

**MOKOLO AND CROCODILE  
WATER AUGMENTATION PROJECT  
PHASE 2 (MCWAP-2)**

**TENDER NO 054/2024/PMID/MCWAP2/RFB**

**PART C3.1  
SPECIFICATION**

**SECTION 9**

**BULK SURFACE EXCAVATIONS  
AND TRENCHING**

## PART C3.1 SPECIFICATION

### SECTION 9 BULK SURFACE EXCAVATIONS AND TRENCHING

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## SECTION 9

### BULK SURFACE EXCAVATIONS AND TRENCHING

#### 9.1 SCOPE

This Section deals with bulk surface excavations that are required for the construction of the Works and that are open to the surface as well as trench excavations that are required for pipelines, culverts, electrical conductors or other components of the Works that requires the excavation of a trench.

Borrow areas and other excavations that are required solely to provide material for construction or for the provision of bedding for pipelines or for the Contractor's requirements, etc., are not addressed here, but are covered in Section 14 – Spoil, Borrow and Excavated Materials.

For Drilling and Blasting operations, this Section shall be read in conjunction with Section 12 - Blasting. For Rock Support operations, this Section shall be read in conjunction with Section 13 - Rock Support.

#### 9.2 DEFINITIONS, ABBREVIATIONS AND REFERENCES

##### 9.2.1 Definitions

- a) **“Battering”** means to form the face or side or wall of an excavation to an angle, usually less than the natural angle of repose, to prevent earth slippage.
- b) **“Bulk excavation”** shall be excavation, for the Permanent Works, which by virtue of their size and extent can only be efficiently excavated by large construction equipment such as bulldozers, motor graders, scrapers, excavators, etc.
- c) **“Bulk volume”** means the un-compacted volume measured after excavation.
- d) **“Classified excavation”** means restricted trench excavations in all materials using conventional construction methods that form part of the train of pipe construction methods.
- e) **“Confined excavation”** shall be excavation which can only be efficiently excavated by hand excavation methods.
- f) **“Excavation profile”** is the initial assumed excavation profile at design and tender stage, interpreting and taking account of the available data regarding the prevailing geotechnical conditions.
- g) **“Fill”, “selected fill” and “structure backfill”** - See Clause 15.2.
- h) **“Formation”** means a surface on which earthworks operations, or a stage of operations, have been completed.
- i) **“Foundation”** means that part of the ground on which a structure will be supported.
- j) **“H”** shall be the excavated trench depth measured from the ground surface after the Topsoil and Fertile Soil, if any, has been removed.
- k) **“Hard excavation in unrestricted bulk surface excavations”** shall be excavation in solid material which cannot be efficiently loosened and excavated by means of a back-acting excavator in mechanically sound condition, fitted with a standard length boom and of flywheel power exceeding 0.10 kW per mm of tined bucket bite width, or a 35 tonne bulldozer

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(minimum 220 kW), in mechanically sound condition with a single tine ripper. This formation shall necessitate the use of explosives or other additional mechanical excavation processes such as drilling, wedging and splitting.

- l) **“Hard excavation in restricted or trench excavations”** shall be excavation in solid material which cannot be efficiently loosened and excavated by means of a 35 tonne back-acting excavator in sound mechanical condition, applying a 1 m wide rock bucket with a tip radius not exceeding 1.85 m with maximum 3 tips. The specified curl force and stick crowd force on the bucket edge should at least be 220 kN and 200 kN respectively. This formation shall necessitate the use of explosives or other additional mechanical excavation processes such as wedging and splitting.
- m) **“Payment line”** means the Employer defined line applicable for measurement and payment for excavation required for the Permanent Works. The payment line is vertical to the underside of the pipe bed or structure base. For pipe chambers and other structures, the vertical payment line is 1 m from the outside of the walls at the base and the horizontal payment line is the underside of the concrete blinding layer to the levels indicated on the drawings. This definition shall be the default approach unless indicated otherwise on the drawings.
- n) **“Restricted excavation”** means an excavation restricted in area or width as to preclude the removal of the material by means of a bulldozer.
- o) **“Random compaction”** is defined as that compaction which can be achieved by a method of systematic routing of construction / haulage equipment across an area such that the mass of the equipment is brought to bear through the tyres or tracks at least twice over the whole area of the layer being compacted.
- p) **“Slope”** means the inclination of a surface expressed as 1 unit of rise or fall for so many horizontal units.
- q) **“Soft excavation”** in restricted or trench excavations shall be excavation in all materials not requiring blasting or mechanical breaking.  
**“Soft excavation”** in unrestricted bulk surface excavations shall be excavation in all materials not requiring blasting or mechanical breaking.
- r) **“Solid volume”** means the volume measured in-situ within the payment line.
- s) **“Spoil”** means excavated material which is unsuitable for use in the Works or material which is surplus to the requirements of the Works.
- t) **“Trench excavation”** shall be excavation for pipelines, culverts, electrical conductors or other items which requires the excavation of a trench for the installation thereof.
- u) **“Un-classified excavation”** means all other restricted trench excavations where conventional construction methods cannot be applied (trench excavations on longitudinal slopes steeper than 30%, trench excavations for stream crossings, as well as excavations for pipe jacking).

**“Un-decomposed boulders”** shall be boulders exceeding 0.3 m<sup>3</sup> in size, or boulders with an average diameter exceeding 700 mm or 75% of the width of the trench or pit, with an unconfined compressive strength > 50 MPa. Un-decomposed boulders shall be held to be hard.

### 9.2.2 Abbreviations

AASHTO	:	American Association of State Highway and Transportation Officials
BS	:	British Standard
HEL	:	Hard Excavation Level

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MPa	:	Megapascal
SANS	:	South African National Standard
SANAS	:	South African National Accreditation System

### 9.2.3 References

When reference is made to a Code of Practice, Specification or Standard, the reference shall be taken to mean the latest edition or replacement at time of tender of the Code, Specification or Standard; including addenda, supplements, modifications and revisions thereto. Where a previous version is intentionally used, it will be indicated as such. Where reference is made to a Code, Specification or Standard that has subsequently been withdrawn and not replaced, the intended content will remain relevant unless confirmed otherwise in writing by the Engineer.

### 9.3 GENERAL REQUIREMENTS

- a) All excavation work shall be subject to the requirements of the Specification and the Occupational Health and Safety Act (Act 85 of 1993 and amendments) and its Regulations. These include, but are not limited to the following:
- The sides of all excavations will be properly shored or close sheeted and the Contractor shall follow the appropriate recommendations in BS 6031 – Code of Practice for Earthworks, and the Code of Practice “Lateral Support in Surface Excavations” published by the South African Institution of Civil Engineering;
  - The Contractor will remove the shoring immediately prior to backfilling or as instructed by the Engineer; and
  - As an alternative to shoring the Contractor shall batter the sides of an excavation and or form steps to ensure the safety of the excavations.
- b) The Contractor shall maintain the sides of excavations in a safe condition during construction and prevent general access to the excavation by unauthorised persons, by children and by animals. No undercutting of the sides of the excavation will be allowed.
- c) Inspect open trenches at least daily to ensure that animals have not become trapped. Such animals will be safely removed and released, where possible. Special equipment for handling of venomous snakes should be available on site to ensure safe removal.
- d) The Contractor shall at all times provide and allow reasonable access to persons occupying properties that fall within or adjoin the area over which he is working. If, for any reason, such access has to be closed for any period(s) during the construction period, the persons affected shall be given reasonable notice by the Contractor, in writing, of each such period of closing. Total closure of access shall only be allowed with the explicit written approval of the Engineer and the landowner(s) or affected persons.
- e) The Contractor may, because of excessive cross-falls, be obliged to carry out general levelling within the servitude strip to facilitate the use of equipment. After completion of the Works, the ground shall be restored to its original contours, except for permanent access roads and where permanent terraces are shown on the drawings and shall be rehabilitated to the satisfaction of the Engineer. The levelling and re-instatement shall be done at the Contractor’s own expense. Such levelling and reinstatement shall consider storm water sheet flow crossing the servitude. Such storm water sheet flow (especially over dolomitic terrain) shall be accepted onto the servitude without causing ponding and/or erosion, facilitated across the servitude without causing ponding and / or erosion, and discharge the stormwater sheet flow onto the downstream property without causing ponding and/or erosion.

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- f) The Contractor shall ensure that excavations are kept free of surface water inflow and groundwater infiltration at all times especially over dolomitic terrain. Under no circumstances should flooding of the pipeline trench led to floatation of the pipeline.
- g) The Contractor shall make adequate provision for subsidence, especially over dolomitic terrain.
- h) The excavation profile shall be used to:
- Perform a realistic and comparative mass balance calculation;
  - Check construction production rates; and
  - Check constructability from an available working space and safety allowance perspective.
- i) The Contractor shall be responsible for all lateral support and the safe-guarding of all excavations, and all costs involved with the proper safeguarding of the excavations and this shall be included in the tendered rates.
- j) The final actual constructed excavation quantities shall be determined from the monthly drone based laser terrestrial survey process. The re-measurable variables associated with the excavation profile are:
- Natural ground level to be agreed at the start of construction;
  - Final trench length;
  - Agreed final rock line / hard excavation line; and
  - Any formal instruction issued by the Engineer that changes dimensions, lines or levels.

## 9.4 CLASSIFICATION OF EXCAVATION

### 9.4.1 Classification Systems

Classification systems have been introduced for establishing an equitable basis of payment for excavation in varying ground conditions. Two basic conditions determine the rate of advance for excavation, namely the excavation volume and the degree of difficulty to excavate.

The initial planned volume is pre-determined by the Employer's design and defined by the excavation profile lines. The Contractor shall allow in his construction planning for bulking and possible under and over excavation situations. The extent of the volume of excavation requiring blasting or a mechanical breaking process is defined by the information made available as part of the Geotechnical Data in Volume 6. This was based on test pits spaced at approximately 200 m centres.

Where the Contractor plans to do blasting prior to excavation it is required that the hard excavation line (HEL) be determined more accurately for blast design and drilling purposes. For these work areas the hard excavation line (HEL) shall be verified and agreed prior to construction by a more detailed field investigation with test pits spaced at 25 m centres or other methods as approved otherwise by the Engineer.

The degree of difficulty of excavation is in some aspects more uncertain. For this reason the restricted aspects given below are introduced to manage the risks on an equitable basis.

The Engineer will decide on the classification of the materials. The classification will be based on inspection of the material to be excavated and on the criteria given in Clause 9.2.1 and Clause 9.4.3

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as applicable. All equipment specified in the determination of the classification shall be in good mechanical condition.

In the event of disagreement between the Contractor and the Engineer, it shall be responsibility of the Contractor, to make available at his own expense such mechanical equipment as specified in Clause 9.2.1 in order to assess the reasonable removability or otherwise of the material. The Engineer's decision on classification shall then, subject to the relevant provisions of the Contract, be final and binding.

#### 9.4.2 Type of Excavation and Machine Restriction

Two basic types of excavation are designated in terms of the degree of machine restriction:

- Trench excavation: Restricted space; and
- Bulk excavation: Relative unrestricted space.

Refer to Clause 9.2 above.

#### 9.4.3 Excavatability Restriction

For both types of machine restrictions, two basic types of excavation are classified in terms of the machine excavatability:

- Soft excavation: All materials machine excavatable; and
- Hard excavation: Not machine excavatable. Require blasting or other additional mechanical excavation process.

The machine capacities are defined in Clauses 9.2.1(k) and (l) above. This classification defines the "Hard Excavation Level" (HEL). The excavation above this level requires a single process and the excavation below this level requires two or more processes which affects cost and the planned rate of advance.

#### 9.4.4 Classified and unclassified trench excavation

The different excavation areas (narrow servitudes, river and stream crossings, pipe jacks, etc.) are catered for in the Bill of Quantities (BoQ).

#### 9.4.5 Differentiated Classified Trench Excavation

For trench excavation, the following excavation classes are designated:

**TABLE 9/1  
CLASSIFICATION OF EXCAVATION CLASSES**

EXCAVATION CLASSIFICATION	PROCESS
Soft excavation	Only machine excavation
Hard excavation	Blast plus machine excavation

The Contractor should use the excavation classes to differentiate between excavation advance rates and payment rates. The excavation advance rate will be sensitive to the assumed drilling and blasting advance rate, site conditions, etc. The proposed advance rates should be reflected in the Contractors Construction Programme.

The Contractor shall clearly indicate the proposed drilling and blasting approach in the blasting design required in Section 12 - Blasting.

#### **9.4.6 Depth of Trench Excavation Restriction**

For the purpose of differentiating between excavation advance rates due to restriction imposed by depth of excavation, the following designation is applicable for trench excavation depths of H (m):

a) **Classified trench excavation**

Trench excavation advance rate is determined by the depth of the trench, reflected in the BoQ for different trench depth categories.

b) **Unclassified trench excavation**

Trench excavation advance rate is determined by the depth of the trench, reflected in the BoQ for different trench depth categories.

The classification allocation shall be agreed in terms of the definitions given in Clause 9.2.1 between the Engineer and the Contractor based on the available geotechnical information and further trial hole tests and inspections of the material to be excavated before excavation commences.

Where the Contractor plans to do blasting prior to excavation it is required that the hard excavation line (HEL) be determined more accurately for blast design and drilling purposes. For these work areas the hard excavation line (HEL) shall be verified and agreed prior to construction by a more detailed field investigation with test pits spaced at 25 m centres or other methods as approved otherwise by the Engineer.

In the event of a disagreement between the Contractor and the Engineer, the Contractor shall, if required, make available such mechanical equipment as specified in Clause 9.2.1 at his own cost, in order to determine whether or not the material can reasonably be excavated. The decision of the Engineer as to the classification allocation shall thereafter be final and this allocation will be used for implementation purposes. The actual surveyed levels will determine the final measurement of quantities. Refer in this regard to Section 5, Clause 5.10 for the application of drone based laser terrestrial surveying.

The use of machines and methods of excavation other than those mentioned above shall not preclude the application of the classification of materials as defined above. The fact that the Contractor may elect to use a ripper, mechanical excavation machine, hydraulic or pneumatic tools or explosives on any particular formation shall not constitute conclusive evidence as to its classification of the various materials encountered in the excavation.

#### **9.4.7 Excavation Quantities**

For measurement and payment purposes, the calculation of pipeline trench excavation quantities shall be based on the vertical excavation payment lines indicated on the relevant drawings. The Contractor must determine its payment rates taking account of site geotechnical conditions, the stability and safety of the trench, etc.

## **9.5 EXCAVATION FOR THE WORKS**

### **9.5.1 General**

The Contractor shall obtain instructions before commencing excavations regarding any changes to the dimensions and slopes shown on the Drawings to suit localised ground conditions.

The Contractor shall excavate as required for safe construction of the structures or pipelines as shown on the Drawings and to provide for adequate working space.

The Contractor shall use such methods as will limit, to the maximum extent practicable, excavated or fill material from spilling down hillsides onto adjacent areas. If, during the course of excavation or filling operations on hillsides, the Engineer is of the opinion that insufficient precautions are being taken by the Contractor to minimise the spillage of material, he may instruct the Contractor to adopt further measures to reduce the spillage. The Contractor shall remove all spillage, including fly rock from his blasting operations, from environmentally sensitive areas. No separate payment will be made for any such measures taken.

In order to assess the nature of the material in an excavation the Engineer may direct that part of the excavation shall be undertaken first, and the remainder shall be excavated only after the first part has been inspected and the Engineer has issued any further instructions which he regards necessary. No additional payment shall be made for such selective excavation.

Where rock support is shown on the Drawings, the excavation shall be carried out in stages of limited height and length such that:

- a) Pre-support is fully installed and tensioned where applicable prior to excavation; and
- b) All remaining rock support may be installed and tensioned within 48 hours of excavating and to within 1.0 m of the next stage to be excavated, regardless of the excavation method, unless otherwise agreed by the Engineer in writing.

Care shall be exercised not to undercut any slopes and proper control shall be exercised at all times by regular survey checking and the use of batter poles at close intervals. Where the slopes are nevertheless undercut, backfilling and compacting with imported material shall not normally be considered as a suitable remedy and the Engineer may order that such remedial measures as he considers necessary be carried out without additional payment, which may in serious cases include cutting back the whole or major portions of the excavation to a uniform slope.

The Contractor shall ensure, especially over dolomitic terrain, that no concentrations or accumulations of water occur either within or around or above the area of any excavation which may affect the safety of that and other excavations. Similarly the Contractor shall not dig any trenches nor dump any soil or other construction materials near the tops of cut slopes other than for catch water berms. Where such dumping is unavoidable or necessary for the execution of any phase of the work, the Contractor shall obtain the Engineer's approval in writing before commencing such work. Divert runoff away from excavations.

No materials, equipment or other load shall be placed so close to any excavation that the stability of the sides of the excavation is endangered.

The Contractor shall remove or otherwise secure by barriers, nets or other means any material which might fall and thereby cause damage to the Works or injury to any person.

Suitable barricading to be erected around open excavations, as per the Construction Regulations or the prevailing legislation. Provide signage as a warning of open excavations.

The Contractor shall make every effort to identify the position of any existing underground services and shall take every precaution not to damage such existing services during excavation for the Works.

Where an excavation for pipes or services crosses a public or private road, the excavation and installation of the pipe shall be so conducted that access is provided to at least one lane of traffic. Suitable traffic control measures shall be maintained.

Suitable pedestrian access shall be provided where long excavation runs are constructed (See also Clause 9.5.7).

### **9.5.2 Site Clearance**

Prior to the start of any excavation or construction of any fill, the Contractor shall clear the designated areas.

The Contractor shall clear (as specified in Section 7 – Clearing Site) the construction servitude area along pipeline routes to ensure that his trench excavated material selection operations are not hampered (see Clause 15.3.8). The Contractor shall ensure that clearing and damage to plant growth is restricted to the servitude area.

The Contractor shall ensure that the measures specified for site clearing (Section 7 – Clearing Site), specifically as they relate to the identification and management of sensitive vegetation, clearing and grubbing and the stripping and stockpiling of topsoil, are implemented prior to the commencement of excavation.

### **9.5.3 Extent of Disturbance**

All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities, particularly with regard to loss of natural vegetation, erosion and dust / noise generation. No equipment associated with earthworks shall be allowed outside of the Site and defined access routes unless expressly permitted by the Engineer. Construction activities to remain within the designated construction servitude.

### **9.5.4 Dust and Noise**

The Contractor shall ensure that the dust and noise control measures specified in Section 3 – Social Management and Socio Economic Development requirements are implemented during excavation and blasting operations.

### **9.5.5 Stability of Excavations**

The Contractor shall ensure that the slopes of all excavations are stable. Accordingly, clearing of any area shall be programmed to occur immediately prior to the onset of construction activities within the area. No time lapse will be allowed between the clearing of the area and the onset of construction activities. Moreover, disturbed areas shall be re-vegetated, as per the requirements of Section 47 – Landscaping and Rehabilitation, as soon as is reasonably possible.

Excavation shall be performed by the use of hand tools and mechanical equipment, in such a manner as to prevent shattering of the sides and bottom of the excavation. The Engineer may

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approve the use of line drilled holes and light blasting in appropriate locations (as specified in Section 12 – Blasting).

If any cracking, slipping or collapsing of the sides of an excavation or trench are noticed, the Contractor shall immediately remove all workmen from the excavation, inform the Engineer and the Employers Agent and shall not proceed with any further work until the remedial measures to ensure safe working conditions have been approved. The Contractor must ensure that all excavations are inspected and declared safe by a person competent to do on a daily basis before work commences, or before work again commences after rainfall events, etc.

Where confined hand excavations are to be made in trench backfill, such excavation shall not extend to a depth of more than 300 mm above the crown of the pipeline without the approval of the Engineer.

### 9.5.6 Trench Widths

Trenches for pipe work shall be so excavated as to allow the pipes to be properly laid to line and level, bedded, jointed, inspected and tested.

To ensure the required pipe soil interface for larger thin wall steel pipes, the width of all trenches from the bottom of the trench to at least half the diameter of the pipe above the crown of the pipe shall be no wider than is practically necessary. This is determined by the allowance for the correct jointing of the pipes laid in the trench and for the bedding material and backfill to be properly placed and compacted. The above is subject to the trench being stable and remaining stable during the construction activities.

The width shall be in accordance with Table 9/2 unless otherwise agreed by the Engineer. For multiple pipes, the distance between the centrelines of the outside pipes shall be added to that given in Table 9/2 or as shown on the Drawings.

**TABLE 9/2  
MINIMUM TRENCH WIDTHS FOR PIPE TRENCH CONDITIONS**

<b>NOMINAL PIPE DIAMETER (D) (MILLIMETRES)</b>	<b>MINIMUM OVERALL WIDTH (W) OF TRENCH (NOTE A) (MILLIMETRES)</b>
D ≤ 600	D + 600
600 < D ≤ 900,	D + 800
900 < D ≤ 1 200	D + 1000
1200 < D ≤ 1800	D + 1 200
D > 1 800	D + 1 400

Notes:

1. The widths refer to trenches containing a single pipeline.
2. Widths of trenches shall be maintained at the base of the trench and the laid pipeline shall be located centrally in the trench to enable selected fill to be effectively rammed below the lower half of the pipe on both sides of the pipe.

The width of trenches for cables or other services shall be so excavated as to allow the bedding, service installation and compaction of the backfill to be done according to specification. The application of narrow trench excavation techniques shall be subject to the approval of the Engineer.

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The Contractor shall submit a method statement in good time for each type of service to be installed using these narrow trench excavation techniques.

### 9.5.7 Trench Excavation

Trench excavation shall proceed progressively from each working head and the opening of trenches haphazardly at various points along the route will not be permitted without approval of the Engineer.

In particular, the Contractor will not be allowed to pass over hard sections of excavations to proceed with soft excavation at further points along the trench. At the discretion of the Engineer this provision may be relaxed insofar as localised road, rail and stream crossings are concerned.

Trench excavations shall not be carried out further ahead of pipe laying than is required for efficient working and in no case shall this exceed the maximum length as reflected in the table below:

**TABLE 9/3  
MAXIMUM LENGTH OF OPEN TRENCH VS PRODUCTION RATE**

<b>NUMBER OF PIPES LAID PER DAY (Note 1)</b>	<b>PRODUCTION RATE (Note 2)</b>	<b>MAXIMUM LENGTH OF OPEN TRENCH (Note 3)</b>
1-3	54 m – 57 m / working day	400 m
4	72 m – 76 m / working day	550 m
5	90 m – 95 m / working day	700 m

Notes:

1. Pipe lengths vary between 18 m and 19 m.
2. Average rate of progress of the train of all pipe installation / construction processes.
3. Length of open trench measured ahead of last pipe laid.

Where rock excavation is continuous, the Contractor may be permitted at the Engineer's discretion to use special rock excavating teams further ahead of the main excavating team.

Chainages and invert levels for pipelines shall be obtained from the longitudinal sections. The Contractor shall excavate and trim trenches to a true and even grade between levels shown on the Drawings. The minimum depth of cover over pipelines shall be 1000 mm. Where a minimum depth of cover of 1000 mm will not be achieved the Contractor shall immediately inform the Engineer who will issue instructions for remedial action required.

Trenches for pipe work shall be excavated below the invert level of the pipe to a depth that will allow the minimum thickness of trench bed material (or concrete encasement or any additional depth to allow for specific trench bottom conditions) to be placed as shown on the Drawings or specified in Section 15 - Backfilling and Bedding.

The bottom of trenches shall be sufficiently straight (or true to alignment in the case of curved pipelines) to enable the pipes to be laid without reduction of the side allowances given in Clause 9.5.6 or of the bedding thickness in conformity with the applicable tolerances specified in any specification covering pipe work that forms part of the Contract.

Where trench bottoms are water logged and or in need of stabilisation or a pioneer layer, the trench depth may have to be increased as per the requirements of Clause 9.5.9.

### **9.5.8 Trench Depths**

Trenches shall be excavated and trimmed to the specified or required depth as indicated on the Drawings. These depths shall be maintained for the full width and length of the trench and all stones, rocks or other projections trimmed accordingly.

### **9.5.9 Preparation of Trench Bottom**

- a) Where the trench excavation is in soft material, and the bottom of the trench is in sound material, all loose and disturbed material and excavation debris shall be removed and disposed of as directed by the Engineer.
- b) Where the trench excavation is in soft material, and the bottom of the trench has been loosened during excavation, it shall be compacted to 90% of Modified AASHTO maximum dry density prior to bedding and pipe laying. Where the trench excavation is in hard material and blasting was required, all loose rock and blast debris shall be removed and disposed of.
- c) Where the trench bottom is too soft, waterlogged, unstable, to permit placement and compaction of bedding material in the normal manner, the trench bottom shall be excavated to a depth below the underside of the pipe and specials for the full width and length of trench affected to accommodate the following trench bottom stabilising layers:
  - i) 300 mm thick compacted 19 mm crushed stone (or similar approved by the Engineer) enclosed within non-woven, needle punched, continuous filament polyester geotextile (Bidim Grade A5 or similar product approved by the Engineer) over the full width of the trench and with a minimum overlap of the geotextile of 1000 mm; plus where required the following layer underneath layer i);
  - ii) 500 mm thick well graded compacted dump rock enclosed within high strength composite (woven or un-woven) geotextile with high modulus characteristics for reinforcement and drainage applications (Rock Grip PC 100/100 or similar product approved by the Engineer) over the full width of the trench and with a minimum overlap of the geotextile of 1000 mm; and
  - iii) The pipe bed material shall be placed on top of layer i).

The necessity for layer i) or layer i) plus layer ii) will depend on the geotechnical conditions and will be subject to the approval of the Engineer.

### **9.5.10 Variations in Founding Conditions**

In consequence of possible variations of the anticipated founding conditions, the dimensions and founding levels specified or shown on the Drawings may be varied during construction.

Each founding level shall be inspected, accurately measured and the agreed level recorded.

### **9.5.11 Method Statements**

At least seven days prior to the commencement of excavations, the Contractor shall submit his Method Statements for the different types of excavation to the Engineer for his approval.

The Method Statements shall include details of the equipment he proposes to use, control methods to be used (such as batter boards, etc.), proposed measures for the control of water and the sequence and program of his operation, undertaking of work in normal and reduced construction servitudes, how access across the servitude will be facilitated, and how Occupational Health and Safety (OHS) requirements will be enforced, etc.

### **9.5.12 Road Crossings**

Road crossings and rehabilitation of roads shall be carried out as described in Section 26 - Road Maintenance. Where trenches cross or run alongside gravel roads which are scheduled to be reinstated, the Contractor shall, for the purpose of reinstatement, separately stockpile the top 300 mm of material excavated.

### **9.5.13 Survey Records**

The Contractor shall survey an area for record and measurement and payment purposes in accordance with Section 5 - Survey and Setting Out, prior to the commencement of any excavation or earthworks, at any change in the classification of the material and at any stage thereafter as required by the Engineer.

### **9.5.14 Protection of Overhead and Underground Services**

#### **9.5.14.1 Existing Services**

Where trenches pass near or across other services, the Contractor shall take every precaution against damaging such services. These services shall be properly supported in the trench until backfilling is complete and the backfilling shall be thoroughly compacted under and around such services.

The Contractor will be held responsible for any damage to known services (i.e. services that are within the Site of the Works and are shown on the Drawings) and he shall take all necessary measures to protect them. All protective work or protective measures shall be subject to the approval of the Engineer. In the event of a service being damaged, the Contractor shall immediately notify the authority concerned as well as the Engineer. The Contractor shall not repair any such service unless instructed to do so by the Engineer or the owner of the service or the relevant service authority, except for if it is an emergency repair for health and safety reasons.

Where no underground services are shown on the Drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Engineer, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section and he shall submit a report as soon as possible (to prevent delays) to the Engineer including the necessary arrangements by the Contractor for the protection, removal or diversion of the services before any construction work commences.

As soon as any underground service not shown on the Drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such service is damaged during the course of its discovery, the cost of making good such damage will be paid by the Employer unless the Engineer established that the Contractor did not exercise reasonable diligence and that the damage was avoidable.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

Permanent alterations to or permanent diversion of services necessitated by the execution of the Works and authorised in writing will be paid for in terms of the Conditions of Contract, but no such work will be paid for if it has not been previously inspected by the Engineer and if proper written instructions have not been given.

#### **9.5.14.2 Detection, Location and Exposure**

The Drawings show the position of existing services based on the information available. The Contractor shall verify the position of all services and all other obstacles and existing works on the Site. Manholes, valve boxes and the like will be regarded as known services. Before commencing construction in any particular area, the Contractor shall report to the Engineer any known services that could not be found or confirmed.

Where any underground services are shown on the Drawings, the Contractor shall have the equipment available on the Site for their detection for as long as is necessary to detect and locate such services and if so ordered, he shall excavate by hand to expose such services in areas and in a manner and at a time agreed upon with the Engineer.

#### **9.5.14.3 Protection of Cables**

The Contractor shall advise the Engineer at least 7 days in advance of the actual date on which he proposes to excavate near any cable. He shall not use mechanical equipment to excavate within 3 m of the estimated position of any cable and shall, if necessary, expose the cable by means of hand excavation carried out under proper supervision. The Contractor shall backfill such cable trenches with material approved by the Engineer to the 90% Modified AASHTO compaction density.

#### **9.5.14.4 Negligence**

Where the service is damaged because of the Contractor's negligence he shall bear the cost of the repairs.

#### **9.5.15 Excavated Surfaces**

All excavated surfaces shall be finished neatly and be safe. Where required, the Contractor shall take appropriate measures to stabilise the slopes, and it should be included in the excavation rates. Such appropriate measures may include battering or shoring. No materials, equipment or other load shall be placed so close to any excavation that the stability of the sides of the excavation is endangered. Where excavations has been open and influenced by rain, the integrity and safety of such excavations shall be assessed and the safety thereof declared.

Excavated surfaces that will remain permanently exposed on completion of the Works shall be cleared of all loose material, pieces of rock, debris, rubbish and the like and left neat and tidy. If required for subsequent grassing or for the establishment of natural vegetation the final surface of excavations shall not be absolutely smooth but shall have a slightly rough surface.

Exposed excavation surfaces against which concrete is to be placed, shall be excavated with minimum overbreak. No material will be permitted to remain within the outline of structural concrete or within the payment line where this is agreed to be different to the outline.

Where, in the opinion of the Engineer, the casting of concrete against an excavated surface is not acceptable the excavation of working space required for the erection of formwork shall be agreed with the Engineer.

In material other than rock, the horizontal surface shall be left undisturbed a distance of at least 150 mm above its final level until immediately before commencing the stage of the construction which covers the foundation. At this time the excavation shall be completed by careful final trimming to line and level.

**9.5.16 Slips and Over Excavation**

Slips, excavation for working space, over-excavation and damaged areas shall be made good to the satisfaction of the Engineer at the Contractor's cost. In the case of surfaces on which or against which Permanent Works are to be constructed, this remedial work shall comprise replacing the slipped, over-excavated or damaged material with suitable filling material or with concrete as instructed by the Engineer.

Slips, falls, subsidence and other damage which have the effect of removing or reducing support to existing or proposed structures, services and the like shall be made good in concrete or otherwise in a manner acceptable to the Engineer.

In the case of permanently exposed surfaces, remedial work shall comprise replacing and compacting material similar to that which has been removed or replacing with concrete in order to provide a surface not less satisfactory than adjacent correctly excavated surfaces. If this is not possible, remedial works shall be as instructed by the Engineer.

**9.5.17 Support of Excavations**

The responsibility of the Contractor for the safety and care of the excavations shall include taking the following measures:

- a) The Contractor shall excavate the sides of excavations which are not positively supported to slopes which will remain stable;
- b) The sides of excavations which are not cut to a stable slope shall be properly and adequately supported to the extent necessary to ensure stability during the period of construction and the excavation shall then be backfilled unless otherwise indicated on the Drawings;
- c) The Contractor shall be responsible for the installation and subsequent removal of all necessary sheeting, timbering, strutting, shoring and the like to secure the excavations, to prevent any movement of adjacent ground, to prevent damage to adjacent structures and to ensure the safety of workmen; and
- d) Where temporary underpinning is required, the Contractor shall submit to the Engineer for agreement, full details of the design, materials to be used and method of working proposed.

**9.5.18 Use of Excavated Material**

In order to achieve the optimum use of excavated material the Contractor shall agree with the Engineer with regard to the usage of this material. The Contractor's methods of excavation shall be such that the materials excavated will yield as much material suitable for re-use as possible.

The Contractor shall program his work so that as far as practicable material excavated is transported directly to its final position without stockpiling.

Where it is impractical, in the opinion of the Engineer, to place such excavated material directly in its final position, such material shall be stockpiled at approved sites. Prior preparation of the site, such as bush clearing, removal of topsoil and limited levelling may be required at the stockpiling area. Materials intended for different uses shall be stockpiled separately.

For trench excavations, all excavated material shall be placed along the side of the trench either separately or in successive layers or in windrows according to the properties and nature of the material removed in such a way that re-use and backfilling in accordance with the Specification may be facilitated. Surplus material and material unsuitable for re-use shall be disposed of to spoil areas.

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Temporary stockpiles of material for later use in the Works shall be formed with side slopes which will remain stable under all conditions to which they will be subject and the tops shall be graded to prevent the ponding of water.

Stockpiles shall be placed so that watercourses are not obstructed or polluted and so that the stockpiles will not obstruct any storm water or drainage paths.

Fertile soil and overburden shall be stockpiled separately to be returned for backfilling in the natural soil horizon sequence.

#### **9.5.19 Disposal of Surplus Excavated Material**

All surplus excavated material not required for backfilling or unsuitable for re-use and restoration shall be disposed of in the designated borrow and spoil areas shown on the Drawings, all in accordance with the requirements of Section 4 – Environmental management and Section 14 – Spoil, Borrow and Excavated Materials. In the event that borrow and spoil areas are not available, surplus excavated material should be disposed of at approved waste disposal sites, or at designated sites subject to the approval of the Engineer.

Side slopes of spoil dumps over a 4 m width shall receive additional compaction, in excess of random compaction, to achieve a compaction of 90% modified AASHTO density.

#### **9.5.20 Excavation in Rock**

##### **9.5.20.1 General**

Excavation of rock by blasting shall be undertaken in accordance with Section 12 - Blasting. The final sides and inverts of the excavation against which concrete will be placed shall be excavated to the specified excavation lines by controlled trim blasting unless otherwise approved by the Engineer.

##### **9.5.20.2 Excavation Adjacent To Existing Structures**

The Contractor's work shall be programmed so as to minimise excavation by blasting adjacent to previously constructed parts of the Works. The Engineer will not approve a program in which, in his opinion, blasting may cause damage to completed Works or their foundation. Where in the opinion of the Engineer it would be impracticable to avoid damage to adjoining works if explosives were used, the Engineer may require the Contractor to continue excavating by line drilling as specified in Section 12 - Blasting, using a hydraulic breaker, barring and wedging, chemical blasting or other approved non-explosive methods.

Rock wedges on rock slopes which are not removed shall be anchored to sound rock as directed by the Engineer.

##### **9.5.20.3 Over-Excavation**

If, at any point in rock excavation, material is excavated beyond the lines shown on the Drawings or directed, or foundation materials are needlessly damaged by blasting or other operations by the Contractor, the over-excavation shall be filled solidly with concrete or with approved granular material compacted to the density specified or ordered by the Engineer and the cost of all such work shall be at the expense of the Contractor.

#### **9.5.20.4 Disposal of Hard Rock Material**

Where the quantity of hard rock material exceeds that which the Engineer allows to be incorporated in the backfill, the surplus shall be removed to designated spoil sites and disposed of.

#### **9.5.20.5 Slurry Trenches / Curtain Walls**

Surface excavations for the Permanent Works will include excavations in permeable alluvial deposits below the water table. Thus they will require sealing off prior to excavations taking place.

The Contractor shall design appropriate water barriers best suited to his method of construction and shall provide a Method Statement dealing with all aspects of achieving an effective seal in the alluviums to enable workable conditions for excavation and construction.

#### **9.5.21 Excavation of Test Pits to Determine the Hard Excavation Level for planning of trench blasting**

Refer to Clause 9.4.1 in this regard. For the work areas where this is required, the Contractor shall excavate test pits along the centre line of all pipelines to determine the hard excavation level. Test pits shall be excavated at a nominal spacing of 25 m or as otherwise approved by the Engineer. The position of the test pits shall be surveyed (X, Y co-ordinates and chainage along the pipeline) and the hard excavation and ground elevations determined. The hard excavation level shall be agreed with the Engineer. On agreement the test pit shall be backfilled and compacted to 90% Mod AASHTO. The position of the test pit and the elevations determined shall be submitted to the Engineer.

The final actual Hard Excavation Level will be surveyed when exposed.

#### **9.5.22 Tolerances**

Except as otherwise specified or instructed by the Engineer the tolerances on the completed excavation after clearing of the excavation faces shall be as follows:

- + 50 mm, - 50 mm                      in level;
- +100 mm, -100 mm                    in plan on the excavated surface as an average; and
- + 500 mm, -500 mm                    in plan locally.

Soft material shall be excavated to rock or to the lines and levels shown on the Drawings, or to lines and levels as directed by the Engineer. Rock shall be excavated to the lines and levels shown on the Drawings, or to lines and levels as directed by the Engineer.

Rock surfaces to be covered with concrete shall be excavated to the lines, levels and dimensions shown on the Drawings with the following local tolerances:

- + 0 mm, - 250 mm                      in level; and
- + 250 mm, - 0 mm                      in the horizontal direction measured from the structure towards the rock face.

Over and above the above tolerances, no excavation surface shall fall within or project into the excavation payment line as indicated on the Drawings.

## **9.6 PREPARATION AND INSPECTION OF FOUNDATIONS**

### **9.6.1 Foundations for Concrete Structures**

#### **9.6.1.1 Preparation of Foundations on Rock**

Rock surfaces to receive concrete shall be free of all dust, mud, loose or fractured material and other debris. Fissures shall be cleaned out and treated to the extent instructed by the Engineer. The surfaces shall be washed completely clean using air or water jets immediately prior to placing concrete, cement mortar or sprayed concrete. If instructed by the Engineer, the Contractor shall clean a trial part of the foundation in advance of the remainder for the purpose of inspection.

Where rock surfaces reach high temperatures under the influence of the sun, washing shall be carried out at night or in the early morning to avoid fracturing due to thermal shock.

#### **9.6.1.2 Foundations on Materials other than Rock**

As specified in Clause 9.5.15, surfaces other than rock shall be trimmed to the correct line and level immediately before commencing construction of any part of the Works and any loose or disturbed material shall be removed. Where directed by the Engineer, the top 300 mm of in-situ material shall be compacted to a minimum of 90% of Modified AASHTO density. The Engineer may instruct re-compaction if the surface has become disturbed.

Where the in-situ material does not provide a suitable foundation the Contractor shall replace the unsuitable material with gravel or other suitable material to such depth as instructed by the Engineer. The replacement fill shall be compacted in layers not exceeding 150 mm in depth to a minimum of 90% of Modified AASHTO density.

### **9.6.2 Foundations for General Earthworks, Embankments and Terracing**

#### **9.6.2.1 General**

Cross-sections of the original ground lines shall be surveyed as instructed by the Engineer before work is commenced. The Engineer's approval of foundation surfaces shall be obtained prior to the placement of any fill. Any Foundation material occurring within the footprint of where the fill and/or Selected fill is to be placed, shall be treated by one or more of the following methods as directed by the Engineer or as shown on the Drawings:

- a) Draining of foundations;
- b) Pioneer layer;
- c) Removal of unsuitable material;
- d) In-situ treatment of foundations; and
- e) Preparation and compaction of foundations.

#### **9.6.2.2 Draining of Foundations**

Any drainable, water-logged foundation, such as, but not limited to, saturated material overlying less pervious strata, shall first be drained by the installation of all permanent surface or subsoil drainage shown on the Drawings or as directed by the Engineer, before any other construction is started on these sections. Water so discharged shall comply with environmental requirements.

### **9.6.2.3 Pioneer Layer**

Where fill is to be constructed across water-logged or soft ground that displays excessive movement under normal compaction equipment and haulage trucks, thereby precluding the effective compaction of the bottom fill layers, the Engineer may direct that a pioneer layer be constructed on the unstable ground. This layer shall be constructed by dumping and spreading successive loads of suitable coarse material in a uniform layer of a thickness just sufficient to provide a stable working platform for the construction of further fill layers which are to be compacted to a controlled density. Light hauling equipment and, where necessary, end tipping shall be used to place the material, and the layer shall be compacted by the use of light compaction equipment that will give the most effective compaction without overstressing the underlying material. Pioneer layers need not be compacted to a controlled density.

Where instructed by the Engineer synthetic fibre filter material, with or without protection or drainage layers, shall be used in conjunction with or in place of a pioneer layer. The compacted volume of material used may be determined by 70% of the loose volume in trucks being taken as an alternative to taking cross-sections before and after construction.

### **9.6.2.4 Removal of Unsuitable Material**

Any Foundation material that is considered by the Engineer to be of a quality that would be detrimental to the performance of the completed fill, shall be removed to such widths and depths as ordered by the Engineer in writing and be disposed of to spoil. The excavated spaces shall then be backfilled, treated and compacted with approved imported fill material.

The Engineer may also order that material which is too wet to provide a stable platform for the construction of the fill be removed and replaced with suitable dry material. The Contractor shall be paid for this work provided the Engineer is satisfied that, despite adequate temporary drainage installed by the Contractor, the wet conditions are not likely to be remedied within a reasonable time and could not have been reasonably foreseen and avoided by proper advance planning to carry out construction during a dry period.

### **9.6.2.5 In-situ Treatment of Foundations**

Wherever shown on the Drawings or directed by the Engineer, the foundation shall be treated in-situ by breaking up undesirable formations of hard or rocky materials in order to achieve a uniform standard of compaction or to improve drainage.

Treatment in-situ shall consist of ripping or blasting the Foundation to depths as ordered by the Engineer.

After ripping or blasting, the material shall be processed as follows:

Where the Engineer instructs the Contractor to rip the in-situ material, the whole of the material shall be sized by rolling or grid rolling until the maximum dimension of any clod or spall is not more than two-thirds of the thickness of the layer after compaction. The material shall then be compacted to a percentage of Mod AASHTO maximum dry density, as indicated on the drawings. Where the Engineer instructs the Contractor to blast the in-situ material, the whole of the material shall be processed and compacted as for rockfill (see Clause 15.6.7.2 b).

In both cases surplus material arising from bulking after in-situ treatment shall be removed and disposed of or utilised elsewhere, as directed by the Engineer.

### **9.6.2.6 Preparation and Compaction of Foundations**

Any Foundation material which is classified as suitable for use in-situ, save that it fails to meet the requirements for density, shall be scarified to a depth of 150 mm, watered and compacted. The degree of compaction shall be a percentage of Mod AASHTO maximum dry density, as indicated on the drawings.

Where any additional material has to be imported to obtain the required levels and layer thicknesses, and where the thickness of the imported material, measured after compaction, would be less than the specified layer thickness, the foundation material shall be scarified, the necessary imported material placed, and this combined material mixed and compacted to the full specified depth of the layer.

### **9.6.3 Inspection Pits and Boreholes**

Where shown on the Drawings or instructed by the Engineer, inspection pits shall be excavated (and backfilled on completion of inspection work) and boreholes drilled in foundations for the purpose of establishing the nature of the underlying ground. Tests shall be carried out in-situ and on samples recovered from the pits and boreholes as instructed by the Engineer (see Clause 9.5.21).

### **9.6.4 Inspection of Foundations**

At least one day before any blinding concrete, bedding material or fill is placed, when the Contractor considers that a foundation is ready for construction of any part of the Works to commence, he shall inform the Engineer in writing, who will either approve the foundation in writing or instruct any further work which he may consider to be necessary. The Contractor shall also cooperate with the Engineer in allowing space and time for detailed geological mapping of the exposed excavation surface.

## **9.7 SPECIFIC REQUIREMENTS**

### **9.7.1 Contamination of suitable backfill material**

Wherever granular material suitable for re-use in fill or for bedding and backfilling of underground pipes, culverts or cables is encountered in the excavation for a part of the Works, care shall be taken during that excavation to ensure that this material is not contaminated by unsuitable material. If such suitable granular material is contaminated, the Contractor shall dispose of and replace the contaminated material at his own cost.

### **9.7.2 Cuttings**

In addition to obtaining instructions before commencing bulk excavation in cuttings, the Contractor shall also obtain instructions regarding treatment of the remaining in-situ material exposed after excavation.

If the Engineer considers it necessary, he may instruct the Contractor to widen cuttings already completed or partially completed, by changing slopes, cutting benches or in any other way.

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Excavation surfaces shall be finished to a standard generally attainable with proper care and workmanship, bearing in mind the nature of the material excavated. Care shall be taken not to undercut any slopes causing sections to have a steeper slope than specified.

**9.7.3 Open Drains**

Open drain excavation shall include all excavation required to construct a channel with a bottom width of less than 4 m or V-shaped channels with side slopes steeper than 1:4 and total width at the top of less than 5 m.

Open drain excavations shall be carefully carried out so as not to loosen the remaining in-situ material outside of the drain profile.

**9.7.4 Subsurface Drains or Subsoil Drains**

The width of trenches for subsurface drains shall be 400 mm wider than the outside diameter of the drain or as otherwise shown on the Drawings. The depth of the trench shall be such as to allow the top of the drain to lie 200 mm below the formation or foundation level at the highest point of the drain. The gradient of any length of the drain shall not be less than 1 in 400 or as otherwise shown on the Drawings.

**9.7.5 Culvert Excavation**

Where culverts are to be constructed under trench conditions as defined in Clause 27.5.3, the Contractor shall first construct the fill to a height above the top of the culvert equal to 25% of the height of the culvert or 300 mm whichever is the greater before excavating the trench.

The width of the trench shall be as given in Table 9/2 or as shown on the Drawings.

Where culverts are to be constructed under embankment conditions in a trench as defined in Clause 27.5.3, the width of the trench shall be at least one diameter or span wider than the culvert on either side.

**9.8 MEASUREMENT AND PAYMENT****9.8.1 General**

The rates tendered under this Section shall not include for the general obligations, Contractor's Equipment and work deemed to be covered by the items included in Section 1 - General.

All measurements for payment purposes will be made in cut.

**9.8.2 Bulk Excavations**

The volume of bulk excavation to be measured for payment purposes will be computed from:

- The dimensions of the structure; and
- The excavation payment lines as defined Clause 9.2.1 and indicated on the Drawings.

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No allowance will be made for material bulking. No material excavated in excess of the payment lines shall be measured for payment. The Contractor shall make allowance in the rates to backfill overbreak that is expected to occur during blasting.

### 9.8.3 Trench Excavations

The volume of trench excavation to be measured for payment purposes will be computed from:

- The dimensions of the pipe and the minimum overall trench width as specified in Table 9/2;
- The dimensions of the pipe bedding, or concrete encasement, as shown on the Drawings; and
- The excavation payment line as defined on the Drawings.

No allowance will be made for material bulking. No material excavated in excess of the payment lines shall be measured for payment. The Contractor shall make allowance in the rates to backfill overbreak that is expected to occur during trench blasting or mechanical breaking. The Contractor shall also make allowance in the measured rates for fox-holes based on the coating repair procedure selected.

### 9.8.4 Scheduled Items: General Bulk Excavations (Unrestricted)

#### 9.001 Excavation in all materials to spoil

**Unit: cubic metre (m<sup>3</sup>)**

Measurement will be the net solid volume of the excavated item calculated from the lines and levels given on the Drawings and agreed ground level surveys, based on a vertical payment line. A distinction will be made for the various locations of excavation. Separate measurement will be made for bulk and restricted excavation as well as for carrying out additional controlled excavations in areas where foundation conditions are deemed by the Engineer to be inadequate.

No material excavated in excess of the payment line will be measured for payment, notwithstanding the tolerances in workmanship allowed. The Contractors rates should include for possible overbreak, geotechnical conditions, safe excavation side slopes, shoring if required, etc.

The rate shall include full compensation for all work required to excavate in all materials, including excavation in stages where required, trimming and preparation of exposed surfaces and foundation surfaces, any overbreak, loading and hauling within the free haul distance the excavated material to the designated borrow and spoil areas or temporary stockpiles. It also includes temporary support of excavated surfaces and subsequent removal and disposal of temporary support, scaling down excavated surfaces and removal of loose material and any protective measures provided. No payment will be made for overbreak.

#### 9.002 Excavation in all materials to fill

**Unit: cubic metre (m<sup>3</sup>)**

Measurement will be the net solid volume of the excavations calculated from the lines and levels given on the Drawings and agreed ground level surveys, based on a vertical payment line. A distinction will be made for the various locations of excavation. Separate measurement will be made for bulk and restricted excavation as well as for carrying out additional controlled excavations in areas where foundation conditions are deemed by the Engineer to be inadequate.

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No material excavated in excess of the payment line will be measured, notwithstanding the tolerances in workmanship allowed. The Contractors rates should include for possible overbreak, geotechnical conditions, safe excavation side slopes, shoring if required, etc.

The rate tendered shall include full compensation for all work required to excavate in all materials and load, including excavation in stages where required, trimming and preparation of exposed surfaces and foundation surfaces, any overbreak, temporary support of excavated surfaces and subsequent removal and disposal of temporary support, scaling down excavated surfaces and removal of loose material and any protective measures provided and for temporary stockpiling of material to suit the Contractor's method of working. No payment will be made for overbreak.

Payment for subsequent hauling, offloading, spreading, compaction and shaping to construct fills for general earthworks, embankments, terraces and platforms will be made under the relevant payment items in Section 15 - Backfilling and Bedding.

**9.003      Excavation in all materials to a provisional stockpile      Unit: cubic metre (m<sup>3</sup>)  
within the free haul distance**

Excavation to a provisional stockpile will only be paid on the written instruction of the Engineer.

Measurement will be the net solid volume calculated from the lines and levels given on the Drawings and agreed ground level surveys. A distinction will be made for the various locations of excavation. Separate measurement will be made for bulk and restricted excavation as well as for carrying out additional controlled excavations in areas where foundation conditions are deemed by the Engineer to be inadequate.

No material excavated in excess of the vertical payment line will be measured, notwithstanding the tolerances in workmanship allowed.

The rate tendered shall include full compensation for all work required to excavate in all materials, including excavation in stages where required, trimming and preparation of exposed surfaces and foundation surfaces, any overbreak, temporary support of excavated surfaces and subsequent removal and disposal of temporary support, scaling down excavated surfaces and removal of loose material and any protective measures provided, loading, hauling, dumping at the material stockpile, spreading and watering at the stockpile. No payment will be made for overbreak.

Payment for re-use (reloading, hauling, dumping, spreading and for compaction and shaping) of the stockpiled material will be made elsewhere.

**9.004      Load from stockpile and use for fill or embankment      Unit: cubic metre (m<sup>3</sup>)  
construction**

Not used.

**9.005      Additional excavation in all materials      Unit: cubic metre (m<sup>3</sup>)**

If, after a foundation has been completed, cleaned and trimmed ready for concrete blinding, the Engineer orders further excavations to be made on account of changed dimensions and/or founding conditions, a payment for the additional volume ordered shall be made.

The rate shall include full compensation for the additional excavation in all materials, including any incidentals to the Contractor over and above the normal excavation costs and shall include the



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**9.009 In-situ treatment of foundations**

- |                                          |                                           |
|------------------------------------------|-------------------------------------------|
| <b>a) Compaction of in-situ material</b> | <b>Unit: square metre (m<sup>2</sup>)</b> |
| <b>b) In-situ treatment by ripping</b>   | <b>Unit: cubic metre (m<sup>3</sup>)</b>  |
| <b>c) In-situ treatment by blasting</b>  | <b>Unit: cubic metre (m<sup>3</sup>)</b>  |

For a), the unit of measurement will be the plan area of in-situ material compacted. The rate shall include full compensation for all work required to compact in-situ material to the density specified, including shaping, scarifying, blading to windrow where required, wetting or drying and compacting in-situ material as specified in Clause 9.6.2.5.

For b) and c), the unit of measurement will be the net volume of in-situ material treated in place as specified. The quantity will be calculated from the dimensions instructed by the Engineer in writing to receive the in-situ treatment. The rate shall include full compensation for ripping or blasting, shaping, scarifying, sizing, breaking down, rolling, mixing of in-situ and imported material if required and for preparing, watering and compacting the material as specified in Clause 9.6.2.6.

**9.010 Excavation by hand** **Unit: cubic metre (m<sup>3</sup>)**

The unit of measurement will be the net solid volume calculated from the lines and levels given on the Drawings and agreed ground level surveys.

The rate tendered shall include full compensation for the operation and use of all equipment, labour and materials required to excavate the material on the written instruction of the Engineer, load, haul to a designated spoil dump as specified in Clause 9.5.19, offload, spread, shape, water and compact randomly.

The rate shall be based upon a vertical payment line.

**9.011 Overhaul** **Unit: cubic metre (m<sup>3</sup>)**

Overhaul distances will be measured to the nearest 0.1 km from the end of the 1.0 km free haul, using the shortest practical route agreed with the Engineer from the point of loading to the point of dumping in one direction only as follows (Distance categories to follow the free haul):

- |                                            |                          |
|--------------------------------------------|--------------------------|
| a) Between 1 km up to and including 3 km   |                          |
| b) Between 3 km up to and including 5 km   |                          |
| c) Between 5 km up to and including 7 km   |                          |
| d) Between 7 km up to and including 9 km   |                          |
| e) Between 9 km up to and including 11 km  |                          |
| f) Between 11 km up to and including 13 km |                          |
| g) Distances further than 13 km            | Unit: m <sup>3</sup> .km |

The rate tendered shall include full compensation for all costs associated with loading, transporting and tipping of material applicable to the greater distance in a distance category over and above the free haul distance, including equipment, materials, fuel and personnel.

No payment will be made against this item for overhaul of material used for reinstatement of Contractor's working and accommodation areas (including the areas designated for the Engineer's use) and temporary roads.

### 9.8.5 Scheduled Items: Trench Excavations

**9.012 Excavate in all materials to specified levels and vertical payment lines, including temporary stockpiling and levelling alongside excavations within the confines of the servitude within the free haul distance of up to and including 1km.** Unit: cubic metre (m<sup>3</sup>)

- a) No material excavated outside of the payment line will be measured for payment.
- b) **Classified trench excavations** for pipelines, culverts, drains, cables, conduits, etc. will be measured by volume (m<sup>3</sup>), for the following excavation depth categories:
  - i) Up to 1 m deep;
  - ii) Over 1 m and up to 2 m deep;
  - iii) Over 2 m and up to 3 m deep;
  - iv) Over 3 m and up to 4 m deep;
  - v) Over 4 m and up to 5 m deep; and
  - vi) Over 5m deep.

Unless otherwise ordered or stated in the Specification, the maximum depth for classified trench excavation will be measured on the pipe centre line from the ground surface after the topsoil had been removed to the bottom of the Bed layer, unless a different sequence of execution has been ordered.

- c) **Unclassified trench excavations** for pipelines, culverts, drains, cables, conduits, etc. will be measured by volume (m<sup>3</sup>), for the different incremental depth categories indicated in b) above or as given in the Bill of Quantities.

Unless otherwise ordered or stated in the Specification, the depth for a depth category will be measured from the ground surface after the topsoil had been removed to the bottom of the Bed layer, unless a different sequence of execution has been ordered.

- d) No separate additional payment will be made for filling excess excavations or any other contingent work, except where the work is specifically prescribed and scheduled.
- e) The length used for computation will be the total through-length of the pipeline, from end to end and no deduction will be made for valve chambers, manholes, scour valve chambers, air valve chambers and the like.
- f) The volume calculated for measurement for classified or unclassified excavation under b) and c) above, shall exclude the volume of topsoil and fertile soil measured under Items 7.004 and 7.005.

The rate shall include full compensation for all work required to excavate in all materials (including hard excavation), including excavation in stages where required, removal of loose material, trimming and preparation of the trench bottom, loading, hauling, dumping and levelling the re-usable excavated material alongside the trench excavation all within the confines of the pipeline servitude within the free haul distance. No payment will be made for overbreak.

The loading from temporary stockpiles, hauling in excess of the free haul of unsuitable / surplus excavated material to the designated borrow pit or spoil site and offloading is covered under item 9.023, The handling of imported materials at borrow pits and spoil areas are covered under item 14.006.

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**9.013 Additional excavation in all materials beyond the Trench Payment Line for valve chambers, thrust blocks, etc. Unit: cubic metre (m<sup>3</sup>)**

Measurement will be the cubic metre of material excavated beyond the Trench Payment Line to the Structure Payment Line, over the length of the structure. Any further working space required by the Contractor will not be measured and shall be backfilled with selected material compacted to 90% Mod AASHTO density, or in the case of thrust blocks with mass concrete, at the Contractor's expense.

The rate shall include full compensation for all work required to excavate in all materials, trimming and preparation of exposed surfaces and moving material to temporary stockpiles, temporary support of excavated surfaces and subsequent removal and disposal of temporary support, and any protective measures provided. No payment will be made for overbreak, loading and hauling the excavated material to the designated spoil dumps as specified in Clause 9.5.19, offloading, spreading, shaping, watering and compaction to the density specified.

**9.014 Extra-Over items 9.012, 9.013, 9.016 and 9.021 for: Hard Excavation for classified and unclassified material (blasting) Unit: cubic metre (m<sup>3</sup>)**

Where applicable, refer to Annexures 33/2 and 33/4 in Section 33 – Laying and Testing Steel Pipes for Transnet and Eskom requirements respectively.

Hard excavation will only be measured where the material being excavated comprises hard rock as defined in Clause 9.2.

The tendered rate shall also cover the costs for drilling, blasting, removal of overburden, excavation of blasted material and moving to temporary stockpile.

The loading, handling, transporting from the temporary stockpile, offloading and disposal thereof to an approved waste disposal site is covered under item 9.023.

Refer to Clause 9.5.20.3 – All cost associated with over-excavation / overbreak will be for the Contractors account.

**9.015 Excavate by hand in soft material to expose existing services Unit: cubic metre (m<sup>3</sup>)**

The rate shall cover the cost of excavation by hand, delays to and disruption of the progress of the work caused by the search for the particular service, in addition to the cost of searching for it. The unit of measurement shall be cubic metre of material excavated and shall include for backfilling and specified compaction. The rate shall be based upon a vertical payment line.

The load from the temporary stockpile, haul to a designated spoil dump, offload and spread, shape, water and randomly compact the material in the spoil dump is covered under item 9.023.

**9.016 Excavation and disposal of unsuitable / surplus material from trench bottom to temporary stockpile within free haul distance. Unit: cubic metre (m<sup>3</sup>)**

The rate shall include full compensation for all work required to excavate in all materials, including excavation in stages where required, removal of loose material, trimming and preparation of the trench bottom, loading, hauling the excavated material to the temporary stockpile within the free haul distance. No payment will be made for overbreak.

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The load from the temporary stockpile, haul to a designated spoil dump, offload and spread, shape, water and randomly compact the material in the spoil dump is covered under item 9.023.

**9.017 Provide and use of specialist team and equipment for the detection of underground services**

- |                                        |                      |
|----------------------------------------|----------------------|
| a) Provide the team and equipment      | Unit: lump sum (Sum) |
| b) Use, operate and maintain equipment | Unit: days (day)     |
| c) Remove the team and equipment       | Unit: lump sum (Sum) |

The rate for the provision and removal of the specialist team and equipment shall cover the cost of providing the team and equipment on site and for the removal from site when no longer required.

The rate for the use, operation and maintenance of the equipment shall cover the cost of using, operating and maintaining the equipment, only for the days actually required, to search for the services as listed. The rate for b) shall also cover the costs of any delays and disruption to the progress of the work, caused by the search for the particular service, in addition to the cost of searching for it.

**9.018 Existing services that intersect or adjoin a pipe trench**

- |                                          |                   |
|------------------------------------------|-------------------|
| a) Services that intersect a pipe trench | Unit: number (No) |
| b) Services that adjoin a trench         | Unit: metre (m)   |

- a) Services that intersect a trench (between centre-lines in plan of 45° – 90°):

Except where pipes are to be recovered, existing water pipes, sewers, storm water pipes, concrete-lined channels and drains, box culverts, electrical cables, ducts, kerbs, channels, erf / farm connections and various sizes of pipes and services that intersect the trench and require various degrees of care, whether or not their presence is known before they are uncovered, will be measured separately for various widths of trench. The unit refers to one service, but services that are so grouped that they can be contained within a horizontal dimension of 1m measured at right angles to the axis of the services will be measured as one unit.

- b) Services that adjoin a trench (parallel to or at an angle between centre lines in plan of less than 45°):

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;
- 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; and
- The length of service within the minimum base width of the trench will be measured for payment under this item and the remaining length, the side of the trench which, in the opinion of the Engineer, is rendered liable to collapse because of the existence of such service, will not be measured separately for shoring.

The rate for an item scheduled in terms of a) and b) above shall cover the additional cost of:

- Care in excavation necessitated by the presence of such service in or across the trench;
- Protecting and maintaining such service in operation by means of temporary supports or shoring, as necessary;

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- Delays and disruption of the progress of the work due to the existence of the service; and
- Repairs necessitated by damage to the service caused by the Contractor.

**9.019 Foundation preparation**

The trench foundation surface preparation as per Clause 9.5.9 a) will not be measured separately.

**9.020 Compaction of trench bottom****Unit: square metre (m<sup>2</sup>)**

The trench foundation surface preparation as per Clause 9.5.9 b) will be measured as the plan area for the compaction of the in-situ material of the excavated trench bottom.

The rate shall include full compensation for all work required to compact the trench bottom in-situ material, as specified under Clause 9.5.9 b), including scarifying, wetting, drying and compacting.

The payment item for work done under Clause 9.5.9 c) is 15.008.

**9.021 Excavation by hand****Unit: cubic metre (m<sup>3</sup>)**

Measurement will be the volume of material excavated by hand and will be measured as net solid volume calculated from the lines and levels given on the Drawings and agreed ground level surveys, based on a vertical payment line.

The rate tendered shall include full compensation for the operation and use of all equipment, labour and materials required to excavate and temporary stockpile the material on the written instruction of the Engineer.

The load from the temporary stockpile, haul to a designated spoil dump, offload and spread, shape, water and randomly compact the material in the spoil dump is covered under item 9.023.

**9.022 Slurry trenches / curtain walls****Unit: vertical square metre (m<sup>2</sup>)**

Measurement will be the vertical area of the slurry trench or curtain wall calculated from the lines and levels given on the Drawings, agreed ground level surveys and agreed slurry trench invert levels.

The rate tendered shall include full compensation for the operation of all equipment, labour and materials required to excavate in all materials and backfill with all materials required to achieve an effective water barrier (e.g. bentonite slurry).

The rate shall, in addition, include the design and planning of the subterranean water barrier, submission of a Method Statement for approval, all support, loading, hauling and disposal of surplus material to a designated spoil dump as specified in Clause 9.5.19, offload, spread, shape water and randomly compact the material in the spoil dump.

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**9.023 Overhaul****Unit: cubic metre (m<sup>3</sup>)**

Overhaul distances will be measured to the nearest 0.1 km from the end of the 1.0 km free haul, using the shortest practical route agreed with the Engineer from the point of loading to the point of dumping in one direction only as follows (Distance categories to follow the free haul):

- a) Between 1 km up to and including 3 km
- b) Between 3 km up to and including 5 km
- c) Between 5 km up to and including 7 km
- d) Between 7 km up to and including 9 km
- e) Between 9 km up to and including 11 km
- f) Between 11 km up to and including 13 km
- g) Distances further than 13 km

Unit: m<sup>3</sup>.km

The rate tendered shall include full compensation for all costs associated with loading, transporting and tipping of material applicable to the greater distance in a distance category over and above the free haul distance, including equipment, materials, fuel and personnel.

No payment will be made against this item for overhaul of material used for reinstatement of Contractor's working and accommodation areas (including the areas designated for the Engineer's use) and temporary roads.

**9.024 Excavation of test pits****Unit: number (No)**

Measurement will be the number of test pits excavated, irrespective of depth.

The rate tendered shall include full compensation for the operation of all equipment, labour and materials required to excavate the test pits along the centre line of the pipeline at a nominal spacing of 25 m down to the hard excavation level as agreed with the Engineer, survey work required to determine position of the test pit (X, Y co-ordinates and chainage along the pipeline) and the ground and hard excavation levels of the test pit, recording of the position of the test pit and the ground and hard excavation levels, submission of the results of the survey work to the Engineer and backfilling and compaction of the backfilling to 90% Mod AASHTO on completion.

**9.025 Extra-Over items 9.012, 9.013, 9.016 and 9.021 for:****Unit: cubic metre (m<sup>3</sup>)****Hard Excavation for classified and unclassified material (by non-explosive means)**

Hard excavation will only be measured where the material being excavated comprises hard rock as defined in Clause 9.2. Where excavation in hard material by non-explosive means is required in terms of the specification or ordered by the Engineer, this shall be measured by volume.

The unit of measurement will be the net solid volume calculated from the lines and levels given on the Drawings and agreed ground level surveys. No payment will be made for excavation in hard material by non-explosive means if such excavation is as a result of the Contractor's omissions.

The rate tendered shall cover the additional cost (additional to the cost of excavation in all materials) of hard excavation by non-explosive means drilling, removal of overburden, excavation of hard material, handling, transporting, offloading and disposal thereof to an approved waste disposal site.

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Refer to Clause 9.5.20.3 – All cost associated with over-excavation / overbreak will be for the Contractors account.

Refer to Clause 9.5.21.