Portland cement	ton			
12.7	8.3.3	Construct 150mm thick subbase, in confined areas between buildings where only small walk-behind compactors have access to. Material from commercial off site sources. Compact to 95% Mod AASHTO density.	m^3			
12.8	8.3.5(d)	Extra over 12.7 for stabilisation	m^3			
TOTAL SECTION 12: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 MF	**SECTION 13: BASE**				
13.1	8.3.3(b)	Construct a base layer of 150mm graded crushed stone from commercial off-site sources and compact to 98% Mod AASHTO density.	m^3			
		Extra over 13.1 for				
13.2		areas $2m^2$ and smaller (i.e. potholes)	m^3			
13.3		areas less than $100m^2$	m^3			
13.4	8.3.5(d)	Stabilization	m^3			
13.5	8.3.8	Stabilising agent - Portland cement.	ton			
13.6	8.3.3(b)	Construct 150mm thick base, in confined areas between buildings where only small walk-behind compactors have access to. Material from commercial off site sources. Compact to 95% Mod AASHTO density.	m^3			
13.7	8.3.5(d)	Extra over 13.6 for stabilisation	m^3			
TOTAL SECTION 13: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 MH	**SECTION 14: ASPHALT SURFACING**				
14.1	8.5.1	**PRIME COAT** Apply a coat of tar prime Grade RTH 3/12P at nominal rate of 0,8ℓ/m².	m²			
14.2	8.5.3	**TACK COAT** Apply tack coat of 30% stable grade emulsion at 0,8ℓ/m².	m²			
14.3	8.5.4	**PREMIX**				
		Supply and lay a premix wearing course of continuously graded asphalt (TPA - Medium) using 60/70 bitumen binder (smoothness accuracy i.t.o. Clause 6.3.6) for thickness:				
14.3.1		30mm	ton			
14.3.2		30mm - 75mm	ton			
14.3.3		75mm - 100mm	ton			
14.4	8.5.5	**VARIATIONS IN QUANTITIES**				
14.4.1		RTH 3/12P	lit.			
14.4.2		30% stable grade emulsion	lit.			
14.4.3		60/70 bitumen binder	lit.			
14.5	8.5.6	**MINERAL FILLER**				
		Ordinary Portland cement	ton			
14.6		**CRACK SEALING**				
14.6.1		a) Sealing of cracks less than 3mm with anionic stable grade emulsion.	l			
14.6.2		b) Crack sealing (3mm to 10mm) in bitumen surfaces.				
14.6.2.1		b.1) Clean cracks by means of compressed air and apply an approved herbicide in accordance with the manufacturers description and allow to dry for 24 hours. Penetrate cracks with MSP/1 or similar suitable primer. Apply one coat of anionic stable grade emulsion by means of pneumatic spraying equipment.	m			
14.6.2.2		b.2) Fill crack with rubber slurry mix of 8 parts rubber crumbs, 2 parts crusher dust, 4,5 parts of 60% cationic stable grade bitumen emulsion, 0,2 parts of ordinary Portland cement and 1,1 part SBR (net rubber). Work slurry neatly into cracks with rubber squeegees and remove excess slurry as soon as emulsion has broken.	l			
14.6.2.3		b.3) Same as above but fill crack with hot bitumen rubber mixture. Rubber content shall be at least 25% by mass of the total bitumen rubber mix.	l			
14.7		**MILLING EXISTING ASPHALT SURFACE**				
		Milling to depths as follow:				
14.7.1		0 - 30mm	m³			
14.7.2		30mm - 60mm	m³			
14.7.3		60mm - 120mm	m³			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
14.8	SANS 1200mm	**ANCILLARY ROADWORKS**				
14.8.1	8.3	Permanent road/danger signs	prov			
14.8.2	8.3.6	Statutory signs complete	prov			
14.9	8.4.	Road marking				
	8.4.1	Non-reflecting paint applied at nominal rate of 0,42 l/m²				
14.9.1	8.4.1(a)	White lines, 100mm wide	m²			
14.9.2	8.4.1(b)	Yellow lines, 100mm wide	m²			
14.9.3	8.4.18	White characters	m²			
14.9.4	8.4.1.(c)	White lines 100mm - 600mm wide	m³			
TOTAL SECTION 14: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 MJ	**SECTION 15: SEGMENTED PAVING** Paving measured are predominantly around buildings, with widths varying from 1m to 3m.				
15.1		**EDGE RESTRAINTS**				
15.1.1	8.2.1	Edge restraints formed with last brick on 100mm x 300mm, 25MPa surface bed and 150mm x 150mm triangular concrete restraint on edge. As per Drawing Detail Type No. DT 03/P.	m			
15.1.2	8.2.1	Triangular edge restraints as per Drawing Detail Type No. DT01/P.	m			
15.2		**PAVING**				
15.2.1	8.2.2	Paving construction of 80mm grey double ZZ, 30MPa interlocking paving bricks, complete including 45mm (uncompacted thickness) bedding sand, weed killer, filler sand with grading less than 1,18mm and PVC sheeting. Bricks laid in stretcher or herringbone pattern (base and subbase and earthworks measured elsewhere). Rate to include square cutting where required. See Drawing Detail Type No. DT 01/P, DT 02/P, DT 03/P and DT 05/P.	m²			
15.2.2	8.2.2	Paving construction of 50mm red coloured standard bond, 30MPa paving bricks, complete including 45mm (uncompacted thickness) bedding sand, weed killer, filler sand with grading less than 1,18mm base and PVC sheeting. Bricks laid in stretcher or herringbone pattern (base and subbase and earthworks measured elsewhere). Rate to include square cutting where required. See Drawing Detail Type No. DT 01/P, DT 02/P, DT 03/P and DT 05/P.	m²			
15.2.3	8.2.2	Paving construction of 50mm grey standard bond, 30MPa paving bricks, complete including 45mm (uncompacted thickness) bedding sand, weed killer, filler sand with grading less than 1,18mm and PVC sheeting. Bricks laid in stretcher or herringbone pattern (base and subbase and earthworks measured elsewhere) Rate to include square cutting where required. See Drawing Detail Type No. DT 01/P, DT 02/P, DT 03/P and DT 05/P.	m²			
15.2.4	8.2.2	Remove and replace existing 50mm paving in sidewalk with inclusion of 150mm deep surface preparation of rip and recompact to 93% Mod AASHTO density of in situ material.	m²			
15.3		**CUTTING**				
	8.2.3	Cutting units to fit edge restraints for paving thickness				
15.3.1		50mm	m			
15.3.2		80mm	m			
TOTAL SECTION 15: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
		SECTION 16: FENCING				
16.1		**PRECAST CONCRETE FENCE**				
16.1.1		Supply and erect 2050mm high precast concrete fence complete as per drawing C5124/30. Rate shall include the clearance of vegetation, filling or excavation of minor irregular surface areas, and erect complete wall.	m			
		Extra over concrete wall:				
16.1.2		Type G overhang complete	m			
16.1.3		Pedestrian gate complete	no			
16.1.4		3100mm vehicle gate (not double gates as shown) including corner posts	no			
16.2		**STEEL FENCE**				
16.2.1		Supply and erect 3000mm high steel fence complete as per C5124/30. Rate shall include the clearance of vegetation, filling or excavation of minor irregular surface areas, and erect complete fence including all excavations, concrete, galvanized 50 x 50mm 2,5mm thick diamond chain link wire (SANS 121, Class B galvanizing) cladding, 2,3mm ht wiring and tension bolts. (All material hot dipped galvanized to SANS 121 class B)	m			
16.2.2		Extra over steel fence:				
16.2.3		Type F overhang complete	m			
16.2.4		Pedestrian gate complete	no			
16.2.5		3100mm vehicle gate (not double gates as shown) including gate posts	no			
16.2.6		Tension post complete	no			
16.2.7		Corner post complete	no			
16.3		**FENCING TO DEMARCATE HIGH RISK AREAS**				
16.3.1		Supply steel chain to fence any area. Links of minimum 10mm diameter and heavy duty hot dipped galvanised to SANS 121 and painted on site with one coat red primer (SANS 5312) and two coats white structural steelwork paint (SANS 684).	m			
		Posts measured separately.				
TOTAL SECTION 16: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
		SECTION 17: SUBSURFACE GROUTING				
		This section deals with the grouting of subsurface cavities and engineering services with a pumpable concrete or cement/sand or cement/soil mixture. Work shall comprise of the pumping of grout mix directly from grout mixer via flexible piping attached to down-the-hole steel piping lowered to a depth as indicated by the Engineer into boreholes or set-up stations for services. Execution of each pumping operation shall be continuous.				
17.1	PE9.1	**SITE ESTABLISHMENT**				
		Site establishment of grout mixer, pump, flexible hoses and pressure metres. Rate shall include the establishing and maintenance of all equipment on site for the duration of grouting operation.	sum			
17.2	PE9.2	**SETTING UP OF GROUTING EQUIPMENT**				
		Set up grouting equipment at each borehole.	no			
17.3	PE11	**STEEL GROUT PIPES**				
		Insert 50mm screwed seamless steel pipe in borehole.	m			
17.4	PE10.3	**GROUTING**				
		Supply, deliver, mix and pump continuously grout as specified below. The amount to be pumped per set up shall be determined by Engineer. For:				
17.4.1		Grout type: Self-compacting concrete	m^3			
17.4.2		1MPa - 2MPa / 70:30 OPC:FA self compacting concrete utilising crusher- and filler sand to suit a slump of 120mm. Mix to be pumpable.				
		Grout type: Soil-cement	m^3			
		Soil as specified mixed with 6% to 10% OPC and with water to have a slump of between 100mm and 150mm and 28 day strength of 2MPa minimum.				
17.5		**MATERIAL FOR VARIATIONS IN QUANTITIES**				
17.5.1		Cement: PC 25	ton			
17.5.2		Unwashed crusher sand	m^3			
17.5.3		Fine filler/plaster sand	m^3			
TOTAL SECTION 17: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
	SANS 1200 GA	**SECTION 18: CONCRETE** Note: no air entraining agents shall be used unless by written instruction of Engineer. All concrete shall be compacted by vibrating, and slump as per Clause 5.4 1.2.				
18.1	8.2	**FORMWORK**				
18.1.1	8.2.3	Smooth formwork in narrow widths (up to 300mm) for floor slabs. Formwork to allow for continuous reinforcement over joint.	m²			
18.1.2	8.2.2	Smooth formwork in widths (up to 800mm) for platforms or stormwater energy-dissipating splitters or benchmark platforms.	m²			
18.1.3	8.2.2	Smooth formwork in vertical walls of canal 1m to 1,5m deep and at 45 degree angle.	m²			
18.1.4		Smooth formwork - vertical on inside of valve chambers, sleeve chambers and storm water catch pits.	m²			
18.1.5	8.2.2	Smooth formwork - horizontal under slabs in small (up to 1,5x 1,5m) valve chambers etc.	m²			
18.1.6	8.2.1	Rough formwork - vertical walls of valve boxes etc,	m²			
18.1.7	8.2.4	Box out 100mm circular holes in 200mm roof slabs	m²			
18.2	8.3.1	**STEEL**				
18.2.1		Y - 12mm in walls	t			
18.2.2		Y - 16mm in walls	t			
18.2.3		Y - 20mm in floor slabs or sinkhole bases	t			
18.2.4		Y - 25mm in floor slabs or sinkhole bases	t			
18.3		**BLINDING LAYER**				
18.3.1	8.4.2	50mm 15MPa/19mm blinding layer under 2m to 3m wide canal floor slab, valve box, etc.	m³			
18.4	8.4	**CONCRETE**				
18.4.1	8.4.3	25MPa/19mm (rapid hardening) concrete placed at base of sinkhole against natural ground formation. Curing as per Clause 5.4.7(a).	m³			
18.4.2	8.4.3	30MPa/19mm concrete placed in reinforced floor slabs, canal floors or foundations. Curing as per clause 5.4.7(b) with uPVC sheets. Accuracy degree II (Clause 6.4).	m³			
18.4.3	8.4.3	30MPa/19mm concrete placed in reinforced vertical walls of manholes, valve boxes, canal etc. Curing of exposed surfaces as per clause 5.4.7(b) with uPVC sheets. Accuracy degree II (Clause 6.4).	m³			
18.4.4	8.4.3	30MPa/19mm concrete placed in reinforced vertical or skew (45 degrees) walls of canal. Curing of exposed surfaces as per clause 5.4.7(b) with uPVC sheets. Accuracy degree II (Clause 6.4).	m³			
18.5	8.4.4	**FINISHES**				
18.5.1	8.4.4(b)	Steel floated finish	m²			
18.5.2	8.4.4(a)	Wooden floated finish	m²			
TOTAL CARRIED FORWARD						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
18.6	8.5	**JOINTS** Rate for joint shall include all work to form the joint as well as materials.				
18.6.1		Expansion joints - formed with 10mm bitumen impregnated soft board. Price shall include raking clean for sealant. See Drawing Detail Type No. DT 05/ST.	m			
18.6.2		Stormwater Canal Floor Expansion Joint. Complete as indicated on Drawing Detail Type No. DT 10/ST.	m			
18.6.3		Cross joint including cutting and sealant. See Drawing Detail Type No. DT 11/ST (Construction Joint - Type 1).	m			
18.6.4		Key Joint. See Drawing Detail Type No. DT 12/ST (Construction Joint - Type 2).	m			
18.6.5		Construction Joint. See Drawing Detail Type No. DT 13/ST (Construction Joint – Type 3).	m			
18.6.6		Sealed tie bar joint including cutting and sealant. See Drawing Detail Type No. DT 04/ST.	m			
18.6.7		230mm Rubber centre bulb water stop. See Drawing Detail Type No. DT 11/ST.	m			
18.6.8		250mm PVC rearguard water stop.	m			
TOTAL SECTION 18: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
		SECTION 19: JOINT SEALANT This section deals with the sealing of joints around buildings and paved areas. Priced items shall allow for the cleaning of joint from all old filler or debris and jetting clean with compressed air. The joint shall be dry (min 4 days without rain after cleaning), cleaned and prepared inclusive of surface preparation as per manufacturer's instructions for the particular application and insertion of bond breaker and compressible joint filler before applying sealant. No claims for re cleaning shall be allowed. Joint filler width to depth dimensions are to be according to supplier detail.				
19.1		**JOINTS - LABOUR AND PROFIT** For items 19.1.1 to 19.1.8 the contractor must submit the total cost of labour, plant and profit of joint sealing exclusive of material. Clean joints, prepare surface and apply: a) Bitumen based				
19.1.1		Joints 0 - 12mm	m			
19.1.2		Joints 12mm -15mm	m			
19.1.3		Joints 15mm -20mm	m			
19.1.4		Joints 20mm -25mm	m			
		b) Polysulphite				
19.1.5		Joints 0 - 12mm	m			
19.1.6		Joints 12mm -15mm	m			
19.1.7		Joints 15mm -20mm	m			
19.1.8		Joints 20mm -25mm	m			
19.2		**MATERIAL** The rate for material shall allow for the supply of material on site ready to use:				
19.2.1		Bitumen Based Sealant .....…… ……. Specify type	lt			
19.2.2		Polysulphite Based Sealant ..... …… Specify type	lt			
TOTAL SECTION 19: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
		SECTION 20: GEOTECHNICAL DRILLING Refer to the Particular Specification: Exploratory Drilling for Engineering Geological Investigation.				
20.1	PD 9	**SITE ESTABLISHMENT**				
20.1.1	PD 9.1	Site establishment includes all cost to establish the complete drilling rig and personnel on site as well as the removal thereof after completion of a drilling phase.	no			
20.2	PD 9.2	**SETTING UP AND REMOVAL OF RIGS AT EACH BOREHOLE**	no			
20.3	PD 10	**ROTARY PERCUSSION DRILLING (165mm DIAMETER) FOR DEPTHS:**				
20.3.1	PD10.2.1	0 to 30m	m			
20.3.2	PD10.2.2	30m to 60m	m			
20.3.3	PD10.2.3	60m to 100m	m			
20.3.4	PD 10.3	Extra over 20.3: Drilling at inclination (1 - 30 degrees)	m			
20.4	PD 10.6	**FOAM/DRILLING MUD**	lt			
20.5	PD 11	**CASING**				
20.5.1	PD 11.1	Temporary	m			
20.5.2	PD 11.2	Permanent	m			
20.5.3	PD 11.3	Permanent (1,5m) casing for grouting	no			
20.5.4	PD 11.4	Concrete grouting surface plug	no			
20.6	PD 13	**BACKFILLING OF BOREHOLE**	m			
20.7	PD 14	**GROUTING TO STABILISE BOREHOLE**	m			
20.8	PD15	**SEAL AND MARKING OF BOREHOLES**	no			
20.9		**DRILLING THROUGH ASPHALT SURFACES**				
20.9.1		Cut 400 x 400 x 100mm deep square portion from the road or other surface areas to expose subbase before drilling commences. Repair area by filling the last 400mm of the borehole with 20MPa concrete up to 100mm below surface level. Repair the surface by applying a 30% stable grade emulsion tack coat and fill hole with a premix wearing coarse of continuously graded asphalt using 60/70 bitumen binder. Accuracy of finishing to be class 1 in terms of SANS 1200 MH 6.3.6.	no			
TOTAL SECTION 20: CARRIED FORWARD TO SUMMARY						

ITEM NO	PAYMENT REFERS	DESCRIPTION	UNIT	QUANTITY	RATE	TOTAL
		SECTION 21: DYNAMIC COMPACTION				
21.1		**SITE ESTABLISHMENT**				
		Rate shall include all procurement and site establishment of equipment and personnel.	sum			
21.2		**MOVEMENT ON SITE**				
		Rate shall cover the full cost to move, level machine area and setup all equipment, between any two locations where DC is equired.				
21.2.1	PA 13.2	Dismantling and re-erection for movement under own power.	no			
21.2.2	PA 13.3	Dismantling and re-erection for movement with truck.	no			
21.2.3	PA 13.4	Movement under own power.	km			
21.2.4	PA 13.5	Protection of paved areas.	m			
21.2.5	PA 13.6	Movement per truck.	km			
21.3		**DYNAMIC COMPACTION**				
		Dynamic compaction of the excavated footprint area, including 2m wide perimeter (note that excavation of sinkhole before DC and reinstatement of the surface area are measured separately under Earthworks):				
21.3.1		a) Excavated surface before backfilling at depth between 1,5m and 2m.	m²			
21.3.2		b) Backfilled material in layers not exceeding 4m thickness.	m²			
21.3.3		c) Ironing of final soil backfilled area at depth of approximately 0,5m below final surface.	m²			
21.4		**VERTICAL PLATE LOAD TESTS**	no			
21,5		**STANDING TIME**	hr			
TOTAL SECTION 21: CARRIED FORWARD TO SUMMARY						

SUMMARY:		
SECTION 1:	PRELIMINARY AND GENERAL	
SECTION 2:	SITE CLEARANCE AND DEMOLISHING OF STRUCTURES	
SECTION 3:	EARTHWORKS	
SECTION 4:	EARTHWORKS(PIPE TRENCHES)	
SECTION 5:	BEDDING	
SECTION 6:	MEDIUM PRESSURE PIPELINES	
SECTION 7:	SEWERS	
SECTION 8:	STORMWATER DRAINAGE	
SECTION 9:	PIPE JACKING	
SECTION 10:	KERBING AND CHANNELLING	
SECTION 11:	EARTHWORKS (ROADS, SUBGRADE)	
SECTION 12:	SUBBASE	
SECTION 13:	BASE	
SECTION 14 :	ASPHALT SURFACING	
SECTION 15:	SEGMENTED PAVING	
SECTION 16:	FENCING	
SECTION 17:	SUBSURFACE GROUTING	
SECTION 18:	CONCRETE	
SECTION 19:	JOINT SEALANT	
SECTION 20:	GEOTECHNICAL DRILLING	
SECTION 21:	DYNAMIC COMPACTION	
	TOTAL SECTIONS 1 to 21 PLUS : VAT @ 14%	
CONTRACT AMOUNT : CARRIED TO TENDER FORM		