

Standard Specifications for Road and Bridge Works for State Road Authorities

Committee Draft Final (CDF)

CHAPTER 2: SERVICES

August 2019

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Roads Coordinating Body (RCB)

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Document Versions

Working Draft (WD). When a COTO subcommittee identifies the need for the revision of existing Standard Specifications for Road and Bridge Works, a workgroup of experts is appointed by the COTO subcommittee to develop the document. This document is referred to as a Working Draft (WD). Successive working drafts may be generated, with the last being referred to as Working Draft Final (WDF). Working Drafts (WD) have no legal standing.

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Comments

Comments on the Chapters must be provided in writing as per the format provided on the SANRAL website www.nra.co.za and e-mailed to cotorevision@nra.co.za no later than **04 October 2019**.

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CHAPTER 2: SERVICES

A2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES

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PART A: SPECIFICATIONS

A2.1.1 SCOPE

Section A2.1 covers the general requirements applicable to civil construction work associated with the location, identification, protection, relocation and the installation of services in existing or new road reserves or servitudes as well as the protection and reinstatement of existing road infrastructure affected in the process of dealing with such services. This section also covers the trenching requirements applicable to the installation of services in road reserves. Section A2.1 covers services installed as individual services as well as when they are to be installed as part of a larger construction contract. Chapter 2 does not cover stormwater and other drainage structures which are specified in Chapter 3.

A2.1.1.1 Installation of new services

The construction work associated with the installation of new (utility) services in road reserves including the installation of new dry services (ducts for cables for communications and electric power etc.) are covered in Section A2.2, the installation of new wet services (water supply and waste water (sewerage) pipelines etc.) are covered in Section A2.3 and the installation of street lighting, electric power and energy services (gas and fuel pipelines) as well as the installation of other new services as may be specified in the Contract Documentation are covered in Section A2.4.

A2.1.1.2 Location, identification, protection and relocation of existing services

Section A2.1 also covers the work associated with the location and identification of all existing services on the Site and the protection and/or relocation of existing services. Existing services shall be located, identified and protected or relocated in accordance with the details shown on the drawings, provided in the Contract Documentation or as directed by the Engineer.

A2.1.1.3 General note

In certain SANS documents referred to in this section the term "*specified in the scope of work*" is used. For the purposes of this specification the term shall be deemed to mean "*specified in the Contract Documentation*".

A2.1.1.4 Applicable supporting specifications

Section A2.1 of Chapter 2 shall be used in conjunction with, amongst others, the following standards or specifications:

SANS 2001-DP1	Earthworks for buried pipelines and prefabricated culverts
SANS 51008	Mixing water for concrete – Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

A2.1.2 DEFINITIONS

The following definitions shall apply to these specifications:

Affected Parties - All persons or organisations that may be affected by the construction work and shall include all Service Owners.

Backfill - Approved compacted materials used to replace excavated materials from the top of the fill blanket or bedding up to the surrounding ground level or the bottom of the pavement layer works, whichever is the lowest.

Cables - Power and auxiliary conductors including optical fibre cables for the transmission and distribution of electricity, communication signals and data signals.

Design - Includes the collection of information, resolution of conflicts with all affected parties, detailing of service location or position and specifications and obtaining the written agreement of all affected parties.

Duct - An enclosed tubular or rectangular conduit for enclosing wires, pipes or cables for the purpose of providing structural or other protection for the wires, pipes or cables and/or allowing for their installation or replacement without re-excavation, jacking or boring.

Equipment - Pipes, cables, poles, manholes, transformers and other components that are a necessary part of a service system or subsystem.

Footway (Footpath/Sidewalk/Walkway) - A formally constructed area or paved strip within a road reserve for the safe passage of pedestrians, animals and non-motorised transport. The terms footpath, sidewalk or walkway are also used with sidewalk generally used where the facility is contiguous to the carriageway/roadway. A footway excludes surfaced or unsurfaced road shoulders.

Known Existing Service - Any existing service on Site that is shown on the drawings, detailed in the Contract Documentation, indicated on the record (as-built) drawings or indicated in the wayleave information or which can be reasonably confirmed or inferred from visible features on Site shall be defined as known existing services. All new or relocated services, once installed by either the Contractor or any other party, shall be also be defined as known existing services. All services located, identified and verified during any investigations for services on Site shall be defined as known existing services as soon as their presence on Site has been detected. Any service which has been temporarily taken out of service to allow for the execution of the works or which has been taken out of service, as a result of an event which necessitated the execution of the works, shall also be deemed to be a known existing service.

Non-motorised transport (NMT) - Non-motorised transport or transport by any means other than a motor vehicle including, but not limited to, walking, cycling and animal-drawn vehicles and wheelchairs.

Pavement layers (Pavement layer works) - Refer to Clause A4.1.2 of Chapter 4.

Pipe - A structural tubular product designed, tested, and manufactured for conveying liquids and gases under specific conditions.

Relocation - The removal of existing equipment and its re-installation in an alternative location. Such relocation may include the replacement of some, or all, of the existing equipment as part of the relocation process.

Replacement - The removal of existing equipment that has been damaged, or is worn, or obsolete, and installation of a similar or improved element of a service system or subsystem.

Reinstatement - The work necessary to replace, repair or otherwise restore all surfaces and features in a road reserve to the same or better condition as existed prior to any construction activities that affected the original condition.

Road - A street, road, or other public way, as well as bridges or other structures, including shoulders, and footways designated for the purpose of vehicular traffic and/or pedestrian and other non-motorised transport.

Road Authority - The authority responsible for a road in terms of the relevant national, provincial or municipal legislation.

Road (or Street) Furniture - A collective term for objects and pieces of equipment installed on streets and roads for various purposes. It includes, but is not limited to, guardrails, traffic barriers, bollards, traffic lights, road signs and street lighting.

Service(s) - The plant, equipment, conduits or other infrastructure installed for the generation, supply, distribution, transmission, transportation, storage, disposal of electricity, signals or data, liquids or gasses for the consumption, use or other benefit of others.

Service Owner - A private company, public authority, municipal council business unit, agency, directorate, or department etc. responsible for providing a service, including but not limited to gas, petroleum products, steam, chemicals, electric power, data, communications, water, sewerage, drainage or irrigation.

Sleeve - As for *Duct*.

Trenchless Methods - The methods of installing a pipe or sleeve under a road without disturbing the surrounding surface medium by using grade and alignment control equipment. Methods covered by this definition include, but are not limited to, pipe jacking, micro-tunneling, ramboring (RB) or directional drilling (DD) methods.

Verge - The area between the outer edge of the **Road Prism**, as defined in Clause A5.1.2 of Chapter 5, and the boundary of the road reserve.

A2.1.3 GENERAL

For the purposes of Clause A2.1.3 the definition of Services under Clause A2.1.2 shall be deemed to include any pipes, culverts or other infrastructure provided for surface or subsurface drainage purposes.

A2.1.3.1 Installation of new services

New services shall be installed in accordance with the details provided in the Contract Documentation or as directed by the Engineer and in accordance with the conditions and requirements of any applicable wayleaves or construction permits. Where sufficient details are not available for the Contractor to plan and carry out the work the Contractor shall, in writing, request that the Engineer provide any outstanding details.

When the investigation of the existing services as described in Clause A2.1.3.2 hereafter has been completed the Contractor shall inform the Engineer if the Contractor has become aware of any possible conflicts between the new proposed services and any known existing services.

A2.1.3.2 Location, identification, protection and relocation of existing services

a) Existing as-built records

The Employer will, on the drawings or otherwise in the Contract Documentation, provide information regarding the location of all known existing services.

Although every care has been exercised in the compilation of the available as-built information, data, records and drawings for the known existing services, the Employer does not guarantee, or accept responsibility for, the accuracy or completeness of the information provided. The Contractor shall therefore locate, identify and verify all known existing services and at the same time investigate, locate, identify and report the existence of any other services not previously known to be present on Site.

b) Location of existing services

Before any work can commence the Contractor shall verify the actual position of each known existing service and bring to the attention of the Engineer any previously unknown service that is not recorded in the existing as-built or wayleave records or indicated in the Contract Documentation.

The Contractor shall comply with the specified wayleave processes and conditions of the relevant road or service authorities including where such processes or conditions include a requirement to locate and verify the positions of services. If no other location and verification process is applicable the process specified hereafter shall apply.

Owing to the possible inaccuracy of the records of existing services the Contractor shall carefully check, determine and verify on the Site the positions of all known existing services shown on the wayleaves, drawings or described in the Contract Documentation. This shall be done by visual inspections, using appropriate detection equipment with acceptable accuracy, and by making excavations to expose the position of the services at critical points. This shall also be done where no services are shown on the drawings or described in the Contract Documentation but where such services are nevertheless believed to be present or the possibility of their presence can reasonably be inferred or expected by an experienced and competent Contractor. Where indicated in the Contract Documentation services shall be detected by means of appropriate Ground Penetration Radar (GPR) or other specified equipment. The Contractor shall propose the nature and extent of the services investigation required and submit it to the Engineer for review and to obtain agreement on the use of any specialist services provided by other parties and on any other related payment matters.

The horizontal and vertical positions of all services detected shall be marked carefully, surveyed and then shown on the drawings together with appropriately recorded details of the service number, type and size.

The position of the existing services shall be checked and verified in advance of the construction works so that the Engineer is able to confirm or make the necessary arrangements for the protection, removal or relocation of the services before work has to commence in their vicinity. The lead times required to make the necessary arrangements for the protection, removal or relocation of services which the Contractor shall allow shall be as indicated in the Contract Documentation or as stated in any applicable wayleaves or construction permits or as confirmed by the Engineer and shall be as agreed with each affected service owner.

As soon as any service which has not been identified and located as described above is encountered on, under, over or within the Site during excavation or any other construction activity during the progress of the works, it shall henceforth be deemed to be a known existing service and the aforesaid provisions pertaining to locating, verifying and recording its position shall apply. The Contractor shall notify the Engineer immediately when any such service is encountered or discovered on the Site. The relevant service owner shall also be notified of any services verified on Site that were not indicated on the original as-built records referred to in Clause A2.1.3.2a).

All the verified services will be defined as "known existing services" and the Contractor will be held responsible for any subsequent damage to them whether caused directly by the Contractor's operations or by the lack of proper protection. The Contractor shall take all reasonable precautions not to damage the services during a search. If a service is damaged during the course of its location, discovery or exposure, the Contractor will be reimbursed for the cost of making good such damage, unless it is established by the Engineer that the Contractor did not exercise reasonable diligence and care and that the damage was avoidable.

Payment for the location and verification of existing services will be made in accordance with the relevant payment items in Part C2.1.

c) Condition of existing services

The Contractor shall acknowledge that he has inspected and examined all known existing services and all existing services subsequently discovered on Site and is satisfied that all such services were in an acceptable and serviceable state at the commencement of the works, or alternatively, upon verification thereof as contemplated in Clause A2.1.3.2b). The Contractor shall report all services that are damaged or not in an acceptable and serviceable state to the Engineer.

In the event of a dispute as to the acceptability and/or serviceability of an existing service at the commencement of the works or upon the verification of such a service, the Contractor shall prove to the satisfaction of the Engineer that the service in question was not in an acceptable and/or serviceable state at the commencement of the works or when located.

d) Protection of services

(i) Service owners

Prior to commencing work, the Contractor shall confer with all service owners, authorities and departments concerned and obtain the necessary wayleaves, permits or permissions for both overhead and underground services affected by the works and shall satisfy himself that all the relevant information required to complete the contract has been obtained. Refer to Clause A2.1.3.8 in this regard.

The Contractor shall carry out the works with minimum interference to existing services. The Contractor shall co-operate with all the service owners, authorities and departments concerned and shall be responsible for timeously informing all service owners, authorities and departments as to the planned date for the stage of the construction which involves the laying and/or relaying of any particular services. The notice periods or lead times that the Contractor has to give each of the relevant service owners for them to be able to lay and/or relay any particular service shall be as indicated in the Contract Documentation or confirmed by the Engineer and shall be as agreed with each affected service owner.

The Contractor shall set out the lines and levels of kerbs, pipes, culverts and any other necessary features of the contract in order that service owners, authorities and departments are able to lay and/or relay services correctly.

The Contractor shall allow all reasonable access to any service owner, authority or department for the purpose of maintaining, laying and/or altering any services during the construction period as ordered by the Engineer and approved by the Employer.

(ii) Protection

During the course of the works all known existing services including traffic signals, water mains, sewers, electricity transmission and communication lines, cables, poles, pipes and ducts as well as any storm water or drainage infrastructure, whether in service or not, shall be protected, supported and maintained to the satisfaction of the service owner, authority or department concerned and the Engineer.

The Contractor shall take all reasonable precautions and shall exercise due care and diligence to locate and protect known existing services and to ensure that any interference with other underground or visible services are limited and controlled during any construction activities including trenching, during the installation of services or during the relocation of services. Where protective measures involve the construction of permanent work, the Contractor shall execute the work in accordance with the details shown or described in the Contract Documentation or in accordance with the Engineer's instructions, and payment shall be made under the relevant payment items. Hydrants under pressure, water main valve covers and manholes shall be kept unobstructed and accessible at all times if they are in service. The covers and frames of service manholes and catch pits will have to be adjusted where they are affected by the works.

The Contractor shall comply with the requirements of Clause A1.2.3.13 of Chapter 1 regarding work which involves blasting or the use of heavy vibratory or impact compaction equipment near known existing services.

Unless otherwise instructed by the Engineer, no services shall be left exposed after their exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted after surveying and recording is complete.

Services which are left exposed with good cause shall be suitably protected from damage and in such a manner as will eliminate any danger arising therefrom to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations.

Where known existing services, which include new services that are being installed, are left exposed or are left partially bedded or backfilled, the Contractor shall provide adequate security measures to, as far as is reasonably possible, eliminate the risk of loss or damage due to theft or vandalism. The Contractor shall ensure that the bedding and backfilling for services is completed without any delay after a service has been laid to reduce the period that the services are exposed.

Survey beacons or reference pegs shall not be removed or disturbed. If such a need arises, the Engineer shall be advised so that the Engineer can determine what suitable action is to be taken.

(iii) Damage

The Contractor will be held responsible for any damage caused by him to known existing services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified in accordance with Clause A2.1.3.2b), due cognisance being taken of such deviations in line and level which may reasonably be anticipated, unless the Contractor can prove that reasonable diligence and care had been exercised and that the damage was unavoidable despite all precautions. The Contractor will be not be held responsible for any damage caused if the position of a known existing service deviated by more than 1,0 m horizontally or 0,5 m vertically from the position as may reasonably have been determined after the location and verification of the service's position in accordance with Clause A2.1.3.2b).

In the event of damage to any services the Contractor shall immediately inform the Engineer, or when this is not possible, the relevant service owner, authority or department, and obtain instructions as to the necessary repairs or protective measures to be taken and as to who should carry out such repair or protection work. The Contractor shall take such immediate action as is necessary to prevent further damage or danger to life or property. In urgent cases, the Contractor shall take appropriate steps to mitigate damage to and interruption of the service. All known existing services of any nature whatsoever damaged as a result of the Contractor's operations shall be repaired and reinstated forthwith by the Contractor or by the service owner, authority or department concerned to the satisfaction of the Engineer and the relevant service owner, authority or department and the Contractor shall, subject to the provisions of the preceding paragraph of this Clause A2.1.3.2d)(iii), be liable for any related costs.

(iv) Relocation

Whenever services are encountered which interfere with the execution of the works, and which must be moved and relocated, the Contractor shall advise the Engineer, who will determine the extent of the work, if any, to be undertaken by the Contractor in moving, relocating and reinstating or protecting such services.

It shall be clearly understood that, in certain instances, existing services can be relocated only after the Contractor has advanced sufficiently on, or has completed, certain sections of the works included in the contract.

The Contractor shall work in close co-operation with all service owners, authorities or departments controlling services which have to be protected, moved or relocated. Details regarding the state of negotiations concluded between the Employer and the service owner prior to the commencement of the contract in respect of the time when either the service owner is prepared to start moving such services or when the Contractor is required to, or will be allowed to, start moving the services, and the duration of such operations, will either be stated in the Contract Documentation or be made available to the Contractor. Should the owners of services refuse to co-operate with the Contractor in a reasonable manner in connection with the protection or moving of services belonging to them, the Contractor shall refer the matter to the Engineer.

If the Contractor is not authorised to remove, relocate or replace services the Contractor shall give notice, in writing to the relevant service owner, that the services on the Site will require removal or protection prior to works being carried out in the vicinity of such services. The Contractor shall advise the service owner of the number of services and their locations and the proposed dates when work will commence in the vicinity of each service.

The Contractor shall give notice as follows:

- Where the details of the services to be relocated are provided at the commencement of the contract the Contractor shall send the notice to the relevant service owners within fourteen days of the commencement of the contract.

- Where the need to relocate a service only becomes apparent after the location and verification of services has been completed as required by Clause A2.1.3.2b) the Contractor shall send the notice to the relevant service owners within fourteen days of the Engineer confirming that the service, as located or discovered, has to be relocated.

In addition to the above notice, the Contractor shall give the service owner a minimum of fourteen calendar days written notice (unless a longer period has been included in the service owner's wayleave or construction permit conditions in which case the longer period shall apply) of the intention to commence work in the vicinity of each relocated service. Upon completion of the work in the vicinity of each service, the Contractor shall notify the service owner, in writing, that work is complete.

Payment to service owners for the relocation of existing services or for any deposits or guarantees required by service owners for work near services will be made in accordance with the relevant payment items in Part C2.1.

A2.1.3.3 Safety, Method Statements, safeguarding the works and accommodation of traffic

a) Safety and Method Statements

All installation of services work shall comply with the health and safety requirements of Clause A1.2.3.6 of Chapter 1 and as specified in the Contract Documentation.

The Contractor shall prepare and submit to the Engineer for review and approval as required, the Method Statements required in terms of the relevant health and safety legislation, the specification or the Contract Documentation. Construction Method Statements shall include, but not be limited to, those indicated in Table A2.1.3-1.

Table A2.1.3-1: Method Statements

Section / Clause	Activity to be Covered by Method Statement
A2.1.3.1	Installation of all new services
A2.1.3.2b)	Location of existing services
A2.1.3.2d)	Protection of services
A2.1.3.4	Protection of existing road carriageways, footways, verges and other infrastructure
A2.1.7.1 excluding A2.1.7.1l) and A2.1.7.1r)	Trenching for services
A2.1.7.1l)	Timbering and shoring
A2.1.7.1r)	Dealing with water
A2.2.7	Installation of ducts
A2.3.7	Installation of sewers and water mains
A2.4.7	Installation of cables

b) Safeguarding the works

The Contractor shall ensure that the works, including but not limited to all excavations that are accessible to the public, are kept safe at all times in accordance with the requirements of the relevant legislation. Safety precautions shall include, but shall not be limited to, suitable barriers, barricades or fencing, the provision of watchmen and the provision of suitable lighting at night as accepted by the Engineer. Payment for the safeguarding of the works shall be in accordance with the relevant sections of the specification.

c) Accommodation of traffic

Traffic accommodation during the installation of services shall comply with the requirements of Section A1.5 of Chapter 1 and shall be as specified in the Contract Documentation. All traffic accommodation measures shall be in accordance with the traffic accommodation plan for the works.

In addition to the accommodation of vehicular traffic the Contractor shall provide safe uncluttered thoroughfares for pedestrians and other NMT (as may be applicable) and also comply with any other specific access or accommodation requirements provided in the Contract Documentation.

A2.1.3.4 Protection of existing road carriageways, footways, verges and other infrastructure

Before construction equipment for services related work is allowed onto surfaced road carriageways or paved footways or verges, the Contractor shall submit, for acceptance by the Engineer, the proposals of how the Contractor intends operating construction equipment without causing damage to any of the existing surfaces. Protection proposals may include the following:

- The use of gravel, wood, tyres, etc. as ramps where kerbs have to be negotiated;
- The use of tyres and rubber mats where crawler-tracked equipment is used;
- The placing of wooden blocks under the hydraulic stabilising arms of excavators or cranes etc.;
- The placing of wooden blocks under the tined buckets of excavating equipment when fully lowered; and
- The use of loading equipment fitted with buckets without tines to remove dumped material to a minimum of 200 mm above any paved surface with the remaining 200 mm of material removed by means of hand work.

The Contractor shall adhere to the accepted proposals and will be held liable for repairing the damage caused by construction equipment or activities to any surfaced roads, footways or verges or kerbing etc. and restoring them to their original condition.

Before any construction commences the Contractor shall submit, for acceptance by the Engineer, the proposals regarding how the Contractor intends to work in the vicinity of any existing infrastructure or road furniture (such as traffic barriers, bollards, traffic lights, traffic signs, fencing, stays and struts for poles and gantries and street lighting) without causing damage to the existing infrastructure.

A2.1.3.5 Programming for services

a) Trenching and installation sequence

Where services including ducts or pipes are to be installed at a level lower than the final level of any mass earthworks that have to be carried out for the purpose of constructing a structure or a road, the trenching for such services, ducts or pipes shall be carried out after the mass earthworks have been completed unless otherwise specified in the Contract Documentation or agreed by the Engineer. Refer to Clause C1.1.2.2d) of Chapter 1 in this regard.

Where services, ducts or pipes are to be installed across or along new roads that are under construction, such work shall be completed before the subbase layer is constructed.

b) Programme and delays

When the Contractor prepares the construction programme, the Contractor shall clearly indicate the proposed start and end dates for the moving of each known existing service or when a service owner will be required to start and conclude the moving of each service. Such scheduling shall include reasonable periods for all such activities and shall take in to account any applicable conditions stated in wayleaves of construction permits or as otherwise agreed with service owners. The Contractor shall update the construction programme, on at least a monthly basis, to reflect the actual progress on the scheduled service work activities. If the Contractor considers that the progress of the works is being affected by the failure of any service owner, authority or department to protect, lay, remove or relocate any service in time or in accordance with construction programme and that a delay in the completion of the work may result, the Contractor shall immediately notify the Engineer in writing. The Contractor shall take appropriate steps to accommodate or mitigate the effects of such delays irrespective of the cause of the delays. Should such delays make it impossible to adhere to the programme of work, the Contractor shall, as agreed by the Engineer, suitably revise the programme in consultation with the Engineer so as to limit, in so far as is possible, the extent of any resultant damages or delays.

If the location of services process, described in Clause A2.1.3.2b), results in the identification of further existing services, the Contractor shall, as agreed by the Engineer, revise the construction programme to take account of any impact, as agreed with the service owner and the Engineer, the recently located services might have on the completion of the works.

The Contractor shall keep detailed records of all dealings with service owners so that, if required, it can be demonstrated that every effort had been made to timeously request and/or apply for the protection, removal or replacement of any services.

A2.1.3.6 Provision of record drawings and details

The Contractor, in addition to the records of the positions of known existing services, as determined in accordance with Clause A2.1.3.2b) above, shall ensure that the horizontal and vertical positions of all new and relocated services installed are accurately recorded and shown on the record drawings. All such drawings and records shall be delivered to the Engineer before the completion of the works. The position of the services shall be determined by a survey carried out by a suitably qualified surveyor. If so specified in the Contract Documentation the surveyor shall be registered as a Professional Surveyor, Technologist Surveyor or Technician Surveyor with the South African Council for Professional and Technical Surveyors (PLATO). The survey required to accurately record the position of the services may have to be carried out before any services are covered up. The position and levels of all manholes, valves, chambers, junction boxes, markers etc. shall be surveyed for the completion records.

A2.1.3.7 Construction supervision

The Contractor shall ensure that all work related to services is carried out, executed by and supervised by appropriately and sufficiently qualified and competent employees or agents.

A2.1.3.8 Liaison with affected parties

The provisions of Clause A1.2.3.22 of Chapter 1 shall apply to any wayleaves and/or construction or work permits required for all services related work.

A2.1.3.9 Limitations and restrictions

a) Work near other or existing services

No work using mechanical trenching equipment shall be undertaken closer than 1,0 m from any existing cable, pipe or duct without the explicit approval of the Engineer and the respective service owner.

Where any applicable wayleave conditions or construction or work permits include other working restrictions, limitations or conditions associated with particular services or other infrastructure they shall become applicable to all such work under the Contract and supersede the restriction stated in the paragraph above.

b) Maintaining accesses

The Contractor shall be responsible for maintaining accesses over trenches where applicable, in which regard the Contractor shall comply with the relevant requirements of Section A1.5 of Chapter 1.

c) Installation under special conditions

The following conditions are defined as special conditions for the installation of services and must be treated in accordance with the site or contract specific Contract Documentation, the wayleave conditions or any other relevant authority conditions as may be applicable in each case.

- Excavation within a radial distance of 500 mm from a power cable.
- Excavation requiring rock blasting.
- Placements requiring augering or horizontal directional drilling (HDD).
- Crossing of railway servitudes.
- Excavation adjacent to or crossing major road cuttings or embankments.
- Excavations near bridge abutments or footings.
- Work involving attachments to bridges or other structures.
- Concrete encasement of ducts in high risk areas.

- Installation of services in active clay conditions.
- Installation of services in areas where specific geotechnical conditions occur i.e. areas underlain by dolomites, collapsing soils or dispersive soils etc.

d) Other conditions

Trenching at the toe, crest or through cut or fill embankments shall be done such that the slope stability of the cut or fill embankment is not compromised.

e) Working widths

The Contractor shall always only occupy such areas as required to execute the specified services related work.

Where required by the Contract Documentation, once the setting out and pre-marking of the trench line has been completed, a corridor of a suitable maximum width, as agreed by the Engineer, shall be allowed for all trenching operations i.e. for all safety and environmental protection measures, accommodating workers and working space, as well as the safe placement of excavated material.

Where trenches are to be made in road reserves, servitudes or designated areas of specified width, the Contractor shall confine all his construction activities to within the limits of such reserves, servitudes and widths unless permission to encroach on to the adjacent property has been obtained, in writing in advance of any work, from any affected owner, lessee or occupier.

Any affected owner, lessee or occupier shall be afforded a reasonable time to remove any tall trees, shrubs or other plants as well as any improvements from a servitude should the affected party wish to do so. No trees or shrubs shall be removed by the Contractor without the written permission of the Engineer.

A2.1.3.10 Setting out of services works

The Contractor shall be responsible for the true and proper setting out of all work required for the installation of services and for the correctness of the position, levels, dimensions and alignment of all parts of such works and for the provision of all necessary instruments, equipment and labour in connection therewith.

The checking of any setting-out or of any line or level by the Engineer shall not relieve the Contractor of his responsibility for the correctness thereof. The Contractor shall rectify any error in the positions, levels dimensions or alignment of the works.

Refer to Clause A1.2.7.2 of Chapter 1 in this regard.

A2.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A2.1.4.1 Temporary works

The temporary works relating to services shall be designed and installed by the Contractor as required to construct the permanent works specified in the Contract Documentation or ordered by the Engineer. Where sufficient details are not available for the Contractor to design and carry out the temporary works the Contractor shall, in writing, request that the Engineer provide any outstanding details.

A2.1.4.2 Alternative designs

Alternative designs, relating to the installation of services, that promote innovative and new technologies and reduce total life cycle costs or reduce construction time or improve safety and provide an end product of similar or better quality and durability to that specified, may be offered.

Any alternative design shall comply with the same design requirements as the original design as detailed in the original Contract Documentation.

a) Pricing of alternative designs

For alternative designs to be considered they must be priced together with the original design. Any cost saving in relation to the original design must be shown.

A detailed total cost of ownership, over a period of 20 years, calculation for the original as well as the alternative designs must be presented with the alternative design.

b) Alternative design approvals

If an alternative design proposal is accepted in principle and is to be considered for approval the following shall be submitted with any proposed alternative design:

- A detail design report by an Engineering Council of South Africa (ECSA) registered Professional Engineer which demonstrates that the alternative design complies with the same design requirements as the original design included in the Contract Documentation;
- Method statements for alternative construction methods;
- All technical data sheets for alternative materials;
- Detailed life cycle cost of ownership calculations;
- Detailed construction program (integrated with the overall contract programme) and
- Any other information the Employer, Engineer or designer deems necessary.

All alternative designs for services will have to be accepted by the Employer in writing before the Contractor may commence with the construction according to the alternative design.

c) Alternative design responsibility

Although the alternative design will be evaluated by the Employer or his representative, the professional liability for such designs shall remain with the Contractor. The conditions and liabilities associated with the professional liability for designs shall be stated in a written agreement between the Contractor and the Employer should any alternative designs be accepted.

A2.1.4.3 Designs

Where the Contractor is responsible for the design of the civil engineering component of any service installations which form part of the permanent works in a road reserve, as may be specified in the Contract Documentation, such work shall be carried out by sufficiently qualified and competent registered professional civil engineers.

Any such designs of the permanent works by the Contractor shall be submitted to the Employer for acceptance before any construction of the designed work may commence. Although the designs will be evaluated by the Employer or his representative, the professional liability for such designs shall remain with the Contractor.

A2.1.4.4 Design criteria for trenches in verges

Design proposals, where these are to be provided by the Contractor, for service trenches in verges shall ensure that the completed and reinstated trenches in unpaved road verges:

- a) Must be able to resist a load of 70kPa i.e. equivalent to the load of a tractor pulling a grass-cutting machine or;
- b) Must have a bearing strength equivalent or better than the adjacent undisturbed material whichever is the highest.

The above criteria will not apply in the case of a trench in steep slopes (slopes exceeding 1:3 V:H) either in fill or cut, marshy clayey areas or in the vicinity of structural elements such as road signs, fence lines, telephone poles etc. where appropriate specific designs shall be prepared and submitted to the Engineer for acceptance.

A2.1.5 MATERIALS

A2.1.5.1 Trench backfill material

Backfill for ducts, pipes or cables installed by methods other than by micro or mini trenching, unless otherwise specified in the Contract Documentation, shall be a material that:

- Contains no detectable deleterious, organic or hazardous waste material.
- Can be placed without significant voids.
- In areas not subject to vehicular traffic loads has a maximum aggregate size of 100 mm and complies with the requirements for a G9 material in terms of Table A4.1.5-3 in Clause A4.1.5.6 of Chapter 4.
- In areas subject to vehicular traffic loads has a maximum aggregate size of 75 mm and complies with the requirements for a G7 or G8 material as specified in Table A4.1.5-3 in Clause A4.1.5.6 of Chapter 4.
- Can be compacted in accordance with the requirements of Clause A2.1.8.2.

A2.1.5.2 Soil cement and stabilised trench backfill material

a) Soil cement backfill

Soil cement material shall consist of an approved soil or gravel mixed, by hand or by means of a suitable concrete mixer, with 3 to 6 % by mass of cement of an agreed class and type, as instructed by the Engineer, and only sufficient water to give it a consistency that will permit the soil cement to be placed, with the use of vibrators or other compactors, to properly fill all voids between the ducts or pipes and the sides of excavations.

The material used for soil cement shall be, as indicated in the Contract Documentation, either a type G5 gravel or crushed stone material or a type G7 or G8 sandy material (all types as specified in Section A4.1 of Chapter 4), which may contain larger particles up to a maximum size of 37,5 mm and have a plasticity index not exceeding 10. Material including silt or clay shall not be used and the material used shall be obtained from a source approved by the Engineer.

b) Cement stabilised backfill

Backfilling shall, where directed by the Engineer, be stabilised with 3 to 6 % by mass of cement of an agreed class and type, as instructed by the Engineer. The material stabilised shall be, as indicated in the Contract Documentation, either an approved type G5 gravel or crushed stone material or a type G7 or G8 soil or gravel material (all types as specified in Section A4.1 of Chapter 4) which may contain larger particles up to a maximum size of 37,5 mm and have a plasticity index not exceeding 10.

A2.1.5.3 Water

The requirements of Clause A1.2.3.21 of Chapter 1 shall apply to the use of water for all services work dealt with in Chapter 2.

Water used for the compaction of any backfill, fill blanket, bedding or layer works dealt with in Chapter 2 shall comply with the requirements of Clause A4.1.5.18 of Chapter 4. For the purposes of Clause A4.1.5.18 of Chapter 4 backfill, fill blanket and bedding material shall be deemed to be earthworks.

Water used for mixing concrete shall comply with SANS 51008.

A2.1.5.4 Other material requirements for dry, wet and energy services

Other material requirements for dry, wet and other services shall be as specified in Clauses A2.2.5, A2.3.5 and A2.4.5.

A2.1.6 CONSTRUCTION EQUIPMENT

A2.1.6.1 Excavation equipment

The Contractor may use trenching equipment that will excavate trenches to a width such that the side allowance does not exceed the appropriate value specified in A2.1.7.1h) by more than 50 %. Where, in terms of the Contract Documentation or of the drawings, the authorised (base) width of a trench for a service, duct or pipe, or a portion of a service, duct or pipe, is not to exceed the minimum authorised (base) width or a stated value, the Contractor shall use trenching equipment that will produce the required trench width or the Contractor shall accept responsibility for all costs incurred in strengthening the relevant service, duct or pipe as required by the additional trench width used.

A2.1.6.2 Compaction equipment

The Contractor may use mechanical compaction equipment but the Contractor shall select such equipment and operate it in such a manner that any service, duct, pipe or cable is not stressed or damaged. Machine compaction shall not be used directly above a service, pipeline, duct or cable until sufficient bedding, fill or backfill has been placed to ensure that machine compaction loads transmitted to the top of the service, pipeline, duct or cable are no greater than would be imposed by normal road traffic over the service, duct, pipe or cable with a cover of 600 mm.

A2.1.6.3 Other equipment requirements for dry, wet and energy services

The bedding and backfilling for ducts, pipes and cables shall be carried out with the construction equipment capable of fulfilling the specified requirements taking into account the relevant trench widths and depths.

A2.1.7 EXECUTION OF THE WORKS

A2.1.7.1 Trenching for Services

a) General

The Contractor shall carry out all trenching work in compliance with the relevant safety regulations and obligations in terms of the Occupational Health and Safety Act. Refer to Clause A2.1.3.3 in this regard.

Trenching may be done either by hand or by using mechanical construction equipment or by a combination of hand trenching and mechanical trenching subject to all other specified restrictions in this regard including those in Clause A2.1.3.9a).

b) Planning

All trenching operations related to services shall be planned and executed in accordance with the specifications and any wayleave conditions or construction or work permit conditions.

Planning for trenching work shall be realistically reflected in the contract programme and should adequately address the risks associated with the periods that trenches are left open before the installation of services and completion of the backfilling. The planning should also address all other risks associated with trenching including impacts on access and on public vehicular and pedestrian traffic and the risks associated with flooding etc.

c) Setting out of trenches

A suitable qualified surveyor shall be used for all setting out to ensure trenching is true to the design and/or wayleave condition lines and levels. Where the setting out is determined by cadastral information a suitably qualified and registered professional surveyor shall be used to verify such information on site.

d) Saw-cutting before excavation

Before excavations are made in an existing surfaced roadway or other paved areas, the width of the trench or such other width as may be agreed on by the Engineer, shall be marked on the surface and the surfacing material or in situ concrete paving shall be neatly cut along the markings, to avoid any overbreak of the surfacing or paving beyond the agreed limits. The saw-cutting equipment shall be capable of cutting the material in a single operation without fragmenting the material, and in straight lines. Paving units (blocks or bricks) shall however not be cut but shall be lifted as near as possible along the markings and stored for re-use. The cost of cutting and removing surfacing and paving material shall be measured under the relevant payment items.

e) Clearing and grubbing

Once the excavation has been pre-marked to a suitable width, the surface shall be cleared to the extent determined by the proposed trenching technique. Complete stripping of vegetation and top soil may not necessarily be required. The removal of large trees or tree trunks shall only be considered under extreme conditions and shall only be done with the approval of the Engineer.

The removal of existing paved footways shall be undertaken to line and level with minimum damage to and edge breaking of any paving lifted, using appropriate concrete or asphalt cutters. Paving slabs/blocks shall be removed for later re-use or reinstatement of paved surfaces, and all spoil shall be removed from the work site, where applicable.

Paving blocks or bricks that are removed shall be neatly stacked on the side, at a minimum 750 mm distance from the edge of the excavation, for later use during trench reinstatement. The paving shall be stacked so as not to fall over or prohibit any pedestrian or other NMT traffic and shall not be mixed with the excavated material from the trench.

f) Safe placement of excavated material

All excavated material shall be placed adjacent to the excavated trench provided it can be done while ensuring the safety of the excavation. Material shall be placed at a distance from the lip/edge of the excavation determined by the Contractor. In order that no back spillage of excavated material is possible into the trench the distance from the lip/edge of the excavation to the excavated material shall be at least 750 mm.

In areas with limited working widths the Contractor shall compile a method statement for the accommodation of excavated material for acceptance by the Engineer. At no time shall any excavated material be placed in any way as to endanger the flow of any vehicular or pedestrian or other NMT traffic.

Where excavated material cannot be temporarily placed alongside the excavation, the material shall be stockpiled in accordance with the requirements of the Contract Documentation.

g) Digging of pilot holes for the location of services

Once the line for the trenching has been set out and marked, pilot holes or trial pits shall be excavated by hand to the specified depth and at intervals of not more than 10 m (unless another interval is agreed by the Engineer) in order to confirm soil conditions and to verify the positions of other services.

h) Excavation

Unless otherwise specified or shown on the drawings, the width of trenches for services, other than cables, shall be the authorised trench widths as determined below and these will be used to calculate the quantities of material excavated. Excavation at widths in excess of these predetermined widths will not be measured for payment and excavations narrower than these widths will only be allowed with the written approval of the Engineer. Also refer to Clause A2.1.6.1 in this regard. The trench widths for the installation of cables shall be in accordance with Clause A2.4.7.2b(i).

The authorised trench width shall, irrespective of the type of service (excluding cables) and the type of bedding or floor slab, be determined by the following formula:

W = B + 2S where;

W = The authorised width.

B = The outside diameter / width of the service (duct or pipe etc). No allowance shall be made for the additional diameter or width of collars, joints or couplings.

S = The side allowance to provide the working space on each side of the service measured between the external surface of the pipe or duct and the side of the trench.

Unless otherwise indicated in the Contract Documentation, S shall be as follows:

Table A2.1.7-1: Side allowance for excavation

Outside Diameter of Service (B) mm	Side Allowance (S) mm
Up to 250	200
Greater than 250 and up to 700	300
Greater than 700 and up to 1000	400
Greater than 1000 and up to 2000	500

Where two or more pipes are to be placed in a trench the authorised width (W) shall not be less than the sum of the external diameters / widths of the pipes plus the side allowance for each of the outer pipes plus, between each pair of adjacent pipes, the average of the side allowance for each pipe. For the installation of more than one duct in a trench refer to Clause A2.2.7.2a).

The minimum authorised width (W) for ducts or pipes of outside diameter not exceeding 125 mm and laid to a depth not exceeding 1,5 m may be less than 400 mm for flexible continuous ducts of pipes that, in terms of the specification, do not require bedding or jointing and provided that the backfilling can be compacted in accordance with the requirements of Clause A2.1.8.2.

Where ducts or pipes are to be encased in concrete or soil cement the trench width shall be determined either by the width of the encasement, or as indicated in the Contract Documentation or as instructed by the Engineer.

The Contractor may slope the trench sides or bench the trench from a point above the top of a duct or pipe in compliance with the relevant safety regulations and obligations at his own cost.

The depth of excavations shall be as specified in the Contract Documentation or as indicated by the Engineer on site. Trenches for water pipes shall, unless otherwise specified, be excavated at a constant depth to follow the general surface contours wherever possible.

Trenches shall be neatly trimmed to line and level. The Contractor shall maintain the correct line and grade throughout the work. Trenches shall be straight along the centre line and between pegs, where applicable. Between pegs the trench bottom shall be carefully graded and tested by sight rails and boning rods or other means.

Trenches shall, except where otherwise indicated or permitted, or in the case of a statutory safety requirement, be excavated with vertical sides without any undercutting of the sides.

The cost of trimming excavations by hand or machine shall not be paid for separately but shall be included in the rates tendered for excavation.

Should the Contractor for any reason whatsoever excavate beyond the limits of the authorised dimensions, the Contractor shall, at his own cost, carry out the additional backfilling that will be required as a result of such excess excavation, and he shall use the same material that has been used for the rest of the trench at the level in question. Where the trench has been excavated deeper than the required depth, the bottom shall be reinstated to the correct level as specified for the applicable service.

i) Classes of excavation

Where mechanical excavation equipment is used the excavation of material in trenches shall be classified as follows:

(i) Hard Excavation

Hard excavation shall be excavation of material which will require breaking up before removal by one of or a combination of the following:

- An excavator fitted with a hydraulic percussion hammer or fitted with a ripper,
- Hand operated pneumatic or electro mechanical equipment such as jackhammers or pavement breakers,
- Drilling and using non-explosive rock-breaking products such as injecting chemical expansion agents, or

- Drilling and blasting.

Excavation of individual large boulders, core stones and lumps of hard material in excess of 20 m³ shall also be classified as hard excavation.

Any material where boulders, each exceeding 0,1 m³ in size, make up more than 40 % of the volume of the material will be classified as hard material.

(ii) Stabilised Layers

All material which has been stabilised with any stabilising agent and requires careful cutting and excavation without damage to surrounding existing road layers, by whatever method, shall be classified as stabilised material.

(iii) Soft Excavation

All material not classified as hard or boulder material or stabilised material shall be classified as soft material.

j) Excavation using Labour Enhanced Construction Methods

Where the planned use of mechanical excavating equipment is likely to cause damage to services, trees or property, the Contractor shall advise the Engineer thereof, who may then instruct, in writing, that the excavations be made by means of labour enhanced construction methods and paid under the relevant items for such excavation. However, no such instruction or payment will be required or applicable where the planned or specified method of excavation, as indicated in the Contract Documentation, was by labour enhanced construction methods. Also refer to Section B2.1 in this regard.

k) Excavations outside the normal trench profile

Excavations outside the normal trench profile, which are necessary for the removal of unsuitable material at founding levels, for accommodating structures such as manholes, valve chambers, junction boxes, thrust blocks, draw pits, catchpits, wing walls or for accommodating any other features, like the portion of sewer-house connections between the junction with the main sewer and its point of connection with the sewer from the property, identified in the Contract Documentation, will be measured and paid for separately from trench excavations. These excavations may be made by means of excavating equipment wherever practicable, or otherwise by hand, but will not be classed as hand excavation. Excavations for handholes to accommodate pipe joints will not be included in payment for excavations outside the normal trench profile. Also refer to Clause A2.1.7.1q) and Part C2.1.

l) Timbering and shoring

(i) Contractor's Obligations for Shoring

The Contractor shall provide all the temporary shoring works required including all the timbering, strutting and shoring required in terms of all the regulations and obligations applicable to the safety of the excavations and structures adjacent to excavated trenches. The Contractor shall be solely and wholly responsible for the design of such temporary shoring works and for ensuring the adequacy of the measures. Without in any way affecting or detracting from the Contractor's responsibility, the Engineer shall have the right to instruct the Contractor to provide additional or improved timbering, shoring or strutting where the Engineer considers this to be necessary. The Contractor shall have no claim for additional payment on this account.

The shoring methods adopted shall be compatible with the soil type and the excavating, backfilling and pipe or duct laying methods adopted and shall not place any undue restrictions on the laying of the ducts or pipes. The specified trench width shall be the neat width between the timbering and shoring. Any extra excavations required for the timbering and shoring shall be included in the rates tendered for excavations. The Engineer shall be informed when any timbering and shoring installed is to be removed.

As an alternative to timbering and shoring, the Contractor may, while complying with all the regulations and obligations applicable to the safety of the excavations and where sufficient space is available and where the safety of nearby services and structures is not jeopardized, elect to slope the sides of the trench from a point above the duct or pipe as mentioned in Clause A2.1.7.1h), and the Contractor shall also make allowance for such additional work in the tendered rates for excavation and backfilling.

No separate payment will be made for timbering, strutting and shoring provided by the Contractor in order to comply with the requirements of this Clause A2.1.7.1l)(i).

(ii) Contract Specific Shoring Requirements

Where specifically required in terms of the Contract Documentation timbering, strutting and shoring shall be provided to ensure the stability of, or for the protection of, particular structures or services etc. Where such requirements are stated and described separate payment will be made for the timbering, strutting and shoring under the pay items scheduled for such specific work. The Contractor shall be solely and wholly responsible the design of such timbering, strutting and shoring and for ensuring the adequacy of such measures.

The Engineer may instruct the Contractor to leave any timbering, strutting and shoring that has been provided by the Contractor in accordance with Clause A2.1.7.1l)(i) permanently in place in an excavation. Where such timbering, strutting and shoring is permanently left in place payment will be made under the relevant pay item.

m) Soil cement backfilling

Where specified in the Contract Documentation soil cement backfill shall be used for the bases of overhead service poles and anchor poles and for any other type of backfill indicated.

n) Erosion protection with sandbags

Where indicated in the Contract Documentation or ordered by the Engineer sandbags shall be used in trenches to prevent the ingress of water and / or erosion during construction of the completed works. The spacing and type of sandbags is a function of the slope of the trench and the features of the catchment area and shall be in accordance with the details provided or as instructed by the Engineer.

o) Tunnels and bolsters

The Contractor shall be permitted to tunnel underneath obstructions such as trees, walls, etc., provided that the Contractor has obtained the Engineer's written approval, the trench is of sufficient depth, and the in situ material is suitable for tunnelling. No blasting shall be allowed for the excavation of tunnels and bolsters. Tunnelling will not be paid for as hand excavation. The tunnel or bolster shall have the same width

as the trench and shall have a minimum vertical height of 1,2 m above the duct or pipe invert. Tunnels and bolsters shall be properly timbered and shored where necessary. Where a pipe or duct passes through a tunnel or bolster, the pipe or duct shall, after having been tested, be encased in concrete or soil cement material as instructed by the Engineer, after which the tunnel or bolster shall be filled with hand-packed rocks having a maximum dimension of 300 mm. The rocks shall be so packed as to provide a minimum of voids. Voids remaining in the rock packing shall be filled with dry sand, as the packing proceeds. Payment will be made under the applicable pay items in Part C2.1.

A tunnel with a length of 3,0 m or less shall be designated as a bolster and shall be paid for as an open trench, and a tunnel longer than 3,0 m shall be paid for as a tunnel. The minimum distance between two consecutive tunnels or bolsters shall be 3,0 m.

p) Preparation of the bottom of trenches

Trenches shall be excavated to the required level as specified in the Contract Documentation.

Where trench bottoms consist of loose in situ gravel material, it shall be thoroughly compacted to a minimum of 90 % of MDD or a maximum DCP penetration of 25 mm per blow for a depth of 75 mm to provide a firm floor.

Poor founding conditions may warrant over-excavating and reinstating the trench bottom in one of the following ways as instructed by the Engineer:

- Lining the trench bottom with an appropriate geotextile or
- Placing a layer of 37,5 mm concrete aggregate or
- Placing a selected backfill material compacted to a minimum of 90 % of MDD or
- Placing a layer of soil cement or
- Placing a layer of concrete.

Such reinstatement will not be paid for in the case of over excavation (overbreak) or where poor founding conditions have been caused by the Contractor's negligence.

Founding and trenching conditions in hard rock must allow for a selected material bedding with a minimum thickness of 100 mm. Trench bottoms in hard material shall be cleared of all rock projections, rock fragments or particles of hard material.

The trench bottom shall be hand trimmed to final levels and grades immediately before bedding is placed or ducts or pipes are laid.

No separate payment will be made for the preparation of trench bottom except where the Engineer orders treatment of the trench bottom due to poor founding conditions.

q) Excavations for pipe joints

If necessary, accurately located recesses shall be cut into trench bottoms to accommodate duct or pipe joints. Such recesses shall be properly shaped and sized to facilitate jointing. Recesses for pipes to be welded together in the trench shall provide a clear space of not less than 0,5 m below the pipes. Payment for making such recesses shall be included in the tendered rates for the supply, installation, joining and testing of the various types of ducts or pipes and fittings.

r) Dealing with water

(i) Contractor's obligations for dealing with water

The Contractor shall properly deal with and dispose of water to ensure that the trenching works are kept sufficiently dry for their proper execution including the provision of adequate protection against flooding and damage by stormwater, flow from springs and seepage of ground water. For this purpose the Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary, and he shall also provide any sumps, furrows, cofferdams, temporary berms and other temporary works as may be necessary to minimize damage, inconvenience or interference. The Contractor shall be responsible for repairing, at his own expense, any damage to the works that may arise as a result of the inadequacy of the protection provided. The Contractor shall comply with the requirements of Clause A1.2.3.19 in Chapter 1.

The Contractor shall plan his excavation work in such a way that the risks of flooding of trenches is properly addressed and, in addition to the measures indicated above, such planning shall include limiting the lengths of open trenches and/or providing cross embankments or bulkheads in open trenches as indicated below. In the case of a trench on sloping ground the Contractor shall take adequate precautions to minimize erosion in the trench and adjacent ground from which vegetation has been removed.

If required by the Engineer, the Contractor shall leave portions of a trench unexcavated to prevent the flow of water down the trench. These bulkheads shall be at least 1,0 m thick and shall be spaced as agreed by the Engineer. No additional payment over and above the normal excavation rate will be made for leaving bulkheads temporarily unexcavated.

The Engineer may instruct the Contractor to provide a layer of aggregate below the bedding to serve as a drain to dispose of excess water. The thickness of the layer shall be determined on site by the Engineer. The drainage layer shall be self-draining. Separate payment will be made under the applicable pay items where such measures are ordered.

Separate pay items are included in Section C2.1 for complying with the general obligations of this Clause A2.1.7.1r(i).

(ii) Contract specific requirements for dealing with water

Where specifically required in terms of the Contract Documentation water inflow shall be controlled using specified temporary works. Where such requirements are stated and described separate payment will be made for the providing and operating the necessary construction equipment under the pay items scheduled for such specific work.

In the case of trenches for sewer pipes, the Engineer may instruct the Contractor to install a subsurface drain below the bottom of the trench. The position and details of the drain in the trench shall be as shown on the drawings or as determined by the Engineer and payment will be made under the relevant pay item.

The Engineer may instruct the Contractor to install sand bag bulkheads to prevent the flow of water down trenches as indicated in Clause A2.1.7.1n). Where such bag bulkheads are ordered payment will be made under the relevant pay item.

s) Use of soil cement and stabilised backfill material

(i) Soil Cement Backfill

The soil cement material, as specified in Clause A2.1.5.2a), shall be mixed on site by hand or by means of suitable concrete mixers. The water and cement contents shall be carefully controlled during mixing. The material shall be placed and then thoroughly compacted by means of concrete vibrators or other compactors so as to fill all the voids between ducts or pipes and the sides of excavations.

Care shall be taken to anchor ducts or pipes in trenches to prevent any displacement or floating during the placement of soil cement material and to prevent ingress of the soil cement material into the ducts or pipes etc.

(ii) Cement Stabilised Backfill

Sufficient water shall be added to cement stabilised material, as specified in Clause A2.1.5.2b), without saturating the mixture, to achieve uniform mixing and compaction to a minimum of 93 % of MDD.

The processing, placing and compaction shall be completed within 6 hours from the time that the cement is first added to the material.

t) Backfilling

Backfilling shall be deemed to be the material placed and compacted on top of the fill blanket or bedding, as applicable, to reinstate an excavated trench. Backfill excludes the reinstatement of any pavement layers or surfacing which work shall be specified separately.

All excavated material from trenching operations, shall be treated as potential backfilling material and therefore neatly stockpiled along the excavation and not allowed to be contaminated with toxic, oversized or organic materials or building rubble.

The backfilling shall be compacted in accordance with the minimum densities specified in Clauses A2.1.7.1s)(ii) and A2.1.8.2a) or in accordance with the Dynamic Cone Penetrometer acceptance criteria in Clause A2.1.8.2c).

The placing and compaction of fill blankets and bedding material shall be carried out as specified in the relevant sections of these specifications.

Backfilling shall be done with approved excavated or imported material. Backfilling shall, in the case of ducts or pipes on a concrete bedding, not be commenced before the concrete has attained a compressive strength of at least 75 % of the strength specified for the concrete. All backfill material shall be compacted to the minimum densities specified in layers not exceeding 150 mm in compacted thickness unless otherwise agreed by the Engineer.

A2.1.7.2 Reinstatement of existing roads and existing road furniture

a) General

Where services are installed in an existing road reserve, all paved areas, including road carriageways, sidewalks, footways and walkways and all unpaved verge areas shall be reinstated in accordance with the details provided in the Contract Documentation or as directed by the Engineer. Where sufficient details are not available for the Contractor to plan and carry out the work the Contractor shall, in writing, request that the Engineer provide any outstanding details.

All drainage affected by any trenching processes, e.g. earth drains, concrete channels, stormwater pipes and subsoil drains shall be reinstated to their original functionality.

All other road furniture or structures, e.g. fences, stays, struts, signposts and signs etc., shall be reinstated or repaired as required after completion of the services installation work. Stay wires and struts on overhead services that were removed and temporarily supported shall be reinstated or restored to their original condition. All reinstated works shall be recorded, photographed, and a register containing this information handed to the Engineer to obviate potential future problems with authorities and/or land-owners.

b) Reinstatement of existing road carriageways and other paved areas

The pavement layers and surfacing required to reinstate any road carriageways, sidewalks, footways and walkways affected by service installations in existing road reserves shall be in accordance with the details regarding pavement layer and surfacing type, thickness, material characteristics and compaction as provided in the Contract Documentation or ordered by the Engineer. The materials and construction required for reinstatement work shall, as applicable, comply with the requirements of Chapters 3, 4, 5, 6, 9, 10 and 11.

If the final base, asphalt or surfacing layers cannot be placed during the reinstatement of trenches across existing roads or other paved areas, approved excavated material shall be used as backfill to the surfacing level, as a temporary measure, to enable the road to be opened to traffic as soon as possible. This may only be done with the prior agreement of the Engineer. The temporary backfill shall be well compacted and maintained until the temporary material is completely removed and the final layer/s are reinstated.

c) Reinstatement of road markings

After completion of any work in existing road reserves, the Contractor shall repaint the road markings that have been damaged or obliterated in accordance with the requirements of Section A11.7 of Chapter 11. Payment for repainting of traffic markings will be made under the relevant pay items for such work.

d) Reinstatement of unpaved areas

Unpaved areas in an existing road reserve affected by service installations shall be reinstated and finished in accordance with the details regarding trimming, top-soiling, establishment of vegetation as provided in the Contract Documentation and in accordance with the requirements of Section A11.8 of Chapter 11. Payment for reinstating unpaved areas will be made under the relevant pay items for such work.

A2.1.7.3 Railway reserves, bridge and other special crossings

Where services or ducts have to be installed across railway reserves, bridges or other structures or in any other special circumstances the work for such crossings shall be carried out in accordance with the requirements of the Contract Documentation and in accordance with the applicable sections of this specification.

A2.1.7.4 Alternative installation techniques

Instead of installing services using trenching other appropriate techniques and equipment may be considered during the installation of services while ensuring compliance with the specified quality and workmanship requirements. Topography and geotechnical site conditions shall be taken into account during the planning and programming for such work. If deemed beneficial and practical the Contractor may submit a proposed alternative installation technique to the Engineer for acceptance.

The choice of equipment shall be based on the principle of limiting any adverse effect on the environment or damage to existing infrastructure. Alternative installation techniques may include trenchless installation (e.g. pipe jacking, micro-tunneling, ramboring or directional drilling), ploughing or the use of over-head structures.

A2.1.7.5 Trenchless methods

a) General

The installation of ducts or pipes using trenchless methods shall comply with the requirements of Section A12.7 of Chapter 12. Trenchless installation shall be carried out by competent staff. Relevant certification of equipment operators and proof of competency shall be submitted to the Engineer and kept available on site at all times.

b) Method Statements and designs

To ensure a well-designed and smooth trenchless installation operation, the Contractor shall comply with the requirements of Clauses A12.7.3.2 and A12.7.3.3 of Chapter 12, regarding the submission of method statements and, if applicable, comply with the requirements of Clause A12.7.4 of Chapter 12, regarding designs by the Contractor. An appropriate and comprehensive risk assessment shall be submitted with the method statements.

c) Minimum Requirements during trenchless operations

The Contractor shall comply with the following during trenchless operations:

- An all-weather access to the sites at the entrance and exit positions of the trenchless operations shall be established and maintained.
- Catch pits shall be excavated at the entrance and exit points before any installation operations commence. These pits shall allow for any drilling residue to be collected and reclaimed preventing spilling or wastage.

A2.1.7.6 Ownership, removal and disposal of existing service materials

In accordance with Clause 1.2.3.12 of Chapter 1 any existing service material (ducts, pipes, cables etc) recovered when existing services are removed shall remain the property of the Employer unless otherwise stated in the Contract Documentation.

Existing services shall only be removed as indicated in the Contract Documentation or as directed by the Engineer. Prior to the removal of any existing service the Contractor shall ensure that the service has been disconnected and that it can be safely removed. Payment for the removal of services will be in accordance with the relevant pay items for excavation, removal and backfilling.

Where stated in the Contract Documentation the Contractor shall become the owner of specific recovered service materials and shall be responsible for the disposal of the materials and for providing the Engineer with a full record of the disposal of the materials for control purposes. Payment for the disposal of the materials will be in accordance with the relevant item in Part C2.1.

A2.1.8 WORKMANSHIP

The requirements of Clause A1.2.8 of Chapter 1 shall apply to the process and acceptance quality control for all services work dealt with in Section 2.1 of Chapter 2.

The Engineer may, at his discretion, elect to use some of the Contractor's process control test results if the Engineer is satisfied that the Contractor's process control requirements are acceptable for acceptance quality control purposes.

The requirements of Clause A1.2.3.14 of Chapter 1 shall apply to any remedial work required where any work or material does not comply with the specified requirements.

The requirements of Clause A12.7.8.1 of Chapter 12 shall apply to the testing of any services installed using trenchless methods.

A2.1.8.1 Tolerances for trenches

a) Horizontal alignment, vertical alignment, grade and level

Any deviation from the specified horizontal alignment or level of the invert and the specified dimensions (widths) of a trench and (for a height equal to at least the diameter of the service, pipe or duct, as applicable) of the lower part of the sides of a trench shall be such that the service, pipe or duct may be laid and bedded in the trench within the tolerances specified for the service, pipe, duct or cable in Clauses A2.2.8.1a), A2.2.8.1b), A2.3.8.2a), A2.3.8.3a) and A2.4.8.2.

b) General

Where trenches are deepened or widened to accommodate structures etc., as mentioned in Clause A2.1.7.1k), the tolerance limits of the excavations shall be the same as those of the structures etc., in so far as invert level and plan position are concerned.

If no other tolerances are applicable the maximum horizontal deviation of the centre line of a trench from the specified position shall be 100 mm and the maximum deviation from the specified invert level shall be 50 mm.

A2.1.8.2 Compaction

The method to be used for backfill and trench bottom compaction acceptance quality control shall be either relative density compaction control or DCP compaction control as indicated below. If it is not clear which method is applicable to a particular situation, due to the conditions or circumstances on site or due to any discrepancy in relevant information, relative density compaction control shall apply.

a) Relative density compaction control

Relative density compaction acceptance quality control shall be used for all areas except where DCP control is permitted as indicated in Clause A2.1.8.2c). Relative density compaction control shall, in particular, be used under any road carriageways or lined drains or under any paved footways, sidewalks or walkways or under any other area indicated in the Contract Documentation. Relative density compaction control shall be used for trenches in embankments, fills or cut slopes unless DCP control is permitted in the Contract Documentation or as agreed by the Engineer.

(i) Areas not subjected to vehicle traffic loads

In areas not subjected to vehicle traffic loads (deemed to only include the unpaved verge of a road reserve) trenches and trench bottoms shall be backfilled in layers of thickness (after compaction) that do not exceed 150 mm and the material shall be compacted to a minimum of 90 % of MDD or a minimum of 100 % of MDD where sand (as defined for fill in Clause A4.1.5.9 of Chapter 4) is used. The compacted material shall, as applicable, comply with the acceptance requirements indicated in Clauses A2.1.8.2b) or A2.1.8.2c).

(ii) Areas subjected to vehicle traffic loads or within the road prism

In areas subjected to vehicle traffic loads (deemed to include any road carriageways, lined drains or any paved footways, sidewalks or walkways or any other areas indicated in the Contract Documentation) or within the road prism (deemed to include any fill or embankment or any other areas indicated in the Contract Documentation) or on cut slopes, trenches and trench bottoms shall be backfilled in layers of thickness (after compaction) that do not exceed 150 mm and the material shall be compacted to a minimum of 93 % of MDD or a minimum of 100 % of MDD where sand (as defined for fill in Clause A4.1.5.9 of Chapter 4) is used. The compacted material shall comply with the acceptance requirements indicated in Clause A2.1.8.2b).

(iii) Compacted layer thickness

Where the minimum specified degree of compaction cannot be achieved using pedestrian type (walk-behind) rollers or other hand operated compactors (tamperers) the thickness of the layer compacted shall be reduced to achieve the required densities.

b) Compaction and moisture content tolerances

The compaction and moisture content tolerances for backfill shall comply with the requirements of Clause 5.2.2.2 of SANS 2001-DP1.

c) DCP compaction control

DCP compaction acceptance quality control shall only be used for trenches in the unpaved verge of a road reserve.

Where compaction control testing for backfill and trench bottoms is done using a Dynamic Cone Penetrometer (DCP) the following requirements shall apply:

1. DCP testing shall be limited to a depth that ensures that ducts, pipes or cables are not damaged by the DCP testing.
2. The DCP testing shall be carried out in accordance with the requirements of TMH6-ST6.
3. The following acceptance quality controls shall apply:
 - A penetration rate of 25 mm per blow or less shall be achieved over the full depth range or;
 - Results with an average penetration rate between 25 mm per blow and 50 mm per blow shall be compared with the results obtained in the adjacent in situ undisturbed material. The penetration rates achieved in the trench shall be equivalent or better (lower rate) than the results from the adjacent in situ undisturbed material.
 - Should the adjacent in situ undisturbed material test below 25 mm per blow then a maximum of 25 mm per blow shall apply to the trench backfill.
4. One full depth range DCP test shall be carried out for each 25 m³ of compacted backfill. The minimum sample size per lot or days work shall be four full depth range DCP tests. A lot will be accepted or rejected as follows:

Table A2.1.8-1: DCP Acceptance requirements

Number of Tests per Lot	Minimum Number of Passing Tests Required for Acceptance of a Lot
4	3
6	5
8	6
10	8
12	10
14	11
16	12
20	16
>20	80 %

The above DCP acceptance criteria may not be used in the following situations:

- In dolomitic areas where the criteria will be as specified in the Contract Documentation.
- At fills, embankments or cut slopes where the criteria will be provided in the Contract Documentation or as confirmed by the Engineer if DCP control is permitted.
- In marshy conditions where the in situ soil has a DCP penetration rate above 50 mm per blow and where backfilling material type and density shall be as specified in the Contract Documentation or as confirmed by the Engineer.

A2.1.8.3 Materials testing and quality control

a) Test methods

The relevant test methods related to the material specifications and control thereof are listed in Clauses A20.1.3.2, A20.1.3.4 and A20.1.3.5 of Chapter 20, with special tests listed in Clause A20.1.6 of Chapter 20. Any ambiguity concerning the relevance of the test methods and the need for additional test methods must be brought, in writing, to the attention of the Engineer for a ruling.

b) Acceptance control

The quality control for purposes of acceptance shall be as specified in Table A.2.1.8-2.

Table A.2.1.8-2: Acceptance control

Property	Test Method	Lot Size Per Test	Number of Tests Passing the Requirements
Plastic Index	SANS 3001-GR10	100 m ³	All
California Bearing Ratio	SANS 3001-GR41	400 m ³	All
Unconfined Compressive Strength *1	SANS 3001-GR53	50 m ³	All
Relative Density (% of MDD)	SANS 3001-GR30 for MDD	400 m ³ or when material changes	All
	SANS 3001-GR35 (sand replacement) or SANS 3001-NG5 (Nuclear)	50 m ³ or a minimum of 3 tests per day	

*1 Only when instructed by the Engineer.

The statistical principles in Chapter 20 are not applicable to this clause.

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B2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B2.1.1 SCOPE

Part B covers the scope for labour enhanced construction associated with the installation of services in a road reserve. Traditionally the installation of services offers a relative high labour component especially if trenching is done by hand.

Typical activities which can be performed using labour enhanced techniques are clearing and grubbing, removal of surfacing and paving materials on the trench line, excavation, digging of pilot holes, preparing the bottom of the trench, duct or pipe installation, preparation of backfilling material and trench backfilling.

Labour enhanced construction methods shall only be used where specified in the Contract Documentation or as ordered by the Engineer.

B2.1.2 DEFINITIONS

Definitions as provided in A2.1.2 shall also apply.

B2.1.3 GENERAL

Any activity specified in Part A where hand work is given as an alternative, shall be executed in such a way as to maximise labour.

B2.1.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A shall apply.

B2.1.5 MATERIALS

The provisions of Part A shall apply.

B2.1.6 CONSTRUCTION EQUIPMENT

The provisions of Part A shall apply.

B2.1.7 EXECUTION OF THE WORKS

B2.1.7.1 Classes of excavation

Where excavation is done using labour enhanced construction methods, the Engineer shall classify excavated materials as either soft or intermediate for payment purposes in terms of Table B2.1.7-1 or, if the Contractor does not agree with the classification, in terms of Table B2.1.7-2. The decision of the Engineer regarding the classification of the excavated materials shall then be final and binding, subject to the provisions of the conditions of contract.

No hard material shall be measured under labour enhanced construction methods.

Table B2.1.7-1: Classification of Excavated Materials

Materials Classification	Description
Soft	Material which can be excavated by means of a suitable shovel with or without the use of a pick or other hand-swung tool.
Intermediate	Material which is difficult to excavate by hand even with the aid of a crowbar and requires the assistance of pneumatic tools for economic removal.

Table B2.1.7-2: Classification of Materials in Terms of Consistency and Shear Strength

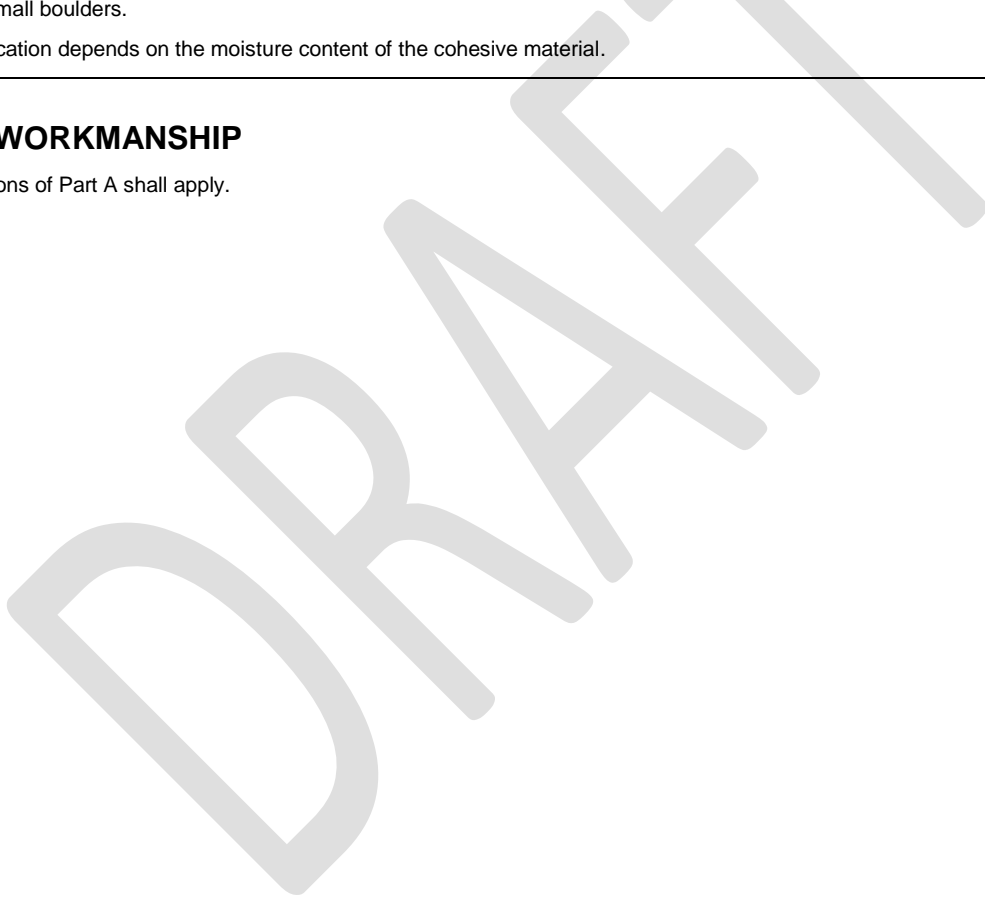
Materials Classification	Consistency		Number of DCP Blows to Penetrate 100 mm ^{*1}	
	Granular Soil	Cohesive Soil	Granular Soil	Cohesive Soil ^{*2}
Soft	Very loose to dense	Very soft to stiff	≤ 15	≤ 8
Intermediate	Very dense	Very stiff	>15	>8

^{*1} Only applicable to materials comprising not more than 10 % gravel of size less than 10 mm and materials containing no cobbles or isolated small boulders.

^{*2} Classification depends on the moisture content of the cohesive material.

B2.1.8 WORKMANSHIP

The provisions of Part A shall apply.



C2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES

PART C: MEASUREMENT AND PAYMENT

(i) Preamble

The tendered rate for each pay item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the pay item as specified, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Clauses C1.1.1, C1.1.2, C1.1.3 and C1.1.4 of Chapter 1 shall apply.

Where pay item Descriptions include any wording in *italics* it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay Items

1. Unless otherwise ordered or stated in the Contract Documentation, trench depths will be measured from the surface of the ground along the centre-line of the trench to the bottom of the specified bedding layer (as applicable). Where no bedding is required it shall be measured to the underside of the duct or pipe.
2. The ground surface will be that existing after any bulk earthworks have been carried out, i.e. the excavated surface or embankment surface, unless a different sequence of execution has been ordered.
3. Excavations will be measured as if taken out with vertical sides, regardless of whether they have been taken out with sloping sides.
4. The length used for trench computations will be the total through-length of a pipe or duct etc. from end to end and no deduction will be made for manholes or access chambers etc.
5. Wherever volumetric measurement is required, the volume will be computed from the depth determined as indicated in 1. and 2. above and using the authorised width (W) determined in accordance with the specification.
6. Where shoring is specified or ordered, the length of shoring measured for payment will be the length of the centre-line of the trench.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as the Contractor deems appropriate:

1. No separate payment will be made for backfilling excess excavations, disposing of surplus material etc. or any other contingent work, unless the work is specifically specified or ordered.
2. No separate payment will be made for setting out the works.
3. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities and for complying with all the requirements of Clause A2.1.3.4.
4. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
5. No separate payment will be made for the loading of any materials.
6. No separate payment will be made for the hauling of any materials where the material is moved over a distance of less than, and up to, 1,0 km.
7. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
8. No separate payment will be made for the removal of any surplus material imported to complete the works.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

For activities in Table C2.1-1 pay items specified in other Chapters or Sections of the specifications, where they relate to work under this section, will be listed in the Pricing Schedule.

Table C2.1-1: Items from other Chapters or Sections

Activity	Section 2.1 Clause Reference	Section - Item Reference
Traffic accommodation	A2.1.3.3c) & A2.1.3.9b)	Section C1.5 of Chapter 1 - All applicable items
The removal of large trees (girth exceeding 1,0 m) and the removal and conservation of topsoil	A2.1.7.1e)	Section C1.6 of Chapter 1 - All applicable items
Hauling materials	C2.1.6, C2.1.9, C2.1.11, C2.1.17 & C2.1.23	Section C1.7 of Chapter 1 - All applicable items
Borrow and spoil areas: <ul style="list-style-type: none"> • Opening and closing down • Excess overburden • Rehabilitation 	C2.1.11, C2.1.17 & C2.1.23	Section C4.1 of Chapter 4 - All applicable items
Temporary stockpiling of excavated material	A 2.1.7.1f)	Section C4.1 of Chapter 4 - All applicable items
Segmented block and in situ concrete paving	A 2.1.7.2c)	Section C6.2 of Chapter 6 – All applicable items
Road markings	A 2.1.7.2.3	Section C11.7 of Chapter 11 - All applicable items 7
Placing of top soil and establishment of vegetation	A2.1.7.1e), A2.1.7.2d), C2.1.6 & C2.1.9	Section C11.8 of Chapter 11 - All applicable items

Activity	Section 2.1 Clause Reference	Section - Item Reference
Trenchless methods	A2.1.7.5	Section C12.7 of Chapter 12 - All applicable items
Special concrete and steel structures	A 2.1.7.3	Chapter 13 - All applicable items

(v) **Items specifically for this section of the specification**

Item	Description	Unit
C2.1.1	Location, identification, protection and relocation of existing services	
C2.1.1.1	Contractor's obligations	lump sum
C2.1.1.2	Permanent services relocation or protection work by others	prime cost (PC) sum
C2.1.1.3	Handling costs and profit in respect of item C2.1.1.2 above	percentage (%)
C2.1.1.4	Permanent services relocation or protection work by the Contractor	provisional sum

The lump sum tendered under item C2.1.1.1 shall be in full compensation for all the Contractor's obligations under Clauses A2.1.3.2, A2.1.3.3a), A2.1.3.3b) and A2.1.3.5 for the location, identification and protection of existing services and for safety and safeguarding and the programming for services.

The prime-cost item C2.1.1.2 shall be paid for work done by others in accordance with the provisions of the conditions of contract for work ordered or agreed by the Engineer. The tendered percentage for item C2.1.1.3 is a percentage of the amount actually spent under the prime-cost item, which shall include full compensation for the handling, supervision and liability costs of the Contractor and the profit in connection with providing the specified service.

The provisional sum under item C2.1.1.4 shall be paid for work done by the Contractor accordance with the provisions of the conditions of contract for work ordered or agreed by the Engineer.

Item	Description	Unit
C2.1.2	Existing services location, detection and verification	
C2.1.2.1	Using specialist detection services (ground penetrating radar, radio detection etc.)	prime cost (PC) sum
C2.1.2.2	Handling costs and profit in respect of item C2.1.2.1 above	percentage (%)
C2.1.2.3	Survey to verify existing service positions	prime cost (PC) sum
C2.1.2.4	Handling costs and profit in respect of item C2.1.2.3 above	percentage (%)
C2.1.2.5	Using hand excavation to locate, expose and verify services	cubic metre (m ³)

The prime-cost item C2.1.2.1 will cover the costs of any specialist detection services used to locate, detect and verify existing services. The use of any specialist detection service providers shall be approved by the Engineer prior to their appointment.

The prime-cost item C2.1.2.3 will cover the costs of any survey services used to determine, fix and record the positions of an existing service after it has been located. The use of any survey service providers shall be approved by the Engineer prior to their appointment.

The prime-cost items C2.1.2.1 and C2.1.2.3 shall be paid for in accordance with the provisions of the conditions of contract. The tendered percentage for items C2.1.2.2 and C2.1.2.4 shall be a percentage of the amount actually spent under the prime-cost item, which shall include full compensation for the handling, supervision and liability costs of the Contractor and the profit in connection with providing the specified service.

The unit of measurement for item C2.1.2.5 shall be a cubic metre of material excavated within the lengths and widths authorised by the Engineer and the depth required to expose the service. Excavation in excess of the authorised dimensions shall not be measured for payment.

The tendered rate for item C2.1.2.5 shall include full compensation for all excavation, backfilling, compacting to 90 % of MDD, disposing of any surplus excavated material, keeping the excavations safe, dealing with any surface or subsurface water, taking special care to ensure that services are not damaged in any way and any other operation necessary for completing the work. The tendered rate shall also include the transporting of surplus excavated material for a haul distance of 1,0 km. Any damage to a service caused by the Contractor's negligence shall be repaired at his own cost, to the satisfaction of the owner of the service and the Engineer. No distinction will be made between the classes of material, neither will distinction be made between the various types of services to be exposed or the depths to which excavations are taken.

Item	Description	Unit
C2.1.3	Obtaining construction or work permits	lump sum

The tendered lump sum shall be in full compensation for all the work required to obtain and arrange for all the necessary construction or work permits in accordance with Clause A2.1.3.8 and Clause A1.2.3.22b) of Chapter 1. The tendered lump sum shall exclude any deposits or the costs of any guarantees required by service owners or other authorities which will be payable under item C2.1.4.

Item	Description	Unit
C2.1.4	Provision of guarantees or deposits for services	
C2.1.4.1	Providing guarantees and deposits	prime cost (PC) sum
C2.1.4.2	Handling costs and profit in respect of item C2.1.4.1 above	percentage (%)

The prime-cost item C2.1.4.1 shall be for any deposits or for the costs of any guarantees required by any service owners or other authorities before any work is permitted in the vicinity of their services etc. and the item shall be paid for in accordance with the provisions of the conditions of contract. Payment under this item will be made when deposits or guarantee payments have been made by the Contractor and acceptable proof of such deposits or payments have been provided to the Engineer. No interest will be paid to the Contractor on these amounts. Where any deposits or guarantee amounts are returned to the Contractor payment under this item will be reversed accordingly. The tendered percentage for item C2.1.4.2 is a percentage of the amount actually spent under the prime-cost item, which shall include full compensation for the handling, supervision and liability costs of the Contractor and the profit in connection with providing the specified service. Payment under item C2.1.4.2 will not be reversed when any deposits or guarantee payments are returned.

Item	Description	Unit
C2.1.5	Provision of record drawings and applicable data	lump sum

The tendered lump sum shall be in full compensation for providing the complete record drawings and any other applicable data in accordance with the requirements of Clause A2.1.3.6 including the costs for surveying the final positions of new or relocated services. The lump sum will be paid after all the required drawings and data have been delivered to, and accepted by, the Engineer.

Item	Description	Unit
C2.1.6	Trench excavation (in soft material)	
C2.1.6.1	Trenches up to 1,0 m wide	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 2,0 m deep	cubic metre (m ³)
(c)	Over 2,0 m deep etc. to be inserted, increased by additional 1,0 m depths as required	cubic metre (m ³)
C2.1.6.2	Trenches over 1,0 m and up to 2,0 m wide	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 2,0 m deep	cubic metre (m ³)
(c)	Over 2,0 m deep etc., increased by additional 1,0 m depths as required	cubic metre (m ³)
C2.1.6.3	Trenches over 2,0 m wide and up to 3,0 m etc., increased by additional 1,0 m widths as required	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 2,0 m deep	cubic metre (m ³)
(c)	Over 2,0 m deep etc., increased by additional 1,0 m depths as required	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated as if in soft material, classified according to the various width and depth ranges listed. The depth classification shall be in accordance with the total depth of the trench for each length of trench excavated and not in accordance with the depth range in which material is situated before excavation i.e. for a section of trench which is up to 1,0 m wide and 1,3 m deep the total volume of excavation will be measured under pay item C2.1.6.1(b). For measurement purposes the width of a trench shall be determined from the authorised dimensions and the depth of excavation shall be measured to the underside of the bedding, except where no bedding is required, in which case it shall be measured to the underside of the duct or pipe.

The tendered rates shall include full compensation for setting out, clearing and grubbing the trench areas except for trees with a girth larger than 1,0 m, the temporary removal of improvements from the line of the trench, the removal and stacking of any surfacing and paving material as applicable, for excavating the trench, preparing the bottom of the trench, separating topsoil, material unsuitable for backfill and selected backfill material, for safeguarding and keeping the excavations safe, which includes the provision, installation and later removal of temporary timbering, shoring and strutting, dealing with any surface or subsurface water and for the temporary stockpiling of material unless otherwise specified in the Contract Documentation. The tendered rates shall include full compensation for trimming trench excavations by hand or by using mechanical equipment and for hauling material within a haul limit of 1,0 km. Excavations in bolsters i.e. tunnels less than 3,0 m in length will be measured and paid for as trench excavations. Where saw-cutting of the excavation edge is required and/or ordered prior to excavation it will be measured and paid under the relevant items.

Item	Description	Unit
C2.1.7	Extra over items C2.1.6, C2.1.8 and C2.1.16 for excavating in:	
C2.1.7.1	Hard material irrespective of depth	cubic metre (m ³)
C2.1.7.2	Stabilised material irrespective of depth	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated (irrespective of depth) and classified as hard material or as stabilised material, in accordance with the classification in Clauses A2.1.7.1(i) and A2.1.7.1(ii).

The tendered rates shall be paid over and above the rate tendered for excavation in respect of items C2.1.6, C2.1.8 and C2.1.16 and shall include full compensation for the additional cost of excavating in material other than soft material. The tendered rates shall include full compensation for any overbreak as well as the additional backfilling required, reinstating the trench bottom, and for any other incidentals resulting from overbreak.

Item	Description	Unit
C2.1.8	Excavations outside the normal trench profile	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated, if necessary, by hand outside the normal trench profile as specified in Clause A2.1.7.1k).

The tendered rate shall include full compensation for excavating outside the normal trench profile, trimming the excavations, preparing the bottom of the excavation, separating any material unsuitable for backfill from selected backfill material, keeping excavations safe, dealing with any surface or subsurface water and for the temporary stockpiling of material unless otherwise specified in the Contract Documentation.

Item	Description	Unit
C2.1.9	Trench excavation using labour enhanced construction methods	
C2.1.9.1	Trenches up to 1,0 m wide (in soft material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.2	Trenches over 1,0 m and up to 2,0 m wide (in soft material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.3	Trenches up to 1,0 m wide (in intermediate material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)
C2.1.9.4	Trenches over 1,0 m and up to 2,0 m wide (in intermediate material)	
(a)	Up to 1,0 m deep	cubic metre (m ³)
(b)	Over 1,0 m and up to 1,5 m deep	cubic metre (m ³)

The unit of measurement shall be the cubic metre of soft or intermediate material, classified in accordance with Clause B2.1.7.1, excavated using labour enhanced construction methods and hand tools (picks and/or hand shovels) as instructed or authorised in writing by the Engineer in accordance with the provisions of Clauses A2.1.7.1j). Excavation will be classified according to the various depths and widths listed. The depth classification shall be in accordance with the actual depth of the trench for each length of trench excavated and not in accordance with the depth range in which material is situated before excavation i.e. for a section of trench which is up to 1,0 m wide and 1,3 m deep the total volume of excavation will be measured under item C2.1.9.1(b). For measurement purposes the width of a trench shall be determined from the authorised dimensions and not from the width range listed and the depth of excavation shall be measured to the underside of the bedding, except where no bedding is required, in which case it shall be measured to the underside of the duct or pipe.

The tendered rates shall include full compensation for setting out, clearing and grubbing the trench areas except for trees with a girth larger than 1,0 m, the temporary removal of improvements from the line of the trench, the removal and stacking of any surfacing and paving material as applicable, for excavating the trench, preparing the bottom of the trench, separating topsoil, material unsuitable for backfill and selected backfill material, for safeguarding and keeping the excavations safe, which includes the provision, installation and later removal of temporary timbering, shoring and strutting, dealing with any surface or subsurface water and for the temporary stockpiling of material unless otherwise specified in the Contract Documentation. Excavations in bolsters i.e. tunnels less than 3,0 m in length will be measured and paid for as trench excavations. Where saw-cutting of the excavation edge is required and/or ordered prior to excavation it will be measured and paid under the relevant pay items. The tendered rates shall include full compensation for loading and transport by wheelbarrow if the material is disposed of or utilised within a distance of 50 m of the point of excavation, or alternatively loading by hand onto transport vehicles for such disposal or utilisation elsewhere, within a haul limit of 1,0 km.

Item C2.1.9 shall be applicable where excavation by hand is required in terms of Clauses A2.1.3.9a) and A2.1.7.1j).

Item	Description	Unit
C2.1.10	Excavation in tunnels exceeding 3,0 m in length in:	
C2.1.10.1	Soft material	cubic metre (m ³)
C2.1.10.2	Hard material	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material excavated in tunnels exceeding 3,0 m in length in accordance with the authorised dimensions.

The tendered rates shall be in full compensation for excavating by hand or machine in tunnels through soft material or hard material, separating any material unsuitable for backfill from selected backfill material, keeping excavations safe, dealing with any surface or subsurface water, for supporting the roof if necessary, for compacting the floor of the tunnel if necessary, and for temporary stockpiling of material unless otherwise specified in the Contract Documentation.

This item shall apply only to tunnels exceeding 3,0 m and up to 10,0 m in length. Tunnels up to 3,0 m long i.e. bolsters, shall be paid as trench excavation.

Item	Description	Unit
C2.1.11	Backfilling of trenches	
C2.1.11.1	Backfill compacted to 93 % (100 % for sand) of MDD (areas subject to traffic loads) using material:	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources (state material type)	cubic metre (m ³)
C2.1.11.2	Backfill compacted to 90 % (100 % for sand) of MDD or complying with the DCP requirements of Clause A2.1.8.2c) (areas not subject to traffic loads) using material:	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources (state material type)	cubic metre (m ³)

The unit of measurement for items C2.1.11.1 and C2.1.11.2 shall be the cubic metre of backfill material in place after compaction calculated from the specified or authorised trench excavation dimensions and placed above the fill blanket or bedding, as applicable. Backfill required for trenches excavated outside the specified or authorised dimensions will not be measured unless such excavation is authorised and measured under item C2.1.8.

The tendered rates shall be in full compensation for the backfilling of trenches including placing the material in the trench, watering and compacting the backfill to the specified minimum density using relative density or DCP compaction control as applicable.

The tendered rates for items C2.1.11.1(b), C2.1.11.1(c), C2.1.11.2(b) and C2.1.11.2(c) shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on Site or from a borrow pit, for hauling the material within a haul limit of 1,0 km and for unloading the material for placement. The tendered rate for items C2.1.11.1(c) and C2.1.11.2(c) shall include full compensation for all operations at borrow pits not subject to any specified separate pay item.

The tendered rates for items C2.1.11.1(d), C2.1.11.1(e), C2.1.11.2(d) and C2.1.11.2(e) shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

Item	Description	Unit
C2.1.12	Backfilling additional excavations in trench floors due to poor founding conditions using:	
C2.1.12.1	Geotextile (state grade or class)	square metre (m ²)
C2.1.12.2	Concrete aggregate (37,5 mm aggregate size)	cubic metre (m ³)
C2.1.12.2	Concrete (state class)	cubic metre (m ³)

The unit of measurement for item C2.1.12.1 shall be the square metre of geotextile placed on the trench bottom, as ordered by the Engineer. The unit of measurement for items C2.1.12.2 and C2.1.12.3 shall be the cubic metre of concrete aggregate or concrete placed on the trench bottom, as ordered by the Engineer.

The tendered rates for items C2.1.12.1, C2.1.12.2 and C2.1.12.3 shall include full compensation for procuring, furnishing and placing the geotextile, aggregate or concrete on the trench bottom including any mixing or compaction required.

Where the Engineer orders that selected backfill material or soil cement be used to backfill the trench bottom payment shall be made under items C2.1.11 and C2.1.13.

Item	Description	Unit
C2.1.13	Extra over item C2.1.11 for backfilling with soil cement or stabilised material	
C2.1.13.1	Backfilling trenches using soil cement using (state type of material i.e. G5, G7 or G8) material	cubic metre (m ³)
C2.1.13.2	Backfilling trenches using stabilised (state type of material i.e. G5, G7 or G8) material compacted to 93 % of MDD	cubic metre (m ³)
C2.1.13.3	Backfilling around poles using stabilised (state type of material i.e. G5, G7 or G8) material compacted to 95 % of MDD	cubic metre (m ³)
C2.1.13.4	Cement (state class of cement)	kilogram (kg)

The unit of measurement for item C2.1.13.1 shall be the cubic metre of soil cement material in place calculated from the specified or authorised trench excavation dimensions less the volume occupied by a duct, pipe, casing, pole or footing.

The unit of measurement for items C2.1.13.2 and C2.1.13.3 shall be the cubic metre of cement stabilised material in place after compaction calculated from the specified or authorised trench or hole excavation dimensions less the volume occupied by a duct, pipe, casing, pole or footing.

The unit of measurement for item C2.1.13.4 for the cement added to achieve the cement content, as instructed by the Engineer, in soil cement and stabilised material shall be the kilogram.

The tendered rate for item C2.1.13.1 shall include full compensation for the additional costs of procuring and furnishing the type of material specified and for mixing in the cement and placing and compacting the soil cement material as specified in Clause A2.1.7.1s)(i). Payment for the backfill material mixed with the cement will be made under item C2.1.11.

The tendered rates for items C2.1.13.2 and C2.1.13.3 shall include full compensation for procuring and furnishing the type of material specified and for mixing in the cement and placing and compacting the stabilised material. Payment for the backfill material mixed with the cement will be made under item C2.1.11.

The tendered rate for item C2.1.13.4 shall include full compensation for procuring and furnishing the cement added to achieve the final cement content, as instructed by the Engineer, in soil cement or stabilised material.

Item	Description	Unit
C2.1.14	Extra over items C2.1.11, C2.1.12 and C2.1.13 for additional compaction of backfill	
C2.1.14.1	Compaction increased from 90 % of MDD to 93 % of MDD	cubic metre (m ³)
C2.1.14.2	Compaction increased from 93 % of MDD to 95 % of MDD	cubic metre (m ³)
C2.1.14.2	Compaction increased from 95 % of MDD to 98 % of MDD	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material subjected to additional compaction, as ordered by the Engineer.

The tendered rates shall be paid as extra over the rates for items C2.1.11, C2.1.12 and C2.1.13 and shall include full compensation for the additional cost resulting from a higher compaction requirement for backfill ordered by the Engineer. Payment under this item will only be made where the Engineer has ordered, in writing, that a specified part or parts of the backfill be compacted to a higher minimum density than the standard specified under items C2.1.11, C2.1.12 and C2.1.13.

Item	Description	Unit
C2.1.15	Stone packing	
C2.1.15.1	In bolsters	cubic metre (m ³)
C2.1.15.2	In tunnels	cubic metre (m ³)

The unit of measurement shall be the cubic metre of stone packing constructed as specified in Clause A2.1.7.1o), determined from the authorised dimensions. The tendered rates shall include full compensation for procuring, furnishing and placing the stones and sand required, including all haul, and for hand packing the stones and filling the voids with sand as specified.

Item	Description	Unit
C2.1.16	Subsurface drains in trench bottoms (Contract Documentation reference or drawing number indicated)	metre (m)

The unit of measurement shall be the metre of subsoil drain constructed complete as specified or shown on the drawings.

The tendered rate shall include full compensation for constructing the subsoil drain complete, including excavation by hand in soft material, the supply and installation of geotextiles and pipes and the supply and placing of any drainage aggregate. The rate shall be subject to an extra over-payment under item C2.1.7 and shall also be subject to additional payment under item C2.1.17 for the removal disposal of any surplus or unsuitable excavated material to spoil sites provided either by the Employer or the Contractor.

Item	Description	Unit
C2.1.17	Removal and disposal of spoil material from trench excavations:	
C2.1.17.1	To spoil sites provided by the Employer as indicated in the Contract Documentation or as instructed by the Engineer	cubic metre (m ³)
C2.1.17.2	To spoil sites or dumping areas provided by the Contractor	cubic metre (m ³)

The unit of measurement shall be the cubic metre of material surplus to requirements or unsuitable for further use as backfill etc., calculated from the specified or authorised trench excavation dimensions, and which has to be spoiled as ordered by the Engineer.

The tendered rate for items C2.1.17.1 and C2.1.7.2 shall include full compensation for loading, off-loading and disposing of spoil material from trench excavations as specified including shaping and levelling off of any piles of spoil material. The tendered rate for item C2.1.17.1 shall also include full compensation for hauling the material up to the haul limit of 1,0 km. The tendered rate for item C2.1.7.2 shall also include full compensation for hauling the material over an unlimited distance, for providing the spoil site or dump area and the rate shall include any relevant payments to the affected land or dump site owners.

The tendered rates shall also include the provision of haul roads and the clearing up and finishing of haul roads, spoil sites and dumping areas on completion of the work. Where spoil is paid under pay item C2.1.17.1 the relevant pay items for finishing-off and rehabilitating borrow areas will apply.

Item	Description	Unit
C2.1.18	Timbering, strutting and shoring	
C2.1.18.1	Timbering, strutting and shoring left in excavations	square metre (m ²)
C2.1.18.2	Timbering, strutting and shoring opposite a structure or service (state reference in Contract Documentation or indicate drawing number etc.)	metre (m)

Item C2.1.18.1 will only be applicable, as indicated in Clause A2.1.7.1)(ii), where the Engineer instructs that timbering, strutting and shoring be permanently left in place in excavations. The unit of measurement for item C2.1.18.1 shall be the square metre of tunnel wall or roof or trench wall against which timbering and shoring is required to be left in position permanently on the Engineer's instructions. Each side of the trench or tunnel shall be measured.

Item C2.1.18.2 will only be applicable, as indicated in Clause A2.1.7.1)(ii), where separate payment for timbering and shoring is indicated and described in the Contract Documentation. The unit of measurement for item C2.1.18.2 shall be the metre of trench shored opposite a structure or service as agreed by the Engineer. The length measured for payment will be that of the centre-line of the trench regardless of whether supports are placed on one or on both sides of the trench.

The tendered rate for item C2.1.18.1 shall include full compensation for leaving the timbering and shoring permanently in position, for ensuring that the timbering and shoring will not be disturbed during backfilling, and that the backfilling is compacted fully around the shoring.

The tendered rate for item C2.1.18.2 shall include full compensation for the cost, for both sides of the trench if necessary, of the supply, placing, maintenance and removal of timbering and other support measures together with any cost that results from the inconvenience of working in the supported trench and the cost of any risks inherent in the operation.

Item	Description	Unit
C2.1.19	Dealing with water during services work	
C2.1.19.1	Dealing with surface water	lump sum
C2.1.19.2	Dealing with subsurface water	lump sum

The tendered sums for items C2.1.19.1 and C2.1.19.2 shall cover the cost for the provision, operation, maintaining and removal of all construction equipment and materials required to deal with any water anywhere on the Site as required in terms of Clause A2.1.7.1r)(i).

The lump sum shall cover the cost of providing the necessary construction equipment or materials, or both, fully erected and operative on the site, the cost of operating and maintaining pumps, well points, sheeting, close timbering, and other equipment, as applicable, for 24 hours a day, 7 days a week, throughout the period during which the facilities are required, and the cost of removing such goods and restoring the site to its original condition on completion of that part of the contract for which the temporary works were erected.

Two equal payments will be made under each subitem, the first after the Contractor has commenced with the services work and the second when all the services work has been completed.

Item	Description	Unit
C2.1.20	Specified temporary works to control water inflow (state reference in Contract Documentation or indicate drawing number etc.)	
C2.1.20.1	Provide equipment	lump sum
C2.1.20.2	Operate and maintain	day
C2.1.20.3	Remove equipment	lump sum

Item C2.1.20 will only be applicable, as indicated in Clause A2.1.7.1r)(ii), where separate payment for the control of water inflow is indicated in the Contract Documentation. The unit of measurement for item C2.1.20.2 shall be the 24 hour day.

The sums tendered for items C2.1.20.1 and C2.1.20.3 shall include full compensation for the provision and removal of equipment and shall cover the cost of providing the necessary equipment or materials or both, fully erected and operative on the site, and of removing such goods and restoring the site to its original condition on completion of that part of the contract for which the temporary works were erected.

The rate tendered for item C2.1.20.2 shall include full compensation for operation and maintenance and shall cover the cost of operating and maintaining the pumps, well points, sheeting, close timbering and other equipment, as applicable, for 24 hours per day, 7 days a week throughout the period during which, as agreed by the Engineer, the facilities are required.

Item	Description	Unit
C2.1.21	Supply and installation of sandbags in trenches	
C2.1.21.1	Biodegradable bags (state bag size, material type and description)	number of bags (No)
C2.1.21.2	Geofabric bags (state bag size, material type and description)	number of bags (No)

The unit of measurement shall be the number of bags filled with soil installed in accordance with the Clause A2.1.7.1n). The tendered rates shall include full compensation for supplying the bags and suitable material to fill the bags, filling of the bags with soil and placing the bags as required and shall also include all associated transport costs. The tendered rates shall include full compensation for removing the bags when no longer required.

Item	Description	Unit
C2.1.22	Existing services that intersect or adjoin a trench	
C2.1.22.1	Services that intersect a trench (angles between centre-lines in plan 45° to 90°)	
(a)	State type and size of each intersecting service	number (No)
(b)	State type and size of each intersecting service	number (No)
(c)	State type and size of each intersecting service etc.	number (No)
C2.1.22.2	Services that adjoin a trench (parallel to or at an angle between centre-lines in plan of less than 45°)	
(a)	State type and size of each adjoining service	metre (m)
(b)	State type and size of each adjoining service	metre (m)
(c)	State type and size of each adjoining service etc.	metre (m)

The unit of measurement for item C2.1.22.1 shall be the number of underground services intersected by the trench excavated. Existing water pipes, sewers, stormwater pipes, concrete-lined channels and drains, box culverts, electric or other telecommunication cables, ducts, kerbs, channels, erf connections and various sizes of pipes and services that intersect a trench of specified width and require various degrees of care, whether or not their presence was known before they were uncovered, will be measured separately. The unit refers to one service, but services that are so grouped that they can be contained within a horizontal dimension of 300 mm measured at right angles to the axis of the services will be measured as one unit.

The unit of measurement for item C2.1.22.2 shall be the metre of trench excavated where there are adjoining services. In a case where a trench of specified width:

- Runs parallel to or at an angle (in plan) of less than 45° to an existing service, and
- Is such that the nearer side of the bottom of the trench lies at least partly between a vertical plane and a plane that lies at an angle of 45° below the horizontal, both planes passing through the axis of the service,

the length of service within the minimum base width of the trench, determined in accordance with Clause A2.1.7.1h), will be measured for payment under this item and the remaining length, the side of the trench which, as agreed by the Engineer, is rendered liable to collapse because of the existence of such service, will be measured for shoring.

The tendered rates for items C2.1.22.1 and C2.1.22.2 shall include full compensation for the additional cost of:

- Care in excavation necessitated by the presence of services adjacent to, in or across a trench;
- Protecting and maintaining such services in operation by means of temporary supports or shoring, as necessary;
- Delays and disruption of the progress of the work due to the existence of the services; and
- Repairs necessitated by damage caused by the Contractor.

Item C2.1.22 shall not be applicable where any services are to be removed and where payment will therefore be made under item C1.2.25.

Item	Description	Unit
C2.1.23	Reinstatement of trenches in existing surfaced roads using:	
C2.1.23.1	Selected material (state material type and source e.g. G7 or G8, commercial/borrow pits/etc. and layer thickness) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)
C2.1.23.2	Subbase material (state material type and source e.g. G5 or G6, commercial/borrow pit etc. and layer thickness) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)

C2.1.23.3	Stabilised subbase material (state material type and source e.g. C3 or C4, commercial/borrow pit etc. and layer thickness) using (state percentage and type of stabilising agent) compacted to (state minimum compaction) % of MDD	cubic metre (m ³)
C2.1.23.4	Base material (state material type and source e.g. G1 or G2, commercial/quarry etc. and layer thickness) compacted to (state minimum compaction either 102 % for G2 or 104 % for G1) % of MDD	cubic metre (m ³)
C2.1.23.5	Prime coat (state type of material and application rate)	square metre (m ²)
C2.1.23.6	Tack coat (state type of material and application rate)	square metre (m ²)
C2.1.23.7	Asphalt material (state asphalt type e.g. continuously graded, binder type, layer thickness and minimum density)	ton (t)
C2.1.23.8	Surface treatments (state surfacing type, binder type and application rate, aggregate size and application rate etc.)	square metre (m ²)

The unit of measurement for items C2.1.23.1, C2.1.23.2, C2.1.23.3 and C2.1.23.4 shall be the cubic metre of compacted pavement layer constructed during the reinstatement of existing surfaced roads. The unit of measurement for items C2.1.23.5 and C2.1.23.6 shall be the square metre of prime or tack coat placed during the reinstatement of existing surfaced roads. The unit of measurement for item C2.1.23.7 shall be the ton of compacted asphalt and the unit of measurement for item C2.1.23.8 shall be the square metre of surface treatment both placed during the reinstatement of existing surfaced roads. Items C2.1.23.1 to C2.1.23.8 will be measured in accordance with the authorised dimensions for the reinstatement area required. Any reinstatement required beyond the agreed or instructed dimensions owing to damage caused by the Contractor will not be measured for payment.

The tendered rates shall include full compensation for procuring, furnishing, placing, compacting and finishing all the materials including stabilising the layers as may be required and including full compensation for providing all labour and construction equipment, preparing the edges of the existing surfacing and protecting and maintaining the completed reinstatement as specified. The tendered rate shall also include full compensation for any temporary backfilling with excavated material and for compacting, maintaining and later removing the temporary material as specified in Clause A2.1.7.2b).

Where the materials are supplied from sources provided by the Contractor or from commercial sources the tendered rates shall include full compensation for the payment of any royalties or charges for procuring the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance. Where the materials are sourced from borrow pits or quarries provided by the Employer or other sources on Site the tendered rates shall include full compensation for hauling the materials within the haul limit of 1,0 km, for unloading the material for placement and for all operations at borrow pits or quarries not subject to any specified separate pay item.

The backfill of the trench up to the bottom of the layers measured under item C2.1.23 will be paid for under items C2.1.11, C2.1.12, C2.1.13 and C2.1.14 as applicable.

Item	Description	Unit
C2.1.24	Saw-cutting before excavation	
C2.1.24.1	Saw-cutting asphalt to an average depth:	
(a)	Not exceeding 50 mm	square metre (m ²)
(b)	Exceeding 50 mm but not exceeding 100 mm	square metre (m ²)
(c)	Exceeding 100 mm but not exceeding 150 mm	square metre (m ²)
C2.1.24.2	Saw-cutting concrete to an average depth:	
(a)	Not exceeding 50 mm	square metre (m ²)
(b)	Exceeding 50 mm but not exceeding 100 mm	square metre (m ²)
(c)	Exceeding 100 mm but not exceeding 150 mm	square metre (m ²)
C2.1.24.3	Saw-cutting other materials (type of material to be specified) to an average depth:	
(a)	Not exceeding 50 mm	square metre (m ²)
(b)	Exceeding 50 mm but not exceeding 100 mm	square metre (m ²)
(c)	Exceeding 100 mm but not exceeding 150 mm	square metre (m ²)

The unit of measurement shall be the square metre of cut area, saw-cut before excavation in accordance with Clause A2.1.7.1d), calculated in accordance with the authorised length of cut and the average depth measured after excavation of the material.

The tendered rates for item C2.1.24 shall include full compensation for all construction equipment, tools, labour, supervision, materials, transport and for all incidentals for cutting the asphalt, concrete or other materials complete as specified and also for work in restricted areas.

Item	Description	Unit
C2.1.25	Removal of existing services:	
C2.1.25.1	State type and size of each service (duct, pipe or cable) removed	metre (m)
C2.1.25.2	State type and size of each service (duct, pipe or cable) removed	metre (m)
C2.1.25.3	Etc., insert additional items as required	metre (m)

The unit of measurement shall be the metre of existing service of each type removed.

The tendered rates for item C2.1.25 shall include full compensation for removing an existing service including dismantling the service, uplifting, loading, off-loading and storing the recovered material on Site as agreed with the Engineer. The tendered rates shall include full compensation for removing all joints, specials, valves etc associated with the service removed.

The demolition of any structures and the excavation and backfill that may be associated with the removal of a service will be measured and paid separately.

Item	Description	Unit
C2.1.26	Disposal of existing service materials:	
C2.1.26.1	State type and size of each service (duct, pipe or cable) disposed of	metre (m)
C2.1.26.2	State type and size of each service (duct, pipe or cable) disposed of	metre (m)
C2.1.26.3	Etc., insert additional items as required	metre (m)

The unit of measurement shall be the metre of existing service material disposed of in accordance with Clause A2.1.7.6.

The tendered rate for item C2.1.26 shall include full compensation for disposing of existing service material including loading, removal from Site, transporting the material over an unlimited haul distance and off-loading the material at the disposal site. The tendered rates shall include full compensation for disposing of all joints, specials, valves etc associated with the service, for any related disposal costs and for providing the Engineer with the disposal records. The tendered rates may be positive or negative as considered appropriate by the Contractor for each service type.

The removal of services will be measured and paid separately under item C2.1.25.

Item	Description	Unit
C2.1.27	Demolition of existing manholes, access chambers and other service structures consisting of:	
C2.1.27.1	Unreinforced concrete	cubic metre (m ³)
C2.1.27.2	Reinforced concrete	cubic metre (m ³)
C2.1.27.3	Masonry	cubic metre (m ³)

The unit of measurement shall be the cubic metre, measured prior to demolition, of concrete or masonry demolished and disposed of.

The tendered rate shall include full compensation for all labour and construction equipment and for all work necessary for, and incidental to, the demolition of the structures. The tendered rates shall include full compensation for the disposal of all rubble and material from the demolition at an approved disposal site including transporting the material over an unlimited haul distance to the disposal site.

For the purposes of this item reinforced concrete shall be taken to mean concrete which contains at least 0,2 % of steel by volume.

Excavation and backfilling will be measured and paid separately.

D2.1 GENERAL REQUIREMENTS AND TRENCHING FOR SERVICES

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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- D2.1.1 SCOPE**
- D2.1.2 GENERAL**
- D2.1.3 PERFORMANCE GUARANTEE REQUIREMENTS**
- D2.1.4 FUNCTIONAL PERFORMANCE ASSESSMENTS**
- D2.1.5 VISUALLY ASSESSED PROPERTIES**
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- D2.1.7 EVALUATION FOR ACCEPTANCE**
- D2.1.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE**
- D2.1.9 NOTIFICATION OF REMEDIAL WORK**
- D2.1.10 REMEDIAL WORKS**

D2.1.1 SCOPE

D2.1.1.1 Proprietary products and materials

The Contractor shall provide detailed specifications and certificates from independent agencies for all proprietary materials that are proposed for use. These certificates shall demonstrate conformance with the performance requirements stipulated in these standard specifications or in the Contract Documentation.

Unless otherwise specified all proprietary products and materials shall be used strictly in accordance with the relevant manufacturer's or supplier's current published instructions or requirements for the specified product.

Agrément certified products shall be used and placed in accordance with their Agrément certification criteria.

D2.1.1.2 Compliance certification for standard specifications

Where products or materials used are required to comply with any specified standard specifications the Contractor shall, if and when so ordered by the Engineer, furnish the Engineer with all relevant certificates or test results to verify that the products or materials used comply with the applicable standards.

Where so specified products or materials shall bear the official mark of the appropriate authority. As required specified products or materials subject to a SANS standard or specification shall carry a SABS mark or a certification mark by any other SANAS accredited certification body for the applicable SANS specification.

Where required suitable samples of the proposed products or materials shall be delivered to the Engineer's office on site free of charge.

A2.2 DRY SERVICES

CONTENTS

PART A: SPECIFICATIONS

A2.2.1 SCOPE

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PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A2.2.1 SCOPE

Section A2.2 of Chapter 2 covers the civil engineering components for the construction work associated with the installation of dry services (ducts for telecommunications, electricity and street lighting) and ancillary works in road reserves.

All dry services shall be installed at the locations shown and in accordance with the details shown on the drawings, provided in the Contract Documentation or as directed by the Engineer.

A2.1.2.1 General note

In certain SANS documents referred to in this section the term “*specified in the scope of work*” is used. For the purposes of this specification the term shall be deemed to mean “*specified in the Contract Documentation*”.

A2.2.1.2 Applicable supporting specifications

Section A2.2 of Chapter 2 shall be used in conjunction with, amongst others, the following standards or specifications:

SANS 558	Cast iron surface boxes and manhole and inspection covers and frames
SANS 677	Concrete non-pressure pipes
SANS 819	Fibre-cement pipes, couplings and fittings for sewerage, drainage and low-pressure irrigation
SANS 920	Steel bars for concrete reinforcement
SANS 1936-1	Development of dolomite land Part 1: General principles and requirements
SANS 1936-3	Development of dolomite land Part 3: Design and construction of buildings, structures and infrastructure
SANS 2001-DP1	Earthworks for buried pipelines and prefabricated culverts
SANS 2001-DP3	Cable ducts
SANS 4427-1	Plastic piping systems: Polyethylene (PE) pipes and fittings for water supply
SANS 10140-3	Identification colour markings Part 3: Contents of pipelines
SANS 50124	Gully tops and manhole tops for vehicular and pedestrian areas
SANS 61386-1	Conduit systems for cable management Part 1: General requirements
SANS 61386-24	Conduit systems for cable management Part 24: Particular requirements – Conduit systems buried underground
ASTM F 2160	Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

ASTM F 2176	Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Innerduct
EN 124-1	Gully tops and manhole tops for vehicular and pedestrian areas Part 1: Definitions, classification, general principles of design, performance requirements and test methods
EN 124-2	Gully tops and manhole tops for vehicular and pedestrian areas Part 2: Gully tops and manhole tops made of cast iron
EN 124-3	Gully tops and manhole tops for vehicular and pedestrian areas Part 3: Gully tops and manhole tops made of steel or aluminium
EN 124-4	Gully tops and manhole tops for vehicular and pedestrian areas Part 4: Gully tops and manhole tops made of steel reinforced concrete
EN 124-5	Gully tops and manhole tops for vehicular and pedestrian areas Part 5: Gully tops and manhole tops made of composite materials
EN 124-6	Gully tops and manhole tops for vehicular and pedestrian areas Part 6: Gully tops and manhole tops made of polypropylene (PP), polyethylene (PE) or unplasticised poly (vinyl chloride) (U-PVC)

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

A2.2.2 DEFINITIONS

The following definitions shall apply to these specifications:

Fibre Optic Telecommunication – Fibre optic communication is a method of transmitting information from one place to another by sending pulses of light through an optical fibre. The light forms an electromagnetic carrier wave that is modulated to carry information.

Handhole - A shallow form of manhole giving access to ducts in an underground cable (normally communications) system.

Micro Trenching – A trench (slot), with a width up to but not exceeding 40 mm, providing at least 300 mm cover over the upper most duct in a duct bank, cut into a road or footway.

Mini Trenching - A trench (slot), with a width greater than 40 mm but not exceeding 100 mm, providing at least 300 mm cover over the upper most duct in a duct bank, cut into a road or footway.

A2.2.3 GENERAL

A2.2.3.1 Location, identification, protection and relocation of existing services

The location, identification, protection and relocation of existing services, unknown or unrecorded services shall be managed in accordance with Clause A2.1.3.2.

A2.2.3.2 Micro and mini trenching

The use of micro or mini trenching to install services will either be according to a design provided by the Contractor (refer to Clause A2.2.4), design by the Employer (refer to Clause A2.2.7.6) or in accordance with a performance specification (refer to Section D2.2).

A2.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The supervision of the civil engineering component of dry services to be installed in a road reserve shall be in accordance with Clause A2.1.3.7. The design of temporary works, alternative designs and other designs by the Contractor shall be in accordance with Clauses A2.1.4.1, A2.1.4.2 and A2.1.4.3.

A2.2.5 MATERIALS

The type of duct to be installed shall be as specified in the Contract Documentation. All ducts shall be joined with watertight couplings made from the same material as the duct.

Unless indicated otherwise in the Contract Documentation ducts shall comply with the following requirements:

A2.2.5.1 Ducts and sleeves

a) Unplasticised Polyvinyl Chloride (U-PVC) ducts

U-PVC ducts and sleeves shall comply with the requirements of Clauses 4.1.1 and 4.1.3 of SANS 2001-DP3.

Normal Duty U-PVC ducts shall be used.

The U-PVC ducts shall have one end plain and chamfered and the other end socketed with an integral socket of the rubber ring type.

b) High Density Polyethylene (HDPE) ducts

(i) HDPE ducts installed by trenching

HDPE ducts to be installed by trenching shall comply with the requirements of SANS 61386-1 and 61386-24.

Normal (code N) Type 450 (Code 450) HDPE ducts shall be used.

As specified in the Contract Documentation the ducts shall either be a Rigid or a Pliable type. Pliable type ducts shall comply with the bending test requirements of Clause 10.4 of SANS 61386-24 for a minimum bending radius of 20 times the outside diameter.

The ducts shall be joined using suitable compression couplings or sleeve type couplings with rubber sealing O rings as specified in the Contract Documentation.

In addition to the requirements above, HDPE ducts for telecommunications shall comply with certain requirements of ASTM F2160 and ASTM F2176 if they are specified in the Contract Documentation.

(ii) HDPE ducts installed by drilling

As indicated in the Contract Documentation HDPE ducts used for directional drilling shall comply with either of the following:

1. The ducts shall comply with SANS 4427-1 subject to the following:
 - Type Smooth wall
 - Material PE 100
 - SDR series 17
 - Pressure rating PN 10
 - The ducts shall be joined by butt welding; or
2. The ducts shall comply with the requirements of Clause A12.7.5.2 of Chapter 12 for non-pressure pipes; or
3. The ducts shall comply with the requirements stated in the Contract Documentation.

c) Concrete pipe ducts

Concrete pipes used as ducts shall comply with the requirements of SANS 677. Reinforced Type SC concrete pipes with Spigot and Socket Type joints with a rolling rubber ring shall be used.

Unless otherwise specified in the Contract Documentation SANS 677 Class 100D pipes shall be used.

d) Fibre-cement (FC) ducts

Fibre-cement ducts shall comply with the requirements of Clauses 4.1.1 and 4.1.4 of SANS 2001-DP3.

LPI (low pressure irrigation) series FC ducts shall be used.

The FC ducts shall be joined using flexible joints of the rubber ring type complying with the requirements of SANS 819.

e) Other duct materials

Where ducts manufactured from materials other than U-PVC, HDPE, concrete or FC are required they shall comply with the requirements as specified in the Contract Documentation.

f) Split ducts

Where required, ducts shall be cut lengthwise into two halves to form split ducts. Split ducts shall normally only be used for providing ducting for existing services which cannot be severed and threaded through the ducts. The ducts shall be accurately cut longitudinally into two equal halves and opposite halves shall be matched as sawn. Split ducts shall be placed around the service as required, firmly bound by straps of an approved material and finally encased in concrete if required.

g) End caps or plugs

End caps or plugs particular to each duct type shall be used to seal the ends of ducts. Where end plugs or caps are not available for a specified duct type the ends shall be sealed as required by the Contract Documentation.

h) Draw wires and marker tapes

Draw wires and safety marker tapes, if required, shall be in accordance with the details indicated in the Contract Documentation.

A2.2.5.2 Bedding

Bedding for ducts, installed by methods other than by micro or mini trenching, unless otherwise specified in the Contract Documentation, shall be material of a granular, non-cohesive nature that is free draining, has a maximum aggregate size of 15 mm, a maximum plasticity index (PI) of 6 and has a compaction fraction, determined in accordance with Clause 5.1.4 of SANS 2001-DP1, that does not exceed 0.2.

A2.2.5.3 Backfill

a) Backfill for trenches (excluding micro or mini trenching)

Backfill for ducts installed by methods other than by micro or mini trenching, unless otherwise specified in the Contract Documentation, shall comply with the requirements of Clause A2.1.5.1.

b) Backfill for micro or mini trenching

Where micro or mini trenching is dealt with in terms of Clause A2.2.7.6 the materials used for bedding, backfilling and reinstatement shall be in accordance with the details provided in the Contract Documentation.

A2.2.5.4 Cable duct markers

Markers for ducts shall be in accordance with the details provided in the Contract Documentation.

A2.2.5.5 Concrete

All concrete required for duct installation shall comply with the applicable requirements of Section A13.4 of Chapter 13 for strength class (Class C) concrete as specified in the Contract Documentation.

A2.2.5.6 Masonry

Masonry units shall comply with the requirements of Clause 4.1.11 of SANS 2001-DP3.

A2.2.5.7 Handhole, manhole and access chamber types and covers

a) Handhole, manhole and access chambers

(i) Telecommunications handholes, manholes and access chambers

Telecommunication handholes, manholes and access chambers for ducts shall be in accordance with the details provided in the Contract Documentation.

(ii) Telecommunications precast handholes

Precast handholes shall comply with the design criteria in the table below:

Table A2.2.5-1: Precast handhole design criteria

Design Parameter	Requirement
Limit state of design	Ultimate
Imposed Load	100 kN static wheel loads acting vertically on cover
Load Factor	1.6
Material Safety Factors	Steel 1.15; Concrete 1.5
Analysis	Static, simply supported
Concrete Strength Class	C28/35-20
Reinforcing	High tensile steel complying with SANS 920

(iii) Telecommunications handholes, manholes and access chambers in dolomite areas

Handholes, manholes and access chambers in dolomite areas shall comply with the requirements of SANS 1936-1 and SANS 1936-3 for a dry engineering service as defined in SANS 1936-3.

(iv) Other handholes, manholes and access chambers

Handholes, manholes and access chambers for ducts for purposes other than telecommunications shall be in accordance with the details provided in the Contract Documentation.

b) Covers and frames

(i) Telecommunications covers and frames

Telecommunication covers and frames shall comply with the requirements of SANS 558 and SANS 50124 or alternatively, if so indicated in the Contract Documentation, be in accordance with EN 124-1 to EN 124-6.

Unless otherwise specified in the Contract Documentation SANS 558 Heavy Duty Class H or SANS 50124 Class D 400 covers and frames shall be used.

(ii) Other covers and frames

Covers and frames for handholes, manholes and access chambers for ducts for purposes other than telecommunications shall comply with the requirements of SANS 50124.

Unless otherwise specified in the Contract Documentation Class D 400 covers and frames shall be used.

A2.2.6 CONSTRUCTION EQUIPMENT

The requirements in Clause A2.1.6 shall apply to construction equipment used for the installation of ducts.

A2.2.7 EXECUTION OF THE WORKS

A2.2.7.1 General

The requirements of Clause A2.1.7 shall apply to trenching for duct installation.

A2.2.7.2 Duct installation by methods other than by micro or mini trenching

a) Trench widths for duct installations

The trench widths for single ducts installed in trenches shall be in accordance with the requirements of Clause A2.1.7.1h).

Unless otherwise specified in the Contract Documentation trench widths where more than one duct is to be installed in a trench shall comply with the requirements of Clause 4.2.1 and Figure 1 of SANS 2001-DP3.

b) Bedding and compaction of bedding

The bedding for ducts shall comply with the requirements of Clause 4.3 of SANS 2001-DP3. Unless otherwise specified in the Contract Documentation bedding for ducts shall be compacted to a minimum density of 90 % of MDD in accordance with Clause 5.1.3 of SANS 2001-DP3. Where permitted in the Contract Documentation the density of the bedding shall comply with the maximum DCP penetration rates indicated in Clause 5.1.4 and Table 1 of SANS 2001-DP3.

c) Duct laying

Ducts shall be laid in accordance with the requirements of Clause 4.4 of SANS 2001-DP3.

During the installation of pliable ducts, which are supplied in rolls, the ducts shall be straightened to remove any residual "coil memory" by pulling the duct into the trench from a stationery reel or by laying the duct from a moving reel. Suitable spacers shall be used to keep the ducts in a straight alignment and, where multiple ducts are to be installed in a single trench, to prevent the ducts from twisting over and around each other.

d) Concrete bedding and encasement

(i) Concrete bedding

Where concrete bedding is required the thickness of the concrete below the duct, the height to which it extends up on either side of the duct as well as the class of concrete to be used shall be as specified in the Contract Documentation or ordered by the Engineer. During concreting, ducts or pipes shall be supported on suitably shaped temporary pedestals and strapped down to prevent uplift.

(ii) Concrete encasement

Where specified in the Contract Documentation or ordered by the Engineer ducts shall be encased in concrete in accordance with the specified dimensions and class of concrete.

During concreting ducts shall be supported on suitably shaped pedestals and strapped down so as to prevent uplift. Poker vibrators shall be used to ensure that all spaces under and around the pipes are properly filled with concrete. Concrete encasements shall be cast in one continuous operation until completed.

e) Laying of ducts with other services

Ducts laid with other services shall be in accordance with the requirements of Clause 4.7 of SANS 2001-DP3.

A2.2.7.3 Crossings of other ducts

Ducts crossing other service ducts shall be in accordance with the requirements of Clause 4.8 of SANS 2001-DP3.

A2.2.7.4 Duct markers

a) Lettering

Unless otherwise specified in the Contract Documentation the symbols or lettering in Table A2.2.7-1 shall be used for marking ducts.

Table A2.2.7-1: Symbols for marking ducts

Duct Usage	Lettering or Symbol
Telecommunications	T
Electricity	E
Irrigation	I
Water (potable)	W
Water (non-potable)	N
Fire protection	F
Gas	G
Sewer	R

Where applicable different colours shall be used to mark service types. As applicable the colours used shall be in accordance with SANS 10140-3.

b) Route markers

Where duct route markers are required they shall be installed in accordance with the requirements of the Contract Documentation.

c) Road crossing markers

Where, in accordance with the Contract Documentation, duct or other service crossings have to be marked on kerbs, the position and type of the ducts or group of ducts crossing shall be marked on the kerbs by cutting the letters, as indicated in Clause A2.2.7.4a), as 75 mm high 35 mm wide letters 5,0 mm deep into the concrete surface with an angle grinder followed by a number indicating the number of ducts or services at the crossing. Kerbs where the lettering or symbols have been precast into the kerb face may also be used. The symbol or lettering shall be painted the applicable colour indicated in Clause A2.2.7.4a).

Where duct crossings cannot be marked on kerbs, markers shall be placed as specified in the Contract Documentation or as ordered by the Engineer.

A2.2.7.5 Crossings

a) Existing road crossings

The requirements of Clause A2.1.7.2 shall apply where ducts are installed under existing roads by trenching (other than by micro or mini trenching).

b) Railway reserves, bridge and other special crossings

The requirements of Clause A2.1.7.3 shall apply where ducts have to be installed across railway reserves, bridges or in other special circumstances.

A2.2.7.6 Duct installation by micro and mini trenching

Where micro or mini trenching is used and the work is not dealt with in terms of Clause A2.2.4 or Section D2.2 the installation work, bedding, backfilling and reinstatement shall be in accordance with the details provided in the Contract Documentation.

A2.2.8 WORKMANSHIP

The requirements of Clause A1.2.8 of Chapter 1 shall apply to the process and acceptance quality control for all services work dealt with in Section 2.2 of Chapter 2.

The Engineer may, at his discretion, elect to use some of the Contractor's process control test results if the Engineer is satisfied that the Contractor's process control requirements are acceptable for acceptance quality control purposes.

The requirements of Clause A1.2.3.14 of Chapter 1 shall apply to any remedial work required where any work or material does not comply with the specified requirements.

The requirements of Section 12.7 of Chapter 12 shall apply to any ducts installed using trenchless methods.

A2.2.8.1 Tolerances

The installation of ducts installed using trenching (excluding micro or mini trenching) shall comply with the requirements stated below:

a) Horizontal alignment

The maximum deviation of the centre line from the specified position shall be ± 35 mm. Successive deviations from the specified position shall be in the same direction to avoid creating s-bends. The maximum deviation of the centre line from the specified alignment shall be 1:250 when taken over any section exceeding 10 m in length.

b) Vertical alignment, grade and level

The maximum deviation from the specified level shall be ± 35 mm.

The maximum deviation of the vertical alignment and grade from the specified alignment, or from the line between duct inverts at successive manholes or access chambers, as applicable, shall be 1:250 when measured over any section exceeding 10 m length, and all such deviations shall be gradual. Reverse falls are unacceptable.

c) Compaction and moisture content tolerances

The compaction and moisture content tolerances for bedding shall comply with the requirements of Clause 5.2.2 of SANS 2001-DP3.

A2.2.8.2 Proving ducts

a) Standard proving requirements

Unless otherwise specified in the Contract Documentation the requirements of Clause 5.1.5 of SANS 2001-DP3 shall apply to the proving of ducts.

b) Other duct integrity requirements

Where particular methods for proving ducts or verifying duct integrity, such as verification (air blow), continuity (mandrill) and air pressure testing, are required, these shall be as specified in the Contract Documentation.

B2.2 DRY SERVICES

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B2.2.6	CONSTRUCTION EQUIPMENT
B2.2.7	EXECUTION OF THE WORKS
B2.2.8	WORKMANSHIP

B2.2.1 SCOPE

Apart from the scope for labour enhancement as described under Section B2.1 no additional scope for labour enhancement is defined under Section B2.2 for Dry Services.

B2.2.2 DEFINITIONS

Definitions as provided in A2.2.2 apply.

B2.2.3 GENERAL

Any activity specified in Part A where hand work is given as an alternative, shall be executed in such a way as to maximise labour.

B2.2.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A shall apply.

B2.2.5 MATERIALS

The provisions of Part A shall apply.

B2.2.6 CONSTRUCTION EQUIPMENT

The provisions of Part A shall apply.

B2.2.7 EXECUTION OF THE WORKS

The provisions of Part A shall apply.

B2.2.8 WORKMANSHIP

The provisions of Part A shall apply.

C2.2 DRY SERVICES

PART C: MEASUREMENT AND PAYMENT

Part C2.2 should be used in conjunction with Part C2.1 where items are provided to cover the excavation and backfilling of trenches for ducts and other associated works not included below.

(i) Preamble

The tendered rate for each pay item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the pay item as specified, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Clauses C1.1.1, C1.1.2, C1.1.3 and C1.1.4 of Chapter 1 shall apply.

Where pay item Descriptions include any wording in *italics* it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay items

Wherever volumetric measurement is required, the volume will be computed from the applicable depths or layer thicknesses and using the authorised width (*W*) determined in accordance with the specification.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as the Contractor deems appropriate:

1. No separate payment will be made for setting out the works.
2. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities.
3. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
4. No separate payment will be made for the loading of any materials.
5. No separate payment will be made for the hauling of all materials where the material is moved over a distance of less than, and up to, 1.0km.
6. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
7. No separate payment will be made for the removal of any surplus material imported to complete the works.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

For activities in Table C2.2-1 pay items specified in other Chapters or Sections of the specifications, where they relate to work under this Section, will be listed in the Pricing Schedule.

Table C2.2-1: Items from other Chapters or Sections

Activity	Section 2.2 Clause reference	Section - Item Reference
Removal and conservation of topsoil	C2.2.4	Section C1.6 of Chapter 1 - All applicable items
Hauling materials	C2.2.4	Section C1.7 of Chapter 1 - All applicable items
Borrow and spoil areas: <ul style="list-style-type: none"> • Opening and closing down • Excess overburden • Rehabilitation 	C2.2.4	Section C4.1 of Chapter 4 - All applicable items
Placing of top soil and establishment of vegetation	C2.2.4	Section C11.8 of Chapter 11 - All applicable items

(v) **Items specifically for this section of the specification**

Item	Description	Unit
C2.2.1	Supply, lay and prove ducts	
C2.2.1.1	State for each duct the material type, class, joint type etc. (example HDPE pliable type N450 with compression couplings)	
(a)	State diameter (example 110 mm diameter (OD))	metre (m)
(b)	State diameter (example 160 mm diameter (OD))	metre (m)
C2.2.1.2	State for each duct the material type, class, joint type etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)

The unit of measurement shall be the metre of duct supplied and laid.

The tendered rates shall include full compensation for procuring, furnishing and laying and jointing the ducts excluding end plugs and draw wires as well as for proving the duct as specified, but excluding excavation, bedding, backfilling and encasing which shall be measured and paid for under the relevant items.

Item	Description	Unit
C2.2.2	Extra over item C2.2.1 for the provision of split ducts	
C2.2.2.1	State for each duct the material type, class, etc.	
(a)	State diameter (example 110 mm diameter (OD))	metre (m)
(b)	State diameter (example 160 mm diameter (OD))	metre (m)
C2.2.2.2	State for each duct the material type, class etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)

The unit of measurement shall be the metre of split duct installed and laid.

The unit of measurement shall be full compensation for all the additional costs associated with the provision and installation of split ducts including any cutting and binding required.

Item	Description	Unit
C2.2.3	Lay and prove ducts provided by others	
C2.2.3.1	State for each duct to be laid the material type	
(a)	State diameter (example 110 mm diameter (OD))	metre (m)
(b)	State diameter (example 160 mm diameter (OD))	metre (m)
C2.2.3.2	State for each duct to be laid the material type	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)

The unit of measurement shall be the metre of duct laid.

The tendered rates shall include full compensation for laying the ducts as well as for proving the ducts as specified, but excluding excavation, bedding, backfilling and encasing the ducts as well as the provision and installation of draw wires and end caps or plugs which shall be measured and paid for under the relevant pay items. This item will be applicable where the Employer or another service owner supplies the duct materials free of charge on Site for the Contractor to lay and therefore there are no duct materials procurement costs to be included in the rates.

Item	Description	Unit
C2.2.4	Bedding for ducts compacted to 90 % of MDD (100 % for sand) using material:	
C2.2.4.1	Selected from the excavated trench material	cubic metre (m ³)
C2.2.4.2	Selected from other excavations on site	cubic metre (m ³)
C2.2.4.3	Selected from approved borrow areas	cubic metre (m ³)
C2.2.4.4	Selected from sources provided by the Contractor	cubic metre (m ³)
C2.2.4.5	From commercial sources	
(a)	Non-cohesive material (state material type)	cubic metre (m ³)
(b)	Crushed stone material (state material type)	cubic metre (m ³)
C2.2.4.6	Extra over items C2.2.4.1 to C2.2.4.5 for stabilising material with cement	cubic metre (m ³)
C2.2.4.7	Cement (state class/type of cement) for stabilising bedding	kilogram (kg)

The unit of measurement for items C2.2.4.1 to C2.2.4.5 shall be the cubic metre of bedding material in place after compaction and the quantity shall be calculated from the specified dimensions of the bedding and backfilling as specified or authorised by the Engineer. The volume occupied by the ducts shall be subtracted when calculating the volume of bedding.

The unit of measurement for item C2.2.4.6 shall be the cubic metre of bedding material stabilised with cement in place after compaction and the unit of measurement for item C2.2.4.7 shall be the kilogram of cement used to stabilise the bedding.

The tendered rates for items C2.2.4.1 to C2.2.4.5 shall include full compensation for procuring, furnishing and placing the bedding material under, alongside and over ducts and for watering and compacting the bedding material to the specified minimum density. The tendered rates for items C2.2.4.2 and C2.2.4.3 shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on Site or from a borrow pit, for hauling the material within the haul limit of 1,0 km and for unloading the material for placement. The tendered rate for item C2.2.4.3 shall include full compensation for all operations at borrow pits not subject to any specified separate pay items.

The tendered rates for items C2.2.4.4 and C2.2.4.5 shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

The tendered rate for item C2.2.4.6 shall include full compensation for mixing the material with the cement where applicable. The tendered rate for item C2.2.4.7 shall include full compensation for supplying the cement required for stabilising bedding.

Item	Description	Unit
C2.2.5	Concrete for bedding and encasement of ducts	
C2.2.5.1	Concrete bedding (state class of concrete)	cubic metre (m ³)
C2.2.5.2	Concrete encasement of ducts (state class of concrete)	cubic metre (m ³)

The unit of measurement shall be the cubic metre of concrete placed and the quantity shall be calculated from the dimensions of the excavation as shown on the drawings or as specified or authorised by the Engineer, irrespective of whether the actual excavation exceeds the specified or authorised dimensions, minus the volume occupied by the ducts.

The tendered rate shall include full compensation for procuring, furnishing and placing all the materials, formwork and pedestals and for all the labour and construction equipment necessary to complete the work as specified.

Item	Description	Unit
C2.2.6	Duct accessories (markers, marking, draw wires and end caps etc.)	
C2.2.6.1	Duct markers (state type)	number (No)
C2.2.6.2	Duct marking (state type)	number (No)
C2.2.6.3	Draw wires (state type)	metre (m)
C2.2.6.4	End caps or plugs (state type)	number (No)
C2.2.6.5	Other accessories	
(a)	State type	number (No)
(b)	State type	metre (m)

The unit of measurement for items C2.2.6.1, C2.2.6.2, C2.2.6.4 and C2.2.6.5(a) shall be the number of markers supplied and installed, marking completed on kerbs or end caps or plugs or other accessories supplied and installed. The unit of measurement for items C2.2.6.3 and C2.2.6.5(b) shall be the metre of draw wire or other accessory supplied and installed.

The tendered rates shall include full compensation for the manufacture, delivery and installation of the markers, draw wires, end caps, plugs or other accessories complete as as specified in the Contract Documentation or for completing the marking on kerbs as specified.

Item	Description	Unit
C2.2.7	Handholes, manholes and access chambers for ducts	
C2.2.7.1	Handholes (state type and drawing reference etc.)	
(a)	State depth range (example over 1,0 m and up to 1,5 m deep)	number (No)
(b)	State depth range (example over 1,5 m and up to 2,0 m deep)	number (No)
C2.2.7.2	Manholes (state type and drawing reference etc.)	
(a)	State depth range	number (No)
(b)	State depth range	number (No)
C2.2.7.3	Access chambers (state type and drawing reference etc.)	
(a)	State depth range	number (No)
(b)	State depth range	number (No)
C2.2.7.4	Other structures	
(a)	State type, depth range and drawing reference etc.	number (No)
(b)	State type, depth range and drawing reference etc.	number (No)

The unit of measurement shall be the number of handholes, manholes, access chambers or other structures completed as specified. Separate items will be scheduled for handholes, manholes, access chambers and other structures etc. of each type and of each depth in increments of 0,5 m.

The tendered rates shall include full compensation for all the labour, construction equipment and materials required to complete the handholes, manholes, access chambers or other structures completed as specified but excluding excavation and backfilling which shall be measured and paid for separately under the relevant items.

The tendered rates shall exclude the provision and installation of covers and frames which shall be measured and paid for under the relevant items.

Item	Description	Unit
C2.2.8	Covers and frames for duct handholes, manholes and access chambers	
C2.2.8.1	State type, strength class and size of cover and frame	number (No)
C2.2.8.2	State type, strength class and size of cover and frame	number (No)
C2.2.8.3	State type, strength class and size of cover and frame	number (No)
C2.2.8.4	Etc., insert additional items as required	number (No)

The unit of measurement shall be the number of covers and frames supplied and installed as specified.

The tendered rates shall include full compensation for the manufacture, delivery and installation of the covers and frames complete as specified in the Contract Documentation.

Item	Description	Unit
C2.2.9	Install duct handhole, manhole and access chamber covers and frames provided by others	
C2.2.9.1	State type, strength class and size of cover and frame	number (No)
C2.2.9.2	State type, strength class and size of cover and frame	number (No)
C2.2.9.3	State type, strength class and size of cover and frame	number (No)
C2.2.9.4	Etc., insert additional items as required	number (No)

The unit of measurement shall be the number of covers and frames installed as specified.

The tendered rates shall include full compensation for the installation of the covers and frames complete as specified in the Contract Documentation. This item will be applicable where the Employer or another service owner supplies the covers and frames free of charge on Site for the Contractor to install and therefore there are no cover and frame procurement costs to be included in the rates.

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D2.2 DRY SERVICES

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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- D2.2.1 SCOPE**
- D2.2.2 WARRANTIES FOR PRODUCT OR ELEMENT DESIGN AND INSTALLATION OF PROPRIETARY SYSTEMS**
- D2.2.3 PERFORMANCE SPECIFICATIONS**
- D2.2.4 VISUALLY ASSESSED PROPERTIES**
- D2.2.5 INSTRUMENTALLY ASSESSED PROPERTIES**
- D2.2.6 EVALUATION FOR ACCEPTANCE**
- D2.2.7 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE**
- D2.2.8 NOTIFICATION OF REMEDIAL WORK**
- D2.2.9 REMEDIAL WORKS**

D2.2.1 SCOPE

Refer to Clause D2.1.1.

D2.2.2 WARRANTIES FOR PRODUCT OR ELEMENT DESIGN AND INSTALLATION OF PROPRIETARY SYSTEMS

Where indicated in the Contract Documentation the design and installation of proprietary dry service systems shall require that a warranty of 15 years be supplied by the Contractor. Certification of the installation by a suitable experienced ECSA Registered Professional Engineer or Technologist is also required together with the warranty.

The warranty form submitted shall include the following details:

- a) Description of System / Works Covered.
- b) Name and address of Main Contractor.
- c) Name of Contact Person.
- d) Name and address of Installer.
- e) Name of Contact Person.
- f) Date of Installation.
- g) Duration of Warranty.
- h) Start date of Warranty.
- i) End date of Warranty.

D2.2.3 PERFORMANCE SPECIFICATIONS

Performance based specifications shall be as specified in the Contract Documentation and shall include the following minimum performance conditions.

D2.2.3.1 Minimum Performance Specifications for Trenching in the Road Verge

- a) No settlement or deformation of trenches will be allowed.
- b) No scouring or erosion on trenches will be allowed.
- c) Vegetation must be re-established as per surroundings.

D2.2.3.2 Minimum Performance of Micro and Mini Trenching Systems

- a) Settlement and or deformation measured under a 3,0 m straight edge across the trench must not exceed 6 mm.
- b) No cracking exceeding 3,0 mm along the trench walls will be accepted.
- c) No diagonal or transverse cracks exceeding 3,0 mm will be allowed.
- d) No trench induced road failures will be allowed.
- e) Delamination of trench reinstatement against trench walls will not be accepted.

A2.3 WET SERVICES

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PART A: SPECIFICATIONS

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PART B: LABOUR ENHANCEMENT

PART C: MEASUREMENT AND PAYMENT

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A2.3.1 SCOPE

Section A2.3 of Chapter 2 covers the civil engineering components for the construction work associated with the installation of wet services (water supply and waste water (sewerage) pipelines) and ancillary works in road reserves. This section only covers medium pressure pipelines of diameter up to 1,0 m, for transporting water and sewerage under working pressures of up to 2.5MPa.

All wet services shall be installed at the locations shown and in accordance with the details shown on the drawings, provided in the Contract Documentation or as directed by the Engineer.

A2.3.1.1 General note

In certain SANS documents referred to in this section the term "*specified in the scope of work*" is used. For the purposes of this specification the term shall be deemed to mean "*specified in the Contract Documentation*".

A2.3.1.2 Applicable supporting specifications

Section A2.3 of Chapter 2 shall be used in close conjunction specifically with the following standards or specifications which must be available for use with Section A2.3:

SANS 2001-DP1	Earthworks for buried pipelines and prefabricated culverts
SANS 2001-DP2	Medium pressure pipelines
SANS 2001-DP4	Sewers
SANS 2001-DP6	Below-ground water installations

Other applicable specifications include:

SANS 1294	Precast concrete manhole sections and components
SANS 50124	Gully tops and manhole tops for vehicular and pedestrian areas

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

A2.3.2 DEFINITIONS

The following definitions shall apply to these specifications:

SANS 2001 Definitions - the definitions as indicated in Clause 3 of SANS 2001-DP2, SANS 2001-DP4 and SANS 2001-DP6 shall be applicable. Where there are any conflicts between the definitions in these SANS specifications and those provided elsewhere in Chapter 2 the latter shall take precedence.

A2.3.3 GENERAL

The location, identification, protection and relocation of existing services, unknown or unrecorded services shall be managed in accordance with Clause A2.1.3.2.

A2.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

A2.3.4.1 General

The supervision of the civil engineering component of wet services to be installed in a road reserve shall be managed in accordance with Clause A2.1.3.7. The design of temporary works, alternative designs and other designs by the Contractor shall be in accordance with Clauses A 2.1.4.1, A2.1.4.2 and A2.1.4.3.

A2.3.4.2 Alternative materials for pipes, fittings and joints

Should the Contractor propose to use pipes and fittings of materials other than those specified in Clause A2.3.5 the Contractor shall submit for approval detailed specifications including full details of the types of joints and specials the Contractor proposes to use with the pipes and fittings. The Contractor shall not use such pipes or fittings until written approval for their use has been obtained from the Employer.

A2.3.5 MATERIALS

A2.3.5.1 Sewers

a) Pipes and fittings

Materials for sewer pipes and fittings (excluding rising mains) shall comply with the requirements of Clauses 4.1.1 to 4.1.11 of SANS 2001-DP4.

Materials for rising main sewer pipes and fittings shall comply with the relevant requirements of SANS 2001-DP2.

b) Manholes and chambers

Materials for sewer manholes and chambers shall comply with the requirements of Clause 4.1.12 of SANS 2001-DP4.

Precast concrete manhole sections shall comply with the requirements of SANS 1294 and shall be manufactured using dolomite aggregate. Joints between precast manhole units shall be of the interlocking, self-centring type. Precast slabs shall comply with the requirements for heavy duty (HD) slabs.

Step irons shall be of the copolymer polypropylene type with a 12 mm diameter high tensile steel reinforced core and shall be of a length suitable for fixing in brick, precast concrete or reinforced fibre cement as applicable.

Covers and frames for manholes and chambers for sewers shall comply with the requirements of SANS 50124. Unless otherwise specified in the Contract Documentation Class D 400 covers and frames shall be used.

c) Materials testing

The requirements of Clause 5.2 of SANS 2001-DP4 shall apply to the testing of sewer materials.

A2.3.5.2 Water Mains

a) Pipes and fittings

Materials for water main pipes and fittings shall comply with the requirements of Clauses 4.1.1 to 4.1.9 of SANS 2001-DP2.

Materials for water mains of diameter up to 160 mm from a water reticulation main to the boundaries of erven shall comply with the requirements of Clause 4.1.1 of SANS 2001-DP6.

b) Couplings, joints, flanges and accessories

Metallic compression-type pipe couplings, flexible joints for plain-ended steel pipes and flanged pipes and fittings shall, as applicable, comply with the requirements of Clauses 4.1.10, 4.1.11 and 4.1.12 of SANS 2001-DP2.

c) Valves, inline strainers, backflow devices and fire hydrants

Valves, inline strainers, mechanical backflow-prevention devices and above and below ground fire hydrants shall, as applicable, comply with the requirements of Clauses 4.1.13, 4.1.14, 4.1.15 and 4.1.16 of SANS 2001-DP2.

d) Manholes, surface boxes, anchor blocks and concrete casings and corrosion protection

Manholes, surface boxes, anchor blocks and concrete casings and corrosion protection shall, as applicable, comply with the requirements of Clauses 4.1.17 and 4.1.18 of SANS 2001-DP2.

e) Materials testing

The requirements of Clause 5.2 of SANS 2001-DP2 shall apply to the testing of water main materials.

A2.3.5.3 Bedding, fill blanket and backfill material for sewers and water mains

a) Bedding and fill blanket

Bedding and fill blanket materials for sewers and water mains shall comply with the requirements of Clauses 4.1.1 to 4.1.4 and 4.2.3 of SANS 2001-DP1.

The class of bedding (Class A, B, C or D) applicable for each rigid or flexible pipeline shall be as specified in the Contract Documentation.

For the purposes of this Clause A2.3.5.3a) all U-PVC and HDPE pipes shall be treated as flexible pipes.

b) Backfill

Backfill for sewers and water mains shall comply with the requirements of Clause A2.1.5.1.

A2.3.5.4 Marker posts

Markers for sewer and water pipelines shall be in accordance with the details provided in the Contract Documentation.

A2.3.6 CONSTRUCTION EQUIPMENT

A2.3.6.1 Pipe handling and rigging equipment

The construction, transportation and rigging equipment used by the Contractor for the handling and placing of pipes shall be of the type recommended by the pipe manufacturer or supplier. The type of equipment used shall be such that at no time during any handling and placing operation is any pipe overstressed or physically damaged in any way.

A2.3.6.2 Other construction equipment requirements

The specified requirements in Clause A2.1.6 shall apply to construction equipment used for the installation of wet services.

A2.3.7 EXECUTION OF THE WORKS

A2.3.7.1 General

a) Construction requirements

The preparatory work, excavation and bedding for sewer and water pipelines shall comply with the requirements of Clause A2.1.7 and Clauses 4.2.1, 4.2.2 and 4.2.3 of SANS 2001-DP1. Where there are any conflicts between the requirements of the Clause A2.1.7 and the stipulated SANS clauses the latter shall take precedence.

b) Compaction of bedding and fill blanket

The compaction of bedding material for sewers and water mains shall comply with the requirements of Clause 4.2.3.7 of SANS 2001-DP1 and the compaction of fill blanket material for sewers and water mains shall comply with the requirements of Clause 4.2.6 of SANS 2001-DP1.

The degree of compaction specified for bedding material in Clause 4.2.3.7 of SANS 2001-DP1 and for fill blanket material in Clause 4.2.6 of SANS 2001-DP1 shall be 100 % of MDD where sand (as defined for fill material in Clause A4.1.5.9 of Chapter 4) is used.

A2.3.7.2 Sewers

a) General construction and pipe laying

The construction and laying of sewers shall comply with the requirements of Clauses 4.2 and 4.3 of SANS 2001-DP4.

b) Construction of manholes and inspection chambers

Manholes and inspection chambers for sewers shall be constructed in accordance with the requirements of Clause 4.4 of SANS 2001-DP4.

c) Concrete casings

Concrete encasement of sewers shall be constructed in accordance with the requirements of Clause 4.5 of SANS 2001-DP4 and Clause 4.2.3.8 of SANS 2001-DP1.

d) Raising or lowering of existing manholes and connecting sewers

The raising or lowering of manholes and the connection of sewers shall be in accordance with the requirements of Clauses 4.6 and 4.7 of SANS 2001-DP4.

A2.3.7.3 Water mains

a) General construction and pipe laying

The construction and laying of water mains shall comply with the requirements of Clauses 4.2 and 4.3 of SANS 2001-DP2.

b) Jointing methods and operations

The jointing of water mains shall comply with the requirements of Clause 4.4 of SANS 2001-DP2.

c) Service connections and setting of valves, specials and fittings

Service connections and the setting of valves, specials and fittings for water mains shall comply with the requirements of Clauses 4.5 and 4.6 of SANS 2001-DP2.

d) Concrete casings and anchor blocks, thrust blocks and pedestals

The construction of concrete casings, anchor blocks or thrust blocks and pedestals for water mains shall comply with the requirements of Clauses 4.7 and 4.8 of SANS 2001-DP2.

e) Valve and hydrant chambers and manholes

The construction of valves, hydrant chambers and manholes for water mains, unless otherwise specified in the Contract Documentation, shall comply with the requirements of Clauses 4.9 and 4.10 of SANS 2001-DP2.

f) Lifting and relaying existing pipes

The lifting and relaying of water mains shall comply with the requirements of Clause 4.11 of SANS 2001-DP2.

g) Disinfection of potable water pipelines and corrosion repairs

The disinfection of potable water pipelines and any repairs to the corrosion protection of pipes, specials or joints shall, as applicable, comply with the requirements of Clauses 4.12 and 4.13 of SANS 2001-DP2.

A2.3.7.4 Excavation, backfilling and re-instatement

The requirements of Clause A2.1.7 shall apply to excavation, backfilling and road re-instatement where sewers or water mains are constructed.

A2.3.8 WORKMANSHIP

The requirements of Clause A1.2.8 of Chapter 1 shall apply to the process and acceptance quality control for all services work dealt with in Section A2.3.

The Engineer may, at his discretion, elect to use some of the Contractor's process control test results if the Engineer is satisfied that the Contractor's process control requirements are acceptable for acceptance quality control purposes.

The requirements of Clause A1.2.3.14 of Chapter 1 shall apply to any remedial work required where any work or material does not comply with the specified requirements.

The requirements of Section A12.7 of Chapter 12 shall apply to any sewers or water mains installed using trenchless methods.

A2.3.8.1 General

a) Compaction and moisture content tolerances

The compaction and moisture content tolerances for bedding for sewers and water mains shall comply with the requirements of Clause 5.2.2 of SANS 2001-DP1.

A2.3.8.2 Sewers

a) Tolerances

Unless otherwise specified in the Contract Documentation the requirements of Clause 5.1 of SANS 2001-DP4 shall apply to tolerances for sewers installed by trenching.

b) Construction tests

(i) General

Unless otherwise specified in the Contract Documentation the requirements of Clause 5.3 of SANS 2001-DP4 shall apply to the construction tests for sewers. The Contractor shall be responsible for carrying out the specified construction tests and reporting the results to the Engineer.

(ii) Water tightness of manholes

Where manholes are to be tested in accordance with Clause 5.3.4 of SANS 2001-DP4 the manholes shall be tested, on completion but before backfilling, for water tightness by completely filling the manhole with water up to the underside of the manhole cover frame after the pipes leading from manholes have been closed off for the test. The manhole shall be allowed to stand for one hour to allow initial absorption to take place, after which the water shall be topped up if necessary. After topping up, the water level shall not drop by more than 20 mm in one hour.

The Contractor shall be responsible for the disposal of the water used in the test by pumping or other approved means.

The Engineer reserves the right to determine whether or not each and every manhole shall be tested. Should it be decided not to test all manholes, the Engineer will determine which of the manholes shall be tested.

(iii) Camera Inspections

Where required in the Contract Documentation sewers shall be inspected by means of a closed-circuit television camera (CCTV) on completion of the backfill and manhole construction. The CCTV camera used shall be equipped with inclinometers so that a pipeline profile can be produced. On completion of the inspection the Contractor shall provide the Engineer with a report in the agreed electronic or hard format.

A2.3.8.3 Water mains

a) Tolerances

Unless otherwise specified in the Contract Documentation the requirements of Clause 5.1 of SANS 2001-DP2 shall apply to tolerances for water mains installed by trenching.

b) Construction tests

Unless otherwise specified in the Contract Documentation the requirements of Clause 5.3 of SANS 2001-DP2 or Clauses 5.3 and 5.4 of SANS 2001-DP6, as applicable, shall apply to the construction tests for water mains. The Contractor shall be responsible for carrying out the specified construction tests and reporting the results to the Engineer.

B2.3 WET SERVICES

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B2.3.7	EXECUTION OF THE WORKS
B2.3.8	WORKMANSHIP

B2.3.1 SCOPE

Apart from the scope for labour enhancement as described under Section B2.1 no additional scope for labour enhancement is defined under section B2.3 for Wet Services.

B2.3.2 DEFINITIONS

Definitions as provided in A2.3.2 apply.

B2.3.3 GENERAL

Any activity specified in Part A where hand work is given as an alternative, shall be executed in such a way as to maximise labour.

B2.3.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A shall apply.

B2.3.5 MATERIALS

The provisions of Part A shall apply.

B2.3.6 CONSTRUCTION EQUIPMENT

The provisions of Part A shall apply.

B2.3.7 EXECUTION OF THE WORKS

The provisions of Part A shall apply.

B2.3.8 WORKMANSHIP

The provisions of Part A shall apply.

C2.3 WET SERVICES

PART C: MEASUREMENT AND PAYMENT

Part C2.3 should be used in conjunction with Part C2.1 where items are provided to cover the excavation and backfilling of trenches and other associated works not included below.

(i) Preamble

The tendered rate for each pay item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the pay item as specified, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Clauses C1.1.1, C1.1.2, C1.1.3 and C1.1.4 of Chapter 1 shall apply.

Where pay item Descriptions include any wording in *italics* it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay items

Wherever volumetric measurement is required, the volume will be computed from the applicable depths or layer thicknesses and using the authorised width (W) determined in accordance with the specification.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as the Contractor deems appropriate:

1. No separate payment will be made for setting out the works.
2. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities.
3. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
4. No separate payment will be made for the loading of any materials.
5. No separate payment will be made for the hauling of all materials where the material is moved over a distance of less than, and up to, 1.0km.
6. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
7. No separate payment will be made for the removal of any surplus material imported to complete the works.

(iv) Items to be measured and paid for using items specified elsewhere in the specifications

For activities in Table C2.3-1 pay items specified in other Chapters or Sections of the specifications, where they relate to work under this section, will be listed in the Pricing Schedule.

Table C2.3-1: Items from other Chapters or Sections

Activity	Section 2.3 Clause Reference	Section - Item Reference
Removal and conservation of topsoil	C2.3.3 & C2.3.29	Section C1.6 of Chapter 1 - All applicable items
Hauling materials	C2.3.3 & C2.3.29	Section C1.7 of Chapter 1 - All applicable items
Borrow and spoil areas: <ul style="list-style-type: none"> • Opening and closing down • Excess overburden • Rehabilitation 	C2.3.3 & C2.3.29	Section C4.1 of Chapter 4 - All applicable items
Placing of top soil and establishment of vegetation	C2.3.3 & C2.3.29	Section C11.8 of Chapter 11 - All applicable items

(v) **Items specifically for this section of the specification**

a) **Measurement and Payment items for Sewers (Items C2.3.1 to C2.3.11)**

Item	Description	Unit
C2.3.1	Supply, lay, joint and test sewers	
C2.3.1.1	State for each sewer the pipe material type, class, joint type and the class of bedding etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)
C2.3.1.2	State for each sewer the pipe material type, class, joint type and the class of bedding etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)
C2.3.1.3	Etc, insert additional items as required	

The unit of measurement shall be the metre of sewer pipe supplied and laid measured linearly on slopes as laid. No deductions will be made for specials but deductions will be made for the internal dimensions of manholes. Separate items will be scheduled for pipes of different materials, diameters, classes, class of bedding and types of joints.

The tendered rates shall include full compensation for procuring, furnishing, laying, bedding and jointing the pipes, making connections into manholes as well as for testing the pipelines as specified, but excluding excavation, provision of bedding material and backfilling which shall be measured and paid for under the relevant items. The tendered rates shall also include full compensation for the cutting of pipes, wastage, the provision of short sections of pipes at manholes and for all work and incidentals required to complete the work as specified.

Item	Description	Unit
C2.3.2	Extra over item C2.3.1 for sewer specials	
C2.3.2.1	State for each sewer special the type, class, etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.2.2	State for each sewer special the type, class, etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.2.3	Etc., insert additional items as required	

The unit of measurement shall be the number of specials installed.

The tendered rates shall include full compensation for procuring, furnishing, laying, installing, bedding, jointing and testing the specials.

Item	Description	Unit
C2.3.3	Bedding for sewers (Class B and C) and fill blanket compacted to 90 % of MDD (100 % for sand)	
C2.3.3.1	Bedding using selected granular material	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources	cubic metre (m ³)
C2.3.3.2	Selected fill blanket material	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)

Item	Description	Unit
C2.3.3	Bedding for sewers (Class B and C) and fill blanket compacted to 90 % of MDD (100 % for sand)	
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources	cubic metre (m ³)
C2.3.3.3	Extra over items C2.3.3.1(a) to C2.3.3.1(c) and C2.3.3.2(a) to C2.3.3.2(c) for screening material	cubic metre (m ³)

The unit of measurement for items C2.3.3.1 and C2.3.3.2 shall be the cubic metre of bedding or fill blanket material in place after compaction and the quantity shall be calculated from the specified dimensions of the bedding and blanket as specified or authorised by the Engineer. The volume occupied by the pipes shall be subtracted when calculating the volume of bedding.

The unit of measurement for item C2.3.3.3 shall be the cubic metre of bedding or blanket material screened as instructed by the Engineer and in place after compaction. The quantity measured shall be increased by including 70 % of the loose volume, measured in stockpile, of the material screened out and discarded.

The tendered rates shall include full compensation for procuring and furnishing the bedding or fill blanket material and placing the material alongside and under the pipes and for watering and compacting the bedding or blanket material. The tendered rates for items C2.3.3.1(b), C2.3.3.1(c), C2.3.3.2(b) and C2.3.3.2(c) shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on Site or from a borrow pit, for hauling the material within the haul limit of 1,0 km and for unloading the material for placement. The tendered rate for items C2.3.3.1(c) and C2.3.3.2(c) shall include full compensation for all operations at borrow pits not subject to any specified separate pay items.

The tendered rates for items C2.3.3.1(d), C2.3.3.1(e), C2.3.3.2(d) and C2.3.3.2(e) shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

The tendered rate for item C2.3.3.3 shall include full compensation for the additional handling and transport necessary, for screening the material and for disposing of the material screened out.

Trench backfill (above the fill blanket) will be measured and paid under separate items.

Item	Description	Unit
C2.3.4	Concrete for bedding (Class A) and encasement for sewers	
C2.3.4.1	Concrete (Class A) bedding (<i>state class of concrete</i>)	cubic metre (m ³)
C2.3.4.2	Concrete encasement (<i>state class of concrete</i>)	cubic metre (m ³)

The unit of measurement shall be the cubic metre and the quantity shall be calculated from the dimensions of the excavation as shown on the drawings or as specified or authorised by the Engineer, irrespective of whether the actual excavation exceeds the specified or authorised dimensions, less the volume occupied by the pipes.

The tendered rate shall include full compensation for procuring, furnishing and placing all materials, formwork and pedestals and for all the labour and construction equipment necessary to complete the work as specified including the provision of all the specified expansion and/or construction joints required.

Item	Description	Unit
C2.3.5	Manholes, inspection chambers and cleaning eyes for sewers	
C2.3.5.1	Manholes (<i>state type and drawing reference etc.</i>)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.5.2	Extra over item C2.3.5.1 for backdrops for manholes (<i>state type and drawing reference etc.</i>)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.5.3	Inspection chambers (<i>state type and drawing reference etc.</i>)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.5.4	Cleaning eyes (<i>state type and drawing reference etc.</i>)	

Item	Description	Unit
C2.3.5	Manholes, inspection chambers and cleaning eyes for sewers	
(a)	State depth range	number (No)
(b)	State depth range	number (No)
C2.3.5.5	Other structures (state type and drawing reference etc.)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)

The unit of measurement shall be the number of manholes, inspection chambers, cleaning eyes or other structures completed as specified.

Separate items will be scheduled for manholes, backdrops, inspection chambers and cleaning eyes etc. of each type and of each depth in increments of 0,5 m. The tendered rates shall include full compensation for all the labour, construction equipment and materials required to construct the manholes, inspection chambers, cleaning eyes or other structures complete as specified including channels, benching, short pipes and all flexible connections in accordance with the details indicated in the Contract Documentation. The cost of dealing with any excavation (in all materials including disposal of surplus) and backfilling with suitable material (including importation of material if required) will be measured under the relevant items.

The depth category of manholes, inspection chambers, cleaning eyes etc. shall be measured as the difference between the cover level and the deepest invert level of the structure.

The tendered rates shall include full compensation for all the labour, construction equipment and materials required to complete the manholes, inspection chambers, cleaning eyes or other structures completed as specified but excluding excavation and backfilling and excluding the provision and installation of covers and frames which shall be measured and paid for under the relevant items.

Item	Description	Unit
C2.3.6	Covers and frames for sewer manholes, inspection chambers and other structures	
C2.3.6.1	State type, strength class and size of cover and frame	number (No)
C2.3.6.2	State type, strength class and size of cover and frame	number (No)
C2.3.6.3	State type, strength class and size of cover and frame	number (No)
C2.3.6.4	Etc., insert additional items as required	number (No)

The unit of measurement shall be the number of covers and frames supplied and installed as specified.

The tendered rates shall include full compensation for the manufacture, delivery and installation of the covers and frames complete as specified in the Contract Documentation.

Item	Description	Unit
C2.3.7	Sewer accessories (anchor blocks, marker posts, plug stoppers etc.)	
C2.3.7.1	Anchor blocks (state type and drawing reference)	number (No)
C2.3.7.2	Anchor blocks (state type and drawing reference)	cubic metre (m ³)
C2.3.7.3	Marker posts (state type and drawing reference)	number (No)
C2.3.7.4	Plug stoppers (state type)	number (No)
C2.3.7.5	Other accessories	
(a)	State type	number (No)
(b)	State type	number (No)

The unit of measurement for items C2.3.7.1, C2.3.7.3, C2.3.7.4 and C2.3.7.5 shall be the number of anchor blocks, marker posts, plug stoppers or other accessories supplied and installed. The unit of measurement for item C2.3.7.2 shall be the cubic metre of concrete measured in accordance with the specified dimensions.

Item C2.3.7.1 will be used where anchor blocks are the same size and where detail drawings are provided for each size or type scheduled. Item C2.3.7.2 will be used where the anchor blocks vary in size but the relationship between the area of formwork and the volume of concrete is reasonably consistent.

The tendered rates for items C2.3.7.1, C2.3.7.2, C2.3.7.4 and C2.3.7.5 shall include full compensation for all the labour, construction equipment and materials required to complete the anchor blocks, plug stoppers or other accessories complete as specified in the Contract Documentation. The tendered rate for item C2.3.7.3 shall include full compensation for manufacturing, installing and painting the marker posts as specified and submitting to the Engineer the records of all the marker posts.

Item	Description	Unit
C2.3.8	Sewer connections (erf and existing line connections)	
C2.3.8.1	Erf connections (state type, depth range and drawing reference)	
(a)	Connection length (state length in metres)	number (No)
(b)	Connection length (state length in metres)	number (No)
C2.3.8.2	Erf connections (state type, depth range and drawing reference)	
(a)	Connection length (state length in metres)	number (No)
(b)	Connection length (state length in metres)	number (No)
(c)	Etc., insert additional items as required	number (No)
C2.3.8.3	Erf connections to sewer manholes	
(a)	State type, depth range, etc.	Sum
(b)	State type, depth range, etc.	Sum
C2.3.8.4	Connecting sewers to existing manholes	
(a)	State position, specification and drawing reference etc.	Sum
(b)	State position, specification and drawing reference etc.	Sum
(c)	Etc. insert additional items as required	Sum
C2.3.8.5	Breaking into an existing sewer and building a new manhole	
(a)	State position, specification and drawing reference etc.	Sum
(b)	State position, specification and drawing reference etc.	Sum
(c)	Etc. insert additional items as required	Sum

The unit of measurement for items C2.3.8.1 and C2.3.8.2 shall be the number of erf connections supplied and installed. The unit of measurement for items C2.3.8.3, C2.3.8.4 and C2.3.8.5 shall be the sum per connection or manhole completed as specified.

Separate items will be listed for erf connections measured at different depths and for different lengths. The depth will be that of the main sewer at the point of connection. The size, type, class and treatment of the junction and bend shall be the same as for the connection pipe. The tendered rate for items C2.3.8.1 and C2.3.8.2 shall cover the cost of excavation in all materials, bedding and backfilling (including importation of suitable material if required), disposal of surplus materials, supply and installation of a junction with the erf connection entering the main sewer line flush with the soffit of the main sewer, a 45 degree bend and the end cap.

The tendered sum for item C2.3.8.3 shall cover the cost of adapting a standard manhole to accommodate the erf connection pipe and the supply and installation of the end cap.

The tendered sum for item C2.3.8.4 shall include full compensation for excavation, making an opening in the existing manhole, installing new pipes in the new opening, for breaking out and modifying the channelization inside the manhole to suit the new pipe layout, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material and debris, all labour and equipment required to make the connection, and liaison with the local authorities.

The tendered sum for item C2.3.8.5 shall include full compensation for excavation, building a new manhole over the sewer, breaking into the existing sewer, building the channelization under wet conditions, ensuring the water tightness of the new connection, supplying all the necessary materials, removing surplus material, all labour and equipment required to make the connection, and liaison with the local authorities but excluding the cost of the cover and frame.

Item	Description	Unit
C2.3.9	Raising and lowering existing sewer manholes	
C2.3.9.1	Raising manholes	
(a)	State manhole type and drawing reference and height raised	number (No)
(b)	State manhole type and drawing reference and height raised	number (No)
C2.3.9.2	Lowering manholes	
(a)	State manhole type and drawing reference and height lowered	number (No)

Item	Description	Unit
C2.3.9	Raising and lowering existing sewer manholes	
	(b) State manhole type and drawing reference and height lowered	number (No)

The unit of measurement for items C2.3.9.1 and C2.3.9.2 shall be the number of manholes raised or lowered as specified or shown on the drawings.

The tendered rates shall include full compensation for all the labour, construction equipment and materials required to raise or lower the manholes as specified including removing the cover and frame, demolishing the top of the manhole if required, rebuilding the manhole and setting and grouting the cover and frame to the new level specified.

Item	Description	Unit
C2.3.10	Testing of sewer manholes	number (No)

The unit of measurement shall be the number of manholes tested and passed, irrespective of the depth and type of manhole.

The tendered rate shall include full compensation for all labour, construction equipment and materials necessary, including the supply and disposal of water and for carrying out the tests as specified.

Item	Description	Unit
C2.3.11	CCTV camera inspections	
C2.3.11.1	State pipe diameter	metre (m)
C2.3.11.2	State pipe diameter	metre (m)

The unit of measurement shall be the metre of each diameter of sewer inspected by CCTV camera and which has met the specified tolerances.

The tendered rates shall include full compensation for the provision of all labour, equipment and materials required for the provision, installation, calibration and operation of the equipment used for inspecting the pipeline and the provision of a report and pipeline profile in the agreed electronic or hard format.

Note:

Pay items C2.3.12 to C2.3.20 have been deliberately left for use for additional contract specific sewer related pay items inserted via the Contract Documentation.

Measurement and Payment Items for Water Mains (Items C2.3.21 to C2.3.36)

(i) *Corrosion protection*

The rates for pipes, valves, specials and couplings for items C2.3.21 to C2.3.26 shall also cover the cost of mortar lining and sheathing, mortar encasing, wrapping and all other corrosion protection as may be specified. The rates shall also cover the costs of all measures deemed necessary to safeguard the specified protection against any damage during transportation, stacking, storage, installation and bedding and backfilling etc and the rates shall also cover the costs of any repairs required as a result of any such damage.

(ii) *Temporary Valves etc*

Payment for the supply or loan of temporary valves, end caps, blank flanges, or other isolating devices ordered by the Engineer in terms of Clause 5.3.1.1 of SANS 2001-DP2 will be made at daywork rates or at rates to be agreed by the Engineer, unless the method of payment for the work has been dealt with in the Contract Documentation and a suitable special item included in the schedule.

Item	Description	Unit
C2.3.21	Supply and lay water mains complete with couplings	
C2.3.21.1	State for each water main the pipe material type, class, coupling type and the class of bedding etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)
C2.3.21.2	State for each water main the pipe material type, class, coupling type and the class of bedding etc.	
(a)	State diameter	metre (m)
(b)	State diameter	metre (m)
C2.3.21.3	Etc., insert additional items as required	

The unit of measurement shall be the metre of water main pipe supplied and laid measured linearly on slopes as laid. No deductions will be made for specials or valves.

The tendered rates shall include full compensation for procuring, furnishing and laying the pipes complete with couplings, including handling, inspecting, transporting, laying, jointing, bedding, cutting and testing the pipes as specified, but excluding excavation, provision of bedding material and backfilling which shall be measured and paid for under the relevant items.

Item	Description	Unit
C2.3.22	Extra over item C2.3.21 for supplying and fixing water main fittings or specials complete with couplings	
C2.3.22.1	State for each water main fitting or special the type, class etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.22.2	State for each water main fitting or special the type, class etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.22.3	Etc., insert additional items as required	

The unit of measurement shall be the number of water main fittings or specials, complete with couplings, installed.

The tendered rates shall be full compensation for procuring, furnishing, laying, handling, fixing, inspecting, transporting, bedding and jointing and testing the fittings or specials including couplings and including the cost of cutting of pipes.

No extra payment over and above the rates will be made in respect of any additional cutting, turning, and jointing of pipes required for the location of specials etc. in the positions given on the drawings. Unless specific provision is made in the schedule, no separate payment will be made for the supply and fitting of any additional joints and jointing materials which may be required for the connection of shortened pipe lengths.

Item	Description	Unit
C2.3.23	Extra over item C2.3.21 for supplying and fixing water main valves	
C2.3.23.1	State for each water main valve the type, class etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.23.2	State for each water main valve the type, class etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.23.3	Etc., insert additional items as required	

The unit of measurement shall be the number of valves installed.

The tendered rates shall be full compensation for procuring, furnishing, laying, handling, fixing, inspecting, transporting, bedding and jointing and testing the valves including couplings and including the cost of cutting of pipes.

No extra payment over and above the rates will be made in respect of any additional cutting, turning, and jointing of pipes required for the location of valves, etc. in the positions given on the drawings. Unless specific provision is made in the schedule, no separate payment will be made for the supply and fitting of any additional joints and jointing materials which may be required for the connection of shortened pipe lengths.

Item	Description	Unit
C2.3.24	Extra over item C2.3.21 for cutting of pipes and the supplying and fixing of extra couplings	
C2.3.24.1	State for each water main the pipe material type and coupling type	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.24.2	State for each water main the pipe material type and coupling type	
(a)	State diameter	number (No)
(b)	State diameter	number (No)

C2.3.24.3 Etc., insert additional items as required

The unit of measurement shall be the number of pipes cut.

The tendered rates shall include full compensation for the cutting of the pipe and of supplying and fitting the additional coupling and, if required by the Engineer, the delivery of unused off-cuts to the Employer's office or store.

Item	Description	Unit
C2.3.25	Extra over items C2.3.21, C2.3.22 and C2.3.23 for supplying and installing joints with machined collars and special couplings	
C2.3.25.1	State for each water main the pipe collar and special coupling type	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.25.2	State for each water main the pipe collar and special coupling type	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.25.3	Etc., insert additional items as required	

The unit of measurement shall be the number of machined collars and special couplings supplied and installed.

The tendered rate shall cover the additional cost of providing pipes with machined collars and slip-on couplings as scheduled and of installation complete as specified.

Item	Description	Unit
C2.3.26	Supplying and installing pipes, specials and valves on short pipe runs	
C2.3.26.1	State for each short run water main the pipe material type, class and class of bedding etc.	
(a)	State pipe diameter and length	metre (m)
(b)	State pipe diameter and length	metre (m)
C2.3.26.2	State for each short run water main the fitting, bend or special type, class etc.	
(a)	State diameter	number (No)
(b)	State diameter	number (No)
C2.3.26.3	Etc., insert additional items as required	

Short pipe runs that include frequent bends or other specials, or both (as, for instance, for a deviation of a water main under a road or round a bridge) will be measured in terms of the quantities of scheduled items such as bends, tees, reducers, valves, and stated lengths (or stated approximate lengths) of straight pipe. The unit of measurement for pipes shall be the metre of water main pipe supplied and installed. The unit of measurement for specials or valves installed shall be the number installed.

The tendered rates shall include full compensation for the provision of each pipe, special, and valve and, as applicable, the fixing anchoring, or bedding of them in the manner required in terms of the Contract Documentation. The tendered rates shall exclude excavation, provision of bedding material and backfilling which shall be measured and paid for under the relevant pay items.

Item	Description	Unit
C2.3.27	Extra over item C2.3.21 for encasing (wrapping) joints	
C2.3.27.1	State for each water main the number of joints to be encased (wrapped)	
(a)	State diameter	number (No)
(b)	State diameter	number (No)

Where steel or ductile iron fittings and joints are to be subject to corrosive soil conditions and the Contract Documentation indicates that they have to be treated in accordance with the note included in Clause 4.1.18 of SANS 2001-DP2 the unit of measurement shall be the number of joints encased as specified.

The tendered rates shall include full compensation for procuring and furnishing the materials and for all the construction equipment and labour required to encase the joints as specified.

Item	Description	Unit
C2.3.28	Installation of hydrants and water meters	
C2.3.28.1	Describe hydrant type	number (No)
C2.3.28.2	Describe water meter type	number (No)
C2.3.28.3	Etc., insert additional items as required	number (No)

The unit of measurement shall be the number of hydrants, water meters or other special items supplied and installed.

The tendered rate for the installation of hydrants shall cover the cost of the supply and installation of all materials from and including the tee (and its joints) on the main up to and including the hydrant outlet. The pipes required will be measured separately. The tendered rates shall exclude anchor blocks and any covers and frames which will be measured separately.

The tendered rate for the installation of water meters shall cover the supply and installation of the water meters including all reducers, adaptors, couplings and other fittings required to complete the installation on the specified size of pipeline.

Item	Description	Unit
C2.3.29	Bedding for water mains (Class B and C) and fill blanket compacted to 90 % of MDD (100 % for sand)	
C2.3.29.1	Bedding using selected granular material	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources	cubic metre (m ³)
C2.3.29.2	Selected fill blanket material	
(a)	From the excavated trench material	cubic metre (m ³)
(b)	From other excavations on Site	cubic metre (m ³)
(c)	From approved borrow areas	cubic metre (m ³)
(d)	From sources provided by the Contractor	cubic metre (m ³)
(e)	From commercial sources	cubic metre (m ³)
C2.3.29.3	Extra over items C2.3.29.1(a) to C2.3.29.1(c) and C2.3.29.2(a) to C2.3.29.2(c) for screening material	cubic metre (m ³)

The unit of measurement for items C2.3.29.1 and C2.3.29.2 shall be the cubic metre of bedding or fill blanket material in place after compaction and the quantity shall be calculated from the specified dimensions of the bedding and blanket as specified or authorised by the Engineer. The volume occupied by the pipes shall be subtracted when calculating the volume of bedding.

The unit of measurement for pay C2.3.29.3 shall be the cubic metre of bedding or blanket material screened as instructed by the Engineer and in place after compaction. The quantity measured shall be increased by including 70 % of the loose volume, measured in stockpile, of the material screened out and discarded.

The tendered rates shall include full compensation for procuring and furnishing the bedding or fill blanket material and placing the material alongside and under the pipes and for watering and compacting the bedding or blanket material. The tendered rates for items C2.3.29.1(b), C2.3.29.1(c), C2.3.29.2(b) and C2.3.29.2(c) shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on Site or from a borrow pit, for hauling the material within the haul limit of 1.0km and for unloading the material for placement. The tendered rate for items C2.3.29.1(c) and C2.3.29.2(c) shall include full compensation for all operations at borrow pits not subject to any specified separate pay item.

The tendered rates for items C2.3.29.1(d), C2.3.29.1(e), C2.3.29.2(d) and C2.3.29.2(e) shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

The tendered rate for item C2.3.29.3 shall include full compensation for the additional handling and transport necessary, for screening the material and for disposing of the material screened out.

Trench backfill (above the fill blanket) will be measured and paid under separate items.

Item	Description	Unit
C2.3.30	Concrete for bedding (Class A) and encasement for water mains	
C2.3.30.1	Concrete (Class A) bedding (state class of concrete)	cubic metre (m ³)
C2.3.30.2	Concrete encasement (state class of concrete)	cubic metre (m ³)

The unit of measurement shall be the cubic metre and the quantity shall be calculated from the dimensions of the excavation as shown on the drawings or as specified or authorised by the Engineer, irrespective of whether the actual excavation exceeds the specified or authorised dimensions, less the volume occupied by the pipes.

The tendered rate shall include full compensation for procuring, furnishing and placing all materials, formwork and pedestals and for all the labour and construction equipment necessary to complete the work as specified. The tendered rate shall also include full compensation for forming any specified and/or construction joints that may be required.

Item	Description	Unit
C2.3.31	Manholes, valve and hydrant chambers etc. for water mains	
C2.3.31.1	Manholes (state type and drawing references etc.)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.31.2	Valve chambers (state valve type (gate valve, single or double air valve etc.) and drawing references etc.)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.31.3	Hydrant chambers (state type etc. and drawing references etc.)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)
C2.3.31.4	Other structures (state type etc. and drawing reference etc.)	
(a)	State pipe size and depth range	number (No)
(b)	State pipe size and depth range	number (No)

The unit of measurement shall be the number of manholes, valve and hydrant chambers or other structures completed as specified.

Separate items will be scheduled for manholes, valve or hydrant chambers etc. of each type and of each depth in increments of 0,5 m. The tendered rate shall cover the cost of construction of manholes, valve and hydrant chambers etc. complete in accordance with the details indicated in the Contract Documentation. The cost of dealing with any excavation (in all materials including disposal of surplus) and backfilling with suitable material (including import of material if required) will be measured under the relevant items.

The depth category of manholes and chambers etc. shall be measured as the difference between the cover level and the deepest invert level of the structure.

The tendered rates shall include full compensation for all the labour, construction equipment and materials required to complete the manholes, valve and hydrant chambers or other structures completed as specified but excluding excavation and backfilling and excluding the provision and installation of covers and frames which shall be measured and paid for under the relevant items.

Item	Description	Unit
C2.3.32	Covers and frames for water main manholes, valve and hydrant chambers and other structures	
C2.3.32.1	Describe manhole or chamber and state type of cover and frame	number (No)
C2.3.32.2	Describe manhole or chamber and state type of cover and frame	number (No)
C2.3.32.3	Describe manhole or chamber and state type of cover and frame	number (No)
C2.3.32.4	Etc., insert additional items as required	number (No)

The unit of measurement shall be the number of covers and frames supplied and installed.

The tendered rates shall include full compensation for the manufacture, delivery and installation of the covers and frames complete as specified in the Contract Documentation.

Item	Description	Unit
C2.3.33	Water main accessories (anchor or thrust blocks, pedestals or marker posts etc.)	
C2.3.33.1	Anchor or thrust blocks (state type and drawing reference)	number (No)
C2.3.33.2	Anchor or thrust blocks (state type and drawing reference)	cubic metre (m ³)
C2.3.33.3	Pedestals (state type and drawing reference)	number (No)
C2.3.33.4	Pedestals (state type and drawing reference)	cubic metre (m ³)
C2.3.33.5	Marker posts or blocks (state type and drawing reference)	number (No)
C2.3.33.6	Other accessories	
(a)	State type	number (No)
(b)	State type	number (No)

The unit of measurement for items C2.3.33.1, C2.3.33.3, C2.3.33.5 and C2.3.33.6 shall be the number of anchor or thrust blocks, pedestals or marker posts or blocks or other accessories supplied and installed. The unit of measurement for items C2.3.33.2 and C2.3.33.4 shall be the cubic metre of concrete placed.

Items C2.3.33.1 and C2.3.33.3 will be used where thrust blocks or pedestals are the same size and where detail drawings are provided for each size or type scheduled. Items C2.3.33.2 and C2.3.33.4 will be used where the thrust blocks or pedestals vary in size but the relationship between the area of formwork and the volume of concrete is reasonably consistent.

The tendered rates for item C2.3.33.1, C2.3.33.2, C2.3.33.3, C2.3.33.4 and C2.3.33.6 shall include full compensation for all the labour, construction equipment and materials required to complete the anchor or thrust blocks, pedestals or other accessories complete as specified in the Contract Documentation. The tendered rate for item C2.3.33.5 shall include full compensation for manufacturing, installing and painting the marker posts or blocks as specified and submitting to the Engineer the records of all the marker posts or blocks.

Item	Description	Unit
C2.3.34	Connections to existing water mains	
C2.3.34.1	State connection details	number (No)
C2.3.34.2	State connection details	number (No)
C2.3.34.3	State connection details	number (No)
C2.3.34.4	Etc., insert additional items as required	number (No)

Connections to existing water mains will be measured by the number of connection points.

The tendered rates shall include full compensation for the cost of locating, exposing and backfilling the water main, liaising with the authority concerned to arrange for turning off the water, cutting into the pipe, dealing with water, cutting pipes to fit, including turning if necessary, and the supply and fitting of long collar repair couplings to complete the connection and, if required, the temporary sealing and anchoring of pipe ends for testing purposes and subsequent removal of seals and anchors. The specials required to make the connection will be measured separately.

Item	Description	Unit
C2.3.35	Raising and lowering existing manholes or valve or hydrant chambers	
C2.3.35.1	Raising manholes or valve of hydrant chambers	
(a)	State manhole type and drawing reference and height raised	number (No)
(b)	State manhole type and drawing reference and height raised	number (No)
C2.3.35.2	Lowering manholes or valve or hydrant chambers	
(a)	State type and drawing reference and height lowered	number (No)
(b)	State type and drawing reference and height lowered	number (No)

The unit of measurement for items C2.3.35.1 and C2.3.35.2 shall be the number of manholes or valve or hydrant chambers raised or lowered as specified or shown on the drawings.

The tendered rates shall include full compensation for all the labour, construction equipment and materials required to raise or lower the manholes or valve or hydrant chambers as specified including removing covers and frames, any demolition required, rebuilding and setting and grouting the covers and frames to the new levels specified. This pay item does not cover the costs of the lowering of pipes.

Item	Description	Unit
C2.3.36	Disinfection of potable water pipelines	
C2.3.36.1	State diameter of pipe disinfected	metre (m)
C2.3.36.2	State diameter of pipe disinfected	metre (m)
C2.3.36.3	Etc., insert additional items as required	metre (m)

The unit of measurement shall be the metre of potable water pipeline disinfected as specified.

The tendered rate shall include full compensation for all labour, construction equipment, chemicals and other materials necessary for disinfecting pipes as specified. Where pipes have to be disinfected more than once due a fault of the Contractor, the cost of the additional water required shall be for the Contractor's account.

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D2.3 WET SERVICES

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

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- D2.3.2 GENERAL**
- D2.3.3 PERFORMANCE GUARANTEE REQUIREMENTS**
- D2.3.4 FUNCTIONAL PERFORMANCE ASSESSMENTS**
- D2.3.5 VISUALLY ASSESSED PROPERTIES**
- D2.3.6 INSTRUMENTALLY ASSESSED PROPERTIES**
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- D2.3.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE**
- D2.3.9 NOTIFICATION OF REMEDIAL WORK**
- D2.3.10 REMEDIAL WORKS**

D2.3.1 SCOPE

Refer to Clause D2.1.1.

There are no specific items in this Section.

Where applicable, details are provided in the Contract Documentation.

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A2.4 ENERGY AND OTHER SERVICES

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PART B: LABOUR ENHANCEMENT

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PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

PART A: SPECIFICATIONS

A2.4.1 SCOPE

Section A2.4 of Chapter 2 covers the civil construction work associated with the installation in road reserves of street lighting and electric power and other energy services (gas and fuel pipelines) and any other types of services (not dealt with elsewhere in Chapter 2) as specified in the Contract Documentation.

It should be noted that Section A2.4 of Chapter 2 only covers excavation and backfilling work for electric power and street lighting services. The section does not cover the supports (poles, struts, stays, pylons, gantries etc.) or the cables or other electric plant associated with such infrastructure which would be installed by specialist contractors or subcontractors with the appropriate skills, experience and equipment required to do such work.

Work on certain energy (gas and fuel pipelines and higher voltage (HV, EHV and UHV)) services, due to their nature, is specialised and therefore few standard specifications and conditions are considered to be applicable to such work. All energy services shall therefore be installed at the locations shown, and in accordance with, the specifications and details shown on the drawings or provided in the Contract Documentation or as directed by the Engineer.

The purpose of Section A2.4 is therefore partly to provide a structured framework for the Contract Documentations for civil construction work related to energy services or any other types of services not dealt with elsewhere in Chapter 2.

A2.4.1.1 Applicable supporting specifications

Section A2.4 of Chapter 2 shall be used in conjunction with, amongst others, the following standards or specifications:

SANS 4437-1	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 1: General
SANS 4437-2	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 2: Pipes
SANS 4437-3	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 3: Fittings
SANS 4437-5	Plastics piping systems for the supply of gaseous fuels- Polyethylene (PE) Part 5: Fitness for purpose of the system
SANS 10198-5	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 5: Determination of thermal and electrical resistivity of soil
SANS 10198-8	The selection, handling and installation of electric power cables of rating not exceeding 33 kV Part 9: Cable laying and installation
SANS 10225	The design and construction of lighting masts
SANS 10280	Overhead power lines for conditions prevailing in South Africa
SANS 10280-1	Overhead power lines for conditions prevailing in South Africa Part 1: Safety
ISO/TS 10839	Polyethylene pipes and fittings for the supply of gaseous fuels - Code of practice for design, handling and installation

Where the documents referenced are undated the latest edition of the referenced document (including any amendments) shall apply. Where references are dated only the edition cited shall apply.

In certain SANS documents referred to in this section the term "specified in the scope of work" is used. For the purposes of this specification the term shall be deemed to mean "specified in the Contract Documentation".

A2.4.2 DEFINITIONS

The following definitions shall apply to these specifications:

Extra high voltage (EHV) - The set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range 220 kV < U_n < 400 kV.

Fuel - See *Gas and Fuel*.

Gas and fuel - Any hydrocarbon gas fuel transported by pipeline.

Gaseous fuel - Fuel which is in a gaseous state at a temperature of 15°C and a pressure of 1 bar.

High voltage (HV) - The set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range 44 kV < U_n < 220 kV.

Low voltage (LV) - The set of nominal voltage levels that are used for the distribution of electricity and whose upper limit is generally accepted to be an a.c. voltage of 1 000 V (or a d.c. voltage of 1 500 V). Note that in certain fields of technology, for example electric motors and mining, voltages up to and including 1 100 V are traditionally regarded as low voltage.

Medium voltage (MV) - The set of nominal voltages that lie above low voltage and below high voltage in the range 1 kV < U_n < 44 kV.

Ultra-high voltage (UHV) - The set of nominal voltage levels that are used in power systems for bulk transmission of electricity in the range U_n > 400 kV.

A2.4.3 GENERAL

The location, identification, protection and relocation of existing services, unknown or unrecorded services shall be managed in accordance with Clause A2.1.3.2.

A2.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The requirements of Clause A2.1.4 shall be applicable.

A2.4.5 MATERIALS

A2.4.5.1 General

All materials for energy services or other types of services (not specified elsewhere in Chapter 2 or in this Section) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.5.2 Bedding for electric power cables

Only sandy clay or loam soil with an acceptable thermal resistivity (not exceeding 1.2K.m/W determined in accordance with SANS 10198-5) shall be used for bedding for electric power cables. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher dust/sand is acceptable. The maximum aggregate size for bedding material shall be 5 mm and, if required, bedding material shall be sieved to meet that requirement. Where no suitable bedding material is available on Site, the Contractor shall import material from other sources and make all the necessary arrangements to do so.

A2.4.5.3 Backfill for electric power cables

Backfill for electric power cables, unless otherwise specified in the Contract Documentation, shall be a material that complies with the requirements of Clause A2.1.5.1.

A2.4.5.4 Electric power warning tape

All cables shall be covered with a continuous brightly coloured corrosion proof (PVC or PE) electrical warning tape. The tape shall have a minimum thickness of 0,8 mm and a minimum width of 150 mm. The tape shall be yellow, marked with the words "ELECTRIC CABLE / ELEKTRIESE KABEL" in red letters at least 70 mm in height. These markings shall not be more than 0,5 m apart.

A2.4.5.5 Electric power concrete slab protection

Where indicated in the Contract Documentation concrete protective slabs shall be installed on electric power cable bedding, approximately 100 mm above MV cables, and shall be a minimum 300 mm wide and 50 mm thick. The slabs shall be constructed of class C16/20-14 concrete. Each slab shall be reinforced with 8,0 mm diameter mild steel bars with at least two longitudinal bars per 300 mm wide slab and transverse bars at a maximum 200 mm spacing.

A2.4.5.6 Electric power cable markers

Unless otherwise indicated in the Contract Documentation cable markers shall consist of concrete blocks in the shape of truncated pyramids, approximately 300 mm high, 150 x 150 mm at the top and 250 x 250 mm at the bottom. Recessed letters, a minimum of 50 mm high, shall be cast into the tops of the blocks with the wording "ELECTRIC CABLE" as well as direction arrows and the cable voltage rating.

A2.4.5.7 Polyethylene pipes for gaseous fuels

Unless otherwise indicated in the Contract Documentation when polyethylene pipes are used for the supply of gaseous fuels they shall comply with the requirements of SANS 4437-1, 4437-2, 4437-3 and 4437-5.

A2.4.6 CONSTRUCTION EQUIPMENT

A2.4.6.1 General

All equipment for the construction of energy services or other types of services (not dealt with elsewhere in Chapter 2) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.6.2 Other requirements

The specified requirements in Clause A2.1.6 shall apply to construction equipment used for the installation of energy services.

A2.4.7 EXECUTION OF THE WORKS

A2.4.7.1 General

All construction of energy services or other types of services (not dealt with elsewhere in Chapter 2), unless specified otherwise in Section 2.4, shall be in accordance with the standards or specifications indicated in the Contract Documentation.

Except as indicated in Clause A2.4.7.2 the requirements of Clause A2.1.7 shall apply mutatis mutandis to the installation of electric power cables.

Electric cable installation shall comply with the requirements of SANS 10198-8.

The specialist electrical or communications contractor or subcontractor shall be attendance during all critical trenching, bedding, backfilling or compaction activities.

A2.4.7.2 Trenching for electric power cables

a) Excavation

Trenches shall be excavated in straight sections as shown on the drawings or as instructed by the Engineer and shall be excavated to the dimensions indicated in this specification. The bottom of the trench shall be of smooth contours and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling. Where levels are not specified the level of the bottom of the trench shall follow the contours of the final ground level. Where the excavation is in excess of the required depth the excavation shall be backfilled and compacted with approved material to the required depth. Prior to cable laying the trench shall be inspected thoroughly and all objects likely to cause damage to the cables during or after laying shall be removed.

Where ground conditions are likely to reduce the maximum current carrying capacities of cables or adversely affect cable insulation or where the cables are likely to be subjected to chemical or other damage or electrolytic action e.g. soil drenched with hydrocarbon based solvents such as oil, the Engineer shall be notified before installing the cables so that the Engineer can issue any necessary instructions.

b) Trench dimensions

(i) Trench width

The width for cable trenches shall be as specified in the Contract Documentation.

The minimum trench width for cables shall be 450 mm. The specified width shall apply to the total trench depth. The width shall be increased where more cables are installed to allow for the spacings stipulated in Clause A2.4.7.2b)(iii) with the minimum trench width allowing for a working space on each side of the cables measured between the centre of the outside cables and the side of the trench. Unless otherwise indicated in the Contract Documentation the working space width shall be 200 mm.

Where trenches change direction or where cable slack is to be accommodated, the Contractor shall ensure that the requirements of the relevant specification regarding the bending radii of cables are met when determining trench widths.

Excavations in excess of the predetermined widths will not be measured for payment and excavations narrower than these widths will only be allowed with the written approval of the Engineer.

(ii) Trench Depth

Trench depths shall be determined in accordance with cable laying depths and bedding thickness.

Unless otherwise indicated in the Contract Documentation cables shall be installed at the following minimum depths below final ground level:

Table A2.4.7-1: Minimum telecommunication and electric power cable depths

Cable Type	Minimum Installation Depth
Telecommunication cables	600 mm
Low voltage (LV) services cables	800 mm
Low voltage (LV) feeder cables	800 mm
Medium voltage (up to 11 kV)	1000 mm
Medium voltage (greater than 11 kV)	1200 mm

Other voltages and cable types	In accordance with the Contract Documentation
All voltages and cable types where, due to security reasons, concrete bedding or other protection is specified	1000 mm

All cable depth measurements shall be made to the top of the cable when laid directly in ground or to the top of the duct or sleeve where these are provided. The above depths shall apply to the top layer where cables are installed in layers. The Contractor may only deviate from the above depths provided prior authority in writing has been obtained from the Engineer. In the event that the minimum depths cannot be achieved the cables shall be protected with a suitable concrete covering.

The depth of cable ducts or pipes beneath railway lines or roads shall be not less than 1,1 m below the formation or road level as applicable.

Trenches shall be excavated to a total depth which take into account the bedding thickness requirements indicated in Clause A2.4.7.3.

(iii) *Cable spacing*

Cables installed in the same trench shall be laid parallel to each other with the following minimum spacings between cables (for the purposes of the list below MV refers to voltages up to 11kV).

Table A2.4.7-2: Minimum electric power cable spacings

Cable Type	Minimum Cable Spacing
LV/LV	2 cable diameters (minimum 25 mm)
LV/MV	150 mm
MV/MV	200 mm
LV/MV/PILOT	1 cable diameter

Where MV and LV cables have to be installed in the same trench, both shall be laid at a depth of 800 mm and then covered with 200 mm of bedding material. The bedding shall then be placed and compacted and the trench then backfilled and compacted layer by layer.

Cables for telephones, communication systems and other low voltage systems (less than 50V) shall be separated from power cables by at least 1,0 m horizontally. All control or pilot cables without a lead sheath and steel armouring shall be laid at least 300 mm from power cables.

Cables shall not be installed on top of each other unless separating layers are specified. The minimum spacing between layers shall be 200 mm. Where cables are to be installed on top of each other the work shall be done in accordance with the details provided in the Contract Documentation.

Cable laying shall be planned so that as far as possible cables do not cross each other. Where crossing is unavoidable, a vertical separation of not less than 150 mm shall be provided for cables of the same voltage and of 300 mm for cables of differing voltage.

A2.4.7.3 Bedding for electric power cables

The bottom of the trench shall be filled across the full width with a layer of bedding material and levelled off. After cable laying a further layer of bedding shall be placed above the cable. The bedding under joints shall be fully consolidated to prevent subsequent settling.

Normal bedding thicknesses for electric cables shall be as follows (unless otherwise stated the dimension indicated is the bedding thickness required above and below the cable/s):

Table A2.4.7-3: Bedding thickness for electric power cables

Cable Type	Minimum Bedding Thickness
MV and LV cables in soft earth	75 mm
MV cables in other conditions (gravel / hard rock)	150 mm
LV kiosk feeder cables in other conditions (gravel / hard rock)	150 mm
LV service connection cables in other conditions (gravel / hard rock)	150 mm (above) 100 mm (below)

Refer to Clause A2.4.7.7 where security risks dictate the use of concrete bedding.

A2.4.7.4 Backfilling for Electric Power Cables

The Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be inspected. Such an inspection will not be unreasonably delayed. Should the Contractor fail to give a timeous notification, the trenches shall be re-opened at the Contractor's cost.

All loose stones or any other materials likely to cause damage to cables shall be removed from trenches or from any excavated material that may be used for backfill, before backfilling commences.

Backfilling of trenches shall be in layers not exceeding 150 mm thick. Compaction of backfill shall achieve the following field densities:

- In areas not subject to vehicular traffic loads 90 % of MDD
- In areas subject to vehicular traffic loads 93 % of MDD

Backfilling across grassed or landscaped areas may be in layers of 300 mm thickness. Removal and replacement of plants, shrubs, grass, etc. including care until growth is re-established, may be required. After completion of the work the route of the trench shall be neatly finished off and cleared. All stones bigger than 25 mm, as well as all loose organic material and rubble, shall be removed.

Where trenches cross a road carriageway and/or footways the reinstatement of the pavement layers and surfacing shall be in accordance with the requirements of Clause A2.1.7.2.

A2.4.7.5 Electric power cable warning tape

All cables shall be covered with an electrical warning tape. The tape/s shall cover all the cables installed in a trench. Where two tapes are laid side by side they shall overlap by at least 20 mm. The warning tapes shall be installed 400 mm above the upper cable in a trench.

A2.4.7.6 Electric power cable concrete slab protection

Where the minimum installation depths cannot be achieved due to the crossing of other services and the service cannot be crossed underneath cables must be protected by additional slabs in accordance with SANS 10198-8.

Where cables cross other services such as water pipes and sewage pipes or where it is possible that the cable may be damaged as a result of excavation by others, the cable shall be protected by means of reinforced concrete slabs.

The slabs shall protect the cable for a distance of 1,0 m on either side of the crossing or vulnerable area.

The slabs shall be installed 150 mm above the cables to be protected.

A2.4.7.7 Electric power cable concrete bedding

Cables installed in a road reserve, where the risk of cable theft is considered to be significant, shall, if specified in the Contract Documentation, be encased in class C16/20-20 concrete. The bottom of the trench must be filled with a 150 mm thick concrete layer, the cable installed while the concrete is still wet, and then the cable covered with a further 150 mm thick concrete layer. The concrete must extend all the way to inside the pole or kiosk where the cables terminate.

A2.4.7.8 Electric power cable markers

Cable markers shall, if specified in the Contract Documentation, be provided along cable routes. Cable markers, where specified, shall be installed on the surface along the underground routes and shall project 35 mm above normal ground level unless the projected markers could be a hazard to pedestrian or other traffic in which case they shall be installed flush with the surface. Cable markers shall be installed at the beginning and end of a cable run (e.g. where a cable enters a substation or building), at all changes of direction, above all joints, above cable duct entries and exits and at intervals not exceeding 50 m along the cable route. The position of cable markers shall be indicated on the record drawings.

A2.4.7.9 Steel supporting structures

Steel supporting structures for lighting and other energy services, such as lighting masts on concrete median barriers shall be carried out in accordance with the requirements of the Contract Documentation and in accordance with the applicable sections of this standard specification. All work shall adhere to the specified levels, alignments and tolerances.

A2.4.7.10 Overhead power lines

Overhead power lines shall be constructed in accordance with the requirements of SANS 10280 and SANS 10280-1.

A2.4.7.11 Polyethylene pipes for gaseous fuels

Unless indicated otherwise in the Contract Documentations or indicated on the drawings polyethylene pipes for gaseous fuels shall be installed in accordance with the requirements of ISO/TS 10839.

A2.4.8 WORKMANSHIP

The requirements of Clause A1.2.8 of Chapter 1 shall apply to the process and acceptance quality control for all services work dealt with in Section A2.4.

The Engineer may, at his discretion, elect to use some of the Contractor's process control test results if the Engineer is satisfied that the Contractor's process control requirements are acceptable for acceptance quality control purposes.

The requirements of Clause A1.2.3.14 of Chapter 1 shall apply to any remedial work required where any work or material does not comply with the specified requirements.

A2.4.8.1 General

The quality of materials and workmanship for energy services or other types of services (not dealt with elsewhere in Chapter 2) shall be in accordance with the standards or specifications indicated in the Contract Documentation.

A2.4.8.2 Tolerances

The excavation, backfilling and bedding for the installation of cables shall be controlled in line and level to ensure that the cable/s installed meet all statutory or specified cable depth, cover and clearance requirements.

A2.4.8.3 Lighting Poles

The tolerances for the installation of free-standing masts for lighting shall comply with the requirements of Clause 7.11 of SANS 10255. Testing shall comply with the requirements of Clause 7.12 of SANS 10255.

B2.4 ENERGY AND OTHER SERVICES

PART B: LABOUR ENHANCEMENT

CONTENTS

PART B: LABOUR ENHANCEMENT

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B2.4.7	EXECUTION OF THE WORKS
B2.4.8	WORKMANSHIP

B2.4.1 SCOPE

Apart from the scope for labour enhancement as described under Section B2.1, no additional scope for labour enhancement is defined under Section B2.4 for Energy and Other Services.

B2.4.2 DEFINITIONS

Definitions as provided in A2.4.2 apply.

B2.4.3 GENERAL

Any activity specified in Part A where hand work is given as an alternative, shall be executed in such a way as to maximise labour.

B2.4.4 DESIGN BY CONTRACTOR / PERFORMANCE BASED SYSTEMS

The provisions of Part A shall apply.

B2.4.5 MATERIALS

The provisions of Part A shall apply.

B2.4.6 CONSTRUCTION EQUIPMENT

The provisions of Part A shall apply.

B2.4.7 EXECUTION OF THE WORKS

The provisions of Part A shall apply.

B2.4.8 WORKMANSHIP

The provisions of Part A shall apply.

C2.4 ENERGY AND OTHER SERVICES

PART C: MEASUREMENT AND PAYMENT

Part C2.4 should be used in conjunction with Part C2.1 where items are provided to cover the excavation and backfilling of trenches and other associated works not included below.

(i) Preamble

The tendered rate for each pay item shall include full compensation for providing, operating, maintaining and decommissioning upon completion, of all the construction equipment, labour, tools, incidentals and supervision to carry out the activity or construct the works in the pay item as specified, unless otherwise stated.

Any prime cost or provisional sums shall be paid in accordance with the provisions of the conditions of contract. The charge or mark-up tendered or allowed for is a percentage of the amount actually paid under the prime cost or provisional sum. This percentage shall cover all the Contractor's handling, supervision, profit and liability costs to provide the services in the prime cost or provisional sum item.

The requirements of Clauses C1.1.1, C1.1.2, C1.1.3 and C1.1.4 of Chapter 1 shall apply.

Where pay item Descriptions include any wording in *italics* it is an indication that contract specific information is to be inserted in the Pricing Schedule included in the Contract Documentation.

(ii) Notes on measurement and pay items

Wherever volumetric measurement is required, the volume will be computed from the applicable depths or layer thicknesses and using the authorised width (*W*) determined in accordance with the specification.

(iii) Items that will not be measured separately

The following activities, whether required to complete the specified work or not, will not be measured and paid for separately and the Contractor shall include the cost thereof in other pay items as the Contractor deems appropriate:

1. No separate payment will be made for setting out the works.
2. No separate payment will be made for the protection or repair as required of any existing or new road furniture, structures, buildings, infrastructure or services damaged by the Contractor's activities.
3. No additional payment shall be made, nor shall any claim for additional payment be considered, for any specified work in confined or restricted areas. Any additional costs associated with working in confined or restricted areas shall be deemed to be included in the standard applicable pay items.
4. No separate payment will be made for the loading of any materials.
5. No separate payment will be made for the hauling of all materials where the material is moved over a distance of less than, and up to, 1,0 km.
6. No separate payment will be made for transporting materials from commercial sources irrespective of the haul distance.
7. No separate payment will be made for the removal of any surplus material imported to complete the works.

(iv) Items to be Measured and Paid for Using Items Specified Elsewhere in the Specifications

For activities in Table C2.4-1 pay items specified in other Chapters or Sections of the specifications, where they relate to work under this section, will be listed in the Pricing Schedule.

Table C2.4-1: Items from other Chapters or Sections

Activity	Section 2.4 Clause Reference	Section - Item Reference
Removal and conservation of topsoil	C2.4.1	Section C1.7 of Chapter 1 - All applicable items
Hauling materials	C2.4.1	Section C1.7 of Chapter 1 - All applicable items
Borrow and spoil areas: <ul style="list-style-type: none"> • Opening and closing down • Excess overburden • Rehabilitation 	C2.4.1	Section C4.1 of Chapter 4 - All applicable items
Placing of top soil and establishment of vegetation	C2.4.1	Section C11.8 of Chapter 11 - All applicable items

(v) **Items specifically for this section of the specification**

Item	Description	Unit
C2.4.1	Bedding for electric power cables using material:	
C2.4.1.1	Selected from the excavated trench material	cubic metre (m ³)
C2.4.1.2	Selected from other excavations on Site	cubic metre (m ³)
C2.4.1.3	Selected from approved borrow areas	cubic metre (m ³)
C2.4.1.4	Selected from sources provided by the Contractor	cubic metre (m ³)
C2.4.1.5	From commercial sources	
(a)	Uncrushed material (state material type)	cubic metre (m ³)
(b)	Crushed stone material (state material type)	cubic metre (m ³)

The unit of measurement for items C2.4.1.1 to C2.4.1.5 shall be the cubic metre of bedding material in place after compaction and the quantity shall be calculated from the specified dimensions of the bedding and backfilling as specified or authorised by the Engineer.

The tendered rates for items C2.4.1.1 to C2.4.1.5 shall include full compensation for procuring, furnishing and placing the bedding material under, alongside and over cables. The tendered rates for items C2.4.1.2 and C2.4.1.3 shall include full compensation for the additional cost of excavation in all materials, for loading the material from an excavation on Site or from a borrow pit, for hauling the material within the haul limit of 1,0 km and for unloading the material for placement. The tendered rate for item C2.4.1.3 shall include full compensation for all operations at borrow pits not subject to any specified separate pay item.

The tendered rates for items C2.4.1.4 and C2.4.1.5 shall include full compensation for the payment of any royalties or charges for procuring and furnishing the material from sources provided by the Contractor or from commercial sources as well as for transporting the material over an unlimited haul distance.

Item	Description	Unit
C2.4.2	Concrete for bedding and encasement for electric power cables	
C2.1.6.1	Concrete bedding (Class C16/20-20 concrete)	cubic metre (m ³)
C2.1.6.2	Concrete encasement of cables (Class C16/20-20 concrete)	cubic metre (m ³)

The unit of measurement shall be the cubic metre of concrete placed, and the quantity shall be calculated from the dimensions of the excavation as shown on the drawings or as specified or authorised by the Engineer, irrespective of whether the actual excavation exceeds the specified or authorised dimensions.

The tendered rate shall include full compensation for procuring, furnishing and placing all materials, formwork and pedestals and for all the labour and construction equipment necessary to complete the work as specified.

Item	Description	Unit
C2.4.3	Cable laying accessories (warning tape, protection slabs, markers etc.)	
C2.4.3.1	Electrical warning tape (state type)	metre (m)
C2.4.3.2	Concrete slab protection (state type and dimensions etc)	metre (m)
C2.4.3.3	Cable markers (state type)	number (No)
C2.4.3.4	Other accessories	
(a)	State type	metre (m)
(b)	State type	number (No)

The unit of measurement for items C2.4.3.1, C2.4.3.2 and C2.4.3.4(a) shall be the metre of electrical warning tape, concrete slab protection or other accessories supplied and installed. The unit of measurement for items C2.4.3.3 and 2.4.3.4(b) shall be the number of cable markers or other accessories supplied and installed.

The tendered rates shall include full compensation for the manufacture, delivery and installation of the electrical warning tape, concrete slab protection, cable markers or other accessories complete as specified in the Contract Documentation.

D2.4 ENERGY AND OTHER SERVICES

PART D: GUARANTEES AND COMPLIANCE CERTIFICATES

CONTENTS

- D2.4.1 SCOPE**
- D2.4.2 GENERAL**
- D2.4.3 PERFORMANCE GUARANTEE REQUIREMENTS**
- D2.4.4 FUNCTIONAL PERFORMANCE ASSESSMENTS**
- D2.4.5 VISUALLY ASSESSED PROPERTIES**
- D2.4.6 INSTRUMENTALLY ASSESSED PROPERTIES**
- D2.4.7 EVALUATION FOR ACCEPTANCE**
- D2.4.8 ADDITIONAL PROCEDURES TO BE ADOPTED IN THE EVENT OF FAILURE**
- D2.4.9 NOTIFICATION OF REMEDIAL WORK**
- D2.4.10 REMEDIAL WORKS**

D2.4.1 SCOPE

Refer to Clause D2.1.1.

There are no specific items in this Section.

Where applicable, details are provided in the Contract Documentation.

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