



Republic of Kenya



## **ATHI WATER WORKS DEVELOPMENT AGENCY**

CKE 1135

NAIROBI WATER AND SANITATION PROJECT

### **CONSTRUCTION WORKS FOR REHABILITATION OF CENTRAL NAIROBI AREA WATER NETWORK PROJECT**

## **Bidding Document Volume III**

- **CONTENTS**
- **General and Particular Specifications**
- **including ESHS and Security Specifications**

**28<sup>th</sup> MAY 2024**

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**BIDDING DOCUMENTS**

**for**

**Procurement of**

**CKE 1135**

**NAIROBI WATER AND SANITATION PROJECT**

**BID No.: AWWDA/AFD/NWSP/W-03/2023**

**CONSTRUCTION WORKS FOR REHABILITATION OF  
CENTRAL NAIROBI AREA WATER NETWORK PROJECT**

**Employer: Athi Water Works Development Agency**

**Country: Kenya**

**Issued on: [28<sup>th</sup> MAY 2024]**

Bidding Documents have been compiled in the following Volumes:

- i)      **Volume I**                      - Instructions to Bidders, Bid Data Sheet, Evaluation and Qualification Criteria, Bidding Forms, Works Requirements, Conditions of Contract and Contract Forms
  
- ii)     **Volume II**                    - Bills of Quantities
  
- ii)     **Volume III**                   - General and Particular Specifications and Standard Reference Numbers
  
- iii)    **Volume IV**                    - Engineering Drawings

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## **SECTION 1: GENERAL AND PARTICULAR SPECIFICATIONS**

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## **1. GENERAL**

All materials, equipment and testing apparatus etc. to be furnished and Works to be executed by the Contractor in this Contract shall conform to the requirements of the latest Kenya Standards, International Standards Organization (ISO), European Norm (EN), Deutsches Institut für Normung (DIN), British Standards (BS) or other approved applicable Standards in Kenya.

Equipment to be purchased shall be from well recognized manufacturers whose products are standardized and controlled by any recognized Standards Organization. All dimensions and measurement units shall be in S.I. units.

The equipment to be employed by the Contractor shall have sufficient performance capacity and durability as to secure the completion of the Works within the construction period stipulated under the Contract. All materials and equipment shall be subject to inspections or tests by the Engineer at any time and in any state of completion both off-site and on-site as he deems necessary. The Contractor shall furnish promptly, without additional charge, all facilities, labour and materials reasonably needed for performing such inspections and tests as may be required by the Engineer.

The Contractor shall make diligent efforts to procure the specified materials, but when the materials specified are unavailable, for reasons beyond the control of the Contractor, substitutes may be used with prior written approval of the Engineer.

### **101. OFFICES FOR THE RESIDENT ENGINEER**

For Supervision of the Works, 1Nr. Rented Office will be established in Nairobi. The Contractor to provide the rented office from the date of Commencement of Work. The Office including location shall be to the Resident Engineer's approval.

The Office shall be of a design and construction approved by the Engineer and shall be constructed of strong, durable and weatherproof materials with walls, ceilings and floors adequately insulated against heat and cold.

The Office shall have a floor area of at least 200 square metres with burglar proofing to all windows and external doors. Provide shaded parking (carports) for at least four (4) vehicles.

Provision shall also be made by the Contractor for all necessary gas, electricity, kerosene, water, light, attendance and stationery required in connection with execution of the Contract.

Security Guards hired from a reputable Security Firm approved by the Engineer shall be provided for day and night security at these Offices. The Office, furniture and equipment shall be insured against fire, theft and natural calamity.

The following minimum equipment and furniture detailed as following:-

**Table 1-1 Equipment and Furniture**

ID	Description	Unit	Qty
1	Writing Desk Type 1: 1800mm long x 750mm wide executive Desk with Side Return Table	Nr	2
2	Writing Desk Type 2: 1800mm long x 750mm wide office Desk with Side Return Table	Nr	2
3	Workstation: 4-Seater Multiple Way Workstation	Nr	2
4	Chairs Type 1: Medium Back, Mesh, Swivel Office Chair	Nr	10
5	Chairs Type 2: Normal Office Visitors Chairs	Nr	6
6	Lockable Office Filing Cabinets	Nr	3
7	16-seater conference table with cable management	Nr	1
8	Conference Chairs: Airmesh Medium Back Chairs	Nr	16
<b>A. Office Equipment</b>			
9	Projector	Nr	1
10	Power Back-up: Battery Backup Power and Surge Protection for Computers and other electronics	Nr	4
11	Fridge: 213 litre capacity	Nr	1
12	Cooker: 2 burner plus 13kg gas cylinder (filled), regulator and pipe connection	Set	1
13	Self-Standing Water Dispenser: Hot-Warm-Cold	Nr	2
14	Kitchen Microwave, min 1200W	Nr	1
15	Electrical extension cables minimum 4 plug, 5meters	Nr	4
<b>B. Other Office Equipment and Furnishes</b>			
16	Wall Mounted Pin Board – 2.4m x 1.2m.	Nr	1
17	Wall Mounted White Board – 2.4m x 1.2m.	Nr	1
18	Fire Fighting Equipment <ul style="list-style-type: none"> <li>• 1Nr. CO2 fire extinguishers 9 litres</li> <li>• 1Nr. H2O fire extinguishers 9 litres.</li> <li>• 1Nr. Fire blanket</li> </ul>	set	1
19	Binding Machine suitable to bind up to 40mm spirals.	Nr	1
20	Heavy Duty Stapler	Nr	1
21	Hot Water Kettle, 3lts, cordless	Nr	1
22	Assorted Kitchen Utensils	Lot	1
<b>C. Digital Equipment</b>			
23	"GENUINE" Desktop Computer 2.7GHz, Intel Core i7,	Nr	4



ID	Description	Unit	Qty
	11th Gen PC, 16GB RAM, 1TB HDD, No TFT, Intel UHD Graphics 630, DVDrw, USB Ports, Ethernet, HDMI, Card Reader, Windows 10 Pro and MS office 2021 Professional, Keyboard, Mouse, Power Cord, 27 Inch Quad HD Monitor and 1 Year Warranty. For 2 desktops, provide 2Nr. Autodesk Architecture Engineering & Construction Collection (AEC) IC Commercial New Single-user ELD Annual Subscription licenses.		
24	Ditto but a GENUINE Laptop Computer; Core™ i7-9750H 2.6GHz 1TB+500GB SSD+16GB, 15.6" (1920×1080) BT, Windows 10 Pro and MS office 2021 Professional, Webcam NVIDIA® GTX 1650 4096MB. For 2 laptops, provide 2Nr. Autodesk Architecture Engineering & Construction Collection (AEC) IC Commercial New Single-user ELD Annual Subscription licenses.	Nr	4
25	Provide "GENUINE" A3 Colour printer, with wireless capability, that is able to Print, Copy, Scan and Fax as Kyocera TASKalfa 2552ci or similar equivalent. Designed for minimum ISO Print Speed: Black: 20 ISO ppm; Color: 20 ISO ppm.	Nr	1
26	2 TB Network Attached Storage Drive. For central document storage.	Nr	1
27	Mobile Phone Handsets for the Engineer and the Employers Project Management Staff	Sum	1
28	Mobile Handsets for Resident Engineers Staff	Sum	1

#### 101.(a) PROVISIONS AND CONSUMABLES FOR THE RESIDENT ENGINEER'S OFFICES

Stationery required **monthly** are as follows:

**Table 1-2 Monthly Stationery**

Stationery	Quantity for Office
Photocopy paper A4	4 Reams
A3 paper	2 Ream
Biro pens blue/black	½ Doz.
Clutch Pencils	½ Doz.
Box files	6 Nr

<b>Stationery</b>	<b>Quantity for Office</b>
Spring Files	6 Nr
Document Wallets	6 Nr
Spirals (various sizes of Reports)	2 Doz.
Embossed (hardback cover)	2 Doz.
Perspex covers	2 Doz.
Cello tape (medium)	1 Nr
Masking tape (medium)	1 Nr
Staples	2 Pac.
Paper clips (various sizes)	2 Pac.
Pencil leads (0.5/0.7)	2 Sets
CDR (Pack of 12)	1 Pac.
CD-RW (Pack of 12)	1 Pac.
4GB Flash drive	1 Nr
Highlighters (set of all colours)	2 Sets
A6 hardcover notebooks	2 Nr
Soft Pencil Erasers (Staedtler or equivalent)	3 Nr
Envelopes (all sizes)	3 Doz.
Black ink cartridge/ toner for the A4/A3 printer	1 Set
Colour cartridges/toner for the A4/A3 printer	1 Set

The Contractor will also be responsible for the following services for each Office:

- i) Payment for all services including water, electricity and sewerage.
- ii) Guarding of the premises (24-hour security services);
- iii) Maintaining insurance against fire and theft of equipment and other materials from the offices;
- iv) Service, maintain / repair office equipment and appliances;

The cost of all the above services shall be included by the Contractor under the relevant items in Bill No. 1 – Preliminaries and General for supply of Provisions and Consumables

for the Resident Engineer's Offices. Apart from the consumables, the rest of equipment will revert to the Employer at the end of the Contract.

#### **101.(b) STAFF FOR THE RESIDENT ENGINEER'S OFFICES**

The Contractor shall provide as listed under the relevant items in Bill No. 1 – Preliminaries and General

- (i) Drivers
- (ii) Office Secretaries
- (iii) Office cleaners / tea people
- (iv) Chain men/women

for the exclusive use of the Resident Engineer for the duration of the Contract. The secretary shall be English speaking, with a minimum 5 years' experience in secretarial / office administration work. The secretary shall be conversant with standard office computer hardware and software (MS-Word, Excel, PowerPoint, etc.). The Secretary shall be interviewed and tested by the Resident Engineer prior to deployment on the Works.

Office Assistants (messenger / tea boy / office cleaner) shall also be provided by the Contractor exclusively for the Resident Engineer's Office.

The Contractor shall provide the services of one Chainman as and when requested for the sole use of the Engineer and Engineer's Representative for the whole period of the Contract.

#### **101.(c) PROJECT VEHICLES**

The Contractor shall service and maintain the vehicles to be used for supervision of the Contract by the Resident Engineer and his staff.

The Contractor shall ensure that all vehicles are licensed, comprehensively insured at all times, serviced and maintained in good condition to the satisfaction of the Resident Engineer or his authorized representative, so that the Resident Engineer shall at all times have the vehicles available for use in good serviceable condition. Regular servicing should be carried out at an approved service center and service records maintained at Resident Engineer's office. In the event of the vehicles being unserviceable for whatsoever reason, the Contractor shall provide alternative vehicles at his own cost of the same model in compliance with the provisions of this clause. The cost for such replacement vehicle to be covered by his rates.

Payments for maintenance shall include for provision of fuels, lubricants and tyres, all regular maintenance, minor and major repairs, including those occasioned by accidental damage from whatever cause arising, and everything else necessary to satisfy fully the requirements of this Clause.

The makes, models and colours of the vehicles shall be approved by the Resident Engineer prior to ordering.

The Contractor shall, at completion bring the vehicle to the appropriate dealers for testing. The dealers shall recommend to the Engineer's Authorized Representative what repairs in addition to the ordinary service are required to be carried out on the vehicle. The Contractor shall then ensure the necessary service/repairs are done. A certificate of road

worthiness and satisfactory mechanical condition to be obtained from the Dealer.

The following will be carried out:

- Inspection by the Government Inspection Unit, if applicable
- Inspection and Valuation by the Automobile Association (AA) of Kenya

The Contractor shall hand over the respective Inspection / Valuation Reports to the Employer together with the vehicles. A Prime Cost item has been included in the Preliminary and General Items bill to cover running and maintenance costs of the Project Vehicles. The vehicles will revert back to the Employer at the end of the Contract.

#### **101.(d) DRIVERS**

The Contractor shall provide licensed drivers for the exclusive use of the Resident Engineer or his authorized representative. The drivers shall be available at all times during normal working hours and when specifically required by the Resident Engineer or his authorized representative, outside these hours.

The drivers shall have a minimum 10 years of clean driving record and a Certificate of Good Conduct from the Kenya Police. The drivers are to be employed and paid by the Contractor (including all overtime, NSSF, NHIF, etc.) but will report directly to the Resident Engineer for day-to-day instructions. The Resident Engineer will interview, test and approve the drivers prior to their deployment on the Works.

#### **101.(e) SURVEY EQUIPMENT**

Listed below are the principal items of survey equipment to be made available for use during the whole duration of Project Implementation. All equipment shall be as new and with all necessary carrying containers, manuals, insurances, etc. The Equipment to revert to Contractor at completion of all Works.

**Table 1-3 Survey Equipment**

<b>Equipment</b>	<b>Quantity</b>
Real time Kinematic (RTK) GPS Machine with Base Station and 2 Nr. Rovers	1 Nr
Total Station including tripods, complete with reflectors, poles, brackets and carrying case (Wild or similar)	1 Nr
Automatic Level (Wild or Similar) with legs and metric staff, complete with carrying case	1 Nr
Metric extending levelling staffs with vertical bubble	2 Nr
30m (enamelled or otherwise protected) steel bands	2 Nr
3 metre ranging rods	10 Nr
Survey umbrellas with stand	2 Nr
Work boots	8 sets
Rain Gear (trousers and jacket type, complete with rain hat)	8 sets
Hard hats	12 sets
5 metre retractable pocket steel tapes	8 Nr
30 metre metal tapes	4Nr
100 metre metal tapes	3Nr
Builders spirit levels 1000mm long	4 Nr

Equipment	Quantity
Hammers 3 kg each	4 Nr

The Contractor shall also supply pegs, crayons, spray paint, nails and all other items required for setting out and measuring the work.

The Contractor shall be responsible for maintaining the survey and field equipment throughout the Contract Period, including replacement of items damaged during the normal course of the Works.

The Contractor shall provide all such labour and assistance as may be required by the Engineer for checking the Contractor's setting out and/or survey.

The Contractor shall make available such labour, materials, equipment and consumables as the Engineer may require from time to time, for inspections and tests in connection with the Works.

#### **101.(f) ACCOMMODATION**

The Contractor to make provision for accommodation for the Resident Engineer (RE), Assistant Resident Engineer (ARE) and Inspectors of Works. The furnished rented houses shall be to the approval of the Resident Engineer and shall comply with all his requirements. All costs in connection with the rental of house, supply, consumption and maintenance of water supply, electrical power, house help, etc., shall be borne by the Contractor. Provisions of full-time security guards shall be made for the houses for day and night security. The provision for this is made under the relevant item in Bill No. 1 – Preliminaries & General.

#### **102. OFFICE FOR CONTRACTOR**

The Contractor shall have an office on the Sites to be approved by the Engineer and which shall be open and attended to at all hours during which work is in progress.

#### **103. CONTRACTOR'S STAFF AND WORKMEN**

The Contractor shall agree to employ Kenyan workers to the maximum extent possible. The Contractor shall provide a competent Site Agent to the approval of the Project Manager to be in charge of the work who shall not be changed except with the consent of the Project Manager.

The Contractor agrees that his workmen and employees shall be considered for all purposes in his direct pay and employment and under his supervision and control. He shall be directly and personally responsible for discharging all obligations, financial or other, which may be or becoming owing to any such workman or employee or to his successors, assignees or personal representatives. There shall be no contractual or legal relations of any kind whatsoever between the Employer and any such workman, employee or any person employed in the performance of the Contractor's obligations under this Contract.

The Project Manager may request and the Contractor agrees to accept the request for the immediate removal from the site of any employee or worker of the Contractor adjudged by the Project Manager to be incompetent, disorderly, and unreliable or of bad character. Such employee shall not again be employed on the Works.

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#### **104. CLIMATE CONDITIONS**

The Bidder to verify on his own, the climate conditions in the Project Area with the Kenya Meteorological Department including rainfall, temperature, etc. and make his Work Plan accordingly.

#### **105. LEVEL DATUM**

Before the commencement of Construction Work the Contractor shall establish, in a position to the approval of the Engineer, a benchmark comprising of steel datum pegs which shall be securely concreted in. The level of these pegs shall be established and agreed with the Engineer and all levels used in the construction of the Works shall be referred to these established datum points. The correctness of this datum shall be checked at regular intervals during the construction period as agreed with the Engineer.

Where possible construction drawings and all levels used for construction shall be referred to the national height datum as defined by the Survey of Kenya. The Contractor shall be responsible for obtaining the location and values of the permanent benchmarks. In cases where such benchmarks do not exist, the site datum shall be agreed with the Engineer.

#### **106. SETTING OUT OF THE WORKS**

The Site Layout Drawings show indicative Site Layouts. Prior to commencing construction, the Engineer will agree with the Contractor the basic information supplementary to that shown on the Drawings such as the position of manholes, chambers, centrelines and base-lines sufficient for the Contractor to locate the Works.

The Contractor shall prepare detailed Setting Out Drawings and Data Sheets as necessary and submit them to the Engineer in triplicate for approval. Any modifications to the Setting Out Drawings or Data Sheets required by the Engineer shall be made by the Contractor and resubmitted for final approval. Should it be necessary during setting out or during construction for the approved setting out details to be amended, the Contractor shall amend the Drawings or Data Sheets or make new ones for approval as required by the Engineer.

For water pipelines, sewers, etc. the Contractor shall in the presence of the Engineer set-out the pipeline alignments in accordance with the indicative alignments shown on the drawings taking into account physical features on the ground, any existing services, any requirements of relevant Authorities and any changes deemed necessary by the Engineer, confirming the locations of all valves, air valves, washouts, hydrants, bends, manholes, etc.

The Contractor shall prepare and submit to the Engineer, at an approved scale, Plans of the Water / Sewer line Pipeline Routes and profiles of ground levels after any initial clearing of the wayleave or easement showing the proposed pipe invert levels and precise chainages for all valves, fittings, manholes, etc. for approval. Following approval, the Contractor shall submit to the Engineer two copies of the agreed alignment and profiles.

The Contractor shall also be required to carry out Site / Engineering Survey of demarcated land where permanent structures / appurtenances will be constructed as directed by the Engineer after initial clearance of sites. The Contractor shall prepare an updated layout plan with contours at 1.0m interval. The contours shall be generated from a 10x10m grid topo survey.

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## **107. CONTROL OF TRAFFIC**

In the event of single way traffic becoming necessary on any particular section of the Works, or on the approaches to the Works, the Contractor shall, in maintaining through traffic routes, provide a width of at least 3 metres for single way traffic. He shall also provide approved electrically operated signals for traffic control on each of the affected sections and any additional traffic signs as may be directed in accordance with Clause 108. Signal lights are to be operated by competent operators provided by the Contractor, if and when required by the Engineer. Manually operated "Stop-Go" signs will only be permitted if approved by the Engineer, and shall be of the size, colour and type authorized. The Contractor shall be responsible for liaison with Police.

## **108. TEMPORARY DIVERSION OF TRAFFIC**

Temporary diversion ways, including those listed in any schedule to the Bill of Quantities shall be constructed whenever the site is intersected by existing public and private roads, footpaths, cycle tracks, farm accesses, temporary and accommodation roads.

Any diversion way shall be of such a standard of construction that it is suitable in all respects for the class or classes of traffic requiring to use it. It shall be constructed in advance of the taking up of the existing way and regularly maintained for so long as required in a satisfactory condition all to the approval of the Engineer.

## **109. TEMPORARY TRAFFIC SIGNS**

The Contractor shall erect and maintain on the Works and at prescribed points on the approaches to the Works, all traffic signs necessary for the warning, direction and control of traffic and the size of all such signs and the lettering and wording thereon shall be reflectorised or adequately illuminated at night by approved means.

## **110. PROTECTION OF WORKS**

The Contractor shall carefully protect from injury by weather all work and materials which may be affected thereby.

## **111. SURVEY BEACONS**

During the progress of the Works, the Contractor shall not remove, damage, alter or destroy in any way whatsoever, any plot or survey beacons. He shall notify the Engineer of the need to interfere with any beacon. The Engineer shall authorize any removal and reinstatement that he considers necessary. Should any beacon be found to be above or below the level of the finished work, the Contractor shall immediately report the same to the Engineer.

Should any beacon be damaged or destroyed, the Contractor shall forthwith report the damage to the Engineer and to the Director of Surveys and shall be held liable for the cost of reinstatement thereof.

## **112. DAMAGE TO LAND**

The Employer shall provide the Site upon which the Permanent Works are to be constructed. Where a drain or pipeline is to be within an existing road or track reserve or is otherwise located in land designated Public Domain, the Site width will be restricted to the limit of the public land. The existing boundary fences and walls shall not be disturbed without prior approval of the Engineer and, unless road diversions and closure notices are



approved and posted, carriageways shall be left available for the safe passage of traffic.

Except where specified for the proper execution of the Works, the Contractor shall not interfere with any fence, hedge, tree, land or crops within, upon or forming the boundary of the site or elsewhere. In the event of such interference, the Contractor shall make good to the satisfaction of the owner and the Engineer and shall pay to the owner such damages as the Engineer may determine.

The Contractor shall not enter upon or occupy with men, tools, equipment or materials any land other than the site without the written consent of the owner of such land.

On occupation of the Site or other land the Contractor shall provide such fencing, as required.

### **113. RIVERS AND DRAINS**

The Contractor shall at all times maintain the free flow of rivers and drains and prevent excavated material from the Works from being deposited in them.

### **114. REINSTATEMENT OF ROADS AND FOOTWAYS FOR WATER MAINS AND SEWER CROSSINGS**

The Contractor shall allow in his rates for liaison with the relevant Roads Authority and obtain a Road Opening Permit. Statutory fee for road crossings will be paid under relevant Item in the Bills of Quantity.

The road crossings shall be constructed in the following specifications and any other requirement stipulated by the Road Authority:

- Excavated width of the trench shall not be less than 1m to ensure compaction to required standard
- Protective concrete raft slab shall be constructed for sewer pipes as per details given in the drawings.
- Backfilling shall be carried out with suitable selected excavated material up to the top. Surplus excavated material to be carted away to tips.
- 300mm, in layer thickness not exceeding 150mm at optimum moisture content
- The top 300mm layer shall be backfilled in two layers of 150mm each comprising of well graded stabilized gravel with 3% cement content at optimum moisture content
- Tarmac roads shall be reinstated to the original condition using approved asphalt from a recommended supplier.

The Contractor shall be responsible for all liaison with the Police for traffic control during execution of the works.

### **115. TEMPORARY WORKS**

The Contractor shall provide, maintain and remove on completion of the Works all temporary Works including roadways, sleeper tracks and stagings etc., over roads, footpaths, suitable in every respect to carry all plant required for the work or for providing access or for any other purpose.

Details of Temporary Works shall be submitted in advance to the Engineer for his



approval and the approval shall not relieve the Contractor of complete responsibility for their safety and satisfactory operation.

#### **116. LIGHTING AND GUARDING OF OBSTRUCTIONS**

The details of the method of signing and guarding an obstruction to traffic caused in the course of the execution of the Works shall be submitted to the Engineer for approval before that portion of the Works is commenced.

No greater area of the road than the Engineer considers necessary shall be closed at any one time.

Temporary traffic signs shall comply with Clause 108. Generally, the following precautions will be required:-

##### **Signing**

An advance warning sign at least 1.22m x 0.92m in size and 70 metres in advance of the obstruction will be required, and where an appreciable change of direction is necessary at the obstruction, a sign (of the arrow or chevron type) at the obstruction itself. At particular danger points more comprehensive signing may be required.

##### **Guarding**

The obstruction shall be marked by posts carrying red flags or reflective red markers and by red lamps. The latter shall be spaced at 6 metres intervals in the direction of traffic flow and at 0.9 metres intervals across this direction. At least 3 lamps shall be placed across this direction of traffic flow. The flags and lamps on the traffic side of the obstruction shall be at least 5 metres from it.

##### **Footpaths**

Where a footpath is affected by an obstruction in any way it shall be separated from both obstruction and traffic by effective banners and red lamps spaced at 0.9 metres intervals.

#### **117. EXISTING SERVICES**

Before commencing Works which include excavation or ground levelling by manual or mechanical excavation the Contractor shall at his own expenses ascertain in writing from Telkom Kenya, Kenya Power & Lighting Co. Ltd., Data Cables Companies, the Water Services Provider, Sewerage services provider and all other Public Bodies, Companies and persons who may be affected, the position and depth of their respective ducts, cables, mains, pipes, or other appurtenances. He shall thereupon search for and locate such services.

The Contractor shall at his own expense arrange to have effectually propped, protected, underpinned, altered, diverted, restored and made as may be necessary, all water courses, pipes, cables or ducts, poles or wires or their appurtenances disturbed or damaged during the progress of the Works, or in consequence thereof.

Where interruptions are expected, Contractor is required to liaise with the authority for approval on the interruption schedule. Shutdowns in residential areas shall be limited to 8:00 to 18:00 on weekdays, while those in the business district and industrial areas shall be limited to 08:00 to 18:00 on weekends. No interruption shall be permitted in an area beyond the aforementioned durations without the approval of the Engineer. The

Contractor shall strive to ensure that no disruption of any service exceeds 24 hours.

The Contractor should provide temporary connections, bypass services or other approved remedies to ensure uninterrupted service to customers where possible. For water supply,

Except that such services as require to be removed or altered by virtue of the layout of the permanent work and not the manner in which the work is carried out, shall be so removed or altered at the direction and at the expense of the Employer.

The Contractor shall be liable for the cost of repairs to any services damaged as a result of carrying out the Works and execution of these Works.

#### **118. CONNECTIONS TO EXISTING PIPES AND EQUIPMENT**

The Contractor shall be responsible for joining up and making connections between water pipes, sewer pipes, etc. equipment installed by him and existing facilities. The Contractor shall submit to the Engineer a drawing showing the details of the connection and shall state the date on which the particular connection is required, and the work shall not proceed until the Engineer's approval has been given.

The Contractor shall be responsible for ensuring the compatibility of new pipes with existing pipework, cables, tubing, equipment, etc.

#### **119. PRIVATELY OWNED OR PUBLIC SERVICES**

If any privately owned or public services passing through the site will be affected by the Works, the Contractor shall provide at his own expense a satisfactory alternative service in full working order to the satisfaction of the owner of the services and the Engineer before the cutting of the existing service. Any damage to private or public services shall be made good by the Contractor at his cost.

In case the remedial work is not executed promptly by the Contractor, the Engineer may make alternative arrangements for the execution of the work and debit the costs to the Contractor.

#### **120. WATER SUPPLY**

The Contractor shall provide for all purposes of the work, an adequate supply of water from a suitable source or sources approved by the Engineer. He must pay the water charges, if any, and make arrangements for supply, transport and distribution.

#### **121. ADDITIONAL LAND**

The Contractor shall select and arrange at his own expenses for any temporary occupation of land outside the site which he requires for the efficient execution of the Works. The Contractor must comply fully with all By-laws and Regulations currently in force in the area.

#### **122. USE OF HEAVY PLANT**

In the event of the Contractor desiring to use heavy machinery or plant, he shall first satisfy the Engineer that they will be of such size and used in such a manner as not to cause any disturbance or damage in particular to water, electricity, Post Office or other mains, cables and connections or to sewers, culverts etc. or interfere with the line or

position of any overhead wires and cables of any sort, telegraph poles, power poles etc.

The Contractor will be held liable for any such damage or disturbance and shall pay the full costs of any reinstatement, relaying, repairing or refixing as may be required, as agreed between the Engineer and the owner affected.

#### **123. PROVISION OF INSTRUMENTS AND LABOUR**

The Contractor shall provide at his own expenses all instruments, materials, tools and other things which the Engineer considers necessary for his proper supervision of the Works and shall maintain the same in good order. He shall also provide materials, an experienced Surveyor and labour for attendance on the Engineer and his representatives in carrying out operations connected with the supervision of the Works. All charges arising out of such services shall be deemed to be included in his rates in the Bill of Quantities.

#### **124. ACCESS TO SITES**

The Contractor shall construct and maintain all temporary accesses required for the execution of the Works. Access roads shall be constructed and maintained up to the Site Offices if required. The cost of all these Works shall be deemed to be covered by rates and prices quoted by the Contractor.

#### **125. POLLUTION**

The Contractor shall ensure that during the course of his operations no pollution of the atmosphere, rivers, reservoir catchment areas or groundwater is allowed to take place.

#### **126. TREE PROTECTION**

Trees within the permanent and temporary easement are the property of owners. Specific trees will be identified by the Engineer, prior to construction, and the Contractor shall neither remove nor cut their roots unless otherwise directed by the Engineer. If the roots of such trees appear within the trench areas, the Contractor shall handle the roots with maximum care so that no portion of the roots will be damaged. During the excavation of the trench, the exposed roots may be removed to a position that will not damage the roots and will not interfere with the pipelaying. During the construction, the roots shall be thoroughly protected by appropriate cover and wetted as directed. After the pipes are laid, the moved roots shall be placed back to the original locations and backfilled carefully by selected soft soil which can support vegetation.

#### **127. GEOLOGICAL DATA**

Any geological data that is made available to the Contractor and is relevant to the Works, will be for his guidance only, and no guarantee is given that other ground conditions will not be encountered. No claims based on the geological data provided shall be entertained by the Engineer. The Contractor shall be deemed to have made any additional investigations required before submission of his Bid.

#### **128. WATCHING, FENCING AND LIGHTING**

The Contractor shall arrange to employ watchmen to guard the Works both during the day and night from the commencement of the Works until the substantial completion of the Works.

Any excavation or other obstruction likely to cause injury or damage to any person or domestic animals must be fenced off as directed by the Engineer.

**129. TIPS**

Where possible all construction waste or spoil material shall be recycled, either on Site or elsewhere. As a last resort all construction waste shall be disposed of off Site at an approved landfill site.

The Contractor shall be responsible for provision of all tips, at his own expense, for disposal of all spoil or other rubbish collected during the construction of the Works. Any surplus excavated material not required shall also be carted away to these tips. The Contractor to liaise with the local Authorities for approval of location of tips.

The Contractor shall supply the Resident Engineer with an approval certificate from local authorities.

**130. TROPICALISATION**

In choosing materials and their finishes, due regard shall be given to the tropical conditions of the site to which they will be subjected. The Contractor shall submit details of his practices which have proven satisfactory and which he recommends for application on the parts of the Works which may be affected by the tropical conditions.

**131. INSPECTION BY ENGINEER DURING DEFECTS LIABILITY PERIOD**

The Engineer will give the Contractor due notice of his intention to carry out inspection during the Defects Liability Period and the Contractor shall upon receipt of such notice arrange for a responsible representative to be present at the times and dates named by the Engineer. This representative shall render all necessary assistance and take notice of all matters and things to which his attention is directed by the Engineer.

**132. SUBMISSION OF SAMPLES**

Before incorporating in the finished work any materials or articles which he supplies under the terms of the Contract, the Contractor shall submit to the Resident Engineer for approval a sample of each respective material or article, and such samples shall be delivered to and kept at his office for reference. All the respective kinds of materials and articles used in and upon the Works shall be at least equal in quality to the approved samples. Each and every sample shall be a fair average of the bulk material or of the article which it represents. The Resident Engineer may decide the method by which each sample to be taken from the bulk material shall be obtained. Any costs related to adhere to above will be deemed to be covered in Bidder's Rates.

**133. RESPONSIBILITY FOR ORDERING MATERIALS AND MANUFACTURED ARTICLES AND SAMPLES FOR TESTING**

The responsibility for so ordering and delivering materials and manufactured articles and samples that they may be tested sufficiently far in advance of the work as not to delay it, shall rest upon the Contractor, and he shall not be entitled to any time credit for delay occasioned by his neglect to order sufficiently well in advance or to effect payment of any costs he may incur as a result thereof.

With regard to any item in the Bill of Quantities which is the subject of a P.C. Sum, the Contractor shall notify the Engineer of his requirements as early as possible leaving ample

time for the Engineer to make any necessary arrangements so that no delay occurs in the progress of the work.

**134. TESTS OF MATERIALS AND MANUFACTURED ARTICLES BEFORE USE**

Any or all of the materials and manufactured articles supplied by the Contractor for use on any of the Works throughout this Contract shall be subject in advance to tests as may be specified in the relevant Standard Specification as may from time to time be deemed necessary by the Engineer. Samples of all such materials and manufactured articles, together with all the necessary labour, materials, plant and apparatus for sampling and for carrying out of tests on the site on all such materials and manufactured articles shall be supplied by the Contractor at his own expenses. For all goods to be supplied including pipes, fittings valves, meters etc., factory and site Acceptance Inspection and Tests will be carried out. In addition, 3<sup>rd</sup> party independent inspection and testing will be carried out as directed by the Engineer. The cost of this has been allowed for in the Preliminary and General Bill.

**135. REJECTED MATERIALS**

Should any material or manufactured articles be brought on to the site of the Works which are in the judgement of the Engineer unsound or of inferior quality or in any way unsuited for the work in which it is proposed to employ them, such materials or manufactured articles shall not be used upon the Works but shall be branded if, in the opinion of the Engineer, this is necessary and shall forthwith be removed from the site of the Works, all at the Contractor's expense and in each case as the Engineer shall direct.

**136. QUALITY OF MATERIALS AND WORKMANSHIP**

The materials and workmanship shall be of the best of their respective kinds and shall be to the approval of the Engineer. In the reading of this Specification the words "to the approval of the Engineer" shall be deemed to be included in the description of all materials incorporated in the Works, whether manufactured or natural and in the description of all operations for the due execution of the Works.

**137. TEST RUNNING OF THE SCHEME**

Upon substantial completion of the scheme and official inspection which agrees to this, the Contractor shall operate the entire scheme or completed and taken over sections for the test period indicated in the Bill of Quantities.

The Contractor shall supply all necessary personnel, equipment and consumables for the test running and together with the Engineer's Representative shall compile a list of detailed operating instructions that shall be incorporated into the Operation and Maintenance Manual. The Contractor shall further bring to the attention of the Engineer's Representative and of the Employer's operational staff any problem or defects he encounters during this period of test running so that solutions may be found and any necessary alterations made.

**138. EQUIPMENT FOR THE RESIDENT ENGINEER**

The Contractor shall provide 2 Nr Digital Cameras, Sony or approved equivalent, suitable for Construction Sites with splash and shock proof casing for exclusive use of the Resident Engineer and his Staff for the purpose of taking record photographs of the progress of the Works. The Cameras should have picture capture resolution of 7.1 megapixels or more, both optical and digital zoom capabilities, storage capacity of 128 MB, downloading

facility by means of USB port, neck strap and hard cover pouch. The Contractor shall further provide 1 Nr suitable photo printer with necessary photo paper and colour ink cartridges for prints production for Monthly, Quarterly Progress Reports as directed by the Resident Engineer. The cost for this service is deemed to be covered by the Contractor in his rates in the Bills of Quantities.

The Contractor shall provide for the Engineer, his Representative and assistants any additional protective clothing and safety equipment necessary for the proper discharge of their duties on the Site.

The Contractor shall provide any necessary protective clothing and safety equipment for the use of authorized visitors to the site including the Employer and his staff and representatives and those of any relevant Authority who have reason to visit the Site.

### **139. OPERATION AND MAINTENANCE MANUALS**

Draft Operation and Maintenance Manuals will be compiled prior to substantial completion and Handing Over of the Works.

The Manuals have to be revised and brought to a final draft state prior to the test running of the Schemes. The Contractor's rates should include for provision in triplicate, and in English, details of all the different manufactured plant and components incorporated in the Works including but not limited to all pertinent Manufacturers' Brochures, 'As-Built' Drawings prepared by the Contractor, Digital Progress Report Photographs, etc.

Substantial completion of the Works will not be considered until such detailed information as is required in triplicate has been submitted by the Contractor to and accepted by the Engineer.

### **140. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN**

Within 42 days of Commencement, the Contractor shall submit a Project Specific Environmental and Social Management Plan (ESMP) for approval of the Engineer. The Contractor must carry out all works in accordance with Kenyan Environmental Laws and Regulations, and the requirements of this document.

It is also a contractual obligation for the Contractor to take full cognizance of the environmental and social concerns and requirements as stipulated in the Employer's Environmental and Social Management Plan (ESMP) prepared for this Project and which is given in Chapter 12. The full Environmental and Social Impact Assessment (ESIA) Report will also be issued to the Contractor on Award.

Accordingly, the Contractor shall be required to prepare a site-specific Environmental and Social Management Plan (ESMP) for the project. This site-specific ESMP shall be based on the Contractor's evaluation of the requirements of these Specifications and the Employer's ESMP. The site-specific ESMP shall be submitted to the Engineer for approval within 42 days of Commencement.

The site-specific ESMP shall generally comply with the guidelines set out below.

The site-specific ESMP is the Contractor's operative document on how to enforce, mitigate, inspect and monitor potential Project impacts during mobilization, construction



and demobilization. In this sense, it is an eminently practical and concrete instrument.

Based on the above, the structure and content of the site-specific ESMP shall emphasize the following aspects:

- i) Executive Summary
- ii) Introduction
- iii) Project Description
  - Focus on impact-generating activities (e.g., demand of water and permanent materials, earth movement, etc.);
  - Environmental liabilities: identify and include a photographic registry of pre-existing environmental liabilities (e.g., gully erosion areas, abandoned borrow pits, unauthorized dumping sites, etc.) that are not attribute to the implementation of the Project.
- iv) Potential Impacts during Mobilisation, Construction and Demobilisation
  - Apply simple rating of significance;
  - Quantity/quality impacts (e.g., surface and type of vegetation to be removed, amount and type of wastes to be generated, noise levels, etc.);
  - Identify places where specific impacts will manifest
- v) Mitigation Plan
  - Specify the detailed measures to mitigate the identified impacts (also by location)
  - Include designs for measures requiring structural solutions (e.g., gabions, etc.);
  - Include the schedule of implementation of mitigation measures in relation to the general construction schedule;
  - Health and Safety Plan (detailed);
  - Waste Management Plan (detailed) including decommissioning of the Existing Asbestos Cement (AC) Mains;
  - Traffic Management Plan (detailed);
  - Training Program (detailed);
  - Accident and Emergency Response Plan (detailed);
  - HIV/AIDS Awareness and Prevention Program (include only a reference to this program to be prepared by an NGO);
  - Community Relations Program;
  - Location and technical specifications for installation and operation of campsites, including workshops, garages, laboratories, offices, communal kitchenette / dining facilities, sanitary installations, etc.;
  - Location, and technical specifications for operation of quarries and borrow pits, and procedures for negotiation with and compensation of landowners where they are located;
  - Location and technical specifications for installation and operation of concrete batching, stone crushing, cement mixing and asphalt plants;
  - Location and technical specifications for installation and operation of temporary and permanent dump sites.
- vi) Inspection Plan
  - Inspection function: specify frequency, locations and instruments (e.g., checklists, site reports, photo registry, etc.) to conduct site inspections;
  - Permitting: required environmental permits and schedule to obtain them;
  - Specific actions and responsibilities: what, who, where, when how and why

- vii) **Monitoring Plan**
  - Specify, for each variable: frequency of measurement, locations, methods/equipment, units/measures, quality standards, and reporting requirements and periodicity, including establishment of trends.
  - Specific actions and responsibilities: what, who, where, when how and why.
- viii) **Organisation and Management**
  - Specify organizational structure, personnel, resource and equipment requirements, reporting requirements and periodicity, and inter-institutional communication and coordination mechanisms.
  - Specific actions and responsibilities: what, who, where, when how and why.
- ix) **Annexes**
  - If the Contractor wishes to incorporate information beyond the indicated above, such as the policy, institutional and regulatory framework for environmental management in Kenya, biophysical and socio-economic characteristics of the area of influence of the Project, etc., that information should be included as an annex and not in the body of the site-specific ESMP. Preferably, such information should not be attached and, further, if necessary, the pertinent chapter of the ESIA should be referenced.
  - Annexes should be used, if necessary, to include detailed information on the specific topics of the ESMP (e.g., inspection forms or checklists, design of structural mitigation measures, photographic registry of environmental liabilities, etc.).

#### **141. PROGRESS REPORTS**

The Contractor shall submit a monthly progress report to the Engineer. The formal, content and level of detail shall be determined and agreed by the Engineer.

The Reports submitted by the Contractor shall include a section on Environment and Social Performance Reporting, under which the Contractor shall report on the aspects included in the ESMP and HSMP (Ref. Clauses 141 and 142).

If the Engineer considers it necessary, the frequency of reporting may be increased. Alternatively, the Contractor may be instructed to provide a special progress report for a particular section of works (that is significantly delayed for example), on a more frequent basis (e.g., weekly, or even daily). The Contractor's rates in his Bid are deemed to cover these costs.

#### **142. DAILY LOGS**

The Contractor shall maintain a daily site log. The logbook entries shall be prepared in triplicate, with one copy being delivered each day to the Engineer.

The content and format of the Daily Log shall be agreed with the Engineer upon commencement of the contract. However, typically the log shall include the date, weather, numbers/movement of plant and labour, main areas of work and daily activity/progress, deliveries of plant and materials to site, tests, issues, shut-downs, key instructions, accidents, among others.

In addition, the log sheet shall have a space designated for comments by the Engineer.

The Engineer may, at his discretion, instruct the Contractor to provide daily labour and



plant returns. Alternatively, the Engineer may request to review such information.

In addition, the Contractor shall provide the Engineer with copies of all delivery notes of plant and materials delivered to site. The Contractor's rates in his Bid are deemed to cover these costs.

#### **143. TEST FORMS**

The Contractor shall prepare, to the satisfaction of the Engineer, test forms to be used for the various components of the works.

All test forms shall be completed, signed and dated by the appropriate persons conducting the tests. The original copy of all test forms shall be submitted to the Engineer. The Contractor's rates in his Bid are deemed to cover these costs.

Test forms shall be submitted to the Engineer regardless of whether the test passes or fails.

#### **144. CONTRACT DOCUMENTS**

Without affecting the provisions in the Conditions of Contract, the Contractor shall print and submit at his own cost to the Employer at least ten (10) bound copies of the Contract Documents in the form and manner approved by the Employer. The Contractor's rates are deemed to cover these costs.

#### **145. AS-BUILT AND RECORD DRAWINGS**

The Contractor shall prepare, and keep up to date, a complete set of "as-built" records of the execution of the works, showing the exact "as-built" locations, sizes and details of the work as executed, with cross references to relevant specifications and data sheets. These records shall be kept on the Site and shall be used exclusively for the purposes of this specification. Two copies shall be submitted to the Resident Engineer prior to the commencement of the Tests on Completion of Works.

In addition, the Contractor shall prepare and submit to the Resident Engineer "as-built-drawings" of the works, showing all works as executed. The drawings shall be prepared as the works proceed and shall be submitted to the Resident Engineer for his inspection. The Contractor shall obtain the consent of the Resident Engineer as to their format, size, the reference system, and other pertinent details such as compatibility with the Water Service Provider's GIS application.

Prior to substantial completion and Handing Over of the Works, the Contractor shall deliver to the Engineer one complete set of record ("as-built") drawings of all works constructed under the Contract, including all underground works such as pipes, services, cables and conduits.

The Engineer shall review and comment on the draft Record Drawings, and within a further two (2) weeks of receiving the comments, the Contractor shall produce a final set of drawings.

If, during the Defects Liability Period, the Contractor modifies any of the Works, the modifications shall be included as amendments to the As-Built Drawings and all other affected documentation.

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Prior to the issue of any Taking-Over Certificate, the contractor shall submit to the Resident Engineer one full-size original copy, six printed copies of the relevant “as-built-drawings” and the corresponding computer files (AutoCAD, Shapefiles, Excel, MS Word, etc.) on CD-ROM and any further Construction Documents specified in the Specifications. The works shall not be considered to be completed for the purposes of Taking-Over until such documents have been submitted to the Resident Engineer.

**The compliance of this Clause by the Contractor is deemed to be covered in his rates as quoted in the Bid.**

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## **2. CLEARING SITE**

### **201. CLEARING SITE**

The Contractor shall demolish, break up and remove buildings, walls, gates, fences, advertisements and other structures and obstructions, grub up and remove trees, hedges, bushes and shrubs and clear the site of the works at such time and to the extent required by the Engineer but not otherwise, subject to the provisions of Clause 7 of the Conditions of Contract: the materials so obtained shall so far as suitable be reserved and stacked for further use; all rubbish and materials for use shall be destroyed or removed from the site, as directed by the Engineer.

Where topsoil has to be excavated this shall be removed and stacked on site. After completion of construction, it shall be spread over the disturbed ground, any surplus being disposed of as directed by the Engineer.

Underground structures and chambers where required to be demolished, shall be demolished to depths shown on drawings or as directed. They shall be properly cleaned out and backfilled and compacted with suitable material to the direction and approval of the Engineer.

### **202. VEGETATION**

No allowance will be made for the cutting and removal of crops, grass, weeds and similar vegetation. The cost of all such work will be held to be included in the rates entered in the Bill of Quantities.

### **203. BUSHES AND SMALL TREES**

All bushes and small trees, the main stem of which is less than 500mm girth at 1 metre above ground level shall be uprooted (unless otherwise directed by the Engineer) and burnt or otherwise disposed off as directed by the Engineer.

### **204. HEDGES**

Where directed by the Engineer, hedges shall be uprooted and disposed off by burning.

### **205. FELLING TREES**

Where shown on the drawings or directed by the Engineer, trees shall be uprooted or cut down as near to ground level as is possible. The rates entered in the Bill of Quantities shall include for cutting down, removing branches and foliage, cutting useful timber into suitable lengths, loading, transporting not more than 1 km. and stacking or disposing off all as directed by the Engineer.

For the purpose of measurement trees cut down shall be classified according to their girth at 1 metre above ground level, the cost of grubbing up roots shall be deemed to be covered by the rate for felling trees.

### **206. GRUBBING-UP ROOTS**

Stumps and tree roots shall, unless otherwise directed, be grubbed up, blasted, burnt or

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removed and disposed of in approved dumps to be provided by the Contractor. Where directed by the Engineer, the holes resulting from grubbing up shall be filled with approved materials, which shall be deposited and compacted in layers not exceeding 225mm loose depth, to the same dry density as that of the adjoining soil. For the purpose of measurement, tree roots shall be classified according to the mean diameter of the stump measured across the cut.

## **207. WEED CONTROL**

The Contractor shall take all necessary precautions against the growth on the site of weeds and remove them as necessary throughout the period of works and maintenance.

The finished base of all footways and elsewhere as directed shall be sprayed with an approved persistent total herbicide at the rate recommended by the manufacturer. The application shall be by an even spray in a high volume of water at about 0.7 to 0.11 litres per square metre. After this application the footways shall receive at least two further waterings before the surface is sealed.

### 3. EXCAVATION

#### 301. DEFINITION AND CLASSIFICATION OF EXCAVATED MATERIALS

Excavation in the Bills of Quantities shall be classified in two categories:-

1) Common Excavation

Any material which in the opinion of the Engineer can be excavated by use of pickaxes and hand levers shall be classified as common excavation. Waterlogged material shall be included in this class. Murram in any form shall be classified as common excavation.

2) Rock

The decision of the Engineer in classifying rock shall be final and binding. Rock in the Bills of Quantities will be itemised in three classes:-

Class 'A'

Soft rock of the type known locally as 'tuff' which in the opinion of the Engineer cannot be considered as hard rock but which considerably increases the amount of labour needed for its removal shall be known as Class 'A' rock.

Class 'B'

Very weathered phonolite lava containing many fissures and faults shall be known as hard rock. This type of rock contains stones and boulders of unweathered or incompletely formed blacktrap or lava. A boulder or outcrop of hard rock 1.5 cubic metres or less and grey or green building stone in a formation which is massive and geologically homogeneous, will be deemed to be Class 'B' rock.

Class 'C'

Phonolite in a formation which is massive and geologically homogeneous shall be known as Class 'C' rock.

#### 302. STORAGE AND HANDLING OF EXPLOSIVES AND BLASTING

The removal of hard materials by use of explosives will only be permitted where specified in the Bills of Quantities subject to compliance by the Contractor in all respects with the Explosives Laws of Kenya.

In the Bill of Quantities hard material is classified as rock where blasting will be permitted subject to this clause.

The Contractor shall provide proper buildings or magazines in suitable positions for the storage of explosives in manner and quantities to be approved; he shall also be responsible for the prevention of any unauthorised issue or improper use of any explosives brought on the works and shall employ only licensed and responsible men to handle explosives for the purpose of the works.

The shots shall be properly loaded and tamped and where necessary, the Contractor shall use heavy mesh blasting nets. Blasting shall be restricted to such periods and such parts

of the works as the Engineer may prescribe. If, in the opinion of the Engineer, blasting would be dangerous to persons or property or to any finished work or is being carried out in a reckless manner, he may prohibit it, and order the rock to be excavated by other means and payment will be made at the rate for rock for excavation where blasting is permitted. The use of explosives by the Contractor in large blasts, as in seams, drifts, pits, or large holes, is prohibited unless authorized in writing by the Engineer. In the event of wasting of rock through any such blasting, the Contractor shall if required by the Engineer, furnish an equivalent amount of approved materials for fill, 1 cubic metre of rock in-situ being taken to equal 1.5 cubic metre of material in embankment.

### **303. EXCAVATION FOR FILL**

Where excavation reveals a combination of suitable and unsuitable materials, the Contractor shall, wherever the Engineer considers it practicable, carry out the excavation in such a manner that the suitable materials are placed separately for use in the works without contamination by the unsuitable materials.

If any suitable material excavated from within the site is, with the agreement of the Engineer, taken by the Contractor for his use, sufficient suitable filling material to occupy after specified compaction, a volume corresponding to that which the excavated material occupied, shall, unless otherwise directed by the Engineer be provided by the Contractor from his own sources.

No excavated material shall be dumped or run to spoil except on the direction or with the permission of the Engineer who may require material which is unsuitable to be retained on site. Material used for haul roads shall not be re-used without the permission of the Engineer.

### **304. COMPACTION OF FILL**

All materials used in fill shall be compacted to specification by plant approved by the Engineer for that purpose. Maximum compacted thickness of such layers shall not be more than 200mm.

Work on the compaction of plastic materials for fill shall proceed as soon as practicable after excavation and shall be carried out only when the moisture content is not greater than 2 per cent above the plastic limit for that material. Where the moisture content of plastic material as excavated is higher than this value the material shall be run to spoil and an equal volume of material suitable for filling shall be replaced, unless the Contractor prefers, at his own expense, to wait until the material has dried sufficiently for acceptance again as suitable material.

Nevertheless, if with any material the Engineer doubts whether compaction will be obtained within the above moisture limits he may require compaction to proceed only when the limits of moisture content for the compaction of non-plastic materials are within the range of the optimum moisture content and 3 per cent below the optimum moisture content as determined by the laboratory compaction test method described in British Standard 1377: Methods of Test for Soil Classification and Compaction.

If any such non-plastic material on excavation is too wet for satisfactory compaction and the Engineer orders the moisture content to be lowered or raised, such work shall be treated as included in the rates. All adjustments of moisture content shall be carried out in such a way that the specified moisture content remains uniform throughout compaction.

Work shall be continued until a state of compaction is reached throughout the fill, which shall have relative compaction determined according to B.S. 1377 not less than 95% of maximum dry density at optimum moisture contents. For excavation under Roads, House Drives and Car Parks the backfilling shall be compacted in 150mm layers to 100% maximum dry density.

If with non-plastic materials the compacted material has become drier in the interval between the completion of compaction and the measurement of the state of compaction, then the moisture content to be used for the calculation of the air content shall be the mean moisture content for the compaction of such materials as specified above.

### **305. EMBANKMENTS OVER SEWERS**

In carrying embankments over sewer pipes, care shall be taken by the Contractor to have the embankments brought up equally on both sides and over the top of any such structures. Earth embankments shall be formed and compacted in layers of 200mm as the Engineer may direct. The filling immediately adjacent to structures shall be deposited and compacted in accordance with the drawings and approved by the Engineer. The cost of these works shall be included in the prices entered in the Bill of Quantities for the excavations from which embankments are formed.

### **306. STONE REVETMENTS (STONE PITCHING)**

Where shown on the drawings, the slopes of embankments, rivers, streams, watercourses and other surfaces shall be protected against water or other action by hand-set stone facing set on end. The larger stones shall be roughly dressed on the bed and face, and roughly square to the full depth of the joints. No rounded boulder shall be used, or stones less than 225mm in depth of 0.05 cubic metre in volume. The stones shall be laid to break bond and shall be well bedded on to a 75mm layer of gravel or fine rubble rammed to a uniform surface and the whole work finished to the satisfaction of the Engineer. Where required, a trench shall be excavated at the bottom of the slope to such a depth as will ensure a safe foundation for the revetment.

### **307. TIPPED REFUSE ON SITE**

Tipped refuse other than artificial deposits of industrial waste or shale found on the site shall be removed and disposed off in a spoil heap to be provided by the Contractor.

### **308. REMOVAL OF INDUSTRIAL WASTE, ETC.**

Artificial deposits of industrial waste or shale found on the site shall be removed and disposed of as directed by the Engineer. Should any particular deposits consist of or contain material which in the opinion of the Engineer is suitable for incorporation in fills, all such material shall be used accordingly and deposited in layers and compacted as specified. The prices entered in the Bill of Quantities for the excavation of the material shall include loading, transportation, disposal and compaction of same as and where directed.

### **309. LAND SLIPS**

Remedial works and/or the removal of materials in slips, slides or subsidence's and overbreak's of rock extending beyond the lines and slopes, or below the levels shown on the drawings or required by the Engineer, will not be paid for.



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### **310. CLASSIFICATION OF MATERIAL FROM SLIPS**

The classification of material from slips or slides will be in accordance with its condition at the time of removal, regardless of prior condition. Measurement of overbreak in rock excavation shall be that of the space originally occupied by the material before the slide occurred and regardless of its subsequent classification.

### **311. BORROW PITS**

Where for any reason, it becomes necessary to form borrow pits, these shall be located and the work executed in all respects to the instructions of the Engineer. They shall be regular in width and shape and admit of ready and accurate measurement and shall be properly graded and drained and finished with neatly trimmed slopes.

### **312. STREAMS, WATERCOURSES AND DITCHES**

Excavations carried out in the permanent diversion, enlargement, deepening, or straightening of streams, watercourses, or ditches shall be performed as directed by the Engineer. The rates for such excavations shall include for excavated materials and all pumping, timbering works, and materials necessary for dealing with the flow of water.

### **313. FILLING OLD WATERCOURSES**

Where watercourses have to be diverted from the sites of embankments or other works, the original channels shall be cleared of all vegetable growths and soft deposits and carefully filled in with approved materials deposited and compacted as directed by the Engineer.

### **314. OPEN DITCHES**

Open ditches for drainage purposes shall be cut where and of such cross section as the Engineer shall direct and where so required by him, they shall be constructed before the cuttings are opened or the embankments begin. The sides shall be dressed fair throughout and the bottom accurately graded so as to carry off the water to the outlet to be provided. The material excavated from the ditches shall be disposed of as directed by the Engineer.

### **315. CLEARING EXISTING DITCHES**

Where directed by the Engineer, existing ditches shall be cleared by removing vegetable growths and deposits. The sides shall be shaped fair throughout and the bottoms properly graded. Material removed from existing ditches shall be disposed of in tips provided by the Contractor. The rates included in the Bill of Quantities for clearing ditches shall include for maintaining and keeping clean until and up to maintenance period.

### **316. EXCAVATION FOR FOUNDATIONS BELOW OPEN WATER**

The rates for excavation for foundations below the water level shall include for the cost of all temporary close timbering and shoring, sheet piling, coffer dams, caissons, pumps and other special appliances required and for the draining of any water in the excavation.

### **317. TRENCHES OF GREATER WIDTH AND DEPTH THAN NECESSARY**

The Contractor shall not be entitled to payment in respect of excavation to any greater extent, whether horizontally or vertically, than is necessary to receive any structure for which the excavation is intended, except where a separate item is provided for additional excavation for working space, timbering, or other temporary work. Excavation to a



greater depth or width than directed shall be made good with suitable materials to the satisfaction of the Engineer and at the Contractor's cost.

### **318. SUPPORTS FOR TRENCHES**

The sides of trenches shall where necessary be adequately supported to the satisfaction of the Engineer by timber or other approved means.

### **319. PROVISION OF SPOIL HEAPS**

The Contractor shall provide spoil heaps at his own expense for the disposal of surplus material and all rubbish collected when clearing the site and during the construction of the works. The sites for these shall be approved by the Engineer.

### **320. USE OF VIBRATORY COMPACTION PLANT**

Where vibratory rollers or other vibratory compaction plant is used, the mechanism for vibration shall be kept working continuously during compaction operations, except during periods when the Engineer permits or directs discontinuance of vibration.

Unless otherwise permitted by the Engineer, the frequency for vibration shall be maintained within the range of amplitude and frequency recommended by the manufacturers of the plant for the material to be compacted. The frequency shall be recorded by a tachometer indicating speed of rotation of any shaft producing vibrations.

### **321. WATER IN EXCAVATIONS**

All excavations shall be kept free from water, from whatever source, at all times during construction of works until in the opinion of the Engineer, any concrete or other works therein are sufficiently set. The Contractor's rates are deemed to cover compliance with this requirement.

The Contractor shall construct any sumps or temporary drains that the Engineer may deem necessary and shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Engineer so as to ensure that excavations are kept dry.

The Contractor shall provide all plant, labour and materials required for such work and all costs incurred shall be deemed to be included in his rates for excavation.

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## **4. PIPELINE CONSTRUCTION WORKS**

### **401. HANDLING OF PIPES AND FITTINGS**

The Contractor shall exercise care in the handling of all pipes, specials, valves etc., to prevent damage to the structure surfaces and to the ends of the pipes.

### **402. LOADING AND UNLOADING**

Normally loading and unloading of small diameter pipes and fittings can be undertaken by hand; where mechanical means are used care should be exercised to ensure that the handling methods do not damage the pipes and fittings.

### **403. STORAGE**

The Contractor shall comply with the manufacturer's specification regarding the storage of pipes, fittings and valves. Where storage dumps are to be provided along the route of the pipeline, these will be subject to the Engineer's approval. The cost of so providing shall be borne by the Contractor and deemed to be covered by his rates in the Bill of Quantities.

### **404. TRANSPORT**

The Contractor shall provide such transport arrangements as will effectively cater for the lengths of pipes provided and the material of the piping. Adequate support shall be provided so as to ensure that the piping and fittings are not subject to excessive movement.

### **405. EXAMINATION OF PIPES AND FITTINGS**

The Contractor shall examine all pipes, valves, fittings and other materials to ascertain that they are in perfectly sound condition before commencing to lay the pipes, valves etc.

### **406. INTERFERENCE WITH FENCES, DRAINS AND OTHER SERVICES**

The Contractor shall ensure the proper reinstatement of fences, drains, telephone lines, KP&L cables etc. where affected by his work. All services shall be adequately protected and propped to the satisfaction of the Engineer. The Contractor shall be liable for any damage caused to the services due to his failure to provide adequate protection.

### **407. METHOD OF EXCAVATION**

The Contractor is deemed to have covered in his excavation rates all the work that is necessary in order to comply with the provisions of the Specifications in general and this Clause in particular.

- a) The Contractor shall excavate the pipe trenches in the line and to the depths indicated on drawings or as indicated by the Engineer. Except where otherwise indicated on the drawings or directed by the Engineer, it is intended that the trench shall be excavated to such a depth as will allow of a minimum cover of 600mm over the top of the barrel of the pipe when laid. All trenches shall be excavated in open cuttings and for trenching to uPVC piping, shall not be opened too far in advance of pipe laying.

- b) For the purpose of measurement, the width of trench shall be taken as the nominated width for the particular size of sewer, irrespective of the width of trench the Contractor may choose to excavate.

Nominated trench width for:

75mm main 0.5m

100mm main 0.6m

150mm main 0.6m

200mm main 0.6m

225mm main 0.6m

250mm main 0.6m

300mm main 0.7m

400mm main 0.8m

500mm main 0.9m

600mm main 1.0m

700mm main 1.1m

800mm main 1.2m

For two or more pipes in the same trench the nominated width shall be the distance between the centres of the outer pipes plus the internal radii of the outer pipes plus 400mm.

- c) Where the trench passes through grassland, arable land or gardens, whether enclosed or otherwise, the turf, if any, shall be carefully pared off and stacked, and the productive soil shall be carefully removed for a width of 600mm greater than the nominated trench width, or equal to the overall width of track of excavating machine, whichever is greater, and laid aside to be subsequently used in reinstating the surface of the ground after the trench has been refilled.
- d) The bottom of the trench shall be properly trimmed off, and all low places or irregularities shall be levelled up with fine material. Where rock or large stones are encountered, they shall be cut down to a depth of at least 100mm below the level at which the bottoms of the barrel of the pipes or flanges are to be laid, and covered to a like depth with fine material, so as to form a fine and even bed for the pipes. The bottom of trenches to accommodate uPVC piping shall be hardened by tamping in gravel or broken stone in all soft spots. The bedding shall consist of soil which can be properly compacted to provide support for the pipe and to comply with Clause 409 b).
- e) Joint holes shall be excavated to suit minimum dimensions as will allow the joints to be well and properly jointed.
- f) The pipe trench shall be kept clear of water at all times as per Clause 321 of this Specification.
- g) The Contractor shall, wherever necessary, by means of timbering or otherwise,

support the sides of the trench so as to make them thoroughly secure, and afford adequate support to adjoining roads, land, buildings and property, during the whole time the trench remains open and shall remove such timbering when the trench has been backfilled. The cost of such timbering or other work shall be deemed to be included in the rates for excavation. In case the Contractor is instructed by the Engineer to leave any portion of such timber in position after backfilling the trench, he will be paid for it accordingly.

- h) The clear width inside the timbering shall be at least 150mm in excess of the external diameter of the pipe being laid, in order to allow it to be freely lowered into position, in the trench without damage to the external protection.
- i) Should the excavation be taken out to a greater depth than is specified the bottom shall be made good to the correct level with Class 15/20 concrete or other material approved by the Engineer. No payment shall be made for any over excavation carried out by the Contractor nor for the cost of filling up to required levels.
- j) If a mechanical excavator is used by the Contractor, he shall indemnify the Employer against all claims for damage which in the opinion of the Engineer, may be caused by the use of this plant.
- k) The Contractor shall fix Sight Rails for use with boning rods at intervals of not more than 30 metres and temporary Benchmarks related to the Survey of Kenya Datum shall be provided at such intervals as directed by the Engineer.

#### **408. PIPE LAYING**

- a) Pipelines shall be laid in straight lines and/or smooth curves as indicated on the drawings. The vertical profile of the pipe shall be to even gradients. Any pipes not so laid shall be removed if so, directed by the Engineer, and re-laid in proper manner at the Contractor's expense.

In laying the pipes and specials care shall be taken not to damage the protective linings and the pipes shall be handled with tackle if so, directed by the Engineer.

The pipes and specials shall be checked for flaws before they are lowered into the trench. After the pipes or specials have been checked they shall be cleaned and set to proper gradient and line so that there is a continuous rise from each washout to air valve.

When laying uPVC pipes, final connection at any fixed joints shall be deferred until the majority of the pipeline has been covered with backfill.

- b) Large diameter curves to mains shall wherever possible be formed by allowing for deflection at flexible joints, not exceeding 3 degrees, or as specified by the manufacturers.
- c) In jointing of the pipes and specials the Contractor shall comply with the standards adopted for the various types of joints as specified.

- d) In laying pipes and specials with flanged joints, flanges shall be brought together and bolted with the faces absolutely parallel. A rubber jointing gasket ring 3mm thick shall be used in each flange joint and one washer with and not provided for each bolt.

The bolts shall be tightened up gradually and equally in the customary manner in order to distribute the stress evenly over the flange. If it is found necessary to deviate slightly from the normal run of the flanged piping, the deflection shall be obtained by means of a bevelled gun metal ring washer between the flanges.

- e) The Contractor shall fix the gate valves, air valves and washout pipes all in accordance with the drawings.
- f) The Contractor shall, subject to approval of the Engineer, cut pipes to such lengths as directed. Pipes should be cut off clean and square with the axis. Cuts should be made with an approved cutting device dependant on the type of pipe specified. Ends of pipes should be tapered by means approved by the Engineer if mechanical joints are to be used.
- g) Equipment for tapping off the mains under pressure may be employed in the making of service or branch connections. The Contractor is required to choose a suitable method for fixing of the ferrule to the type of pipe specified, to the Engineer's approval.

#### **409. BACKFILLING OF TRENCH**

- a) When a section of the main has been jointed, the ends shall be temporarily closed with caps, plugs or flanges to prevent ingress of foreign matter into the pipe to the satisfaction of the Engineer. The trench shall be properly backfilled and rammed for its whole length so that the soil cover to the main shall not be less than 600mm except at joint holes which shall be kept clear of all backfilling, if necessary, by the use of timbering, so that each joint is left fully exposed for the Engineer's inspection. Special care shall be exercised when using surround to A.C. and uPVC pipes which shall be free from any stones and well compacted in layers to not less than 100mm above the crown of the pipe.
- b) The Contractor's attention is drawn to the special requirements for bedding and side fill to uPVC pipes. Clay should not be used. Soils which are of a granular nature and provide adequate support after compaction shall be used. If unavailable from excavated material the Contractor should provide suitable material for which an item in the Bill has been included.

With flexible pipes it is important that the side fill should be firmly compacted between the pipe and the soil sides of the trench. The bedding material shall be placed in 75mm layers up to the crown of the pipe with adequate compaction and then to a minimum height of 100mm or two thirds of the pipe diameter. The progress of filling and tamping should proceed equally on either side of the pipe so as to maintain an equal pressure on both sides.

- c) Where a main is laid across a road or is in such a position as to interfere seriously

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with the normal use of the road, the Contractor may, with the consent of the Engineer and at his own risk, fill such holes as may be necessary. Due consideration is to be given to compaction of section of the trench across the road to prevent undue settlement. In the event of damage at this section the Contractor is required to re-excavate and repair the pipeline all at his own expense.

#### **410. ANCHOR BLOCKS AND SUPPORTS**

Concrete Class 20/20 shall be placed in anchor blocks at all changes of direction of the pipeline exceeding 6 degrees and wherever else required to withstand thrust resulting from internal water pressure e.g., at blank ends. Concrete in plinths shall be placed where specified.

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## **411. TRENCHLESS PIPELINE CONSTRUCTION**

### **411.0 General Requirements**

#### **411.0.1 Submissions**

The Contractor shall submit the following documentation for review and approval by the Engineer prior to commencing any trenchless technology pipeline construction works;

- a) The Contractor shall provide proof of personnel training and certification in their respective duties and in the safety of operating any equipment that will be utilised during the course of the Works.
- b) The Contractor shall provide proof of certification by the equipment manufacturers of the energy, condition, and operational characteristics of all Equipment to be used for the Works.
- c) Detailed Method Statement for the execution of the trenchless pipe installation for each work section. The works shall not commence without the approval of the Contractor's Method Statement by the Engineer. This Method Statement shall have but is not limited to the following;
  - Description of construction method and sequence of operations. Include daily work hours and duration of operation.
  - Specifications of equipment(s) to be used and the suitability for the work section
  - Existing underground utility services locations and proposed special precautions
  - Assessment of the geotechnical conditions and the suitability of the site for the specific trenchless pipeline construction method
  - Type and condition of existing pipe and services reconnection details
  - Details of size, depth and location of launch and exit pits
  - Planned work areas for onsite material storage, stock piling, pipe welding etc.
  - Planned utility service interruption schedule
  - Details of by-pass water supply or equivalent for uninterrupted water supply
  - Ground monitoring equipment and methods e.g. heaving, fluid loss etc.
- d) Specific ESHS, Traffic Management, Waste Management plans effective for the planned work section
- e) Approvals or liaison confirmation from the relevant utility service providers e.g. water, sewerage, telecom, roads, power etc.

#### **411.0.2 Pipes**

The pipes shall be high density polyethylene (HDPE) or pipes of other materials which have been specifically designed for installation by pipe bursting or HDD.

The pipes and types of joints or couplings shall be detailed in the specification data. All materials supplied and installed shall be guaranteed to be free of defects arising from the manufacture, transportation, installation or any other process or factors. Further to this, the pipe shall:

- a) resist the tensile and bending forces as well as frictional forces resulting from the pipe installation,
- b) meet the in-service structural requirements.
- c) have an actual internal diameter not less than the diameter given on the drawings or stated in the schedule.
- d) if intended as a sleeve pipe, not be deformed (circular not oval), have inside walls smooth and free from projections and sharp edges.
- e) have the allowable bend radius stated.

The pipes and couplings shall be certified as being able to withstand without damage, deformation or separation, the forces transmitted by the horizontal directional drilling pulling equipment.

#### **411.0.3 Pipe Joints**

All HDPE pipe joints shall be done in accordance with CI 503. The Contractor shall in accordance with the manufacturer's specification ensure that a butt-fused joint is constructed in true alignment with a result uniform roll-back-beads. The joint shall be allowed adequate cooling time before removal of pressure. Any identified defective areas of the pipe shall be cut out and the joint fused in accordance with the procedures stated by the manufacturer and replaced at no additional cost to the Client.

Pipes not joined by welding shall be joined by using industry tested and approved mechanical joints or couplings and be joined in accordance with the manufacturer's specifications.

#### **411.0.4 Safe Working Practices**

The Contractor shall undertake all trenchless pipeline installation works in accordance with appropriate safety requirements by the Employer, the Engineer and local regulations. Safety measures shall include, but not be limited to, personal protective equipment, pedestrian and vehicular access barriers, warning tapes, warning signs, etc.

### **411.1 PIPE REPLACEMENT CONSTRUCTION USING PIPE BURSTING/ CRACKING/ SPLITTING**

#### **411.1.1 General**

##### **I. Pipe Bursting Techniques**



There are three pipe bursting techniques in use that are differentiated by the way in which the bursting force is generated and applied to the host pipe to break it and displace into the surrounding soil:

- Pneumatic bursting uses a percussive bursting head that is pulled through the host pipe. The head applies a horizontal hammering force.
- Static bursting uses a tapered bursting head that is pulled through the host pipe with force.
- Hydraulic bursting uses a head that is pulled through the host pipe and expanded at intervals to apply radial forces.

The Contractor should specify in the Method Statement the pipe bursting technique proposed to be applied on the specific Work Section.

## **II. Pipe Insertion Methods**

There are two distinct methods of inserting the pipes:

- The continuous insertion method whereby a (long) continuous pipeline is pulled into the host pipe. The replacement pipeline is prepared and welded or joined on the surface in advance of the pipe bursting, ready for installation via an insertion pit in a continuous operation.
- The sectional insertion method, whereby single pipes are lowered into the insertion pit, joined onto the existing pipeline behind the bursting head and pulled into the host pipe in an incremental manner.

Contractor to specify in Method Statement the pipe insertion method to be applied.

Excavations are limited to a pulling (or winching, exit or reception) pit, an insertion (or launching or entry) pit and re-connection pits, resulting in minimal surface disturbance, traffic disruption or service interruption.

All debris shall be cleared out of the existing pipeline prior to the commencement of pipe bursting, the cost of which shall be included in the rates tendered.

## **III. Potential surface movement**

The potential for surface heaving and the potential for damage of nearby existing services and structures by the pipe bursting operations shall be assessed and any necessary precautionary measures shall be taken. Care shall be exercised to protect existing surfaces, structures and services in the planning and execution of the work. Any surfaces, structures or services that may be subject to damage shall have their condition inspected and recorded prior to commencing construction work. During the pipe bursting operations all surfaces, structures and services shall be monitored for settlement, heaving or movement. Should any such settlement, heaving or movement occur the pipe bursting operations must cease until suitable actions have been taken to rectify the situation.

## **IV. Pulling equipment**

Cables, rods and winches shall be suitable for the particular pipe bursting operation and shall have sufficient pulling capacity. Pulleys and any associated framework installed in the pulling points shall be capable of withstanding the substantial forces that may be applied. Pulling equipment shall be equipped with load gauges and controls to avoid overloading.

## **V. The bursting head**

The bursting head shall be suitable for attaching to the replacement pipe securely. It shall be capable of withstanding the pulling forces and guiding the replacement pipe into and through the host pipeline. It shall have a rotating eye to avoid the replacement pipe twisting the cable. Once the replacement pipe has been installed, the pulling head shall be capable of being easily removed from the host pipeline.

### **411.1.2 Preliminary Activities**

#### **I. Measurement of existing pipelines**

The internal diameters and lengths of the existing pipelines to be replaced shall be measured and verified on site prior to the replacement pipe being ordered

#### **II. Condition of existing pipelines**

The condition of the existing pipeline to be replaced shall be inspected, if necessary with CCTV equipment, and its condition assessed before the pipe bursting operation commences. All defects in the existing pipeline such as sagging, misaligned joints, protruding connections, excessive silting, unexpected turns or bends, collapsed pipes or any other defect that will cause undue stress on the pulling operation shall be identified. This information shall be used in planning the positions of the insertion pits and any pulling pits.

#### **III. Existing services**

All existing services in the vicinity of the pipelines to be burst shall be located and where necessary protected against damage that might occur during the pipe bursting operation. This includes all services that cross over the path of the pipeline and that are within three times its diameter above it. These services shall be exposed and protected.

#### **IV. Planning of Insertion Pits**

The number and location of insertion pits shall be planned to keep them to a minimum and maximize the lengths of individual insertions. If possible, insertion pits and any pulling pits shall be located where excavations are to be made for other fittings e.g., valves, fire hydrants, etc.

The dimensions of the insertion pits and any pulling pits shall be the minimum necessary to accommodate the pipe bursting operations. The insertion pits shall be designed and constructed so that the radius of curvature of the replacement pipe is not less than the minimum allowable during insertion. The minimum allowable radius of curvature shall be as stipulated by the Engineer.

The excavations for the insertion pits and any pulling pits shall have the necessary shoring and dewatering, backfilling and reinstatement similar to pipe trenches.

#### **VI. Work Areas**

The areas required for storage, butt welding and stringing the replacement pipe ready for insertion shall be pre-planned and demarcated. The replacement pipes shall be stored and transported in a manner to avoid any damage to the pipes.

#### **VII. Contingency Plan**

There shall be a contingency plan for the removal of the bursting head and any other equipment in the event that the bursting head becomes stuck for whatever reason and where no further pipe bursting is possible.

#### **411.1.3 Pipe Bursting Activities**

##### **I. Excavation, backfilling and reinstatement**

The excavation, backfilling and reinstatement of the insertion pits and any pulling pits shall be in accordance with the relevant requirements of CL 407 and 409. The excavations for the insertion pits and pulling pits shall have shoring wherever found necessary by the Engineer. Approved dewatering equipment shall also be used to ensure the pits are free of water. The excavations shall proceed with care near the existing pipeline, which may be structurally unsound so as to avoid damaging it.

All debris shall be cleared out of the existing pipeline prior to the commencement of pipe bursting.

##### **II. Allowable Stress of Replacement Pipe**

Care shall be exercised to avoid over-stressing the replacement pipe. The maximum allowable pulling forces shall be calculated for the replacement pipe (limited by the cross-sectional area and maximum safe permissible short-term tensile stress of the replacement pipe material). The winch load gauge shall be monitored during the entire pulling process.

##### **III. Replacement pipe support**

The whole length of replacement pipe shall be continuously supported on rollers before entry into the insertion pit to minimise friction and avoid damaging it during the pipe bursting operation. It may be necessary to put guards over the edges of the existing pipe to prevent gouging of the replacement pipe during insertion. The replacement pipe shall be pulled through in one continuous operation

##### **IV. Use of lubricant**

A lubricant may be used to reduce friction between the replacement pipe and the host pipeline during installation. The lubricant shall be a non-toxic product that has no detrimental effect on the environment, the replacement pipe or the existing pipeline, and does not support bacterial growth or affect the general characteristics of the flow in the replacement pipe.

##### **V. Relaxation period of the replacement pipe**

Allowance should be made for the replacement pipe stretching during insertion and then shortening after the completion of the installation. The manufacturer's specifications shall be followed in this regard. A 24-hour relaxation period should be allowed for but under no circumstances should this be less than four (4) hours.

##### **VI. Reinstatement of service connections**

After the successful installation of the replacement pipe the existing connections shall be re-established onto it. The connections shall be free of sharp edges or protrusions.

##### **VII. Contingency plan**

There shall be a contingency plan for the removal of the bursting head and any other equipment in the event that the bursting head becomes stuck for whatever reason and where no further pipe bursting is possible. This should be included in Contractor's method statement.

#### **VIII. Approval of replaced pipe**

The section of pipeline that has been replaced by pipe bursting may only be accepted once it has passed all the required tests.

#### **IX. Authority to install pipeline under facilities controlled by third parties**

The Contractor will liaise with necessary authorities where permission is required to control the land or any structure on the land and/or under the surface of which the pipeline is to be installed and any requirements for warnings and procedures to be observed before and during the pipe cracking operations.

#### **X. Reinstatement of service connections**

After the successful installation of the replacement pipe the existing connections shall be re-established onto it. The connections shall be free of sharp edges or protrusions

#### **XI. Tolerances and Acceptance**

The replacement pipe shall be checked to ensure that the tolerance requirements as stated in the specification data are met.

The section of pipeline that has been replaced by pipe bursting will only be accepted once it has passed all the required leak and pressure tests and the reinstatement works have been completed.

#### **SPECIFICATION DATA FOR PIPE BURSTING/ CRACKING/ SPLITTING WORK**

<b>Clause Number</b>	<b>Specification</b>
411.0.1(ii)	The replacement pipe shall be a solid wall High Density Polyethylene (HDPE) <b>as specified in Cl 503</b>
411.1.1(i)	The pipe bursting shall be performed using <b>the approved</b> pipe bursting technique.
411.1.1(ii)	The pipe insertion method shall be <b>approved</b> by the Engineer
411.1.2(iv)	Generally, for continuous butt-welded HDPE replacement pipes the insertion pit should have a length at least 12 times the replacement pipe diameter with the pit end sloped up to ground level at 1 in 2.5 or flatter.
411.1.1(iii)	Movement of <b>paved surfaces</b> shall be monitored <b>as directed by the Engineer.</b>

411.1.3(xi)	The replacement pipe shall be pressure tested to the specifications stipulated in <b>CI 414</b>
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## **411.2 PIPE CONSTRUCTION USING HORIZONTAL DIRECTIONAL DRILLING (HDD)**

### **411.2.1 General**

#### **I. Plant**

Suitable HDD equipment shall be provided and shall consist of a HDD machine, a drilling fluid system, a guidance system and ancillary equipment.

The drilling equipment shall have sufficient capacity to drill the bore, ream and pullback the pipe. The drilling fluid system shall consist of a fluid mixing, pumping and delivery system of sufficient capacity to successfully complete the drill, and a vacuum truck or other system of sufficient capacity to handle the volume of used drilling fluid required.

A fluid recycling system may be used to remove the cuttings from the drilling fluid so that the fluid can be re-used, or if the drilling fluid is not to be recycled it will have to be spoiled if not biodegradable.

The guidance system must be matched to the actual crossing to ensure the accuracy of the guided boring operations, trained and competent personnel to operate the system. All equipment shall be in a good and safe operating condition with sufficient fuel, supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

#### **II. Drilling machine**

The directional drilling machine shall comprise a power system to rotate, push and pull hollow steel drill rods into the ground at a variable angle while delivering a pressurized drilling fluid mixture to a guidable drill head. The power system shall be self-contained or umbilical with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leaks. The machine shall have a system to monitor and record pullback forces during pullback operations and an electrical strike alert system and all the necessary safety equipment such as an operator's presence seat switch and a remote lockout system.

#### **III. Cable strike alarm**

The drilling machine shall be fitted with a permanent alarm system capable of detecting an electrical current or voltage differential. The system shall have an audible alarm to warn the operator if the drill head detects or contacts electrified cables. The strike alarm should be tested prior to commencing each drilling process and the operators must be familiar with the procedure in the event of a strike.

#### **IV. Drilling head and reamers**

The drilling head shall be steerable by changing its rotational orientation and shall provide the necessary cutting surfaces and drilling fluid jets. Suitable drilling heads and reamers for bores in all soil conditions including rock shall be available.

Drill rods shall be constructed of high-quality seamless steel tubing suitable for the expected soil conditions as recommended by the drilling machine manufacturer. Safety tongs must be used on site for connecting and disconnecting torque threaded joints in a safe manner.

**V. Drill rods**

Drill rods shall be constructed of high-quality seamless steel tubing suitable for the expected soil conditions as recommended by the drilling machine manufacturer

**VI. Safety tongs**

Safety tongs must be used on site for connecting and disconnecting torque threaded joints in a safe manner.

**VIII. Potential surface movement**

The potential for surface heaving and the potential for damage of nearby existing services and structures by the HDD operations shall be assessed and any necessary precautionary measures shall be taken. Care shall be exercised to protect existing surfaces, structures and services in the planning and execution of the work. Any surfaces, structures or services that may be subject to damage shall have their condition inspected and recorded prior to commencing construction work. During the HDD operations all surfaces, structures and services shall be monitored for settlement, heaving or movement. Should any such settlement, heaving or movement occur the HDD operations must cease until suitable actions have been taken to rectify the situation.

**411.2.2 Drilling fluid system**

**I. Mixing system**

The drilling fluid mixing system shall be self-contained, closed, and have the capacity to mix and deliver sufficient drilling fluid. The mixing system shall continually agitate the drilling fluid during operations.

**II. Drilling fluid**

The drilling fluid shall be composed of clean water, sodium bentonite clay and appropriate additives. The water shall be from an approved source. The water and additives shall be mixed thoroughly and without any clumps or clods. No potentially hazardous material may be used in drilling fluid. Drilling fluids are available that are biodegradable and environmentally safe.

**III. Delivery system**

The delivery system shall have filters in-line to prevent solids from being pumped into the drill rods. Connections between the pump and drill rods shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained, collected and returned to the drilling fluid recycling system or spoiled. A berm at least 300 mm high, shall be maintained around the drilling machine, the drilling fluid mixing system, entry and exit drilling pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumps, vacuum truck(s), or any other system must have the required capacity to convey excess drilling fluid from containment areas to storage and recycling facilities.

**IV. Drilling fluid recycling system**

The drilling fluid recycling system, if used, shall separate the cuttings from the drilling fluid to render the drilling fluid re-usable. Cuttings separated from the drilling fluid will be stockpiled for later use or disposal.

## **V. Control of drilling fluids**

Control shall be exercised over operational pressures and pumping volumes, drilling fluid viscosities and densities, drilling speeds, and any other operational factors required to avoid hydro fracture fluid losses, inadvertent pressure release of fluid to the surface (frac-out) and drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. Provision shall be made for on-site mobile spill removal equipment during all drilling, pre-reaming, reaming and pullback operations and for quickly removing spills. Any inadvertent returns or spills shall be reported and immediately contained and cleaned up.

The local authority and environmental requirements regarding drilling fluids shall be adhered to. The relevant material data sheets shall be kept in the health and safety file.

## **VI. Guidance system**

Tracking and guidance systems are required to ensure that the position of the drill head is correctly aligned horizontally and vertically. These systems include walkover and wireline (hardwire) systems.

The walkover system has a battery powered transmitter or sonde located near the drill head. When the receiver on the ground surface is positioned directly above the drill head it locates the position, depth and pitch of the drill head.

The wireline system has a magnetic sensor placed in a non-magnetic drill head assembly, which is connected to a computer at the surface by wires which pass through the inside of the drill rods. Magnetic readings of the inclination and direction are interpreted by the computer providing information on the alignment and pitch of the bore. Accuracy can be increased, where possible, by using electrical wires on the surface to create a magnetic field.

The guidance system shall be capable of tracking at depths of up to 10 meters and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), inclination (vertical direction), temperature and battery status. The guidance system shall be accurate to  $\pm 5\%$  of the vertical depth of the borehole and to  $\pm 0.1\%$  of the inclination (pitch).

The guidance system shall be of a proven type and shall be operated by personnel trained and experienced with the system. The operator shall be aware of any metallic objects or electromagnetic anomalies near the drill path and shall consider influences such as these in the operation of the guidance system.

### **411.2.3 Other equipment**

#### **I. Pipe rollers**

Pipe rollers, if used, shall be of sufficient size to fully support the forces and the weight of the pipe during pullback operations. The bearing capacity of the soil under the rollers should be checked to ensure that it will not settle during pipe insertion.

#### **II. Pipe grip or pulling head**



The end of the pipe shall be connected to the swivel and reamer with a pipe grip or pulling head. The type may be a basket, internal, internal/external clamp or bolting device, or a fused HDPE pipe adaptor with a built-in pulling eye.

### **III. Pipe rammers**

Pipe rammers shall only be used if necessary to assist the pullback operation and only with approval.

#### **411.2.4 Preliminary Activities**

##### **I. Underground services**

The Contractor will liaise with necessary authorities where permission is required to control the land or any structure on the land and/or under the surface of which the pipeline is to be installed and any requirements for warnings and procedures to be observed before and during the horizontal directional drilling operations.

The installation of underground pipes using HDD may necessitate some additional requirements to protect existing underground services

- Verification - All existing underground services shall be located on site in liaison with the relevant service authorities by means of maps, plans, access covers, ground penetrating radar, cable locating equipment and/or excavations. Each service shall be exposed by hand or vacuum excavations and surveyed to confirm its exact horizontal and vertical position as well as size, number and type of service pipes or cables
- Ground Penetrating Radar Survey – where necessary a ground penetrating radar survey shall be performed along the route of the proposed drill path in an endeavor to detect any other unknown underground services or obstructions and reduce the chance of conflicting with any unforeseen obstacles
- Waypoints - where required by a service authority pits shall be excavated by hand at waypoints near or next to existing services to visibly confirm that the drill string, reamer or pipe is on course and will clear the existing services. As an alternative vacuum excavated potholes may be used.

##### **II. Geotechnical information**

Geotechnical information is to be collected by the Contractor. This information shall be used in planning the drill path, selecting suitable tooling and the drilling fluid design and management plan. Additional investigations may be undertaken to supplement the geotechnical information provided. For measurement and payment purposes, the classification of rock is stated in the preamble to the Bills of quantities.

### **III. Design Criteria**

The design criteria shall be as follows, unless stated otherwise in the specification data:

<b>Pipeline Location</b>	<b>Minimum Requirement</b>
Under roads	Greater of 10 x O.D. or 1.2m



Under sidewalks	Greater of 10 x O.D. or 1.0m
Elsewhere, where surface disruption is not important	0.9 m
Minimum setback from road edge	1.5 m
Minimum clearances to existing services	
Crossing (vertical clearance)	1.0 m
Parallel (horizontal clearance)	2.0 m
Minimum clearance between parallel bores	10 x larger O.D.

O.D. = Outside Diameter (Pipe)  $\leq \pm 300$  mm

The setbacks from road edge shall be the minimum distance from the existing road edge to any pits, drilling equipment or plant.

The clearances to existing services shall be the clear distance between the nearest outside of the existing service and the nearest outside of the largest reamer to be used in the installation.

In designing a drill path to achieve the above criteria, there should be as few as possible curves and the drill path should preferably be in a straight line in plan

#### IV. Road Crossings

The Contractor shall allow in his rates for liaison with the relevant Roads Authority and obtain a Road Opening Permit. Statutory fee for road crossings will be paid under relevant Item in the Bills of Quantity. The Contractor shall be responsible for all liaison with the Police for traffic control during execution of the works.

The road crossings shall be constructed in the following specifications and any other requirement stipulated by the Road Authority:

- Pipe depth shall not be less than 1.0m below the road surface.
- Protective steel pipe sleeves shall be provided where required as instructed by contract.
- Drains, footpaths and other infrastructure shall be reinstated to the original condition as required by the Authority.

#### V. Drilling Plan

The drill plan shall be prepared by the HDD Contractor for approval by the Engineer and include detailed design calculations, specifications, drill path and working drawings to show the proposed methods of installation and methods of providing temporary support for any road, rail track, or other service or structure and any modifications to structures required before HDD operations commence.

The drill plan shall include:

- a) final bore diameter to be reamed, based on the pipe size and conditions, shall be

stated in the drill plan.

- b) drawings showing the detailed alignment of the drill path both horizontally and vertically. The drill path shall be designed to account for surface features, structures, roads, railways, ground surface profile, required minimum depths, confirmed position of existing services, positions of pits and required clearances including setbacks from roads.
- c) the drilling machine entry and exit angles, the pipe size, the number of pipes if in a bundle and the allowable rates of curvature of the drill rods and the product pipe.
- d) the characteristics of the drilling machine including pumping capacity and available tooling
- e) that must be taken into account, plus any other parameters specific to the plant, equipment and method of working. The potential for drilling fluid loss can be reduced with deeper bores.
- f) the proposed positions and approximate sizes of waypoint pits, entry and exit drilling pits shall be shown as well as the proposed locations, plus the footprint dimensions, required for stringing out and supporting of the pipeline ready for the pullback.
- g) shall show the ends of the pipeline to be installed for measurement purposes. The drill plan shall also show any allowances to counteract the recovery of axial strain on the product pipe.
- h) shall state the planned selection of drilling and reaming tools and the preliminary drilling fluid design suitable for the geotechnical conditions and volume calculations.
- i) shall show the radius of curvature of the drill path and the calculations determining this. The curvature of the drill path is limited by the steering capabilities of the drilling equipment, the minimum allowable bending radius of the drilling rods and the product pipe, and the allowable tensile stress in the curved pipe due to pulling loads.
- j) Topographical survey measurements shall be taken before, during and after the construction period and any change in line or level (or both) of any road, rail track, or other service or structure being traversed, recorded. A copy of such records shall be kept on file.

The HDD Contractor is responsible for the design of the directional bore and shall determine the maximum allowable pullback force for the pipe and conditions. The need to reduce the buoyancy of the pipeline and determine any measures to counteract this buoyancy shall also be considered.

No work shall commence until the drill plan has been completed and approved

#### **411.2.5 Pipe Installation**

##### **I. Competence**

The HDD operations shall be undertaken and supervised only by competent persons experienced with this work. Operators should have certified manufacturers and/or formal training and should have a good theoretical understanding of HDD operations.

##### **II. Safety**

- Requirements of the Health and Safety Plan must be followed including the operation and use of cable strike alarms, electric grounding rods and safety mats, ignition key procedures, operation of two-way radios, safety perimeters around equipment,

procedures for safely connecting/disconnecting tooling, personal protection equipment, dielectric boots, gloves, hard hats, dust masks, high visibility vests and safety glasses.

- Before commencing work in the vicinity of any structure, there shall be a detailed examination of the structure, record of its condition (including photographs), and the record filed.
- Where required, measurements shall be taken before, during and after the construction period and any change in line or level (or both) of any road, rail track, or other service or structure being traversed, recorded. A copy of such record shall be kept on file.
- Except when temporary support is provided by others, temporary support shall be provided when necessary to carry road and rail traffic, and in the case of railway tracks, to prevent horizontal or vertical misalignment

### **III. Drilling Pits**

Drilling pits shall be excavated at each end of the section of pipeline or sleeve that is to be installed. The pits shall be located at the ends of the proposed pipeline to define the extent of the installation and facilitate containment of drilling fluids and the fixing and removal of tooling if necessary. The pits shall be of dimensions at least equal to the minimum dimensions needed for the equipment and for safe and efficient working. If possible, the capacity of the pits should be at least equal to the volume of the final bore between the pits. The position and approximate dimensions of the pits shall be included in the drill plan before work commences. The excavated material shall be stockpiled for later backfilling and compaction in layers not exceeding 150mm to 93% of modified AASHTO maximum density (100% for sand).

Every face of any excavation that exceeds a depth of 1.5 m shall be supported or contained by shoring unless the face is cut back to a safe slope.

Where a pit adjoins a railway or a heavily used road, the sides of the pit shall be shored during the entire operation to prevent any movement caused by vibration arising from rail or road traffic.

It is to be ensured that at all times, each pit has barriers and provides a safe working environment.

### **IV. HDD Procedure**

- After the drill plan has been approved, the HDD Contractor shall give 48 hours minimum notice that he intends commencing drilling. The drilling may not commence until the preparation work has been completed
- Prior to commencing any work on the site, inspections shall be made of the site of work and a record with photographs of the existing condition of the areas that will be affected by the work. A similar set of photographs shall be taken after completion. Copies of the inspections shall be filed
- The drawings showing the drill path in plan and long section, with cross sections where necessary, showing all services shall be on the drilling site for reference at all

times. In addition to this the drill operator will have his own drill procedure detailing rods, pitch and distance schedule

- The setting out of the drill path shall be completed and the drill guidance system prepared.
- The work area required for the welding, storage and stringing out of pipes ready for pullback shall be planned and staked out.
- Pilot Bore
  - The pilot bore shall be drilled along the path shown on the drawings. The guidance system shall be on site at all times and operational. The guidance system shall be used to locate the drill both horizontally (longitudinally and laterally) and vertically. The position of the drill shall be plotted on the drill plan drawings to confirm its correct position. The position shall be recorded at least once per drill rod length.
  - The pitch, line and level shall be checked continuously during the drilling of the pilot bore, and corrective steering action shall be applied as necessary. A copy of the results of all checks including the plot of the bore and a statement of any corrective measures taken shall be recorded in a drilling log and be available for inspection on the site. As soon as the pilot bore has been completed a copy of the drilling log and as-built drill plan shall be filed for the record.
  - Care shall be exercised at service crossings to ensure the required clearances are achieved. This may require excavating waypoint pits to confirm the position of the drill during the pilot bore and all reaming passes.
  - The drilling machine operator shall continuously monitor the instruments showing torque and axial forces, and drilling fluid pressure, flow rates and volumes and rod changes during the drilling of the pilot bore.
  - Any unexpected subsurface conditions, such as an underground obstruction, or cavities that impede, or otherwise influence drilling operations shall immediately be reported
- Pullback
  - Pre-reaming and pipe pullback can be performed simultaneously with pipe diameters not exceeding 300 mm. Pre-reaming allows bores, particularly larger ones, to be created in stages, reducing the required torque and thrust loads on the machine as well as the amount of spoil in the drilling fluid returns.
  - The final bore diameter shall be not more than 50% greater than the outside diameter of the pipe to provide clearance for the pipe grip or pulling head, allow spoils flow and reduce the required loads during the pipe pullback operation
  - A swivel shall be provided between the reamer and the pipe grip or pulling head to prevent the transmission of torsion loads to the pipe

- The end of the product pipe shall be connected to the swivel and reamer with a pipe grip or pulling head. The product pipe end shall be sealed and suitably prepared. The pipe grip or pulling head shall be securely fastened to the pipe end
- A breakaway link may, or where specified shall, be provided between the main swivel and the pipe grip or pulling head to ensure the pipe is installed within the maximum allowable pulling force. The breakaway link shall be rated at or not more than the maximum allowable pulling force. Broken links will require the removal of the pipe from the entry end, or possible abandonment. Following a determination of the problem, and an appropriate solution, another attempt may be made, possibly requiring a new bore path. A pullback gauge may, or where specified shall, be provided and attached to the pipe grip or pulling head to continuously monitor the actual tension applied to the product pipe.
- The length of pipe to be installed shall be laid out and supported during the pullback operations so that it moves freely without the pipe being damaged. A sufficient number of rollers shall be used to avoid excess sagging. Any curves in the pipeline shall be at more than the pipe's allowable radius of curvature
- Once pullback operations have commenced the operation must continue without interruption until the pipe is completely pulled through the bore hole. The constraints of any permitted working hours shall be considered in the planning of the pullback. The frictional resistance is normally the highest just prior to movement and decreases with movement. When pullback ceases, frictional forces and drag forces increase due to the thixotropic nature of the drilling fluid. The drilling fluid starts to gel when it is undisturbed and could result in the pipeline being held in place (freezing). Therefore, pullback should never be stopped, except for drilling rod removal, until the pipe is completely pulled into its permanent position
- The drilling machine operator shall continuously monitor the instruments showing torque and pullback forces, and drilling fluid pressure and flow rates during reaming and pullback operations. The pulling force during pullback shall not exceed the maximum allowable pullback force
- Any requirements for reducing the buoyancy of the pipeline shall be applied prior to pullback
- Hydrolock can occur where the soil conditions, a bore collapse, cuttings not being effectively removed, or where external hydrostatic and/or drilling fluid pressure holds the pipeline and/or deforming it, causing the maximum allowable pullback force to be exceeded. The pulling operations shall halt to allow the pressure to subside, then an attempt should be made to continue pulling as soon as possible to prevent the drilling fluid gelling and holding the pipeline in place (freezing). Any unexpected subsurface conditions, such as hydrolock, that impede drilling operations, shall immediately be reported.
- The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking and movement or distortion of surface features

- Prior to sealing the annulus space, restoring the access chambers, and backfilling the insertion pit, the installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four hours, for cooling and relaxation. Sufficient excess length of new pipe shall be allowed to protrude into the access chamber to allow for cooling and relaxation and the consequential contraction
- Where shown on the drawings more than one pipe can be installed as a pipe bundle
- Completion
  - Pipe end caps shall be installed on the ends of empty pipes to prevent the ingress of water and soil. Where cables are inserted, the remaining annulus between the outside of the pipe and the inside of the bored hole at the pipe ends shall be sealed with an appropriate compound
  - Where required, permanent markers shall be installed at the pipe ends
  - The installed pipe shall only be accepted once it is within the specified tolerances and has passed all inspections and tests
  - When the pipe installation has been completed and the plant removed, any drilling pits shall have any remaining drilling fluid removed for disposal or recycling and the pits backfilled. Surplus excavated materials shall be disposed of as directed by the Engineer.

#### **SPECIFICATION DATA FOR HDD PIPE INSTALLATION WORK**

<b>Clause Number</b>	<b>Specification</b>
411.0.1(ii)	The replacement pipe shall be a solid wall High Density Polyethylene (HDPE) <b>as specified in CI 503</b>
411.2.4(v)	The drill plan shall be approved by <b>the Engineer</b>
411.2.4(v) / 411.2.5(iv)	Generally, for continuous butt-welded HDPE replacement pipes the insertion pit should have a length at least 12 times the replacement pipe diameter with the pit end sloped up to ground level at 1 in 2,5 or flatter.
411.2.1(vii)	Movement of <b>paved surfaces</b> shall be monitored as <b>directed by the Engineer.</b>
411.2.5(iv)	The installed pipe shall be pressure tested to the specifications stipulated in <b>CI 414</b>

## **412. CLOSED CIRCUIT TELEVISION**

CCTV inspection of pipelines covers the internal condition survey of gravity pipelines of any material using CCTV cameras with appropriate transport and lighting mechanisms to view internal surfaces.

CCTV inspection shall be performed on the approval of the Engineer to verify pipe alignment, point repairs and existing fittings in the presence of representatives from the water utility.

## **413. CHAMBERS AND SURFACE BOXES**

Gate valves, air valves and fire hydrants etc. shall be provided with suitable chambers or surface boxes in accordance with detailed drawings. In roads and footpaths, the boxes shall have lockable metal or fibre reinforced plastic covers or surface boxes laid flush with the surface capable of load bearing to level as specified in drawings. Indicator posts to suit shall also be provided.

## **414. PRESSURE TESTING OF PIPELINES**

- a) The Contractor shall test a section of main as long as possible subject to the maximum length of open trench approved by the Engineer. The test shall be carried out within 12 working days of the completion of such section of the main.
- b) The pipeline shall be adequately anchored during the test at stop ends or valves to prevent movement under the test pressures.
- c) The test section shall be filled with water and great care should be taken to drive out all air through air valves, ferrules etc. The test pressure is to be at least 1.5 times the nominal working pressure for the class of pipe being tested and is to be applied for at least 2 hours.
- d) The leakage from the mains and connections from each section tested shall be according to SRN 316, i.e., not exceeding 0.02 litres per millimetre of nominal bore per kilometre of pipeline per 24 hour per bar of applied pressure head.

To determine the rate of leakage, the Contractor shall furnish a suitable hydraulic test pump, pressure gauge, connections and water meter or other appliance, for measuring the amount of water pumped. The pressure shall be raised to the amount required and specified by the Engineer and shall be so maintained for a period of not less than two hours or whatever longer period as required by the Engineer to examine every joint to satisfy himself that they are sound.

If the leakage is at a greater rate than that specified, the Contractor shall re-excavate the trench where necessary and shall re-make the joints and replace defective work until the leakage shall be reduced to the allowable amount.

- e) The Employer shall charge the Contractor the cost of any couplings required to join up tested lengths of main if, in the Engineer's opinion, greater lengths could reasonably have been tested or if failure under test, requires the pipe to be cut, or other methods of laying should



have been adopted.

Water used in testing the main shall be supplied by the Contractor. The Contractor shall carry out all work which may be necessary for making temporary connections to the existing mains to obtain water for testing at his own expense.

In carrying out the test for water tightness the Employer only shall authorize the operation of all valves, but the Contractor shall provide all the necessary labour to assist in the opening and closing of the valves to the Engineer's instructions, and he shall allow in his prices for all his expenses in connection with testing on completion.

The Engineer shall be the sole judge of water tightness.

#### **415. CLEANING AND STERILISING OF PIPELINES**

- a) When a pipeline is complete and where applicable, has successfully passed the test, it shall be thoroughly washed out, using if possible, an open end. Thereafter it shall be sterilized by being filled with a suitable solution containing not less than 20 p.p.m. of free available chlorine or such other sterilizing agent as the Engineer shall approve. After standing for 24 hours the main shall again be washed out and refilled with mains water prior to the taking of bacteriological samples. The Contractor shall provide all necessary stop-ends, fittings and chemicals for this work.
- b) Emptying and washing out of the pipes shall be done in such a manner as not to damage the trench or cause undue flooding of the vicinity, and the Contractor shall supply and use piping, specials and/or hose as may be necessary to facilitate the flow of water to the nearest drain or watercourse. Water used for washing out and sterilizing may be supplied by the Employer when a suitable supply is available but all expenses should be payable by the Contractor.

Before any section of the main is put into use, a bacteriological sample or samples will be taken by the Engineer's Representative and only on receipt of a satisfactory certificate from a Medical Research Laboratory or similar organisation will the main or section of main be permitted to be put into supply and be considered as having been substantially completed.

Any expenditure involved in providing facilities or materials for the taking of samples shall be included in the Contractor's Bidding rates and the Engineer will specify and shall be the sole judge as to the number of samples required and the points at which they are to be taken.

The cost of the bacteriological examination will be borne by the Employer but if the sample or samples are not satisfactory, the cost of any subsequent analysis will be borne by the Contractor.

#### **416. CLEARANCE OF SITE**

The Contractor shall remove all surplus pipes, specials and other fittings from the site as directed by the Engineer. The site of works shall be levelled and all surplus excavation, debris, cut trees or bushes shall be carted to approved tip sites.



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#### **417. UNINTERRUPTED WATER SUPPLY**

The Contractor shall liaise with the water service provider where construction works will require to interrupt regular water supply. The contractor is to engage with the service provider not less than one week prior to commencement of works on a new work front. Planned service interruptions should maximize times of off-peak demand and aligned with regular maintenance shutdowns to minimize disruption of regular supply schedules.

Contractor shall maintain temporary uninterrupted supply of water to existing customers during construction works connecting consumers to a suitable bypass pipeline for the duration of service interruption. Consumers shall be reconnected to the new pipeline after construction is completed.

Consumers shall be notified in writing by the contractor in a manner approved by the water service provider. General notice shall be provided seven (7) days in advance. Detailed notice shall be provided at a minimum 48 hours prior to service interruption.

## **5. PIPES, FITTINGS, VALVES AND METERS**

### **501. GENERAL**

The approval in writing or otherwise by the Consultant of any material shall not in any way whatsoever relieve the Supplier from any liability or obligation under the Contract and no claim by the Supplier on account of the failure, insufficiency or unsuitability of any such materials will be entertained.

- a) All items shall be suitable for water works purposes and for use with cold water installation and operation being in a tropical climate.
- b) All items hereinafter specified shall be to such other Standard or Specification which in the opinion of the Consultant provides for a quality of material and workmanship. The Standard or Specification must be submitted to the Consultant for approval before commencement of work.
- c) All ferrous pipes and fittings shall be coated with a protective paint suitable for use in and transport through a tropical climate.
- d) The Supplier shall supply to the Purchaser a certificate stating that each item supplied has been subjected to the tests hereinafter laid down and conforms in all respects to the said Specification.
- e) The Supplier shall provide adequate protection to all piping, flanged items and valves so as to guard effectively against damage in transit and storage and ingress of foreign matter inside the valves.
- f) All pipework and fittings shall be subjected to a works hydrostatic test pressure which shall be not less than twice the maximum operating pressure.
- g) The Supplier should exercise diligence to provide the best material.
- h) Where applicable, the manufacturer's Specification should accompany all offers. The name of the manufacturer must in every case be stated.
- i) Where necessary the Supplier shall provide rubber gaskets to comply with EN 1514, DIN 2693 or DIN 2697 and all other bolts, nuts, washers, etc. to undertake jointing at fittings etc.
- j) Any articles required under this Contract which are found to be faulty due to a crack, flaw or any other reason or is not in accordance with the Specification stipulated will not be accepted nor will the Purchaser be liable for any charges in respect of such an article. Where any such rejected article can, in the opinion of the Consultant, be rendered usable, the Supplier may deal with it accordingly and include it in the Contract at a price to be mutually agreed. Straight pipes which have been cut will be accepted at the discretion of the Consultant, provided the length is not less than 4 metres or two thirds of the standard length whichever is the lesser and will be priced

pro-rata.

- k) Wherever possible, samples of pipes and fittings shall be submitted for approval of the Consultant prior to the Supplier obtaining the total requirements.

## **502. UNPLASTICISED PVC (uPVC) PIPES**

Unplasticised PVC piping shall be in accordance with BS EN 1452.

The maximum sustained working pressures to which the pipes and fittings will be subjected is based on water at a temperature of 20 degrees centigrade.

The Supplier shall submit full details of the pipes he intends to supply.

The pipes up to and including 40mm diameter can be of a solvent weld type. The pipe shall be supplied with interchangeable sockets preformed at the factory and of such internal diameter that it takes the plain end of the pipe with the same nominal diameter.

The joint shall sustain the end thrust to which the pipe shall be subjected. The Supplier shall supply sufficient quantity of the cleaner and adhesive which shall be required to make the joints with the pipes.

The pipes of 50mm diameter and over shall consist of a grooved socket at one end of the pipe. The socket shall be designed to give a clearance fit on the outside diameter of the parent pipe. The sealing medium which shall seat in the groove shall be a rubber ring.

If the formation of the socket and groove results in the thinning of the original wall thickness of the pipe, it shall be compensated for by shrinking on to the outside of the socket area a reinforcing sleeve of the same material as the pipe. The socket and groove shall incorporate no sharp angles where the stress points are created.

The joint shall take 10% deformation of the spigot at the point where it enters the socket without leakage from the pipe when subjected to the test pressure specified for the pipe. Thermal expansion of the pipe shall be accommodated in the joint. The joint shall be capable of linear deflection up to 3 degrees.

The sealing ring shall be of first grade natural rubber and the physical properties of the mix shall meet the requirements of DIN 4060, BS2494 or EN 681. The Supplier shall supply sufficient quantity of any lubricant or other material which shall be needed to make the joint which shall be assembled by hand.

The Supplier shall submit full details of the type of joint offered and a full description of the method of jointing. The fittings shall have the same type of joint as for the pipes to be used. The Supplier shall submit full details of the materials dimensions and test pressures of the fittings offered.

Precautions shall be taken to avoid damage to the pipes and fittings.

In handling and storing the pipes and fittings, every care shall be taken to avoid distortion, flattening, scoring or other damage. The pipes and fittings shall not be allowed to drop or strike objects. Pipe lifting and lowering shall be carried out by approved equipment only.

Special care shall be taken in transit, handling and storage to avoid any damage to the ends. Pipes and fittings shall be marked at not greater than one metre intervals showing their class and diameter.

### 503. HIGH DENSITY POLYETHYLENE (HDPE) PIPES

HDPE Pressure Pipes and Fittings shall be manufactured using a pre-compounded blue pigmented PE100 resin, having a Minimum Required Strength (MRS) value of  $\geq 10.0$  MPa, at a service temperature of 20°C for a minimum design service life of 50 years.

The pipes and fittings shall be manufactured in accordance with EN 12201:2011, ISO 4427 / ISO 4437 or other acceptable International Standard. The Pipes and Fittings shall comply with the following:

**Table 5-1 Pipes and Fittings Specifications**

<b>Pipes:</b>	Material:	Polyethylene PE100 (MRS100), density $\geq 0.95$ kg/dm <sup>3</sup>
	Colour:	<b>Blue</b> <b>Black with Blue stripes</b> <b>Black with Blue outer coextruded layer</b>
	Pressure Rating:	SDR 17 – PN10 SDR 11 – PN16
	Supply Lengths:	All pipe sizes up to and including OD 110 mm supplied in coils of 50 or 100 meters. All pipes, OD 90mm and above shall be supplied in straight exceeding 12metres.
<b>Fittings:</b>	Material:	Polyethylene PE100 (MRS100), density $\geq 0.95$ kg/dm <sup>3</sup>
	Colour:	Black or Blue
	Type of Joint:	Electrofusion / Spigot type for Butt Fusion / (For sizes 110mm and below)
	Pressure Rating:	SDR 26 – PN6.3 upto SDR7.4 – PN25
<b>Diameters:</b>	<i>as per EN 12201-2</i>	

DIMENSIONAL CHART FOR HDPE PE100 PRESSURE PIPES - ISO 4427 - 2: 2007																	
				6.3 Bar		8 Bar		10 Bar		12.5 Bar		16 Bar		20 Bar		25 Bar	
Outer Diameter		Ovality		Sdr 26		Sdr 21		Sdr 17		Sdr 13.6		Sdr 11		Sdr 9		Sdr 7.4	
Min	Max	mm Max	Std Length of Roll (mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)	MIN WALL THK (mm)	WT / Mtr (kg/ mtrs)
16.00	16.30	1.20												2.00	0.09	2.30	0.10
20.00	20.30	1.20	100.00							1.90	0.10	2.00	0.12	2.30	0.13	3.00	0.16
25.00	25.30	1.20	100.00					1.60	0.12	2.00	0.15	2.30	0.17	3.00	0.21	3.50	0.24
32.00	32.30	1.30	100.00	1.60	0.16	1.60	0.16	2.00	0.19	2.40	0.23	3.00	0.28	3.60	0.33	4.40	0.39
40.00	40.40	1.40	100.00	1.60	0.20	2.00	0.25	2.40	0.29	3.00	0.36	3.70	0.43	4.50	0.51	5.50	0.61
50.00	50.40	1.40	100.00	2.00	0.31	2.40	0.37	3.00	0.45	3.70	0.55	4.60	0.67	5.60	0.79	6.90	0.94
63.00	63.40	1.50	100.00	2.50	0.49	3.00	0.58	3.80	0.72	4.70	0.88	5.80	1.06	7.10	1.27	8.60	1.48
75.00	75.50	1.60	100.00	2.90	0.67	3.60	0.83	4.50	1.02	5.60	1.24	6.80	1.48	8.40	1.78	10.30	2.11
90.00	90.60	1.80	100.00	3.50	0.98	4.30	1.19	5.40	1.47	6.70	1.78	8.20	2.14	10.10	2.57	12.30	3.03
110.00	110.70	2.20	50.00	4.20	1.44	5.30	1.78	6.60	2.18	8.10	2.64	10.00	3.17	12.30	3.81	15.10	4.54
125.00	125.80	2.50	12.00	4.80	1.85	6.00	2.28	7.40	2.78	9.20	3.40	11.40	4.12	14.00	4.93	17.10	5.84
140.00	140.90	2.80	12.00	5.40	2.33	6.70	2.85	8.30	3.49	10.30	4.26	12.70	5.13	15.70	6.18	19.20	7.34
160.00	161.00	3.20	12.00	6.20	3.06	7.70	3.74	9.50	4.56	11.80	5.56	14.60	6.73	17.90	8.05	21.90	9.55
180.00	181.10	3.60	12.00	6.90	3.81	8.60	4.70	10.70	5.76	13.30	7.05	16.40	8.51	20.10	10.18	24.60	12.07
200.00	201.20	4.00	12.00	7.70	4.73	9.60	5.83	11.90	7.11	14.70	8.65	18.20	10.50	22.40	12.59	27.40	14.93
225.00	226.40	4.50	12.00	8.60	5.94	10.80	7.36	13.40	9.02	16.60	10.98	20.50	13.29	25.20	15.94	30.80	18.88
250.00	251.50	5.00	12.00	9.60	7.34	11.90	9.01	14.80	11.06	18.40	13.53	22.70	16.34	27.90	19.59	34.20	23.30
280.00	281.70	9.80	12.00	10.70	9.18	13.40	11.37	16.60	13.89	20.60	16.95	25.40	20.49	31.30	24.62	38.30	29.22
315.00	316.90	11.10	12.00	12.10	11.70	15.00	14.29	18.70	17.59	23.20	21.48	28.60	25.93	35.20	31.14	43.10	36.99
355.00	357.20	12.50	12.00	13.60	14.78	16.90	18.15	21.10	22.39	26.10	27.24	32.20	32.92	39.70	39.56	48.50	46.90
400.00	402.40	14.00	12.00	15.30	18.74	19.10	23.14	23.70	28.29	29.40	34.54	36.30	41.79	44.70	50.18	54.70	59.56
450.00	452.70	15.60	12.00	17.20	23.70	21.50	29.27	26.70	35.85	33.10	43.75	40.90	52.92	50.30	63.53	61.50	75.35
500.00	503.00	17.50	12.00	19.10	29.23	23.90	36.11	29.70	44.29	36.80	53.98	45.40	65.30	55.80	78.28		
560.00	563.40	19.60	12.00	21.40	36.64	26.70	45.19	33.20	55.49	41.20	67.73	50.80	81.81	62.50	98.22		
630.00	633.80	22.10	12.00	24.10	46.43	30.00	57.09	37.40	70.28	46.30	85.60	57.20	103.65	70.30	124.29		

Figure 5-1 Dimensional Chart for HDPE Pipes

### Performance Characteristics

The pipes shall have the following basic minimum performance characteristics:

Table 5-2 Pipe Performance Characteristics

Paramet	Unit	Val
Average Density as per ISO 1183	Gm/cm <sup>3</sup>	≥
Melt Flow Index MFI 190°C / 50N as per ISO 1133	Gm/10 min.	0.4-0.55
Minimum Tensile Strength	N/mm <sup>2</sup>	2
Elongation at Break	%	≥ 600%
E-Modulus (Modulus of Elasticity)	N/mm <sup>2</sup>	12
Minimum Radius of Curvature at 20°C		25 x OD
Linear Coefficient of Thermal Expansion (VDE 0304)	°K <sup>-1</sup>	1.3 x 10 <sup>-4</sup>

### Marking and Identification

Pipes shall be clearly and indelibly marked to show the following:

- Name of Manufacturer / Brand
- Nominal Diameter x Minimum Wall Thickness
- Material Classification (i.e., PE100)
- Standard Dimension Ratio and Pressure Rating (SDR17 PN10 or SDR11 PN16)

- Reference Standard of Manufacture (e.g., EN 12201)
- Date of Manufacture

### **Transportation, Storage and Laying of Pipes and Fittings**

Before transporting HDPE pressure pipes the loading surface of the vehicle must be cleaned and free from projecting nails, screws or other sharp objects. The bottom layer of all pipes must as far as possible be in contact with the loading surface throughout their entire length and not project beyond it. The pipes must be secured from slipping and shall not be pulled over sharp edges when loading and offloading. Pipes shall not be dragged along the ground.

Pipes, fittings and coils shall be stored in such a way that they are completely protected from direct sunlight. When covered, they must be well ventilated to avoid accumulation of heat and resultant deformation. Transparent coverings shall not be used. The storage location shall be flat and shall, for pipes, support the pipes throughout their length. Stones and sharp objects shall not be present. Pipes shall not be stacked to a height exceeding 1m. The pipes must be secured at the sides to prevent them from rolling. Contact with harmful materials shall be avoided. As far as possible, coils shall be stored in a horizontal position. The area shall be free of stones and sharp objects. If stored upright they must be secured to avoid tilting.

Prior to laying in trench, the bed of the trench must provide support throughout the entire length of the pipe. The pipe shall not be laid directly on cohesive, rocky or stony soil. Such material shall be over excavated to a depth of not less than 0.1m and shall be removed and replaced by non-cohesive soil or a special pipe support. This shall initially be recompact and then the surface loosened on the day of and prior to laying.

Pipes supplied in coils and of up to 63mm diameter may be unrolled with the coil in the vertical position. For larger diameters an unwinding device shall be used. A turnstile can be used with the coil laid in a horizontal position on it or with the coil mounted vertically on a slow-moving lorry. The pipe shall never be removed from a coil in a spiral manner as this may cause kinking. Should kinking nevertheless occur the Contractor shall cut the pipe on either side of the kink, prepare the ends, and then use an approved joint after laying. All costs of dealing with kinking shall be to the Contractor's expense. A minimum bending radii of 35 x the diameter shall be observed.

### **Joining Methods**

**A. Butt Fusion:** The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians.

**B. Saddle Fusion:** Saddle fusion shall be done in accordance with ASTM F 2620 or TR-41 or the fitting manufacturer's recommendations. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on this project. [Saddle fusion is used to fuse branch saddles, tapping tees, and other HDPE constructs onto the wall of the main pipe] (ASTM F905).

**C. Socket Fusion:** Moulded socket fusion fittings are only to be used for joining

of HDPE pipe from 1/2 inch to 2" in size. Socket fusion shall be done in accordance with ASTM F 2620 or the fitting manufacturer's recommendations. Socket fusion is the process of fusing pipe to pipe, or pipe to fitting by the use of a male and female end that are heated simultaneously, and pressed together so the outside wall of the male end is fused to the inside wall of the female end. Qualification of the fusion technician shall be demonstrated by evidence of socket fusion training within the past year on the equipment to be utilized on this project. *[Socket fusion is not widely used, and the specifier may decide to prohibit its use]*

**D. Electrofusion:** Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project.

**E. Mechanical:**

- Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use mechanical joint adapters and other devices in conformance with AWWA Manual of Practice M55, Chapter 6.
- Mechanical connections on small pipe under 3" are available to connect HDPE pipe to other HDPE pipe, or fittings, or to a transition to another material. The use of stab-fit style couplings is allowed, along with the use of metallic couplings of brass and other materials. All mechanical and compression fittings shall be recommended by the manufacturer for potable water use. When a compression type or mechanical type of coupling is used, the use of a rigid tubular insert stiffener inside the end of the pipe is recommended.
- Mechanical couplings that wrap around the pipe and act as saddles are made by several manufacturers specifically for HDPE pipe. All such saddles, tapping saddles, couplings, clamps etc. shall be recommended by the manufacturer as being designed for use with HDPE pipe at the pressure class listed in this section.
- Unless specified by the fitting manufacturer, a restraint harness or concrete anchor is recommended with mechanical couplings to prevent pull-out.
- Mechanical coupling shall be made by qualified technicians. Qualification of the field technician shall be demonstrated by evidence of mechanical coupling training within the past year. This training shall be on the equipment and pipe components to be utilized for this project

**F. Joint Recording:** The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded either manually or by an electronic data logging device. All fusion joint data shall be included in the Fusion Technician's joint report.

**Testing**

- a. Hydrostatic leakage testing is recommended and shall comply with ASTM F 2164, ASTM F 1412, AWWA Manual of Practice M55 Chapter 9.



- b. If the test section fails this test, the Contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the Owner.
- c. Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

#### **Cleaning and Disinfecting**

- a. Cleaning and disinfecting of potable water systems shall be in accordance with AWWA C651 and AWWA Manual of Practice M55 Chapter 10.
- b. After installation and pressure testing, new water mains should be disinfected according to AWWA C651.
- c. The disinfection chemicals should be limited to less than 12% active chlorine. The duration of the disinfection should not exceed 24 hours.
- d. Upon completion, the system should be thoroughly flushed with fresh water, and retested to verify the disinfectant chlorine level has been reduced to potable drinking water concentrations in all service water tubing and branch lateral pipes.

#### **504. POLYPROPYLENE PIPES**

Propylene co-polymer pressure pipe shall comply with the relevant provisions of BS 4991 and DIN standards and, where it is to be in contact with potable water, shall be Series 1.

Polypropylene pipes shall be available in diameters from 12mm to 1400mm and shall be suitable for working use at temperatures up to 90°C, and withstand short-term use at a maximum 110°C.

#### **505. STEEL PIPES AND SPECIALS**

All pipes shall be made by spiral seam pipe forming process with submerged arc as its main method of pipe manufacture.

#### **Typical Specifications**



**Table 5-3 Steel Pipe Specifications**

Application	Specifications
Oil and Gas	API 5L, ASTM A 139, DIN 17172, BS EN 10208, GB 9711, AS 1579
Water	API 5L, AWWA C200, ASTM A139, AS1579, BS EN 10244/BS3601, DIN 1626/DIN 2460, NFA 49-150, JIS G3457, UNI 6363, SABS 719
Sewerage	BS EN 10224/BS 3601, AWWA C300, AWWA C301
Steam	API 5L, ASTM A 139, DIN 1626 & DIN1628 (<300°C)
Piling	ASTM A252, JIS A 5525, ST/Y 5040
Structural & Mechanical Engineering	ASTM A134, DIN 1626, DIN 1628

### **Pipe Ends**

Spherical socket and spigot joints: These fillet welded slip joints covered under BS EN 10224 and UNI 6363 offer 5° joint deflection. Ends (shown right) are formed to give a spherical surface and spigot ends can have a double wall that protects the lining from external welding of the joint. Another variation of this is the parallel socket and spigot joint where deflection is limited to 10. These are covered under BS EN 10224, AWWA C200, NFA 49-150, and UNI 6363.

Spigots and plain ended pipes shall be plain ended unless otherwise specified and suitable for use with flexible mechanical couplings. The grade of steel used shall comply with the requirements of BS EN 14164.

### **Surface Preparation**

Except for cement mortar lining and coating, all surfaces are grit blasted to ISO 8501-1 SA 2.5 to remove all rust and mill scale before application of coatings and linings. Steel grit is used as the abrasive media in order to achieve a roughness profile of 38-102 microns, as this is required for good adhesion of coatings. All equipment is automated to ensure consistent high-quality blasting.

### **Protective Coatings and Linings**

Internal

**Table 5-4 Pipe Internal Lining Specifications**

Type of Lining	Liquid Epoxy	Cement Mortar	Fusion Bonded Epoxy
Standards	API PR 5 L2 AWWA C210 NFA 49-709 SABS 1217 EN 10289	AWWA C205 AWWA C303 EN 10298 DIN 2614 DIN 2880 NF A 49-701	AWWA C213 SABS 1217
Typical Lining Thickness	200 - 400 microns	5 – 19 mm	200 - 400 microns

All the pipes shall be internally protected with epoxy coatings for internals and externals

of steel pipes in accordance with AWWA C210. External protection to be as specified in DIN 30671, EN 10309, AWWA C213 or NFA 49-706.

External

**Table 5-5 Pipe External Coating Specifications**

Type of coating	Fusion Bonded Epoxy	Extruded Polyethylene/ Polypropylene
Standards	AWWA C213 DIN 30671 NF A 49-706 SABS 1217	AWWA C215 BS EN 10288 DIN 30670 DIN 30678 NF A 49-704 NF A 49-710 NF A 49-711
Typical Coating Thickness	200 - 400 microns	1.2 – 3.5 mm
Remarks	Exposed and buried	Buried

### **Jointing**

All joints shall be of the flexible mechanical type and shall be supplied complete with all bolts, nuts, washers and joint rings as may be required. All metal parts of joints shall be adequately protected with rust-proof paint. The joints shall be protected from corrosion by wrapping with Denso paste and tape or by some similar approved material.

All fittings and specials shall be of such dimensions as will conform / fit with the piping supplied.

Flanged adaptors shall be pieces suitable for connecting a flanged gate valve etc. to the type of piping supplied and shall be supplied complete with all bolts, nuts, washers and joint rings.

The spigot ends of all Tees shall be suitable for connection to the pipework supplied using the aforementioned flexible mechanical joints.

All flanges on specials shall conform to NP 16 or NP 25, as specified in the Price Schedules in accordance with BS EN 1092, unless otherwise detailed.

All flanged joints shall be protected from corrosion by wrapping with Denso paste and tape or some similar approved material.

## **506. G.R.P. PIPES AND SPECIALS**

Glass Reinforced Plastic piping shall be in accordance with SRN 317.

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**507. GALVANISED PIPES AND SPECIALS**

All piping shall conform to SRN 823 and SRN 903 for “Medium” Piping. The pipes shall be screwed and socketed, coupled or flanged.

All specials shall be of such dimensions as will mate with the piping supplied. Screw down stop valves shall conform to SRN 826. Barrel nipples shall conform to SRN 823 and all other specials shall conform to SRN 824.

All pipes supplied shall be certified by the manufacturer to have been tested in accordance with the relevant Standard Specification.

**508. DUCTILE IRON AND CAST IRON PIPES AND SPECIALS**

All cast iron piping and fittings shall conform to the requirements of SRN 200.

Ductile iron pipes and fittings shall comply with SRN 202. Where required the pipes shall be protected as specified by the manufacturer of the pipes and shall be used as recommended by the manufacturer of the pipe.

Where the requirements include for the supply of flexible couplings the Contractor shall submit for approval by the Engineer full details of the type of joint offered and a full description of the method of jointing prior to arranging for the delivery of goods on site.

All flexible couplings shall be protected from corrosion by wrapping with Denso paste and tape or by some similar approved material. The quality of metal used for the manufacture of the pipes shall be of good quality grey cast iron and subject to the various quality control tests as specified in the relevant Standards.

All piping and fittings shall be coated internally with cement mortar lining to SRN 211. Cement mortar lining shall not contain any constituents soluble in water nor any ingredient which could impart any taste or odour whatsoever to the water after sterilization and washing out of the mains. External protection to be as specified in SRN 258.

The flanges of straight pipes shall be at right angles to axis of the pipe and the faces of the flanges shall be parallel and machine finished. The faces of the flanges of fittings shall be at right angles to the directional axis. The bolt holes shall be concentric with the bore and located symmetrically off the centre line.

In flanged pipework the holes in one flange shall be located in line with those in the other. All flanges shall be drilled to SRN 207, unless otherwise detailed. The weights of the pipe and fittings shall comply with the Specification in the relevant Standard.

**509. CONCRETE PIPES AND SPECIALS**

Concrete pipes and specials shall comply with the requirements of SRN 840. They shall carry the relevant Standards Institution registration certification trademark, or test certificates shall be furnished by the manufacturers.

**510. CONCRETE POROUS PIPES**

Concrete porous pipes shall comply with the requirements of SRN 410: Concrete Porous Pipes for Under-drainage.

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## **511. FLANGED JOINTS**

Where specifically called for or deemed appropriate, flanged joints shall be utilised. They shall conform to DIN Standards 2500, 2501, 2519, 2576, 2627, 2566, 2655-56, 2673, 2526, 2527, BS EN 1092, BS 1560 or ISO 7005: 1988., drilled to NP10 except where otherwise indicated in Price Schedules, with gaskets made of reinforced elastomer rubber to DIN Standards 2693, 2697 or EN 1514 and minimum thickness of 3mm.

All flanges on fittings and pipework where flanged connections are required must comply with the requirements of DIN Standards 2500, 2501, 2519, 2576, 2627-38, 2566, 2655-56, 2673, 2526, 2527, BS EN 1092, BS 1560 or ISO 7005: 1988 and drilled to NP 16, unless otherwise specified.

Inspection gaskets for flanged joints shall be rubber reinforced with cotton, 3mm thick and shall be in accordance with DIN Standards 2693, 2697 or EN 1514. Bolts, washers and nuts for flanged joints shall be of mild steel complying with ISO 898/1, ISO 898/2.

## **512. FLEXIBLE JOINTS**

All flexible couplings (Viking Johnson or other approved type) shall be supplied and shall be coated with fusion bonded epoxy layer 350 microns thick, complete with rubber gaskets, bolts, nuts and washers. All couplings shall be coated with red oxide primer and bituminous composition suitable for use with potable water.

Flexible couplings shall be of a mechanical type coupling consisting of a centre sleeve, two end ring flanges, two wedge shaped sealing rings of grade T Nitrile rubber, and with galvanized nuts bolts. The main components shall be made from malleable cast iron to ASTM A 47-77 for larger diameters. If specifically called for, couplings shall be provided with a suitably sized screw plugged hole in the sleeve to allow for the introduction of molten bitumen for additional internal protection. The manufacturer shall then include the necessary removable internal backing-up rings of rubber composition and shall further include for all materials for in-situ jointing and protecting both for remedial works and for internal and external protection at such joints. After jointing, the exposed part of the bolt shall be provided with a tight-fitting polythene protection cap.

## **513. SLUICE VALVES / GATE VALVES DN50 - DN400**

### Product description

The valve shall be a resilient seated, clear way, flanged gate type, designed for installation in water supply systems to enable isolation of separate lines for maintenance or repair.

### Basic Design

Face-to-face shall be according to EN 558, ser. 3 (BS).

All dimensions shall be clear way and full bore.

End connections shall be flanges drilled acc. to EN 1092.

### Coating

Valve body and bonnet shall be both internally and externally corrosion protected with 250-300µm fusion bonded epoxy coating complying with DIN 30677-2 and GSK. Colour shall be blue RAL 5017. No uncoated parts of the iron surfaces may be in contact with the

fluid or the environment.

Surface preparation, coating material, application process and final result shall be quality checked and documented by the valve manufacturer, approved by the GSK and frequently supervised through notified body inspections.

### Body/Bonnet

Valve body and bonnet shall be ductile iron, grade GJS-500-7.

Bonnet-body bolt holes shall be designed as threaded bottom holes, i.e., not going through the casting.

Bonnet bolts shall be socket head, stainless steel A4, counterbored into the bonnet casting, sealed with hot melt glue and with no contact to environment or fluid.

Bonnet-body gasket shall be EPDM with a circular cross shape, positioned in a groove in the bonnet and encircling the bonnet bolts completely.

Body shall have internal rails or grooves for wedge open/close travel guidance.

Internal body seats shall have plane surfaces in symmetric angles to position and support the wedge into closed position. Body waterway shall be smooth and unobstructed with no internal pockets in the dome above the seating area.

Following information shall be cast into the body:

- Manufacturer's brand
- Size
- Pressure-class
- Cast material

Following information shall be shown on the label

- Stem material
- Additional information for product standard
- Product number
- Barcode
- Fluid type
- Max. application temperature
- Operation direction (CTO/CTC)

### Stem

Stem shall be stainless steel, 1.4404 (AISI 316L) with the thread rolled on in a trapezoidal profile to DIN 103.

A wedge stop shall block the upward movement before the rubber parts touch the inner coating.

Thrust bearing shall be a 2-piece collar made of hot forged, dezincification resistant brass, CW602N.

Radial bearing shall be a PA6.6 bushing with two outer and two inner NBR O-rings.

Stem seal shall consist of three systems:

- Innermost a lip seal in EPDM shall act as main seal against the internal fluid pressure.
- In the middle the radial bearing O-rings shall back up the inner main seal
- Outermost an NBR wiper ring shall seal against dust and dirt from outside.

Interface to operating equipment shall be a square.

### Wedge

The wedge shall consist of an inner ductile iron core fully encapsulated in drinking water approved EPDM.

It shall have no closed or poorly ventilated hollow areas where the fluid can accumulate. The stem-space below the wedge nut shall go all the way down through the bottom. The surface shall be smooth with no grooves, splits or pockets. Except for the point of closure, the only contact between wedge and body shall be via polyamide travel guides vulcanized into the wedge. The wedge shall be marked with logo, time of manufacture and rubber material.

The wedge nut shall be an integral part of the design, firmly fixed and not able to move within the wedge core. The joint between nut and wedge shall be tightly sealed in the rubber encapsulation process.

Material shall be dezincification resistant brass, CW602N or CW626N.

### Installation

The body shall be fitted with feet for upright standing, but the design shall allow for installation with the stem in both vertical and horizontal position.

Flow can vertical or horizontal and bi-directional.

For inspection purpose it shall be possible to remove the valve bonnet without having to remove the valve body from the pipeline.

### Operation

Operation shall be manual by hand wheel, T-key or extension spindle.

Clockwise to Close (CTC).

Lifetime according to EN 1074 when used under normal conditions, including installation buried underground without a special valve chamber.

Maximum operating temperature shall be at least 70°C.

Apart from regular exercising no maintenance shall be required during the lifetime.

### Quality

The complete valve shall be type approved to EN-Standards.

The manufacturer shall have an ISO 9000 certified quality system and be audited by an independent third party.

Each finished product shall be inspected and tested for compliance with the product standards and local market specification.

### Standards and Approvals

The design and testing shall be according to following:

- EN 1074-1 and -2 (water supply, isolating valves)
- EN 1171 (industrial cast iron gate valves)
- EN 558 (face-to-face)
- EN 1092-2 (flanges)

Materials and manufacturing shall be according to following:

- EN 1563 (cast iron)
- EN 10088 (stainless steel)
- EN 12165 (brass)
- EN 12164 (brass)
- DIN 30677-2 (coating)
- GSK (coating)
- EN 681 (rubber seals water)



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### Other

The gate valves shall be suitable for use in pipelines and for the operating pressure to a head of 160 metres or 250 metres of water (NP 16) or NP 25.

Spindles of the gate valves shall be provided with cast iron caps conforming to the requirements as specified under “Valve Caps” in DIN 3230, DIN 3352, BS 5163 or AWWA C203-78, or handwheels if so specified.

The spindles of the gate valves shall be of the non-rising type, except where specifically indicated otherwise and screwed so as to close the valves when rotated in a clockwise direction. The direction of closing shall be clearly cast on the valve cap or hand-wheel. Where specified, valves for replacement washouts shall be in accordance with specification Clause 202 except that the valve bodies shall be of epoxy coated ductile iron and the flanges shall be undrilled. Face to face dimensions for these valves shall be to BS 5155 basic series 14 (short).

The gate valves shall be subject to “Closed End Tests” in accordance with the procedure set out in BS 5163, AWWA C203-78, DIN 3230 Part 1-3, DIN 3352 Part 1-4.

The gate valves shall be suitable for opening and closing against an unbalanced head by manual operation.

The gate shall be of ductile iron fully rubber encapsulated, the gate sealing in the body being ensured by compressing of the rubber.

The gate valves shall be works cleaned and shot-blasted in accordance with BS 2640. They shall be coated internally and externally with fusion bonded powder epoxy or equivalent suitable for potable water and to a minimum thickness of 150 microns. The body, the bonnet and the gate of the valve shall be made of ductile iron to BS EN 1563 OR BS EN 1564, the gate being encapsulated with elastomer EPDM, nitrile or equivalent.

## **514. AIR VALVES**

### Description

Combination Air Valve has the features of both an air release valve and an air & vacuum valve. The air release component is designed to automatically release small pockets of air to the atmosphere as they accumulate along a pipeline or piping system when it is full and operating under pressure. The air and vacuum component is designed to automatically discharge or admit large volumes of air during the filling or draining of a pipeline or piping system. This valve will open to relieve negative pressures whenever water column separation occurs.

### Product Features

- Combines the features of both an air & vacuum valve and an air release valve.
- Triple function:
  - Air & vacuum component discharges large volumes of air during filling of the system.
  - Air & vacuum component admits large volumes of air during drainage and at water column separation.
  - The air release component releases entrapped air in pressurized systems.
- Dynamic design allows for high velocity air discharge while preventing premature

closure.

- Rolling seal mechanism.
- Available in sizes: 25mm, 50mm and 80mm threaded male connections, NPT or BSPT.

#### Materials and Corrosion Protection

- The body is made of high-strength composite materials.
- All operating parts are made of corrosion- resistant materials.
- Body protected by a shell made of Cast Iron ASTM A48 CL.35B.

#### Application Range

- Working pressure range: 10bar and 16 bar
- Maximum operating temperature: 60°C.
- Maximum intermittent temperature: 90° C.

### **515. CHECK VALVES (NON-RETURN or DIRECTIONAL VALVES)**

#### Product Description

The valve shall be designed for installation in water supply to secure flow in one direction only.

#### Basic design

A valve disc hinged on a shaft shall turn to either open or closed position.

Housing design shall be acc. to EN 1074 with end connections as flanges drilled to EN 1092.

Housing and disc shall be free of flow obstruction or pockets.

The main seal shall be the resilient rubber on the disc closing directly against the iron housing.

#### Coating

Valve body and bonnet shall be both internally and externally corrosion protected with 250 µm, blue RAL 5017, fusion bonded epoxy approved for drinking water and complying with DIN 30677-2.

No uncoated parts of the iron surfaces may be in contact with the fluid or the environment. Surface preparation, coating material, application process and final result shall be quality checked and documented by the valve manufacturer and frequently supervised through notified body inspections.

#### Body/Bonnet

Valve body and bonnet shall be ductile cast iron acc. to EN 1563 grade GJS-500-7.

Face-to-face distance shall be according to EN 558 ser. 48.

Bonnet-body bolt holes shall be designed as threaded bottom holes, i.e., not going through the casting. Bolts shall be stainless steel grade A2.

Bonnet-body gasket shall be drinking water approved EPDM with a near circular cross shape, positioned in a groove in the bonnet and encircling the bonnet bolts completely to protect the bolts against the fluid and prevent gasket blow-out.

The body waterway shall be smooth and unobstructed with no closed internal pockets.

A set of bosses shall be cast adjacent to each flange to enable later installation of e.g., a pressure gauge or a by-pass valve.



Following information shall be cast into the body:

- Manufacturer
- DN-class
- PN-class
- Cast material

Following information shall be shown on the label

- Additional information for product standard
- Product number
- Barcode
- Fluid type
- Max. application temperature

#### Disc and rubber

The valve disc shall be completely enclosed in drinking water approved EPDM.

#### Hinge

The disc shall be mounted on a hinge made of stainless steel for sizes  $\leq$  DN 200; ductile iron coated with drinking water approved epoxy for larger. The connection shall be a loosely fitting polyamide bushing that makes the disc able to tilt slightly in all directions and adjust exactly to the valve seat.

#### Shaft

The shaft shall be made of 1.4021 (AISI 420) stainless steel.

The bearings shall be dezincification resistant brass bushings, CW602N, CW626N or equivalent.

The shaft shall protrude to the right for lever attachment. The shaft end shall be hexagonal to allow for 6 different positions of the lever.

The shaft seal in protruding side shall consist of at least two O-rings.

#### Main Seal

The main seal shall be the resilient rubber on the disc closing directly against the iron housing.

#### Installation

The body shall be fitted with feet for upright standing, but the design shall allow for installation in both vertical and horizontal position.

Flow can be horizontal or rising vertical.

Items weighing more than 15 kg shall be fitted with lifting ribs or lugs.

#### Operation

The valve shall operate automatically.

Lifetime shall acc. to EN 1074.

Maximum operating temperature shall be at least 70°C.

The bonnet shall be easy to remove to gain access to the inner parts of the valve for cleaning or inspection.

#### Quality

The manufacturer shall have an ISO 9000 certified quality system which is audited by an

independent third party.

Each finished item shall be inspected and tested for compliance with the product standards and local market specification.

#### Other

Check valves shall be suitable for waterworks purposes and shall be manufactured to comply with the general requirements of BS EN 12334. They shall be double flanged type, non-slamming and recoilless on flow reversal. Valves of DN 700 and larger shall be of the multi-disc type or tilting disc type. The valves shall have a high-grade cast-iron body and cover to BS EN 1561 Grade 220/260 with gun metal nickel bronze alloy door seating. The hinge pin shall be of stainless steel carried on non-corrodible bearings.

The body and cover material of the valves shall be made of carbon steel conforming to ASTM A216, Grade WCB. The hinge pin material shall conform to ASTM A479, the disc carrier material shall conform to ASTM A217, the seat material shall conform to ASTM A106 and the disc material shall conform to ASTM A216.

### **516. CONSUMER WATER METERS**

#### **General**

Domestic water meters for house connection shall comply with BS 5728, KS 06-248 1, 2 and ISO 4064/2 & 2 /Add.1. In addition, it shall comply with the EEC Council Directive No. 75/33/EEC.

The domestic water meters shall be suitable for both Vertical and Horizontal installation and shall be single jet meters specifically designed for measuring cold water.

Must have accurate metering capability, particularly with low flow rates, ruggedness and resistance to clogging.

The meter shall have a profiled inlet nozzle to make it immune to disturbances in the piping before or after the meter. Meters must comply with the European regulations and hold a sanitary conformity certificate.

The meters shall be modular, capable of being fitted at any time with an IZAR clip-on module, converting it into a communicating meter ready for mobile or fixed (radio/wired) network reading.

#### **Features:**

- DN 15
- $Q_3=2.5 \text{ m}^3/\text{h}$
- MID approval up to R=200H & R=40V
- Starting flow rate:  $< 6 \text{ l/h}$
- Cold water
- Composite body
- Integrated plastic inlet filter
- Tamper-proof ring

The domestic meters shall be supplied as a complete kit comprising the following items:

- Meter (calibrated in litres or cubic metres);
- Meters are to be corrosion proof polymer plastic where specified;
- Isolating/disconnection valve;
- Union sockets;

- DN 15 BSP threaded inlet and outlet tail pieces complete with unions on each end, suitable for connection to galvanised iron pipe;
- Built-in strainer
- Built-in non return valve to prevent meter reversal
- “small dial”

The meter shall be complete as a package for instant connection and use. The domestic meters shall have threaded connections.

The meter box shall be made of high-density polyethylene (HDPE) or approved equivalent with the following minimum dimensions: length 265mm, width 150mm and height 180mm. The box shall be supplied complete with a base to prevent ingress of soil. The body shall have crush resistant ribbing along the outside of the box.

The meter box lid shall have a non-skid surface. The lid shall have a slot in the top of the lid for reading of the water meter fitted with a cover spring loaded to close. The lid shall be fixed to the meter box with a tamperproof locking mechanism. A gasket shall be installed between the water meter box and lid to prevent ingress of water or dust. The box and lid should be designed to withstand external loads, including traffic loads if installed in roadways or pedestrian areas.

### **Performance**

The maximum flowrate ( $Q_{max}$ ) is the highest flowrate at which the meter can function over limited periods without damage, and without exceeding the maximum permissible errors (+/-2%) and the maximum permissible value for loss of pressure (1 bar).

The nominal flowrate ( $Q_n$ ) is equal to half the maximum flowrate,  $Q_{max}$ . It is expressed in cubic metres per hour and is issued to designate the meter.

At the nominal flowrate ( $Q_n$ ) the meter should be able to function in normal use, i.e., in continuous and intermittent operating conditions, without exceeding the maximum permissible errors (+/-2%).

The minimum flowrate ( $Q_{min}$ ) is the flowrate above which the meter must not exceed the maximum permissible errors (+/-5%), and is fixed as a function of  $Q_n$ .

The transitional flowrate ( $Q_t$ ) is the flowrate which divides the upper and lower regions of the flow range and the rate of the maximum permissible error is +/-2%.

**Table 5-6 Water Meter Performance Parameters**

Performance Parameter		Nominal Diameter (mm)			
		15	20	25	40
Nominal Flow Rate - $Q_n$	m <sup>3</sup> /h	1.5	2.5	3.5	10
Maximum Flow Rate - $Q_{max}$	m <sup>3</sup> /h	3	5	7	20
Minimum Flow Rate - $Q_{min}$	l/h	15	25	35	100
Transitional Flow Rate - $Q_t$	l/h	22.5	37.5	52.5	150

### **Meteorological Classes**

The meters performance specification shall be to ISO 4064/1 or BS 5728/1 Part 1, Class

C or to equivalent internationally recognized Standard according to the value of  $Q_{min}$  and  $Q_t$  as shown in the following table:

**Table 5-7 Water Meter Class and Performance Specifications**

Class	On=Lessthan15m <sup>3</sup> /	On=15m <sup>3</sup> /hormore
<u>Class C</u>		
Value of: $Q_{min}$	0.01Q	0.006Q <sub>n</sub>
Value of: $Q_t$	n	0.015Q <sub>n</sub>

The meters must be able to retain their accuracy when installed in either horizontal, vertical or inclined planes.

Contractor shall provide certificate of the meteorological class of the meters offered.

### **Tightness, Pressure and Temperature Resistance**

The water meter shall permanently sustain (without leakage, malfunctioning or permanent deformation) a minimum working pressure of 10 bar (DN 15 mm) or 16 bar (DN 20 mm) and be suitable for water temperatures up to 50 degree Celsius.

### **Head loss**

Characteristic curves of head losses plotted against the rate of flow from the minimum flow rate shall be provided by the Tenderer. The meters shall show a loss of head not exceeding 1 Bar at  $Q_{max}$  and 0.25 bar at  $Q_n$  in accordance with ISO 7858/1:1985 and ISO 4064/1.

### **Materials**

The materials used in the construction shall be designed to withstand raw and treated (potable) water and operate for at least 5 years without normal need for maintenance or repair and without the maximum error exceeding the specified limits.

Tenderer shall specify the optimum pH and the water quality for which the meters have been designed.

They must be constructed throughout of materials which are resistant to internal and external corrosion and if necessary be protected by some suitable surface treatment. All materials of the water meter which are in contact with the water flowing through the water meter shall be non-toxic and non-tainting. Water temperature variations within the working range shall not adversely affect the materials used in the construction of the water meter.

The outer body casing shall be of the split case type. The outer casing may consist of two parts which are screwed together and a watertight seal between the two. The meter body casing must be made from materials with a life expectancy under normal use in excess of 20 years.

The water meter shall be made with materials appropriate to each specific use. The body of domestic meters (DN15 - DN25) shall be manufactured from copper alloy or polymer.

The measuring element shall be of high-grade polymer to ensure minimum wear and a high degree of reliability.

## **Counter**

The indicator shall provide for reliable and unambiguous direct reading of the volume of water measured in cubic metres or in cubic meters and litres.

The indications of volume shall be by any of the two types as follows:

- Type 1            By a row of inline consecutive digits in one or more apertures (drum counters); or
- Type 2            A combination of drum counters for whole units of cubic meters and pointers on circular scales for fractions of cubic meters.

Drum counters shall be black for indication of a cubic metre and its multiples shall be red for indication of fractions of a cubic metre. Visible movements of the digits shall be upwards and the actual or apparent height of the digits on the drums shall be not less than 4 mm. The advance of a digital unit shall be completed while the next lower valued digit is within the last tenth of its travel. The drums showing digits of lowest value shall move continuously in Type 1 and may move continuously in Type 2. Indicators with pointers (Type 2) shall rotate in a clockwise direction. The value of each division on the scales shall be expressed in multiples or sub-multiples of ten. Each scale shall be graduated in cubic meters or accompanied by a multiplying factor (x0.01, x0.1, x10, x100) according to the value of the scale. The symbol m<sup>3</sup> shall appear on the dial. The gear unit and the counter shall be combined and completely sealed.

The number drums shall be contained in a non-toxic fluid for lubrication and protection. The counter shall be placed in a window in the meter body and be placed so as to allow for ease of meter reading. Counter window shall be of minimum 7mm thickness. Black numbers on white shall denote cubic metres and white numbers on red shall denote litres. The counter shall reset to zero at a reading of not less than 10,000 m<sup>3</sup>.

The indicator shall, as minimum requirement, record the following values:

**Table 5-8 Water Meter Counter Parameters**

<b>Size of Meter (DN)</b>	<b>Minimum Registration (m<sup>3</sup>)</b>	<b>Maximum Registration Before Se l Re- Set (m<sup>3</sup>)</b>
15mm	0.001	10,000
20mm to 40mm	0.001	100,000

## **Protection**

A suitable in-built strainer (0.75 mm aperture and 2.844 mm<sup>2</sup> mesh area) shall protect the measuring mechanism and an in-built non return valve shall prevent meter reversal.

## **Marking**

Each water meter shall be marked on the casing with the following information:

- Direction of flow of water on both sides of the meter
- Maximum flow rate (3m<sup>3</sup>/hr)
- Individual Serial number (engraved)

- Manufacturer's name
- Country of Origin
- Year of manufacture
- WSP's name (max 10 letters)

### **Sealing**

Water meters shall be provided with a means of sealing so that after sealing, both before and after the water meter has been properly installed, there shall be no possibility of dismantling or altering the water meter or its adjustment device without visibly damaging the seal. The meters shall be sealed subsequent to manufacture and before delivery to the purchaser.

The preferred method of sealing is by a corrosive resistant wire inserted through 2.5 mm diameter holes in the halves of the body, and secured by a circular metal seal impressed by a device which provides a unique imprint on the seal.

Tenderers shall provide details of the sealing wire type with proof of corrosive resistant and method proposed.

### **Pre-Shipment Testing**

A representative sample of the meters shall undergo Pre-shipment testing at the manufacturers premise as directed by the Engineer.

### **Packing**

Packing shall be made of strong wooden crates, and inside such crate, each meter shall be packed in its own carton box.

### **Workmanship**

The meters shall be guaranteed against defects in materials and workmanship for a minimum period of one year from date of delivery. Parts to replace those in which a defect may develop within such period shall be supplied without charge, piece for piece, upon the return of such defective parts to the supplier thereof or upon proof of such defects.

Meters should be designed for easy disassembly and re-assembly without the use of special tools or equipment and should be easy to maintain and repair. Meters designed to resist vandalism will be preferred.

## **517. MECHANICAL BULK WATER FLOW METERS**

### **Application**

- The bulk water meter used for measuring volumes of cold water (up to 50°C) in supply lines with high flow at low pressure loss.
- The measuring chamber shall be replaceable without removing the meter from the pipe.
- It shall be equipped with a rotating glass metal register as standard,
- Same or equivalent to WESAN WP meters which can be fitted with different pulse emitters.

### **Features**

- For horizontal and vertical installation
- Calibratable and exchangeable measuring insert
- Sealed measuring inserts for better accuracy
- Hydraulic bearing relief
- Encapsulated and rotating glass/copper counter, IP68
- Integrated measurement outputs as standard
- 2 low frequency pulse emitters (index) and 1 high frequency pulse emitter (flow)
- Display range 5.0lts to 99,999,999m<sup>3</sup>

## **518. ELECTROMAGNETIC FLOW METERS**

### Description

The meters shall feature processor-based signal conversion with accuracies of  $\pm 0.4\%$ , with no moving parts in the flow stream. Its accuracy shall not be affected by temperature, pressure, viscosity, or density. It shall operate practically with no maintenance required. It shall be encased in an IP68 housing to make it reliable meter even when submerged.

### Application

The meters shall be able to operate without power line access. It shall indicate flow rate and flow totalization.

The meter shall be equipped with an internal datalogger or M-Bus interface, or in future with an externally powered RS485 interface with Modbus®. The collected data can be retrieved via radio frequency or GSM/GPRS.

### Operating Principle

The flow meter is a stainless-steel tube lined with a non-conductive material. Outside the tube are two DC-powered electromagnetic coils positioned opposite each other. Perpendicular to the coils are two electrodes inserted into the flow tube. The energized coils create a magnetic field across the diameter of the pipe. As a conductive fluid flows through the magnetic field, a voltage is induced across the electrodes. This voltage is proportional to the average flow velocity of the fluid and is measured by the two electrodes. This induced voltage is then amplified and digitally processed by the converter to produce an accurate analogue or digital signal. The signal can then be used to indicate flow rate and totalization, or to communicate to remote sensors and controllers. In addition, the processor controls zero-flow stability, frequency outputs, serial communications, and other parameters.

### Features

- Battery powered, with battery life up to 20 years.
- $\pm 0.4\%$  of measured value  $\pm 2$  mm/s accuracy independent of fluid viscosity, density, and temperature.
- Unaffected by most solids contained in fluids
- LCD Display
- Pulsed DC magnetic field for zero-point stability
- No pressure loss for low operational costs
- Corrosion resistant liners for long life
- Calibrated in state-of-the art facilities

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- Integral and remote signal converter availability
  - Optional grounding rings or grounding electrode
  - Measurement largely independent of flow profile
  - Low-power digital microcontroller (16 bit)
  - Simple programming procedure
  - Digital and infrared outputs
  - Automatic zero-point stability
  - Non-volatile programming
  - NSF, OIML and MID certified
  - Data logging
  - Verification device
  - IP68 protection class
  - Modbus RTU (RS232), IRDA, M-Bus, optional Modbus RTU (RS 485)

Electromagnetic flowmeters shall be sized and installed in accordance with the manufacturer's recommendations as approved by the Engineer



## Specifications

<b>Flow Range</b>	0.1...32.8 ft/s (0.03...10 m/s)	
<b>Accuracy</b>	± 0.4% of measured value ± 2 mm/s OIML/MID: 2...12 in. (DN50...300) with 0d up and 0d downstream ±1% ≥ 1.2 ft/s (0.35 m/s)	
<b>Repeatability</b>	± 0.1%	
<b>Data Logging</b>	About 7,000 records (read out by Modbus or IrDA interface) Logging interval from 1 min to 24 h	
<b>Ambient Temperature</b>	-4...140° F (-20...60° C)	
<b>Flow Direction</b>	Uni-directional or bi-directional. Two separate programmable totalizers for uni-directional measurement.	
<b>Digital Outputs (4)</b>	Galvanically isolated open collector, 30V DC maximum, 20 mA each, maximum output frequency at 100 Hz	
<b>Status Outputs</b>	ADE, High/low flow alarm (0...100% of flow), error alarm, empty pipe alarm, flow direction	
<b>Communication</b>	RS232, Modbus RTU, IrDA, M-Bus, RS 485 (optional), External AMR or GSM/GPRS module (optional)	
<b>Empty Pipe Detection</b>	Separate electrode, field-tunable for optimum performance based on specific application	
<b>Min-Max Flow Alarm</b>	Programmable outputs 0...100% of flow	
<b>Low Flow Cut-Off</b>	Programmable 0...10% of maximum flow	
<b>Galvanic Separation</b>	Functional 500 volts	
<b>Pulse Width</b>	Programmable 5...500 ms	
<b>Coil Power</b>	Pulsed DC	
<b>Sampling Rate</b>	Programmable from 1 to 63 seconds. Standard sampling period is 15 seconds.	
<b>Display</b>	Two lines x 15 characters (7 on top + 8 on bottom), LCD display	
<b>Programming</b>	Three external buttons	
<b>Units of Measure</b>	Gallons, ounces, MGD, liters, cubic meters, cubic feet, imperial gallon, barrel, hectoliter and acre feet	
<b>Battery Life</b>	<i>Standard:</i> 10 years with one battery pack; <i>optional:</i> up to 20 years with two battery packs for sizes 6 in. (DN 150) or smaller.	
<b>Power Supply</b>	<i>Standard:</i> Internal lithium batteries 3.6 volt, optional external battery pack <i>Optional:</i> battery back-up model (100...240V AC or 9...36V DC)	
<b>Processing</b>	Low power microcontroller (16 bit)	
<b>Amplifier Housing</b>	NEMA 4X (IP67, optional IP68), cast aluminum, powder-coated paint	
<b>Mounting</b>	Detector-mount or remote wall mount (bracket supplied)	
<b>Meter Enclosure Classification</b>	<i>Standard:</i> NEMA 4X (IP67); <i>Optional:</i> Submersible NEMA 6P IP68, remote amplifier required	
<b>Junction Box Enclosure Protection</b>	For remote amplifier option:	<i>Standard:</i> Powder coated die-cast aluminum, NEMA 4 (IP67) <i>Optional:</i> Stainless steel housing 304, Submersible NEMA 6P (IP68)
<b>Approvals</b>	NSF-61	Models with hard rubber liner 4 in. (DN 100) size and up; PTFE liner, all sizes.
	OIML R49-1	
	MID MI-001	

Figure 5-2 Electromagnetic Flow Meters Specifications

### Other

The flow meters shall be supplied with a verifiable calibration certificate.

Electromagnetic flow meters shall be of new technology microprocessor based electronic water flow meter and be capable of monitoring instantaneous and cumulative flows and flow rate in both forward and reverse flow direction. The flow meter shall have no moving parts to ensure that there is no damage from particulate matter, e.g., stones, weed, etc., nor cause any restriction in the flow path and be capable of setting adjustments without the need to stop the flow. Each metering system shall comply with BS 5792 and comprise a flow sensor mounted in the pipework line and a signal converter, wither integrally mounted or remotely located preferably within the main control panel.

The meter shall be suitable for 85 to 265 Volt AC, 40 to 400 Hz supply without the need for link setting or voltage selection and shall be supplied with an uninterrupted power supply (UPS) inclusive of voltage protector. In addition, automatic battery backup must be included to ensure no loss of metering during AC power loss periods.

Alternatively, the meter shall be suitable for operation from two internal 3.6V Lithium batteries which provide an uninterrupted operating life of five years. It shall be possible to change the batteries in the field.

The accuracy of  $\pm 0.25\%$  for AC meters and  $\pm 0.5\%$  for battery meters shall be achieved. The meters shall be suitable for maximum working temperature to 70°C at pressure up to at least 16 bars. The electronics of the E/M bulk water meter should be watertight in submerged condition of 10 m water head

The meters shall have GSM- equipped transmitters capable of operating in 850/ 900/ 1800/ 1900 Quad Band Ranges. The meters should have USB-Type Data output port with a USB connector cable supplied together with the meter for data downloads.

The manufacturer shall also supply a detailed list of all parts comprising the proposed meter, duly labelled in English and numbered together with the indicative unit prices for each separate component. This is to enable normal usage and cost of the spares to be taken into consideration when assessing the cost of each meter which will be factored in the selection of the meter to be used in the project.

The warranty offered for each component should be explicitly indicated.

## **519. ULTRASONIC FLOW METERS**

The water meter shall be an in-Line battery operated ultrasonic flow meter with detached electronic interface units for both flow and pressure measurements complete with Narrow Band Internet of Things (NB IoT) for coverage within the project scope area and requisite peripherals.

### Applicable Standards:

The meter shall conform to:

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International Organization of Legal Metrology OMIL R 49-1:2013, Measuring Instrument Directive MID 2014/32/EU. In addition, it shall comply with the Council Directive 2011/17/EU.

Manufacturer: The Manufacturer of the water meters must hold the Quality Management System Certificate for the standard ISO 9001:2015. A copy of the certificate must be attached to the bid.

The Manufacturer of the water meters must hold the Certificate for Quality System for Production, Final Product Inspection and Testing as issued according to Module D of Directive MID 2014/32/EU.

Meter Performance: Meter lifetime - Minimum 10 years maintenance-free operation. Meter Protection Class - Must comply to IP68 Standard for indoor and outdoor operation.

Calibration:- 3-Point calibration with calibration certificate available for each unit. The bidder to provide the Calibration Certificate.

Dynamic Ratio R (Q3/Q1): Minimum of R 400

Meter Material: The water meter body shall be made of corrosion resistant metallic material like brass, bronze, stainless steel or carbon steel, with suitable protective coating.

Meter Connectors: Meter body casing shall have standard flanges to ASME/ANSI B16.5 - 1996 / BS 4504. Each meter shall be supplied complete with 2 No. flange adapters to match the meter flange and pipe, rubber gaskets of equal diameter with the meter, stainless steel bolts and nuts.

Operating Temperature: 0°C to 50°C. Operating Pressure - > 16 Bars

Principle Of Operation:

The Ultrasonic Flow Meter (UFM) shall be capable of measuring flow rate and total flow in both directions, with two independent totalizers to give flow for network management purposes.

The accuracy shall be  $\pm 1.2$  % of reading  $\pm 0.01$  m/s of the actual measured flow in both forward and reverse directions or better. The repeatability shall be 0.15 % of reading  $\pm 0.01$  m/s of the reading or better.

A calibration certificate shall be provided for each meter during delivery.

The UFM shall offer lifetime stable zero so that routine zeroing is not required. The UFM shall indicate power status and empty pipe detection. The UFM shall be fully IP68 (including connector for connection to Automated Meter Reading).

The UFM shall be mains powered with activated pulse outputs. The UFM shall be compatible with any Automated Meter Reading system measuring instantaneous flow rate by time measuring between 2 pulses.

The flow meter transmitter shall indicate totalized flow, instantaneous flow rate in selectable units, flow direction, flow rate, instantaneous pressure and empty pipe.

The display register shall be presented as follows:

**Table 5-9 UFM Display Register**

Flow meter size	Indicating range (m <sup>3</sup> )	Scale interval (m <sup>3</sup> )
DN 200 or more	99,999,999	0.01

Flow meter size	Indicating range (m <sup>3</sup> )	Scale interval (m <sup>3</sup> )
DN 150	9,999,999	0.01

**Transmitter:**

The UFM transmitter shall be built as follows:

**Table 5-10 UFM Transmitter Requirements**

Requirements	All sizes
General	<p>Volumetric flow, mass flow rate and flow velocity shall be measured.</p> <p>The transmitter shall allow for bi-directional measurements. Bi-directional communication and remote parameterization of the transmitter via Ethernet shall be possible.</p> <p>The transmitter shall be parameterized via USB port.</p> <p>Shall allow for programming of event based triggering of data recording.</p> <p>The transmitter shall have alarm functions for threshold exceedances for flow rate and flow direction changes.</p> <p>Each transmitter shall be pre-calibrated and delivered with a calibration certificate.</p>
Diagnostic functions	<p>Sound speed, Signal amplitude, Signal-Noise-Ratio (SNR), Signal-Coherent-Noise-Ratio (SCNR), Standard deviation of amplitudes and transit times</p>
Degree of protection	<p>The transmitter shall be IP68.</p>

Display	Legible with backlight
Data Logger	1,000,000 values or more
Communication options:	Modbus, M-Bus, RS485, NBIoT
Measurable flow velocity	0.01...25 m/s
Repeatability	0.15 % of reading $\pm 0.01$ m/s
Accuracy:	$\pm 1.2$ % of reading $\pm 0.01$ m/s
Transmitter cable type	To be made of water-tight and durable material.
Transmitter cable length:	Minimum 2 - 10m dependent on site.
Power supply	Battery Operated

Technical Specification for UFM NBIoT wireless technology modules.

The meter shall have either an inbuilt or external communication unit that communicates via NBIoT wireless technology. The data from the meters will be transmitted from the meters to a central server. The transmission of data shall be programmable up to as often as required to ensure a sufficient level of data to support continuous optimization and troubleshooting.

**Table 5-11 UFM Technical Specifications**

Item No	Technical specification required including applicable standards	Specifications offered by bidder.	Compliance of specification offered
A	B	C	
	The specification outlined below is for automatic and intelligent monitoring solution units for the metering points. The units can be separate or integrated within the Ultrasonic Flow meters.		
1	<p>Communication</p> <p>The unit or system is capable to operate with Data (SMS and Email)/ on NBIoT wireless technology for local networks.</p> <p>All the units shall transmit accumulated data at scheduled times. Users can, at any time poll the meter for any data.</p>		

Item No	Technical specification required including applicable standards	Specifications offered by bidder.	Compliance of specification offered
	<p>The unit shall communicate in real time for Peak flow, Backflow, High Pressure, Low Pressure and Tamper alarms, in order to provide relevant monitoring and management data for operational purposes.</p> <p>The unit must be equipped with a digital output display for both pressure and flow.</p> <p>Environmental Protection. The device shall be rated IP68.</p>		
2	<p><b>Materials &amp; workmanship:</b></p> <p>All materials used in the manufacture and assembly of units shall be of current production models with proven performance and operation records in tropical conditions at altitudes of 1500 – 2000 mASL.</p> <p>The units themselves shall then be installed in boxes to be protected against UV rays and unauthorized tampering.</p>		
3	<p><b>Installation</b></p> <p>Installation of the device shall not require special equipment. The device shall use a Keypad and the LCD screen to be configured.</p> <p>The system shall provide real-time confirmation from the back-end server to ensure that the device is set up before the technician leaves the site. During this process the device shall receive the confirmation from the server in order to prevent differences between devices and server.</p> <p>The system shall provide real-time transmission with the reception software to ensure that the device shall operate under installed conditions. The system shall include a delay feature to permit finalizing installation.</p> <p>The Configuration Menu shall be protected by password to ensure only authorized personnel can modify the parameters.</p> <p>It should be possible to program “on-the-fly”, i.e., without stopping the meter. The Devices shall be connected to large</p>		

Item No	Technical specification required including applicable standards	Specifications offered by bidder.	Compliance of specification offered
	<p>users or network operational locations, and therefore no interruption of the meter is permitted.</p> <p>Individual meters shall be configurable independently of other meters</p>		
4	<p><b>Module Features</b></p> <p>The device shall be capable of transmitting measured forward and backflows.</p> <p>The device shall be capable of transmitting measured pressure. The device shall be able to connect up to 4 Pulse Inputs or 2 Pulse Inputs with Backflow.</p> <p>The device shall be sealed using tamper proof seals. The devices shall be protected from unauthorized opening.</p> <p>Firmware shall be upgradeable either via Optical port (on-site) or remote connection. It is expected that software features will change, and the device should allow for upgrading over the web or for implementing future improvements.</p> <p>The device shall be capable of connecting to an external antenna. Devices may be installed with an antenna in remote locations for optimal reception levels.</p> <p>The device shall have mounting points for installation. The device shall be easily installed to achieve best efficiency during installation.</p> <p>The device shall be able to display Signal Strength to allow Technicians to ascertain very quickly whether the device will work in the chosen location.</p> <p>The device shall be capable of generating a pulse output and integrable with a SCADA system.</p> <p>The device shall have a tamper detection e.g., if the wire is cut.</p>		

Item No	Technical specification required including applicable standards	Specifications offered by bidder.	Compliance of specification offered
	The device shall have a connection possibility for an optional board (module/interface) in order to enable future technology to be added without removing the product from the field.		
5	<p>Alarms</p> <p>The device shall send real-time alarms to a mobile phone and to the server.</p> <p>The system shall provide real time alarm for:</p> <ul style="list-style-type: none"> <li>• Tampering</li> <li>• Power outage</li> <li>• Meter blockages.</li> <li>• Potential leakages in the network.</li> <li>• Backflow.</li> <li>• Peak flow to help identify when network is overloaded, or when meter is running above specifications.</li> <li>• The meter is recording out of range.</li> <li>• Zero flow rate</li> <li>• Pressure limits</li> </ul>		
6	<p>Warranty</p> <p>The Warranty shall be at least two years for the communication device.</p>		

## 520. FLANGED Y-STRAINERS

### Product description

A filter designed to remove pebbles and other impurities from water supply

### Basic Design

Basic design shall be a Y-formed strainer in cast iron with detachable screen in stainless steel.

Face-to-face shall be according to EN 558.

### Coating

The body shall be both internally and externally corrosion protected with fusion bonded epoxy coating, 250 µm blue RAL 5017, approved for drinking water.



No uncoated parts of the iron surfaces may be in contact with the fluid or the environment.

Surface preparation, coating material, application process and final result shall be quality checked and documented by the valve manufacturer and frequently supervised through notified body inspections.

### **Body**

Body and cap shall be made of ductile cast iron acc. to EN 1563, grade GJS 450-10.

Cap bolts shall be made of stainless steel, A2. A flow direction shall be marked so that the filtered impurities are collected on the inside of the screen cylinder.

Following information shall be cast into the body:

- Manufacturer
- DN-class
- PN-class
- Cast material
- Flow direction

Following information shall be shown on the label

- Product number
- Barcode
- Max. application temperature

### **Screen**

The filter screen shall be a 1.4301 (304) stainless steel cylinder with punched holes. Hole diameter shall be from 1.5 mm for the smallest DN-sizes to 2.7 mm for the largest. Wall thickness shall be from 0.8 for the smallest DN-sizes to 1.2 mm for the largest. The open area ratio (total-hole-area to piping area) shall be greater than 2.

### **Flow Coefficient**

Pressure drop across a clean unit with no impurities shall not exceed following approximation:

$$P \approx 2400 \times DN^{-4} \times Q^2$$

where P is measured in bar, DN is the nominal diameter in mm and Q is the flow in m<sup>3</sup>/h.

### **Seals**

The sealing shall be an O-ring in high temperature (130°C), EPDM.

### **Installation**

Installation shall be possible in both vertical and horizontal position. Items weighing more than 15 kg shall be fitted with lifting eyes.

### **Operation**

The strainer itself shall not need operation. A drain plug in stainless steel, A2 shall be fitted to make it possible to empty the system before removing the filter cylinder for cleaning.

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### **Quality**

The manufacturer shall have an ISO 9000 certified quality system and be audited by an independent third party.

Each finished product shall be inspected and tested for compliance with the product standards and local market specification.

### **Standards and Approvals**

Materials and processes shall be according to following:

- EN 1563 (cast iron)
- EN 10088 (stainless steel)
- EN 681 (rubber seals water)
- DIN 3476 (coating)

## **521. COUPLINGS AND FLANGE ADAPTORS**

Tensile couplings, flange adaptors and end caps dedicated for PE and uPVC pipes.

Coupling/adaptors shall offer a great flexibility be easy to mount by having a combined compression gasket which enables  $\pm 3.5^\circ$  angular deflection and makes it easy to insert the pipe ends even in the large dimensions.

They shall have external M16 bolts of anti-friction coated stainless steel and high-quality coating to offer a durable corrosion protection.

### **Standards**

Designed according to EN 12842, designed according to AS4020, designed according to 4158, Designed according to AS4130

Standard flange drilling to EN1092-2 (ISO 7005-2), PN10/16

### **Features**

The combined gasket of drinking water approved EPDM rubber with tensile grip segments of RG5 bronze enables  $\pm 3.5^\circ$  angular deflection

- The design with external bolts prevents corrosion between sleeve and bolts.
- The M16 bolts of stainless steel A2 and the nuts of acid-resistant stainless steel A4 are anti-friction coated to offer easy tightening and to prevent galling
- The bolt ends are protected with plastic caps
- The compression type gasket makes it easy to insert the pipe end, even in large dimensions
- Sleeve and bracket of ductile iron with fusion bonded epoxy coating in compliance with DIN 3476 part 1 and EN 14901.
- Manufactured to suit nominal pipe OD, with a sealing range of nominal diameter +2mm to - 5mm.
- Zinc Plated and Passivated fasteners
- Corrosion resistant construction
- Fusion bonded epoxy coating
- EPDM seals
- Maximum Working Pressure: 16 Bar
- Temperature Range: -10°C to +70°C Insulation essential for temperatures of 0°C and below.

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## **522. ELECTRO-FUSION JOINTING MACHINE**

The fusion jointing machine shall be suitable for carrying out electro- fusion welding for HDPE pipes and fittings up to 110mm diameter. The welding process is controlled and regulated with energy output compensation to account for variations in ambient temperatures.

The Unit should be complete with all accessories and shall have the following minimum general specifications;

- An internal memory with a capacity of at least 350 jointing records
- Support for USB data transfer. A USB connector cable should be supplied together with the jointing machine
- The Unit Display should be scratch resistant and dust proof, easily readable with an adjustable contrast function and give relevant information (in English) such as;
  - Recognition of fitting type, dimension and manufacturer
  - Resistance of connected fitting
  - Primary voltage and frequency
  - Actual running and final fusion duration
  - Ambient temperature, appropriate cooling time etc.
- Minimum operating range of ambient temperature of between -10°C and +45°C
- Two pairs of 4mm and 4.7mm angle adapter clips
- The complete control unit must not exceed a maximum weight of 25 kilograms including all standard primary and secondary cables
- The unit should have the relevant software and system accessories necessary for data processing and transmission
- Recognition support for different manufacturer products
- The unit should have a minimum of IP 54 Protection rating
- The unit should be supplied with a detailed operation manual written in English with clear step wise operating instructions, troubleshooting procedures, error codes and other relevant information

Site demonstration and training of the Water Company Staff on use of the equipment should be carried out.

## **523. BUTT-WELDED FUSION JOINTING MACHINE**

The fusion jointing machine shall be self-aligning, suitable for welding under-pressure pipes for water, gas and other fluids up to 250mm diameter. The machine body shall be able to assume two working positions; inclined or horizontal and have a supporting frame, four clamps and two hydraulic cylinders with fast non-drip coupling connections.

The machine shall have the possibility to choose the best configuration for the working conditions by adjusting only 4 screws on the machine frame. Fast-locking adapters shall speed up the welding preparation time without using any additional equipment. The automatic detaching of the heating plate from the pipes / fittings shall be applicable on every welding configuration. This shall enable two rollers to be lodged very quickly on the sides of the machine body, allowing lifting of the welded pipes to make them roll and prepare a new weld.

The fusion machine shall include a Teflon-coated (PTFE) heating plate with a built-in independent thermometer, to check the working temperature, and a high-precision

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electrical thermoregulator ( $\pm 1^{\circ}\text{C}$ ) with digital display and regulating buttons. This system shall include Led indicators to check if the machine is working normally (live tension and working temperature), contingent probe's failures and/or temperature anomalies.

The machine shall include an extractable electric milling cutter to face the heads of the pipes and/or fittings. It includes a safety micro-switch and a thermal circuit breaker. The machine shall include an electro-hydraulic gearcase protected from crashes and atmospheric corrosion by a plastic box. The gearcase shall consist of a control lever, to open and close the clamps, maximum pressure and discharge valves (useful also for the "Dual Pressure" welding process), hydraulic connection hoses with non-drip fast couplings and timer (to check the warming and welding time). The machine shall be pre-set for the connection of the electronic controller.

A milling cutter / heating plate support which shall include a high-temperature-proof bag shall be included in the components of the fusion machine as it shall be required to protect the heating element from being scratched.

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## **6. DRAINS, SEWERS AND MANHOLES**

### **601. EXCAVATION FOR DRAINS, SEWERS AND MANHOLES**

The ground shall be excavated to the lines and depths shown on the drawings or to such other lines and depths as the Engineer may direct. Excavations taken out to a greater depth than is necessary shall be filled to the required level with approved material as specified for the pipe bed at the Contractor's own cost. Trenches shall be of sufficient width to enable the pipes to be properly laid and jointed. In case of pipes of greater diameter than 300mm, the width of trench shall be external diameter of pipe, plus 400mm. When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or as directed by the Engineer, the Engineer shall be informed accordingly so that he may inspect the completed trench and no excavation shall be filled in or covered with concrete until it has been so inspected and the Contractor has been authorized to proceed with the work. All surplus materials from such excavations not required for refilling shall be carted away to tips, or otherwise disposed of, as directed. All excavations shall be kept dry, and all bailing and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations and backfilling of trenches shall be taken to provide a solid and even bed for barrels of the pipes and, where a concrete bed is not specified, the floor of the trench shall be properly shaped to receive the sockets and the backfill must be thoroughly rammed along the sides of the pipe.

The rate of excavation in the Bill of Quantities shall include for keeping trenches dry and for all bailing, pumping, timbering, shoring and supporting of sides that may be required.

### **602. SUPPORTS FOR PITS, TRENCHES AND OTHER EXCAVATIONS**

The sides of pits, trenches and other excavations shall, where necessary, be adequately supported to the satisfaction of the Engineer, and all such excavations shall be of sizes sufficient to enable the pipes and bedding to be laid accurately, and proper refilling and compacting to be carried out.

The Contractor shall take all precautions necessary for the safety of adjoining structures and building by shoring, opening in short lengths or otherwise, during the time the trenches are open.

### **603. ROCK CUTTING IN TRENCHES FOR PIPES**

Where solid rock is met within trenches, it shall be cut out to a depth of 100mm below the intended level of the bottom of the pipes and replaced with 100mm of approved material as specified. In measuring such rock excavation, the Contractor will be allowed a width of 400mm more than the external diameter of the pipes to a level of 100mm below the bottom of the pipes. The price inserted in the Bill of Quantities shall be held to cover all expenses in connection with excavating the rock, backfilling after laying of pipes and disposing of surplus material as directed by the Engineer.

### **604. WATER IN TRENCHES FOR PIPELINES**

Trenches shall be kept free from water at all times during construction of works until, in the opinion of the Engineer, any concrete or other works therein are sufficiently set, and the Contractor shall construct any sumps or temporary drains that the Engineer may deem

necessary.

The Contractor shall be responsible for the removal and disposal of all water entering the excavations from whatever source and shall deal with and dispose of such water in a manner approved by the Engineer so as to ensure that excavations are kept dry while ensuring that the disposal of this water does not cause a nuisance to adjacent plot holders or works.

The Contractor shall provide all plant, labour and materials required for such work and all costs incurred shall be deemed to be included in his rates for excavation.

#### **605. LAYING AND JOINTING RIGID JOINTED CONCRETE PIPES**

Concrete pipes shall be laid true to line and level, each pipe being separately boned between sight rails.

For spigot and socket joints, the spigot of each pipe shall be placed home in the socket of the one previously laid, and the pipe then adjusted and fixed in its correct position with the spigot of the pipe accurately centred in the socket. A ring of tarred rope yarn shall next be inserted in the socket of each pipe previously laid and driven home with a wooden caulking tool and wooden mallet, such yarn when in position shall be 25mm in depth. The socket shall then be completely filled with cement mortar 1 to 2 as specified in Clause 1010 and a fillet of the same worked all round the side. The fillet shall be levelled off and extend for a length of not less than 50mm from the face of the socket.

For 'Ogee' jointed pipes, the joints shall be thoroughly cleaned before laying, and cement mortar shall be applied evenly to the ends for jointing so as to completely fill the joint. The pipes shall then be neatly pointed with a band of cement mortar approximately 125mm wide and 20mm thick. The inside of each joint shall also be pointed up as the work proceeds.

Special care shall be taken to see that any excess of cement mortar etc. is neatly cleaned off while each joint is being made and any earth, cement or other material cleaned out of the pipes by drawing a tight-fitting wad through them as the work proceeds, or by other approved means. A properly fitting plug shall be well secured at the end of the last laid pipe and shall be removed only when pipe laying is proceeding. The trenches, pipes and joint holes shall be kept free from water until the joints are thoroughly set.

Where shown on the drawings or directed by the Engineer, concrete pipes shall be bedded and haunched or surrounded with concrete as specified in Clause 619.

The price inserted in the Bill of Quantities shall include for providing, laying and jointing of pipes.

#### **606. PIPES LAID WITH OPEN JOINTS**

Concrete porous pipes shall be laid unjointed with a space of 12mm between the spigot and the inner end of the socket.

All pipes shall be packed and surrounded as directed by the Engineer with approved broken stone, sand or gravel aggregate, to the gradings as shown on the drawings or stated in the Bill of Quantities. The prices inserted in the Bill of Quantities shall include the

trench excavation, providing and laying pipes, supplying and placing graded packing material, refilling trench and disposing of surplus all as specified.

**607. CAST IRON PIPES**

Cast iron pipes and special castings shall be supplied, laid and jointed with lead wool properly caulked to form perfectly uniform and watertight joints, and when laid and jointed they shall be true to line and level.

Where cast iron pipe drains are laid on unstable ground or ground which is likely to settle appreciably over a period of years, they shall be pointed by means of an approved self-adjusting or screwed gland joint as directed by the Engineer.

**608. DRAINS TO BE LEFT CLEAN ON COMPLETION**

On completion, all drains, manholes, etc. shall be flushed from end to end with water from an approved source and left clean and free from obstructions.

**609. REFILLING TRENCHES**

Trenches shall be refilled with suitable excavated material of 100mm surround but not before the work has been measured and approved by the Engineer. For pipes which are not surrounded with concrete, the first layer of filling material shall be free from stones and shall not be thrown directly on to the pipes but shall be placed and packed with care all round them. All filling shall be deposited and compacted in layers, not exceeding 225mm loose depth, to a dry density not less than that of the adjoining soil. The last 450mm of filling must be returned in the order in which it has been removed. Timber and framing shall be withdrawn ahead of the layer to be compacted, care being taken to keep the sides of the trenches solid and to fill all the spaces left by the withdrawn timber.

**610. CONNECTIONS OF EXISTING SEWERS AND DRAINS**

Where shown on the drawings, existing sewers and drains shall be properly extended, connected and jointed to new sewers, culverts, drains or channels. All such connections shall be made during the construction of the main sewer, drain or other work and a record of their positions kept for future use or reference. Where pipe connections are made to a sewer, stone pitched or lined channel, the pipes shall be well and tightly built into the concrete, or masonry work and be so placed as to discharge in the direction of the main sewer, drain or channel and with the end of the pipe carefully cut to the necessary angle. Where the connections are between pipe sewers or drains, special connecting pipes as shown on the drawings shall be supplied and be truly laid and properly jointed.

**611. MANHOLES AND INSPECTION CHAMBERS**

Manholes and inspection chambers shall be constructed in accordance with the drawings and in the position shown on the drawings or directed by the Engineer. Foundation slabs shall consist of concrete of the appropriate classes as specified on drawings. The side walls shall consist of similar concrete or building stone as specified in Clause 1007 in accordance with the drawings.

The side walls shall be fair faced or rendered internally as specified on drawings. They shall be brought up vertically to receive a precast slab formed of concrete of the appropriate classes specified and reinforced all as shown on the drawings. Cast iron manhole covers and frames as specified in Clause 1032 shall be provided and frames shall



be bedded in cement mortar 1 to 3 and so set that the tops of the covers shall be flush at all points with surrounding surface of the footway, verge or carriageway, as the case may be. Any slight adjustment of the slab level which may be necessary to accomplish this shall be effected by topping the side walls with concrete integral with the slab.

If required, half channel pipes, bends and junctions as specified in Clause 1040 shall be laid and bedded in cement mortar 1 to 3 to the required lines and levels, and both sides of the channel pipes shall be benched up with concrete of the appropriate class and finished smooth to the slopes and levels as shown on the drawings or directed by the Engineer. The ends of all pipes shall be neatly built in and finished flush with cement mortar 1 to 3. Where the depth of the invert exceeds 1 metre below the finished surface of the carriageway or the adjacent ground, step irons as specified in Clause 1033 shall be built in with alternate steps in line vertically and with such additional hand irons as the Engineer may direct.

All manholes when completed shall be watertight and to the satisfaction of the Engineer. The prices inserted in the Bill of Quantities shall include for excavation, provision of all materials, construction, refilling and disposal of surplus.

**612. PRECAST CONCRETE MANHOLES**

Precast concrete manholes as specified in Clause 1040 shall be supplied and laid generally in accordance with Clause 611 and the drawings.

**613. GULLY CONNECTIONS**

Connections from gullies to sewers and surface water drains or ditches shall consist of concrete pipes and fittings as specified in Clause 509 jointed with cement mortar 1 to 3 as specified in Clause 1010. All pipes, bends and junctions shall be laid to the lines and levels shown on the drawings or as directed by the Engineer.

**614. SURFACE BOXES, COVERS ETC.**

Surface boxes, manholes and other covers lying within the site of the works, shall be raised, lowered, altered or removed as directed by the Engineer.

**615. GULLIES**

Gullies complete with gratings and with rodding eyes where necessary all as specified in Clause 1024 shall be supplied and laid in accordance with the drawings. Where directed by the Engineer, precast concrete gullies shall be laid on and surrounded with 100mm of concrete of the appropriate grade. The concrete surround is to be brought up to the underside of the frame or flush with the top surface as the case may be. Masonry gullies shall be constructed from 225mm building stone and rendered internally. The rates included in the Bill of Quantities shall include for excavation, provision of all materials, construction, making junctions with connections to main drains, accurate setting of frames to line and level, refilling and disposal of surplus materials. Gullies shall be trapped where leading into foul sewers or into combined foul and surface water sewers.

**616. COMPLETION OF DRAINAGE WORKS**

All sub-soil and surface water drains shall be completed in advance of the construction.



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**617. TEMPORARY STOPPERS**

Junction pipes which are laid but not immediately connected to gullies shall be fitted with temporary stoppers or seals, and the position of all such junctions shall be clearly defined by means of stakes or training wires properly marked and labelled.

**618. PROVISION FOR FUTURE CONNECTION TO MANHOLES**

Inlet pipes of the required diameters shall be built into the walls of manholes and elsewhere for future use and shall be of the diameters shown on the drawings. The external ends of all such connections shall be sealed off with temporary stoppers, approved by the Engineer. The pipes shall be laid and jointed as specified in Clause 611 and during the placing of the concrete they shall be adequately supported.

**619. SURROUNDING OR HAUNCHING OF PIPES WITH CONCRETE**

Surrounding or haunching of pipes shall be carried out using concrete of the appropriate grade. In carrying out this work the Contractor shall take care to pack the concrete under and around the pipes to ensure even bedding and solidity in the concrete and the concrete shall not be thrown directly on to the pipes. The upper surface of the concrete shall be struck off with a wooden screed or template and neatly finished off. The rates shall include for any formwork that the Contractor requires to use under this item.

**620. INVERT BLOCK AND STONE-PITCHED DRAINS**

Precast concrete invert blocks and side slabs shall be formed of concrete of the appropriate grade to the dimensions shown on the drawings. Each course of side slabs required in the Bill of Quantities shall be interpreted as one complete row of side slabs to one side of the channel concerned. Stone used for channels shall be 225mm x 100mm building stone. Drains should not normally be laid to a radius of curvature less than 10 times the actual width of the drain.

Invert block and stone-pitched drains shall be constructed in the positions and to the levels and dimensions shown on the drawings and laid to true line and even fall. Where under-filling is required, it shall be in 100mm maximum thickness layers of compacted murram. The earth sides to such channels shall be neatly finished to a slope of 1 to 1 or such other slope as the Engineer may direct. Invert blocks and side slabs shall be laid on a 100mm minimum thickness of compacted murram and be neatly jointed with cement mortar 1 to 3 as the work proceeds. The excavation, murram bedding, providing, laying and jointing invert blocks or stone, backfilling and disposal of surplus shall all be as specified and all in-situ connections shall be in concrete of the appropriate grade.

**621. TESTING OF JOINTED PIPES AND MANHOLES**

Sealed jointed drains, up to and including 600mm diameter shall be tested in sections (e.g., between manholes) by filling with water under a head of not less than 1 metre. Drains found to be water-tight after a period of 30 minutes will be passed as satisfactory but the water must be retained in the pipes until a depth of at least 450mm of filling has been deposited and compacted on top thereof. Drains failing to stand the test shall be taken out and the pipes re-laid and re-jointed until completely watertight.

Drains exceeding 600mm in diameter shall be tested by means of a smoke test before they are covered up. Both ends of the lengths of drain to be tested shall be sealed to the satisfaction of the Engineer, and smoke shall then be pumped into the section from an

approved machine. Should any joint in the section show an escape of smoke, the section shall be taken out and the pipes re-laid and re-jointed until there is no further escape of smoke.

Should the Engineer so direct, manholes shall be tested by completely filling with water, and there shall be no appreciable loss over a period of 2 hours.

On completion of the works, or at suitable intervals during construction, infiltration tests will be carried out. The permissible amount of infiltration shall be 1 litre per hour per linear metre of nominal internal diameter.

The Contractor shall provide all labour and apparatus for the above tests.

All testing will be done in accordance with the procedure of the British Standard Code.

## **622. PIPES WITH RUBBER RING JOINTS**

Rubber rings complying with SRN 308 will be provided by the Contractor. They will be laid in the socket and the pipes then jointed as specified. The jointing of pipes shall be carried out in accordance with manufacturer's instructions and in conformity with any modifications proposed by the Engineer.

## **623. LAYING, JOINTING AND BACKFILLING FOR FLEXIBLE JOINTED PIPES**

The Contractor shall ensure that any hard spots and loose stones are removed from the formation prior to laying of bedding materials. The Contractor shall lay a bed of thickness 100mm consisting of granular material i.e., sand, gravel, or approved soil of friable nature.

After laying of pipes the Contractor shall lay bedding material on the sides of the pipe compacted by tamping into soffit of sewer.

After completion of this operation the Contractor shall lay the bedding material on top of the pipe in 150mm layers to a thickness of 300mm. The material is to be compacted by tamping. However, precautions are to be taken to avoid excessive tamping on top of the pipe. The remaining trench excavation is to be backfilled to comply with Clause 609 of specification.

The pipes shall be laid with flexible ring seal joints provided that solvent cement joints could be used for fittings where necessary subject to the approval of the Engineer. Pipes and fittings shall be checked for deformities prior to laying. Deformed pipes and fittings shall not be accepted.

### **Flexible Rubber Ring Joints**

The Contractor shall ensure that the spigot end is free from grit, dust or dirt and sealing rings should be seated evenly in the socket groove. Pipe lengths and fittings are supplied with a chamfer on the spigot. Where pipes are to be cut or are supplied without a chamfer on the spigot end the Contractor shall ensure that the pipe is cut square and then form a chamfer on the spigot end with a medium file to an angle of 15 degrees. Remove saw flashing by scraping with a penknife.

### **Expansion Gap**

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It is necessary to leave a gap between the edge of the spigot end and the base of the socket to allow for expansion. Moulded fittings are supplied with an embossed line indicating the correct depth of insertion. In other cases where the marking is not done, the Contractor shall ensure that an expansion gap of at least 3mm per metre length of pipe or at least 15mm per pipe length is provided. This can be done by marking spigot ends or by pushing spigot fully home, making a small mark on pipe and then withdrawing the pipe by 15mm.

After completing jointing the pipe shall be laid on the prepared bed making sure that a suitable depression is created in the bed for the socket.

### **Solvent Cement Joints**

For solvent cement joints make sure that mating surfaces are clean and free of grease and dirt. Roughen mating surface with sandpaper, clean both surfaces with cleansing fluid using a clean cloth. Apply solvent cement on both mating surfaces. Without delay bring mating surfaces together and hold in position firmly for a few seconds. A layer of cement should be visible at the edges. Joints should not be disturbed for at least 10 minutes after assembly.

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## **7. CONCRETE**

### **SCOPE OF SECTION**

This section covers the materials, design of mixes, mixing, transport, placing, compaction and curing of concrete and mortar required in the Works. It also covers formwork and reinforcement for concrete.

### **DEFINITIONS**

- Structural concrete is any class of concrete which is used in reinforced, prestressed or unreinforced concrete construction, which is subject to stress.
- Non-structural concrete is composed of materials complying with the Specification but for which no strength requirements are specified and which is used only for filling voids, blinding foundations and similar purposes where it is not subjected to significant stress.
- A formed surface is a face which has been cast against formwork.
- An unformed surface is a horizontal or nearly horizontal surface produced by screeding or trowelling to the level and finish required.
- A pour refers to the operation of placing concrete into any mould, bay or formwork, etc. and also to the volume which has to be filled. Pours in vertical succession are referred to as lifts.

### **701. THE DESIGN OF CONCRETE MIXES**

#### **a) Cement**

Cement for structural concrete shall be CEM I – 42.5 to KS EAS 18-1 and KS EAS 183.

#### **b) Classes of Concrete**

The classes of structural concrete to be used in the works shall be those shown on the Drawings and designated in Table 7-1, in which the class designation includes two figures. The first figure is the nominal strength at 28 days expressed in  $\text{N/mm}^2$  and the second figure is the maximum nominal size of aggregate in the mix expressed in millimetres.

#### **c) Design of Proposed Mixes**

The Contractor shall design all the concrete mixes called for on the Drawings, making use of the ingredients which have been approved by the Engineer for use in the Works and in compliance with the following requirements:

**Table 7-1 Concrete Classes and Strengths**

Class of Concrete	Nominal Strength N/mm <sup>2</sup>	Maximum Nominal Size mm	Maximum Water / Cement Ratio		Trial Mixes Target Mean Strength (Clause 401 c) N/mm <sup>2</sup>	Early Works Test Cubes (Clause 401 c)	
			A	B		Any one Cube N/mm <sup>2</sup>	Average of any Group of 4 Cubes
10/75	10	75	0.60	0.55	13.5	8.5	13.3
15/75	15	75	0.60	0.50	21.5	12.8	20.0
15/40	15	40	0.60	0.50	21.5	12.8	20.0
15/20	15	20	0.57	0.50	21.5	12.8	20.0
20/40	20	40	0.55	0.48	31.5	17.0	27.5
20/20	20	20	0.53	0.48	31.5	17.0	27.5
20/10	20	10	0.50	0.48	31.5	17.0	27.5
25/40	25	40	0.52	0.46	36.5	21.3	32.5
25/20	25	20	0.50	0.46	36.5	21.3	32.5
25/10	25	10	0.48	0.46	36.5	21.3	32.5
30/40	30	40	0.50	0.45	41.5	25.5	37.5
30/20	30	20	0.48	0.45	41.5	25.5	37.5
30/10	30	10	0.47	0.45	41.5	25.5	37.5
40/20	40	20	0.46	0.43	51.5	34.0	47.5
40/10	40	10	0.45	0.43	51.5	34.0	47.5

**NOTES:** 1. Under water/cement ratio, column A applies to moderate and intermediate exposure, and column B applies to severe exposure. See NOTE after Table 7-2.

2. In case of concrete having a maximum aggregate size of 40mm or less, 150mm cubes should be used.

In case of concrete having a 75mm or larger aggregate, 200mm cubes should be used.

- i) The aggregate portion shall be well graded from the nominal maximum size of stone down to the 150-micron size.
- ii) The cement content shall be such as to achieve the strengths called for in Table 7-1 but in any case, not less than the minimum necessary for

- impermeability and durability shown in Table 7-2.
- iii) The workability shall be consistent with ease of placing and proper compaction having regard to the presence of reinforcement and other obstructions.
  - iv) The water/cement ratio shall be the minimum consistent with adequate workability but in any case, not greater than that shown in Table 7-1 taking due account of any water contained in the aggregates. The Contractor shall take into account that this requirement may in certain cases require the inclusion of a workability agent in the mix.
  - v) The drying shrinkage determined in accordance with BS 1881 shall not be greater than 0.05 percent.

**Table 7-2 Minimum Cement Content**

<b>Minimum Cement Content - kg/m<sup>3</sup> of Compacted Concrete</b>			
<b>Class of Concrete</b>	<b>Moderate Exposure</b>	<b>Intermediate Exposure</b>	<b>Severe Exposure</b>
10/75,15/75	200	220	270
15/40, 20/40, 25/40, 30/40	240	270	290
15/20, 20/20, 25/20, 30/20	260	300	330
40/20	300	320	330
20/10, 25/10, 30/10	300	340	390
40/10	310	340	390

**Note:** the minimum cement contents shown in the above table are required in order to achieve impermeability and durability. In order to meet the strength requirements in the Specification higher contents may be required.

The categories applicable to the Works are based broadly on the factors listed hereunder:

- Moderate exposure      Surface sheltered from severe rain; buried concrete, concrete continuously under water
- Intermediate drying      Surface exposed to driving rain; alternate wetting exposure and drying; exposure traffic; corrosive fumes; heavy condensation
- Severe exposure          Surface exposed to sea water, moorland water having a pH of 4.5 or less, groundwater containing sulphates.

**d) Trial Mixes**

At least six weeks before commencing placement of concrete in the Permanent Works trial mixes shall be prepared for each class of concrete specified.

For each mix of concrete for which the Contractor has proposed a design, he shall prepare three separate batches of concrete using the materials which have been approved for use in the works and the mixing plant which he proposes to use for the Works. The volume of each batch shall be the capacity of the concrete mixer proposed for full production.

Samples shall be taken from each batch and the following action taken, all in accordance with BS 1881:-

- a. The slump of the concrete shall be determined.
- b. Six test cubes shall be cast from each batch. In the case of concrete having a maximum aggregate size of 40mm or less, 150mm cubes shall be used. In the case of concrete containing 75mm or larger aggregate, 200mm cubes shall be used and in addition any pieces of aggregate retained on a 53mm BS sieve shall be removed from the mixed concrete before casting the cubes.
- c. Three cubes from each batch shall be tested for compressive strength at seven days and the remaining three at 28 days.
- d. The density of all the cubes shall be determined before the strength tests are carried out.

Subject to the agreement of the Engineer, the compacting factor apparatus may be used in place of a slump cone. In this case the correlation between slump and compacting factor shall be established during preparation of the trial mixes.

The average strength of the nine cubes tested at 28 days shall be not less than the target mean strength shown in Table 7-1.

The Contractor shall also carry out tests to determine the drying shrinkage of the concrete unless otherwise directed by the Engineer.

Based on the results of the tests on the trial mixes, the Contractor shall submit full details of his proposals for mix design to the Engineer, including the type and source of each ingredient, the proposed proportions of each mix and the results of the tests on the trial mixes.

If the Engineer does not agree to a proposed concrete mix for any reason, the Contractor shall amend his proposals and carry out further trial mixes. No mix shall be used in the works without the written consent of the Engineer.

#### **e) Quality Control of Concrete Production**

##### **i) Sampling**

For each class of concrete in production at each plant for use in the works, samples of concrete shall be taken at the point of mixing and/or of deposition as instructed by the Engineer, all in accordance with the sampling

procedures described in BS 1881 and with the additional requirements as set out below.

Six number 150mm or 200mm cubes as appropriate shall be made from each sample and shall be cured and tested all in accordance with BS 1881, two at seven days and the other four at 28 days.

Each sample shall be taken from one batch selected at random and at intervals such that each sample represents not more than  $20\text{m}^3$  of concrete unless the Engineer agrees to sampling at less frequent intervals.

Until compliance with the Specification has been established the frequency of sampling shall be three times that stated above or such lower frequency as may be instructed by the Engineer.

#### ii) Testing

- 1) The slump or compacting factor of the concrete shall be determined for each batch from which samples are taken and in addition for other batches at the frequency instructed by the Engineer.

The slump of the concrete in any batch shall not differ from the value established by the trial mixes by more than 25mm or one third of the value, whichever is the greater.

The variation in value of the compacting factor, if used in place of a slump value, shall be within the following limits:

For value of 0.9 or more	+0.03
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For value of between 0.8 and 0.9	+0.04
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For values of 0.8 or less	+0.05
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- 2) The water/cement ratio as estimated from the results of (a) above, determined by samples from any batch shall not vary by more than five per cent from the value established during the trial mixes.
- 3) The air content of air entrained concrete in any batch shall be within 1.5 units of the required value and the average value of four consecutive measurements shall be within 1.0 unit of the required value, expressed as a percentage of the volume of freshly mixed concrete.
- 4) Until such time as sufficient test results are available to apply the method of control described in 5) below, the compressive strength of the concrete at 28 days shall be such that no single result is less than the value shown in Table 7-1 under the heading early works test cubes' and also that the average value of any four consecutive results is not less than the value shown in Table 7-1 under the same heading.

The 7-day cube result may be used as an early strength indicator, at the



discretion of the Engineer.

- 5) When test cube results are available for at least 20 consecutive batches of any class of concrete mixed in any one plant, the average of any four consecutive results at 28 days shall exceed the nominal strength by not less than half the current margin (Table 7-3) and each individual result shall not be less than 85 per cent of the nominal strength.

The current margin shall be defined as 1.64 times the standard deviation of cube tests on at least 20 separate consecutive batches produced from one plant over a period exceeding five days but not exceeding six months or on at least 50 separate consecutive batches produced from one plant over a period not exceeding 12 months. If both figures are available, the smaller shall be taken.

The current margin shall in any case not be less than the figure given below:-

**Table 7-3 Minimum Current Margin for Test Cubes**

	Minimum Current Margin for		
	10N/mm <sup>2</sup>	15N/mm <sup>2</sup> & above	20N/mm <sup>2</sup>
After 20 batches	3.3	5	7
After 50 batches	1.7	2.5	5

Failure to comply with requirements:

If any one test cube result in a group of four consecutive results is less than 85% of the nominal strength but the average of the group of which it is part satisfies the strength requirement, then only the batch from which the failed cube was taken shall be deemed not to comply with the Specification.

If more than one cube result in a group of four consecutive results is less than 85% of the nominal strength or if the average strength of the group fails to satisfy the strength requirement then all the batches between those represented by the first and last cubes in the group shall be deemed not to comply with the Specification, and the Contractor shall immediately adjust the mix design subject to the agreement of the Engineer to restore compliance with the Specification. After adjustment of the mix design the Contractor will again be required to comply with sub-clauses 701(b) and 701(c) of this Section of the Specification.

The Contractor shall take necessary action to remedy concrete which does not comply with this Specification. Such action may include but is not necessarily confined to the following:-

- Increasing the frequency of sampling until control is again established.
- Cutting test cores from the concrete and testing in accordance with SRN 117.
- Carrying out strengthening or other remedial work to the concrete where possible or appropriate.

- iv) Carrying out non-destructive testing such as load tests on beams.
- v) Removing the concrete.

## **702. MIXING CONCRETE**

Before any plant for batching, mixing, transporting, placing, compacting, and finishing concrete is ordered or delivered to site, the Contractor shall submit to the Engineer full details including drawings of all the plant which he proposes to use and the arrangements he proposes to make.

Concrete for the Works specifically for Treatment Works Units and Storage Reservoirs shall be and mixed using an automatic batching plant in one or more central location. If the Contractor proposes to use ready mixed concrete, he shall submit to the Engineer for his approval full details and test results of the concrete mixes. The Engineer may approve the use of ready mixed concrete provided that:

- a) the proposed mixes, the material to be used and the method of storage and mixing comply with the requirements of the Specification;  
and
- b) adequate control is exercised during mixing.

Approval for the use of ready mixed concrete may be withdrawn if the Engineer is not satisfied with the control of the materials being used and control during mixing.

The mixing of concrete shall be carried out at central plant located at a site remote from place of discharge of mixed concrete. The mixed concrete shall be transported from the central plant using transit lorry mixers and/or agitator trucks.

Batching and mixing plants shall be modern efficient equipment complying with the requirements of SRN 118 and capable of producing a uniform distribution of the ingredients throughout the mass. Truck mixes shall comply with the requirements of SRN 121 and shall only be used with the prior agreement of the Engineer. If the plant proposed by the Contractor does not fall within the scope of SRN 118, it shall have been tested in accordance with SRN 119 and shall have a mixing performance within the limits specified in SRN 118.

All mixing operations shall be under the control of an experienced supervisor.

The aggregate storage bins shall be provided with drainage facilities arranged so that drainage water is not discharged to the weigh hoppers. Each bin shall be drawn down at least once per week and any accumulations of mud or silt removed.

Cement and aggregate shall be batched by weight. Water may be measured by weight or volume.

The weighing and water dispensing mechanisms shall be maintained in good order. Their accuracy shall be maintained within the tolerances described in SRN 118 and checked against accurate weighs and volumes when required by the Engineer.

The weighs of cement and of each size of aggregate as indicated by the mechanisms

employed shall be within a tolerance of plus or minus two percent of the respective weights per batch agreed by the Engineer.

The Contractor shall provide standard test weights at least equivalent to the maximum working load used on the most heavily loaded scale and other auxiliary equipment required for checking the satisfactory operation of each scale or other measuring device. Tests shall be made by the Contractor at least once a week or at intervals to be determined by the Engineer and shall be carried out in his presence. For the purpose of carrying out these tests, there shall be easy access for personnel to the weigh hoppers. The Contractor shall furnish the Engineer with copies of the complete results of all check tests and shall make any adjustments, repairs, or replacements necessary to ensure satisfactory performance.

The nominal drum or pan capacity of the mixer shall not be exceeded. The turning speed and the mixing time shall be as recommended by the manufacturer, but in addition, when water is the last ingredient to be added, mixing shall continue for at least one minute after all the water has been added to the drum or pan.

The blades of pan mixers shall be maintained within the tolerances specified by the manufacturer of the mixer and the blades shall be replaced when it is no longer possible to maintain the tolerances by adjustment.

Mixers shall be fitted with an automatic recorder registering the number of batches discharged.

The water to be added to the mix shall be reduced by the amount of free water contained in the coarse and fine aggregates. This amount shall be determined by the Contractor by a method agreed by the Engineer immediately before mixing begins each day and thereafter at least once per hour during concreting and for each delivery of aggregates during concreting. When the correct quantity of water, determined as set out in the Specification, has been added to the mix, no further water shall be added, either during mixing or subsequently.

After mixing for the required time, each batch shall be discharged completely from the mixer before any materials for the succeeding batch are introduced.

Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed and thereafter the first batch of concrete through the mixers shall contain only half the normal quantity of coarse aggregate. This batch shall be mixed for one minute longer than the time applicable to a normal batch.

Mixers shall be cleaned out before changing to another type of cement.

### **703. HAND-MIXED CONCRETE**

Concrete for structural purposes shall not be mixed by hand. Where non-structural concrete is required, hand mixing may be carried out subject to the agreement of the Engineer.

The mixing shall be done on a hard impermeable surface. The materials shall be turned over not less than three times dry, water shall then be sprayed on and the materials again

turned over not less than three times in a wet condition and worked together until a mixture of uniform consistency is obtained.

For hand mixed concrete the specified quantities of cement shall be increased by 10% and not more than 0.5 cubic metre shall be mixed at one time. During windy weather efficient precautions shall be taken to prevent cement from being blown away during the process of gauging and mixing.

#### **704. TRANSPORT OF CONCRETE**

The concrete shall be discharged from the mixer and transported to the Works by means which shall prevent adulteration, segregation, or loss of ingredients, and which shall ensure that the concrete is of the required workability at the point and time of placing. The loss of slump between discharge from the mixer and placing shall not exceed 25mm. The mixed concrete shall be transported using agitator trucks or transit truck mixers. The agitating speed of the drum shall be between 2 and 4 rpm. The interval between feeding of water into the mixer drum and final discharging of the concrete shall not exceed one hour.

The time elapsed between mixing and placing a batch of concrete shall be as short as practicable and, in any case, not longer than will permit completion of placing and compaction before the onset of initial set. If the placing of any batch of concrete is delayed beyond this period, the concrete shall not be placed in the Works.

#### **705. PLACING OF CONCRETE**

##### **a) Consent for Placing**

Concrete shall not be placed in any part of the Works until the Engineer's consent has been given in writing, and the Contractor shall give the Engineer at least 1 full working days' notice of his intention to place concrete.

If concrete placing is not commenced within 24 hours of the Engineer's consent the Contractor shall again request consent as specified above.

##### **b) Preparation of Surface to Receive Concrete**

Excavated surfaces on which concrete is to be deposited shall be prepared as set out in Section 3 of this Specification.

Existing concrete surfaces shall be prepared as set out in Clause 714. Before deposition of further concrete, they shall be clean, hard, and sound and shall be wet but without any free-standing water.

Any flow of water into an excavation shall be diverted through proper side drains to a sump or be removed by other suitable methods which will prevent washing away the freshly deposited concrete or any of its constituents. Any underdrains constructed for this purpose shall be completely grouted up when they are no longer required by a method agreed by the Engineer.

Unless otherwise instructed by the Engineer surfaces against which concrete is to be placed shall receive a prior coating of mortar mixed in the proportions similar to those of the fines portion in the concrete to be placed. The mortar shall be kept

ahead of the concrete. The mortar shall be well worked into all parts of the excavated surface and shall not be less than 5mm thick.

If any fissures have been cleaned out as described in Section 3 of this Specification they shall be filled with mortar or with concrete as instructed by the Engineer.

The amount of mortar placed at any one time shall be limited so that it does not dry out or set before being covered with concrete.

**c) Chutes**

In general, transportation of concrete by the use of chutes will not be permitted unless approved by the Engineer. The chute shall have a section with round corners and shall have a proper fixed slope so as to allow the concrete to flow satisfactorily and without segregation. The lower end of chute shall be provided with a drop chute not less than 0.6m in height to avoid segregation of falling concrete. The height of drop shall not exceed 1.5m. Chutes shall be protected from direct sunlight, wind and rain.

**d) Concrete Pump or Placer**

The type and capacity of pump shall be determined to meet the specified requirements, taking into account the placing speed, construction schedule, quality of concrete, location to which concrete is poured, etc. Diameter of the delivery pipes shall be not smaller than 3 times of the maximum size of aggregates to be used in the concrete.

Delivery pipes shall be so installed as to permit easy removal. Before starting the pump or placer operation, about one cubic metre of mortar with the same proportion of water, admixture, cement and fine aggregate as designated for the regular concrete mix shall be passed through the pipe. The pipe shall be set as straight and horizontally as possible to prevent clogging of the concrete mix in the pipe. The supports of the pipeline shall be stiff enough to fix the pipes firmly without adverse effect on forms and reinforcing steel already set in position. Care shall be taken to prevent leakage of the concrete mix from the pipeline or any other part.

Air boosters shall not be used except in conditions where the outlet of the pipe is completely embedded at least 2 metres in fresh concrete.

**e) Placing Procedures**

The concrete shall be deposited as nearly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or formwork. It shall be brought up in layers approximately parallel to the construction joint planes and not exceeding 500mm in compacted thickness unless otherwise permitted or directed by the Engineer, but the layers shall not be thinner than four times the maximum nominal size of aggregate.

Layers shall be placed so that they do not form feather edges nor shall they be placed on a previous layer which has taken its initial set. In order to comply with this requirement, a layer may be started before completion of the preceding layer.

All the concrete in a single bay or pour shall be placed in a continuous operation. It shall be carefully worked round all obstructions, irregularities in the foundations and the like so that all parts are completely full of compacted concrete with no segregation or honeycombing. It shall also be carefully worked round and between water stops, reinforcement, embedded steelwork and similar items which protrude above the surface of the completed pour.

All work shall be completed on each batch of concrete before its initial set commences and thereafter the concrete shall not be disturbed before it has set hard. No concrete that has partially hardened during transit shall be used in the Works and the transport of concrete from the mixer to the point of placing shall be such that this requirement can be complied with.

Concrete shall not be placed during rain which is sufficiently heavy or prolonged as to wash mortar from coarse aggregate on the exposed faces of fresh concrete. Means shall be provided to remove any water accumulating on the surface of the placed concrete. Concrete shall not be deposited into such accumulation of water.

In drying weather, covers shall be provided for all fresh concrete surfaces which are not being worked on. Water shall not be added to concrete for any reason.

When concrete is discharged above its place of final deposition, segregation shall be prevented by the use of chutes, downpipes, trunking, baffles or other appropriate devices, as approved by the Engineer.

Forms for walls, columns and other thin sections of significant height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on the formwork or reinforcement above the level of the placed concrete.

When it is necessary to place concrete under water the Contractor shall submit to the Engineer his proposals for the method and equipment to be employed. The concrete shall be deposited either by bottom-discharging watertight containers or through funnel-shaped tremies which are kept continuously full of concrete up to level above the water and which shall have the discharging bottom fitted with a trapdoor and immersed in the concrete in order to reduce to a minimum the contact of the concrete with the water. Special care shall be taken to avoid segregation.

If the level of concrete in a tremie pipe is allowed to fall to such an extent that water enters the pipe, the latter shall be removed from the pour and filled with concrete before being again lowered into the placing position. During and after concreting under water, pumping or dewatering in the immediate vicinity shall be suspended if there is any danger that such work will disturb the freshly placed concrete.

**f) Interruptions to Placing**

If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the Contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as



possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already placed in accordance with Clause 706. All work on the concrete shall be completed while it is still plastic and it shall not thereafter be disturbed until it is hard enough to resist damage. Plant and materials to comply with this requirement shall be readily available at all times during concrete placing.

Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or uncompacted concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.

If it becomes possible to resume concrete placing without contravening the Specification and the Engineer consents to a resumption, the new concrete shall be thoroughly worked in and compacted against the existing concrete so as to eliminate any cold joints.

**g) Dimensions of Pours**

Unless otherwise agreed by the Engineer, pours shall not be more than two metres high and shall as far as possibly have a uniform thickness over the plan area of the pour. Concrete shall be placed to the full planned height of all pours except in the circumstances described in sub-clause 705(d).

The Contractor shall plan the dimensions and sequence of pours in such a way that cracking of the concrete does not take place due to thermal or shrinkage stresses.

**h) Placing Sequence**

The Contractor shall arrange that as far as possible the intervals between placing successive lifts of concrete in one section of the Works are of equal duration. This duration shall normally be not less than three or more than seven days under temperate weather conditions unless otherwise agreed by the Engineer.

Where required by the Engineer to limit the opening of construction joints due to shrinkage, concrete shall not be placed against adjacent concrete which is less than 21 days old.

When the drawings call for contraction gaps in concrete, these shall be of the widths and in the locations shown on the drawings and they shall not be filled until the full-time interval shown on the drawings has elapsed.

**706. COMPACTION OF CONCRETE**

The concrete shall be fully compacted throughout the full extent of the placed layer. It shall be thoroughly worked against the formwork and around any reinforcement and other embedded items, without displacing them. Particular care shall be taken at arises and other confined spaces. Successive layers of the same pour shall be thoroughly worked together.

Concrete shall be compacted with the assistance of mechanical immersion vibrators unless the Engineer agrees to another method.

Immersion vibrators shall operate at a frequency of between 7,000 and 10,000 cycles per

minute. The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacturer in order that the compactive effort is not reduced.

A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and, in addition, standby vibrators shall be available for instant use at each place where concrete is being placed.

Where the concrete contains aggregate with a nominal size of 75mm or more, vibrators with a diameter of 100mm or more shall be used.

Vibration shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. Vibrators shall not be used to move concrete laterally and shall be withdrawn slowly to prevent the formation of voids.

Vibration shall not be applied by way of reinforcement nor shall vibrators be allowed to touch reinforcement or other embedded items. The vibrators shall be inserted vertically into the concrete to penetrate the layer underneath at regular spacing. The spacing shall not exceed the distance from the vibrator over which vibration is visibly effective.

## **707. CURING OF CONCRETE**

### **a) General**

Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperature differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete.

Curing shall be continued for as long as may be necessary to achieve the above objectives but in any case, for at least seven days or until the concrete is covered by later construction whichever is the shorter period.

The above objectives are dealt with in sub-clause 707(b) and (c) but nothing shall prevent both objectives being achieved by a single method where circumstances permit.

The curing process shall commence as soon as the concrete is hard enough to resist damage from the process, and in the case of large areas or continuous pours, shall commence on the completed section of the pour before the rest of the pour is finished.

Details of the Contractor's proposals for curing concrete shall be submitted to the Engineer before the placing of concrete commences in the Works.

Formed surfaces may be cured by retaining the formwork in place for the required curing period.

If the use of the foregoing methods is inappropriate, surfaces which will not have further concrete bonded to them and which are not to receive an application of a finish may be cured by the application of a curing compound having an efficiency



index of at least 90 percent. Curing compounds shall contain a fugitive dye to enable the extent of the spread to be seen easily.

Curing compound is used on surfaces exposed to the atmosphere shall contain sufficient finely divided flake aluminium in suspension to produce a complete coverage of the surface with a metallic finish when applied at the rate recommended by the manufacturer.

Curing compounds shall become stable and impervious to the evaporation of water from the concrete surface within 60 minutes of application. The material shall not react chemically with the concrete surfaces for at least the first four days of the curing period.

If instructed by the Engineer, the Contractor shall, in addition to the curing provisions set out above provide a suitable form of shading to prevent the direct rays of the sun reaching the concrete surfaces for at least the first four days of the curing period.

**b) Loss of Moisture**

Exposed concrete surfaces shall be closely covered with impermeable sheeting, properly secured to prevent its removal by wind and the development of air spaces beneath it. Joints in the sheeting shall be lapped by at least 300mm.

If for some reason it is not possible to use impermeable sheeting, the Contractor shall keep the exposed surfaces continuously wet by means of a water spray or by covering with a water absorbent material which is kept wet, unless this method conflicts with sub-clause 707(c).

Water used for curing shall be of the same quality as that used for concrete mixing as stated in Clause 702.

**c) Limitation of Temperature Differential**

The Contractor shall limit the development of temperature differentials in concrete after placing by any means appropriate to the circumstances including the following:

- i) limiting concrete temperatures at placing as set out in sub-clause 709(b);
- ii) use of low heat cement, subject to the agreement of the Engineer;
- iii) insulation of exposed concrete surface by insulating blankets. Such blankets shall have an insulation value at least equivalent to 50mm of dry mineral wool;
- iv) leaving formwork in place during the curing period. Steel forms shall be suitably insulated on the outside;
- v) preventing rapid dissipation of heat from surfaces by shielding from wind;

- vi) avoiding the use of water sprays when such use would cause rapid cooling of the surface.

#### **708. PROTECTION OF FRESH CONCRETE**

Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from these causes.

No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

Concrete placed in the Works shall not be subjected to any loading until it has attained at least its nominal strength as defined in Clause 701.

If the Contractor desires to impose loads on newly placed concrete, he shall make at least three test cubes and cure them in the same conditions as the concrete they represent. These cubes shall be tested singly at suitable intervals in order to estimate the time at which the nominal strength is reached.

#### **709. CONCRETING IN HOT WEATHER**

##### **a) General**

The Contractor shall prevent damage to concrete arising from exposure to extreme temperatures and shall maintain in good working order all plant and equipment required for this purpose.

In the event that conditions become such that even with the use of the equipment the requirements cannot be met, concrete placing shall immediately cease until such time as the requirements can again be met.

##### **b) Concrete Placing in Hot Weather**

During hot weather the Contractor shall take all measures necessary to ensure that the temperature of concrete at the time of placing in the Works does not exceed 30 degrees centigrade and that the concrete does not lose any moisture during transporting and placing.

Such measures may include but are not necessarily limited to the following:-

- i. Shielding aggregates from direct sunshine.
- ii. Use of a mist water spray on aggregates
- iii. Sun shields on mixing plants and transporting equipment.
- iv. Cooling the mixing water. If ice is used for this purpose, it should preferably be in flake form. Lump ice shall not be allowed to enter the tank supplying the mixer drum.
- v. Covering skips closely with polythene sheet so that the latter is in contact with the concrete.

Areas in which concrete is to be placed shall be shielded from direct sunshine and rock or concrete surfaces shall be thoroughly wetted to reduce absorption of water from the concrete placed on or against them.

After concrete in any part of an area has been placed, the selected curing process shall be commenced as soon as possible. If any interval occurs between completion of placing and start of curing, the concrete shall be closely covered during the interval with polythene sheet to prevent loss of moisture.

## **710. FINISHES ON UNFORMED SURFACES**

Horizontal or nearly horizontal surfaces which are not cast against formwork shall be finished to the class shown on the drawings and defined hereunder.

### **UF 1 Finish**

All surfaces on which no higher class of finish is called for on the drawings or instructed by the Engineer shall be given a UF 1 finish.

The concrete shall be levelled and screeded to produce a uniform plain or ridged surface; surplus concrete being struck off by a straight edge immediately after compaction.

### **UF 2 Finish**

This is a floated finish for roof or floor slabs and other surfaces where a hard trowelled surface is not required.

The surface shall first be treated as a Class UF 1 finish and after the concrete has hardened sufficiently, it shall be floated by hand or machine sufficiently only to produce a uniform surface free from screed marks.

### **UF 3 Finish**

This is a hard trowelled surface for use where weather resistance or appearance is important, or which is subject to high velocity water flow.

The surface shall be floated as for a UF 2 finish but to the tolerance stated below. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

**Table 7-4 Surface Tolerances**

Class of Finish	Tolerance in mm. See notes		
	A	B	C
UF 1	N/A	10	+ 20 or - 10
UF 2	Nil	10	+ 20 or 10
UF 3	Nil	5	+ 12.5 or -7.5

**Notes:**

1. Col. A is the maximum allowable value of any sudden change of level in the surface.
2. Col. B is the maximum allowable value of any gradual irregularity of the surface, as indicated by the gap between the surface and a three-metre-long straight edge or correctly shaped template placed on the surface.
3. Col. C is the maximum allowable value of the difference in level or position between a three-metre-long straight edge or correctly shaped template placed on the surface and the specified level or position of that surface.

Where dimensional tolerances are given on the drawings or in this Special Specification, they shall take precedence over those given in

Table 7-4.

## **711. MORTAR**

This clause covers mortar for use ahead of concrete placing, and other uses not covered elsewhere in the Specification.

Mortar shall be composed of fine aggregate complying with Clause 721 c) and ordinary Portland cement complying with SRN 103. The mix proportions shall be as stated on the drawings or elsewhere in this Specification or if not stated shall be one part of cement to two parts of fine aggregate by weight.

Small quantities of mortar may be hand mixed but for amounts over 0.5 cubic metre a mechanical mixer shall be used.

The water content of the mortar shall be as low as possible consistent with the use for which it is required but, in any case, the water/cement ratio shall not be more than 0.5.

Mortar which is specified as 'dry pack' shall be mixed with sufficient water for the mix to become cohesive but not plastic when squeezed in the hand. Dry pack mortar shall be rammed into the cavity it is required to fill, using a hand rammer with sufficient force to ensure full compaction.

## **712. CONCRETE FOR SECONDARY PURPOSES**

- a) Non-structural concrete (NS concrete) shall be used only for non-structural purposes where shown on the drawings.

NS concrete shall be composed of ordinary Portland cement complying with SRN 103 and aggregates complying with SRN 108-111 including all-in aggregate within the grading limits of SRN 109 and SRN 111.

The weight of cement mixed with 0.3 cubic metres of combined or all-in aggregate shall not be less than 50 kg. The mix shall be proportioned by weight or by volume. The maximum aggregate size shall be 40mm nominal.

The concrete shall be mixed by machine or by hand to a uniform colour and consistency before placing. The quantity of water used shall not exceed that required to produce concrete with sufficient workability to be placed and compacted where required.

The concrete shall be compacted by hand or by mechanical vibration.

- b) No Fines concrete (NF concrete) is intended for use where a porous concrete is required and shall only be used where shown on the drawings or instructed by the Engineer.

The mix shall consist of ordinary Portland cement complying with SRN 115. The aggregate size shall be 40mm to 10mm only. The weight of cement mixed with 0.3 cubic metre of aggregate shall not be less than 50 kg. The quantity of water shall not exceed that required to produce a smooth cement paste which will coat evenly the whole of the aggregate.

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### **713. RECORDS OF CONCRETE PLACING**

Records, in a form agreed by the Engineer, shall be kept by the Contractor of the details of every pour of concrete placed in the Works. These records shall include class of concrete, location of pour, date of pour, ambient temperature and weather conditions during mixing and placing and concrete temperature at time of placing, moisture contents of aggregates, details of mixes, batch numbers, cement batch number, results of all tests undertaken, location of test cube sample points and details of any cores taken.

The Contractor shall supply to the Engineer four copies of these records each week covering work carried out the preceding week. In addition, he shall supply to the Engineer monthly histograms of all 28-day cube strengths together with accumulative and monthly standard deviations and any other information which the Engineer may require concerning the concrete placed in the works.

### **714. CONSTRUCTION JOINTS**

Whenever concrete is to be bonded to other concrete which has hardened, the surface of contact between the sections shall be deemed a construction joint.

Where construction joints are shown on the drawings, the Contractor shall form such joints in those positions. The location of joints which the Contractor requires to make for the purpose of construction shall be subject to the agreement of the Engineer. Construction joints shall be in vertical or horizontal planes except in sloping slabs where they shall be normal to the exposed surface or elsewhere where the drawings require a different arrangement.

Construction joints shall be so arranged as to reduce to a minimum the effects of shrinkage in the concrete after placing and shall be placed in the most advantageous positions with regard to stresses in the structures and the desirability of staggering joints.

Feather edges of concrete at joint shall be avoided and any feather edges which may have formed where reinforcing bars project through a joint shall be cut back until sound concrete has been reached.

The intersection of horizontal or near horizontal joints and exposed faces of concrete shall appear as straight lines produced by use of a guide strip fixed to the formwork at the top of the concrete lift, or by other means acceptable to the Engineer.

Construction joints formed as free surfaces shall not exceed a slope of 20 per cent from the horizontal.

The surface of the fresh concrete in horizontal or near horizontal joints shall be thoroughly cleaned and roughened by means of high-pressure water and air jets when the concrete is hard enough to withstand the treatment without the leaching of cement. The surface of vertical or near vertical joints shall be similarly treated if circumstances permit the removal of formwork at a suitable time.

Where concrete has become too hard for the above treatment to be successful, the surface whether formed or free is to be thoroughly scabbled by mechanical means or wet sand blasted and then washed with clean water. The indentations produced by scabbling shall

be not less than 10mm deep and shall not extend closer than 40mm to a finished face.

If instructed by the Engineer the surface of the concrete shall be thoroughly brushed with a thin layer of mortar composed of one part of cement to two parts of sand by weight and complying with Clause 711 all as set out in sub-clause 705(b) immediately prior to the deposition of fresh concrete. The mortar shall be kept just ahead of the fresh concrete being placed and the fresh layer of concrete shall be thoroughly and systematically vibrated to full depth to ensure complete bond with the adjacent layer.

No mortar or concrete may be placed in position on or against a construction joint until the joint has been inspected and passed by the Engineer.

#### **715. EXPANSION AND CONTRACTION JOINTS**

Expansion and contraction joints are discontinuities in concrete designed to allow thermal or other movements in the concrete.

Expansion joints are formed with a gap between the concrete faces to permit subsequent expansion of the concrete. Contraction joints are formed to permit initial contraction of the concrete and may include provision for subsequent filling.

Expansion and contraction joints shall be formed in the positions and in accordance with the details shown on the drawings or elsewhere in the Specifications.

#### **716. WATERSTOPS**

All references to water stops include grout stops.

Water stops shall be of the material and form shown on the drawings. No water stop material shall be brought on the site until the Contractor has submitted full details of the materials he proposes to use, including samples, and these have been tested and approved by the Engineer. All samples shall be of adequate length for testing.

Water stops shall be made of materials which are resistant to chlorides, sulphates, or other deleterious substances which may be present in the environment of the Works.

Rubber water stops may be of natural rubber and shall have an elongation at breaking stress of at least 500 percent at 25 degrees centigrade and shall allow a joint movement of at least 50mm.

Polyvinyl chloride (PVC) water stops shall be extruded from an unfilled plasticised PVC polymer or copolymer which does not contain any reclaimed or scrap PVC. PVC water stops shall have an elongation at breaking stress of at least 225 percent at 25 degrees centigrade and shall allow a joint movement of at least 10mm.

Low modulus water stops shall be of rubber or PVC as described above but shall have an elongation of at least 200 percent at 25 degrees centigrade under a tensile stress of 6 N/mm<sup>2</sup> and shall allow a joint movement of at least 50mm.

Water stops shall be supplied in lengths as long as possible consistent with ease of handling and construction requirements.

In rubber or plastic materials, joints other than butt joints shall be supplied ready made by the manufacturer. Butt joints shall be made on site in accordance with the manufacturer's instructions and with equipment supplied for the purpose by the manufacturer.

Water stop material shall be stored carefully on site to avoid damage and contamination with oil, grease, or other pollutants. Rubber and plastic water stops shall be stored in cool well-ventilated places away from direct sunlight.

Rubber and plastic water stops which are embedded in one side of a joint more than one month before the scheduled date of placing concrete on the other side, shall be protected from the sun.

Water stops shall be firmly fixed in the formwork so that they cannot be displaced during concrete placing and shall be completely free of all dirt, grease, oil, etc., before placing concrete. Where eyelets are provided these shall be fully wired to the reinforcement and be the only means whereby the water stop is fixed. In no circumstances shall a water stop be punctured with nails etc. as a means of fixing.

Concrete shall be placed carefully round water stops so as to avoid distortion or displacement and shall be fully compacted. Where water stops lie in a horizontal or nearly horizontal plane the Contractor shall ensure that no voids are left on the underside of the water stop.

Formwork around water stops shall be carefully removed to avoid damage. If water stops suffer any damage which cannot be properly repaired in-situ the Engineer may require a section of concrete to be removed and the water stop replaced.

#### **717. GROUTING OF POCKETS AND HOLES AND UNDERPINNING OF BASEPLATES**

Pockets and holding-down bolt holes shall be thoroughly cleaned out using compressed air and water jet. Holes drilled by a diamond bit shall be roughened. The pockets and holes shall be filled with grout consisting of cement and clean fresh water mixed in proportion of two parts by weight of cement to one part by weight of water. The pouring of liquid grout shall cease as soon as each hole is filled and any excess grout on the surface of the concrete foundation shall be completely removed and the surface dried off before the next operation proceeds.

The space between the top surface of foundation concrete and the underside of the baseplates shall be filled with a special mortar made up in the following proportions:-

- Portland Cement ..... 50 kg.
- Fine aggregate ..... 50 kg.
- An additive acceptable to the Engineer to counteract shrinkage in proportions recommended by the manufacturer.

The special mortar shall be mixed with the lowest water-cement ratio which will result in a consistency of mix of sufficient workability to enable maximum compaction to be achieved.

The special mortar shall then be well rammed in horizontally below the baseplate and from one edge only until it is extruded from the other three sides. The mortar which has



extruded shall then be rammed back to ensure complete support without voids.

#### **718. REMEDIAL WORK TO DEFECTIVE SURFACES**

If on stripping any formwork the concrete surface is found to be defective in any way, the Contractor shall make no attempt to remedy such defects prior to the Engineer's inspection and the receipt of any instructions which the Engineer may give.

Defective surfaces shall not be made good by plastering. Areas of honeycombing (of a mild nature) which the Engineer agrees may be repaired shall be cut back to sound concrete or to 75mm whichever is the greater distance. In the case of reinforced concrete, the area shall be cut back to at least 25mm clear distance behind the reinforcement or to 75mm, whichever is the greater distance. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, a thin layer of cement grout shall be brushed on to the concrete surface in the cavity and it shall then be filled immediately with concrete of the same class as the main body but with aggregate larger than 20mm nominal size removed. A form shall be used against the cavity, provided with a lip to enable concrete to be placed. The form shall be filled to a point above the top edge of the cavity.

After seven days the lip of concrete shall be broken off and the surface ground smooth. Surface irregularities which are outside the limits of tolerance set out in Clause 710 shall be ground down in the manner and to the extent instructed by the Engineer.

Severe honeycombing and defects other than those mentioned above shall be dealt with as instructed by the Engineer.

#### **719. BENDING REINFORCEMENT**

Unless otherwise shown on the drawings, bending and cutting shall comply with SRN 129.

The Contractor shall satisfy himself as to the accuracy of any bar bending schedules supplied and shall be responsible for cutting, bending, and fixing the reinforcement in accordance with the drawings. Any discrepancies should be brought to the attention of the Engineer prior to ordering the reinforcement.

Bars shall be bent cold by the application of slow steady pressure. At temperatures below 5 degrees centigrade the rate of bending shall be reduced if necessary to prevent fracture of the steel.

After bending, bars shall be securely tied together in bundles or groups and legibly labelled as set out in SRN 129.

Reinforcement shall be thoroughly cleaned and all dirt, scale, loose rust, oil and other contaminants removed before it is placed in the Works.

#### **720. FIXING REINFORCEMENT**

Reinforcement shall be securely fixed in position within a dimensional tolerance of 20mm in any direction parallel to a concrete face and within a tolerance of 5mm at right angles to a face, provided that the cover is not thereby decreased below the minimum shown on the drawings, or if not shown shall be not less than 25mm or the diameter of the bar,

whichever is the greater. Cover on distribution steel shall not be less than 15mm or the diameter of the bar whichever is the greater.

Unless otherwise agreed by the Engineer, all intersecting bars shall either be tied together with 1.6mm diameter soft annealed iron wire and the ends of the wire turned into the body of the concrete or shall be secured with a wire clip of a type agreed by the Engineer.

Spacer blocks shall be used for ensuring that the correct cover is maintained on the reinforcement. Blocks shall be as small as practicable and of a shape agreed by the Engineer. They shall be made of mortar mixed in the proportions of one part of cement to two parts of sand. Wires cast into the block for tying into the reinforcement shall be 1.6mm diameter soft annealed iron.

Alternatively, another type of spacer block may be used subject to the Engineer's agreement.

Reinforcement shall be rigidly fixed so that no movement can occur during concrete placing. Any fixings made to the formwork shall not be within the space to be occupied by the concrete currently being placed.

No splices (laps) shall be made in the reinforcement except where shown on the drawings or agreed by the Engineer. Splice lengths shall be as shown on the drawings. Reinforcement shall not be welded except where required by the Contract or agreed by the Engineer. If welding is employed, the procedures shall be as set out in SRN 937 for gas welding or SRN 919 for metal arc welding. Full strength butt welds shall only be used for steel complying with SRN 126, and if used on high yield deformed bars complying with SRN 126 the permissible stresses in the vicinity of the weld shall be reduced to those applicable to plain bars complying with that Specification.

Mechanical splices shall not be used unless the Engineer agrees otherwise.

The Contractor shall ensure that reinforcement left exposed in the Works shall not suffer distortion, displacement or other damage. When it is necessary to bend protruding reinforcement aside temporarily, the radius of the bend shall not be less than four times the bar diameter for mild steel bars or six times the bar diameter for high yield bars. Such bends shall be carefully straightened before concrete placing continues, without leaving residual links or damaging the concrete around them. In no circumstances will heating and bending of high yield bars be permitted.

Bars complying with SRN 127 or other high tensile bars shall not be bent after placing in the Works.

Before concrete is placed in any section of the Works which includes reinforcement, the reinforcement shall be completely clean and free from all contamination including concrete which may have been deposited on it from previous operations.

The Engineer's approval for concrete placing is to be sought in writing for each pour, leaving adequate time to inspect and rectify any defects noted in the formwork, falsework, reinforcement, scaffolding, concreting arrangements, etc.

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## **721. MATERIALS FOR CONCRETE**

### **a) General**

The Contractor shall submit to the Engineer full details of all materials which he proposes to use for making concrete. No concrete shall be placed in the Works until the Engineer has approved the materials of which it is composed. Approved materials shall not thereafter be altered or substituted by other materials without the consent of the Engineer.

### **b) Cement**

Cement shall comply with the following Kenya Standards:-

- SRN 103 for Ordinary Portland cement.
- SRN 103 for Rapid Hardening Portland cement plus all special conditions to its use stipulated by the manufacturer.
- SRN 104 for Sulphate Resisting or High Alumina cement.

Cement shall be free flowing and free of lumps. It shall be supplied in the manufacturer's sealed unbroken bags or in bulk. Bagged cement shall be transported in vehicles with effective means of ensuring that it is protected from the weather.

Bulk cement shall be transported in vehicles or in containers specially built and equipped for the purpose.

Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well-ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it.

Each delivery of cement in bags shall be stacked together in one place. The bags shall be closely stacked so as to reduce air circulation but shall not be stacked against an outside wall. If pallets are used, they shall be constructed so that bags are not damaged during handling and stacking. No stack of cement bags shall exceed 3 metres in height. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stacks.

Cement from broken bags shall not be used in the Works.

Cement in bags shall be used in the order in which it is delivered.

Bulk cement shall be stored in weatherproof silos which shall bear a clear indication of the type of cement contained in them. Different types of cement shall not be mixed in the same silo.

The Contractor shall provide sufficient storage capacity on site to ensure that his anticipated programme or work is not interrupted due to lack of cement.

Cement which has become hardened or lumpy or fails to comply with the Specification in any way shall be removed from the site.

All cement for any one structure shall be from the same source.

All cement used in the Works shall be tested by the manufacturer or the Contractor in a laboratory acceptable to the Engineer. The tests to be performed shall be those set out in SRN 103 and the Contractor shall supply two copies of each certificate to the Engineer.

Each set of tests carried out by the manufacturer or Contractor shall relate to not more than one day's output of each cement plant and shall be made on samples taken from cement which is subsequently delivered to the site. Alternatively, subject to the agreement of the Engineer, the frequency of testing shall be one set of tests for every 200 tons of cement delivered to site from each cement plant.

Cement which is stored on site for longer than one month shall be re-tested in the laboratory of the Materials Branch of the Ministry of Transport & Communications or at the Kenya Bureau of Standards or at any other approved laboratory at the rate of one set of tests as shown in SRN 103 for every 200 tonnes, and at monthly intervals thereafter.

Cement which does not comply with the Specification shall not be used in the Works and it shall be disposed of by the Contractor.

The Contractor shall keep full records of all data relevant to the manufacture, delivery, testing and use of all cement used in the Works and shall provide the Engineer with two copies thereof.

**c) Fine Aggregate**

Fine aggregate shall be clean, hard and durable and shall be natural sand, crushed gravel sand or crushed rock sand complying with SRN 108. All the material shall pass through a 5mm standard sieve and the grading shall be in accordance with Zones 1, 2 or 3 of SRN 109. In order to achieve an acceptable grading, it may be necessary to blend materials from more than one source. Fine aggregate for mortar only shall comply with SRN 135.

The fine aggregate shall not contain iron pyrites or iron oxides. It shall not contain mica, shale, coal or other laminar, soft or porous materials or organic matter unless the Contractor can show by comparative tests, on finished concrete as set out in SRN 117, that the presence of such materials does not adversely affect the properties of the concrete.

Other properties shall be as set out below:

Content passing a 75-micron standard sieve shall not exceed 3 per cent for natural or crushed gravel sand or 15 per cent for crushed rock sand.

Chlorides soluble in a 10 per cent solution by weight of nitric acid shall not exceed 0.05 per cent by weight expressed as chloride ion when tested as set out in SRN 107, subject also to the further restriction given in the note on total chloride content in Clause 721 (d).

Sulphates soluble in a 10 per cent solution by weight of hydrochloric acid shall not exceed 0.4 per cent by weight expressed as SO<sub>3</sub>, when tested as set out in SRN 601, subject also to the further restriction given in the note on total sulphate content in Clause 721 (d).

Soundness: After five cycles of the test in AASHTO T104 or an approved equivalent, the aggregate shall not show a weight loss of more than 10 per cent.

Organic impurities: If the test for presence of organic impurities in aggregates described below shows that more than a trace of organic impurities is present, the fine aggregate shall not be used in the Works unless the Contractor can show by tests on finished concrete as set out in SRN 117 that the presence of organic impurities does not adversely affect the properties of the concrete.

Test for presence of organic impurities in aggregates:

This test is designed to indicate the presence of organic impurities in aggregates used for making concrete.

A 350-cc graduated bottle shall be filled to the 120-cc mark with a sample of the aggregate to be tested and a 3% solution of sodium hydroxide in water added until the volume of aggregate and liquid after shaking gives a total volume of 200 cc. The bottle shall be stoppered, shaken thoroughly and allowed to stand for 24 hours. If, after 24 hours, the colour of the solution is not darker than a pale brown, the aggregate under test may be deemed satisfactory.

**d) Coarse Aggregate**

Coarse aggregate shall be clean, hard and durable crushed rock, crushed gravel or natural gravel complying with the requirements of SRN 110. The material shall not contain any iron pyrites, iron oxides, flaky or laminated material, hollow shells, coal or other soft or porous material, or organic matter unless the Contractor can show by comparative tests on finished concrete as set out in SRN 117 that the presence of such materials does not adversely affect the properties of the concrete. The pieces shall be angular, rounded or irregular as defined in SRN 107.

Coarse aggregate shall be supplied in the nominal sizes called for in the Contract and shall be graded in accordance with SRN 111 for each nominal size.

Other properties shall be as set out below:-

The proportion of clay, silt and other impurities passing a 75-micron standard sieve shall not be more than one per cent by weight.

The content of hollow and flat shells shall be such as will not adversely affect the concrete quality when tested as set out in SRN 117.

The total content of aggregate shall not be more than the following:

- |                               |                  |
|-------------------------------|------------------|
| • 40mm nominal size and above | 2% of dry weight |
| • 20mm nominal size           | 5% of dry weight |

- 10mm nominal size 15% of dry weight

Chlorides soluble in a 10 per cent solution by weight of nitric acid shall not exceed 0.03 per cent by weight, expressed as chloride ion when tested as set out in SRN 107 but subject also to the further restriction under the note on total chloride content hereunder. Sulphates soluble in a 10 per cent solution by weight of hydrochloric acid shall not exceed 0.4 per cent by weight expressed as SO<sub>3</sub> when tested as set out in SRN 601 subject also to the further restriction given in the note on total sulphate content hereunder.

Soundness: After 5 cycles of the test in AASHO T104, the aggregate shall not show a weight loss of more than 12 per cent.

When tested in accordance with test C289 of the American Society for Testing of Materials, the aggregate shall be non-reactive.

Flakiness Index when tested in accordance with SRN 113 shall be as set out hereunder:

- For 40mm stone and above, not more than 40
- For 20mm stone and below, not more than 35

If the Flakiness Index of the coarse aggregate varies by more than five units from the average value of the aggregate used in the approved trial mix, then a new set of trial mixes shall be carried out if the workability of the mixes has been adversely affected by such variation.

Impact value: Not more than 45 percent when tested in accordance with SRN 107.  
Ten percent fines value: Not less than 50kN when tested in accordance with SRN 107.

Shrinkage: When mixed with other ingredients in the approved proportions for concrete and tested as set out in SRN 117, the shrinkage factor shall not exceed 0.05 percent.

Organic impurities: If the test for presence of organic impurities in aggregates shows that more than a trace of organic impurities is present, the aggregate shall not be used in the Works unless the Contractor can show by tests on finished concrete as set out in SRN 117 that the presence of organic impurities does not adversely affect the properties of the concrete.

Water absorption: The aggregate shall not have a water absorption of more than 2.5 percent when tested as set out in SRN 112.

Aggregate Crushing Value (ACV): Not more than 35 percent. Los Angeles Abrasion (LAA): Not more than 50 per cent.

**Note:** Total chloride and sulphate content:-

The total chloride content, expressed as chloride ion, arising from all ingredients in a mix including cement, water and admixtures shall not exceed the following limits, expressed as a percentage of the weight of cement in the mix:-

For prestressed concrete, steam cured concrete or concrete containing sulphate resisting or super sulphated cement: 0.05 percent.

For any other reinforced concrete: 0.3 percent in 95 percent of all test results provided no result is more than 0.5 percent.

The total sulphate content expressed as SO<sub>3</sub> of all the ingredients in a mix including cement, water and admixtures shall not exceed 0.4 per cent by weight of the aggregate or 4.0 percent of the weight of cement in the mix, whichever is the lesser.

**e) Testing Aggregates**

**i) Acceptance Testing**

The Contractor shall deliver to the Engineer samples containing not less than 50 kg of any aggregate which he proposes to use in the Works and shall supply such further samples as the Engineer may require. Each sample shall be clearly labelled to show its origin and shall be accompanied by all the information called for in SRN 107.

Tests to determine compliance of the aggregates with the requirements of Clause 721(c) and (d) shall be carried out by the Contractor in a laboratory acceptable to the Engineer. If the tested materials fail to comply with the Specification, further tests shall be made in the presence of the Contractor and the Engineer and acceptance of the material shall be based on such tests.

A material shall be accepted if not less than three consecutive sets of test results show compliance with the Specification.

**ii) Compliance Testing**

The Contractor shall carry out routine testing of aggregates for compliance with the Specification during the period that concrete is being produced for the Works. The tests set out below shall be performed on aggregates from each separate source on the basis of one set of tests for each day on which aggregates are delivered to site provided that no set of tests shall represent more than 250 tonnes of fine aggregate nor more than 500 tonnes of coarse aggregate, and provided also that the aggregates are of uniform quality. If the aggregate from any source is variable, the frequency of testing shall be increased as instructed by the Engineer.

- Grading SRN 107
- Silt and clay contents SRN 107
- Moisture content SRN 107
- Check on organic impurities

In addition to the above routine tests, the Contractor shall carry out the following tests at the frequencies stated:

Moisture content: As frequently as may be required in order to control the water content of the concrete as required by the Specification.



Chloride content: As frequently as may be required to ensure that the proportion of chlorides in the aggregates does not exceed the limit stated in the Specification.

The Contractor shall take account of the fact that when the chloride content is variable it may be necessary to test every load in order to prevent excessive amounts of chloride contaminating the concrete. For this purpose, the Contractor shall use the rapid field test (the QuanTab test). In the event of disagreement regarding the results of the field test, the chloride content of the aggregate shall be determined in the laboratory as described in SRN 107 (the Volhard test).

**f) Delivery and Storage of Aggregates**

Aggregates shall be delivered to site in clean and suitable vehicles. Different types or sizes of aggregate shall not be delivered in one vehicle.

Each type or size of aggregate shall be stored in a separate bin or compartment having a base such that contamination of the aggregate is prevented. Dividing walls between bins shall be substantial and continuous so that no mixing of types or sizes occurs.

The storage of aggregates shall be arranged so that as far as possible rapid drying out in hot weather is prevented in order to avoid sudden fluctuations in water content. Storage of fine aggregates shall be arranged so that they can drain sufficiently before use in order to prevent fluctuations in water content of the concrete.

**g) Water for Concrete and Mortar**

Sea water or brackish water containing more than 1,000 ppm chloride ion or 2,000 ppm sulphate ion shall not be used for mixing or curing concrete.

Water shall be clean and free from harmful matter and shall comply with the requirements of SRN 114.

The Contractor shall carry out tests in accordance with SRN 114 to establish compliance with the Specification.

If water for the works is not available from the Employer's supply the Engineer's approval must be obtained regarding the source of supply and manner of its use. Water to be used with cement or lime shall be free from salt, oil, alkali, organic matter, and other deleterious substances.

**h) Admixtures**

**i) General**

The use of the admixtures in concrete may be required under the Contract to promote special properties in the finished concrete or may be proposed by the Contractor to assist him to comply with the Specification.

In all cases the Contractor shall submit to the Engineer full details of the admixture he proposes to use and the manner in which he proposes to add it to the mix.



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The information provided shall include but not be limited to:-

- i. The typical dosage, the method of dosing and the detrimental effects of an excess or deficiency in the dosage.
- ii. The chemical names of the main active ingredients in the admixture.
- iii. Whether or not the admixture contains chlorides, and if so, the chloride ion content expressed as a percentage by weight of admixture.
- iv. Whether the admixture leads to the entrainment of air when used at the manufacturer's recommended dosage, and if so, the extent to which it does so.
- v. Details of previous uses of the admixture in Kenya.

The chloride ion content of any admixture shall not exceed 2 per cent by weight of the admixture nor 0.03 per cent by weight of the cement in the mix.

Admixtures shall not be mixed together without the consent of the Engineer

Calcium chloride or admixtures containing calcium chloride shall not be used in prestressed concrete.

## **ii) Workability Agents**

Workability agents shall comply with SRN 149 and shall not have any adverse effect on the properties of the concrete.

## **i) Reinforcement Steel**

Reinforcement which shall comply with the following Standards, covers plain and deformed bar reinforcement and steel fabric to be cast into concrete in any part of the Works but does not include prestressing tendons or any other embedded steel.

- SRN 126 for hot rolled plain bar and high yield deformed bar
- SRN 127 for cold worked steel bar
- SRN 128 for steel mesh fabric

All reinforcement shall be from an approved manufacturer and, if required by the Engineer, the Contractor shall submit a test certificate from the manufacturer.

All reinforcement for use in the Works shall be tested for compliance with the appropriate British Standard in a laboratory acceptable to the Engineer and two copies of each test certificate shall be supplied to the Engineer. The frequency of testing shall be as set out in the relevant Standard.

In addition to the testing requirements described above, the Contractor shall carry out additional tests as instructed by the Engineer.

Any reinforcement which does not comply with the Specification shall be removed from site.

All reinforcement shall be delivered to site either in straight lengths or cut and bent. No reinforcement shall be accepted in long lengths which have been

transported bent over double.

Any reinforcement which is likely to remain in storage for a long period shall be protected from the weather so as to avoid corrosion and pitting. All reinforcement which has become corroded or pitted to an extent which, in the opinion of the Engineer, will affect its properties shall either be removed from site or may be tested for compliance with the appropriate Standard at the Contractor's expense.

### **Dowel Bars**

Dowel bars and tie bars shall consist of mild steel, or deformed bars of high yield steel all complying with SRN 126 and they shall be free from oil, paint other than bond-breaking compound, dirt, loose rust and scale.

Dowel bars and tie bars shall be of sizes as shown on the drawings and directed by the Engineer, and shall be straight, free from burred edges, or other irregularities and shall have their sliding ends sawn or, if approved, sheared.

Bond breaking compound for dowel bars shall consist of 66 per cent of 200 pen bitumen blended hot with 14 per cent light creosote oil and, when cold, brought to the consistency of paint by the addition of 20 per cent solvent naphtha or other approved compound meeting the following requirements.

- i) It shall not retard or in any other way affect the setting of concrete.
- ii) The average bond stress on bars coated with the compound with half their length cast into concrete specimens and subject to pull out tests at 7 days shall not exceed 0.14 newtons per square millimetre and the total movement of the dowel bar relative to the concrete shall not be less than 0.25 millimetres at that stress. The concrete specimens shall be 150 millimetres by 150 millimetres in section and 0.45 metre long and made with the same mix proportions as used in the Works.

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## **8. FORMWORK**

### **801. FORMWORK FOR CONCRETE**

#### **Definitions**

Formwork means the surface against which concrete is placed to form a face, together with all the immediate supports to retain it in position while concrete is placed.

Falsework means the structural elements supporting both the formwork and the concrete until the concrete becomes self-supporting.

A formed face is one which has been cast against formwork.

An exposed face is one which will remain visible when construction has been completed.

### **802. CONSTRUCTION OF FORMWORK AND FALSEWORK**

Before construction begins, the Contractor shall submit to the Engineer, drawings showing details of the proposed formwork and falsework.

Formwork and falsework shall be so constructed that they will support the loads imposed on them by the fresh concrete together with additional stresses imposed by vibrating equipment and by construction traffic, so that after the concrete has hardened the formed faces shall be in the positions shown on the drawings within the tolerances set out in Clause 806.

Ground supports shall be properly founded on footings designed to prevent settlement. Joints in formwork for exposed faces shall, unless otherwise specified, be evenly spaced and horizontal or vertical and shall be continuous or form a regular pattern.

All joints in formwork including formwork for construction joints shall be tight against the escape of cement, water and fines. Where reinforcement projects through formwork, the form shall fit closely round the bars.

Formwork shall be so designed that it may be easily removed from the work without damage to the faces of the concrete. It shall also incorporate provisions for making minor adjustments in position if required, to ensure the correct location of concrete faces. Due allowance shall be made in the position of all formworks for movement and settlement under the weight of fresh concrete.

Where overhangs in formwork occur, means shall be provided to permit the escape of air and to ensure that the space is filled completely with fully compacted concrete.

Formwork shall be provided for concrete surfaces at slopes of 30 degrees to the horizontal or steeper. Surfaces at slopes less than 20 degrees may be formed by screeding. Surfaces at slopes between 20 degrees and 30 degrees shall generally be formed unless the Contractor can demonstrate to the satisfaction of the Engineer that such slopes can be screeded with the use of special screed boards to hold the concrete in place during vibration.

Horizontal or inclined formwork to the upper surface of concrete shall be adequately secured against uplift due to the pressure of fresh concrete. Formwork to voids within the body of the concrete shall also be tied down or otherwise secured against floating.

The internal and external angles on concrete surfaces shall be formed with fillets and chamfers of the sizes shown on the drawings unless otherwise instructed by the Engineer.

Supports for formwork for non-water retaining structures may be bolted to previously placed concrete provided the type of bolt used is acceptable to the Engineer. If metal ties through the concrete are used in conjunction with bolts, the metal left in shall not be closer than 50mm to the face of the concrete.

Supports for formwork for water retaining structures may be bolted to previously placed concrete provided the type of bolts and positions of fixing are acceptable to the Engineer. After concreting the Contractor shall remove all support bolts and seal all holes with well rammed cement/sand mortar containing approved waterproofing cement additive. Metal ties which would be left in the concrete shall not be permitted.

Formwork shall not be re-used after it has suffered damage which in the opinion of the Engineer is sufficient to impair the finished surfaces of the concrete.

Where circumstances prevent easy access within the form for cleaning and inspection, temporary openings for this purpose shall be provided through the formwork.

Shear keys shall be provided in all construction joints of the size and shape indicated on the drawings.

Where precast concrete elements are specified for use as permanent formwork or proposed by the Contractor and agreed by the Engineer, they shall comply with the requirements of the Specification. Such elements shall be set true to line and level within the tolerances prescribed for the appropriate class of finish in Clause 506 and fixed so that they cannot move when concrete is placed against them.

### **803. PREPARATION OF FORMWORK**

Before any reinforcement is placed into position within formwork, the latter shall be thoroughly cleaned and then dressed with a release agent. The agent shall be either a suitable oil incorporating a wetting agent, an emulsion of water suspended in oil or a low viscosity oil containing chemical agents. The Contractor shall not use an emulsion of oil suspended in water nor any release agent which causes staining or discoloration of the concrete, air holes on the concrete surface, or retards the set of the concrete.

In order to avoid colour difference on adjacent concrete surfaces, only one type of release agent shall be used in any one section of the works.

In cases where it is necessary to fix reinforcement before placing formwork, all surface preparation of formwork shall be carried out before it is placed into position. The Contractor shall not allow reinforcement or prestressing tendons to be contaminated with formwork release agent.

Before placing concrete all dirt, construction debris and other foreign matter shall be

removed completely from within the placing area.

Before concrete placing commences, all wedges and other adjusting devices shall be secured against movement during concrete placing and the Contractor shall maintain a watch on the formwork during placing to ensure that no movement occurs.

#### 804. REMOVAL OF FORMWORK

Formwork shall be carefully removed without shock or disturbance to the concrete. No formwork shall be removed until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.

The minimum periods which shall elapse between completion of placing concrete and removal of forms are given in Table 8-1 and apply to ambient temperatures higher than 10 degrees centigrade. At lower temperatures or if cement other than ordinary Portland are involved, the Engineer may instruct that longer periods be used.

Alternatively, formwork may be removed when the concrete has attained the strength set out in Table 8-1, provided that the attained strength is determined by making test cubes and curing them under the same conditions as the concrete to which they refer.

Compliance with these requirements shall not relieve the Contractor of his obligation to delay removal of formwork until the removal can be completed without damage to the concrete.

**Table 8-1 Minimum Periods for Formwork Removal**

Position of Formwork	Min. Period for temp over 10 Degrees Centigrade	Strength to be attained
Vertical or near vertical faces of mass concrete	24 hours	0.2 C
Vertical or near vertical faces of reinforced walls, beams and columns	48 hours	0.3 C
Underside of arches, beams and slabs (formwork only)	4 days	0.5 C
Supports to underside of arches, beams and slabs	14 days	C
Arched linings in tunnels and underground works	24 hours	4 N/mm <sup>2</sup>

**Note:** C is the nominal strength for the class of concrete used.

If the Contractor wishes to strip formwork from the underside of arches, beams and slabs before the expiry of the period for supports set out above, it shall be designed so that it can be removed without disturbing the supports. The Contractor shall not remove supports temporarily for the purpose of stripping formwork and subsequently replace them.

As soon as the formwork has been removed, bolt holes in concrete faces other than construction joints which are not required for subsequent operations shall be completely filled with mortar sufficiently dry to prevent any slumping at the face. The mortar shall

be mixed in the same proportions as the fine aggregate and cement in the surrounding concrete and with the same materials and shall be finished flush with the face of the concrete.

## **805. SURFACE FINISHES ON FORMED SURFACES**

### **Classes of Finish**

The surface finish to be achieved on formed concrete surfaces shall be as shown on the drawings and defined hereunder:-

#### **a) Class F1 Finish**

This finish is for surfaces against which backfill or further concrete will be placed. Formwork may be sawn boards, sheet metal or any other suitable material which will prevent the loss of fine material from the concrete being placed.

#### **b) Class F2 Finish**

This finish is for surfaces which are permanently exposed to view but where the highest standard of finish is not required. Forms to provide a Class F2 finish shall be faced with wrought thickened tongued and grooved boards with square edges arranged in a uniform pattern and close jointed or with suitable sheet material. The thickness of boards or sheets shall be such that there shall be no visible deflection under the pressure exerted by the concrete placed against them. Joints between boards or panels shall be horizontal and vertical unless otherwise directed. This finish shall be such as to require no general filling of surface pitting, but fins, surface discoloration and other minor defects shall be remedied by methods agreed by the Engineer.

#### **c) Class F3 Finish**

This finish is for surfaces which will be in contact with water flowing at high velocity, and for surfaces prominently exposed to view where good appearance is of special importance. To achieve this finish, which shall be free of board marks, the formwork shall be faced with plywood complying with B.S. 1088 or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features or changes in direction of the surface.

All joints between panels shall be vertical and horizontal unless otherwise directed. Suitable joints shall be provided between sheets to maintain accurate alignment in the plane of the sheets. Unfaced wrought boarding or standard steel panels will not be permitted for Class F3 finish. The Contractor shall ensure that the surface is protected from rust marks, spillages and stains of all kinds.

#### **d) Curved Surfaces**

For curved surfaces where F2 or F3 finishes are called for, the formwork face shall be built up of splines cut to make a tight surface which shall then be dressed to produce the required finish.

Alternatively, single curvature surfaces may be faced with plastic or plywood linings attached to the backing with adhesive or with escutcheon pins driven flush. Linings shall not bulge, wrinkle or otherwise deform when subjected to

temperature and moisture changes.

## 806. TOLERANCES

All parts of formed concrete surfaces shall be in the positions shown on the drawings within the tolerances set out in Table 8-2.

In cases where the drawings call for tolerances other than those given in Table 8-2 the tolerances shown on the drawings shall take precedence.

Where precast units have been set to a specified tolerance, further adjustments shall be made as necessary to produce a satisfactory straight or curved line. When the Engineer has approved the alignment, the Contractor shall fix the units so that there is no possibility of further movement.

**Table 8-2 Tolerances**

Class of Finish	Tolerances in mm (See Note)		
	A	B	C
F1	10	10	+ 25 to - 10
F2	5	10	+ or - 15
F3	2	5	+ or - 10

**Note:** The tolerances A, B and C given in the table are defined as follows:

1. Column A is an abrupt irregularity in the surface due to misaligned formwork or defects in the face of the formwork.
2. Column B is a gradual deviation from a plane surface as indicated by a straight edge 3m long. In the case of curved surfaces, the straight edge shall be replaced by a correctly shaped template.
3. Column C is the amount by which the whole or part of a concrete face is displaced from the correct position shown on the drawings.

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## **9. MASONRY**

### **901. GENERAL**

All masonry work shall be constructed from building stone as specified in Clause 1007.

For culvert headwalls and other small works, the stone shall, unless otherwise specified, be rough dressed. For walls, facing and other exposed works the stone shall unless otherwise specified, be medium chisel dressed.

### **902. WORKMANSHIP**

The Contractor shall provide and use proper setting out rods for all work.

Stones shall be well soaked before use and the tops of walls shall be kept wet as the work proceeds. The stones shall be properly bonded so that no vertical joint in a course is within 115mm of a joint in the previous course. Alternate courses of walling at angles and intersections shall be carried through the full thickness of the adjoining walls. All perpendics, reveals and other angles of the walling shall be built strictly true and square.

The stones shall be bedded, jointed and pointed in 1:3 cement: sand mortar in accordance with Clause 1009 with beds and joints 9mm thick flushed up and grouted solid as the work proceeds.

All masonry work shall be cured in accordance with the relevant requirements to acceptable International Standards and/or as directed by the Engineer.

### **903. CAST STONWORK**

Cast stone shall be as specified in Clause 1008. Facing stones shall be brought up in courses to a height not exceeding 1 metre at a time, the concrete backing being then brought up and well incorporated into and round the backs of the stones and the projecting metal ties to ensure a complete bond. The stones shall be bedded and jointed as shown on the drawings.

All materials, moulds, mixing, casting and surface treatment, setting, jointing and pointing, and all cantering, scaffolding and labour required to complete the cast stonework specified or as shown on the drawings, shall be included in the rates for such work.



## **10. MISCELLANEOUS ITEMS AND MATERIALS**

### **1001. GENERAL**

The approval in writing or otherwise by the Engineer of any materials shall not in any way whatsoever relieve the Contractor from any liability or obligation under the Contract and no claim by the Contractor on account of the failure, insufficiency or unsuitability of any such materials will be entertained.

- a) All items shall be suitable for water works purposes and for use with cold water installation and operation being in a tropical climate.
- b) All items hereinafter specified shall be to such other Standard or Specification which in the opinion of the Engineer provides for a quality of material and workmanship not inferior to the Standard Reference Number (SRN) quoted. The Standard or Specification must be submitted to the Engineer for approval before commencement of work.
- c) All ferrous pipes and fittings shall be coated with a protective paint suitable for use in and transport through a tropical climate.
- d) The Contractor shall supply to the Employer a certificate stating that each item supplied has been subjected to the tests hereinafter laid down and conforms in all respects to the said Specification.
- e) The Contractor shall provide adequate protection to all piping, flanged items and valves so as to guard effectively against damage in transit and storage and ingress of foreign matter inside the valves.
- f) All pipework and fittings shall be subjected to a works hydrostatic test pressure which shall be not less than twice the maximum operating pressure.
- g) The Contractor should exercise diligence to provide the best material.
- h) Where applicable the manufacturer's Specification should accompany all offers. The name of the manufacturer must in every case be stated.
- j) Where necessary the Contractor shall provide rubber gaskets to comply with SRN 208 and all other bolts, nuts, washers, etc. to undertake jointing at fittings etc.
- k) Any articles required under this Contract which are found to be faulty due to a crack, flaw or any other reason or is not in accordance with the Specification stipulated will not be accepted nor will the Employer be liable for any charges in respect of such an article. Where any such rejected article can, in the opinion of the Engineer, be rendered usable, the Contractor may deal with it accordingly and include it in the Contract at a price to be mutually agreed. Straight pipes which have been cut will be accepted at the discretion of the Engineer, provided the length is not less than 4 metres or two thirds of the standard length

whichever is the lesser and will be priced pro-rata.

- 1) Wherever possible, samples of pipes and fittings shall be submitted for approval of the Engineer prior to the Contractor obtaining the total requirements.

#### **1002. SUBMISSION OF SAMPLES**

As soon as possible after the contract has been awarded, the Contractor shall submit to the Engineer a list of the suppliers from whom he proposes to purchase the materials necessary for the execution of the Works. Each supplier must be willing to admit the Engineer or his representatives, to his premises during ordinary working hours for the purpose of obtaining samples of the materials in question. Alternatively, if desired by the Engineer, the Contractor shall deliver the samples of the materials to the Engineer's office without charge.

The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no source of supply shall be changed without the Engineer's prior approval once a supplier, source or material has been approved.

Samples of materials approved will be retained at the Engineer's office until the completion of the contract. Samples may be tested to destruction.

All materials delivered to site must be at least equal in all respects to approved samples, otherwise they shall be rejected. No special payment will be made for compliance with clauses specifying tests etc. to ensure quality control etc. unless specifically itemised in Bills of Quantities.

#### **1003. ARCHITRAVES AND STOPS**

Architraves and stops shall be Class 1 Mvuli matching to the frames and linings.

#### **1004. BLOCKWORK**

Building blocks shall be dense concrete blocks complying with the requirements of B.S. 2028, 1364, with faces for plastering and having a compressive strength of 14 N/mm<sup>2</sup>. (Table 2, Type A14).

Blocks shall be obtained from an approved manufacturer and shall be equal to sample blocks previously approved by the Engineer's Representative.

Blocks shall be carefully handled and stored on site and protected from the weather at all times.

Surfaces on which blockwork is to be built shall be kept clean. Blocks shall be well wetted before being laid and the tops of walls where blockwork has been left shall be well wetted before re-commencing. Blockwork shall be built plumb, true to line and level, with all perpends vertical and in line. Blocks shall be built in half bond and alternate courses shall be block bonded at all junctions, no cut block shall be less than half a block. Joints in concrete blockwork shall be well filled with gauged mortar and shall not exceed 10mm in width.

#### **1005. BOLTS AND NUTS**

Bolts and nuts shall comply with the relevant requirements of the British Standards as set

out below:-

Black Hexagon Bolts, Screws and Nuts	B.S. 4190, Grade 4.6
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Metal Washers for General Purpose	B.S. 4320
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Black Cup and Countersunk Head Bolts and Screws with Nuts	B.S. 4993
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The items shall preferably have coarse metric threads but items with B.S.W. threads may be used. Bolt lengths shall be sufficient to ensure that nuts are full threaded when tightened in their final position.

#### **1006. BONDING TIES**

Bonding ties shall be 75mm wide x 250mm long galvanized bitumen-coated expanded metal strip, cast 100mm into concrete surfaces in contact with block work. The bonding tie used shall be approved by the Engineer's Representative.

#### **1007. BUILDING STONE**

All building stone shall be capable of withstanding when wet a crushing stress of 3.5 N/mm<sup>2</sup>. The source of stone shall be approved by the Engineer and stone supplied therefrom shall be free from Magadi, overburden, mudstone, cracks, sand holes, veins, laminations or other imperfections.

The stone shall be chisel dressed into true rectangular blocks, with each surface even and at right angles to all adjoining surfaces, to the size specified. For exposed stonework the maximum permissible variation of any of the specified dimensions shall be 6mm provided that cut stone, supplied as 'rock face' stone may be hammer dressed on one face only, or on one face and one end, if in other respects it conforms with this specification. Stones shorter than 375mm will not be accepted.

Unless the Engineer allows otherwise the Contractor shall at his own expense provide and dress four 100mm cubes of stone for testing.

The stone shall be sound when tested in accordance with SRN 870 except that:-

- i) The treatment shall be repeated for 10 cycles only; and
- ii) The second criterion of failure shall be amended to allow for a loss of weight of not more than 20% of its original weight.

#### **1008. CAST STONE**

Cast stone shall be manufactured by an approved manufacturer to the shapes and dimensions shown on the drawings and shall conform to the requirements of SRN 871: Cast Stone. It shall have a dense and even surface of the texture and colour detailed on the drawings or required by the Engineer. Where indicated exposed faces of the stone shall be formed of a specially graded mix. Metal bond ties of approved manufacture shall be cast in with the stone as shown on the drawings. Samples of the completed stone shall be submitted for the Engineer's prior approval.

All stones shall be protected from damage during transport and erection by means of cement slurry coatings or by other approved methods.

**1009. CEMENT GROUT**

Cement grout shall consist of Portland Cement and water mixed in the proportion of one part by volume of cement and one and a half parts by volume of water. The grout shall be used within one hour of mixing.

**1010. CEMENT MORTAR**

Cement mortar shall consist of proportions by volume as specified of Portland Cement and natural sand or crushed natural stone or a combination of both as specified in SRN 135 and SRN 136: Building Sands from Natural Sources. The constituent materials shall be accurately gauged and mixed in an approved manner.

Cement mortar shall be made in small quantities only as and when required, and any mortar which has begun to set or which has been mixed for a period of more than one hour shall be rejected.

**1011. CEMENT-LIME MORTAR**

Cement-lime mortar shall consist of Portland Cement, hydrated lime and natural sand or crushed natural stone or a combination of both, as specified for cement mortar in Clause 712. The constituent materials shall be accurately gauged and mixed by volume in an approved manner in the proportions specified.

Cement-lime mortar shall be made only in small quantities as and when required. Any mortar which has begun to set or which has been mixed for a period of more than two hours shall be rejected.

**1012. CONCRETE BLOCKS**

Solid and hollow concrete blocks for walling shall comply with SRN 804 in every respect.

All solid and hollow concrete blocks used in the walling must be capable of withstanding a crushing pressure of not less than 0.35 kg per square millimetre after 28 days. The blocks shall be cast in Metric sizes.

**1013. CONCRETE DRAIN INVERT BLOCKS**

Precast concrete invert blocks shall be manufactured to the detail drawings supplied from concrete Class 20/10 as specified in Table 7.2 using maximum 12mm size aggregates. If required, cube test certificates shall be supplied by the manufacturer.

**1014. CONCRETE SLABS FOR OPEN DRAINS**

Precast concrete slabs for lining open drains shall be manufactured to the detail drawings supplied from concrete Class 20/10 as specified in Table 7.2 using maximum 12mm size aggregates. If required, cube test certificates shall be supplied by the manufacturer.

**1015. DAMP-PROOF COURSE (D.P.C.)**

Hessian based metal cored bitumen for damp-proof courses shall be lead cored, complying

with B.S. 743 paragraph 4, type D, weighing not less than 4.4 kg. per square metre. Damp-proof course shall be bedded horizontally in mortar as for blockwork with 115mm laps in length and full laps at angles.

#### **1016. DOORS**

Internal doors shall be hardwood framed solid cored flush doors constructed in accordance with B.S. 459 Part 3, faced both sides with 3mm thick Mvuli veneered plywood and lipped all round with matching hardwood lipping. Moisture content at delivery shall be 12% (+ or - 2%).

#### **1017. ELECTRICAL INSTALLATION**

The electrical installations will be carried out by Licensed Electrician and complying with the following:-

- a) Regulations for Electrical Equipment of Buildings issued by the Institution of Electrical Engineers.
- b) Electric Power Act.
- c) The Kenya Power Company's Byelaws.
- d) Relevant current British Standards and Codes of Practice.
- e) All the relevant clauses in this Specification.

#### **1018. FIRE HYDRANTS**

Fire hydrants shall be in accordance with SRN 509. They shall be for installation underground and shall be in accordance with SRN 509.

The spindle shall be provided with a universal cast iron cap conforming to SRN 501.

The spindle of the fire hydrant shall be of the non-rising type and screwed so as to close the hydrant when rotated in a clockwise direction viewed from above. The direction of closing shall be clearly cast on the valve cap.

The flanged outlet of the outlet bend shall have a Bayonet Joint Outlet for a 80mm standpipe. The outlet of the hydrant shall be of the hooked type with hooks 112mm apart.

The outlet shall have a gun metal standpipe seating and be covered by a loose cast iron cap which shall be attached to the hydrant by means of a chain. Both flanges shall be 80mm drilled to requirements of SRN 207.



**Figure 10-1 Fire Hydrant Fitting**

The outlet bends shall be subject to a hydrostatic test in accordance with procedure set out in SRN 509.

#### **1019. FIXING IRONMONGERY**

The rates for supplying and fixing ironmongery shall include for all sinking, cutting, boring, mortising etc., making good, replacing damaged screws, oiling, adjusting and leaving in good working order and for mastering all keys.

#### **1020. FIXING JOINERY**

Doors shall be hung on one or one and a half pairs of butt hinges to give a maximum even tolerance of 2mm all round.

Sub-frames shall be fixed to blockwork with three fixing clamps per side and one dowel let 50mm into the floor and 50mm into the foot of each leg. Linings shall be fixed after completion of other finishings by means of screwing and pelleting to sub-frames with matching hardwood pellets. Architraves and stops shall be pinned on, heads punched and filled with tinted filler.

#### **1021. FRAMES AND LININGS**

Door frames and linings shall be Class 1 Mvuli mortice and tenon jointed at angles. Sub-frames for internal doors shall be Class 1 Mvuli tongued at angles.

#### **1022. GABIONS**

Gabions shall be of the hexagonal wire mesh type, with mesh dimensions of 80 mm x 100 mm. The minimum dimension shall not exceed 83 mm. Wire shall be galvanised prior to weaving the mesh to resist corrosion from water.

All wire used in the fabrication of the gabion and in the wiring operation during construction shall be in accordance with BS 1052/1980 Mild Steel wire appended having a tensile strength of 38-50 kg/mm<sup>2</sup>

All wire shall be galvanised to BS 443: 1982 'Zinc coatings on steel wire' with the minimum weight of Zinc coating in accordance with Table below.

Diameter	Minimum Weight of Coating
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Mesh wire	2.7	260
Binding and connecting wire	2.2	240
Selvedge wire	3.4	275

All wire used in the fabrication of gabions and in the wiring operations during construction shall, after galvanising, have extruded onto it a coating of polyvinyl chloride compound referred to as PVC. The coating shall be black in colour, not less than 0.4 mm thickness and shall be capable of resisting deleterious effects of exposure.

Gabions shall be of the following standard sizes:

2m x 1m x 0.5m

2m x 1m x 1m

6m x 2m x 0.3m

Gabions shall be provided with diaphragms to divide the boxes in compartments with a maximum dimension in any direction of 1m.

Joints shall be flexible and shall consist of not less than one and a half full turns of wire, at each mesh point of the joint line.

Gabions shall be as manufactured by Maccaferri, or equivalent. Alternative materials shall be subject to the approval of the Engineer.

Rockfill for gabions shall consist of hardcore i.e., sound hard stone or broken rock. The maximum size shall be 220mm, and the minimum size shall be 120mm; however, up to 10% of some smaller blinding material (min. 75mm) to fill the internal voids between the bigger rocks will be allowed.

Gabions shall be placed in their final positions prior to filling with rock and shall then be tied together and filled with rock. After filling with rock, the tops shall be closed and securely tied with connecting wire. The larger rocks shall be placed on the upper face of the gabion in order to present a reasonably closed surface. All assembly, erection, stretching, filling with rock and final filing shall be in accordance with the instructions as issued by the manufacturer.

### **1023. GALVANISED WORK**

Iron and steel, where galvanized, shall comply with B.S. 729, entirely coated with zinc after fabrication by complete immersion in a zinc bath in one operation and all excess carefully removed. The finished surface shall be clean and uniform.

### **1024. GULLY GRATINGS AND FRAMES**

Gully gratings and frames shall be basically in accordance with the requirements of SRN 846, nominal size 500mm x 350mm except that the gully gratings shall be constructed of mild steel concrete filled in accordance with the standard detail drawings.

Where indicated as being kerb inlet type, the gullies shall conform to the shape and dimensions given on the detail drawings supplied, but in respect of materials and workmanship conform to SRN 846.



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**1025. HARDWOOD**

Hardwood for joinery shall be sound, well-conditioned and seasoned Mvuli complying with the requirements of B.S. 1186 Part 1, Class 1. A sample of each representative section for use in the work shall be previously submitted by the Contractor for approval by the Engineer's Representative. Moisture content shall be 12% (+ or - 2%).

**1026. HYDRATED LIME**

Hydrated lime shall comply with SRN 801: Building Limes and shall be of the semi-hydrated type.

**1027. IRONMONGERY**

All ironmongery shall be obtained from a source approved by the Engineer's Representative. Samples shall be submitted before ordering and the articles ordered shall match up with the approved samples. Screws of a like metal shall be used for all fittings.

**1028. JOINERY**

All exposed joiner's work shall have wrought faces. The prices of all joiner's work shall include for slightly rounded arises.

Where the term 'framing' or 'framed' is made use of, it shall be understood to mean all halving's, dovetails, tenons and hardwood pins and the best-known means of putting the work together.

All framed work shall be put together loosely and stacked under cover where a free current of air can circulate and is not to be wedged and glued until it is required for fixing.

All joinery, when brought on the works, shall be stacked under cover.

The Engineer or his representative, shall have full right of access to the joinery works and power to condemn any work not approved and any approval expressed or implied is not to relieve the Contractor from his responsibility and liability to make good any shrinkage or other defects that may appear after the work is fixed.

All joinery to be painted shall be knotted and primed.

The Contractor shall provide all materials, labour, framing, fixing, etc., nails, screws and everything necessary for the proper execution and completion of the work.

**1029. JOINT PRIMER**

Joint priming compound shall be entirely in accordance with the manufacturer's recommendations for the joint sealant to be used.

**1030. JOINT SEALING COMPOUND**

Poured joint sealing material shall consist of an approved rubber-bitumen compound, complying with the requirements of SRN 879, or a two component, cold applied compound complying with SRN 879 as stated in the Bill of Quantities. Test Certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the material does in fact comply in respect of cone penetration, flow and bond with the under-mentioned



requirements:

**Table 10-1 Joint Sealing Compound Requirements**

<u>Test Cone Penetration</u>	<u>Hot-poured Materials</u>	<u>Cold-poured Materials</u>
0.15 kg. for 5 secs. at 25 <sup>0</sup> centigrade using standard grease cone	Penetration not to exceed 9mm	Penetration to be not less than 5mm not more than 27.5mm
<u>Flow</u>		
On a plane inclined at 75 <sup>0</sup> to the horizontal, 5 hours at 60 <sup>0</sup> centigrade	Flow not to exceed 5mm	Flow not to exceed 20mm
<u>Bond</u>		
25mm wide joint extended 12mm at rate of 4mm per hour at 18 <sup>0</sup> centigrade. No more than one specimen in three to develop a crack separation or other opening more than 4mm deep	Five cycles of extension and recompression	Three cycles of extension and recompression

Approved hot-poured materials shall also comply with a requirement whereby when heated for a period of 6 hours at a temperature of 80 degrees centigrade above recommended pouring temperature or 30 degrees centigrade below the safe heating temperature whichever is the greater shall still comply with the flow requirements of this clause.

In addition to materials complying with SRN 879, the Engineer may approve the use of alternative materials provided that they meet the requirements of this clause relating to cold-poured joint sealing compounds.

### **1031. LIME MORTAR**

Lime mortar shall consist of proportions by volume as specified of hydrated lime and naturals and/or crushed natural stone or a combination of both as specified for cement mortar in Clause 1010. The constituent materials shall be accurately gauged and mixed in an approved manner.

### **1032. MANHOLE COVERS AND FRAMES**

Manhole covers and frames shall be basically in accordance with the requirements of SRN 846: Cast Manhole Covers, Road Gully Gratings and Frames for Drainage Purposes except that the manhole covers shall be constructed of mild steel, concrete filled, in accordance with the standard detail drawings.

Foul water sewer manholes shall have triangular Grade "A" heavy duty covers and frames. Circular manhole covers and frames shall be used on surface water sewer manholes.

### **1033. MANHOLE STEP IRONS**

Step irons of general-purpose type shall comply in all respects with SRN 845: Malleable Step Irons.

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#### **1034. MARKER AND INDICATOR POSTS**

Marker posts shall be erected at changes in direction of water mains as directed by the Engineer. Indicator posts shall be erected at valves and other fittings as directed. Marker and indicator posts shall be embedded in concrete as shown on drawings and shall be vibrated precast reinforced concrete as per dimensions shown on drawings. They should be painted in colours as indicated on the drawings.

#### **1035. MURRAM**

Murram shall be from an approved source quarried so as to exclude vegetable matter, loam, topsoil or clay. The California Bearing Ratio of the murram, as determined for a sample compacted to maximum density (as defined under SRN 601) and allowed to soak in water for four days, shall not be less than 30%. This C.B.R. is a guide to quality only and the compaction in the work will be judged by density.

#### **1036. PAINTS**

All priming, undercoating and finishing paints shall be in accordance with SRN 877 or SRN 878 as appropriate.

The painting of all building works shall comprise a special paint recommended for external work while all other paints, plastic emulsion coating etc. are to be of an approved manufacturer. All paints, distempers etc. shall be delivered on site intact in the original drums or tins and shall be mixed and applied in accordance with the manufacturer's printed directions. The only addition which will be allowed to be made will be liquid thinners, driers etc. supplied by the makers for the purpose.

All surfaces must be thoroughly cleaned down prior to painting and decorating work and no external painting shall be carried out in rainy weather. All paint must be thoroughly well worked on and excess of paint in any coat must be avoided.

All colours will be selected by the Engineer from the standard range of colours.

#### **1037. PENSTOCKS**

Cast iron penstocks shall be all in accordance with SRN 906 and SRN 916. Seating faces shall be gun metal or bronze.

Spindles shall be threaded as necessary and non-rising unless otherwise specified. Spindles shall be of aluminium bronze; manganese bronze and extension spindles may be of mild steel.

Handwheels shall be of cast iron and words "OPEN" and "SHUT" marked on upper side with appropriate direction arrows.

#### **1038. PLYWOOD**

Plywood generally shall comply with B.S. 1455. That from sources not included in B.S. 1455 shall be of corresponding grades of veneers and types of bonding. Plywood for flush doors shall be Grade I Mvuli veneered.

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### **1039. PRECAST CONCRETE GULLIES**

Precast concrete gullies shall be unreinforced and shall comply with the requirements of SRN 854: Concrete Cylindrical Pipes and Fittings including Manholes, Inspection Chambers and Street Gullies.

### **1040. PRECAST CONCRETE MANHOLES AND INSPECTION CHAMBERS**

Precast concrete manholes and inspection chambers shall comply with the requirements of SRN 854: Concrete Cylindrical Pipes and Fittings including Manholes, Inspection Chambers and Street Gullies, and they shall carry the relevant Standard Institution registered certification trademark, or test certificates shall be furnished by the manufacturer.

### **1041. PRECAST CONCRETE UNITS**

Precast concrete covers to be precast units for use in the works, whether instructed under the Contract or proposed by the Contractor.

#### **a) Formwork for Precast Units**

Moulds shall be so constructed that they do not suffer distortion or dimensional changes during use and are tight against loss of cement grout or fines from the concrete.

Moulds shall be set up on firm foundations so that no settlement occurs under the weight of the fresh concrete.

Moulds shall be constructed so that units may be removed from them without sustaining any damage.

Release agents used for demoulding shall not stain the concrete or affect its properties in any way.

#### **b) Reinforcement for Precast Units**

Reinforcement in precast units shall comply with the requirement of Clauses 721 i) and 719-720. When preformed cages are used the cages shall be made up on jigs to ensure dimensional accuracy and shall be carefully supported within the mould in such a way that they cannot move when concrete is placed. Reinforcement complying with SRN 126 may be tack welded where bars cross to provide rigidity in the cage but reinforcement complying with SRN 127 shall not be welded.

Cover to main reinforcement shall be as shown on the drawings, or if not shown shall be not less than 25mm or the diameter of the bar, whichever is the greater. Cover on distribution steel shall not be less than 15mm or the diameter of the bar whichever is the greater.

Bars shall be spaced so that the minimum clear distance between them is the maximum nominal aggregate size plus five millimetres but in any case, not less than the diameter of the bars.

Bars may be placed in pairs provided that there are no laps in the paired lengths.

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**c) Casting of Units**

Concrete for precast units shall comply with Clauses 1039/1040 and 701-710 using the class of concrete specified on the drawings.

If lightweight aggregates are specified, they shall comply with SRN 147.

The area in which units are cast shall be adequately protected from the weather so that the process is not affected by rain, sun or drying winds.

**d) Curing Precast Units**

Requirements for curing shall be generally as set out in Clause 707.

The Contractor shall ensure that units do not suffer any loss of moisture or sudden changes of temperature for at least four days after casting. If a water spray is used for curing, the water shall be at a temperature within 5 degrees centigrade of the temperature of the unit being cured.

If Contractor proposes curing at elevated temperatures, the method shall be subject to the agreement of the Engineer and shall include means whereby units are heated and subsequently cooled evenly without sudden changes of temperature.

**e) Dimensional Tolerances of Precast Units**

Units shall be accurately formed to the dimensions shown on the drawings unless closer tolerances are called for by the Engineer.

**f) Surface Finish of Precast Units**

The formed faces of precast units shall be finished to Class F3 as set out in Clause 805c) unless another class of finish is specified on the drawings.

Free faces shall be finished to Class UF2 unless another class of finish is specified on the drawings

In cases where a special finish is required a trial panel shall be constructed by the Contractor which after approval by the Engineer shall be kept available for inspection at the place of casting and production units shall thereafter match the approved pattern.

Those parts of the unit which are to be joined to other units or to in-situ concrete shall be brushed with a stiff brush before the concrete has fully hardened. Alternatively, if the concrete has been allowed to harden, the surfaces shall be roughened by sand blasting or by the use of a needle gun.

**g) Handling and Storage of Precast Units**

Precast units shall be handled in a manner which will not cause damage of any kind and shall be stored on a hard impermeable base.

Prestressed units and large precast normally reinforced units shall be handled and stored so that no stresses shall be induced in excess of those which they will incur in their final positions in the Works unless they have been designed to resist such

stresses.

Units shall be provided with adequate lifting holes or loops, placed in the locations shown on the drawings or agreed by the Engineer and they shall be lifted only by such holes or loops. Where it is not possible to provide holes or loops, suitable sling positions shall be indicated in paint on the units.

Units shall be marked indelibly with the reference number and date of casting and shall be stacked on suitable packers which will not damage the concrete or stain the surfaces. Not more than two packers shall be placed under each unit and these shall be located either at the positions of the permanent support points or in positions such that the induced stresses in the unit will be a minimum.

#### **h) Testing Precast Units**

Precast units shall be capable of safely sustaining the loads which they have been designed to carry. The Contractor shall subject units selected by the Engineer to load tests simulating the working conditions. Details of such tests shall be agreed between the Engineer and the Contractor.

In the case of units subject to bending loads the test piece shall be supported at full span and a loading equivalent to 1.25 times the sum of the live and dead loads which were assumed in the design shall be maintained for one hour without the appearance of any signs of distress. The recovery one hour after the removal of load shall be not less than 75 per cent of the full load deflection.

If the unit fails to meet the above requirements, further tests shall be carried out on two more units. If either of these fail the whole batch of units will be rejected.

If the Engineer so requires, a test to destruction shall also be carried out which on units subject to bending shall be as follows:-

The units shall be supported at full span and a load applied in increments instructed by the Engineer up to 95 per cent of the designed ultimate load. This load shall be held for 15 minutes without failure of the unit. The deflection at the end of this period shall be not more than  $1/40^{\text{th}}$  of the span. The load shall then be further increased until failure occurs.

If the unit fails to sustain the required load for the prescribed period or if the deflection exceeds the specified amount, the Engineer may order two further tests, and if either of these fail, the batch of units which they represent may be rejected.

### **1042. PRECAST LINTELS**

All precast items shall be marked with the date of casting and shall not be built into the works until they have matured for 28 days. Ends of bar reinforcement shall be hooked or bent as required. The cover for reinforcement shall be 25mm from internal faces and 38mm from external exposed faces. The 'top' of lintels shall be numbered for identification.

Lintels shall have timber or pre-formed inserts cast in for fixing metal windows where required and shall have fair face finish on all surfaces exposed to view and hacked surfaces where plastered.

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#### **1043. PREFORMED JOINT FILLER**

Preformed joint filler shall be of the thickness shown on the drawings or as stated in the Bill of Quantities.

The material comprising joint filler shall be as stated on the drawings or approved by the Engineer.

#### **1044. STONE DUST**

Stone dust for blinding shall be blacktrap screened to the following grading:-

Passing 10mm sieve	100% Passing
No. 4 sieve	85% - 100%
Passing No. 100 sieve	5% - 25%

#### **1045. STOP VALVES**

All stop valves shall be in accordance with SRN 826. Samples of valves shall be submitted for test and approval to the Engineer.

#### **1046. STRUCTURAL STEEL FOR WELDED WORK**

Structural steel for riveted and welded work shall comply with the requirements of SRN 125: Structural Steel, SRN 126: The Use of Structural Steel in Building and for Welded Work, SRN 125: High Yield Stress and High Tensile Structural Steel, High Tensile (Fusion Welding Quality) Structural Steel for Bridges, etc. and General Building Construction.

#### **1047. STRUCTURAL STEELWORK**

The whole of the structural steelwork and testing shall comply with the relevant clauses of B.S. 449. The Contractor shall include for the preparation of all shop details from the drawings supplied by the Engineer. All such details shall be approved in writing by the Engineer before the work is put in hand. Every drawing shall show the number and sizes of all rivets and bolts, complete details of welds, type of electrodes, welding procedure, whether the welds are to be made in the shop or elsewhere and any other relevant information. The Contractor shall be responsible for the accuracy of his shop details and for shop fittings and site connections.

The Contractor shall take the dimensions from the structure and he shall verify all dimensions given on the drawings before the work is put in hand.

Any damage to materials on the site due to inadequate precautions being taken during the erection of the steelwork shall be made good to the satisfaction of the Engineer's Representative at the Contractor's expense.

The fabrication and erection of the steelwork shall be carried out in accordance with Part 5 of B.S. 449.

#### **1048. TIMBER**

Timber shall be sound, well-seasoned and entirely free from worm, beetle, warps, shakes, splits, and all forms of rot and deadwood. Where required, all timber shall be treated with creosote, as specified in SRN 872: Coal Tar Creosote for the Preservation of Timber or an

alternative approved timber preservative.

#### **1049. WATER BARS**

Water bars shall be “Dumbbell” type and be of natural or synthetic rubber or extruded PVC. They shall be flexible, tough, elastic and durable and of dimensions detailed. They should be unaffected on contact with dilute acids or alkalis. Joints and junctions shall, when possible, be prefabricated by the manufacturer, but if made at site the manufacturer’s instructions including recommended adhesives shall be followed and used. Samples shall be submitted for approval of the Engineer before use of any material.

#### **1050. WATERPROOF UNDERLAY**

Waterproof underlay shall consist of either waterproof paper complying with SRN 856: Waterproof Building Paper, containing approved fibrous reinforcement, or 500-gauge polythene sheeting as stated in the Bill of Quantities.

#### **1051. GROUND PENETRATION RADAR**

Ground penetration radar shall be used as directed to detect and map above ground and sub-surface utility pipelines in a specified section using non-intrusive Ground Penetrating Radar (GPR) Technique. The scan should be carried out at 20m intervals along the selected pipeline wayleave. The output should provide the depth and location of the pipeline. The information should be counterchecked with manual assessments and measurements to verify the GPR results.

The accurate location shall be captured. Data obtained shall be verified and processed and a map produced showing the GPS location of utility pipelines, manholes, above ground services, etc and produced in CAD format and shape files.

The exercise shall require prior instruction and approval of the engineer with the required reconnaissance survey and desktop study of available documentation carried out.

The equipment required shall include the following with associated accessories or approved equivalent

- GNSS Leica GG04,
- Leica T06 Total Station,
- RIS MF Hi-Mod Dual frequency (200MHz-600MHz) GPR Unit,
- EziCATM 200,
- GS15 RTK Survey



## 11. PROJECT SPECIFIC INFORMATION AND CONTRACTOR'S GENERAL RESPONSIBILITY

### 1101. PROJECT LOCATION

The Project Site is within Nairobi County.

### 1102. SCOPE OF WORKS

The Works comprise of:

- Rehabilitation of existing water pipelines with diameters ranging from OD 90 to 400mm using trenchless technology and open trench installation.
- Requisite Appurtenances (Air Valve, Washout Valves, Section Valves, Bulk Zonal Water Meters etc.) and consumer connections.

**Table 11-1 Scope of Works**

<b>Project Components</b>				
1.	<b>Primary and secondary pipelines</b>	<b>Trenchless Installation, Km</b>	<b>Open cut installation, Km</b>	<b>Total Length, Km</b>
	Central Business District	13.6	-	13.6
	Central Industrial area	27.0	5.9	32.9
	Eastleigh (provisional)	11.1	3.8	14.9
	Ngara (provisional)	3.5	-	3.5
	Jogoo Road (provisional)	5.2	3.6	8.8
	<b>TOTAL Length</b>	<b>60.4</b>	<b>13.3</b>	<b>73.7</b>
2.	New consumer connections	181	(Provisional 161)	
3.	Reinstating consumer connections	874	(Provisional 778)	



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### 1103. ADDITIONAL CONTRACTOR'S RESPONSIBILITIES

The Pipelines are to be laid within highly built up and congested Urban Areas.

Briefly, the Contractor's Responsibilities will include:

- Setting out and verification survey of pipeline routes;
- Preparation of "As-Built" drawings and O&M manuals for the whole Project;
- Compliance with the project specific Environmental and Social Management Plan, all according to NEMA Conditions. This shall include issues such as disposal of wastes, health and safety of workers, safety of public, access and avoid nuisance to the public and property owners, confirm to emissions requirements, drainage and excessive erosion, among others;
- Maintaining the works for a pre-determined period (12 months) following hand-over, to ensure that the materials and workmanship are performing as intended.
- The Client has no land available for Contractor's Camp or Camps. The Contractor will procure / rent adequate land for his camps including offices, workshops, stores, labour camp and other facilities within the vicinity of the Project Site. The Contractor will submit probable camp site(s) location details with the Bid.
- The Client has no land available for Storage of Materials including Pipes, Valves, Fittings, etc. The Contractor will procure / rent adequate land for proper storage and protection of all pipes, valves, fittings, etc. The Contractor will submit probable storage site(s) location details with the Bid.
- The Contractor shall be responsible for locating and protecting existing utilities and services, including existing bulk water supply trunk mains, electrical power cable routes (KPLC/Kenya Power), telephone (KPTC/Telekom), Fibre optic cables (Safaricom, Airtel, etc) and other service providers), water and sewerage pipes (the water company), roads and drains (KeNHA, KURA, KERRA). In this respect, the Contractor shall be responsible for obtaining all Permits and Approvals, and in general complying with the requirements of the individual utilities and agencies.
- The new works will be connected to the existing, operational water distribution systems. The Contractor will be required to liaise closely with the Water Company when executing the works activities. Further, strict "rules" will apply to all such tie-in works since, in general, they may require for some time, a partial shut-down of the supply system and affected consumers to be informed well in advance.
- The pipelines traverse along roads and densely populated commercial and residential areas. Working in these areas will require provision of safety barriers, warning signs and lighting, temporary accesses to properties, etc. The Contractor should indicate the cost of these works in Bill No. 1. If this item is not priced or inadequately priced, the Contractor's rates for Other Works will be deemed to cover this requirement.
- The Contractor shall be responsible for identifying and paying all Government Levies and Statutory costs such as training levy, licencing fee, etc. The costs of these are deemed to be covered in the Contractor's rates for the Works.

### 1104. CONDITIONS OF CONTRACT

The General and Particular Conditions of Contract are given in Volume I of the Bidding Document.

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#### **1105. CONSTRUCTION PERIOD**

The proposed construction period will be **24 months**. Potential Contractors will note that multiple teams will be required to comply with this requirement and will provide documentation to demonstrate adequacy of resources in this respect. Additionally, potential Contractors to note that some disruptions to scheduled work may be expected to occur during the rainy seasons. This to be allowed for in their programme of implementation.

#### **1106. SITE AND OTHER DATA**

- The works are to be executed along roads and densely populated commercial and residential areas. Working in these areas will require provision of safety barriers, warning signs and lighting, temporary accesses to properties, diversion management of traffic, etc.
- There are several major hospitals within the Project Area. The Contractor will be required to maintain basic medical facilities and transport on site for emergency use;
- Design, manufacture and construction standards will conform to recognize international Codes and Standards. Local Kenyan Codes and Regulations shall also apply.

#### **1107. WAYLEAVE / EASEMENT FOR PIPELINE WORKS**

The proposed water pipelines traverse along existing roads and are to be laid within the existing road reserves. Large sections of the road reserves also have other existing utilities such as fibre optic cables, electrical cables, water mains, sewer pipes, manholes and chambers. In some instances, the road reserve is paved with concrete / Cabro / PCC slabs / asphalt. Sections of the road reserve may have encroachment by temporary structures. As-built details of the existing utilities are not available and Contractor will be required to carry out pilot excavation to determine the location and extent of the existing utilities. Contractor will liaise with person(s) who have encroached within the road reserve and obtain clear right of way prior to commencement of work and to ensure no delay occurs in the construction work programme.

Any additional space required for purposes of construction including working space for plant, other access, storage and movement of materials, excavated materials/filling, etc. will have to be appropriately arranged and paid for by the Contractor. In case of limited space in some sections, the Contractor may have to revert to manual excavation, double haulage of excavated material or any other means to execute the Works. The cost of all these exigencies will be deemed to be included in his rates for work.

The Employer will obtain and pay for the requisite permissions from Road Authorities - KeNHA, KURA, KERRA and the County Government to lay the pipes within the road reserves. However, the Contractor will allow in his rates all costs for conditions prescribed by the authorities during the construction of the pipeline and reinstatement of all reserve areas to the original condition.

#### **1108. RESTRICTIONS ON USE OF ROADS**

The Contractor shall not run tracked vehicles or tracked plant on any public or private road without the written approval of the Engineer and the responsible authority or owner and subject to such conditions as each may reasonably require.

The Contractor shall observe all weight and dimensions restrictions which apply to roads and tracks in Kenya and he shall comply with all reasonable restrictions which may from time to time be imposed by the Engineer. Where damage to roads and tracks is caused by the

Contractor, this shall be repaired at the Contractor's expense. In particular, the Contractor shall fill potholes in roads with roadstone when these are deepened by his plant.

The Engineer shall have the power to restrict the Contractor's use of any roads, either in direction of traffic, speed of traffic or numbers of vehicles in order to preserve such roads or to make such roads safe for use by the general public.

#### **1109. PREVAILING CONDITIONS**

The Contractor is deemed to be fully familiar with local conditions and the potential effect (direct or indirect) on the planning and execution of the Works. The Contractor shall make his own studies / investigations in this respect. These conditions include, but are not limited to the following:

i) Climatic Conditions

There are generally two rainfall seasons, long rains between March and May and short rains between October and December.

ii) Access

The works are to be executed along roads and densely populated commercial and residential areas. The pipelines also cross a number of rivers/ streams. Bidders to visit the Project Areas and familiarize themselves with the specific conditions in each area.

iii) Services

The Contractor shall make provision for the temporary supply of all services necessary for the execution of the works, including water, electricity, communications including Internet, fuels and consumables etc. The Contractor shall make all such applications and payments as necessary in order to obtain these services.

The Contractor is deemed to be familiar with the levels of service provided and shall make all necessary backup provisions (such as generator sets, water tankers, on-site storage for key materials, etc.) to ensure that delays are not experienced.

iv) Local Materials

The Contractor shall be familiar with the supply of local materials with respect to sources and location, delivery times, prices, quality and standards of products, sizes, quantities available, reliability and customer service, delivery capability, etc.

With respect to quarries and borrow pits, the Contractor shall be responsible for all fees, royalties, permits and other obligations concerning such activities.

v) Laws and Regulations

The Contractor is deemed to be familiar with all laws and regulations pertaining to the implementation of the Contract, including relevant National Design And Construction Standards, Environmental Regulations, Transportation of Heavy Equipment by Road, Minimum Wage and Employment Standards, Health and Safety Regulations, Establishing / Operating / Decommissioning of Borrow Pits, Disposal of Wastes, Procedures and Regulations related to Procurement of Imported Goods, Local Customs, etc.

vi) Local Labour

The Contractor shall liaise with Local Authorities (Chiefs, Labour Office, etc.) to recruit casuals and semi-skilled / skilled labour from the Project Area sites.

vii) Ground Conditions

The Contractor is deemed to be familiar with the site soil conditions, rock depths (whether hard or soft) including the presence of groundwater.

No geotechnical information is available along the pipeline's routes. Approximate rock excavation quantities have been appropriately provided for in the Bills of Quantities. These quantities are re-measurable. Contractor to verify site conditions through site inspections prior to tendering.

In addition, the Contractor shall be aware of maximum flood levels in all Rivers along which works will be carried out and schedule the construction works accordingly.

## **1110. CONSTRUCTION PROGRAMME**

The Contractor shall submit to the Engineer for approval, a revision of the Construction Programme attached in four (4) copies and after approval to the Employer in two (2) copies in the following manner:

- (1) Within thirty (30) days after receiving the Letter of Acceptance, the Contractor shall submit to the Engineer for approval, a detailed Programme based on the key date stated hereinafter or other dates which are given in the Letter of Acceptance in the form of a Critical Path Method (hereinafter referred to as CPM Network) showing the order of procedure in which he proposes to carry out the Works including design, manufacture, delivery to the site, transport, storage, survey, construction, commissioning and maintenance. This Programme shall clearly indicate all activities and its duration along with the earliest and the latest event, times and the first and last dates of the submission of the Drawings and each date of shop inspection by the Engineer for the section or portion of the Works.

The Programme so prepared shall be rearranged in the form of a Time Bar-chart Schedule of which size shall be 841mm x 594mm (A-1 size). This Time Bar-chart Schedule shall be submitted to the Engineer together with the CPM Network.

- (2) The CPM Network shall be in accordance with commonly accepted practices and shall show graphically the chain of activities / sub-activities and their sequential relationship with each other from the start of construction to the completion of the Contract. The Time Bar-chart Schedule shown in weeks shall list all main activities and its applicable sub-activities.
- (3) In preparing the CPM Network and the Time Bar-chart Schedule the Contractor shall make due allowances for possible delays. Under no circumstances shall the CPM Network or the Time Bar-chart Schedule show a completion in excess of the "Time for Completion" stated in the Form of Bid.
- (4) The Programme once approved by the Engineer shall thereafter be referred to as the Contractual Programme. The Engineer's approval of such programme shall not

relieve the Contractor of any of his duties or responsibilities under the Contract.

The Contractual Programme approved shall supersede all other Programmes and shall be deemed to be the Programme on which the Contractor has based his Contract Sum and in accordance with which he will undertake the execution of the Works. This Programme shall become part of the Contract.

The Contractor shall ensure that all the Works especially Electrical and Mechanical Works which may be carried out by the Electrical/Mechanical Sub-Contractor, are well coordinated with the overall Works under the Contract for the efficient execution of the Works and shall clearly indicate them on the construction Programme.

The Contractor shall also describe the conditions of working shifts, if necessary, to execute the Works and whether work needs to be carried out at night and/or on Sundays and holidays. The Contractor should also indicate which particular Works are subject to these timings in his construction Programme.

Whenever the Contractor proposes to change the Contractual Programme, approval of the revision shall be obtained in writing from the Engineer.

If the Contractor has fallen behind the approved Contractual Programme or can foresee delay(s) therein, he shall, immediately after such default or event occurred or foreseen or at the request of the Engineer submit a revision of the Contractual Programme showing the reasons of such a delay and the proposed measures to recover such delay or to complete the Works on time, for the approval of the Engineer.

#### **1111. MONTHLY SITE MEETINGS**

Throughout the project period, site meetings will be held at the Resident Engineer's Office once every calendar month to discuss the progress of the work, schedule for the ensuing month, methods of construction, procurement, transportation, labours, etc. These meetings can be called at any other time intervals at the request of the Contractor or as directed by the Engineer. The meetings will be attended by Senior Representatives of the Client, Supervision Team and the Contractor. Costs of holding the meetings shall be deemed to be covered under the Contractor's rates.

#### **1112. METHOD STATEMENTS**

If the Method Statement submitted with the Bid requires revision, then the Contractor will within 28 days of signing the Contract, submit a Revised Method Statement to the Engineer for his Approval.

The Method Statement shall describe the Contractor's overall approach to the Contract, including issues such as type, number and layout of Contractor's buildings, stores and facilities; provision of temporary services: personnel issues including management structure, supervision and labour; Contractor's plant and equipment, and maintenance thereof; quality control management procedures; general methods for key work components such as structural works, electrical-mechanical installation, construction of pipelines etc.; working adjacent to existing River Courses and any other special considerations, etc.

From time to time the Engineer may request detailed Method Statements for specific activities. The Contractor shall comply in full with the Engineer's requirements.

### **1113. PROGRAM OF WORKS**

If the Work Program submitted with the Bid requires revision, then the Contractor will within 28 days of signing the Contract, submit a Revised Program of Works to the Engineer for his acceptance.

The Program of Works shall be in bar chart format and shall indicate the major work components (including mobilization, any designs, procurement, substantial completion, etc.) and the main sub-activities. The program shall have a unit of time of one month (with part months indicated) unless the Engineer indicates otherwise.

The program (or, if necessary, a secondary program similarly formulated) shall clearly indicate the various work teams by discipline, including specialist sub-contracts and suppliers, as well as the Contractor's major plant and staff requirements, in order to demonstrate sequencing and non-conflict of resources.

The Engineer may request summary versions of the program, or additional detail for critical sections. The Contractor will comply with all such requests.

Once a Work Program has been approved by the Engineer it shall remain as the current version until such time as the Engineer instructs the Contractor to update or revise the program. The Contractor shall not modify his program without such instruction from the Engineer. Specifically, the Contractor's progress reports shall relate to the current program, and any delays shall be duly indicated.

The exact format of the Work Program shall be to the approval of the Engineer but shall comprise the minimum of a detailed resource and cash flow schedule for the work, using Microsoft Project or a similar approved software system. This schedule, to be finalised and agreed between Employer and Contractor, will be used to measure Value of Work Done to enable the Contractor and Employer to monitor the progress of the project in terms of integrated cost, schedule and technical performance measures. In order for Value of Work Done to be estimated, the Contractor will provide a system that can accurately and demonstrably measure the following three fundamental factors:

- i. The PLANNED VALUE COST also known as the Budgeted Cost of Work Scheduled (BCWS). This is the amount of expenditure the Employer anticipated he would have spent at time of reporting.
- ii. The ACTUAL COST of the progress made, known as the Actual Cost of Work Performed (ACWP). This is the actual amount of expenditure the Employer incurs at time of reporting.
- iii. The EARNED VALUE, known as the Budgeted Cost of Work Performed. This is the percentage complete



Payment within the Contract will be based on the achievement of earned value agreed between Employer and Contractor, independently assessed by the Engineer, in accordance with the value achieved based on measured quantities of work done.

#### **1114. PROGRESS REPORTS**

The Contractor shall submit a Monthly Progress Report to the Engineer. The format, content and level of detail shall be determined and agreed with the Engineer.

If the Engineer considers it necessary, the frequency of reporting may be increased. Alternatively, the Contractor may be instructed to provide a special progress report for a particular section of works (that is significantly delayed for example), on a more frequent basis (e.g., weekly, or even daily).

#### **1115. DAILY LOGS**

The Contractor shall maintain a daily site log. The logbook entries shall be prepared in triplicate, with one copy being delivered each day to the Engineer.

The content and format of the Daily Log shall be agreed with the Engineer upon commencement of the contract. However, typically the log shall include the date, weather, numbers/movement of plant and labour, main areas of work and daily activity/progress, deliveries of plant and materials to site, tests, issues, shut-downs, key instructions, accidents, among others. In addition, the log sheet shall have a space designated for comments by the Engineer.

The Engineer may, at his discretion, instruct the Contractor to provide daily labour and plant returns. Alternatively, the Engineer may request to review such information.

In addition, the Contractor shall provide the Engineer with copies of all delivery notes of plant and materials delivered to site.

#### **1116. TEST FORMS**

The Contractor shall prepare, to the satisfaction of the Engineer, test forms to be used for the various components of the works.

All test forms shall be completed, signed and dated by the appropriate persons conducting the tests. The original copy of all test forms shall be submitted to the Engineer.

Test forms shall be submitted to the Engineer regardless of whether the test passes or fails.

#### **1117. MISCELLANEOUS FORMS**

The Engineer and/or Contractor shall prepare other forms as necessary. These may include, but are not limited to:

- i. Site Instruction Form;
- ii. Request for Information / Inspection / Approval Form;
- iii. Materials Supply Form;
- iv. Setting Out Works Form;
- v. Pipeline Final Excavation Level Form;
- vi. Pipeline Laying Form;

- vii. Pipeline Backfilling Form;
- viii. Pipeline Testing Form;
- ix. Dayworks Form; and
- x. Concrete Pour Form; etc.

#### **1118. CERTIFICATES OF COMPLETION**

The Engineer shall prepare such forms in accordance with the Conditions of Contract. These include:

- i. Taking-Over Certificate, issued upon successful completion of the Tests on Completion
- ii. Performance Certificate, issued upon expiry of the Defects Liability Period and successful completion of defects and all other requirements under the Contract.

#### **1119. VERIFICATION BY CONTRACTOR**

##### **Survey and Dimensional Checking**

The Contractor shall be responsible for checking the following prior to carrying out construction work:

- i. Confirm the alignment and elevations of each proposed pipeline. All elevations shall be related to a single benchmark;
- ii. Confirm the location and elevation of existing pipelines through excavation and backfilling of trial holes
- iii. Verify the locations, depths and other details of existing services along the proposed pipeline alignment
- iv. Confirm extent of existing road reserve and available wayleave;
- v. Confirm proposed distances and lengths;
- vi. Confirm location of proposed structures and pipeline routes, including preliminary setting out. Confirm elevations of pipelines at key locations such as crossings of rivers and roads. In particular this shall include sections where pipelines shall cross these locations. The Contractor shall excavate and backfill all necessary trial holes to confirm such elevations;
- vii. The Contractor shall provide the Engineer with drawings and other such documentation confirming all surveys and setting out.

#### **1120. CONSUMER CONNECTION WORKS**

##### **a) Types/ Classification of Consumer Connections**

Consumer Connections under the proposed Works are classified into two groups:

##### **i) New Connections**



New Connections are new customers being connected to the rehabilitated network for the first time.

New Connections can only be made by the Water Services Provider (NCWSC) upon receipt and processing of applications by potential customers and payment of the requisite Connection Fee.

## **ii) Existing Connections**

Existing Connections are Connections that are already present within the Existing Distribution Network.

Where an existing Tertiary/ Service Main is replaced with a new Main, the Existing Connections need to be located, verified/ documented and then reconnected to the New Main.

## **b) Supply of Pipes, Fittings and Accessories for New Consumer Connections**

New Connections are dependent on applications being made by potential customers to NCWSC, processing of applications and payment of requisite Connection Fees.

Upon approval of the application, the Contractor will carry out the work of installing New Connections with the procured requisite Pipes, Fittings and other Accessories for the specified number of New Connections.

## **c) Reinstatement of Existing Consumer Connections**

Reinstatement of Existing Consumer Connection on the new Tertiary/ Service Mains will be done once they have been identified by the Contractor and confirmed by NCWSC. This will require close coordination between the Contractor, NCWSC and the Community Liaison Consultant.

The typical sequence of activities for the consumer connection installation will be as follows:

- i. All pipes, fittings, valves, meters and other accessories for Reinstatement of Existing Consumer Connections will be procured by the Contractor and kept in proper storage as directed by the Engineer. The meters will be registered in a consumer meter database according to their serial numbers in readiness for installation.
- ii. Prior to the commencement of any activities, the Contractor will notify the Community Liaison Consultant and NCWSC of the planned consumer connection works. All requisite details that NCWSC and the Community Liaison Consultant request shall be provided by the Contractor.
- iii. The Contractor will then identify, and where necessary expose all consumer connections to be reinstated in liaison with NCWSC. The contractor will then confirm all the fittings required to reinstate the consumer connections. For the

new consumer connections, the Contractor will confirm all fittings required to complete the new consumer connection works.

- iv. With the inspection and approval of the Engineer, the Contractor will commence with the installation works for the new and reinstated consumer connections. The Contractor will be responsible for all costs stemming from transportation of pipes, fittings and other accessories from storage to site, laying and jointing pipes in trenches, including excavation, preparation of surface, disposal of excavated material, backfilling and final reinstatement.
- v. Upon completion of the consumer connection installation works in an area/ zone, the Contractor will proceed with testing of the connections. NCWSC and the Engineer will then verify and certify the completed works and, on this basis, the Contractor can include the completed works in his application for interim payment certificates.
- vi. The Contractor will then prepare the last mile consumer connection documentation which will include the maps and consumer database with the relevant data as directed by the Engineer.

A Summary Responsibility Matrix for the key activities is given below:

**Table 11-2 Responsibility Matrix for Key Activities on the Consumer Connection Works**

*x = action                      A= Approval*

<b>Responsibility</b>	<b>Supervising Engineer</b>	<b>NCWSC</b>	<b>Main Contractor</b>	<b>Remarks</b>
Review detailed design of primary & secondary distribution network and issuance of construction drawings	X	input		
Identification of all existing consumer connections (on existing secondary & tertiary mains) to be replaced and all new consumer connections	input	input	X	Ahead or at least parallel to detailed survey or excavation by the main contractor
Status verification and reconciliation of customer database and located connection		X	Input	Ahead or at least parallel to detailed survey or excavation by the main contractor

Survey of alignment of new secondary and tertiary mains, based on instruction of Supervising Engineer	A		X	Quantities included under Works Contract
Commissioning of new secondary & tertiary mains	A		X	
Installation of Consumer Connections (New and reinstated connections)	A	Input	X	Contractor to reconnect existing and install new consumer connections.
Geo-referencing of consumer connections and inputting data in GIS	A	Input	X	
Update customer database	Input	X	Input	
Indicate <u>all</u> abandoned <u>existing</u> mains on As-Built drawings/GIS	A		X	

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## **1121. ASBESTOS CEMENT (AC) PIPES**

The Project involves replacement of Asbestos Cement (AC) Mains. To mitigate Environmental Health and Safety issues associated with handling and disposal of Asbestos Containing Materials (ACM) , the AC pipes will be decommissioned, removed and disposed off appropriately in line the National Guidelines on Safe Management and Disposal of Asbestos. .

The selected contractor shall observe the following safety measures in the removal, storage (if any), packaging, transportation and disposal of the AC pipes.

The contractor will ensure he has a competent team to implement the guidelines and/or engage a NEMA authorised handler.

- i. Adherence to regulations regarding asbestos handling to, disposal, and worker safety. These include EMCA CAP 387, EMC (Waste management) Regulation 2006, Public Health Act CAP 242, OSHA ACT 2007, National Guidelines on Safe Management, and disposal of Asbestos, 2013.
- ii. .
- iii. Precautionary Measures: the contractor shall identify, locate and prepare an inventory of all the AC pipes to be replaced; prepare written work procedures; sensitize all workers on the activities; and notify NEMA on their intended removal and disposal.
- iv. Conduct a comprehensive risk assessment to identify potential hazards associated with asbestos concrete pipes which shall include assessing the condition of the pipes and determine the level of asbestos content.
- v. If the contractor decides to undertake the management of the AC for engaging an approved handler, the contractor will undertake an ESIA and submit the same to NEMA for processing and issue of EIA License. Notification: the contractor will notify all parties likely to be affected by issuing a notice of planned removal at least seven days.
- vi. Removal: the contractor will secure the sites to prevent unauthorized access and restrict movement. Workers must be provided with appropriate PPE, observe safe work procedures in excavation/ exposure of the AC pipes. Should accidental breakage occur, the contractor will wet the cracked or broken AC pipes.
- vii. Storage: the contractor may require temporary storage of the AC pipes prior transportation to designated disposal site(s). The contractor will identify suitable storage areas/ spaces. The removed AC pipes will be stacked and wrapped, into stacks which can be easily loaded into the transportation vessel, in a plastic sheet of a minimum of 500 gauge double wrapped and secured with tape and labelled. Any debris (broken pieces) should be collected in a sealed polythene woven bag or any other air tight container. The bags should then be wrapped, into stacks which can be easily loaded into the transportation vessel, in a polythene sheet awaiting final disposal. Care should be taken to ensure that sharp pieces do not puncture the bags/ wrappers.  
The storage area must have restricted entrance and locked or secured on a 24 hour basis. Warning label (“Asbestos hazard area, keep out”) and danger signs should be affixed to each wrapped stack or storage area using English, Swahili and Local language.

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- viii. Transportation: The vehicle transporting the asbestos waste should be licensed as per the EMCA (Waste Management) Regulations 2006 and must be accompanied by a tracking document. The contractor will ensure the AC is transported to the disposal site in an enclosed vehicle or container, capable of being washed without lodgment of debris and fibres, and secure from escape of fibres to the atmosphere.
  - ix. Disposal Site: the contractor will ensure the disposal of asbestos must be at a site; designated by the local authorities and licenced by NEMA, or privately owned disposal facility licenced by NEMA.

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## **12. PROJECT SAFETY HEALTH & ENVIRONMENT SPECIFICATIONS**

### **1201. INTRODUCTION**

The protection of the environment, prevention of injury and/or illness to the site personnel and the public, damage to the works and to public and private property, and compliance with applicable laws, are primary objectives of the Employer. Because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Specifications with which Contractors shall comply while working on this contract. Given that these Specifications cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Specifications, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer nor its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

The Contractor shall throughout the execution and completion of the Works and the remedying of any defects therein:

- (a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;
- (b) know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and sub-contractors;
- (c) take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment; and
- (d) avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequent of carrying out the Works.

### **1202. COMPLIANCE WITH SPECIFICATIONS**

The Contractor shall comply with the requirements of these Safety, Health and Environmental Specifications and all other applicable regulations or requirements under Kenyan laws, laid down by relevant authorities or issued by the Employer or the Employer's Representative concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.

In so far as these Specifications are applicable, they shall apply to sites and personnel outside the site associated with the performance of the Contract.

The Specifications equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Specifications.

The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Specifications by the Employer, Employer's Representative or relevant authorities within the time specified in the notification or instruction.

The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action by:

- (a) ensuring the Specifications are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Specifications shall be regarded as a failure by the Contractor.
- (b) paying attention to possible injury to unauthorized persons entering the site, particularly children.

Whenever in these Specifications the Contractor is required to provide test certificates for equipment and personnel and to comply with the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Kenya, the Contractor shall provide:

- (a) in lieu of independent test certificates:
  - for equipment – details of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;
  - for personnel – details of the training and experience of the personnel and a written statement that the Contractor has satisfied himself that they have the required level of competency;
- (b) in lieu of relevant authorities' requirements – details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Employer's Representative is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Employer's Representative.

When the Employer's Representative has satisfied himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc. shall be deemed to form part of these Specifications.

### **1203. FAILURE TO COMPLY WITH SPECIFICATIONS - GENERAL**

Should the Contractor fail to comply with any of the Specifications or requirements of the Employer's Representative:

- (a) the Employer's Representative may suspend the Works or part of the Works until the Contractor has taken the necessary steps, to the satisfaction of the Employer's Representative, to comply with the Specifications or requirements.

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- (b) the Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they may consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.
  - (c) the Employer's Representative may, by written notice of suspension to the Contractor, suspend all payment to the Contractor under the Contract if the Contractor fails to rectify any breach of the Specifications within the period specified by the Employer's Representative, provided that such notice of suspension:
    - (i) shall specify the nature of the failure or failures; and
    - (ii) shall request the Contractor to remedy each such failure within a specified period after receipt by the Contractor of such notice of suspension.

Such suspension of payment shall remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Employer's Representative. No interest shall be paid on the suspended payments.

Failure to comply with the Specifications or requirements shall be considered a breach of the Contract by the Contractor and may result in termination of the Contract by the Employer. In the event of the Employer taking action based on this Clause, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date. All costs incurred by the Employer pursuant to Clause 12.3 (b) shall be deducted from the amounts otherwise due to the Contractor.

## **1204. GENERAL REQUIREMENTS**

### **1204.(a) PREAMBLE**

All references to safety shall be deemed to include health and the environment.

### **1204.(b) SAFETY OFFICER**

The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his/her duties.

The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with red cross symbol and an identification badge. The appointment of the Safety Officer shall be in writing and copied to the Employer's Representative. The appointment shall include specific instructions to enforce these Specifications and delegated authority to take any action, measure or to issue instruction regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction in safety matters, verbal or in writing issued by the Safety Officer.

The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessible and available at all times including normal working hours.



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#### **1204.(c) SAFETY TRAINING**

The Contractor shall provide safety induction training for all site personnel upon starting on site. The Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

#### **1204.(d) SAFETY MEETINGS**

The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall be given to the Employer's Representative. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" shall be an item on the agenda.

#### **1204.(e) SAFETY INSPECTIONS**

The Safety Officer shall make regular safety inspections of the work sites. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Specifications and any other matters or situations relating to safety found during the inspection, instructions issued by the Safety Offices and actions taken by the Contractor. A copy of the Safety Officer's reports shall be given to the Employer's Representative.

#### **1204.(f) CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH**

Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufacturers and/or prescribed by relevant authorities.

Only properly trained and equipped personnel shall handle hazardous materials.

#### **1204.(g) POTENTIAL HAZARDS**

The Contractor shall inform employees of potential hazards, take the appropriate steps to reduce hazards and be prepared for emergency situations. The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Employer's Representative prior to the delivery and use of the substance on Site.

#### **1204.(h) ACCIDENT REPORTING**

The Contractor shall report all accidents and dangerous occurrences to the Employer's Representative. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Employer's Representative. A reportable accident or dangerous occurrence shall include any accident to any person on site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.

In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Employer's Representative.

All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site

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Accident Book shall be available at all times for inspection by the Employer's Representative.

The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

**1204.(i) NOTICES, SIGNS, Etc.**

All safety, health, environmental and other notices and signs shall be clearly displayed and written in English and Swahili. All requirements, instructions, procedures, etc. issued by the Contractor concerning these Specifications shall be printed in English and Swahili and displayed and readily available to the Contractor's personnel.

**1204.(j) FIRST AID AND MEDICAL ATTENTION**

The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.

The Contractor shall have trained first aiders on site in the required numbers as per the First Aid Rules, 1977 of Republic of Kenya. Such persons shall be provided with appropriate identification, including a red hard hat with a white "red cross" symbol; and an identification badge.

The Contractor shall make contingency arrangements for medical evacuation to hospital. The telephone numbers of the emergency services and the name, address and telephone number of the medical evacuation personnel/ Doctor and nearest hospital shall be prominently displayed in the Contractor's site office and other work fronts.

**1204.(k) EMPLOYEE QUALIFICATION AND CONDUCT**

The Contractor shall employ only persons who are fit, qualified and skilled in the work to be performed. All persons shall be above the minimum working age. The Contractor shall ensure:

- (a) that no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.
- (b) That all personnel obey warning signs, product or process labels and posted instructions.
- (c) That drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.
- (d) All workers have signed the project's code of conduct.

**1204.(l) WELFARE PROVISIONS**

The contractors shall ensure all workers have access to appropriate gender segregated sanitary facilities and clean portable drinking water.

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#### **1204.(m) WORKERS TRANSPORTATION**

The contractor shall ensure workers are ferried in appropriate passenger vehicles in compliance to the traffic act requirements and other requirements issued by the National Transport and Safety Authority, Kenya.

The Contractor shall ensure that all vehicles are licensed and insured at all times, serviced and maintained in good condition to the satisfaction of the Resident Engineer. Annual inspections should be carried out by National Transport and Safety Authority, Kenya as required by the traffic act.

#### **1205. SAFETY REQUIREMENTS**

##### **1205.(a) PERSONAL PROTECTIVE EQUIPMENT**

The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required informed by hazards and risks, and shall take all measures or actions for the protection and safety of Contractor's personnel.

Personnel shall not be permitted to work without the appropriate PPE. The contractor shall encourage employees and/or have an enforcement program on use of PPE.

##### **1205.(b) FIRE PROTECTION AND PREVENTION**

The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations. The Contractor shall, upon moving on site, provide the Employer's Representative and the Authorities with a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto. Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in specified areas set aside for the purpose and approved by the Employer's Representative. Storage tanks shall be adequately bundled to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.

Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame of other situations which could result in a fire risk.

All temporary accommodation and stores shall be provided with smoke detectors and fire alarms. Smoking shall be banned in high risk areas.

When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable materials shall be cleared from areas of hot works or work locations prior to welding or oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for smoldering materials. Where appropriate, areas of hot works are to be soused in water before the shift ends.

An adequate number of fire extinguishers of types suited to the fire risk and the material exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Fire appliances shall be regularly inspected as per the Fire Risk Reduction rules, 2007 of Republic of Kenya.

Only approved containers shall be used for storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans. Fuel burning engines shall be shut off while being refuelled. Adequate ventilation to prevent an accumulation of flammable vapours shall be provided where solvents or volatile cleaning agents are used.

Flammables shall not be stored under overhead pipelines, cable trays, electrical wires or stairways used for emergency egress.

Oily waste, rags and other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

#### **1205.(c) ELECTRICAL SAFETY**

All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations. The Contractor shall establish a permit-to-work system for work in or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Employer's Representative.

Only authorized personnel shall be allowed to work or repair electrical installations and equipment.

Unauthorized personnel shall not enter enclosures or areas containing high voltage equipment such as switchgear, transformers or substations.

#### **1205.(d) USE OF LADDERS**

Use of ladders within the project shall meet the provisions of Part VIII section 75 of the Occupational Safety and Health Act, 2007 of Republic of Kenya.

#### **1205.(e) CRANES AND OTHER LIFTING MACHINES**

Use of cranes within the project shall meet the provisions of Part VII section 65 of the Occupational Safety and Health Act, 2007 of Republic of Kenya.

The Contractor shall give a minimum of 48 hours' notice to the Employer's Representative prior to bringing a crane on site.

- (a) No cranes shall be erected on the site without the prior approval of the Employer's Representative. The Employer's Representative may direct the Contractor as to a location where cranes may not be located. The Contractor shall take such directions into account

when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase of the Contract Price.

- (b) Safety harnesses shall be worn and used at all times by personnel engaged in the erection, alterations and dismantling of tower cranes.
- (c) The Contractor shall provide a copy of the current Test Certificate to the Employer's Representative before any crane (tower or mobile) is brought into operation on the Site.
- (d) Under no circumstances shall a crane or load come within 4m of any energized overhead power line or other critical structure.

#### **1205.(f) WORKING IN CONFINED SPACES**

Confined spaces, including trenches or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorization from the Site Safety Officer and the issuance of a Hazardous Work Permit.

Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged.

Personnel working in a confined space where emergency escape or rescue could be difficult, shall wear a safety harness attached to a lifeline.

#### **1205.(g) HIGH RISK ACTIVITIES**

A detailed Method Statement detailing procedures/techniques to be used for high risk activities shall be submitted to and approved by the Employer's Representative prior to commencement of work activity on site. The Method Statement must include full details of measures/ risk assessment.

#### **1205.(h) EXCAVATION AND TRENCHING**

An excavation permit signed by the Employer's Representative must be issued before excavation proceeds in any work location. The contractor shall investigate and identify the location of existing services by studying drawings, a visual/physical study of the site, sweeping by appropriate detection equipment and where necessary hand excavation of trial holes.

Following this investigation, the Contractor shall submit a written request for an excavation permit to the Employer's Representative. The Employer's Representative will return the permit signed and dated to indicate:

- services which are to be maintained.
- services which are to be isolated.
- any special precautions to be taken.

The issue of an Excavation Permit by the Employer's Representative shall not relieve the Contractor of his responsibilities under the Contract.

The side of all excavations and trenches which in the opinion of the Employer's Representative might expose personnel or facilities to danger resulting from shifting earths shall be protected by adequate temporary supports or sloped to the appropriate angle of repose.

All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.

Excavations 1.3 metres or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 metre above the top of the excavation.

The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day or night.

Excavated or other materials shall be stored at least 0.65 metres from the sides of excavations.

## **1206. ENVIRONMENTAL AND HEALTH REQUIREMENTS**

### **1206.(a) Contractor Environmental and Social Management Plan**

The Contractor shall develop his own Environmental and Social Management Plan to ensure actions and mitigation necessary to protect the environment as contained in the Project ESIA Report and License, are incorporated into all site procedures. At a minimum, the contractor's ESMP must address the following:

- Policy
- Planning
- Implementation and Operation

#### **i. Policy**

The Contractor shall develop an environmental policy that includes, as a minimum, the following:

- A commitment to comply with applicable regulations and other requirements that the construction company subscribes to;
- A commitment to provide a safe work environment;
- A commitment to provide the training and equipment necessary for employees to conduct their work safely;
- A commitment to continuously improve performance and to pollution prevention; and
- A commitment to communicate the policy to all persons working for and on behalf of the company.

#### **ii. Planning**

Environmental issues and the legal and other requirements in construction of the project have been identified in the project's ESIA Report. The Contractor must demonstrate within his plan that he has read and understood the ESIA Report and its provisions for environmental, social and safety management and monitoring.

#### **iii. Implementation and Operation**



Roles, responsibilities and authorities must be defined, documented and communicated to ensure effective environmental and social management. A specific management representative with requisite qualifications shall be assigned the responsibility for ensuring that the ESMP is established, implemented and maintained and shall be responsible for reporting performance, reviewing the Plan and making recommendations for improvement. Documented confirmation is required that the training needs of all persons working for or on the company's behalf whose work poses significant hazards to their health and safety and/or may create a significant impact on the environment has been identified. Records of all training must be maintained.

Management, supervisory, and employee responsibilities must be communicated to all employees through training, formal job descriptions, work experience, hiring practices, etc. Awareness training shall be provided that includes the importance of conforming to the policy and procedures, the significant environmental issues, and the roles and responsibilities of management and staff.

Records shall be legible, identifiable and traceable to the activity. Records shall be stored and maintained in such a way that they are retrievable and protected against damage, deterioration or loss.

The Contractor shall establish, implement and maintain procedures to identify potential emergency situations and potential accidents that can have an impact on the environment, surrounding communities, the employees, and/or the public.

The Contractor shall be prepared to respond to actual emergency situations and accidents and prevent or mitigate associated adverse environmental or social impacts. The ESMP must also address how the Contractor will receive, document and respond to external interested parties.

#### **iv. Protection of the Environment**

The Contractor shall be knowledgeable of and comply with the Environmental Management Plan (EMP) and with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his control. The contractor shall not dump, release or otherwise discharge or dispose of any such materials without the authorization of the Employer's Representative.

Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Employer's Representative immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

#### **v. Air Pollution**

The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.

The Contractor shall take all necessary measures to limit pollution from dust and any windblown materials during the Works, including damping down with water on a regular basis during dry

climatic conditions.

The contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

**vi. Water Pollution**

The contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions on the city drainage system or watercourse and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible for the control of all run-offs, erosion, etc.

**1206.(b) SOLID WASTE**

The contractor shall adhere to the provisions of the Waste Management Regulations, 2006 of Republic of Kenya in handling and disposal of project waste.

**General Housekeeping**

- (a) The Contractor shall maintain the site and any ancillary areas used and occupied for the performance of the Works in a clean, tidy and rubbish-free condition at all times.
- (b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Employer's Representative. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Notification Period.

**Rubbish Removal and Disposal**

- (a) The Contractor shall comply with statutory and county regulations and requirements for the disposal of rubbish and waste.
- (b) The Contractor shall provide suitable containers for the temporary storage of waste.
- (c) The Contractor shall provide suitable containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.
- (d) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.
- (e) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.

**Asbestos Handling and Removal**

The Contractor shall comply with all local regulations regarding the handling of asbestos materials, including the National Guidelines on Safe Management and Disposal of Asbestos (NEMA, 2013).

The contractor shall adhere to the Environmental, Health and Safety Management Plan – Removal and Disposal of AC Material (performance indicators, monitoring and reporting requirements and responsibility) and the Safe Work Method Statement for Asbestos Cement Removal contained in the project's ESIA Report (presented in Appendix 1 No. 17 these specifications)



Step by step guidelines in management of asbestos within the project is presented in section 1121 of this document.

#### **1206.(c) NOISE CONTROL**

The Contractor shall ensure that the works is conducted in a manner to comply with requirements of the Environmental Management and Coordination (Noise and Excessive Vibration Pollution (Control) Regulations, 2009 and the Factories and other Places of Work (Noise Prevention and Control) Rules, 2005 of the Republic of Kenya.

The Contractor shall, in all cases, adopt the best available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas and, where necessary, acoustic barriers shall be used to shield them. Such barriers may be proprietary types or may consist of site materials such as bricks or earth mounds as appropriate.

Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be used during days of rest or after normal working hours without the consent of the Employer's Representative.

#### **1207. ADDITIONAL REQUIREMENTS FOR WORK IN PUBLIC AREAS**

##### **1207.(a) GENERAL**

These additional requirements shall apply to all works carried out in Public Areas. Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.

All work in Public Areas shall be carried out to minimize disturbance and avoid dangers to the public.

Before commencing work, the Contractor shall ensure that all necessary resources, including labour, plant and materials will be available when required and that the works will proceed without delays and be completed in the shortest possible time. A period of inactivity and slow progress or delays in meeting the agreed programme for the Works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed programme. Details of the actions and acceleration measures shall be submitted to the Employer's Representative. If the Employer's Representative is dissatisfied with the Contractor's proposals, the Contractor shall take further actions or measures as required by the Employer's Representative. All costs incurred shall be the responsibility of the Contractor.

##### **1207.(b) METHOD STATEMENT**

The Contractor shall submit to the Employer's Representative a method statement for each separate area or work in Public Areas. The Method Statement shall include:

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- (a) A general description of the Works and methodology of how it will be carried out.
  - (b) Details of the measures and temporary works to minimise disturbance and safeguard the public. These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.
  - (c) Details of temporary reinstatement and maintenance of same prior to final reinstatement.
  - (d) For works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (e.g., up to temporary reinstatement, final reinstatement) to be carried out at any one time.
  - (e) Details of the availability of necessary resources (labour, plant, materials, etc.) to complete the work.
  - (f) A programme showing start and completion dates and period for all activities of each length or section, including temporary works, and the works overall.
  - (g) Such further information as necessary or required by the Employer's Representative.

The Contractor shall not commence work, including temporary works, until after the approval of the Contractor's Method Statement by the Employer's Representative.

Method Statements shall be updated based on actual progress or as and when required by the Employer's Representative.

#### **1207.(c) CLOSURE OF ROADS**

The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Employer's Representative and Relevant Authorities. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure, and where appropriate, proposed diversions.

#### **1207.(d) TRENCH AND OTHER EXCAVATIONS**

The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.

The following guidelines apply particularly to trenches but shall also apply to other types of excavations:

- (a) before commencing work the Contractor shall:
  - notify the Employer's Representative of the location and duration of the work. An excavation permit signed by the Employer's Representative must be issued in accordance with Clause 121205(h) before excavation proceeds in any work location;
  - obtain permission from relevant authorities including the police when required;
  - erect all temporary works such as barriers, warning signs, lighting, etc.;
  - have available adequate materials for temporary support to sides of excavations and necessary labour, plant and materials to complete the work within the shortest possible time.
- (b) in carrying out the works the Contractor shall, unless otherwise permitted or required by the Employer's Representative:
  - not open more than one excavation within a radius of 250 metres;

- limit the length of trench excavation open at one time to 150 metres;
- maintain and alter or adapt all temporary works including supports to sides of excavations;
- remove all surplus excavated material the same day it is excavated;
- complete the works, including final reinstatement within ten days;
- where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
- ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.

The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

#### **1207.(e) SAFETY BARRIERS**

Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as launch pits and the like. When exposed to the public, safety barriers shall be provided to both sides and ends of trenches and around all sides of openings.

The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Employer's Representative prior to commencing work. No work shall commence until the safety barriers are in place.

The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

- Type 1: excavated material;
- Type 2: non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- Type 3: rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted onto the ground.

The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavation, existing openings onto the perimeter of work areas:

- areas not subject to vehicular traffic - Types 1 or 2;
- roadways (low traffic speed) - Types 1 or 2;
- roadways (high traffic speed or where excavation are greater than 2m) - Type 3.

The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

#### **1208. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN**

Within 42 days of Commencement, the Contractor shall submit a Project Specific Environmental and Social Management Plan (ESMP) for approval of the Engineer. The Contractor must carry out all works in accordance with Kenyan Environmental Laws and Regulations, and the requirements of this document.

It is also a contractual obligation for the Contractor to take full cognizance of the environmental and social concerns and requirements as stipulated in the Employer's Environmental and Social Management Plan (ESMP) prepared for this Project and which is given in Appendix 1 (B)(10). The full Environmental and Social Impact Assessment (ESIA) Report will also be issued to the Contractor on Award.

Accordingly, the Contractor shall be required to prepare a site-specific Environmental and Social Management Plan (ESMP) for the project. This site-specific ESMP shall be based on the Contractor's evaluation of the requirements of these Specifications and the Employer's ESMP. The site-specific ESMP shall be submitted to the Employer's Representative for approval within 42 days of Commencement.

The site-specific ESMP is the Contractor's operative document on how to enforce, mitigate, inspect and monitor potential Project impacts during mobilization, construction and demobilization. In this sense, it is an eminently practical and concrete instrument.

Based on the above, the structure and content of the site-specific ESMP shall emphasize the following aspects:

- i) Executive Summary
- ii) Introduction
- iii) Project Description
  - Focus on impact-generating activities (e.g., demand of water and permanent materials, earth movement, etc.);
  - Environmental liabilities: identify and include a photographic registry of pre-existing environmental liabilities (e.g., gully erosion areas, abandoned borrow pits, unauthorized dumping sites, etc.) that are not attribute to the implementation of the Project.
- iv) Potential Impacts during Mobilisation, Construction and Demobilisation
  - Apply simple rating of significance;
  - Quantity/quality impacts (e.g., surface and type of vegetation to be removed, amount and type of wastes to be generated, noise levels, etc.);
  - Identify places where specific impacts will manifest.
- v) Mitigation Plan
  - Specify the detailed measures to mitigate the identified impacts (also by location)
  - Include designs for measures requiring structural solutions (e.g., gabions, etc.);
  - Include the schedule of implementation of mitigation measures in relation to the general construction schedule;
  - Health and Safety Plan (detailed);
  - Waste Management Plan (detailed) including decommissioning of the Existing Asbestos Cement (AC) pipes;
  - Traffic Management Plan (detailed);
  - Training Program (detailed);
  - Accident and Emergency Response Plan (detailed);
  - HIV/AIDS Awareness and Prevention Program;
  - Community Relations Program;
  - Location and technical specifications for installation and operation of campsites, including workshops, garages, laboratories, offices, sanitary installations, etc.;
  - Location and technical specifications for installation and operation of temporary and permanent dump sites, as applicable.
- vi) Inspection Plan

- Inspection function: specify frequency, locations and instruments (e.g., checklists, site reports, photo registry, etc.) to conduct site inspections;
- Permitting: required environmental permits and schedule to obtain them;
- Specific actions and responsibilities: what, who, where, when how and why
- vii) Monitoring Plan
  - Specify, for each variable: frequency of measurement, locations, methods/equipment, units/measures, quality standards, and reporting requirements and periodicity, including establishment of trends.
  - Specific actions and responsibilities: what, who, where, when how and why.
- viii) Organisation and Management
  - Specify organizational structure, personnel, resource and equipment requirements, reporting requirements and periodicity, and inter-institutional communication and coordination mechanisms.
  - Specific actions and responsibilities: what, who, where, when how and why
- ix) Annexes
  - If the Contractor wishes to incorporate information beyond the indicated above, such as the policy, institutional and regulatory framework for environmental management in Kenya, biophysical and socio-economic characteristics of the area of influence of the Project, etc., that information should be included as an annex and not in the body of the site-specific ESMP. Preferably, such information should not be attached and, further, if necessary, the pertinent chapter of the ESIA should be referenced.
  - Annexes should be used, if necessary, to include detailed information on the specific topics of the ESMP (e.g., inspection forms or checklists, design of structural mitigation measures, photographic registry of environmental liabilities, etc.).

## **1209. HEALTH AND SAFETY MANAGEMENT PLAN**

Within 42 days of Commencement, the Contractor shall submit a project specific Health and Safety Management Plan (HSMP) for approval of the Employers Representative.

The Contractor must at all times comply with the National and County Laws and Regulations during the Construction and Commissioning Phases of the Project.

### **Site-Specific Health and Safety Management Plan**

The Contractor shall appoint a full-time qualified Health and Safety Officer who shall have responsibility for all health and safety issues on the Project. The Contractor must submit a site-specific Health and Safety Management Plan (HSMP), which shall, as a minimum, address the following:

- 1) Introduction (including objectives of the HSMP)
- 2) Hazard Prevention and Control
  - i) Risk assessment (including description of risk assessment method used);
  - ii) Prevention, protection and control measures (based on risk assessment performed):
    - a) Personal protective equipment and clothing: safety goggles, ear plugs, work boots, dusk masks, protective clothing etc.;
    - b) H&S and sanitary facilities, equipment, materials and personnel: first- aid kits and stations, health personnel, safe drinking water, sanitary facilities, accommodation, washing facilities, domestic waste disposal, etc.;
    - c) On-site safety measures and procedures to protect workers against accidents and

health risks in the performance of construction-related activities:

- Site security: access, safety of visitors, separation of work and rest areas, signage, etc.
  - Handling of raw materials: earthwork, gravel, sand, etc.
  - Handling of other materials causing dust development, such as cement;
  - Hazardous materials management
  - Handling of inflammable materials;
  - Maintenance of vehicles and machinery;
  - Deep Excavation and trenching;
  - Emergency prevention, preparedness and response.
- iii) Contractor's participation in Health and Safety Training Program
  - iv) Contractor's participation in HIV/AIDS Awareness and Prevention Program
  - v) Provide specifics of training and instruction: topics, frequency, modalities, target audiences, instructors, training materials, etc.
  - vi) Potential Topics:
    - a) Occupational safety risks and prevention
    - b) Health risks and prevention
    - c) Use of personal protective equipment
    - d) Safe work procedures: general and specific.
    - e) Organization and Management
  - vii) Organizational structure, personnel, equipment, communication and reporting requirements, accident and incident reports, and procedures and tools to verify and ensure compliance with occupational health and safety requirements.
  - viii) And be used, if necessary, to include detailed information on the specific topics of the HSMP, such as (illustrative list):
    - a) Accident Report forms.
    - b) Dangerous Occurrence forms (near misses).
    - c) Safety Audit Forms.
    - d) Safety Check List.
    - e) Safety Rules.
    - f) List of hospitals, emergency evacuation strategy and other arrangements to treat seriously injured staff.
    - g) List of personnel trained in first aid and their places of deployment.
    - h) List of first aid kits and locations where these will be held.

The Compliance of these Clauses (1208 &1209) by the Contractor is deemed to be covered in his rates quoted in the Bid.

## **SECTION 2: STANDARD REFERENCE NUMBERS**

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## **101. INTRODUCTION**

The Engineer has agreed to use a method of modifying the text of Engineering specifications by referring to a Standard Specification Reference Number (SRN) instead of a National Standard and then providing a tabulated comparison between British and German Standards, cross-referenced further where appropriate to an International Standard (ISO), an International Electro-technical Standard (IEC), to an American Waterworks Standard (AWWA) or other appropriate National Standards.

## **102. GENERAL CLAUSE ON STANDARD SPECIFICATION**

A general introductory clause to be inserted into general specification documents has been prepared. It is quoted below to assist in the preparation of Future Specification Volumes.

### **Standards**

The Contractor shall observe these Specifications and shall carry out all work in a skilled and workmanlike manner in keeping with modern methods of mechanical and construction Engineering.

In addition, the Contractor shall conform with all conditions currently in force with regard to the execution of construction work and shall follow all instructions issued by the competent Authorities, the Employer and the Engineer.

Where Standard Specifications are referred to in the Text of the Specifications this is done by reference to a Standard Specification Reference Number (SRN). A table of comparison is annexed to this Specification where the SRN is cross-referenced to Standard Specifications issued by the International Standards Organization (ISO) and to National Standard Specification that will be accepted in their English version by the Engineer as providing for the quality of workmanship etc. required.

The Bidder shall at his discretion base his Bid on one or other of the National Standard Specifications indicated in that table save that where a relevant Standard Specification issued by the ISO exists at the date of Bid, such an International Standard should as a minimum be complied with. As the National Standards referred to in the table of comparison may expand on or strengthen further the requirements of ISO, Bidders choosing not to comply with one of the National Standards indicated may either indicate an alternative National Standard with which they shall comply or provide with their Bid a full and detailed description of the Standards they propose to attain.

Where a Bidder offers a particular item to a National Standard not specified in the table of comparison he shall comply with the requirements of the Instructions to Bidders in this respect and shall enclose a copy in English of the alternative National Standard offered with his Bid. Alternative National Standards or Bidder's own detailed description of the Standards they propose shall be subject to the approval of the Engineer.

## **103. List of National Specification Cross Referenced**

The list has been sub-divided into sections as follows: -

<u>SRN No.</u>	<u>Specification</u>
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001-099	Electrical and Mechanical
100-199	Concrete
200-299	Metallic Pipes and Fittings
300-399	Plastic Pipes and Fittings
400-499	Other Pipes and Fittings
500-599	Valve, Meters, Hydrants and Other Specials
600-649	Testing Methods and Equipment
650-699	Site Work Codes of Practice
700-749	Drawing Practice, Standard Symbols, etc.
750-799	Glossary
800-899	Building Materials (exclude. In-situ Concrete)
900-999	Miscellaneous

### 103.(a) CONCRETE

**Table 1-0-1 Concrete Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
100	METHOD FOR	1045	TBL. 1	5328	TBL. 3	KS 02-594	
101	STANDARD OF	See	VOB	8110		VOB 2	
102	STANDARDS OF		SUB.	8007			
103	ORDINARY	1164	1	12		KS 02-	
104	SULPHATE	1164	1-CL. 4	4027			
105	MORTAR CUBES	1164	1;CL. 4-	12	METHOD	ISO 3803	
106	CEMENT TEST FOR		6	12	CL. 0		
107	SAMPLING AND TESTING	4226	1-4	812	1, 2, 3	BS EN 1097-3	BS 812 Part 1 Replaced by BS 882
107	SAMPLING	1045		812	101-119		
108	FINE AGGREGATE	4226	1-4	882	CL.4.1		
108	FINE AGGREGATE	1045					
109	FINE AGGREGATE	4226	1-4	882	TBL.2		
110	COARSE	4226		882	CL.4.1		
110	COARSE	1045					
111	COARSE	4226		882	TBL.2		
111	COARSE	1045					
112	COARSE	4226		812	2	ISO 6783	BS 812 Part 120
112	COARSE	1045					
113	COARSE	4226		812	105.1		
113	COARSE	1045					
114	WATER FOR	4226		3148			
114	WATER FOR	4030					
114	WATER FOR						
115	CONCRETE MIX			5328			
115	CONCRETE MIX	1084	1				
116	TRIAL MIXES	1048		1881	108		
117	SAMPLING &	1048		1881	5, 114,	ISO 1920,	
118	CONCRETE BATCH			1305			BS 1305
119	CONCRETE BATCH	450		3063			BS 3063
120	STRUCTURAL USE	1045		8110	1		
121	CONCRETE TRUCK	1084	3	4251	Withdrawn		BS 4251 Withdrawn
122	BITUMEN			2499	TYPE A1		
123	POLYSULPHIDE			4254			BS 4254
124	WATERPROOF			1521	CLASS		
125	IMPACT TESTING OF MILD STEEL	488	3	7613 7668	Grade NDI, CL.B		BS 4360 Withdrawn. Replaced by BS 7613, BS 7668,
126	STEEL R/E HOT	488	1-3	4440			
127	STEEL R/E COLD	488	1-3	4440			
128	STEEL R/E STEEL	488	4-5	4483			
129	BAR			4466			
130	SAND FOR	4226		1100			
131	PLYWOOD SHUTTERING	68791		6566	1-8		BS 6566 Withdrawn. Replaced by various
131	PLYWOOD	68792					
132	CONCRETE	4235	1-2				
133	CONCRETE SITE	1084	1				

134	DESIGN OF	52171		See		HMS	
135	SAND FOR MORTAR	4226		1200			

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
126	SAND FOR	4226		1100			
127	HOT APPLIED JOINT			2400			
128	WATER STOPS AND	7865	1, 2	8007			
139	TESTING			1881	121		
140	TESTING			1881	122		
141	TESTING CON-	1048		1881	101-110 &	KS 02-595	
142	PRECAST			5642/2	2		
143	STRUCTURAL			8110	1		
144	STRUCTURAL						
145	IN SITU CONCRETE	4126					
146	TEST SIEVES FOR			410			
147	LIGHT WEIGHT	4226	2, 3	3797	2		BS 3797 Partly
148	SUPERSULPHATED			4248			BS 4248 Partly
149	CONCRETE			5075			
150	GRADUATE			604		ISO 4788	
151	COLD REDUCED			4482			
152	FUSION BONDED EPOXY COATED			7295	1 & 2		Part 1: Coated bars Part 2: Coatings

### 103.(b) METALLIC PIPES AND FITTINGS

**Table 1-0-2 Metallic Pipes and Fittings Specifications**

SR	SUBJECT	DIN	PA	BSS	PA	OTHER	REMARKS
200	GREYCAST IRON			12		ISO 13;	BS 1211
200	GREY IRON PIPES			46		ISO 13	BS 4622
201	CAST IRON FLANGED			20		ASME	BS 2035
202	DUCTILE IRON					ISO 2531,	
202	DUCTILE IRON					EN 598	
202	DUCTILE IRON PIPES					EN 969	
203	STEEL TUBES WITH			13		ISO 65	
203	STEEL TUBES	2440					
203	STEEL TUBES WITH	2441					
203	STEEL TUBES	2442					
203	STEEL TUBES	7	2	2		ISO	
204	WROUGHT STEEL			17	1	ISO 4145	
204	TH. STEEL PIPE	2980					
204	TH. STEEL PIPE	2981					
204	TH. STEEL PIPE	2982					
204	TH. STEEL PIPE	2983					
204	TH. STEEL PIPE	2987	1,				
204	W. STEEL PIPE	2990					
204	W. STEEL PIPE FITT. TO SSRN 203-PLUGS	2991					
204	TH. STEEL PIPE	2986				ISO 7-	
204	W. STEEL PIPE	2988					
205	COPPER TUBES FOR					EN 1057,	
205	COPPER TUBES FOR	1754	3				
205	COPPER TUBES FOR	1755	3				
206	COPPER TUBES -			28	2	ISO	
206	COPPER TUBES -	1754	1,2				
206	COPPER TUBES -	1755	1,2				
207	FLANGES FOR FERROUS PIPES -	2500		45 04	3-3.1	ISO 7005-1:1992	BS 4504 Part 3: Sections 3.2 (1989)
207	FLANGES FOR	2501	1	15	3-3.1	ISO	
207	FLANGES FOR	2519	1	15	3-3.2	ISO 7005-	
207	FLANGES FOR FERROUS PIPES -				2	EN 1092, ISO	
207	FLANGES FOR	2576					
207	FLANGES FOR	2627-					
207	FLANGES FOR	2566					
207	FLANGES FOR	2655-					
207	FLANGES FOR	2673					

207	FLANGES FOR	2526					
207	FLANGES FOR	2527					
SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
208	GASKET				1	EN 1514	
208	GASKET				2	EN 1514	
208	GASKET				3	EN 1514	
208	GASKET				4	EN 1514	
208	GASKETS FOR	2693					
208	GASKETS GROOVED	2697					
209	C.I. PIPE					ISO	
210	STEEL PIPES &			53			
210	STEEL PIPES -	2460		53		EN	
	WATER-GENERAL			4		10224,	
210	STEEL PIPES &	2413	1	8010		AWWA	
210	STEEL PIPES &	2559	1,	8010		AWWA	
	FITTINGS -		2, 3	2.1		M11	
211	CEMENT MORTAR			EN		EN 545,	
211	CEMENT MORTAR	2614					
211	CEMENT MORTAR					DVGW	
	LINING - D.I. PIPES					W343	
212	CEMENT MORTAR	2614		53		AWW	
	LINING - STEEL PIPES			4		A C	
212	CEMENT MORTAR	2614				205	
						AWWA C	
213	S. PIPES & TUBES-	1629		36		AWWA	
213	CARBON STEEL			36		ISO	
213	STEEL PIPES AND	1626					
213	STEEL PIPES AND	2448					
213	STEEL PIPES AND	2458					
214	BITUMEN			41		(BS	
214	BITUMEN			34		(BS 3416	
214	BITUMEN	3067	Type				
214	BITUMEN	3067	4				
215	EXT.			no		AWWA	
216	STEEL FITTINGS -			no		AWWA	
216	STEEL FITTINGS -			53		AWWA	
217	D.I. PIPES & FITT.-					See SSRN	
218	D.I. PIPES & FITT.					See SSRN	
219	D.I. PIPES & FITT. S &			80	2.		
219	D.I. PIPES & FITT. S &					EN 545	
219	D.I. PIPES & FITT. S &	2860					
219	PIPELINES ON			80	2.		
	LAND; DESIGN,			10	8		
	CONSTRUCTION						
220	D.I. PIPES-ZINC	3067	3	no			
221	IRON AND STEEL			78		AWWA	
221	STEEL FLANGED	2873					
222	ELASTOMERIC			24			Partly replaced by
222	ELASTOMERIC				1	EN 681	

222	ELASTOMERIC	4060					
223	PIPE	See		2		ISO	

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
224	CAST IRON S & S PIPES AND FITTINGS			7 8	2		BS 78 Withdrawn, Replaced by BS
225	STEEL PIPES, HOT DIP					EN 10240	
226	CARBON STEEL FITTINGS - BUTT-	2609 2615 2616 2617	1 1,	19	1		BS 1965 Part 2
227	POLYTHENE	none		no		ISO	
227	POLYTHENE	3067	5				
228	ST. PIPES-	2413	1,	36			
228	S. PIPES-	2460					
229	STAINLESS STEEL TUBES AND WIRES			15 48 63	1	ISO ISO 7598	
		1745 1744					
230	STEEL PIPES FOR	2460		CP201		EN	
230	STEEL PIPES FOR	2460		CP201		EN	
231	FERROUS P.			no		ISO	
232	STEEL PIPELINES	3067	1	no		AWWA	
233	BURSTING DISCS &			29		ISO	
234	STEEL PIPES FOR	1717				EN	
235	FITTINGS TO STAINLESS STEEL TUBES			48 48 48 48	2 3 4 5	ISO ISO ISO	
236	FITTINGS TO BRASS			20	1		
237	RUBBER GASKET			24		ISO 4633;	
238	STORAGE OF			no		ISO	
239	BITUMINOUS			no		ISO	
240	FOUNDING -					EN 1563	
240	FOUNDING -					EN 1564	
241	FUSION BONDED EPOXY COATINGS FOR STEEL PIPES	3067 1		no ne		EN 10309, AWWA	
241	FUSION BONDED					AWWA	
242	FLEXIBLE BOLTED			53		AWWA	
243	FLEXIBLE					AWWA	
244	SPHERICAL			53		UNI 6363	
245	BIT. SEAL			78			
246	POLYMERIC FILM	3067	5	60		EN 534	
247	HOT ENAMEL			78			
248	EXTERNAL ZINC	2444		no		ISO	
249	BOLTS & NUTS FOR	2507		no			



250	STEEL PIPELINES - THERMOSET PLASTIC COATINGS	3067 1		BGC/ CW6		AWW A C215	
SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
251	STEEL PIPES -	3067		no		EN	
252	STEEL TUBES -				1	EN 10246	
253	TWO- & THREE- LAYER	3067 0		53 4		AWWA C215,	
254	LIQUID EPOXY					AWWA	
255	LIQUID EPOXY					AWW	
256	LIQUID	3067				AWWA	
257	LIQUID					AWW	
258	EXTRUDED	3067	1	EN		EN 545	
259	CEMENT MORTAR	3067	2				
260	LIQUID EPOXY			EN		EN 545	
261	FUSION BONDED					AWWA	
262	LIQUID			EN		EN 545	
263	LIQUID			EN		EN 545	
264	TWO LAYER EPOXY NYLON					EN 10246	

### 103.(c) PLASTIC PIPES AND FITTINGS

**Table 1-0-3 Plastic Pipes and Fittings Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
300	uPVC PIPES FOR	19532		3505		ISO 2505,	
300	uPVC PIPES FOR	8062				ISO 3472,	
<del>300</del>	<del>uPVC PIPES FOR</del>					ISO 161/1	
<del>300</del>	<del>uPVC PIPES FOR</del>					KERS 06	
301	JOINTS AND FITTINGS FOR uPVC PRESSURE	8063	1, 12	4346	1-3	ISO 2035,	
		16450				ISO 2045,	
		16451					
302	uPVC PIPELINES -	16928		See CP		CP 312	
303	uPVC PIPELINES -	4279	1, 7				
304	uPVC PIPELINES -	16970					
<del>305</del>	<del>uPVC PIPES</del>	<del>8061</del>		<del>3505</del>			
<del>305</del>	<del>uPVC PIPES</del>	<del>8062</del>		<del>3506</del>			
<del>305</del>	<del>uPVC PIPES</del>	<del>19532</del>					
306	uPVC PIPES - PRESSURE TESTS TO			4728		ISO 1167	Obsolescent (but still remains current) Replaced
307	HDPE PIPES, JOINTS,	16963	1-3	3284			Obsolescent -
308	RUBBER RINGS			2494			
309	uPVC			4660			Partially replaced by
310	uPVC PIPES IMPACT			3505		ISO 3127	
311	uPVC PIPES SHORT			3505			
312	uPVC PIPES LONG			3505			
313	uPVC PIPES	8061					
<del>314</del>	<del>uPVC WATER</del>	<del>8061</del>				ISO 2508	
315	uPVC PIPES -					ISO 2505,	
<del>316</del>	<del>PIPES RATE OF</del>			<del>8010-2</del>			
<del>317</del>	<del>G R P PIPES</del>			<del>6464</del>			
318	PLASTICS PIPES			4962			
318	POLYPROPYLENE WASTE PIPE AND			5254			
319	THERMOPLASTIC			5255			
320	GLASS REINFORCED			5480			
321	UNPLASTICIZED			5481			
322	PLASTICS PIPEWORK (THERMOPLASTICS)			5955	6		Part 6: Installation of unplasticized
323	BLUE POLYETHYLENE			6572			
324	BLACK POLYETHYLENE			6730			

### 103.(d) OTHER PIPES AND FITTINGS

**Table 1-0-4 Other Pipes and Fittings Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
401	ASBESTOS	19800	1-3	486		ISO 160	BS 486 Withdrawn
401	ASBESTOS			4624			
402	A/C SEWER PIPES,			3656		ISO 881	BS 3656 Withdrawn
402	A/C SEWER PIPES,						
402	A/C SEWER PIPES,	19850	1, 2				
403	A/C PIPES FOR					ISO 1188	
404	A/C PIPES - GUIDE			5027		ISO 1182	
405	A/C PIPES - FIELD	4270	1, 6, 9	5886		ISO 1183	
406	PIPE SUPPORTS	See		3974	1	DVGW	
407	UNREINFORCED	4032		5911	3		
408	PRESTRESSED	4035		4625			
409	PRECAST	4032		5911	1, 3		
409	PRECAST	4035					
410	CONCRETE			5911	114		
411	NON-PRESSURE					ISO 7186	
412	RUBBER AND					ISO 7751	
413	CONCRETE CYLINDRICAL			5911	1-3	AWWA C602-83	BS 5911 Part I: 1981 Withdrawn
414	CLAY PIPES			65			
415	TESTING OF			2005			BS 2005 -
416	CONCRETE					BS EN	
153	SURFACE BOX	4055					

### 103.(e) VALVES, METERS, HYDRANTS

**Table 1-0-5 Valves, Meters and Hydrants Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
501	DOUBLE			5163		AWWA	
501	DOUBLE	3230	1-3				
501	DOUBLE						
501	DOUBLE	3352	1, 4				
502	C.I. GATE VALVES			5150			
502	C.I. GATE VALVES	3352	1, 4				
503	C.I. (PARALLEL			5151			
504	C.I. GLOBE VALVES	3356	1, 5	5152			
505	C.I. CHECK VALVES	3202		5153		AWWA	
505	C.I. CHECK VALVES -	See		6282	1, 4	DVGW-	
506	C.I. AND STEEL	3354	1-4	5155		BS EN	BS 5155 Withdrawn
507	BOURDON TYPE			1780		BS EN	BS 1780 Withdrawn
508	FLOAT OPERATED			1212	1, 2, 3		
509	FIRE HYDRANTS	3221	1, 2	750			
510	WATER METERS	19648	1-3	5728	1, 2	ISO 4064-	BS 5728 Part 1
510	WATER METERS					KS 06 248	
511	COPPER ALLOY	3352	11				
511	COPPER ALLOY			5154			
512	FIRE HOSE	14244		336			
512	SURFACE BOXES			5834	2, 3		
512	SURFACE BOXES						
512	SURFACE BOXES						
512	SURFACE BOXES						
512	SURFACE BOXES						
514	METALLIC BALL	3357	1, 7				DIN 3357 Part 6, 7
515	UPVC VALVES	3441	2				
517	FIRE			5041	1-5		
518	BUTTERFLY VALVES			5155			
519	DIAPHRAGM			5156			
520	CAST IRON PLUG			5158			
521	UNDERGROUND			5433			

### 103.(f) TESTING METHODS AND EQUIPMENT

**Table 1-0-6 Testing Methods and Equipment**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
600	NON-DESTRUCTIVE	8564	1	3889	1, 2A	AP15LS	BS 3889 Partially
600	NON-DESTRUCTIVE	50120	1, 2	6072			
601	SOILS FOR	18196		1377			
602	TESTING OF	4279	1-7, 9,				
603	TESTING OF CEMENT	See EDIN		4550	1, 2, 3	BS EN 196-7	BS 4550 Part 1 & Part 2 Withdrawn
604	MATERIAL TESTING					ISO 404,	
605	MEASUREMENT					ISO	
606	DRINKING WATER					KS 05	
607	RECOMMENDA			3882			
608	METHODS OF			4551			
609	STRUCTURAL FIXINGS IN			5080	1 & 2		Part 1: Method of test for tensile
610	SIZE OF			5450			
611	RECOMMENDATIO			5835	1		Part 1:

### 103.(g) SITE WORK CODES OF PRACTICE

Table 1-0-7 Site Work Codes of Practice

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
650	SITE	18196		5930			
650	SITE	18307					
651	WATER SUPPLY	2000	See BS	BS		CP 310	CP 310 Withdrawn
651	WATER SUPPLY	2425	3, 5	BS		CP 301	CP 301 Withdrawn
651	WATER SUPPLY	4046					
651	WATER SUPPLY	10630					
652	BUILDING	1986	2-4	BS		CP 301	CP 301 Withdrawn
652	WATER PIPELINE	10630					
654	TRENCHING FOR	4124					
655	SEWAGE PIPELINE						
656	WALLING (BRICK & BLOCK MASONRY)	18330	See BS	5390 5628		CP 121	CP 121 Withdrawn Replaced by BS
657	USE OF STRUCTURAL	18203	1, 2	449 BS	2	GB 7101-91	BS 449 Parts 1 and 2 Withdrawn Part
658	SEWERAGE			8005		BS EN	
659	SMALL SEWAGE			6297			
660	TEST DUMPING OF			6316			
661	METHODS OF MEASUREMENT OF LIQUID FLOW IN OPEN CHANNEL			3680	1-10	BS ISO 748 BS ISO 1100-2	BS 3680 Part 3A Withdrawn Replaced by BS ISO 748: 1997
662	MEASUREMENT OF FLOW IN					ISO 7194	
663	CONSTRUCTION					ANSI	
664	DRAINAGE OF			6367			
665	FOUNDATIONS			8004		CP 2004	CP 2004 Withdrawn
666	STRUCTURAL USE OF TIMBER			5268		CP 112, 2	CP 112, 2 Withdrawn
667	RETAINING WALLS	4085					
668	WATERPROOFING	18195	1-4				
669	WATER QUALITY					ISO	
670	WELDING PROCEDURES -			4870	1	BS EN 288-3	BS 4870 Part 1 Withdrawn
671	WELDING - APPROVAL TESTING			4871	1	BS EN 287-1	BS 4871 Part 1 Withdrawn
672	LOGGING OF ROCK CORES					LOGGING OF ROCK CORES	
673	TEST FOR			1024			
674	DRAIN AND SEWER SYSTEMS OUTSIDE				1, 2 & 3	BS EN 752	Part 1: Generalities and
675	CONSTRUCTION					BS EN	
676	IDENTIFICATION			1710			
677	WELDING OF STEEL			4515			
678	PERFORMANCE REQUIREMENTS			5114			

679	STRUCTURAL USE OF TIMBER			5268	2, 3 & 5		Part 2: Permissible stress design, materials and workmanship
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SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
680	STAIRS, LADDERS AND WALKWAYS			5395	1, 2 & 3		Part 1: Design of straight stairs Part 2: Design of
<del>681</del>	<del>INTERNAL</del>			<del>5402</del>			
<del>682</del>	<del>GUIDE TO</del>			<del>5606</del>			
683	SAFE USE OF			5607			
683	USE OF MASONRY			5628	3		Part 3: Materials
<del>684</del>	<del>EARTHWORKS</del>			<del>6031</del>			
<del>685</del>	<del>PAINTING OF</del>			<del>6150</del>			
<del>686</del>	<del>LOADING FOR</del>			<del>6300</del>	1		Part 1: Dead and
687	GUIDE TO			6683			
688	DESIGN, INSTALLATION, TESTING AND			6700			
689	GUIDE FOR STRUCTURAL			7533			
690	SEWERAGE			8005	1		Part 1: Guide to
691	PROTECTION OF			8102			
692	DESIGN AND INSTALLATION OF			8215			
693	CODE OF PRACTICE			8217			

### 103.(h) DRAWING PRACTICE, STANDARD SYMBOLS ETC.

**Table 1-0-8 Drawing Practice, Standard Symbols**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
700	IDENTIFICATION	2403					
701	GRAPHICAL	2406		1553	1		
701	GRAPHICAL SYMBOLS FOR PROJECT NETWORK	2429	1				
702	DRAWING			1192	1-4		BS 1192 Part 2
703	CONSTRUCTION ENGINEERING			308	1	ISO 128,	BS 1192 Part 2
704	DRAWING PRACTICE FOR ENGINEERING			5070	1-3	BS EN 61082	BS 5070 Part 1 Partially Replaced
705	BUILDING AND			6100	1-6		
706	WATER SUPPLY	2425	2, 5				
707	CARTOGRAPHIC	50019	1				
708	CONCRETE (INC. P/E)			6100	6, 2, 6, 3		
709	VALVES GLOSSARY						
710	IRON AND STEEL			6562	1-2		

### 103.(i) BUILDING MATERIALS

**Table 1-0-9 Building Materials Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
801	LIME FOR MORTAR	1060	1, 2, 3	890	CL.B		DIN 1060 Part 2 & 3
802	QUARRY TILES FOR SILLS			6431		BS EN ISO 10545-2, 3, 4 & 7	BS 6431 Parts 10, 11, 12 & 14 Replaced by BS EN ISO 10545-2, 3, 4 & 7
803	DAMP-PROOF COURSE			743 (6398: BS 6398)			BS 743 Partially Replaced by
804	CONCRETE BLOCKS			6398		KENYA	
804	CONCRETE BLOCKS			6073	1, 2		BS 6073 Partially
805	HOLLOW CLAY	278		3921			BS 3921 Partially
806	BRICK WALLING	105	1-5	3921			BS Partially
806	BRICK WALLING	106	1, 2				
807	ASBESTOS ROOF SLATES			690	3, 4		BS 690 Part 3 & 4 Withdrawn
808	FIXING BOLTS						
809	INSULATION BOARD AND HARD BOARD			1142	1, 2, 3	ISO 766/7/9,	BS 1142 Partially Replaced by
810	BLOCKBOARD	68705	1, 3	3444		ISO 1096,	DIN 68705 Part 1
811	PLYWOOD	4078		6566	1-8	ISO 1096,	BS 6566 Replaced
811	PLYWOOD	68705	1, 5			ISO 1098	DIN 68705 Part 1
812	SEALING OF EXT	18540	SH 1, 2				
813	CHIPBOARD	68761	4	5669			BS 5669 Part 1 Partially Replaced by BS EN 120, 309, 310, 311, 312, Parts



SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
		<del>68763</del>					
		<del>68764</del>					
814	LAMINATED PLASTIC SHEETING	16922		3794		BS EN 138	BS 3794 Withdrawn Replaced by BS EN
814	LAMINATED						
814	LAMINATED						
815	WOOD WOOL SLABS	1101		1105			BS 1105
815	WOOD WOOL SLABS	1102					
816	QUALITY OF TIMBER	<del>68141</del>		1186	2		
817	MATERIAL FOR	<del>68706</del>		450			BS 450 Part 3
817	MATERIAL FOR	<del>18101</del>					
817	MATERIAL FOR						
818	WATERPROOF	53255		1203	TYPE MP		
819	STRUCTURAL STEEL & METALWORK			4360 7316 7668		ISO 630, 6891 BS EN	BS 4360 Withdrawn - Replaced by BS 7316, BS 7668,
819	STRUCTURAL					JIS	
820	SPLIT RING TIMBER			1570			
821	METAL WINDOWS			6510			
822	GLASS FOR GLAZING	1240	1	052	1		
822	GLASS FOR GLAZING	18301					
823	GALVANISED M.S.	2440		1387		ISO 65	
823	GALVANISED M.S.	2441		21			
823	GALVANISED M.S.	2442					
823	GALVANISED M.S.	2999	1				
824	FITTINGS TO M.S.	2460		1256			
824	FITTINGS TO M.S.			143		BS EN	
824	FITTINGS TO M.S.			1740	1		
825	POLYTHENE TUBING FOR COLD	19533		2782		ISO 161-1 BS ISO	
825	POLYTHENE	8072		6572			
825	POLYTHENE	8073					
825	POLYTHENE	8075					
825	POLYTHENE	8074					
826	BRASSWORK &			1010	2		
827	BALL VALVES FOR			1212	3		
828	PLASTIC FLOATS			2456			
829	CAST IRON SOIL			416			
829	CAST IRON SOIL,						
829	CAST IRON SOIL,	19522	1, 2				
830	GALVANISED MILD			417	2 CL.A		
831	ENAMELLED CAST			1180			
831	ENAMELLED CAST						
831	ENAMELLED CAST	4774					
832	PILLAR TAPS	7572		1010	2		
833	GLAZED VITREOUS	1387		5503			
833	GLAZED	1381					
834	HINGED PLASTIC			1254			
835	GLAZED	4462		1188			
835	GLAZED			5506	2		
836	STAINLESS STEEL	4465		1244	2		
837	BRASS "S" AND "P"			1184			BS 1184
839	A/C DRAIN PIPES AND FITTINGS	19831		3656		BS EN	BS 3656 Withdrawn Replaced by BS EN
839	A/C	19841				588-1	

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
839	A/C	19850	1, 2				
840	CONCRETE	See		2870			
841	PITCH FIBRE			2760			BS 2760 Withdrawn
842	CAST IRON DRAINPIPES	10500		137		ISO 6504	
		10501					
		10502					
		10503					
		10504					
		10505					
		10506					
		10507					
		10508					
		10509					
		10501					
		10501					
		10501					
		10501					
		10521					
843	JOINTING			BS	1, 5, 6, 7		
844	C.I. S & S FITTINGS	10510		137			
845	STEP-IRONS TO	1211	1	1247			
845	STEP-IRONS TO	1212	1				
845	STEP-IRONS TO	1213					
845	STEP-IRONS TO	4281					
846	C.I. MANHOLE COVERS AND FRAMES	1229		497	1	BS EN	BS 497 Withdrawn
		4271	1, 3				
		19593	1 2 3				
		19594	1 2				
		19596					
		19597					
847	STEEL LADDERS	3620		4211			
848	HANDRAILING	24523		6180			
849	GALVANISED CHAIN	11001		1722	1		
850	OPEN MESH STEEL			1502	1		
851	MASTIC ASPHALT			6025			
852	ALUMINIUM FOR LOUVRE WINDOWS			1470		BS EN 485	BS 1470 Withdrawn Replaced by BS
853	FIXING			1494	1		BS 1494 Part 2
854	PRECAST CONCRETE MANHOLES	4034		5911	2, 3		BS 5911 Part 1 Withdrawn Replaced by
855	PRECAST	483		7263	1		
856	WATERPROOF BUILDING PAPERS	4122		1521			
		52126					
		52127					
		52128					
		52129					
		52130					
857	METAL TIES FOR			1243			
858	A/C	274	1-4	4624			
859	PRECAST CONCRETE	485		7263	1		
860	ASBESTOS	19831	1-9	569			
860	ASBESTOS	19841	1-6				
860	ASBESTOS	19850	1				
861	LINTELS			5077	2		
862	uPVC SOIL AND	1187		4514			
863	STRUCTURAL STEEL			449	2		BS 449 Part 2

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
864	PROTECTIVE BARRIERS IN AND			6180			
866	BITUMENS FOR			3690	1, 3		
<del>867</del>	<del>SOLID WATER</del>					AS 2813	
868	FLOORING -			6263	2		
869	RIGID FLAT						
<del>870</del>	<del>BUILDING STONE</del>			1438			
<del>871</del>	<del>CAST STONE</del>			1217			
<del>872</del>	<del>WOOD</del>			144			
<del>873</del>	<del>WASTE TRAPS</del>			3043			
874	COPPER FLOATS			1968			
<del>875</del>	<del>VITREOUS CHINA</del>			3402			
876	PAINTS - LEAD			2523			BS 2523
877	READY MIXED			2521/			
878	READY MIXED OIL-						
879	COLD POURED			5212			
880	GULLY TOPS AND MANHOLE TOPS					BS EN 124	
881	STRUCTURAL			338			
882	CLAY ROOFING TILES AND FITTINGS			402	1		Part 1: Specification for
883	BITUMEN ROAD			434	1		Part 1: Bitumen road
884	DRESSED			435			
885	CONCRETE					BS EN	
886	AIR BRICKS AND			493			
887	EAVES GUTTERS					BS EN	
888	EAVES GUTTERS					BS EN	
<del>889</del>	<del>PLYWOOD</del>					BS EN	
<del>890</del>	<del>TIMBER IN JOINERY</del>					BS EN	
891	PRESSED STEEL			1091			
892	WC FLUSHING CISTERNS			1125			
893	NAILS			1202	1, 2 & 3		Part 1: Steel nails Part 2:
893	FIXING			1494	1		Part 1 Fixings for
894	AUTOMATIC			1876			
895	WASTES			3380			
896	LIGHTWEIGHT AGGREGATES			3797			
<del>897</del>	<del>TERRAZO TILES</del>			4131			
<del>898</del>	<del>WELDABLE</del>			4360			
899.	UNPLASTICIZED POLYVINYL			4576			
899.	INDUSTRIAL TYPE METAL FLOORING,			4592	1, 2, 3 & 4		Part 1: Open bar gratings Part 2: Expanded
<del>899.</del>	<del>READY MIX</del>			4721			
899.	INTERNAL AND			4787	1		Part 1: Dimensional
899.	HOT-ROLLED			4848	2 & 4		Part 2: Hot-finished
<del>899.</del>	<del>LIPINALS</del>			4880	1		Part 1: Stainless steel

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
899.7	MORTAR ADMIXTURES			4887	1 & 2		Part 1: Air-entraining
899.	SOFTWOOD			4978			
899.9	COATED MACADAM FOR ROADS AND			4987	1 & 2		Part 1: Constituent
899.	WATER-BORNE			5082			
<del>800.</del>	<del>MASONRY CEMENT</del>			<del>5224</del>			
<del>800.</del>	<del>EXTERNAL</del>			<del>5262</del>			
899.	SOLVENT-BORNE			5358			
899.14	WALL AND FLOOR TILING			5385	1, 2, 3, 4 & 5		Part 1: Design and installation of internal ceramic wall tiling and mosaics in normal conditions Part
<del>800.</del>	<del>STONE MASONRY</del>			<del>5300</del>			
899.16	SPECIFICATION FOR LOW-SUITABLE FOR OPERATION AT PN 10			5412			
899.17	VITREOUS CHINA WASHDOWN WC PANS WITH			5503	1 & 2		Part 1: Connecting dimensions
899.	VITREOUS			5520			
<del>800.</del>	<del>PRESERVATION OF</del>			<del>5580</del>			
899.20	PLASTIC CONNECTORS FOR			5627			
899.	STILES, BRIDLE			5709			
<del>800.</del>	<del>GLAZING FOR</del>			<del>6262</del>			
899.23	MANUFACTURE OF GLUED			6446			
899.	POLYETHYLEN			6515			
899.	INSTALLATION			6576			
899.	PORTLAND			6588			
<del>800.</del>	<del>PRECAST CONCRETE</del>			<del>6717</del>	1		Part 1: Paving blocks
899.	EXTERIOR WOOD			6952	1		Part 1: Guide to
899.	PRECAST			7263	1 & 2		Part 1: Specification
899.	IN-SITU FLOORINGS			8204	2		Part 2: Concrete

### 103.(j) ELECTRICAL / MECHANICAL

**Table 1-0-10 Electrical/Mechanical Specifications**

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
001	FRACTIONAL <del>HORSE POWER</del>	42021		2048	1		
002	CURRENT			7626		IEC 60185	
003	VOLTAGE			7625		IEC	
004	CIRCUIT BREAKERS			5311		IEC	
005	CIRCUIT			842		BS EN	
006	CIRCUIT A.C. <del>CURRENT</del>			4293		BS IEC	BS 4293 Partially
007	FUSE SWITCHES (AIR <del>BREAKER</del> )			5419		IEC 408	BS 5419 Withdrawn Replaced by BS EN
008	MOTOR STARTERS AND CONTROLLERS	46062		587			BS 587 Withdrawn Replaced by BS EN
009	MOTOR STARTERS			5856	1	IEC	
010	ELECTRIC MOTOR	42673	BL. 1-4	4999	10	IEC	
011	INDUCTION	42673	BL. 1-4	5000	10	IEC 60072	
012	ENCLOSURE	40050	BL. 2, 6,	5420		IEC 60144	BS 5420 Withdrawn
013	MOTOR STARTERS	46062		4941	1, 3, 4	IEC 292,	BS 4941 Withdrawn
014	ELECTRICITY METERS			37	1, 5, 8		BS 37 Withdrawn Replaced by Parts 1
015	WATT-HOUR METERS			5685		IEC 521	BS 5685 Part 1 (1979) and Part 2, 2
016	ACCEPTANCE	4325		5316	1	ISO 2548	
017	ACCEPTANCE	4325		5316	2	ISO 3555	
018	CODE OF					IEE W.	
019	ELECTRICAL PROTECTIVE DEVICES			142			BS 142 Part 1 Section 1.5 Sub-
020	FACTORY	57670	TL. 6	5486	1, 2, 3, 13	IEC 439-2	BS 5486 Part 1
021	RECIPROCATING INT/COMB. ENGINES			5514	1, 2	ISO 3046,	BS 5541 Part 2 (1988) 'Test
022	MACHINES FOR			5000	99		
023	INSULATING			2757		IEC 85	
024	PCV	57207	4, 5	6346			
025	ROTATING			4999	1, 2, 3	IEC 34-1,	Renumbered as EN
026	CONCRETE CABLE			2484			BS 2484
027	ELECTRIC POWER	57660		5486 5727			
028	SAFETY ISOLATING			3535			
029	ROTATING	42961		4999	4	IEC	
030	ROTATING	40050		4999	20	IEC	
031	ROTATING			4999	31	IEC	
032	ROTATING	See		4999	32	IEC	
033	ROTATING	See		4999	50	ISO 2373	
034	ROTATING			4999	60	IEC	
035	GENERATORS	See		5000	3	VDMA	
036	MACHINES	22418		5000	17		
037	MAINTENANCE			6626			

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
038	PROTECTION PROVIDED BY			5490		IEC 600529	BS 5490 Withdrawn Replaced by BS EN
039	ELECTRICAL EQUIPMENT			2771		EN 60204, Part 1	BS 2771 Part 1 Replaced by EN
040	SWITCHGEAR AND CONTROL			4752		IEC 600157-1	BS 4752 Withdrawn Replaced by BS EN
041	PVC INSULATED			6231			
042	BASIC			2011	1.1	IEC	BS 2011 Parts
043	DEFINITIONS					IEC	
044	PANEL MOUNTED					IEC 600473	
045	CELLULOSIC			5626	1, 2, 3	IEC	
046	COMMISSIONING					IEC	
047	RUBBER INSULATED					IEC	
048	VOLTAGE					IEC	
049	ELECTRIC CABLES -					KS 04-290	
050	ROTATING			5000	16		
051	POWER					BS EN	
052	ELECTRIC CONDUIT			4568	2		
053	RUS BARS			150			
054	NON-METALLIC			4607	2		Partially Replaced
055	PVC CABLES IN			6004			
056	INSULATED			6500			
057	M.I.C.C. CABLES			4782	1		
058	FLUSH SWITCHES			3676			
059	ELECTRIC SOCKETS			1363			Part 3: 1989
060	FUSED SPUR BOXES			1362			
061	CONTACTORS			775			Part 1 (1969)
062	SECURITY LIGHTING					CP 1004	Renumbered as BS
063	ALUMINIUM SOLID			3988			

### 103.(k) MISCELLANEOUS

**Table 1-0-11 Miscellaneous**

SERN	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
900	ZINC SPRAY PROTECTION	55928	1-9	2569	1	ISO 2063 BS EN 22063	BS 2569 Withdrawn Replaced by BS EN 22063
900	ZINC SPRAY PROTECTION (CONT.)			5493		BS EN ISO 12944	BS 5493 Proposed for Obsolescence
901	METALLIC ZINC RICH			4652			
902	COLOUR OF FINISH (BUILDING)	See VOB		4800		VOB pt. C	
903	HOT DIP GALVANIZING ON			729		ISO 1459	
903	HOT DIP GALVANIZING ON IRON & STEEL (CONT.)			5493		ISO 1461 BS EN ISO 12944	BS 5493 Proposed for Obsolescence
904	BLACK BITUMEN SOLUTION (COLD APP.)		See DVGW	3416	TYPE II	DVGW-GWS	
905	WELDABLE STRUCTURAL STEELS	1025	1-5	4360		ISO 630	BS 4360 Withdrawn - Replaced by BS 7613, BS 7668, BS EN
906	CLASSIFICATION OF GREY CAST IRON			1452		ISO 185	BS 1452 Withdrawn Replaced by BS EN 1561
907	BEARING DESIGN LIFE						
908	BITUMEN - HOT APPLIED COATINGS	30673		4147			
908	BITUMEN - HOT APPLIED COATINGS			5493			
909	PRESSED STEEL			1564			
910	GREY IRON CASTINGS FOR MANHOLE COVERS			1452	GRADE 10		
911	MALLEABLE CAST IRON			6681		ISO 5922	BS 6681 Withdrawn - Replaced by BS EN 1562
911	MALLEABLE CAST IRON					ASTM A 47-	
912	ROLLED STEEL			4360		ISO 630	BS 4360 Withdrawn - Replaced by BS 7613, BS 7668, BS EN
912	ROLLED STEEL (CONT.)						
913	STRUCTURAL STEEL SECTIONS	1025	1-5	4	1		BS 4 Part 2 (1969) Withdrawn
914	ISO METRIC BLACK HEXAGONAL BOLTS	267	1, 2	4190		ISO 272, 4750, 1, 2	BS 4160 Obsolescent
914	ISO METRIC BLACK HEXAGONAL BOLTS					ISO 885, 888	
914	ISO METRIC BLACK HEXAGONAL BOLTS					ISO 898/2, 808/1	
915	SIZES FOR FERROUS & NON FERROUS BARS			6722			
916	MECHANITE IRON, GRADE E					ASTM A48, No.	
917	CORROSION PROTECTION OF STEEL	55928	1-9	5493		BS EN ISO 12944	BS 5493 Proposed for Obsolescence
918	INGOT ZINC			3436		ISO 752 BS EN 1179	BS 3436 Withdrawn Replaced by BS EN 1179
919	WELDING OF STEELS (METAL ARC)	8528	1-2	5135	1		BS 5135 Partially Replaced by BS EN
919	WELDING OF STEELS (METAL ARC) (CONT.1)	8553		499	1		BS 499 Part Obsolescent / Withdrawn
919	WELDING OF STEELS (METAL ARC) (CONT.2)	8558	1				
919	WELDING OF STEELS (METAL ARC) (CONT.3)	50120	1				
920	STEEL PLATE, SHEET AND STRIP			1449	1 (Withdrawn)	ISO 3573	BS 1499 Parts Withdrawn Replaced by BS EN 10111, 10209, BS EN 10149-2 & 3, 10051, 10131, 10139,
						ISO 3574	
		1614					
		1632	2				
		1624					

SR	SUBJECT	DIN	PART	BSS	PART	OTHER	REMARKS
921	ELECTROPLATE D COATINGS ON			3382	1-6		
922	ELECTROPLATE D COATINGS ON			3382	7	ISO-DIS 4042	
923	ISO METRIC SCREW			3643	1-2	ISO 68,	
<del>923</del>	<del>ISO METRIC SCREW</del>					ISO 1106	
924	ISO METRIC			3692		ISO 887	BS 3692
925	METAL WASHERS FOR			4320		ASS 2602: 83	
926	STEEL						
<del>927</del>	<del>HEAD TEST EOP</del>	<del>50141</del>					
928	WELDED STEEL					APS 650	
929	LIFTING					ISO	
<del>930</del>	<del>HIGH STRENGTH</del>			<del>4325</del>			
931	ELECTRODES			639		BS EN	BS 639 Withdrawn
932	BLACK CUP			4933			BS 4933
<del>933</del>	<del>METAL LATHING</del>			<del>1260</del>			
934	ROLLED ASPHALT			594			
935	BINDER DIST.			1707			
<del>936</del>	<del>BITUMINOUS</del>			<del>747</del>		<del>CP 114-3</del>	<del>CP 114-3 Withdrawn</del>
<del>937</del>	<del>GAS WELDING</del>			<del>2640</del>			
938	METALLIC COATINGS. HOT					BS EN 1460	
939	METHOD FOR SPECIFYING			1706			
940	DIMENSIONS OF GASKETS FOR			4865	1		Part 1: Non-metallic flat gaskets
941	BONDING AGENTS FOR			5270	1		Part 1: Polyvinyl acetate (PVAC)
<del>942</del>	<del>EAL SEWOPK</del>			<del>5075</del>			
943	TUBULAR POLYETHYLENE			6076			
944	FLEXIBLE JOINTS FOR GREY OR DUCTILE CAST			6087			
945	HOT ROLLED			10025			
946	STAINLESS STEELS			10088	2		Part 2: Technical delivery conditions
947	PIPE BURSTING					SASTT- TS-	
947	HORIZONTAL DIRECTIONAL					SASTT- TS-	



**103.(I) DIN**

**Table 1-0-12 DIN**

DIN	SRN	DIN	SRN	DIN	SRN	DIN	SRN	DIN	SRN
105	806	2000	651	2088	204	1270	405	10620	651
106	806	2403	700	2090	204	1270	602	10648	510
267	914	2406	701	2091	204	1281	845	10800	401
278	805	2410	213	2093	204	1325	017	10850	402
450	110	2413	210	2099	203	1325	016	10850	830
483	855	2413	228	2099	823	7572	832	10850	860
488	128	2425	708	3202	502	7865	138	22418	036
488	127	2425	651	3202	505	8061	305	28500	201
488	126	2429	701	3202	501	8061	314	28500	200
488	125	2440	203	3221	509	8061	313	28601	217
1025	905	2440	823	3230	501	8062	300	28602	218
1025	913	2441	203	3352	501	8062	305	28603	219
1045	108	2441	823	3352	502	8063	301	30670	227
1045	107	2442	203	3352	511	8072	825	30671	215
1045	110	2442	823	3354	506	8073	825	30672	221
1045	120	2444	225	3356	504	8074	825	30673	214
1045	111	2448	213	3357	514	8075	825	30673	008
1045	113	2458	213	3441	515	8528	010	30674	220
1045	112	2460	210	3620	847	8553	010	40050	012
1048	116	2460	213	4030	114	855	010	40050	030
1048	117	2460	824	4032	407	8564	600	42021	001
1060	801	2500	207	4032	409	8565	220	42673	010
1084	115	2501	207	4033	655	1045	100	42673	011
1084	121	2505	216	4034	854	16450	301	42961	029
1084	133	2519	207	4035	409	16451	301	46062	008
1101	815	2526	207	4035	408	16922	814	46062	013
1102	815	2559	210	4046	651	16928	302	50019	709
1164	103	2566	207	4060	222	16963	307	50120	600
1164	106	2605	226	4078	811	16970	304	50120	010
1164	105	2615	226	4085	667	18101	817	50141	927
1164	104	2615	216	4124	654	18195	668	50976	903
1187	862	2616	226	4126	145	18196	601	52128	856
1199	849	2616	216	4226	109	18196	650	52129	856
1211	845	2617	216	4226	110	18203	657	52130	856
1212	845	2617	226	4226	108	18301	822	53255	818
1229	846	2632	207	4226	107	18307	650	55028	900
1230	414	2633	207	4226	130	18330	656	55028	017
1249	822	2673	207	4226	111	18540	812	57207	024
1381	833	2693	208	4226	136	19522	829	57660	027
1387	833	2695	208	4226	114	19532	300	57670	020
1614	920	2696	208	4226	113	19532	305	68705	811
1623	920	2697	208	4226	112	19533	825	68706	817
1624	920	2873	221	4226	135	19593	846	68761	813
1626	213	2950	209	4235	132	19594	846	68763	813
1629	213	2980	204	4271	846	19596	846	68764	813
1754	205	2986	203	4279	202	19597	846	68791	131
1986	652	2987	204	4279	303	19630	653	68792	131

**103.(m) BSS**

**Table 1-0-13 BSS**

BSS	SRN	BSS	SRN	BSS	SRN	BSS	SRN	BSS	SRN
4	913	1188	835	2494	308	4466	129	5486	20
12	103	1189	831	2499	137	4483	128	5493	900
12	106	1192	703	2439	122	4504	207	5493	908
12	105	1192	704	2569	900	4514	862	5493	917
21	203	5911	410	2640	937	6811	12	5506	835
21	223	1199	130	2757	23	4550	603	5514	21
21	823	1199	136	2871	206	4568	52	5626	45
5685	14	1200	135	2871	205	4592	850	5642	142
65	414	1203	818	3148	114	4607	54	5669	813
78 (4772)	224	1211 (4772)	200	3284 (6811)	307	4622	200	5685	15
143	824	1212	508	3382	921	4624	401	5728	510
144	872	1212	827	3382	922	4624	858	5834	513
159	53	1217	871	3402	875	4625	408	5856	9
308	705	1243	857	3416	904	4652	901	5886	405
336	512	1244	836	3444	810	4660	309	5911	407
368	859	1247	845	3505	311	4670	938	5911	409
410	146	1254	834	3505	310	4800	902	5911	413
416	829	1256	824	3505	300	4870	670	5911	854
417	830	1363	59	3505	305	4871	671	5927	404
437	844	1369	933	3505	312	4999	30	5930	650
437	842	1377	601	3506	305	4999	33	5977	861
459	817	1387	203	3535	28	4999	34	6004	55
499	919	1362	60	3600	213	4999	31	6072	600
534	210	1387	823	3600	228	4999	10	6073	804
534	212	1438	870	3601	213	4999	29	6100	707
569	860	1449	920	3643	923	4999	25	6100	750
594	934	1521	124	3656	839	5000	11	6180	864
604	150	1521	856	3676	58	5000	22	6231	41
690	807	1553	701	3680	661	5000	36	6263	868
729	903	1554	229	3690	866	5000	35	6282	505
743	803	1564	909	3692	924	5000	50	6297	659
747	936	1579	820	3889	600	5041	517	6316	660
750	509	1707	935	3921	805	5070	706	6346	24
775	61	1722	849	3921	806	5075	149	6367	664
812	107	1740	204	3941	3	5135	919	6398	804
812	112	1740	824	3943	873	5150	502	6431	802
812	113	1881	139	3988	63	5151	503	6464	317
842	5	1881	140	3974	406	5152	504	6500	56
882	108	1881	141	4027	104	5153	505	6510	821

882	109	1881	116	4147	214	5154	511	6626	37
882	110	1881	117	4147	908	5163	501	6722	915
882	111	1924	673	4211	847	5212	879	6746	24
890	801	1968	874	4248	148	5311	4	6925	851
952	822	2011	42	4293	6	5316	16	8007	102
1010	826	2048	1	4320	925	5316	17	8010	316
1010	832	2494	318	4335	702	5328	100	8110	101
1105	815	2521	877	4346	301	5328	115	8110	143
1142	809	2456	828	4395	930	8007	138		
1186	816	2494	222	4449	126	5419	7		

### 103.(n) OTHER STANDARDS

**Table 1-14 Other Standards**

OTHER STANDARDS	SRN	OTHER STANDARDS	SRN
AAS 2602:83, 2603:03	926	ISO 2035, 2044	301
AGMA 5T 510	907	ISO 2045, 2048, 2536	301
ANSI A10 9-1983	663	ISO 2063	900
AP15LS	234	ISO 2505, 3114, 3472, 3473, 3474	315
APS 650	928	ISO 2531	202
AS 2813-85	867	ISO 2531	207
ASTM A 47-77	911	ISO 2548 ICE 198	16
ASTM A 48, No. 308	916	ISO 272, 4759-1, 3	914
AWWA C. 508-82	505	ISO 3046, PARTS 1, 2	21
AWWA C.104A, C602-	211	ISO 3114, 3606	300
AWWA C.200-75	210	ISO 3127	310
AWWA C.200-75	230	ISO 4042	922
AWWA C.203-78	221	ISO 4179, 6600, DVGW W342	211
AWWA C.205 DVGW-W-342-71	212	ISO 4200	228
AWWA C.214-83	232	ISO 4633	222
AWWA C.602-83	212	ISO 49	209
AWWA C.602-89	413	ISO 7/2	203
CP 1004	62	ISO 7005/2, 3	207
CP 112, 2	666	ISO 7-1/2	223
CP 2004	665	ISO 7186	411
CP 2005	658	ISO 7194	662
CP 301	652	ISO 7268	231
CP 310	651	ISO 752	918
CP 312	302	ISO 7751	412
CP 499	848	ISO 7752/5	929
IEC 60072	11	ISO 8493	205
IEC 60072, 72A	10	ISO 881	402
IEC 600805	46	ISO 885, 888	914
IEC 600827	48	ISO 887	925
IEC 60085	23	ISO 898/2, 898/1	914
IEE W. REGS (15TH EDITION)	18	ISO 965/3, 262	923
ISO 1106-3, 7438	924	ISO DIS 4042	921
ISO 1167	306	KENYA M.O.W. STANDARD SPEC.	804

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ISO 128, 2162, 2203, 5455, 5457	705	KS 04-290	49
ISO 13	200	KS 05-459:5	606
ISO 160	401	KS 06-149:2	300
ISO 161/1	300	KS 06-248 1, 2	510
ISO 161-1	825	VDB 2	101
ISO 185	906	VDB PART C	902
ISO 1920, 4012, 4108, 4013	117	VDMA 6280	35
ISO 196 (TESTS)	206		

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**APPENDICES**

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## **APPENDIX 1: ENVIRONMENTAL, SOCIAL, HEALTH AND SAFETY (ESHS) SPECIFICATIONS**

## Specifications for Environmental, Social, Health and Safety Management (ESHS) of the Works

### 1. Essential ESHS issues of worksite management

The ESHS topics identified during the Environmental and Social Impact Assessment study of the project, which present a major risk for the worksites management are:

a) ESHS resources and facilities and ESHS monitoring organization	YES
b) Project Areas management (base camps, quarries, borrow pits, storage areas)	YES
c) Health & Safety on worksites	YES
d) Local recruitment and ESHS trainings of local staff (capacity building), ESHS trainings of subcontractors and local partners (transfer of knowledge)	YES
e) Relations with stakeholders, information and consultation of local communities and authorities	YES
f) Traffic management	YES
g) Hazardous products	YES
h) Wastewater (effluents)	YES
i) Protection of water resources	YES
j) Atmospheric emissions, noise and vibrations	YES
k) Waste management	YES
l) Biodiversity: protection of fauna and flora	YES
m) Site rehabilitation and revegetation	YES
n) Erosion and sedimentation	YES
o) Control of infectious and communicable diseases (HIV/AIDS, malaria, etc.)	YES

### 2. ESHS Requirements not applicable under this Contract

**The ESHS norms, standards and discharge limit values recommended by the specialised international organisations affiliated to the United Nations shall apply to the Contract:** Yes ☐ / No ☒

The following Clauses of the ESHS Specifications shall not apply to this Contract and shall not be priced by the Bidder under the specific ESHS Cost Schedule:

Number of the non-applicable Clause	Description
9.2 and 9.3 - Norms, standards and discharge limit values recommended by the specialised international organisations affiliated to the United Nations, as described in ESHS Specifications	Sub-Clause 9.1 remains applicable: The Contractor shall be required to comply with applicable norms, standards, and discharge limit values according to the regulations of the country where the work is performed.

Throughout the present ESHS Specifications (hereinafter called "**the ESHS Specifications**"), a reference to Conditions of Contract, abbreviated by CC, means a



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reference to both the General Conditions of Contract and the Particular Conditions of Contract. Readers should apply due care, when being referred to a specific Clause or Sub-Clause, to:

- Read first the Clause or Sub-Clause text from the General Conditions of Contract;
- Then check whether this text has been amended by the Particular Conditions of Contract, and if so, to which extent.

As per CC Sub-Clause 1.5 – Priority of Documents, when interpreting the Contract, the terms of the Particular Conditions of Contract prevail over those found in the General Conditions of Contract.

Any term in these ESHS Specifications which is identical to a term in the Conditions of Contract shall have the same meaning as the one defined in the Conditions of Contract.

Any term in capital letters in these ESHS Specifications is defined in CC Sub-Clause 1.1 – Definitions.

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**A. Environmental, Social, Health and Safety Management System**

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**1. Responsibilities and Liabilities**

- 1.1 In conjunction with his obligations defined under the Contract, the Contractor will plan, execute and document construction works pursuant to the Environment, Social, Health and Safety (ESHS) Specifications.
- 1.2 The Contractor is liable for all damages to natural resources caused by the execution of the Works or the methods used for execution, unless it is established that the execution or methods were necessary, according to the provisions of the Contract or an Engineer's instruction.
- 1.3 Under the Contract and as introduced by the ESHS Specifications, the term "Project Area" means:
- a) The land where work will be carried out; or
  - b) The land necessary for the implantation of construction facilities (work camp, workshops, offices, storage areas, concrete production plants) and including special access roads; or
  - c) Quarries for aggregates, rock material and riprap; or
  - d) Borrow areas for sand and other selected material; or
  - e) Stockpiling areas for backfill material or other demolition rubble; or
  - f) Any other location, specifically designated in the Contract as a Project Area.

The term "Project Area" encompasses any individual Project Area or all Project Areas.

For the sake of clarity, Project Area is a different concept than Site under CC Sub-Clause 1.1.6.7.

Project Area defines an area within which the Contractor is to comply with environmental, social, health and safety obligations defined in the ESHS Specifications.

Site is the places where the Permanent Works are to be executed and to which Plant and Materials are to be delivered, and where right of access to, and possession of, is to be given by the Employer to the Contractor. The Employer is under no similar obligation for any area located outside the Site, even if within the Project Area, where access is at Contractor's risk.

In term of physical footprint, the CC Sub-Clause 1.1.6.7 Site is included in the Project Area. The Project Area is then of greater geographical extent than the Site.

- 1.4 The ESHS Specifications refer to the entire area of influence for the Works:
- a) Protection of the natural environment (water, air, soil, vegetation, biological diversity) in areas within any Project Area and its surroundings, i.e. including but not limited to access roads,

quarries, borrow areas, stockpiling of backfill material, camps or storage areas;

- b) Health and safety conditions to be maintained for the Contractor's personnel and any other person present on the Project Areas, or along access routes;
- c) Working practices and the protection of people and populations living near the Project Area, but exposed to the general disturbance caused by works.

#### 1.5 Subcontractors:

The ESHS Specifications apply to the Contractor and unless explicitly agreed with the Engineer, all Subcontractors used for the execution of the Works. Pursuant to Sub-Clause 4.4 of the CC, the Contractor is fully liable for all actions, non-compliance and negligence by Subcontractors, their representatives, employees and workers, to the same degree as it would be held liable for its own actions, non-compliance or negligence or that of its own representatives, employees or workers.

#### 1.6 Applicable regulations:

The Contractor must identify all regulations in relation to the protection of the environment (water, air, soils, noise, vegetation, fauna, flora, waste, groundwater) and, pursuant to Clauses 4 and 6 of the CC, the protection of people (labour law, indigenous populations, standards on occupational exposure, other). The Contractor must list all texts, standards and other regulatory limitations in its Worksite Environmental and Social Management Plan (Worksite - ESMP as specified in Sub-Clause 2.1 of the ESHS Specifications) and specify the means taken for compliance.

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|----------------------------------|--|
| <b>2. ESHS Planning Document</b> | <b>2.1 Worksite Environmental and Social Management Plan (Worksite - ESMP)</b> |
|----------------------------------|--|
- 2.1.1 The Contractor prepares and ensures prior validation by the Engineer, implementation and regular update of a Worksite Area Environmental and Social Management Plan (Worksite - ESMP).
- a. The Worksite - ESMP represents the unique reference document in which the Contractor defines in detail all organisational and technical provisions implemented to satisfy the obligations of the ESHS Specifications.
  - b. The Contractor defines in the Worksite - ESMP the number, the locations and the type of Project Area as defined in Sub-Clause 1.3 of the ESHS Specifications. For each of the identified Project Area, unless otherwise agreed by the Engineer, the Contractor establishes an Environmental Protection Plan (EPP). The EPP(s) are annexed to the Worksite - ESMP.
  - c. The Worksite - ESMP covers the entire period from the Contract Agreement signature date to the date of issue of the Performance Certificate by the Engineer.
  - d. Unless agreed otherwise by the Engineer, the Worksite - ESMP is written in the language of communication defined under Sub-Clause 1.4 of the CC.
  - e. The first draft version of the Worksite - ESMP is to be provided by the Contractor to the Engineer within 28 days from the date of execution of the Contract Agreement.
  - f. No physical work or activity shall commence on any Project Area until such time the Worksite - ESMP, and the annexed EPP corresponding to the Project Area, are approved by the Engineer.
  - g. During the execution of the Works, whenever instructed by the Engineer, the Worksite - ESMP will be updated by the Contractor and reissued to the Engineer. The revised version shall highlight the new elements incorporated in the document.
  - h. The Worksite - ESMP (and the EPP) is structured according to the plan specified in Appendix 1 to the ESHS Specifications.
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- 3. Management of non-conformities**
- 3.1** In application of Clause 5, non-conformities detected during inspections carried out by the Contractor or Engineer are subject to a process adapted to the severity of the situation. The non-conformities will be defined as deviations from the requirements of the applicable regulations, the ESHS Specifications, the ESMP, and the Worksite - ESMP. Non-conformities are divided into 4 categories as follows:
- 3.1.1** Notification of observation of minor non-conformities. The non-conformity results in a notification to the Contractor's Representative, followed-up by a signed notification of observation prepared by the Engineer. The multiplication of notifications of observation at the Project Area, or absence of corrective actions by the Contractor, can result in the severity of the non-conformity being raised to that of level 1.
- a. Level 1 non-conformity: Non-conformities that present a moderate and non-immediate risk for health, environment, social or safety. The non-conformity is identified in writing to the Contractor and shall be resolved within five (5) days. The Contractor addresses to the Engineer the proof explaining how the non-conformity has been corrected. Further to an inspection and a favourable evaluation of effectiveness of the corrective action, the Engineer validates in writing the close-out for the non-conformity. In all cases where a non-conformity of level 1 is not resolved within one (1) month, the severity of the non-conformity is raised to level 2.
  - b. Level 2 non-conformities: applies to all non-conformities that represent a moderate and immediate risk or with significant consequences to health and/or the environment, social or safety. The same procedure as for level 1 non-conformities is applied. Corrective action shall be taken by the Contractor within three (3) days. All level 2 non-conformities which are not resolved within one (1) month, are raised to level 3.
  - c. Level 3 non-conformities: applies to all non-conformities that have resulted in damage to health or the environment, or which represent a high risk for health, safety, environmental or social hazards. The highest levels of the Contractor's and Engineer's hierarchies present in the Employer's country are informed immediately and the Contractor has twenty-four (24) hours to bring the situation under control. Pursuant to Clause 14.7 of the CC, a level 3 non-conformity results in the suspension of interim payments until the non-conformity has been resolved. If the situation requires, and in pursuance to
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Clause 8.8 of the PC, the Engineer can order the suspension of work until the resolution of the non-conformity.

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**4. Resources allocated to environmental management**

**4.1 ESHS supervisors and Manager:**

- 4.1.1 Pursuant to Sub-Clause 4.18 of the CC and in addition to the provisions of Sub-Clause 6.7 of the CC, the Contractor appoints one (or two depending on the case) Environment, Social, Health and Safety Manager(s) in charge of implementing the ESHS Specifications. Several experts may be assigned to fulfill this position. The manager(s) will be the Key ESHS Personnel identified in the bidding process, if any.
- 4.1.2 The ESHS Manager is permanently based at the Project Area for the full duration of the Works as of Contractor's mobilisation until Taking-Over Certificate is issued.
- 4.1.3 This manager holds the power within the Contractor's organisation to be able to suspend the Works if considered necessary in the event of level 2 or 3 non-conformities, and allocate all resources, personnel and equipment required to take any corrective action considered necessary.
- 4.1.4 The ESHS Manager speaks fluently the language of communication of the Contract, and the official language of the Employer's country, if the language of communication of the Contract is not the official language. The ESHS Manager will hold a relevant University degree or a significant experience of at least five (5) years in designing and monitoring the implementation of an environmental and social management plan for construction works.
- 4.1.5 ESHS supervisors are appointed in sufficient numbers and represent the ESHS Manager within work teams. Their role is to ensure that the Works are carried out pursuant to the ESHS Specifications and notify the ESHS Manager of any detected non-conformities.

**4.2 Person in charge of relations with external stakeholders:**

- 4.2.1 The Contractor appoints a person responsible for relations with external stakeholders: local communities, administrative authorities, religious and other representatives. If necessary, a team will be created.
- 4.2.2 Administrations and local authorities will be informed of the existence of this person as of the start of works and will be provided with contact details so as to be able to contact this person if a problem arises during the execution of works, or



concerning the behaviour of the Contractor's Personnel, inside or outside the Project Area.

- 4.3 The team, including the ESHS supervisors and manager, and the person in charge of relations with external stakeholders, will be allocated the necessary resources to operate independently (travel, office equipment and communication).

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- 5. Inspections**
- 5.1 In addition to the ESHS Manager's own inspections, an ESHS inspection will be carried out on the facilities and Project Area on a weekly basis jointly with the Engineer.
  - 5.2 A written report will be drafted for each weekly inspection, in a format approved by the Engineer, addressing non-conformities detected on the Project Area as specified in the ESHS Specifications.
  - 5.3 Each non-conformity will be documented by a digital photograph with captions to provide a visual illustration, explicitly indicating the location, date of inspection and the non-conformity in question.

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## 6. Reporting

- 6.1 As part of the Progress Report specified in Sub-Clause 4.21 of the CC, the Contractor submits an ESHS activity report summarising all ESHS initiatives implemented in relation to the execution of the Works during the reporting period to the Engineer on a monthly basis. The activity report is a separate document from the update of the Worksite - ESMP, which is updated at the intervals indicated in Sub-Clause g of the ESHS Specifications.
- 6.2 The ESHS activity report is written exclusively in the language of communication defined under Sub-Clause 1.4 of the CC.
- 6.3 Pursuant to Sub-Clause 4.21 of the CC, the ESHS activity report is submitted at the latest 7 working days after the last day of the month in question. The report contains the following information.
  - 6.3.1 List of ESHS personnel present at the Site at the end of the month.
  - 6.3.2 Construction works activities conducted during the month.
  - 6.3.3 Inspections carried out (location and intervals).
  - 6.3.4 Non-conformities detected during the month with descriptions of the root cause analysis and corrective actions taken.
  - 6.3.5 Description of actions conducted and measures taken during the month to remedy non-conformities and to manage environmental, social, health and safety risks and impacts.
  - 6.3.6 Description of stakeholder engagement activities undertaken with neighbouring populations, local authorities, governmental agencies.
  - 6.3.7 Monitoring results for the following indicators:
    - a. Effluent quality (Sub-Clause **Error! Reference source not found.** of the ESHS Specifications), if applicable;
    - b. Drinking-water quality, if applicable;
    - c. Hazardous and non-hazardous waste generation;
    - d. Air and noise emissions, if applicable;
    - e. Project Area state (Sub-Clause **Error! Reference source not found.** of the ESHS Specifications);
    - f. Recruitment, number of positions and hours worked by local Contractor's Personnel (Sub-Clause **Error! Reference source not found.** of the ESHS Specifications);
    - g. Health & safety statistics: in pursuance to Clauses 4 and 6 of the CC, number of fatal accidents, lost-time accidents, number of accidents without lost-time, serious illness, frequency of accidents, and serious misconduct by Contractor's Personnel (record sheet attached as an appendix to the activity report, pursuant to

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Sub-Clause 7.7 of the ESHS Specifications); including root cause analysis and corrective actions taken.

- 6.3.8 Where appropriate, description of the formal or informal complaints (negative media attention, strikes or labour disputes, protests, complaints from communities, NGO or workers or formal notice from authorities, etc.) related to environmental, social, health and safety risks and impacts of the Works; including root cause analysis and corrective actions taken.
  - 6.3.9 Report on training activities (topic, number and duration of sessions, number of participants).
  - 6.3.10 Provisional environmental, social, health and safety actions for the coming months.
- 6.4 Notification of ESHS events:
- 6.4.1 The Engineer is informed within one hour of any accident, (i) involving serious bodily injury to a member of personnel, a visitor or any other third party, caused by the execution of the Works or the behaviour of the personnel of the Contractor, or (ii) any significant damage to private property, or (iii) any significant damage to the environment.
  - 6.4.2 The Engineer is informed as soon as possible of any near-accident relating to the execution of the Works which, in slightly different conditions, could have led to bodily injury to people, or damage to private property or the environment.

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- 7. Rules of Procedure**
- 7.1** Rules of procedure are established by the Contractor for the Project Areas, addressing the following: safety rules, zero tolerance for substance abuse (refer to Clause Error! Reference source not found.), environmental sensitivity of areas around the Project Areas, the dangers of STDs with HIV/AIDS, gender issues (in particular sexual harassment) and respect for the beliefs and customs of the populations and community relations in general (drawing special attention to the risks of prostitution and human trafficking).
- 7.2** The rules are clearly displayed at the different Project Areas.
- 7.3** The rules confirm the Contractor's commitment to implementing the ESHS provisions provided for in the Contract.
- 7.4** New Contractor's Personnel and existing Contractor's Personnel are made aware and acknowledge their understanding of the rules of procedure and the associated provisions. Rules of procedure document are initialed by all Contractor's Personnel prior to the start of any physical work at any Project Area.
- 7.5** Pursuant to Clauses 6.9 and 6.11 of the CC, the rules of procedure include a list of acts considered as serious misconduct and which must result in dismissal from any Project Area by the Contractor, or by the Engineer if the Contractor is not acting in due course, should a Contractor's Personnel repeatedly commit an offence of serious misconduct despite awareness of the rules of procedure, and this is without prejudice to any legal action by any public authority for non-compliance with applicable regulations:
- a. Drunkenness during working hours;
  - b. Drug use;
  - c. Punishable statements or attitudes, and sexual and mental harassment in particular;
  - d. Violent behaviour;
  - e. Intentional damage to the assets and interests of others, or the environment;
  - f. Repeated negligence or imprudence leading to damage or prejudice to the environment, the population or properties, particularly breaching provisions intended to prevent the spreading of STD with HIV/AIDS;
  - g. Possession and/or consumption of meat or any other part of an endangered animal or plant as defined in the Washington convention (CITES) and national regulations.
- 7.6** Serious misconduct, such as organization of sex trade (pimping), committing pedophilia, rape, physical aggression, drug trafficking, deliberate and severe pollution, trading and/or trafficking in all or part of protected species, shall lead to immediate dismissal as of the first report of misconduct is detected, in application of the rules of procedure and labour laws.
- 7.7** The Contractor establishes a record for each case of serious misconduct, and a copy will be provided to the Contractor's Personnel in question, indicating all action taken to terminate the misconduct by the Contractor's Personnel in question and to bring
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the attention of other Contractor's Personnel to the type of incident detected. This record will be provided to the Engineer as an attachment to the ESHS activity report (see Sub-Clause 6.3 of the ESHS Specifications).

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8.     **ESHS Training**
- 8.1     The Contractor prepares a training and capacity building program for its Contractor's Personnel, as described in the Worksite - ESMP and documented each month in the ESHS activity report.
- 8.2     The Contractor also details in the training program the actions and ESHS training for Subcontractors and other members of the joint venture when applicable.
- 8.3     Training sessions are two-fold: introductory sessions for starting work at the Project Area, and technical training as required in relation to the execution of the Works.
- 8.3.1 Starting work sessions are organised for each Contractor's Personnel and shall cover as a minimum:
- a.     Rules of procedure;
  - b.     Safety rules on Project Areas;
  - c.     Protection of areas adjacent to Project Area;
  - d.     Risks relating to sexually transmitted diseases (Sub-Clause 6.7 of the CC), prostitution, human trafficking, and sexual harassment;
  - e.     Basic health: combating malaria (if prevalent) and waterborne diseases, improving hygiene;
  - f.     Emergency response procedures or evacuation.
- 8.3.2 Technical training:
- a.     Training in the skills needed for tasks requiring a work permit (Clause **Error! Reference source not found.** of the ESHS Specifications);
  - b.     Training in first aid and transporting the injured in order to achieve the targets defined in Sub-Clause **Error! Reference source not found.** of the ESHS Specifications on the number of first aid officers per Project Area and per team;
  - c.     Ability to drive on rough ground.
- 8.4     The Contractor prepares an awareness program, where applicable, for local communities adapted to the main risks relating to the Works. This program will be included in the training program described in Sub-Clause 8.1 of the ESHS Specifications.

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**9. Standards**

- 9.1 The Contractor complies with all norms, standards and discharge limit values defined in the national regulations of the Employer's country regulations and pursuant to Sub-Clause 1.6 of the ESHS Specifications.
- 9.2 The Contractor comply with norms, standards and discharge limit values recommended by the specialised international organisations affiliated to the United Nations, as described in Sub-Clause 9.3 below of the ESHS Specifications. In the event of discrepancies in between international standards and national regulations, the Contractor shall comply with the most stringent requirements.
- 9.3 The specialised international organisations affiliated to the United Nations referred to in Sub-Clause 9.2 of the ESHS Specifications include:
- World Bank, including the IFC and its Environmental, Health and Safety guidelines available from <http://www.ifc.org/ehsguidelines>.
- For matters not addressed in the IFC above document, the most stringent of the norms, standards and discharge limit values of the following institutions shall apply:
- World Health Organization (WHO);
  - International Labour Organization (ILO) (in particular in pursuance to Sub-Clauses 6.20, 6.21, 6.23 and 6.24 of the CC);
  - International Maritime Organization (IMO).



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## **B: PROTECTION OF THE ENVIRONMENT**

### **10. Project Environmental and Social Management & Monitoring Plan (ESMMP)**

The measures presented in the ESMMP summarize in a matrix format, the key impacts identified, the remedial measures to be taken, the responsible person(s) for execution, and the monitoring activities to be undertaken. An indication of the timing for implementation and the cost involved is also provided.

The actions proposed in the ESMMP are designed to ensure compliance with local legislation and adoption of best practices that apply to environmental and social management.

The outline management plans have been developed and will be further expanded (for construction and operations purposes) with documented procedures and guidelines for work practices in order to be responsive to the situations that the construction Contractor and Project Operator (NCWSC) will encounter.

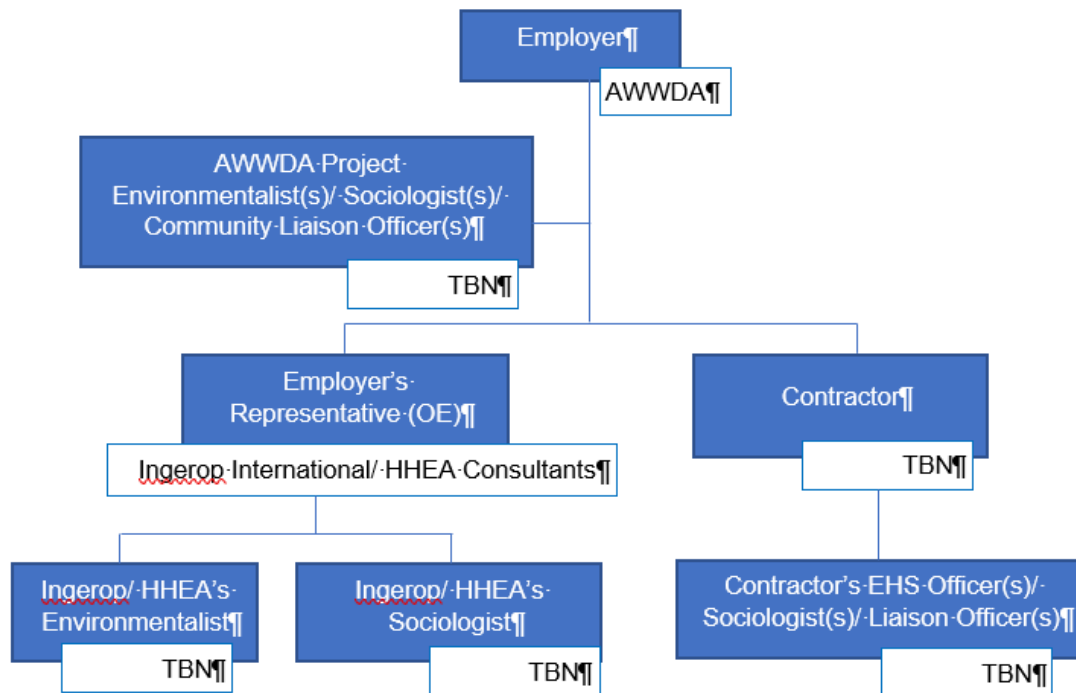
The effectiveness of the ESMMP will be monitored and assessed regularly through inspections and reporting throughout construction and during operations.

### **11. Project organization structure**

The project will be implemented as a unit pricing construction contract whereby the appointed contractor will be responsible for all construction, commissioning, and handover of the project to AWWDA who will thereafter entrust it to NCWSC to operate.

Overall Project Management (PM) during construction will be performed by the project proponent through the Owner's Engineer (OE) – Ingerop International Consultants/HHEA. There will be Environmental, Social, Health & Safety (ESHS) resources in the OE team who will be responsible for achievement of E&S objectives in construction work. To strengthen his role, the Project Proponent will include in the construction contract, E&S provisions in line with local standards and good international industry practice (GIIP) to ensure that the Contractor gives full attention to the requirements.

Below is the organogram for the implementation of the ESMP.



**Organogram for the monitoring/ implementation of the ESMMP**

## 12. Environmental and social monitoring

Environmental and social monitoring will commence at the initiation of the construction activities for the project and will be carried out through the construction phase to commissioning and operations phase of the infrastructure.

The environmentalist and sociologist in the OE's team will perform the following:

- Verify that all project approvals and permits are in place prior to the start of construction.
- Evaluate contractor plans and monitor their implementation.
- Develop inspection checklists to ensure site inspections are focused and useful.
- Conduct environmental and social monitoring of construction works to ensure that that mitigation measures are appropriately implemented, and that emergent issues are addressed; and
- Prepare regular written reports to the Project Management Team (PMT), Contractor and, where need be, NEMA on an agreed schedule.

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**13. Outline management plans during the construction phase**

Construction phase potential impacts and mitigation measures were identified during the ESIA study. These have been carried forward to outline management plans proposed for construction phase activities. The outline plans will be further detailed in the Construction Phase Environmental & Social Management Plan (CP-ESMMP) which is a practical and achievable plan of management to ensure that any environmental, social health and safety impacts during the construction phase are minimized.

The CP-ESMMP contains a series of sub-plans to deal with the various aspects of the construction process/activities and the related environmental, social, health and safety risks.

- Air Quality
  - Water resources
  - Noise
  - Ecology and Biodiversity
  - Soil erosion and sedimentation
  - Occupational Health and Safety Risks
  - Traffic and pedestrian Management
  - Potential damage of underground infrastructure
  - Waste
  - Spread of HIV/AIDS
  - Social conflicts and Accidents and Injuries
- **The contactor shall prepare the CP-ESMMP covering the above sub-plans to adequately manage anticipated impacts from the construction activities. The plans shall be reviewed and approved by the proponent (employer) or the appointed representative (supervising consultant).**

#### 14. Construction Phase Environmental and Social Management and Monitoring Plan - Construction ESMMP matrix

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
Air Quality	Exhaust emissions from construction equipment; Dust from vehicle movements and excavations.;	<p>Sprinkling of dusty accesses and other dust prone areas to lay dust.</p> <p>Minimize the period for machinery idling</p> <p>Proper equipment and vehicle maintenance; use of low sulphur fuels.</p> <p>Provision of PPE e.g. dust masks to workers.</p> <p>Rehabilitation of disturbed areas once completed.</p>	<p>Complaints or lack of complaints;</p> <p>watering logs/</p> <p>Dust deposition on surrounding vegetation and homes/Buildings;</p> <p>Vehicle maintenance schedules; Use of PPE by workforce;</p> <p>Vehicle speeds on sites;</p>	<p>Weekly site inspections and regular measurements.</p> <p>Site inspection logs and corrective actions.</p>	<p>Site logs of inspections;</p> <p>Vehicle maintenance logs; Logs of sprinkling of dusty sections</p>	Contractor/ Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>The Contractor will document the maintenance records for its fleet of vehicles, machinery and equipment.</p> <p>When storage, handling and transportation of bulk materials is made in the open air and exposed to the wind, the Contractor implements the necessary dust abatement measures such as tarpaulin cover for trucks when in the vicinity of</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		sensitive receptors.				
Water resources	Release of hazardous substances and sediments into water courses.	<p>Conservative use of water in construction works.</p> <p>Institution of spill prevention and control measures.</p> <p>Educate construction workers on safe and proper storage, handling, use, clean- up, and disposal of oils, fuels, and other chemicals.</p> <p>Provide appropriate sanitary facilities at construction</p>	Water consumption levels; Water pollution incidences; Housekeeping practices	Regular inspections (weekly), and measurements	Site logs of inspections and proposed corrective actions	Contractor; Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>camp and sites, worker compounds and other construction facilities.</p> <p>Take precaution in the discharge of hydro-test water to avoid erosion and deposition of sediments into watercourses. The Contractor will list, locate, and characterize (flow, expected quality, discharge frequency) all sources of effluents and outlets in the natural environment.</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		Contractor will undertake effluent monitoring as appropriate				
Noise	Noise emissions by construction equipment and activities	<p>Use of noise abatement equipment for machinery.</p> <p>Limit construction activities to daytime only.</p> <p>Switch off noisy equipment when not in use.</p> <p>Provide PPE such as earmuffs to workers at the site as necessary.</p> <p>Conduct regular quantitative monitoring.</p>	Noise levels at point sources and receptor locations; Noise complaints entered in complaints register	<p>Decibel level measured at various points within the project area</p> <p>Regular noise measurements at point sources and receptor locations</p>	Noise measurement records; Entries in the complaints register	Contractor



Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		Locate noisy equipment away from receptors / site boundaries if possible. Sensitise drivers/operators against hooting, revving and other measures when in the vicinity of sensitive receptors.				
Vibration	Potential damage to structures due to ground movement	Safe work procedure(s) when working near structures likely to be affected.  Ensure efficiency of bursting machine.	Lack of complaints/ non-damaged/ affected structures.	Regular inspections and engagement with building owners.	Reports/ photos of structures prior works and after.	Contractor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		Avoid excavation too close to structures				
Ecology and Biodiversity	Clearance of existing natural vegetation; spillages of hazardous substances Inappropriate disposal of wastes;	Development of a Reinstatement Plan and a landscaping/ revegetation plan; Ensure minimal stripping of vegetation at work areas; Establishment of sediment traps and silt fences; Institution of containment measures for hazardous substances; Institution of a waste management plan. Only clear	Extent of vegetation clearance; Vegetation damage from pollution incidences; Number of trees replanted; Number of pollution incidences recorded and mitigated; awareness and training records/ reports	Logs of pollution incidences (spillages and clean-ups); Records of trees planted.  Weekly site inspections	Reports on cleared vegetation and pollution incidents	Contractor; Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>vegetation absolutely necessary for the construction activities.</p> <p>Vegetate areas that may be cleared during the construction phase.</p> <p>Specific agreement from the Employer's Representative is obtained prior to any clearing works.</p> <p>No burning of vegetation, no clearing with chemicals</p> <p>The Contractor shall ensure that</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		all personnel are informed and aware of the importance to protect fauna and flora. Information and awareness training is documented.				
Soil erosion and sedimentation	Earthworks involving site clearance and excavation; Spillage of hazardous substances on the ground; Compaction of soil by vehicles and machinery	Avoid offsite disposal of spoil; Salvage, stockpile and ensure re-use of native topsoil during re-vegetation activities in disturbed areas; Implementation of a site-specific reinstatement plan; Institution of spill prevention and control	Level of soil erosion observed at sites; Quantity of excavated soil carted away against that used on site; Housekeeping practices with an impact on erosion and pollution	Regular Inspections (Weekly)  Records of soil pollution incidences; Volumes of spoil disposed off-site		Contractor; Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>measures; Oils, fuels, paints and any hazardous materials to be stored in accordance with their respective MSDS's; Use of designated routes and avoid deviation from established roads.</p> <p>Restoration to ensure that trench backfill material is compacted to a similar value to the surrounding soils; Limit clearance of vegetation to the plinth of proposed structures and trench line;</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		Stabilize and maintain access roads created to access project sites to minimize erosion and dust from vehicular traffic; Stabilize construction sites and camp(s) entrances/exits to reduce the amount of sediment tracked off-site by construction vehicles;				
Occupational Health and Safety Risks	construction vehicles and the public), or exposure to dust  Machinery operations	Ensure machine operators are qualified and licensed.  All the workers involved in the construction	Number of reported occupational accidents and injuries.  Number of training sessions	EHS section on and monitoring  Toolbox talks.  Induction trainings		Contractor /  Environmental monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
	Ergonomic Hazards  Noise and vibration	<p>should be well educated on potential accidents that may occur during construction. Training should be done to all the workers on safety, health and the environment (SHE) to increase awareness.</p> <p>Workers should all be provided with PPEs with a policy “NO PPE NO WORK” established to ensure all the workers have PPEs during working hours.</p>	<p>on occupational safety and health</p> <p>Number of occupational safety and health inspections conducted.</p> <p>Number of occupational safety and health meetings</p>			

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>Signage should be erected during the construction phase.</p> <p>First Aid kits and Boxes should be provided and be available on site in case of accident occurrence.</p> <p>Provide adequate sanitary facilities to all workers.</p> <p>In places where the construction interferes with traffic a trained flagman or flag woman should be employed.</p>				



Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>Machines should be properly maintained.</p> <p>Fire extinguishers should be provided and placed in areas that have potential fire threat.</p> <p>Set of clear working plan for all the workers to avoid overworking them.</p>				
Traffic and pedestrian Management	<p>Road closures and diversions</p> <p>Heavy machinery and equipment</p> <p>Poorly managed construction sites</p>	Expedite construction work so as to minimize the duration upon which the roads are closed.	average travel time along the affected routes during peak hours	Monitoring implementation of traffic management plan		Contractor/Environmental monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>Establish a clear traffic management plan, including schedule for transporting and installing pipes and other bulky materials.</p> <p>Good driving habits by the delivery cars to minimize traffic.</p> <p>Ensure areas where workers are walking and where pedestrians are diverted to be protected by hardstanding barriers with sufficient buffer.</p>	number of traffic accidents and the number of complaints received from local residents and businesses about traffic disruptions.	Weekly site inspections		

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>Erect traffic signage with relevant message indicating speed limits and warning signs to ensure public safety.</p> <p>Give construction tinier in advance so as the potential affected people can use alternative routes to get to their respective destinations in areas where the road is blocked.</p> <p>The Contractor should ensure that the truck drivers adhere to the</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>speculated time limits.</p> <p>The Contractor should ensure all the trucks are in good condition especially the ones carrying construction material and no material fall while being transported.</p> <p>Traffic department should approve crossing plan prior to construction,</p> <p>Use of diverse routes</p>				

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
Potential damage of underground infrastructure	Construction activities including trenching and heavy machinery	<p>Sensitize workers carrying out excavation.</p> <p>Work closely with institution/ providers likely to be affected.</p> <p>Maps of the available underground infrastructure from the relevant authority are necessary.</p> <p>Trial holes to determine location, size of pipelines, services or structures.</p> <p>Ground Penetrating Radar (GPR) and ELM</p>	Number of incidents of damage to underground infrastructure during the project	<p>Weekly site inspections</p> <p>Grievance logs</p>		Contractor/Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		to determine the precise location of existing services.  Damage costs included in the BOQ.				
Waste	Construction activities which generate wastes; Residence in construction camp which generates wastes; Poor management of wastes generated	Modification of construction activities and methods to reduce potential adverse impacts.  Segregate wastes generated into inert fill materials, recyclable/ reusable materials and hazardous wastes for appropriate disposal Compost organic wastes; Provide adequate	Waste management plan developed and implemented; Site status; Quantities of wastes recycled/reused; Waste disposal records	Weekly inspections of sites to establish adequacy of plans in place.  Periodic Inspection Reports;		Contractor; Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		sanitary facilities at construction camp and sites.				
Spread of HIV/AIDS	Immigrants, Human behaviour	Provision of Condoms regularly to workers  Provide adequate HIV/AIDS counselling education to workers.  Employ people within the work locality to prevent influx from people in other areas	Number of condoms supplied.  Number of counselling undertaken	Periodic reports on training and activities undertaken to mitigate spread of HIV/AIDS		Contractor/Environmental Monitor
Social conflicts	Stakeholder misunderstanding	Education of the surrounding community about	Meeting with stakeholders	Number of meetings and feedbacks from stakeholders		Contractor /client

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>the project benefits</p> <p>Regular stakeholders engagement, including disruption of supply (damage of utilities or planned closure)</p> <p>All the accidents, either environmental or social will be managed in accordance with the legal framework in place.</p> <p>All accidents and complaints recorded and</p>				



Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		solved appropriately				
	GBV/ sexual harassment	<p>Develop and implement code of conduct, signed by all workers.</p> <p>Provide training and awareness programs to project staff, contractors, and community members on GBV and sexual harassment prevention and reporting.</p> <p>Implement clear and confidential reporting mechanisms for any incidents of</p>	<p>Number of reported incidents of GBV or sexual harassment</p> <p>Percentage increase in awareness levels and understanding of GBV and sexual harassment.</p> <p>Number of individuals accessing support services for GBV or sexual harassment.</p>	Regularly collect and analyse data on reported incidents.	<p>Awareness records/ reports.</p> <p>Investigation reports</p>	

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>GBV or sexual harassment.</p> <p>Collaborate with local communities, leaders, and women's groups to address concerns related to GBV and sexual harassment.</p> <p>Collaborate with local law enforcement and authorities to address and prevent GBV incidents.</p>	Cases investigated and support offered to victims			
Accidents and Injuries	Construction related activities	Maintain work areas to minimize slipping and tripping hazards;	Number of accidents reported.	Inspection of proper used of PPE and		Contractor/Environmental Monitor

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>Use proper techniques for trenching and shoring.</p> <p>Implement fire and explosion prevention measures in accordance with internationally accepted standards.</p> <p>When installing or repairing mains adjacent to roadways, implement procedures and traffic controls.</p> <p>Establishment of work zones so as to separate workers from</p>	Number of incidence/ near miss recorded/reported	<p>provided work procedure.</p> <p>Accidents/incidence reports</p>		

Potential Impacts	Source of impacts	Mitigation Measure (Controls)	Performance Indicators	Monitoring requirements	Reporting	Responsibility
		<p>traffic and from equipment as much as possible</p> <p>Reduction of allowed vehicle speeds in work zones.</p> <p>Use of high-visibility safety apparel for workers in the vicinity of traffic</p> <p>For night work, provision of proper illumination</p> <p>Locate all underground utilities before digging.</p>				

- 15. Handling and Management of Asbestos**      The contractor shall adhere to regulations regarding asbestos handling to, disposal, and worker safety; and other guidelines as outlined in Section 1121.

## 16. Environmental, Health and Safety Management Plan – Removal and Disposal of AC Material

### Construction Phase Management Plan

Potential Impact	Source of Impact	Mitigation Measure (control)	Performance Indicator	Monitoring Requirements	Reporting	Responsibility
Health Effect	Broken AC material (dust)	<p>Ensure that there is adequate wetting during the whole removal process to prevent the A-C materials from crumbling and the micro fibres becoming airborne.</p> <p>Use a hammer or wheel-type pipe cutter to make your initial cut and make sure the pipe is drained of any liquid.</p> <p>The pipe should be removed from joint collars by breaking them with a sledge hammer, or cutting them.</p> <p>The waste material should be wrapped in a heavy-duty polythene cover and lifted using straps loaded in a truck in an 'intact' position.</p> <p>After identifying the A-C, stocks pile the waste in a designated loud-out area probably at the contractor's camp.</p> <p>The stockpile shall be on a raised structure that shall be erected for this purpose only.</p> <p>The recovered/ stored AC material will be collected on quarterly basis</p>	Report of irritation. AC quantities stored on site.	Record the objective data to confirm the Initial Exposure assessment. Disposal tracking forms	<p>Form for Initial Assessment exposure and method statement to be attached.</p> <p>Daily Inspection Reports</p>	<p>Contractor/ Environmental Monitor.</p> <p>See Safe Work Method in Section below</p>

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Potential Impact	Source of Impact	Mitigation Measure (control)	Performance Indicator	Monitoring Requirements	Reporting	Responsibility
		for disposal by a NEMA authorised handler.				

## 17. Safe Work Method Statement for Asbestos Cement Removal

Description of activity:	Removal of Asbestos Cement Pipe		Period of work at this site: From: To:
			Work site:
Procedure (steps)	Possible Hazards	Risk score	Safety controls:
Workers to enter on site	Potential exposure to Asbestos and other construction related hazards.	High to low	<ul style="list-style-type: none"> <li>• All workers on site to have undergone AC removal procedure and then site induction procedure.</li> <li>• All workers on site to be issued with required PPE including respirators, disposable coveralls, gloves, and protective eyewear.</li> </ul>
Providing general work facilities for all workers.	<ul style="list-style-type: none"> <li>• Lack of amenities for workers</li> <li>• Lack of emergency and first aid facilities</li> <li>• Lack of warning notices.</li> </ul>	Moderate to low.	<ul style="list-style-type: none"> <li>• Ensure required amenities are provided (toilets, wash facilities, shed for meal breaks) and all are set up safely and with power and water connected where required</li> <li>• Ensure emergency plans and first aid facilities are in place and first aid kit has been checked for adequate contents.</li> <li>• Ensure there are adequate fire extinguishers in the work area.</li> <li>• Ensure all warning notices are in place around perimeter boundary</li> <li>• Ensure appropriate decontamination equipment is placed on site.</li> </ul>
Working near public areas	Potential exposure to Asbestos and other construction related hazards.	High	<ul style="list-style-type: none"> <li>• Isolate the entire site if possible with a barricading tape to restrict access</li> <li>• If this is not possible, isolate the work area where asbestos work will be undertaken with restricted access barriers extending at least 10 metres from the asbestos work.</li> <li>• Erect warning signs and keep all gates and access ways locked when possible.</li> </ul>
Working in and around the work area.	Trips over material.	Low	<ul style="list-style-type: none"> <li>• Examine pathways and access ways before moving material around the site and remove any obstacles or debris before using equipment</li> <li>• Keep pathways clear of trip hazards.</li> <li>• Place rubbish and material in the bins provided.</li> </ul>



Description of activity:	Removal of Asbestos Cement Pipe		Period of work at this site: From: To:
			Work site:
Procedure (steps)	Possible Hazards	Risk score	Safety controls:
Lifting and carrying material or heavy loads.	Handling potential sprains/strains, injuries to back, shoulders, muscles, joint	Moderate	<ul style="list-style-type: none"> <li>• <b>Share the load between two or more workers.</b></li> <li>• <b>Reduce the number of A-C material that is carried.</b></li> <li>• <b>Only carry what is a comfortable weight and do not overload the loader</b></li> </ul>
Removal of AC pipes.	Particles of asbestos dust from broken pieces being dislodged to the workers and members of the public may be affected	High to Extreme (long term).	<ul style="list-style-type: none"> <li>• <b>All Workers must NOT use power tools and compressed air to cut, dislodge, and remove the A-c pipes.</b></li> <li>• <b>Close all windows and doors on buildings to confine the potential spread of asbestos.</b></li> <li>• <b>If the A-C has become deteriorated or friable with age and wear it should be sprayed with water or a sealant before removal.</b></li> <li>• <b>Workers to avoid breakage of the pipes when removing. The pipes should also be lowered to the ground and not dropped.</b></li> <li>• <b>All Workers in the area are to be wearing appropriate PPE. All Workers removing asbestos pipes to be wearing full disposable coveralls, safety goggles, gloves, safety boots and full or half face respirators with P3 dust filter cartridges in place.</b></li> <li>• <b>All workers removing asbestos to use the decontamination facilities on site and remove and/or replace PPE at this stage.</b></li> </ul>
Temporary storage at site or contractor's camp	Particles of asbestos dust from broken pieces being dislodged to the workers and members of the public may be affected	Moderate	<ul style="list-style-type: none"> <li>• <b>Identify a location within a site or the contractors camp with restricted access for the temporary storage prior to final disposal location/ site</b></li> <li>• <b>Asbestos containing materials should be securely contained in leak-proof, labelled containers or packing to prevent fiber release</b></li> <li>• <b>The temporary storage not exceed thirty days</b></li> </ul>
Removal of asbestos from site.	Particles of asbestos dust from broken pieces being dislodged to	High to Extreme	<ul style="list-style-type: none"> <li>• <b>Select an area where the asbestos pipes can be placed so it will not be in the way of the work being carried out and will not be damaged.</b></li> </ul>

Description of activity:	Removal of Asbestos Cement Pipe		Period of work at this site: From: To:
			Work site:
Procedure (steps)	Possible Hazards	Risk score	Safety controls:
	the workers and members of the public may be affected	(long term).	<ul style="list-style-type: none"> <li>Stack the asbestos on polyethylene sheeting, wrapped and sealed into appropriate bundles for disposal.</li> <li>Broken pipes and associated waste (including contaminated clothing) should be placed directly into bins that have been lined with polyethylene sheeting or placed in heavy duty plastic bags.</li> <li>All tools and equipment used in the removal area will be vacuumed.</li> </ul>
Transpotation of asbestos	Release of asbestos of asbestos dust to the atmosphere where members of the public may be affected	High	<ul style="list-style-type: none"> <li>The asbestos transporting vessel shall be lined with a 500-gauge double-wrapped plastic sheet, ensuring every seam is sealed with tape and securely covered.</li> <li>The vessel shall be prominently labelled "Danger - Contains ACM.</li> </ul>
Disposal site	Load of absbestos being disposed find its way to the atmosphere where member of the public may be affected	High	<ul style="list-style-type: none"> <li>Asbestos shall be lowered gently into the disposal site and should not be dropped from any height to avoid breakage</li> <li>Disposal site shall be completely fenced off with at least chain link and a lockable gate which shall be locked at all times.</li> <li>Site to be clearly marked with warning notices stating "Asbestos hazard area, keep out"</li> </ul>

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## **C: Local Labour and Relations with Local Communities**

### **18. Labour conditions**

17.1 The Contractor should ensure decent labour conditions for workers and notably compliance with applicable law and regulations in the country of implementation of the contract, and with the fundamental conventions of the International Labour Organisation (ILO). This includes workers' rights related to wages, working hours, rest and leave, overtime, minimum age, regular payment, compensation and benefits. The Contractor should respect and facilitate workers' rights to organise and provide a grievance mechanism for all direct and indirect workers. The Contractor should implement non-discrimination and equal opportunity practices, and ensure prohibition of child or forced labour.

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- 19. Local recruitment**
- 18.1 Local recruitment defined as the number of positions actually allocated to people residing in the region of the Works, which must be defined by the Contractor in its offer according to relevant criteria by giving priority to populations living in the area of influence or in the immediate proximity of the Project Area.
- 18.2 Pursuant to Sub-Clause 6.1 in the CC, the Contractor implements a voluntary local recruitment policy for its personnel for the duration of the Works and shall enforce this policy to its Subcontractors CC
- 18.3 The Contractor demonstrates the effective implementation of this voluntary policy to the Engineer in its monthly activity report as defined in Sub-Clause 6.3 of the ESHS Specifications.
- 18.4 Pursuant to Clause 8 of the ESHS Specifications, the Contractor shall develop a training program. This training program must be open to women and men and be adapted to their level of education and needs of each group to occupy the positions proposed during the Works.
- 18.5 Local labour needs are estimated prior to the start of Works and described in the Worskite - ESMP with the following information:
- a) Identification of positions that could be filled by local staff and the level of qualification required
  - b) Definition of the planned procedure for the effective recruitment of these members of staff
  - c) Establishment of mechanisms to ensure non-discrimination of women in accessing recruitment procedures. This mechanism must cover the definition of the positions, the methods of communication of the positions to be filled, etc.
  - d) Deployment schedule for these positions
  - e) Initial training to be provided by the Contractor for each job description
- 18.6 In order to prevent outsiders from entering the Project Area, local recruitment at the Project Area, including at the entrance, is prohibited.
- a. Local recruitment office:
    - Prior to the start of works, the Contractor establishes a local recruitment office in the district where the main Project Area is located, at a location pre-approved by the Engineer.
    - A representative of the Contractor is present in this office at least two mornings each week, from the start of the Works to a date pre-approved by the Engineer.
    - The representative provides information on job vacancies with the Contractor for the execution of the Works (required qualifications,
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duration, and location) and on the information to be provided in applications.

- Lists of local candidates are drafted by the representative allocated to the office and forwarded to the Contractor's human resources manager on a weekly basis.
  - a. The Contractor's Human Resources manager selects candidates listed by the local recruitment office based on requirements for the Works and the Contractor's recruitment procedures. A written contract between the Contractor and the local Contractor's Personnel is drafted, signed and archived by the Contractor.
  - b. If the Project Areas are located near to several different communities, the Human Resources manager ensures a fair distribution of local recruitment between the different communities, by giving priority to the people affected by the project.
  - c. The Human Resources manager will ensure that recruitment campaigns in local communities have been spread to women and that the latter have not been discriminated in recruitments.
  - d. Pursuant to Sub-Clause 6.22 of the CC, the Contractor maintains one record per local Contractor's Personnel indicating the hours worked per person allocated to the Works, the type of tasks carried out, the wages paid and any training taken. Records are available at the main Project Area at all times, so the Engineer and the authorised representatives of the government can assess the content.

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| <p><b>20. Transport &amp; accommodation</b></p> | <p>19.1 Unless specified otherwise in the Contract, or instructed otherwise by the Engineer, the Contractor provides or enables access to daily transport for Contractor's Personnel living more than 15 minutes' walk from the Project Area and more than one hour by land transport.</p> <p>19.2 The transport is organised under conditions which comply with local regulations and which ensure the safety of the people transported.</p> <p>19.3 The Contractor organises collective transport: pick-up times and locations are defined and services organised appropriately.</p> <p>19.4 If the Project Area is moved during the working season and if the Contractor retains the local personnel trained at the start of the Works, the accommodation of the Contractor's Personnel is managed by the Contractor:</p> <ul style="list-style-type: none"> <li>a. Within a mobile camp with the other non-local Contractor's Personnel; or</li> <li>b. In villages located near to the mobile Project Area, in this case, each local Contractor's Personnel will receive a housing allowance in addition to his wages.</li> </ul> |
| <p><b>21. Meals</b></p>                         | <p>20.1 Food supplies for the meals of the Contractor personnel will exclude any meat obtained from hunting or poaching, with the exception of fish.</p> <p>20.2 The Contractor provides at least two meals per day to local Contractor's Personnel pursuant to the hygiene conditions specified in Clause <b>Error! Reference source not found.</b> of the ESHS Specifications, at reasonable price.</p>  |

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| <p><b>22. Damage to people and property</b></p>  | <p>21.1 The Contractor shall not disturb or interfere with the inhabitants of local communities close to or in the Project Area, and shall respect their houses, cultures, animals, properties, customs and practices.</p> <p>21.2 Pursuant to Sub-Clauses 4.14 and 17.1 of the CC, the Contractor is responsible for damages to people and property caused by the execution of the Works or the procedures used for execution.</p> <p>21.3 Access to the Project Areas is prohibited to unauthorized persons. The Contractor is responsible for the security and access control of the Project Areas.</p> <p>21.4 The Engineer is informed of any damage caused to people, or the property of individuals, other than the Contractor's personnel, within 6 hours of the event, regardless of the value of the prejudice.</p> <p>21.5 Housing existing before the start of the Works, located within a minimum radius of 800 m around the perimeter of the quarries and within a minimum radius of 500 m around the other Project Areas that will be subject to blasting, will be examined by a bailiff unless agreed upon otherwise with the Engineer.</p> <p>21.6 The bailiff's sworn statement is prepared and provided to the Engineer with the EPP.</p> <p>21.7 Should any problems be detected due to the intensity of blasting, the Engineer is entitled to request that the Contractor carry out seismic measurements of the intensity of the vibrations induced by the blasting, at variable distances from the blasting points, under the supervision of the Engineer, and at the cost of the Contractor.</p> |
| <p><b>23. Land acquisition and land take</b></p> | <p>22.1 Pursuant to Sub-Clause 7.8 of the CC, the Contractor will cover (i) occupancy indemnities for the extraction or use of construction materials and (ii) the cost of acquiring or temporarily occupying the necessary land to stockpile excess backfill material.</p> <p>22.2 The Contractor provides compensation for any prejudice suffered by the owners and users of this land, if these users are not the same parties as the owners.</p> <p>22.3 The Contractor demonstrates to the Engineer (i) who are the owner and the users, if different parties have been identified, and (ii) a written agreement governing the temporary occupancy or acquisition of this land has been negotiated and duly paid up to the two parties, if different.</p>  |
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- 24. Traffic**
- 23.1 The Contractor defines a Traffic Management Plan in Worksite - ESMP (section 11 as defined in Appendix 1 to the ESHS Specifications).
  - 23.2 The Traffic Management Plan:
  - 23.3 includes the characteristics of its fleet of vehicles and site machinery; and
  - 23.4 defines the itineraries used on a map for each route between the different Project Areas that must be validated by the Engineer.
  - 23.5 The Contractor requests that the Employer obtain the authorisations of the competent administrative authorities if public roads are used. Any Engineer's instruction to update the Traffic Management Plan shall be implemented.
  - 23.6 Within one month of the physical start of Works, the Contractor informs the administrative authorities of areas crossed by the Contractor's vehicles, of the itinerary and characteristics (frequency of passing, size and weight of trucks, materials carried) of the Contractor's fleet of vehicles.
  - 23.7 If public roads are used, and unless approved otherwise by the Engineer, the Contractor mandates a bailiff to make a sworn report regarding the state of the road prior to use by the Contractor's vehicles. The report is annexed to the Traffic Management Plan.
  - 23.8 The Contractor describes in the Traffic Management Plan the expected traffic created by its fleet of vehicles (frequency of trips between Project Areas, working hours, convoys).
  - 23.9 The Contractor also describes the number and positioning of flagmen.
  - 23.10 Unless specified otherwise in the Contract or instructed otherwise by the Engineer, heavy vehicles (i.e. with a GVWR of more than 3.5 tons) may not be used at night between 22:00 and 06:00.
  - 23.11 Speed limits:
    - 23.11.1 The Contractor takes action to limit and check the speed of all vehicles and machinery used to execute the Works.
    - 23.11.2 The maximum speed of all machinery and vehicles of the Contractor comply with the lowest of the following: the speed limit defined according to the Employer's country regulations or the following limits.
      - a. 10 km/h within the Project Area;
      - b. 30 km/h in villages or hamlets, in towns, from 100 m before the first house;
      - c. 80 km/h on unpaved roads outside of towns, villages, hamlets and camps.
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- 23.11.3 Pursuant to Sub-Clause 4.15 of the CC, and in coordination with the competent Employer's country authorities, the Contractor provides and installs signs for the fleet of vehicles along public roads, when public signs are inadequate.
- 23.11.4 The Contractor provides each of its drivers with a map at the appropriate scale of the roads authorised for the execution of the Works, clearly indicating the maximum speeds authorised, and ensures their understanding.
- 23.12 It is strictly prohibited to transport people, equipment or products other than those required for the Works and the management of Project Areas, on board any of the Contractor's vehicles. This provision also applies to the transport of live animals and meat obtained from hunting, fishing or poaching.
- 23.13 The trailers and skips used to carry materials which could be projected (sand, crushed material, aggregates, selected materials) are covered with a tarpaulin for the entire itinerary between two Project Areas.
- 23.14 The Contractor carries out regular inspections along the roads used by its fleet of vehicles to ensure compliance with the provisions of Clauses 23.10 to 23.13 of the ESHS Specifications. The Contractor records these inspections and the results and transmits a summary of checks carried out for the previous month to the Engineer on a monthly basis.

## APPENDIX 2: SPECIFICATIONS FOR PREVENTION OF GENDER-BASED VIOLENCE/SEXUAL ABUSE AND EXPLOITATION (SGBV)

<p><b>SPECIFICATIONS FOR PREVENTION OF GENDER-BASED VIOLENCE/SEXUAL ABUSE AND EXPLOITATION (SGBV)</b></p>	<p>Gender-Based Violence is an umbrella term for any harm that is perpetrated against a person as a result of gender power inequalities that exist among males and females. It refers to any violent act inflicted on a person primarily because of their gender. Gender-Based Violence is often a display of male power that manifests in various forms, including physical, economic, psychological, and sexual. It can also be a display of female power, especially where the man does not seem to conform to the standards of masculinity. It also includes unwanted behaviour directed towards another person, which disrupts such person's work or reduces their quality of life. The commonest forms include bullying, physical abuse, shouting, domestic violence, threats, name-calling, stalking, isolation, and actual or threatened physical harm.</p> <p>Gender based violence also manifest in the form of Sexual Abuse, Sexual Exploitation and Abuse (SEA) or Sexual Harassment.</p> <p>While <b>Sexual Abuse</b> is the actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions; <b>Sexual assault</b> refers to a wide range of forms of non-consensual sexual conduct ranging from sexual coercion, attempted rape, rape, gang rape, marital rape and date rape. Sexual assault involves unwanted sexual experiences, sexual aggression and sexual abuse, ranging from non-consensual kissing to non-consensual sexual intercourse. It also refers to the use of objects (other than the sexual organs) to cause penetration.</p> <p><b>Sexual exploitation and abuse (SEA)</b> refers to any actual or attempted abuse of a position of vulnerability, differential power, or trust for sexual purposes, including but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another. Sexual abuse refers to actual or threatened physical intrusion of a sexual nature, whether by force or under unequal or coercive conditions. It is abuse of a sexual nature including acts such as rape, incest, fondling and indecent exposure. SEA therefore refers to unlawful forceful sexual or intercourse directed a beneficiary or member of the community (In the context of Bank-supported projects).</p> <p><b>Sexual harassment</b> refers unwelcome sexual advances, requests for sex favours or other verbal or physical conduct of sexual</p>
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	<p>nature. This manifests by way of words, acts, gestures or comments that would embarrass, humiliate, demean or compromise a reasonable person at whom such advances, requests or conduct are directed. It also refers to the imposition of sexual requirements in the context of a relationship of unequal power. Sexual harassment is the abuse of power and an assault of one's right to dignity, respect and freedom.</p> <p>The project may exacerbate the risk of GBV in both public and private spaces in a number of ways:</p> <ul style="list-style-type: none"> <li>• Influx of workers may increase the demand for sex work including risk of trafficking of women for the purposes of sex work or risk of forced early marriages in a community. Higher wages for workers in a community can increase transactional sex.</li> <li>• When land redistribution occurs e.g., due to resettlement for civil works, women may be extremely vulnerable to GBV.</li> <li>• Increased risk of violence can also be experienced when women are confronted with traveling long distances to access work opportunities or forced to travel at night.</li> </ul> <p>The contractor therefore shall develop and implement an appropriate system for prevention, mitigation and management the risks. The purpose of this is to prevent and mitigate risks against incidences of SGBV during implementation of the project. The SGBV shall focus on Sexual exploitation and abuse and workplace Sexual harassment since these are the types of SGBV most likely to occur on or be exacerbated by the project. The specific objectives will be:</p> <ol style="list-style-type: none"> <li>1. To create awareness on SGBV focusing on SEA among members of the targeted communities and their leaders within the project areas</li> <li>2. Sensitize the project workforce, their supervisors and other project persons involved in the project on SGBV focusing on SEA and SH.</li> <li>3. Enhance the contractor's ability to implement measures to prevent and respond to GBV issues.</li> <li>4. Establish GBV prevention and management good practices and systems in the project.</li> </ol> <p>The contractor shall undertake the following actions to address SEA/SH Risks:</p> <ol style="list-style-type: none"> <li>1. Recruit a GBV consultant to support implementation of GBV activities;</li> </ol>
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	<ol style="list-style-type: none"> <li>2. Map out GBV prevention and response actors in communities adjoining the project. This should incorporate an assessment of the capabilities of the service providers to provide quality survivor-centred services, including GBV case management, acting as a victim advocate, providing referral services to link to other services not provided by the organization itself;</li> <li>3. Develop a SEA/SH Prevention and Response Action Plan including an Accountability and Response Framework as part of the Construction Environment and Social Management Plan (C-ESMP);</li> <li>4. Make certain of the availability of an effective Grievance Redress Mechanism (GRM) with multiple channels to initiate a complaint. It should have specific procedures for SEA/SH, including confidential reporting with safe and ethical documenting of SEA/SH cases;</li> <li>5. The contractor's staff shall sign the Codes of Conduct (CoC) and the contractor should             <ol style="list-style-type: none"> <li>i. Ensure requirements in CoCs are clearly understood by those signing;</li> <li>ii. Train project staff on the behaviour obligations under the CoCs;</li> <li>iii. Disseminate CoCs and discuss with employees and local communities;</li> <li>iv. Create an appropriate Accountability and Response Framework.</li> </ol> </li> <li>6. Have project workers undergo training on SEA/SH.</li> <li>7. Undertake community sensitization on SEA risks and project activities to get their feedback on safeguard issues. This should occur at the start and throughout the implementation of the project;</li> <li>8. Implement appropriate project-level activities to reduce SEA/SH risks prior to construction works commencing such as:             <ol style="list-style-type: none"> <li>i. Have separate, safe and easily accessible facilities for women and men working on the site. Locker rooms and/or latrines should be located in separate areas, well-lit and include the ability to be locked from the inside.</li> <li>ii. Visibly display signs around the project site (if applicable) that signal to workers and the community that the project site is an area where SEA/SH is prohibited.</li> <li>iii. As appropriate, ensure public spaces around the project grounds are well-lit.</li> </ol> </li> </ol>
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	9. Undertake quarterly monitoring and evaluation of progress on SEA/SH prevention and response activities, including reassessment of risks as appropriate.
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## APPENDIX 3: CONTENTS OF WORKSITE - ESMP

1. **Environmental policy** ➤ Declaration of ESHS policy signed by the managing director of the Contractor and clearly defining the commitment of the Contractor in terms of (i) ESHS management for its construction sites and (ii) compliance with the ESHS Specifications of the Contract.
2. **Worksite -ESMP** ➤ Target and content of the Worksite Environmental and Social Management Plan  
➤ Preparation and updating schedule  
➤ Quality assurance and validation
3. **ESHS resources** ➤ Human resources:
  - ESHS Manager
  - ESHS Supervisors
  - Person in charge of relations with stakeholders
  - Medical personnel
 ➤ Logistics & communications:
  - ESHS vehicles
  - IT stations
  - In situ noise, air and water measuring equipment
  - Analysis laboratory used
 ➤ Reporting:
  - Weekly inspections
  - Monthly
  - Accident / Incident
4. **ESHS regulations** ➤ Definition of standards for the applicable national ESHS regulations and the ESHS recommendations of institutions affiliated to the United Nations (WHO, ILO, IMO, IFC), applicable to the execution of works:
  - Discharge standards
  - Minimum wage
  - Day and/or night traffic restrictions
  - Other
 ➤ Definition of ESHS standards for the industry applied
5. **ESHS operational inspection resources** ➤ Site tracking procedure:
  - Frequency
  - Personnel
  - Assessment criteria
 ➤ Non-conformity handling and detection procedure:
  - Distribution information
  - Notification depending on the level of importance allocated to non-conformities
  - Tracking of the closing of the non-conformities
 ➤ Management of data on tracking and non-conformities:
  - Archiving
  - Use as a performance indicator
6. **Project Areas** ➤ Description of Project Areas (as per definition in Sub-Clause 1.3 of the ESHS Specifications):

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- Number
    - Location on a topographical map
    - Activities
    - Opening & closing schedule
    - Access
  - Reference to the Appendix: an Environment Protection Plan (EPP) for each Project Area
  - 7. Health and Safety Plan**
    - Identification and characterisation of health and safety risks, including the exposure of personnel to chemicals, biological hazards and radiation
    - Description of working methods to minimise hazards and control risks
    - List of the types of work for which a work permit is required.
    - Personal protection equipment.
    - Presentation of the medical facilities at Project Areas:
      - Healthcare centre, medical equipment and allocation of medical staff
      - Medical acts that can be carried out on-site
      - Ambulance, communications
      - Referring hospital
    - Evacuation procedure for medical emergencies.
    - Description of the internal organisation and action to be taken in the event of an accident or incident.
  - 8. Training plan**
    - Basic training for non-qualified staff
    - Health & safety training
  - 9. Labour Conditions**
    - Description of Human Resource Policy for construction works of direct and indirect workers
  - 10. Local recruitment**
    - Local labour requirements:
      - Job descriptions and the levels of qualifications required
      - Recruitment procedure and deployment schedule
      - Initial training to be provided by the Contractor for each job description
    - Location and management of the local recruitment office(s)
  - 11. Traffic Management Plan**
    - Description of the fleet of vehicles/machinery used for the execution of the Works
    - Deployment (Project Area & schedule) and maintenance sites for each vehicle and machine
    - Mapping of itineraries, travel times, and areas where speeds are limited
    - Dust suppression:
      - Mapping of road sections where dust reduction initiatives apply
      - Water points identified or to be created for refuelling tanker trucks
      - Capacity of the tanker trucks used and calculation of the number of trucks required
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- Width of the track to determine if one watering run or equivalent is adequate (narrow track) or if two runs are required (wide track)
  - Number of watering or equivalent operations proposed per day depending on the climate
- 12. Dangerous products**
- Inventory of dangerous products per Project Area and per period
  - Transport and storage conditions and chemical incompatibility
- 13. Effluents**
- Characterisation of effluents discharged to the receiving environment
  - Facilities for the treatment or pre-treatment of effluents
  - Measures for reducing the sediment content of rainwater runoff
  - Measures for monitoring the efficiency and performance of facilities for reducing sediment content of rainwater runoff
  - Resources and methods for monitoring effluent and rainwater runoff quality
- 14. Noise and vibrations**
- Estimation of the frequencies, duration, days of the week and noise levels per Project Area
- 15. Waste**
- Inventory of waste per Project Area and per period
  - Collection, intermediate storage, handling and treatment methods for ordinary or inert waste
  - Storage and handling methods for dangerous waste
- 16. Clearing and revegetation**
- Methods & schedule for clearing vegetation and earthwork activities
  - Methods, species and schedule for the revegetation of Project Areas disturbed by the Works
- 17. Biodiversity**
- Schedule for adequate fauna and flora management
  - Measures for minimizing impact on fauna and flora species based on the Contracting Authority procedures
  - Measures for monitoring the efficiency and performance of the plan in place
  - Measures for limiting IAS
  - Measures for monitoring the efficiency and performance of the plan in place
- 18. Prevention of erosion**
- Location of zones suffering from erosion
  - Methods and schedule for the implementation of anti-erosive actions, including topsoil storage
- 19. Documentation on the Project Area condition**
- List and cover of viewpoints
  - Imaging method
  - Archiving photographs
- 20. Rehabilitation**
- Method and schedule for Project Area rehabilitation
- 21. Appendices**
- Environment Protection Plans (number and location specified in Section 6 “Project Areas” above):
    - Marking out of the Project Area perimeter on a map
    - Definition of zones for vegetation clearing, zones for the storage of usable timber, zones for burning of green waste
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- Definition of on-site activities: construction, storage areas, accommodation areas, offices, workshops, concrete making units
  - Layout of activity areas on the Project Area: construction works, production/operation areas, rehabilitation and closure
  - Zones for the storage of topsoil, spoil from earthworks, materials
  - Access routes and checkpoints
  - Project Area occupancy schedule
  - Organisation of Project Area preparation
  - Liquid discharge outlet points
  - Proposed sampling points for monitoring water quality
  - Atmospheric emission outlet points
  - Location of the storage site for dangerous products
  - Location and mapping of waste treatment facilities when handled by an external service provider
  - Any other information relating to the environmental management of the Project Area
- Emergency plan:
- Description of facilities
  - Characterisation of hazards
  - Emergency situations
  - Organisation structure - roles and responsibilities
  - Emergency procedures
  - Human and material resources
  - Triggering of the plan
  - Reporting
- Bailiff's sworn reports as specified in Sub-Clauses **Error! Reference source not found.**, 21.4 and 23.7 of the ESHS Specifications.

## APPENDIX 4: PROPERTIES RENDERING A PRODUCT DANGEROUS<sup>1</sup>

1. **Explosive** substances and preparations which could explode in the presence of a flame or which are more sensitive to impacts and friction than dinitrobenzene.
2. **Combustive** substances and preparations which, when in contact with other substances, particularly inflammable substances, undergo strongly exothermic reactions.
3. **Easily inflammable** substances and preparations (i) in liquid phase (including extremely inflammable liquids), with a flash point below 21°C, or which can heat up to the extent of spontaneous combustion in ambient air; or (ii) in solid phase, which can burst into flames easily in the brief presence of a source of inflammation and which will continue to burn after the removal of the source of inflammation or (iii) in gaseous phase, which are inflammable in air at normal pressure; or (iv) - which, when in contact with moist air or water, produce dangerous quantities of gases which are easily inflammable.
4. **Inflammable** liquid substances and preparations, with a flash point equal to or above 21°C and less than or equal to 55°C.
5. **Irritant** non-corrosive substances and preparations which, when in immediate, extended or repeated contact with the skin and mucosa, can cause inflammation.
6. **Harmful** substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to risks of limited severity.
7. **Toxic** substances and preparations (including highly toxic substances and preparations), which, in case of inhaling, swallowing or cutaneous penetration, can lead to serious, acute or chronic risks, and even death.
8. **Carcinogenic** substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to or increase the frequency of cancer.
9. **Corrosive** substances and preparations which, in case of contact with living tissues, can destroy the latter.
10. **Infectious** substances containing viable micro-organisms or their toxins, for which it is known or we have good reasons to believe that they cause disease in humans or other living organisms.
11. **Harmful to reproduction function** substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can induce or increase the frequency of undesirable non-hereditary effects in offspring or have a negative effect on reproductive functions and abilities.

<sup>1</sup> Source: French Environment Law (Code de l'environnement) / Articles R541-8

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| <b>12. Mutagenic</b>                     | substances and preparations which, in case of inhaling, swallowing or cutaneous penetration, can lead to hereditary genetic disorders or increase the frequency of these disorders.  |
| <b>13. React with water</b>              | substances and preparations which, in case of contact with water, air or an acid, release a toxic or highly toxic gas.   |
| <b>14. Sensitising</b>                   | substances and preparations which, in case of inhaling or cutaneous penetration, can lead to a hypersensitisation, so that renewed exposure to the substance or preparation will cause characteristic harmful effects. This property can only be considered if test methods are available. |
| <b>15. Ecotoxic</b>                      | substances and preparations with inherent or potential immediate or deferred risks for one or several environmental components.  |
| <b>16. Dangerous for the environment</b> | substances and preparations which are likely, after elimination, to lead to another substance, by any means, e.g. a lixiviation product, with one of the above characteristics.  |

### **SECTION 3: SECURITY SPECIFICATIONS**

## 1. Preamble

Below please find map of Kenya with security classification by the French Ministry of Europe and Foreign Affairs.



**Figure 3-1: Security classification map by the by the French Ministry of Europe and Foreign Affairs**

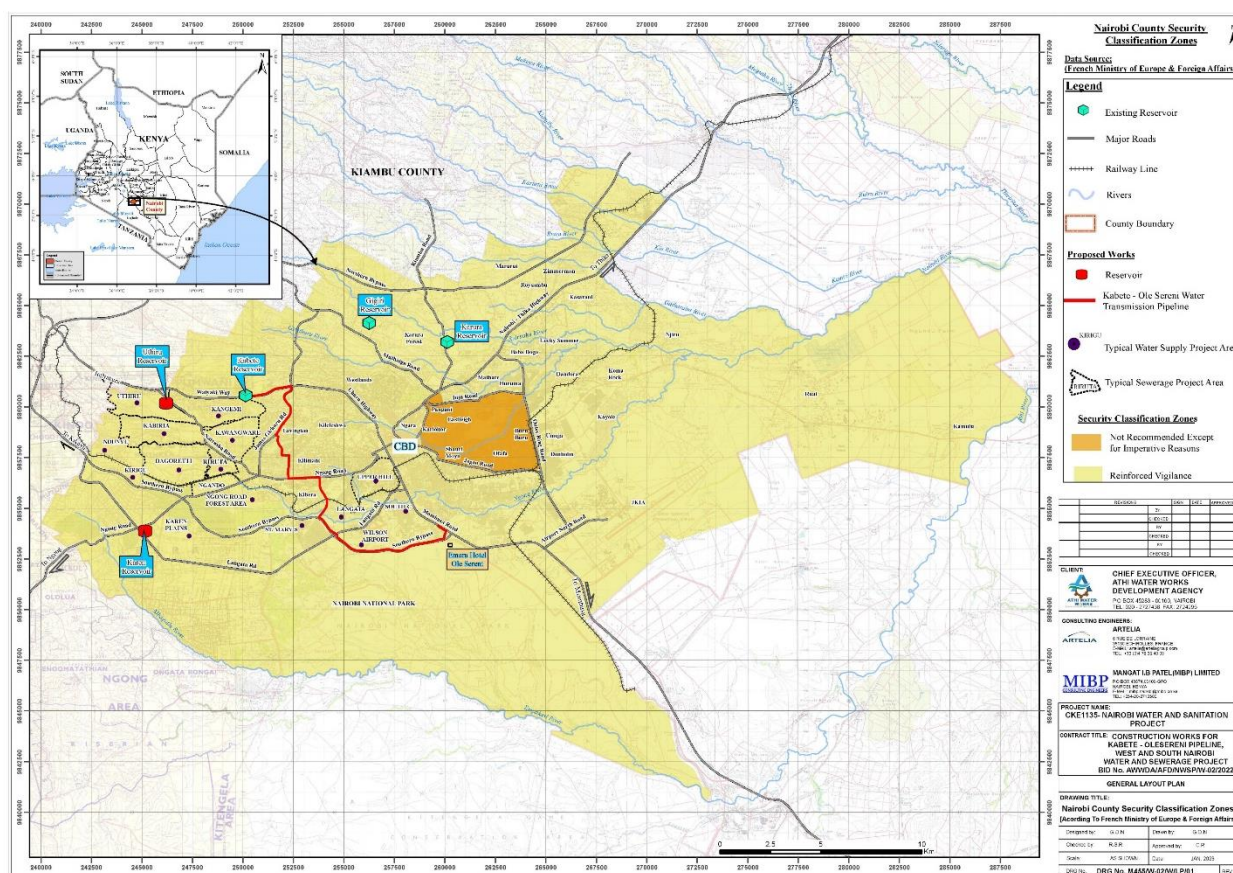
The key potential security risks include:

- Terrorism;
- Common crime.



As presented in the Figure 3-2 below; the project area fall under the yellow zone where reinforced vigilance should be observed as per the French Ministry of Europe and Foreign Affairs security clarification map.

The Pipelines are to be laid within highly built up and congested Areas in Nairobi including densely populated medium and low class residential areas and informal settlements; which are prone to common crime including robbery.



**Figure 3-2: Map of the project area with the Security classification map by the French Ministry of Europe and Foreign Affairs**

The state Government of Kenya has however put in place requisite security measures such as police stations all over the country.

The Contractor must, however, show the care it exercises to protect its employees who perform Works in the country. Therefore, it must identify the risks and, in light of this analysis, define prevention and protection resources, incorporating additional resources therein, which may be organisational, technical or human resources. These elements shall be described in a methodology, which for each of the headings below must address and describe what the Contractor has planned.

**Disclaimers:**

- 1 - Although the specified admissibility requirements endeavour to correlate with the potential risks to which the Contract may be exposed, they are intended to be used solely to evaluate Bid Documents in order to eliminate Bidders that do not meet a minimum set of requirements. They are in no event to be understood to constitute sufficient measures to ensure the security of persons and property in connection with the Contract. **The risk assessment and security measures to be defined in consequence thereof are the responsibility of the Contractor, who shall explain them in its security methodology.**
- 2 - **A methodology that fails to meet any one of the admissibility requirements set out in the sections below will be declared non-compliant and the Proposal of the Contractor will be rejected.**

2. **Analysis of Security Issues and Threats**

The Contractor shall describe its view of the security environment and threats in the area where the Contract will be performed and/or the danger area, and present a security analysis for the relevant area and for the activities it will perform therein. It shall specify the method and references used to perform this analysis and describe the main threat scenarios that can be identified at the Proposal stage.

In addition, it shall at all times be able to share information learned from its country watch by its local organisation or head office.

**Admissibility Requirements:**

- Document describing the method used to carry out this analysis;
- At least one identifiable reference source must be used;
- Identification and evaluation of security threats in relation to the contract;
- Description of measures planned to monitor local security

3. **General Security Organisation**

The Contractor shall define the general security roles and responsibilities within its organisation and the allocation of the associated tasks for this Contract (including subcontractors and co-contractors), and shall designate a security reference person. It shall define the planned organisation and resources. In the event of a Joint Venture (JV), the leader shall designate a security officer as the JV's sole contact for this Contract.

**Admissibility requirements:**

- Description of the organisation;
- The Contractor (and each member in the case of a JV) shall provide the name of the company's internal security officer, who shall be responsible for defining

and monitoring the measures implemented for the Contract.

#### **4. Specific Security Measures Planned**

Based on its own security analysis and the main threat scenarios it may have identified, the Contractor shall plan specific and appropriate measures. These measures shall cover at least the following matters:

##### **4.1. Security Organisation**

The Contractor shall describe its local security organisation in the location where the Services will be performed. In particular, it shall specify whether this organisation relies on internal resources, using its own resources already existing in the country, or whether it uses a local partner, a security services provider or a "Security Officer" dedicated to the Contract, or whether it relies on the country's State resources and whether it can request them directly. It shall describe the respective roles planned for each participant operating locally.

##### **Admissibility Requirements:**

- Description of the organisation and resources mobilised in the country of the Contract;
- The Contractor (and each member in the case of a JV) shall provide the name of the person who will be its contact for all security issues in relation to the Contract. This person may be the same person identified in Article 3 above;
- In the event of a JV, describe the coordination and distribution of responsibilities among the members;
- Designation:
  - of a "security officer" (CV to be provided); **OR**
  - a security service provider (references to be provided), with experience in the region where the Contract will be performed.

##### **4.2. Travel Within the Country and to the Relevant Area**

Depending on the security analysis, special measures may be required to ensure secure travel within the country. These means may include the use of aircraft of national companies or private aircraft, the use of passenger vehicles amongst others.

The Contractor shall describe the resources and measures planned to protect itself against security risks (crime, kidnapping, etc.) during these trips. These provisions may be technical, organisational or human. It shall distinguish between measures concerning protective actions and measures deemed forward-looking actions.

The Contractor shall describe the planned transport logistics, including human, technical and organisational resources and mechanisms for monitoring travel. It shall also define its requirements for maintenance management and rules of conduct.



**Admissibility Requirements:**

- Description of modes of travel, the physical means of travel and the security measures planned in connection with such travel;
- Distribution of roles and measures planned for the Contractor itself, for external participants and those expected from the Client and local authorities, identifying each actor;

**4.3. Accommodation During Assignments**

The Contractor shall describe the type of accommodation and the measures planned to ensure the security of teams (security guards, physical means, etc.).

**Admissibility Requirements:**

- Description of the accommodation selection criteria and security measures planned for each overnight stay;
- Provision of the names and addresses of hotels or accommodation venues planned for overnight stays

**4.4. Accommodation and Security on Project Sites and Worksites**

The Contractor shall ensure the security of project sites (living camps, technical base, quarries, etc.), and worksites by describing the security system applicable to each of these sites.

The Contractor shall describe the passive security measures and means planned to protect itself from security risk (fencing, embankments, alternating entry/exit, safe haven, etc.) as well as active means and measures (security guards, defence forces, etc.).

**Admissibility Requirements:**

- Identification and location of each project site (living camp, technical base, quarry, etc.), with a description of the active and passive measures that are planned to be implemented at each site;

**4.5. Communication**

The Contractor shall implement a communication and exchange process between the various Contract participants, to ensure reporting of security events, and that preventive or corrective actions deemed necessary are properly carried out. It shall describe the means enabling it to ensure effective communication.

**Admissibility Requirements:**

- Description of the planned means of communication and measures taken to ensure their reliability;

## 5. **Information, Awareness-Raising and Training Before Departure**

The Contractor shall make arrangements to inform, raise awareness and train its employees prior to departure on assignment. These arrangements shall be in the form of formal communication actions. It shall describe the provisions specifically planned for this Contract, in the form of "service orders" or similar documents.

### **Admissibility Requirements:**

- Description of essential instructions provided to employees (welcoming, briefings, updating of instructions booklets, etc.);
- Provision of the list of emergency numbers (local numbers and service providers, repatriation, head office on-call security service) furnished for the Contract's assignments;

## 6. **Alert Management and Crisis Management**

The Contractor shall prove that it has set up a crisis management process involving the local organisation and its head office. It shall describe the main procedures for triggering this process and its key operating procedures.

For this purpose, the Contractor shall describe the alert process, from the local organisation to its head office, and the interaction with the Client.

### **Admissibility Requirements:**

- Summary of the crisis management procedure dedicated to security, describing triggers, roles and responsibilities.