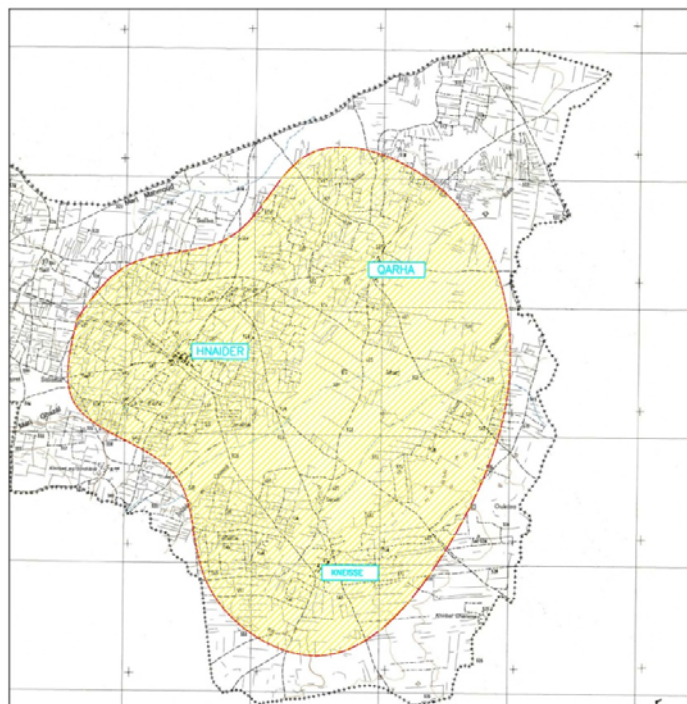


**REPUBLIC OF LEBANON**  
**MINISTRY OF ENERGY AND WATER**  
**UNITED NATIONS DEVELOPMENT PROGRAMME**

**FEASIBILITY ASSESSMENT AND DESIGN OF A  
WASTEWATER MANAGEMENT SYSTEM IN  
AL AMAYER-WADI KHALED**

**(KNAISSE VILLAGE)**



**VOLUME 4**  
**PARTICULAR SPECIFICATIONS**

- Part 1 – General Requirements
- Part 2- Civil Works

**APRIL 2016**

**BUREAU TECHNIQUE  
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## **PART 1**

### **GENERAL REQUIREMENTS**

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## **PART 1**

### **101. GENERAL REQUIREMENTS**

#### **101.1 APPLICATION OF PARTICULAR SPECIFICATION**

This Particular Specification is to be read and construed together with the General Specification contained in Volume 3 of the Contract Documents for this Tender. In case of ambiguities or discrepancies between this Particular Specification and the General Specification, the Particular Specification shall prevail, except if and to the extent otherwise provided by the Contract or directed by the Engineer.

Whenever the term “Specification” without further qualification is used in the Contract Documents, it shall mean the General Specification together with the Particular Specification.

#### **101.2 LOCATION OF WORKS**

The Works cover the construction of the wastewater collection networks in Wadi Khaled region. The localities serviced by the wastewater systems for which wastewater networks are to be constructed under the scope of this contract include Knaisse village.

#### **101.3 THE SITE**

For work along pipelines within public roads and tracks, the limits of the Site shall be the limits of land in public ownership which shall be taken to be any boundary fence or wall or if there is no such clearly identified boundary the width shall be taken as one meter beyond the edge of the carriageway.

For work along pipelines within private land or open country the Site shall comprise an easement width conforming to the relevant land acquisition documents.

The Contractor shall have inspected the Site and shall have included for the provision of any additional working area that he may require outside the limits of the Site.

#### **101.4 SCOPE OF WORK**

The items covered by this contract are summarized as follows:

- Supply, installation and testing of about 8,8 km of gravity sewers uPVC pipes diameter 200 mm.
- Construct, equip and test of about 281 reinforced concrete manholes various types and dimensions.
- Provide lay and test of about 125 lateral house connections. uPVC pipes 200 mm diameter shall be used for the house connections.
- Construct, equip and test of two septic tanks, dimensions as shown in the drawings.

### **101.5 CONDITIONS PREVAILING AT SITE OF WORKS**

The Contractor's attention is drawn to his obligation to satisfy himself, before submitting his Tender, as to the conditions prevailing at the Site of Works and its surroundings (General Specification for Civil Engineering Works).

### **101.6 PRIVATE LANDS**

The Contractor shall not enter upon or occupy with men, tools, or materials of any nature, any lands other than the working areas shown on the Drawings, except after consent shall have been received by him from the proper parties and a certified copy of such consent shall have been furnished to the Engineer. Any rentals or damages paid for occupying private lands shall be at the Contractor's expense.

### **101.7 EXISTING SERVICES**

In the course of works, the Contractor will encounter within the limits of the working areas and in the vicinity, miscellaneous above ground and underground services such as drains, pipes, cables, telephone and electric poles and lines, water supply and similar existing services. The Contractor's attention is directed to the provisions of Clause 101.12.4 of the Technical Specification.

### **101.8 ACCESS ROADS**

The necessity of construction Access Roads and temporary roads may arise, in which case such temporary roads shall be subject to the provisions of Clause 101.12.3 of the General Specification for Civil Engineering Works.

### **101.9 PROGRAM AND MONITORING**

It is a primary requirement of the Employer that a comprehensive knowledge of the status of progress to date, predicted progress, costs and cash flow forecasts is available at all times. The Contractor shall be responsible of the requisite information and shall be responsible for programming the Works, preparation of cash flow estimates and measuring and reporting the progress of the works in an approved format. In order that programming, progress measurements and reporting is executed in a timely and efficient manner, the Contractor shall program the Works, monitor progress and generate cost reports and cash flow projections by utilizing a recognized industry standard approved P.C. based Project Management software package.

The Contractor's master program and cash flow estimates and subsequent updates shall, as a minimum, detail the sequence of procurement, installing, testing and commissioning, and handing over for each of the works items including each item described in the Bill of Quantities.

At least 21 days prior to taking possession of any portion of the Site and starting of work, the Contractor shall submit a detailed construction program for that portion of the Site. The detailed construction program shall be to a level to adequately identify the intended sequence of working on each individual item of work. The minimum level of detail shall not be less than that needed to identify each individual payment item included in the Bill of Quantities.

The Engineer's obligation to measure the Works shall be dependent on the Work being programmed and progress being monitored and reported in accordance with the requirements of the Contract.

#### **101.10 LIST OF ABBREVIATIONS**

In the Contract Documents, the following abbreviations have been employed:

uPVC	- Unplasticized Polyvinyl Chloride
D.I.	- Ductile Iron
R.C.	- Reinforced Concrete
C.I.	- Cast Iron
G.S.	- General Specification
C.O.C.	- Conditions of Contract
B.O.Q.	- Bill of Quantity
ID	- Inner Diameter
OD	- Outer Diameter

#### **101.11 OR EQUAL CLAUSE**

Wherever reference to Standard Specifications, such as British Standards are made they shall not be construed to restrict materials to British products. Materials from other scheduled countries will be considered provided that the producer of the material certifies its conformity to the appropriate Standard Specification.

Similarly whenever a material or article required is specified or shown in the plans by using the name of the proprietary product or of a particular manufacturer or vendor; any material or article which will perform adequately the duties imposed by the general design will be considered equal and satisfactory provided the material or article so proposed is of equal substance and function in the Engineer's opinion. It shall not be purchased or installed without his written approval.

#### **101.12 GOVERNMENT REGULATIONS**

The Contractor shall comply with all provisions of the rules, regulations and orders of Government and Municipal agencies, such as the Public Works Department, Electricity of Lebanon, and Telecommunications Authority.

The Contractor shall co-operate with the Employer in promptly furnishing any information that may be required by such governmental agencies. It shall be the obligation of the Contractor to keep himself informed of these governmental rules, regulations, and orders and the Contractor shall make the requirements of this article a part of any sub-contract he may enter into.

#### **101.13 FACILITIES FOR THE ENGINEER'S REPRESENTATIVE**

Replace the text of section 101.22 of Volume 3 - Technical Specifications - Part 1 - General Requirements with the following:

The Contractor shall, within 4 weeks of the award of the Contract, hand over to the Engineer a fully completed, furnished and equipped Engineer's office. The Contractor shall provide suitable temporary office space for the Engineer until the office is completed.

The office shall be set-up on land provided by the Contractor. The office shall have a minimum floor area of 30 square meters partitioned into at least two rooms and one toilet. The floor shall be of floated concrete or raised timber adequately damp, termite and ant proofed. The doors are to be fitted with both a Yale type and a rim lock with two keys to each.

A 24 hour electrical supply shall be made available, either from mains or from Contractor's generating plant. The office shall be wired for electricity and provided with a minimum of two ceiling light fixtures and two electrical outlets per room.

The Engineer's office shall be completely separate from that of the Contractor and located as specified by the Engineer.

A latrine and washroom, a potable water supply and water-borne sewage disposal system shall be provided for the office.

The Contractor shall provide an access road not less than three meters wide to the Engineer's main office and a car parking area of adequate size, constructed to a minimum of 150 mm consolidated thickness of gravel, properly graded, cambered and drained.

The Contractor shall provide the following satisfactory and serviceable furniture fittings and equipment in the office.

1. Two desks containing drawers with locks complete with desk chair.
2. one lockable plan cabinet of six drawers.
3. 5 sq.m of wall boarding for maps and plans.
4. one conference table with six chairs.

The Contractor shall bear all charges related to the consumable services and maintenance work of the Engineer's office.

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.

#### **101.14 ACCESS TO WORK**

The Engineer and his duly appointed representatives and the Employer or his representatives or agents may at any time and for any purpose whatsoever enter into and upon the work and the premises used by the Contractor. The Contractor shall provide free, proper, and safe facilities therefore.

#### **101.15 SURVEY AND SETTING OUT**

All levels used for construction shall be referred to the National Height Datum. The Contractor shall be responsible for obtaining the location and values of the permanent bench Marks. In cases where such bench Marks do not exist, a site datum shall be agreed with the Engineer.

Prior to the commencement of the work the Engineer shall approve all plans showing benchmarks, limits of plot and auxiliary baselines. The Contractor, under the supervision of the Engineer, shall set out on-site and erect appropriate permanent markers where instructed by the Engineer. Permanent bench marks shall be constructed from steel pins, road nails or painted marks on existing stable features. A minimum of two site bench marks shall be established on existing stable features.

The Contractor shall employ an experienced licensed Surveyor for the duration of the Contract. He shall furnish the Engineer with a duly signed map showing the various centerlines, baselines, reference points permitting the renewal of markers and boundaries of parcels and blocks, if destroyed. Before starting and during earthwork on the site, the Contractor shall set out a net of square coordinates at distances not exceeding 10 m in each direction. A peg shall be driven at each intersection and at other relevant points and levels of peg tops and of ground at the same spot shall be measured.

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are not guaranteed to be correct. All man-made hand detail features, road edges, kerbs, existing manholes, inspection covers, culverts, and underground service pipeline shall be surveyed in their true position and shown by conventional symbols.

Wherever dimensions or levels are marked on the Drawings such dimensions or levels shall take precedence over dimensions scaled from the Drawings. Where no dimensions or levels are shown on the Drawings, instructions shall be obtained from the Engineer. Large scale drawings shall be taken in preference to drawings of smaller scale.

All surveyors which will subcontract the Contractor for the topographical works shall be approved by the Engineer and the responsibility still on the Contractor to satisfy the Engineer by the accuracy of the survey.

#### **101.16 NOTICE BOARDS**

The Contractor shall provide and erect sign boards at the sites where works are being executed, giving information to the public on the Project and the Employer and further details as will be prescribed by the Employer. The location, dimension and number of the sign boards at the sites will be indicated by the Engineer. The Contractor shall maintain, alter, move and adapt the sign boards from time to time as instructed by the Engineer. The display of any named Subcontractors or any other information associated with the Works shall be to the approval of the Engineer.

#### **101.17 MANUFACTURE'S CERTIFICATES**

The Contractor shall furnish the Engineer with a manufactures certificate confirming compliance to the specification in respect of all items of equipment.

The original and one copy of the manufacturer's certificate shall be delivered to the Engineer not later than 14 days prior to the intended date of delivery of the Item to site.

#### **101.18 PRECAUTIONS AGAINST CONTAMINATION OF THE ENVIRONMENT**

The Contractor shall at all times take every possible precaution against contamination of the environment. The site and all permanent and temporary works shall be kept in a clean

condition. The Contractor shall at all times take measures to avoid contamination of the existing water courses and drains by petrol, oil or other harmful materials.

#### **101.19 ACCESS TO PROPERTIES**

The Contractor shall not disrupt any private or public access way without first providing alternative arrangements.

#### **101.20 DRAWINGS AND DOCUMENTS**

All drawing and documents submitted by the Contractor shall have been checked, signed and be ready for issue and shall bear the title of the drawing, the scale, the date, the Contract number and name, the document number complying with an approved numbering system, the name and references of the Contractor, the name of the Employer and the Engineer, the date of approval by the Contractor and the signature of the person responsible for approval.

As-built drawings shall be prepared after completion of the work and shall be also submitted to the Engineer for approval.

It is the duty of the Contractor to undertake all the Engineer's recommendations, modifications and corrections at his own expense until complete satisfaction of the Engineer.

Unless otherwise specified the Contractor shall allow a minimum of 21 days for approval of drawings and documents by the Engineer.

#### **101.21 MEASUREMENT AND PAYMENT**

Unless otherwise provided for in the B.O.Q, all costs incurred in complying with the requirements of this Division 101 shall be deemed to be included by the Contractor in his unit rates in Bill of Quantities and shall not be paid for separately.

**PART 2**  
**CIVIL WORKS**

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## **201. CONCRETE WORKS**

### **201.1 GENERAL**

#### **201.1.1 Span Life of Concrete Structure**

New works are to be designed for a life of 60 years.

#### **201.1.2 Codes and Standards**

Complementary or new design shall as far as possible be carried out in compliance with relevant International Standards such as:

- BS Standards.
- ACI and Uniform Building code.
- BAEL 1992
- AFPS 90
- or equivalent standards

### **201.2 SOIL PARAMETERS**

The Contractor shall carry out soil investigations to satisfy himself with the prevailing soil conditions for all sites.

### **201.3 MATERIALS**

#### **201.3.1 Grades of Concrete**

The minimum grades of concrete for the various structures are given as follows:

<b>Grade</b>	<b>Component</b>
C30	Reinforced concrete for Reservoirs (400 Kg cement/cu.m)
C25	Reinforced concrete for Buildings and Structures and manholes (350 Kg cement/cu.m)
C20	Mass concrete (250 Kg cement/cu.m)
C20	Blinding concrete (250 Kg cement/cu.m)

Reinforced and mass concrete must be vibrated. Cement used for structures in contact with wastewater and buried surfaces in contact with underground water shall be sulfate resisting Portland cement (BS 4027). Cement for all other structures shall be ordinary or/and rapid hardening Portland cement. (BS 12).

Admixtures and mix design of the different Grades of concrete shall be submitted for approval prior to commencing the work.

### **201.3.2 Reinforcement**

All reinforcing steels shall be Type 2 High Yield Bars and comply with the requirement of BS 8110 and shall have a specified characteristic strength of 420 N/mm<sup>2</sup>.

Dowel bars and stirrups shall be Mild Steel grade 25,  $f_y = 250 \text{ N/mm}^2$

Lap lengths shall be 50 diameters. Mechanical bending for  $\phi \geq 12 \text{ mm}$  is required.

### **201.3.3 Minimum Cover of Reinforcement**

The concrete cover for all steel bars including stirrups shall not be less than 40 mm in structures where concrete surfaces are in contact with water.

Where concrete surfaces are in contact with soil, the cover of reinforcement shall not be less than 35 mm.

The cover of reinforcement in external surfaces of structures, and all elements of buildings shall not be less than 30 mm.

Formwork for all concrete surfaces in contact with water and/or soil and internal surface (walls and ceilings) of technical rooms shall be of form panels (marine plywood or metallic formwork) in order to obtain a regular and smooth finish.

### **201.3.4 Classes of Exposure and Crack Width**

External and internal walls, columns and beams are to be considered as subject to severe exposure as defined in Sub-Clause 3.3.4 of BS 8110.

The faces of structures in contact with ground shall also be considered as subject to severe exposure.

Concrete surfaces in contact with water are designed for a maximum crack width of 0.2 mm.

### **201.3.5 Admixtures**

Admixtures (retarders, mass waterproofing, silica fume, ...) are to be added to concrete in contact with liquid. Technical sheets and the mix design of concrete shall be submitted for approval.

## **202. PIPELINES AND PIPEWORK**

### **202.1 TRENCH EXCAVATION**

Excavation for pipelines shall be carried out in accordance with Sub-Section 201.3.2 of the General Specifications. During the pipe laying, jointing, testing of pipes and backfilling, the trench shall be completely dry.

The trench details shall be as per standard details drawings.

The Contractor shall excavate the trenches without damaging existing pipes, cables and any other structure. In this respect, the Contractor shall excavate the necessary depth or change the route in order to avoid damaging the pipes, cables and culverts that cross the roads.

In case the modification of the pipe depth or route is impossible, the Contractor shall, after the approval of the Engineer, undertake all the necessary works including preparation of drawings, excavation, fill and concrete works, etc... to modify the culvert in a way to maintain the passing section of the culvert.

The Contractor shall clear away within the same day, all excavated material arising from trenches and headings on asphalted roads as the work proceeds, and shall keep these roads free from any accumulations and clear in a good condition, to the satisfaction of the Engineer.

In addition to Sub-Section 201.3.2 of the General Specifications, Earthwork shall not be classified in accordance with the hardness of the excavated material, all excavation should be classified as common excavation and the Contractor shall take the whole responsibility for his assessment of excavated material and conditions. He should also use all suitable materials in the permanent construction required under the contract. However, the trenches types shall be classified according to the sewer diameter and to the average 'depth to invert' of sewer, which means depth to the internal invert of the pipe, as listed in Table 217.1.

**Table 217.1:** Type of Trenches for Sewer Pipes

TRENCH TYPE	SEWER DIAMETER (mm)	SEWER INVERT LEVEL (m)
T1-H1	200-250-300	$0 < H \leq 1.5$
T1-H2	200-250-300	$1.5 < H \leq 2.5$
T1-H3	200-250-300	$2.5 < H \leq 3.5$
T1-H4	200-250-300	$3.5 < H \leq 4.5$
T1-H5	200-250-300	$4.5 < H \leq 5.5$
T1-H6	200-250-300	$5.5 < H \leq 6.5$
T1-H7	200-250-300	$6.5 < H$

## 202.2 BACKFILLING OF PIPE TRENCHES

Backfilling shall be carried out in accordance with the sub-section 201.3.9 of the General Specifications.

All pipes shall be placed in sand bedding and surround if the pipeline is above water table and in gravel bedding and surround if the pipeline is below water table.

The following descriptions are provided to further define the two classes of materials:

a) Material suitable for filling:

The material suitable for filling are from type A or B described in Sub-section 201.3.4 and 201.3.5 of the General Specifications.

b) Material unsuitable for filling:

Shall mean material other than suitable material and unless accepted by the Engineer shall include:

- Material from swamp, marshes, or bogs and solid containing more than 12% organic matter when tested in accordance with Test 8 of BS 1377, and which occurs below the top soil layer.
- Clay-based materials of liquid limit exceeding 40 and/or plasticity index exceeding 10 as and if directed by the Engineer,
- Boulders.
- Maximum granular diameter > 5 cm.

Where the pipe slope is greater than 25% suitable anchors blocks shall be installed.

### 202.3 PIPELINES AND MATERIALS

#### Gravity sewer pipelines:

Unless specifically itemised in the B.O.Q, gravity sewers shall be constructed from uPVC pipes. The uPVC pipes and fittings for gravity sewers shall comply with EN 1401 and shall be obtained from an approved manufacturer. Restrained rubber ring type push-fit flexible joints shall be used unless otherwise stated.

The pipes diameters specified in the B.O.Q. are inner diameters (ID). In case of use of uPVC pipes, OD 200 is accepted to use for 200 mm.

The class or series of all pipes specified for gravity sewer pipelines is the minimum required. However for some diameters in certain depths of trenches, this minimum is not sufficient and the Contractor should supply transport and install the pipes having the adequate pressure class without any change of unit prices. The Contractor should submit for approval the choice of pipes materials and pressure class in function of pipes diameter and depths of trenches.

As for the materials used, they shall comply with the requirements of Section 101.9 of the General Specifications. Any unsuitable material not satisfying the specifications shall be rejected by the Engineer, removed from the Site and replaced by the Contractor at his own expense.

### 202.4 WARNING TAPES

Warning tapes shall be placed on well compacted Backfill at 450mm below the finished level and directly above the center-line of the pipeline.

Warning tapes shall be made of pigmented low density polyethylene and aluminum foil in a bright color or other approved material not less than 100 mm wide for pipes diameter ≤ 200mm and 2 x 100mm for pipes diameter > 200 mm and 0.15 mm thick. When laid, the tapes shall provide a continuous band detectable with a metal detector if the pipe itself is not detectable. The tapes shall be continuously and alternatively labeled in Arabic and English.

Where possible, tapes shall also be laid above ducts and concrete protection slabs as directed by the Engineer.

### 202.5 MANHOLES

Manholes shall be constructed as specified in Sub-Sections 202.11.2, 202.14.2 and 202.14.5 of the General Specifications and a sulfate resistant cement should be used. As for classifying the

manholes, it will be the basis of the sewer diameter and the “depth to invert” of the manhole, which means depth to the internal invert of the manhole, as specified in the Table 217.2.

**Table 217.2:** Type of Manholes for Sewer Pipes

MANHOLE - TYPE	SEWER DIAMETER (mm)	DEPTH OF MANHOLE (m)
M1-H1	200-250-300	$0 < H \leq 1.5$
M1-H2	200-250-300	$1.5 < H \leq 2.5$
M1-H3	200-250-300	$2.5 < H \leq 3.5$
M1-H4	200-250-300	$3.5 < H \leq 4.5$
M1-H5	200-250-300	$4.5 < H \leq 5.5$
M1-H6	200-250-300	$5.5 < H \leq 6.5$
M1-H7	200-250-300	$6.5 < H$

Manholes shall be constructed as per standard details drawings.

All concrete faces in contact with the soil shall receive a waterproofing treatment consisting of one layer of bituminous coating in accordance with Sub-Section 213.2.1 of the General Specifications.

## 202.6 COVERS AND FRAMES

Covers and frames shall be non-rocking, locking, sold top to specifications comply with British Standards BS2789 or ISO 1083 or DIN 1229 or BS EN 124[31]. Equivalent, wording on cover shall indicate nature of network (wastewater), the type of manhole shall be integrally casted in Arabic and/or English on the manhole cover. Grades shall be as follows:

- In Roadways: Heavy duty test load 40 tons
- In Sidewalks, Carriage Drive and Cycle Tracks: medium duty test load 25 tons.
- In Footpaths and Fields: Light duty, test load 7 tons.
- Manhole covers shall be of a circular pattern unless otherwise indicated on the Drawings. Frames shall be provided with openings for fixing bolts for solid frame embedment into manhole concrete necks. Covers and frames shall be coated with a bitumen based compound to BS 3416:1991 with a minimum thickness of 200 microns.
- Manholes covers for wastewater collectors should be ventilated.

## 202.7 HOUSE LATERAL CONNECTIONS

The works shall include:

- Construction of the 1m x 1m x 1m manhole including formwork, concrete, reinforcement and all related works.
- Manhole cover and frame.
- Manhole testing.
- All related works as specified and shown on drawings and with full coordination with relevant authorities.

Moreover, the construction works shall include all required materials and equipment to supply and lay a 200mm connecting pipe to the lateral manhole including but not limited to the following:

- Breaking out and reinstatement of existing paved surfaces.
- All necessary excavation in any type of soil.
- Supply and lay of 200mm diameter pipe connecting the lateral manhole to the sewer manhole with all related works.
- Testing the connecting pipe.
- Reinforced concrete bedding and surrounds.
- Backfilling with selected excavated or imported fill materials.
- And all other related works, all as specified, shown on drawings, and with full coordination with relevant authorities.

The locations of inspection chambers, lateral house connections and connecting lateral sewers shall be defined on site.

#### **202.8 REINSTATEMENT OF ASPHALTED ROADS**

The Contractor shall lay pipes on one side of the streams and on one side of the roads (even if this is not shown on the drawings) and if possible outside the carriageway in order to avoid damaging the roads. The Contractor shall coordinate with the Administration and the Engineer and the relevant Authorities in order to obtain official authorization prior to any construction work.

Reinstatement of asphalted roads shall be done according to the Clause 218 of General Specifications. Asphalt wearing course shall be executed immediately after the completion of the backfilling, sub-base and base layers. This asphalt work will be considered as temporary. The contractor shall repair all future damages using the same procedure as above. When no damage occurs anymore to the reinstated trenches, asphalt work will be considered permanent and completed after presenting a clearance from the concerned authority to the supervising Engineer and getting the approval of the latter.

## 203. SEPTIC TANK

### 203.1 GENERAL

The Septic tank consists of two underground concrete compartments. One end is connected to an inlet wastewater pipe from a collection system and the other to a nearby existing water course through an overflow pipe 200 mm diameter. These pipe connections are made with a T concrete pipe, allowing liquid to enter and exit without disturbing any crust on the surface. The two compartments; were equipped with a manhole cover, and separated by a dividing wall with openings located about midway between the floor and roof of the tank, as shown in the drawings.

Wastewater enters the first chamber of the tank, allowing solids to settle and scum to float. The settled solids are anaerobically digested, reducing the volume of solids. The liquid component flows through the dividing wall into the second chamber, where further settlement takes place. The excess liquid, now in a relatively clear condition, then drains from the outlet into the water course.

### 203.2 DETAILED SPECIFICATIONS

The septic tanks shall be constructed in accordance with the following criteria and as detailed in the drawings:

- There will be no structural failure or undue distortion under pressure when the tank is either full or empty,
- The septic tank will be watertight and retain structural integrity during construction and operation,
- The dividing partition wall shall be provided with transfer openings centrally located within the liquid depth and be equally spaced from the vertical axis center line and the external wall as shown in drawings,
- Connections for the inlet, outlet and inspection openings shall be integrally cast with concrete structures, so as to be water-tight and have a strength equal to that of the parent material,
- Unless provided with an access openings with cast iron cover and frame located over the two chambers, the septic tank is to be provided with an inspection opening shafted to the surface level with a DN 300 pipe fitted with removable cover,
- The septic tank must be installed on a compacted, level base not less than 300mm depth with an approved material and the top of the tank shall terminate at least 30mm above the finished ground surface level, with the surrounding surface graded away from the septic tank and be provided with access covers as follows:
  - Be constructed of a material as approved and be of sufficient strength to withstand all imposed loadings,
  - Be constructed so as to be child proof and effectively sealed to prevent the ingress and/or egress of water or gas and be removable for maintenance purposes,
  - Be positioned centrally over the compartment wall and have an access opening of at least 900mm long and 750mm wide, and be positioned to permit inspection of the inlet and outlet fittings and enable access to each compartment for maintenance

As mentioned above, the septic tank is divided into two compartments with the first compartment having twice the volume of the second compartment. This arrangement shall ensure that the hydraulic load and the turbulence created by the incoming wastewater is absorbed in the first compartment. The second compartment shall achieve settlement for the low density solids since it receives the hydraulic load at a lower rate than does the first compartment.

The incoming wastewater from the collection system shall enter the first compartment via a 200 mm tee. The tee shall be designed and installed so as to dissipate the energy of the incoming water, to minimize turbulence, and to prevent short circuiting. The vertical leg of the inlet tee shall extend below the liquid surface to the specified level in accordance with the drawings.

The outlet of the first and second compartment shall be constructed in a manner so as to retain the sludge and scum formed in both compartments. The outlet of the first compartment is comprised of two (2) 200 mm dia elbows equally spaced along the width of the intercompartmental wall. The outlet of the second compartment is comprised of a one(1) 200 mm diameter tee. The outlets shall have the submergence and height above the liquid level in accordance with the drawings.

A gas deflection baffle shall be provided underneath the outlets to prevent the entrance of gas disturbed sludge in the rising leg of the outlets.

### **203.3 VENTING PROVISIONS**

The septic tank shall be vented to allow for the escape of accumulated methane, hydrogen sulfide, and other gases produced from digestion of the settled solids.

A 200 mm vent pipe shall be constructed on top of the second compartment and shall extend 3m above the finished grade level. Gases formed in the first compartment shall be vented to the second compartment via two 100 mm dia openings in the intercompartmental wall. The two openings shall be located above the scum level in accordance with the drawings.

### **203.4 ACCESS MANHOLES**

Two manholes with cast iron covers and frame shall be provided over the inlet and final outlet pipes. The manholes shall provide access and means to inspect the inside of both compartments. The manholes shall also be used whenever tank desludging is required. The manhole covers shall be fitted with gaskets to provide a weather proof seal. Two each 300 mm inspection pipes with removable covers shall be provided on top of the first compartment outlets pipes as shown in the drawings.

### **203.5 STRUCTURE OF THE SEPTIC TANK**

The tank shall be structurally sound, smooth internally, watertight and the concrete used shall comply with the requirements of the general and particular specifications for Reinforced Concrete Reservoirs, and shall have a compressive strength of not less than 30 MPa at 28 days.

The dimensions of the septic tank as well as the thickness and reinforcement of slabs and walls

are as shown in the drawings, in particular the following should be considered:

External and internal walls (partitions) of the cast-in-place septic tank shall have a nominal thickness of 50cm.

Each vertical wall shall be reinforced with two layers of high yield steel bars installed at the rate of 14 Ø14/m for inside part of wall in contact with water and 14 Ø16/m for the outside part. Bars shall be kept at least 4 cm clear from the formwork.

The base slab shall be connected to the upper slab by bending the bars in such a way as to ensure a minimum 50 cm penetration into each of the slabs, and shall be 35 cm thick and shall extend a distance of 15 cm, from both sides of the tank walls. It shall be laid on a 10 cm thick concrete blinding layer and a 30 cm of compacted gravel.

The upper slab shall be 40 cm thick

The concrete mix design for Base slab, upper slab and vertical walls is 400 kg/m<sup>3</sup> of sulfate resistant cement for 400 liters of sand and 800 liters of fine gravels

Generally, hydrostatic tests shall be conducted on the pipes before they are connected to fixtures.

In no case shall the pressure tests of pipes, equipment, etc. ... exceed the working pressure of such pipes, equipment, etc. ... Prior to and upon completion of tests, all equipment, piping, strainers, etc. ... shall be thoroughly cleaned and put into working order.