THE REPUBLIC OF RWANDA

MINISTRY OF INFRASTRUCTURE

CONSULTANCY SERVICES TO FORMULATE RWANDA NATIONAL CONNECTION GUIDELINES

FINAL REPORT

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CONSULTANCY SERVICES TO FORMULATE RWANDA NATIONAL SEWERAGE CONNECTION GUIDELINES

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation / acronym	Meaning
BOD	Biochemical Oxygen Demand
CCTV	Closed Circuit Television
COD	Chemical Oxygen Demand
DI	Ductile Iron
Dia	Diameter
DLP	Defects Liability Period
E&M	Electrical and Mechanical
EDPRS II	Economic Development and Poverty Reduction Strategy 2
EMRA	Encroachment, Maintenance and Removal Agreement
FOG	Fats, Oil, and Grease
FSE	Food Service Establishments
GoR	Government of Rwanda
GRD:	Grease Removal Devices
mg/1	milligrams per liter
MININFRA:	Ministry of Infrastructure
NISR	National Institute of Statistics of Rwanda
O&M	operation and maintenance
PVC	Polyvinyl Chloride
R O	Reverse Osmosis
REMA	The Rwanda Environmental Management Authority
ROW	Right of Way
RSB	The Rwanda Standards Board
RURA	Rwanda Utilities Regulatory Agency
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds
WASAC	Water and Sanitation Corporation Limited
WSSP	Water and Sanitation Strategic Plan

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SECTION 1: PURPOSE

1.1 This document offers guidance on the connection to the Rwanda Sewerage in terms of Sewer System Standards (material, size, depth, slope, sewer, spacing, protection, access, sewerage operation and maintenance), easement requirements (setbacks, land acquiring, etc), connection requirements and procedures, use of sewers (rights, obligation, offenses, permitted, prohibited discharges, etc), sewerage administration (roles and responsibilities), financial framework (fees, charges, surcharges and subsidies), sewer guidelines enforcement and sewerage monitoring and evaluation.

1.2 These guidelines apply to any property in coverage area of the sewerage that intends to connect to, disconnect from, or otherwise interfere with the sewerage.

SECTION 2. DEFINITIONS

2.1 Biochemical Oxygen Demand (BOD5): The amount of oxygen utilized by micro-organisms in the process of decomposition of organic material in wastewater over a period of five days at 20°C. In practical terms, BOD is a measure of biodegradable organic content of the waste.

2.2 Building Drain: Shall mean that part of the lowest piping of a drainage system which receives the discharge from waste, and other drainage pipes inside the walls of the building and conveys it to the building (house) sewer.

2.3 Building Sewer: shall mean the extension from the building drain to the public sewer or other place of disposal.

2.4 Commercial User: All retail stores, restaurants, office buildings, laundries, and other private businesses and service establishments Competent Authority: Shall mean the concerned authority (Institution in charge of Sanitation, entity in charge of sanitation, regulatory agency or Municipality)

2.5 *Construction Standards*: The general construction requirements adopted by the Entity in charge of Sanitation Authority for installation of sewerage facilities

2.6 Cooling water: shall include the clean wastewater from air conditioning, industrial cooling, condensing and similar apparatus and from hydraulically powered equipment. In general, cooling water will include water, which is sufficiently clean to allow discharge into the environment without adverse consequences. The discharge of this water in environment should respect the minimum temperature otherwise it will lead to an ecological threat

2.7 Easement: shall mean an acquired legal right for the specific use of land owned by others.

2.8 Entity in charge of sanitation : Authority/Agency in charge of sanitation under the ministry in charge of sanitation

2.9 Fats Trap: A unit with a special engineering design connected to the private sewage networks of commercial kitchens, restaurants, food factories, hotels etc which separate food oils and fats from liquid wastes before draining the same into the public sewage network or septic tanks.

2.10 Garbage: Shall mean solid wastes from the preparation, cooking and dispensing of food, and from the handling, storage and sale of produce.

2.11 Gravity Flow: shall mean the flow of wastewater within a pipe caused by gravity; therefore, the pipe should slope downward in the direction of flow and no pumping or other means of pressurizing the flow is used.

2.12 Heavy Metals: Metals such as copper, zinc, cadmium, nickel and lead that are used in industry. These can, if in sufficiently high concentrations, affect the biological sewage treatment processes and be harmful to living organisms.

2.13 Holding Tank Sewage: Any wastewater from holding tanks such as vessels, chemical toilets, campers, trailers, septic tanks, sealed vaults and vacuum-pump tank trucks.

2.14 Industrial User: Any person who discharges industrial waste into public sewers.

2.15 Industrial Wastes: shall include the liquid or water-carried wastes of any industrial process not clearly included within the definitions of sanitary sewage, storm water or cooling water. In general, wastewaters carrying any quantity of oils, grease, fats, abrasives, chemical residues of manufacturing processes, wastes from commercial food preserving or canning, from slaughterhouses or meat processing plants, and similar substances, whether dissolved, in suspension, or mechanically carried by water, shall be considered as industrial wastes.

2.16 Infiltration: shall mean the seepage of water into a sewer system, including service connections from the ground or water body, through such means as (but not limited to) defective or cracked pipes, pipe joints, connections, or manhole walls.

2.17 Inspector: Is a person designated by the Competent Authority to carry out sanitary activities inspection in accordance with these Guidelines.

2.18 Institution in charge of Sanitation: A Ministry level Institution in charge of Sanitation

2.19 Interference: a discharge that alone or in conjunction with a discharge or discharges from other sources, inhibits or disrupts the sewage treatment plant, its treatment processes or operations or its sludge processes, use or disposal.

2.20 Lift Station: shall mean a device designed to pump wastewater from a lower to a higher elevation. The device typically consists of a reservoir to store wastewater and an internal or external pump.

2.21 Liquid Waste Hauler" - An industrial user who transports waste for the purpose of discharge into public sewers.

2.22 Maintenance cost: Those costs, including labor, materials, supplies, equipment, accessories and appurtenances required to maintain the capacity and performance during the service life of the sewerage system and/or water supply system for which such facilities were designed and constructed.

2.23 Manhole: means a large Chamber which facilitates human access to and working space at Pipe level; Means a pit together with a superstructure housing a seat or squat plate, for the deposition of human excrement.

2.24 Municipality: A town or Municipality that has local government.

2.25 New Sewer Connection: means any direct or indirect sewer connection serving any building or structure which was not physically attached to the sewer system of a servicing municipality.

2.26 Non domestic wastes: Shall mean waterborne wastes resulting from any process of industry, medical services, and garages, laboratories, manufacturing trade or business or from development of any natural resources as distinct from domestic wastewater.

2.27 Notice of Violation: shall mean a written notification to a user of sewerage system that it has violated the conditions of its discharge permit or other permission to discharge to the system.

2.28 Oil Interceptor: Used to intercept, separate and prevent the passage of oil.

2.29 Oils/Fat/grease Trap: A unit with a special engineering design used for separating metallic oils and fats from liquid wastes resulting from washing, oiling and lubricating cars, prior to drainage into the public sewage network or septic tanks

2.30 Owner: shall mean any person vested with ownership, legal or equitable, sole or partial, of any property.

2.31 Permit: Permit shall mean the permission granted by Entity in charge of Sanitation or other competent Authority for residences, apartments, business buildings or properties, institutional or industrial establishments to connect to a public sewer or water line of the System.

2.32 Pollutant: means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, medical wastes, chemical wastes, biological materials, radioactive materials, heat, wrecked or discharged equipment, rock, sand, cellar dirt, and industrial, municipal, agricultural waste and certain characteristics of wastewater (e.g., pH, , Temperature, TSS, turbidity, color, BOD, COD, toxicity, or odor).

2.33 Potable Water: Shall mean water that does not contain objectionable pollution, contamination, minerals, or infective agents and is considered satisfactory for domestic consumption.

2.34 Pretreatment or Treatment: The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in the wastewater to a less harmful state prior to or in lieu of discharging or otherwise introducing such pollutants into the system.

2.35 Private Sewage Disposal System: Shall mean that, where a public Sanitary Sewer is not available, sewage and sanitary drainage piping shall be connected to an individual sewage disposal system found to be adequate and approved by Entity in charge of Sanitation.

2.36 Private Sewage Network: All the sewage installations inside the building and all items which are related to or connected with such installations such as traps, manholes and inspection chambers within the limits of the land on which the building is constructed up to the point of connection to the public sewage network.

2.37 Privy: A structure used for disposal of human waste without the aid of water; it consists of a shelter built above a pit or vault in the ground into which human waste falls. The vault may be impermeable (vault privy) or may include soil absorption (pit latrine or pit privy).

2.38 Public Authority: shall mean any government entity having jurisdiction.

2.39 Public Sewer: shall mean a sewer that is part of the City/Municipality sewer system and thereby collects flow from multiple service connections. A public sewer is located in public ways, easements, or Town Land and is thereby unconditionally accessible to the Authority for its monitoring and maintenance.

2.40 Residential User: Any contributor to the Municipality's collection system whose lot, parcel or real estate, or building is used for domestic dwelling purposes only.

2.41 Senior Management Personnel: **Personnel that** actively participate in the daily supervision, planning and administrative processes required by a sewerage systems to help meet its objectives.

2.42 Septage: shall mean the liquid and solid wastes of sanitary sewage origin that are removed from a cesspool, septic tank or similar on-site wastewater disposal system.

2.43 Septic Tank Waste: means any Waste extracted from a cesspool, septic tank, sewage holding tank, seepage pit, interceptor or other containment for human excretion and wastes.

2.44 Septic tank: A buried, preferably watertight tank that is designed and constructed to receive and partially treat raw wastewater. The tank separates and retains settleable and floatable solids suspended in the raw wastewater.

2.45 Sewage Sanitary: Shall mean water borne wastes discharging from the sanitary facilities of buildings including, but not limited to, houses, hotels, office buildings, factories or entitys, and being free from storm water, surface water and industrial wastes.

2.46 Sewer Connection: The point where the service sewer connects to the local sewer.

2.47 Sewer Interceptor: shall mean those sections of the system that intercept sanitary sewage and wastes from trunk or local sewers and that transport such sanitary sewage and wastes to the wastewater treatment plants.

2.48 Sewer Service: shall mean that public sewer, in the right of way, from the building sewer to the point of connection with the local or public sewer.

2.49 Sewer Storm or Storm Drain: shall mean a sewer that carries storm and surface waters and drainage but excludes sanitary sewage and industrial wastes.

2.50 Sewer: shall mean a pipe or conduit for carrying sewage.

2.51 Sewerage system: shall mean any device, equipment or works used in the transportation, pumping, storage, treatment, recycling, and reclamation of sewage and industrial wastes, and may also be called sewage works.

2.52 Sludge: shall mean waste containing varying amounts of solid contaminants removed from water, sanitary sewage, wastewater or industrial wastes by physical, chemical and biological.

2.53 Storm Sewer: Shall mean a sewer that carries only storm, surface, and ground water drainage.

2.54 Suspended Solids: Shall mean solids that either float on the surface of, or are in suspension in water, sewage or other liquids.

2.55 The public sewage network: All the installations and devices used for collecting, transporting and delivering liquid waste to the processing and drainage sites' including pipes, collection tanks, inspection chambers, pumping stations and ventilation manholes and valves.

2.56 Toxic Wastes: shall mean wastes containing toxic or poisonous solids, liquids or gases in sufficient quantity, either singly or by interaction with other wastes, to injure or interfere with any sewage treatment process to constitute a hazard to humans or animals, and to create any hazard in the receiving waters of the sewage treatment plants.

2.57 Trunk Sewer: shall mean the principal public sewer to which branch public sewers

2.58 Vesting: is the mode by which the ownership of non-real property water services infrastructure transfers to Water and Sanitation Authority pursuant to the requirements of the Connection Agreement between the Customer and Irish Water.

2.59 *Viscosity:* The property of a fluid that resists internal flow by releasing counteracting forces.

2.60 Wastewater Contribution Permit; shall mean a permit to convey or discharge wastewater into any sewer under the jurisdiction of the Entity in charge of Sanitation.

2.61 Wastewater Treatment Plant: shall mean any arrangement of devices and structures used for treatment of wastewater.

2.62 Wastewater: shall mean a combination of the liquid and water-carried wastes from premises together with any groundwater, surface water, or storm water that may be present.

2.63 Watercourse: shall mean a channel in which a flow of water occurs, either continuously or intermittently.

SECTION 3. TECHNICAL CONSIDERATIONS

3.1 Types of connection to the sewerage

Connection to the sewerage will be permitted only by a connection method approved by the Entity in charge of sanitation. Some of the methods to be used include pre formed junction, saddle connection, existing manhole, new manhole, pumped connection and indirect connection.

3.1.1 Pre-formed junction

3.1.1.1 Pre-formed junction method is only permitted for up to two domestic properties. To a 300mm diameter sewer or less, by neatly removing an appropriate length of the sewer using a suitable pipe cutter or disc saw. A pre formed junction shall then be inserted and secured using couplings to form flexible joints. The couplings shall be fully compatible with the pipes and fittings involved and they shall comply with any appropriate Water Industry Standard. You may also use this method for larger pipes.

3.1.2 Saddle connection

3.1.2.1 Saddle connection shall be applied to pipes having a diameter in excess of 300mm diameter and all brick sewers, by cutting a hole into the pipe or brickwork with a suitable trepanning device.

3.1.2.2 All connections shall, where practical, be made just above springing level and obliquely to the sewer at an angle of about 45 degrees.

3.1.2.3 Saddle connection and pre-formed junction shall be restricted to two domestic properties or connections to a brick sewer for more than two domestic properties. Connections to commercial properties or to more than two domestic properties and a non-brick sewer shall be carried out using manholes.

3.1.3 Existing manhole

3.1.3.1 Existing manhole is applicable to pipes of any diameter where there is a convenient existing manhole, directly to the brick or concrete manhole at soffits level, by cutting the brickwork, or concrete with a trepanning device or other approved method, inserting the stub pipe and reinstating accordingly. Manhole benching is to be reformed to suit new flow patterns using high strength concrete, channels as appropriate with a 25mm granolithic screed.

3.1.4 New manhole

3.1.4.1 If the connection is to serve three or more domestic properties or a large commercial premise and there is no existing manhole available, the new connection will require a new manhole. This is to ensure satisfactory access for future maintenance.

3.1.5 Pumped connection

3.1.5.1 If the connection is via a pumped system, then a surge chamber must be provided on the private system before a connection to the public sewer is made. The permitted maximum discharge rate will be specified in the approval notice.

3.1.5.2 If it is necessary to pump flows in order to connect to the public sewer, the pumping main should discharge into the boundary demarcation chamber. The lateral drain/sewer between

demarcation chamber and the public sewer should be a gravity pipe. Where this is not possible then a hatch box is to be provided as a demarcation chamber.

3.1.6 Indirect Connections

3.1.6.1 An indirect connection is a connection made to an existing private pipe that is already connected to the public sewer i.e. a connection to an existing private drain or sewer.

3.1.6.2 In the case of connection to a private drain or sewer, the sewerage management will be approving the principle of the discharge to the public sewer and not the physical connection.

3.1.6.3 Permission to connect must be obtained from the owner of the sewer (entity in charge of sanitation) who must ensure the adequacy of the sewer.

3.1.6.4 It is the responsibility of the Sewerage management to inspect indirect connections**.**

3.1.6.5 If more than three domestic dwellings (or the non-domestic equivalent) connections are concerned to the public sewer the owner of the direct connection must submit a Pre-Development Enquiry to the sewerage management. This process will confirm if the public sewerage system has capacity to accept the proposed discharges.

3.1.7 Any other type of connection which is not highlighted above will be approved by entity in charge of sanitation.

3.2 Minimum pipe size, depth of pipes and permitted materials

3.2.1 Minimum pipe size

3.2.1.1 The size of a sewer pipe shall be defined as the nominal diameter of the pipe.

3.2.1.2 A sewer is subjected to a wide range of flow conditions and must have sufficient capacity to cater for the designed peak flow and minimise the deposition of solids under low flow conditions.

3.2.1.3 Small sized sewers are prone to blockage by grease and silt, reason why sewer mains (Secondary) shall be a minimum of 210 mm in diameter in residential areas, and a minimum of 250 mm in commercial, industrial, and high-income building areas.

3.2.1.4 Tertiary or service sewers may have lower diameters (Table 3-1)

a. Minimum size of 210 mm diameter if less than ten houses (or equivalent) connected
b. Minimum size of 260 mm diameter if more than ten houses (or equivalent) connected.

*Table 3- 1***. *Minimum size for single service Pipes***

Pipe Diameter for Single Service (Tertiary)	Premise User
110 mm	Residential Unit
160 mm	Commercial unit
160 mm	Industrial Unit

3.2.2 Trenching

3.2.2.1 The width of the trench shall be ample to allow the pipe to be laid and jointed properly and to allow the bedding to be placed and compacted to adequately support the pipe.

3.2.2.2 The trench sides shall be kept as nearly vertical as possible. When wider trenches are specified, appropriate bedding class and pipe strength shall be used.

3.2.2.3 In unsupported, unstable soil the size and stiffness of the pipe, stiffness of the embedment and in situ soil and depth of cover shall be considered in determining the minimum trench width necessary to adequately support the pipe.

3.2.2.4 The width of the trench shall not exceed the maximum width shown in Table 3-2.

3.2.2.5 Open trench construction within pavement structure limits should only be allowed when approved by the road authority.

3.2.2.6 Where trenching within the right-of-way is permitted, proper backfill compaction and materials should be required. Compaction should equal that of the surrounding soil and restoration of the area's vegetation should be required. Erosion control measures as determined by the road authority.

3.2.2.7 Where open trenching across an existing highway is permitted, backfill and compaction requirements should be in line with road authority.

Table 3- 2: **Maximum Trench Width**

Nominal Pipe Diameter (mm)	100-400	450-500	525	600	675	750	825	900	1000	1050	1350
Max. Trench Width (mm)	1050	1100	1200	1275	1375	1500	1575	1725	1950	2175	2400

3.2.3 Minimum depth of cover between top of pipes and ground level

3.2.3.1 The minimum depth of cover between top of pipes and ground level shall be:

a. 0.35m for domestic garden and pathways without vehicular access
b. 0.9m for domestic driveways, parking areas with limited access for vehicles with a gross weight in excess 7.5 tonnes
c. 0.9m for gardens/open spaces and agricultural
d. 1.2m for highways (including footways)

3.2.4 Depth of Pipes

3.2.4.1 If the depth of the pipe is going to be very shallow, or the pipe will be below existing foundations, additional protection should be provided to prevent the pipes or building being damaged.

3.2.4.2 To protect pipes and building from damage due to settlement, drain trenches excavated lower than existing foundations should either:

a. be filled with concrete to the lowest level of the foundation where the trench is within 1.0m of the building; or
b. be filled with concrete to a level below the lowest level of the foundation equal to the distance from the building, less 150mm.

3.2.4.3 If the pipes are under a road and have less than 0.9 metres cover, reinforced concrete bridging or a reinforced concrete surround with movement joints formed with compressible board at each socket or sleeve joint face should be provided.

3.2.4.4 Where pipes are not under a road and have less than 0.6 metres cover they should have concrete paving slabs laid as bridging above the pipes with a minimum of 75 mm of granular material between the top of the pipe and the underside of the slabs.

3.2.5 Access to Drains

3.2.5.1 Sufficient and suitable access points should be provided for clearing blockages from drain runs which cannot be reached by other means.

3.2.5.2 The siting, spacing and type of access points will depend on the layout, depth and size of runs. Access to the drainage system shall be provided at the following locations:

a. on or near the head of each drain run;
b. at a bend and at a change of gradient;
c. at a change of pipe size;
d. at a junction.

3.2.5.3 Access shall be provided on long runs. The distance between access points will depend on the type of access fitting used. Access points may be one of the following:

a. Rodding eye-100mm capped pipe extensions raised up to ground level;
b. Access fitting–small chambers sized at between 150mm and 225mm diameter or 150mm x 100mm to 225mm x 100 when rectangular and can be used up to 600mm maximum depths:
c. Inspection chambers–chambers with working space which can be 450mm diameter or 450mm x 450mm when used a depths no greater than 1.2m:
d. Manholes–large chambers with working space at drain level, which can be between 1m and 1.2m diameter or range from between 750mm x 675mm and 1800mm x 550m when used at depths no greater than 1.5m.

3.2.6 Demarcation chamber

3.2.6.1 A demarcation chamber shall be provided at the point where the private drain or sewer becomes vested in the sewerage. It is to be located:

a. Inside the property boundary
b. Preferably in the driveway
c. Not more than 1 meter from boundary
d. Located outside of probable vehicle wheel tracks

3.2.7 Lateral drain demarcation chamber

3.2.7.1 A Lateral drain demarcation chamber serving one property shall be 450mm for 100/150mm pipes.

3.2.7.2 The Chamber access should be restricted to 350mm opening if chamber is more than 1.2m deep. Chambers may be of plastic construction to BS 7158 with integral seals. Backdrops are generally not permitted and all incoming pipes are to be ramped.

3.2.7.3 For a Lateral drain demarcation chamber serving many properties

a. For depths less than 1m from top of pipe to ground, the chambers internal dimensions shall be 900mm long and 675mm wide. The chamber can be constructed using regular concrete sections or in class B engineering brick. For depths between 1.0 –1.5m from top of pipe to ground, the chambers internal dimensions shall be 1040mm long and 675mm

wide. The chamber can be constructed using regular concrete sections or in class B engineering brick.

b. For depths greater than 1.5m from top of pipe to ground, the chambers internal dimension shall be a minimum of 1200mm diameter. The chamber shall be constructed using precast concrete rings.

3.2.8 Cover to Sewers

3.2.8.1 Sanitary sewers shall be installed with sufficient depth to meet the following requirements:

a. Where a sewer in a road reserve will be parallel to the road pavement, the top of the sewer shall be at least 1m lower than the crown of the road or the ground level at the centre of the road reserve.
b. The minimum cover to sewers elsewhere shall be 1m.
c. In special cases the minimum cover may be varied with the approval of the Water and Sanitation Authority but particular conditions may apply

d. Sanitary sewers located in roadways or subject to other traffic loading should be installed with at least 2m of cover to the top of the pipe with appropriate protective means approved by the entity in charge of sanitation.

e. Sanitary sewers larger than 2.5 m in diameter which are located in roadways or subject to other traffic loading should be installed inside a steel protective casing.

f. Manhole covers should be sufficiently strong to take the live load of the heaviest vehicle likely to pass over them and should remain durable in a damp atmosphere.

g. Heavy duty manhole covers should be used when traffic or heavy loading is anticipated;

h. The cover should have the required strength to withstand the traffic flow above it as shown in Table 3-3.

Table 3- 3. ***Requirements for a cover***

Surface	**Class or Loading in Kilonewton (KN)**	**Loading**
Road	Diameter Nominal (DN) 400	Vehicle impact
Footway + Driveway	Capable of withstanding a 12.5 tonnes test load (B125)	Occasional vehicle loading
Gardens	Capable of withstanding a load of 1.5 tonnes of pedestrian and cyclist traffic only (A15)	Pedestrian + Cyclist (no vehicle traffic)

3.3 Choice of Pipe Material

3.3.1 The pipe to be used should be able to ease the installation with proven past performance, with ease of cutting and branch connections, with the availability of different pipe sizes, fittings and lengths in the market for construction and subsequent maintenance. ease.

3.3.2 Pipes, joints and chambers should remain watertight under working and test conditions. Pipes are usually required to be bedded and backfilled with granular material graded from 5mm to 10mm material or single sized material (pea shingle for example). Clayware pipes and Concrete pipes can also be used.

3.3.3 The pipe to be used shall be able to resist to:

a. gravity or pressure flows
b. crushing test strengths;
c. characteristics of the wastewater and corrosion and abrasion;

3.4 Corrosion Protection

3.4.1 To protect the pipe from corrosion, pipes may be coated with inert protective materials.

3.4.2 For concrete pipes with protective liners, the pipe joints should also be covered by linings and the lining must be subsequently jointed after installation if the pipe diameter is large enough for man access.

3.4.3 If the diameter is too small, the pipes should be supplied with joint surfaces already safeguarded with lining.

3.4.4 Where sulphide generation is a possibility, the problem shall be minimized by designing sewers to maintain flows at a minimum cleansing velocity of 1.0 m/s.

3.4.5 Where corrosion is anticipated because of sulphate attack or sulphides, consideration shall be given to the provision of corrosion resistant pipe material or effective protective linings and optimum sizing of the sewers.

3.5 Hydraulic Design

3.5.1 Minimum Velocity

3.5.1.1 A minimum velocity enables the sewage flow to self-cleanse the nominal amount of silt carried through the sewers and helps to minimize sewer blockage as a result of siltation and grease accumulation.

3.5.1.2 Self cleansing for small diameter sewers of diameter less than 300mm can generally be achieved by ensuring either that a velocity of at least 0.6 m/s occurred daily.

3.5.1.3 For larger diameter sewers, higher minimum velocities should be used particularly if relatively coarse sediment is expected to be present. For sewers of diameter up to 900mm, it should be designed to achieve a self-cleansing velocity of 1.0 m/s in full pipe condition.

3.5.1.4 All sewers shall normally be designed and constructed to give mean velocities, when flowing full, of not less than 0.6 metres per second or greater than 4.5 metres per second. Velocities above 4.5 m/s may be permitted with high velocity protection.

3.5.1.5 Sewers 1200 mm or larger should be designed and constructed to give mean velocities, when flowing full, of not less than 0.9 m/s, based on Manning's formula using an "n" value of 0.013

3.5.1.6 To achieve 0.6 m/s flow velocities in sewers which will flow less than 1/3 full, steeper slopes than given above must be used where conditions permit. For instance, the minimum slopes mentioned above would have to be doubled when depth of flow is only 1/5 full and quadrupled when depth of flow is only 1/10 full to achieve 0.6 m/s flow velocity.

3.5.1.7 Table 3-4 shows minimum slopes which will provide a velocity of 0.6 m/s when sewers are flowing full.

Table 3- 4*: Relationship between Nominal Sewer Size and Minimum Slope*

Sewer Size (mm)	Minimum Slope in Metres per 100 Metres
150	0.57
200	0.40
250	0.28
300	0.22
350	0.17
375	0.15
400	0.14
450	0.12
525	0.10
600	0.08
675	0.067
750	0.058
900	0.046
975	0.04
1050	0.037

Pipe capacity is to be calculated using Manning's formula: Although the Manning's equation (Appendix 6) was originally developed for the analysis of flow in open channels, it is now widely used to analyze flow in both open channels and closed conduits.

3.5.2 Maximum Velocity

3.5.2.1 The maximum flow velocity shall be limited to 3.0 m/s. This is to prevent undue turbulence, minimize odours due to sulphide generation, and limit the erosive and momentum effects of the flow.

3.5.2.2 If velocities of 4.5m/s are attained, special provision shall be made to protect against displacement by erosion and impact

3.6 Anchor Spacing

3.6.1 Sewer lines approved for slopes of 20 percent or greater shall be anchored securely with concrete anchors or other approved method. Structural and installation details of anchors shall be included in the project plans. Space anchors as shown on Table 3-5.

***Table 3- 5*: Anchor Spacing**

Percent Slope of Sewer	Anchor Spacing (Center to Center)
20-35	11.0 m
35-50	7.5 m
Over 50	5.0 m

3.7 Manholes and special structures

3.7.1 Manholes

3.7.1.1 Manholes should be of the pre-cast concrete or cast-in-place concrete type. Manhole lift holes and grade adjustment rings should be sealed with non shrinking mortar. Watertight manhole covers are to be used wherever the manhole tops may be flooded by street runoff or high water. Locked manhole covers may be desirable in isolated easement locations or where vandalism may be a problem.

3.7.1.2 Manholes shall be located at all junctions, changes in grade, size or and termination points of sewers.

3.7.1.3 The last manhole that is located within the last housing unit shall not be more than 60m away from the point of connection.

3.7.1.4 Sewers shall be laid with uniform slope between manholes.

3.7.1.5 All manholes shall be 1200 mm minimum inside diameter and constructed to the Construction Specifications

3.7.1.6 Manholes of 1200 mm diameter shall be installed at all changes in sewer size, grade or alignment and at all junctions.

3.7.1.7 Manholes 1500 mm diameter or larger shall be required to be when connecting sewers 750 mm or larger.

a. Backdrop manholes will be used to connect sewers at significantly different levels, and should be used where the level difference is greater than 0.6 m .

b. The minimum diameter for inside drop manholes shall be 12O mm.

c. The details of manhole Diameter and spacing of manholes are shown in Table 3-6, 3-7.

d. Due to septicity or other agents that can cause corrosion, corrosion protection on the interior of the manholes shall be provided

e. Gravity mains shall have manholes on each end of the bridge. Manholes shall be within 8 to 12 m beyond the end of the bridge and outside the approach slabs

f. Force mains shall have isolation shut-off valves on each end of the bridge and each valve shall be located in a vault. Shut-off valves are required to be within 8 to 12 m beyond the end of the bridge and outside the approach slabs.

Table 3- 6: Manhole Diameters

Diameter of Largest Pipe in Manhole (mm)	Internal Diameter of Manhole (mm)
Less than 375	1200
375-450	1350
450-700	1500
750-1050	1800
1125-1500	2100
>1500	Consult Entity in charge of Sanitation

Table 3- 7: Maximum spacing of manholes for access

Sewer Size (mm)	Maximum Spacing (m)
Less or equal to 250	900
300 -900	120
Greater or equal to 975	150

3.7.1 Access Openings

3.7.1.8 Access openings shall be installed for man access and for desilting purposes.

3.7.1.9 Desilting openings should not be smaller than 750 mm by 900 mm, and should be placed along the centre line of the sewer to facilitate desilting.

3.7.1.10 Man access opening should not be smaller than 675 mm by 675 mm. If ladders are installed in the manhole, minimum clear opening should be 750 mm by 900 mm.

3.7.1.11 Man access openings should be placed off the centre line of the sewer for deep manholes and along the centre line of the sewer for manholes shallower than 1.2 m.

3.7.2 Access Shafts

3.7.2.1 Minimum size of access shaft shall be 750 mm by 900 mm.

3.7.2.2 The access shaft shall be orientated such that the step irons are provided on the side with the smaller dimension.

3.7.2.3 The access openings shall be confined to one traffic lane.

3.7.2.4 For manholes deeper than 1.2 m, works inside generally cannot be easily carried out from ground level. Manholes of this type should be provided with working chambers with access shafts, if necessary, leading from ground level.

3.7.2.5 The working chambers should enable persons to work inside.

3.8 Protection of Potable Water Supplies and public utilities and streams

3.8.1 Protection of Potable Water Supplies

3.8.1.1 Whenever practical, sewers should be laid at least 2 m horizontally from any existing or proposed water main.

a. The distance should be measured edge to edge.
b. Should local conditions prevent a lateral separation of 2 m, a sewer may be laid closer than 2 m to a water main if it is laid in a separate trench and if the elevation of the top (crown) of the sewer is at least 2 m below the bottom of the water main.

3.8.1.2 Water mains should cross above sewers wherever possible.

3.8.1.3 Whether the water main is above or below the sewer, a minimum vertical distance of 0.5 m between the outside of the watermain and the outside of the sewer should be provided to allow for proper bedding and structural support of the watermain and sewer pipes.

3.8.1.4 Sufficient structural support for the sewer pipes should be provided to prevent excessive deflection of the joints and settling.

3.8.1.5 When it is impractical to obtain proper horizontal and vertical separation as stipulated above, the sanitary engineer may grant a written variance to the separation requirements.

3.8.1.6 Sewers may be laid to any distance horizontally from any existing or proposed water main after approval by the entity in charge of sanitation.

3.8.2 Protection of Dry Utility Pipes

3.8.2.1 Whenever practical, sewers should be laid at least 2 m horizontally from any existing or proposed dry Utility Pipes (Fiber optic cables, Telephonic cables, etc).

3.8.2.2 Minimum 2m horizontal separation is desirable between sewer mains and any other utility infrastructure.

3.8.2.3 Separations of less than 2 m must be approved by the Municipality and Entity in charge of Sanitation.

3.8.2.4 When it is impractical to obtain proper horizontal and vertical separation as stipulated above, the sanitary engineer may grant a written variance to the separation requirements.

3.8.2.5 Sewers may be laid to any distance horizontally from proposed dry Utility Pipes (Fiber optic cables, Telephonic cables, etc) after approval by the entity in charge of sanitation.

3.8.3 Sanitary Sewer crossing streams

3.8.3.1 Sanitary sewer systems shall be designed to minimize the number of stream crossings.

3.8.3.2 Sanitary sewers crossing streams shall be designed to cross the stream as nearly perpendicular to the stream flow as possible. Changes in alignment or grade in a stream are not permitted.

3.8.3.3 The sewer manholes, gate boxes, or other structures should be appropriately installed so they do not interfere with the free discharge of flood flows of the stream.

3.8.3.4 Sewers entering or crossing streams should be constructed of ductile iron pipe or any other certified pipe with mechanical joints; otherwise, they should be constructed to remain watertight without changes in alignment or grade.

3.8.3.5 The top of all sewers entering or crossing streams should be at a sufficient depth below the natural bottom of the stream bed to protect the sewer. In general, the following cover requirements should be met:

a. 0.3 m of cover, where the sewer is located in rock;

b. 0.9 m of cover, where the sewer is not located in rock. In major streams, more than 0.9 m (of cover may be required;

c. In paved stream channels, the top of the sewer line should be placed below the bottom of the channel pavement. Less cover may be justified only if the proposed sewer crossing will not interfere with future modifications to the stream channel.

3.8.4 Stream Aerial crossings

3.8.4.1 Sanitary sewer pipe attached to piers across streams shall be allowed when it can be demonstrated that no other practical alternative exists.

3.8.4.2 Support shall be provided for all joints in pipes utilized for aerial crossings.

3.8.4.3 Support shall be provided for all joints. All supports shall be designed to prevent frost heave, overturning or settlement. Expansion jointing shall be provided between above-ground and below-ground sewers.

3.8.4.4 Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving.

3.8.5 Sanitary Sewer Crossings Bridges

3.8.5.1 As part of the evaluation of sewer pipelines at bridge crossings, the design engineer shall consider safety, aesthetics, accessibility, maintenance and environmental impacts. He shall consider the use of alternative pipeline locations and configurations, such as routing the pipeline around the bridge or using multiple smaller diameter pipes to adapt to the physical conditions of the site, hanging pipes between two adjacent bridges etc.

3.8.5.2 Pipeline facilities in bridges shall be sized to accommodate future needs or provide a pipeline casing to facilitate future expansion. Where required for redundancy, provide multiple pipeline casings.

3.9 Pipeline Location and Loading Considerations

3.9.1 Pipelines and appurtenances shall be located under the shoulder or sidewalk area. For slab type bridges, sewer mains shall be suspended beneath the structure near the outer edge of the bridge where vertical clearance or freedom of movement for personnel and equipment is available. Where this is not possible, provisions shall be provided for ready access with scaffolding from underneath the bridge.

3.9.2 Pipelines shall be designed for all imposed loads. Calculations shall include checks for internal pressure, seismic, and wind loads and other loads.

3.9.3 All thrust forces shall be calculated, and longitudinal deflection resisted.

3.9.4 Maximum thermal expansion and contraction shall be calculated and accommodated. Check bending, shear, and local buckling at supports. Design to accommodate differential movement between bridge and pipeline materials due to traffic loading, thermal expansion, seismic loading, long term deflection (camber), etc.

3.9.5 Confirm that pipelines in the vicinity of an abutment to an embankment transition are capable of accommodating large amounts of differential movement.

3.9.6 Submit all calculations with plans to municipality and Entity in charge of Sanitation and other competent Authority or plan reviewer

3.10 Joints

3.10.1 Expansion joints for pipelines carrying sewage shall be designed to avoid trapping solids. Piping on either side of expansion joints shall be properly supported to minimize stresses on the expansion joint itself. A support directly below the expansion joint may be required.

3.11 Sewer Crossings Roads and Railways

3.11.1 The number of sewer crossings under, roads and railways should be kept to a minimum.

3.11.2 Care should be taken in utility installations to avoid disturbing existing highway or private drainage facilities.

3.11.3 Traffic controls for utility construction and maintenance operations should conform to the road authority's requirements. Any utility construction or maintenance operation should be planned with full regard to safety, and interference with highway traffic should be kept to an absolute minimum.

3.11.4 On heavily traveled highways, utility construction or maintenance operations interfering with traffic should not be allowed during periods of peak traffic flow.

3.11.5 All road crossings, except minor country road crossings, should be at the normal 90 degrees.

3.11.6 Sewers should be located so that crossings under all roads and railways are approximately at right angles to the road and railway reserve boundary.

3.11.7 Where it is proposed to construct sewers crossing under road and railway the following conditions shall be complied with:

a. Written approval for the crossing shall be obtained from Road controlling authority
b. Sewers within the road reserve shall be adequately protected.
c. If it is necessary to locate Access Chambers or Maintenance Shafts in the road reserve they shall be placed as close as possible to the reserve boundary.
d. All underground Sewers installations should be of durable materials, designed for long service life expectancy and be relatively free from routine servicing and maintenance.
e. Underground sewers crossings should be avoided in deep cuts, near footings of bridges and retaining walls, at highway cross drains where flow of water or streambed load may be obstructed, in wet or rocky terrain where it is difficult to attain minimum cover and through paved or unpaved slopes under structures.

3.12 Inspection of Construction

3.12.1 All pipelines, maintenance holes, and service lines shall be inspected during all phases of construction. The level of inspection is at the discretion of the Engineer of Record, and will be based partly on the Contractor's ability, experience, and past performance. Prior to final acceptance, all maintenance holes shall be visually inspected for defects, debris, and infiltration by the Entity in charge of Sanitation.

3.12.2 During construction, any damage arise due to the actions or negligence of the contractor, it shall be his bonded duty to correct any such damage within a period of four days. Upon the contractor's failure to do so, the entity in charge of sanitation shall cause such damage to be repaired either by contract, without advertising, or by such other arrangement as may be most convenient and satisfactory. The bill for the entire cost of the same shall be rendered to the contractor who shall be liable therefore and shall pay the same at once.

3.12.3 The Entity in charge of Sanitation shall inspect the system to identify any deficiencies including infiltration, deformation, and any damages. All sanitary service lateral connections shall be inspected; pictures and videos recorded. A digital and hardcopy

record of the video inspection along with written certification from the developer's consulting engineer confirming that the sanitary system has been constructed as per the approved design drawings and approved plans must also be provided. The sanitary sewer and maintenance holes shall be thoroughly flushed and cleaned to remove any accumulated sewage and debris as required.

3.12.4 Deflection tests shall be performed on all flexible pipe

3.12.5 The test shall be conducted after the final backfill has been in place at least 30 days to permit stabilization of the soil-pipe system;

3.12.6 No pipe shall exceed a deflection of 5 percent;

3.12.7 If deflection exceeds 5 percent, the pipe shall be excavated; and replacement or correction shall be accomplished in accordance with requirements in the approved specifications.

3.12.8 The Leakage Test, Infiltration Test, etc will be conducted to ensure a smooth running of a sewerage system

3.13 Final Backfill

3.13.1 Final backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for final backfill within 0.6 m of the top of the pipe.

3.13.2 Final backfill shall be placed in such a manner as not to disturb the alignment of the pipe.

3.14. Taking Over of Completed Works

3.14.1 Prior to handing over of the works, joint inspection must be carried out and any outstanding works agreed.

3.14.2 Completion certificate should be issued together with the agreed list of outstanding works. Within 1 month of issuing the completion certificate, the final operation and maintenance (O&M) manual for Civil Engineering Works, as-built drawings and calculations should be submitted.

3.14.3 Prior to the end of the Defects Liability Period (DLP), a joint inspection should again be carried out to check if further works are required and that all outstanding works have been completed and defects rectified.

3.14.4 Reference should be made to the Project Administration Handbook and the relevant technical memoranda/circulars for details of handing over and taking over procedures.

3.14.5 Where possible, all pipes and culverts to be handed over should be inspected in dry conditions. When the pipes or culverts have to be commissioned prior to handing over (e.g. due to the requirement to maintain the existing flow or staged completion) and a temporary diversion of flow is not feasible, an additional inspection should be arranged prior to the commissioning.

3.15 Inspection of the system operation

3.15.1 During the sewerage inspection, sampling, and flow measurement, the user is requested to allow inspection for the whole facility situated on his/her premises.

3.15.2 There shall be ample room in or near such sampling manhole or facility to allow accurate sampling and preparation of samples for analysis. The monitoring facility and sampling equipment shall be maintained at all times in a safe and proper operating condition at the expense of the user.

3.15.3 The sampling and monitoring facilities shall be provided in accordance with the Country's requirements and all applicable local construction standards and specifications

3.16 Non-Standard Sewer Systems

3.16.1 Private Lift Stations

3.16.1.1 Private lift stations may be required for single users or groups of users as part of a private system when the dwellings are located lower in elevation than the adjacent municipality -Owned sewer main line.

3.16.1.2 Issuance of a "Sewer Availability" or "Will Serve" letter does not guarantee a private lift station will not be provided in order to connect to the municipality sewer.

3.16.1.3 Lift stations for a single user or group of users in a private system will be owned and operated by said users. All costs associated with the lift station, including but not limited to, construction, operation, and maintenance, shall be borne by the users.

3.16.2 Sanitation Entity Owned Lift Stations

3.16.2.1 The Sanitation Entity public -owned lift stations are designed to serve multiple users attached to the public's collection system. All costs of these lift stations are borne by Entity in charge of Sanitation as a whole.

3.16.2.2 Entity in charge of Sanitation's Capital Facility Plan may be updated to show the need for the future lift station or replacement of existing lift stations to increase capacity.

3.16.3 Pit latrines, Septic Tanks and Privy

3.16.3.1 No pit latrine, septic tank or privy, privy vault, septic tanks or other facility may be used or constructed for the purpose of disposing sewage at any premises in a designated area after sewerage and wastewater services are provided to those premises under these guidelines, unless the competent Authority gives approval for the use or construction.

3.16.3.2 All sewer construction involving interceptor sewer lines, pump stations, metering stations and appurtenances which shall become a part of the Entity in charge of Sanitation sewer system shall not be constructed without the plans therefore having first been approved and the construction inspected and approved by Entity in charge of Sanitation.

3.16.3.3 Whether public sewerage service is not available, the building's sewer shall be connected to a private sewage disposal system complying with the provisions of the Entity in charge of Sanitation. Prior to commencement of construction of a private sewage disposal system, the owner or his agent shall first obtain a written permission from the Municipality.

3.16.3.4 The owner or his agent shall operate and maintain the private sewage disposal facilities at owner's sole expense and in compliance with this National Sewerage Connection Guidelines.

SECTION 4. CONNECTION REQUIREMENTS AND PROCEDURES

4.1 General

4.1.1 The Sewerage management shall define the sewerage coverage area.

4.1.2 Connection to the sewerage will be compulsory to all properties within the coverage area when approved by entity in charge of sanitation.

4.1.3 A new building in the sewerage coverage area shall be entitled to submit plans for connection to the sewerage and get approval from the municipality. No new building in the sewerage coverage area will be given the construction permit without the approved plans for connection to the sewerage.

4.1.4 Existing building, industries, institutions or other premises in the coverage areas of the sewerage system after notification by municipality that a sewer system is available will connect automatically on his own expenses for a period of not more than 30 days.

4.1.5 The Entity in charge of Sanitation may determine that certain premises or locations within a designated area will not be included in a sewerage and wastewater scheme, and shall not be entitled to connect to a public sewer in a scheme.

4.1.6 Connection of properties outside the sewerage coverage area will only be permitted by the Entity in charge of sanitation.

4.1.7 It should be clearly understood that it is a criminal offence to make a connection to a public sewer without the written approval of the sewerage management.

4.1.8 There shall be three (3) classes of building sewer permits: (a) for residential service, (b) Institutional services and commercial service and (c) for service to establishments producing industrial, medical and other hazardous wastes. In all cases, the owner or his agent shall make application on a special form furnished by Entity in charge of Sanitation in accordance with applicable State laws. The permit application shall be supplemented by any plans, specifications, or other information considered pertinent in the judgment of the Superintendent of Entity in charge of Sanitation.

4.1.9 In case a property wants to connect to a public sewer the owner will make the prerequisites and necessary construction for connection This means that he/she carry out the connection, install the pipe and a chamber, which is required at the boundary of the property for maintenance purposes, using a competent contractor. On completion and a satisfactory inspection, the sewerage management will take ownership of the pipe between the existing public sewer and the boundary of the property being connected, if the connection is within the public highway. The rest of the pipe located in the premises will remain the owner's responsibility.

4.1.10 The entity in charge of sanitation will inspect all works related to the connection to the sewerage. The said connection shall be ordered by Water and Sanitation Authority in accordance with National sewerage connection Guidelines.

4.1.11 Connections to a sanitary sewer shall only be permitted where it can be demonstrated to the satisfaction of the entity in charge of sanitation: that the downstream sewerage system has sufficient reserve capacity to adequately and efficiently handle the additional anticipated sanitary sewage load.

4.1.12 Connecting to the public sewerage shall require paying the connection permit fees set by the regulatory entity.

4.1.13 Non-domestic discharges require a Trade Effluent Consent. If anything other than domestic sewage is discharged into the public sewers without a Trade Effluent Consent, an offence is committed and the applicant will be liable to the penalties contained. The discharge of non-domestic effluent is not permitted after inspection and when the sewerage management has issued a valid Trade Effluent Consent.

4.1.14 All costs and expenses incidental to the installation and connection of the building sewer shall be borne directly and solely by the Owner. The Owner and contractor shall indemnify the concerned owner from any loss or damage that may directly or indirectly be occasioned by the construction or installation of the building sewer.

4.1.15 When any building, or other structure previously served by a connection to any public sewer is demolished, destroyed, abandoned, or altered so that any drain or portion of an abandoned plumbing system which is directly or indirectly connected to any public sewer is no longer used and is no longer connected to the drainage system of the building or structure, the open end of such drain which discharges, directly or indirectly, into a public sewer shall be promptly closed and sealed off so that not water or waste not otherwise permitted to enter the public sewer or drain shall be so discharged therein to. The Superintendent shall be notified, in writing, of such abandonment or discontinuance and all sealing of building sewers shall be inspected by and performed to the satisfaction of the Superintendent.

4.1.16 All owners of any building that is located within an area that has been designated for establishing and implementing a sewerage and wastewater scheme are required to apply to the Authority for a sewer connection permit, and to connect to the system.

4.1.17 Permits shall be kept and displayed at the construction site at all times while work is in progress.

4.1.18 Streets and other public or private property disturbed in the course of the work shall be restored by the person undertaking the works to their previous condition in a manner and to the extent required by the municipality.

4.1.19 All material, pipe, bends, and equipment needed to properly install the building sewer must be on the site prior to the initiation of construction.

4.1.20 All excavations for building sewer installations shall be adequately guarded with barricades and lights to protect the public from hazard.

4.1.21 All construction must take place or conducted as stated in the Rwanda national labor law.

4.1.22 Entity in charge of Sanitation or his authorized agent shall approve the quality of all materials and workmanship and shall have the right to inspect the same at all times. Any inferior or defective material may be ordered from the job and shall be cause for a portion of a building sewer to be replaced and reinstalled.

4.1.23 If any contractor neglects or refuses to comply with any of the requirements of guidelines within a reasonable time after receiving written notice from Entity in charge of Sanitation or Sanitary Engineer to do so, the Sanitary Engineer may cause such work to be performed and the cost thereof shall be charged to the contractor.

4.2 Sewerage connection Permit Application

4.2.1 All Users proposing to connect to the sewerage system shall obtain a sewerage connection permit prior to any such connection.

4.2.2 All users required to obtain sewerage connection permit shall complete and file with the Entity in charge of sanitation an application, with the applicable fees. In support of the application, the user shall submit the information preseted in Annex 4.

4.2.3 For the sake of professionalism, the completion of the above information for non-residential buildings may require hiring the authorized sanitation skilled persons.

4.2.4 Entity in charge of Sanitation shall evaluate the data furnished by the user and may require additional information. After evaluation and acceptance of the data furnished, the Entity in charge of Sanitation shall issue a Wastewater Contribution Permit subject to terms and conditions provided herein.

4.3 Permit Transfer

4.3.1 Wastewater Contribution Permits are issued to a specific user for a specific operation and shall not be reassigned, transferred or sold to a new owner, new user, different premises, or a new or changed operation without the approval of the Entity in charge of Sanitation. Any succeeding user shall comply with the terms and conditions of the existing permit.

4.3.2 All Significant Users proposing to connect to the sewerage system shall obtain a sewerage connection permit prior to any such connection.

SECTION 5. EASEMENT

5.1 Introduction

5.1.1 Easement is commonly used to allow the underground services (water, sewage, drainage, gas, electricity, telephone and TV cables, etc) of one property to pass beneath the land of one or more neighbouring properties. In this document, the easement will be understood as a right benefiting one parcel of land (known as the dominant tenement) that permits the rightful users (not necessarily solely the owner) of that land to connect to the sewerage over a neighbouring parcel of land (known as the servant tenement).

5.2 Easement Alignment

5.2.1 The authorized staff (by the Entity in charge of sanitation or other competent authority) shall determine the required easement sewer alignment and its width.

5.2.2 Where there are competing options of locating the sewer main in a street or in an easement, the sewer main shall be located in the street.

5.2.3 The authorized staff must satisfactorily demonstrate that no other reasonable alternative alignment exists prior to requesting permission to locate a sewer, trunk sewer, within an easement.

5.2.4 Easements shall be located entirely within one lot or parcel and longitudinally adjacent to the property line.

5.2.5 Lighting poles, power conductors, pressurized water lines, retaining walls and other encroachments shall be limited and approved by the Senior Civil Engineer of municipality and other competent Authority. These facilities shall be clearly shown on the public improvement plans. If approved, these encroachments shall require an Encroachment, Maintenance, and Removal Agreement (EMRA).

5.2.6 Bisecting a lot with an easement shall not be permitted. Existing sewers within easements which cut across an undeveloped lot shall be considered temporary and shall be relocated to streets or adjacent to the property line, as a condition of development or as part of any sewer replacement project.

5.3 Easement Width

5.3.1 Easement widths are determined by the diameter of the pipe being installed and the depth of cover from the centreline of the road/ground over the pipe to the invert of the sewer or water main.

5.3.2 The minimum width of a sewer easement at a depth of up 1.5 meters, shall be 3 meters (1.5 meters each side of sewer).

5.3.3 Sewer mains 400 mm in diameter and less shall require a minimum 3 m wide easement.

5.3.4 A minimum 4 m wide easement shall be required for 500mm to 800 mm diameter mains and minimum 5 m wide easement shall be required for mains 1m in diameter and larger.

5.3.5 Easements located in private streets that contain more than one utility line shall require a minimum of 3m of additional width for each additional utility). Deviations from this requirement may be allowed on a case-by-case basis.

5.4 Easement Acquiring

5.4.1 A sanitary sewer easement shall be granted by a land owner through a Deed of Grant to the municipality or the nearby land for the purpose of connecting to the sewerage.

5.4.2 A Deed of Grant shall specify the terms of granting the easement (free of charge, monetary, etc). Also granted will be the right to maintain and repair the system and control all connections to it.

5.4.3 The easement will be acquired prior to construction. Generally, if the homeowner refuses to grant the easement, the municipality shall take the easement right and oblige the homeowner to grant the easement by all means. Thus, a parcel of land will have a right of way of necessity over the sewerage if that route is the only means of access between the public highway and that parcel of land.

5.4.4 Easements secured by fencing shall have a locked vehicular access gate. Keys to the lock shall be provided to the various utility agencies with facilities enclosed by the fenced area.

5.5 Planting In the vicinity of Sewers

5.5.1 In general, no trees shall be planted within 2 m from both sides of any existing or proposed sewers.

5.5.2 The distance less than 2m shall be approved by the entity in charge of sanitation.

5.5.3 Turf, plants and minor flowering shrubs may be accepted over sewerage provided they do not have profuse or penetrating roots.

5.5.4 Planting within the space of 1.5m around the cover of any chambers should be avoided.

5.5.5 There shall be free access to all sewerage installations at all times even when the turf, plants and shrubs are mature.

5.5.6 In areas where soil conditions dictate, additional easement width may be required in order to assure adequate width for open-cut replacement of the sewer mains.

SECTION 6. USE OF THE PUBLIC SEWERS

6.1 General Provisions

6.1.1 In accordance with these Sewerage Connection Guidelines, the owner or his agent of buildings, or properties used for human occupancy, employment, recreation, industries or other purposes, situated within the sewer line and abutting on any street, alley, or right-or-way in which there is now located or may in the future be located a municipality line, is hereby required, at his expense, to connect direction to the sewer line in accordance with the provisions herein with thirty (30) days after date of official notice to do so, provided that said municipality line is within hundred (100) meters of the owner's property line. Mandatory connection to the public sewer is required under this national Guideline.

6.1.2 For the Distance more than hundred (100) meters the entity in charge of sanitation shall determine that certain premises or locations within a designated area will be included in a sewerage and wastewater scheme, and shall be entitled to connect to a public sewer in a scheme;

6.1.3 No septic tank or privy may be used or constructed for the purpose of disposing sewage at any premises in a designated area after sewerage and wastewater services are provided to those premises under these guidelines, unless the competent Authority gives approval for the use or construction;

6.1.4 Restaurants, laundries, wash racks, vehicle service stations, Garage, private multi-user systems, engine or machinery repair shops and other facilities that produce grease, grit, oil, lint or other materials which accumulate and cause or threaten to cause stoppages or impair the efficiency of the Municipality/ city's sewers or threaten the safety of its employees, shall install and maintain a grease trap, grit trap, lint trap, oil interceptor, or other appropriate device of standard design and construction to prevent excess discharges of such materials. The design and construction of any such device shall be subject to prior approval Sanitation Authority;

6.1.5 During maintenance of a trap or interceptor, the hauler is not allowed to discharge any substance back into the trap for discharge to the sewer;

6.1.6 Whenever possible, the building sewer shall be brought to the building at an elevation below the basement floor. In any case where the building drain is too low to permit gravity flow to the public sewer, the owner shall install a pump approved by the entity in charge of Sanitation. The costs associated with the pump installation, operation and maintenance shall be at the sole expense of the Owner;

6.1.7 The size, slope, alignment, materials and methods of construction for installing building sewers shall conform to this Guidelines and good engineering practices;

6.1.8 The entity in charge of Sanitation may require that backflow or check valves be installed on building sewers where necessary to protect the owner's property.

6.2 Prohibited Discharges

6.2.1 Solids or viscous substances in quantities or of such size capable of causing obstruction to the flow in wastewater works, or other Interference with the proper operation of the wastewater Works such as, but not limited to ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, ungrounded garbage, whole blood, hair and fleshing, entrails, paper dishes, cups, milk containers, etc.,

6.2.2 No person shall discharge or make a connection which would allow for the discharge of any storm water, surface drainage, groundwater, roof runoff, cooling water or other

water into any sanitary sewer. However, storm water and all other unpolluted drainage can be discharged to sanitary sewers if authorized by the entity in charge of sanitation, or when the system is designed to collect both sewage and storm water (combined system).

6.2.3 Any Waste which is capable of causing or contributing to an explosion or supporting combustion in any Sewer or Sewage Facility including, but not limited to, gasoline, benzene, diesel or other fuel oil, waste crankcase oil and sludge resulting from the manufacture of acetylene.

6.2.4 Infectious or physically dangerous medical biological waste including but not limited to: blood and blood products; pathological Wastes; cultures and stocks of infectious agents and associated biological; contaminated animal carcasses, body parts, and bedding of research animals known to be exposed to pathogens; discarded medical articles that may cause punctures or cuts (known as "sharps"); and any discarded preparations made from genetically altered living organisms and their products;

6.2.5 Any wastewater having an acid pH less than 5.0 or more alkaline than 12.0 or wastewater having any other corrosive property capable of causing damage or hazard to structures, equipment, and/or personnel of the Municipality.

6.2.6 Any Pollutant, including oxygen demanding Pollutants (BOD, etc.) released in a discharge or at a flow rate and/or Pollutant concentration which will cause Interference with the Wastewater Works;

6.2.7 Wastewater having a temperature greater than 104◦F (40◦C), or which will inhibit biological activity in the treatment plant resulting in interference, but in no case wastewater which causes the temperature at the introduction into the treatment plant to exceed 104◦F (40◦C);

6.2.8 Any wastewater containing pollutants which either singly or by interaction with other pollutants, may injure or interfere with any wastewater treatment process, constitute a hazard to humans or animals, create a toxic effect in the receiving waters of the wastewaters, contaminate the bio-solids of any treatment systems;

6.2.9 Any garbage that has not been properly shredded and is greater than 12.5 mm in any dimension or particles that will not be conveyed freely in the sewerage system. The installation and operation of any garbage grinder be subject to the review and approval of the Superintendent;

6.2.10 Any waters or wastes containing arsenic, iron, chromium, copper, zinc, and similar objectionable or toxic substances; or wastes exerting an excessive chlorine requirement, to such degree that any such material received in the composite sewage as the sewage treatment works exceeds the limits established by the Taunton Wastewater Treatment Facility for such materials.

6.2.11 No user shall ever increase the use of process water, or in any way attempt to dilute a discharge, as a partial or complete substitute for adequate treatment to achieve compliance with a discharge limitation unless expressly authorized by an applicable pre-treatment standard or requirement. Pre-treatment Superintendent may impose mass limitations on users who are using dilution to meet applicable pre-treatment standards or requirements or in other cases when the imposition of mass limitations is appropriate.

6.2.12 It is forbidden to cool down wastewater so much that it causes a danger of freezing in the sewers or interferes with the operations of the treatment plant.

6.2.13 Other substances which are harmful or toxic from the point of view of the sewer system or recipient watercourse; substances which disturb the function of the sewer network or operations of the wastewater treatment plant or endanger the health of the employees

6.3 Institutional Wastewaters Containing Fats, Oil, And Grease (FOG)

6.3.1 All persons discharging wastewater into a sewer network shall comply with these fats, oils, and grease (FOG) control requirements for the following purposes:

a. To prevent the introduction of excessive amounts of FOG into the wastewater collection system and which exceed the national effluent guidelines on FOG;
b. To implement procedures to recover any costs incurred by the Entity in charge of Sanitation including but not limited to physical damages, monetary damages, and fines due to the effects of FOG discharges into the sewer system;
c. The penalties and fines will be applied to institutions or households discharging above the allowable limit into the sewerage;
d. To establish Commission inspections of all FSE and Grease Removal Devices (GRD).
e. To establish procedures and guidelines for notification of violations and establishment of penalties and fines to FSE which are in violation of this guideline;
f. To prevent blockages of the sewer system;
g. To prevent sewer backups.

6.3.2 Entity in charge of Sanitation will have jurisdiction over certain components of the issues relating to FOG and its disposal.

6.4 FOG - Pretreatment Required

6.4.1 Food Services Establishment (FSE) are required to install, operate, and maintain an approved type and adequately sized GRD necessary to maintain compliance with the requirements and objectives of this guideline. The GRD shall be adequate to separate and remove FOG contained in wastewater discharges from FSE prior to discharge to the public sewer system. Fixtures, equipment, and drain lines located in the food preparation and clean up areas of FSE that are sources of FOG discharges shall be connected to the grease interceptor.

6.4.2 The Facility Owner(s) of GRD shall submit design plans and maintenance plans to the Entity in charge of Sanitation and Technical Services for fats, oils and grease (FOG) interceptors and sand interceptors. The design criteria determined by a Professional Engineer, or Registered Architect, or by Sanitation Engineer of Entity in charge of Sanitation.

6.5 FOG - Pretreatment Not Required

6.5.1 GRD are not required for residential building(s), structure(s), dwellings or dwelling units or any private residence unless there is centralized food preparation and/or service.

6.6 FOG New Food Service Establishments

6.6.1 Entity in charge of Sanitation shall require all FSE which are newly proposed or constructed, or existing FSE which will be expanded or renovated, or have change in use, which includes an FSE, where an FSE did not previously exist, shall be required to install, operate, and maintain a GRD, in accordance with this connection guidelines.

6.7 FOG Control Prohibitions

All FSE shall comply with the following prohibitions:

6.7.1 Disposal of waste cooking oil into sewer or drainage pipes is prohibited. All waste cooking oils shall be collected and stored properly in receptacles such as barrels or drums for recycling or other acceptable methods of disposal.

6.7.2 Discharge of Wastes from toilets, urinals, wash basins, and other fixtures containing fecal materials to any GRD is prohibited.

6.7.3 Discharge of any waste including FOG and solid materials removed from the GRD to the sewer system is prohibited.

6.7.4 FOG that has accumulated in a grease interceptor shall not be allowed to pass into any sewer lateral, sewer system, storm drain, or public right of way or water body during maintenance activities.

6.8 FOG - Control Inspections and Maintenance

6.8.1 GRD shall be maintained in efficient operating condition by periodic removal of the full content of the interceptor which includes wastewater, accumulated FOG, floating materials, sludge, and solids.

6.8.2 Inspection and maintenance of GRD shall be in accordance with the Entity in charge of Sanitation's Guidelines and Policies.

6.8.3 The FSE or authorized agent must perform inspections of GRD accumulation of grease and solids, need for maintenance/cleaning and repairs.

6.8.4 Maintenance activities shall not cause FOG, solids, or sludge to pass into any sewer lateral, sewer system, storm drain, public right of way, or water body.

6.8.5 FSE with GRD may be required to submit inspection, maintenance and cleaning records and information necessary to establish the maintenance frequency of Grease Interceptors.

6.9. Accidental Discharge

6.9.1 Each user shall provide protection from the accidental discharge of prohibited materials or other substances regulated by these Guidelines, with such facilities being provided and maintained by the user at his expense.

6.9.2 Detail plans showing the proposed facilities and outlining the operation procedures to provide this protection shall be submitted to the competent Authority for review and approval prior to the initiation of construction.

6.9.3 In the case of an accidental discharge, it is the responsibility of the user to immediately notify the Entity in charge of Sanitation by telephone of the incident. The notification shall include location of the discharge, type of waste, concentration and volume and corrective action taken.

6.9.4 Within five (5) days following an accidental discharge, the user shall submit to the Sanitary Engineer of Entity in charge of Sanitation detailed written report describing the cause of the discharge and the measures to be taken by the user to prevent similar future occurrences.

6.9.5 Such notification shall not relieve the user of any expense, loss, damage, or other liability which may be incurred as a result of damage to the sewerage system, fish kills or any

other damage to person or property; nor shall any notification relieve the user of any fines, civil penalties, or other liability which may be imposed.

6.10 Tampering with Sewerage System

6.10.1 No person other than an authorized agent of the competent organ shall attempt to make any type of connection to a sanitary sewer without permission of the competent Authority.

6.10.2 To do so shall constitute a tampering violation which carries the penalty

6.10.3 No act shall be permitted that would hamper or restrict in any way the normal function of the sewerage system.

6.11 Disposal of Septic Tank Wastes

6.11.1 No person, firm or corporation shall discharge septic tank wastes into any manhole or other appurtenance of any sanitary sewer;

6.11.2 Approved septic tank wastes may be discharged at the Wastewater Treatment Plant;

6.11.3 Any person, firm or corporation, either owner or agent, violating the provisions of this regulation shall be subject to a penalty per violation. In addition, such person, firm or corporation shall be liable for any expense, loss or damage occasioned by reason of such violation.

6.12 Private Sewage Disposal

6.12.1 Private Disposal Prohibited

6.12.1.1 No person shall construct, use or maintain any privy, privy vault, septic tanks, cesspool or other facility intended or used for the disposal of sewage within the Sewerage covered Area.

6.12.1.2 After notification from the Municipality that service is available within the coverage area, a direct connection shall be made to the sewerage by the owner at owner's expense in compliance with the provisions herein contained, and any septic tank, cesspool, privy, or similar private sewage disposal facilities shall be immediately emptied and filled with suitable material.

6.12.2 Private Disposal Authorized

6.12.2.1 Whether Municipality sewerage service is not available within the coverage area, the building's sewer shall be connected to a private sewage disposal system complying with the provisions of the entity in charge of Sanitation.

6.12.2.2 Prior to commencement of construction of a private sewage disposal system, the owner or his agent shall first obtain a written permission from the Municipality.

6.12.2.3 The owner or his agent shall operate and maintain the private sewage disposal facilities at owner's sole expense and in compliance with the National sewerage connection guidelines.

6.13 Flow-Equalizing Facilities

6.13.1 Where preliminary treatment and flow-equalizing Facilities may be requested by Entity in charge of Sanitation, they shall be maintained continuously in a condition satisfactory to the said Authority and be effectively operated by the Owner at the Owner's expense

6.14 Pre-Treatment

6.14.1 Users shall provide the necessary facilities to pre-treat wastewater if requested by entity in charge of Sanitation or other Competent Authority, with such facilities being provided, operated and maintained at the user's expense. Detailed plans showing the pre-treatment facilities and operating procedures shall be submitted to the entity in charge of Sanitation for review and approval.

6.14.2 No user shall ever increase the use of process water or attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in these Guidelines or in any other pollutant-specific limitation developed under this national sewerage connection guideline.

6.14.3 Grease, oil, and sand interceptors shall be provided by non-residential users, when determined to be necessary by the Sanitary Engineer, for the proper handling of liquid wastes containing grease in excessive amounts, or any flammable wastes or other harmful ingredients. The location, type and capacity of all such interceptors shall be approved by Sanitary Engineer of entity in charge of Sanitation.

6.14.1 Non Domestic Wastewater

Industrial and Non Domestic Wastewater conveyed to the sewer network shall not include substances, listed below, more than the concentrations shown in Table 6-1, 6-2 and 6-3.

6.14.1.1 Solids

6.14.1.1.1 Solids accumulate in the sewer pipes and dry wells of the wastewater pumping stations and disrupt the wastewater discharge. The composition of solids shall be monitored from the point of view of biological degradation rate (If solids do not degrade biologically, they may influence the settling properties of activated sludge, sludge drying and utilization options for sludge).

a. the limit value for total suspended solids in wastewater conveyed to the sewer shall be 350 mg/l.
b. the limit value for total Dissolved solids in wastewater conveyed to the sewer shall be 700 mg/l.
c. the limit value for Settleable solids in wastewater conveyed to the sewer shall be 15mg/l.

6.14.1.2 Chloride

6.14.1.2.1 High concentrations of chloride corrode the structures of sewers and pumping stations. Chloride is extremely harmful to the concrete rebar of pumping stations or other concrete structures if they are visible or near the concrete's surface so that chloride included in water can affect them and thus cause corrosion to the steel.

6.14.1.2.2 The limit value of the chloride concentration in wastewater conveyed to the sewers shall be 2500 mg/l.

6.14.1.3 Magnesium salts

6.14.1.3.1 Magnesium salts cause damage to concrete. The overall effect of magnesium and ammonium is based on leaching of concrete; in other words, they dissolve calcium from concrete by replacing it with magnesium or ammonium.

6.14.1.3.2 Limit value used for magnesium in these guidelines shall be 300 mg/l.

6.14.1.4 Other corrosive substances

6.14.1.4.1 All acidic substances corrode concrete sewers and pumping stations and should be reduced to their minimum concentration (Appendix 7).

a. The authorized pH shall be in the range of 6-10;

b. The authorized free" carbonic acid shall be in the range of 15-30 mg/CO2/L;

c. The authorized ammonium shall be in the range of 15-30 mg/NH4/L;

d. The authorized sulphate shall be in the range of 200-600 mg/NH4/L;

6.14.1.5 Hydrogen sulphide

6.14.1.5.1 The formation of hydrogen sulphide is affected by the amount of organic substances and nutrients, oxygen content, pH value, temperature, discharge rate of wastewater, area of the pipe, time span how long wastewater remains in the pipe and sulphate content. Table 6-2 presents symptoms caused by hydrogen sulphide at different concentration levels.

6.14.1.5.2 The limit value for hydrogen sulphide in wastewater to be conveyed to the sewer shall be 5 mg/l.

6.14.1.6 Arsenic

6.14.1.6.1 Arsenic is a metalloid which is biologically non-degradable in the environment and which accumulates in the human body. Arsenic is very toxic to aquatic organisms. Arsenic may end up in wastewater along with biocides, fertilizers or waste from the metal industry. Other pollutant sources are metal smelting plants, wood impregnation plants and different kinds of incineration processes.

6.14.1.6.2 The limit value for arsenic in wastewater to be conveyed to the sewer shall be 0.2 mg/l.

6.14.1.7 Fats

6.14.1.7.1 Fats are generated, among others, by slaughterhouses, dairies, plants treating animal-origin by-products, restaurants and dairies of dairy farms. Fats block sewer pipes and blockages in pipes can cause water damage in a property. Additionally, fats both of animal-origin and plant-origin consume a lot of oxygen during the treatment process. In other words, they can negatively interfere with the oxygen supply of a biological process and thus cause the growth of filamentous bacteria. Fat-containing wastewater generated by industry nearly always requires a pretreatment of wastewater. This Guideline provides regulations on fat and grease separation.

6.14.1.7.2 The limit value for wastewater to be conveyed to the sewer shall be 100 mg/l.

6.14.1.8 Phenols

6.14.1.8.1 Phenols are mainly used for producing phenolic resins but they can also be found in different solvents, detergents and disinfectants. Phenol dissolves well in water and hardly evaporates at all. Phenols are toxic to aquatic organisms but do not accumulate in the food chain.

6.14.1.8.2 The limit value for phenol concentrations in wastewater conveyed to the sewer shall be 10 mg/l.

6.14.1.9 Silver

6.14.1.9.1 Silver is lethal to bacteria already in low concentrations. Silver ions and many silver compounds are extremely toxic to freshwater fish and aquatic organisms and also to mammals. Silver is included in many daily items, such as in cutlery, jewellery and mirrors. It has been used in large quantities in graphics and picture production, as well as in dental care clinics (amalgam fillings and x-rays). Along with the digitalisation of radiography equipment, silver concentrations in sludge have decreased. Silver halides, i.e. silver salts, are used as antibacterial substances in some consumer goods, such as socks and sports shoes. Electronic devices also contain silver.

6.14.1.9.2 The limit value for silver in wastewater conveyed to the sewer shall be 0.1 mg/l.

6.14.1.10 Mineral oils, hydrocarbons C10-C40

Compounds are classified as mineral oils if they include hydrocarbon fractions in the range of C10-C40. C10-C21 mineral oils are semi-heavy, i.e. fuel oil and diesel. Hydrocarbon fractions C21-C40 refer to heavy fuel oils and lubricants. Mineral oils can cause blockages in the sewer network, inhibit the functionality of activated sludge by preventing oxygen entry into sludge particles and create higher treatment costs for the water utility. The limit value for the total concentration of oil hydrocarbons in wastewater conveyed to the sewer shall be 50 mg/l.

6.14.1.11 Chemical Wastes

6.14.1.11.1 Wastewater conveyed to the sewer network shall not contain the following:

a. Extremely flammable solvents,

b. highly flammable solvents,

c. solvents insoluble in waster (e.g. diethyl ether, petroleum ether, cyclohexane)

d. Chlorinated solvents (e.g. trichloroethylene, tetrachloroethylene, methylene chloride, chloroform and carbon tetrachloride;

e. Wastewater conveyed to the sewer can contain monocyclic aromatic hydrocarbons and volatile organic compound (e.g. benzene, ethylbenzene, toluene, xylene) not higher than 3 mg/l;

f. The total carbonic concentration of wastewater conveyed to the sewer shall be 200 mg/l at most.

6.14.1.11.2 Wastewater conveyed to the sewer network shall not include substances with concentrations listed in Table 6-1, 6-2 and 6-3 and elsewhere in this section..

*Table 6- 1**: Limit values for heavy metals***

Metal	**maximum allowed concentration (mg/l)**
Arsenic (As)	0.2 mg/l
Mercury (Hg)	0.03 mg/l
Silver (Ag)	0.1 mg/l
Cadmium (Cd)	0.08 mg/l
Total chromium (Cr)	1 mg/l
Copper	1 mg/l
Lead (Pb)	0.5 mg/l
Nickel (Ni)	1 mg/l
Zinc (Zn)	3.0 mg/l
Tin (Sn)	2.0 mg/l
Magnesium (Mg)	300 mg/l

*Table 6- 2**: Other substance-specific limit values***

Parameter	***Requirement***
pH	6.0–10.0
Temperature	40 °C
Sulphate thiosulphate Sulphite altogether	400 mg/l
Total cyanide	0.5 mg/l
Ammonium	30 mg/l
Formaldehyde	1.0 mg/l
Phosphorus	8 mg/l
Phenol and cresol	10 mg/l
Nitrogen	40 mg/l
BOD	350 mg/l
Chemical Oxygen Demand (COD)	600 mg/l
Chloride	2500 mg/l
Fat	100 mg/l
Grease	100 mg/l
Oil	50 mg/l

Parameter	*Requirement*
Phenols	10 mg/l
Total Suspended Solids (TSS)	350 mg/l
Total hydrocarbon concentration	100 mg/l

*Table 6- 3**: Instructions for solvents***

Substances which the requirement concerns	*Requirement*	*concerns*	*Requirement*
Extremely flammable solvents, highly flammable solvents, and solvents insoluble in waster (e.g. diethyl ether, petroleum ether, cyclohexane)	Forbidden to convey to the sewer		
Chlorinated solvents (e.g. trichloroethylene, tetrachloroethylene, methylene chloride, chloroform and carbon tetrachloride)	Forbidden to convey to the sewer		
Total hydrocarbon concentration	100 mg/l		

6.14.1.12 **Slaughterhouses and Meat Processing Plants**

6.14.1.12.1 Wastewater generated by slaughterhouses and meat processing plants results from the cleaning of cattle sheds and transport vehicles, as well as from the different stages of slaughtering. A screen with a 6 mm mesh is used to prevent solids from entering the sewer the aim should be to prevent coagulated blood and fat from ending up in wastewater as efficiently as possible.

6.14.1.12.2 Chemicals, e.g. ferric nitrate, which improve the oxygen level, can be used to combat odour emissions.

6.14.1.12.3 The applied pre-treatment can be, among others, fat separation, solids separation, chemical precipitation, pH adjustment and reducing of organic loading (biological processes). The slaughterhouse wastewater is monitored for BOD, COD, total nitrogen, total phosphorus, solids, pH value, electrical conductivity and fat concentration.

6.14.1.13 Laboratories

6.14.1.13.1 General

6.14.1.13.1.1 Laboratories operate in many different kinds sectors including industries, universities, high schools and research entities. Various kinds of chemicals are generated by laboratories where different kinds of tests and analyses are applied.

6.14.1.13.2 Chemicals which are expired or removed from use cannot be conveyed to the sewer.

6.14.1.13.3 If the solution includes, for instance, mercury, lead, cadmium, nickel or other heavy metal clearly toxic to the biological activities, it must be separately sorted into the hazardous waste collection.

6.14.1.13.4 All liquids and reaction products classified as hazardous waste must be collected separately.

6.14.1.13.5 Neither chlorinated solutions of organic solvents can be conveyed to the sewer, nor extremely volatile solvents, nor highly flammable fluids (e.g. ethers and hexanes). Chlorine-free VOC compounds (e.g. benzene, ethylbenzene, toluene or xylene) can be conveyed to the sewer if the total concentration of the original solution does not exceed 3 mg/l.

6.14.1.13.6 The concentration limit value cannot be achieved by diluting the solution before conveying it to the sewer.

6.14.1.13.7 Special attention must be paid to solvents which do not dissolve in water because they clearly constitute a fire risk in the sewer network.

6.14.1.13.8 If a compound is classified by its concentration as hazardous waste, it cannot be conveyed to the sewer. Today, more attention than ever must be paid to such substances which do not degrade biologically and which are accumulative or persistent compounds.

6.14.1.13.9 Other sub

6.14.1.13.1 General instructions for laboratories

6.14.1.13.1.1 It is prohibited to convey to the sewer:

a. Chemicals which are old or removed from use
b. Substances toxic to the aquatic environment
c. Highly flammable substances
d. Substances classified as hazardous waste
e. solids causing blockages
f. Laboratories must pay attention to the limit values and instructions provided by the entity in charge of sanitation.

6.14.1.14 Reagents

6.14.1.14.1 Reagents stain the microorganism in the diagnostic sample. Typical reagents commonly used in departments such as Microbiology include a combination of crystal violet, iodine and neutral red. Disposal of these reagents is via dilution with tap water to sewer may be permitted by the entity in charge of sanitation as long as they meet the national discharge standards to the sewer.

6.14.1.14.2 It is not uncommon for laboratories to use a range of mercury containing devices such as calibration manometers, water bath thermometers, incubators and refrigeration thermometers. Should these devices break, mercury spills should be collected using mercury spills kits. Mercury and mercury contaminated materials should not be discharged to sewer under any circumstances but disposed of as hazardous waste.

6.14.1.15 Hospitals and health care services

6.14.1.15.1 Hospital-generated wastewater includes washing fluids, disinfectants, pharmaceutical and chemical residues, bacteria and viruses. Wastewater generated in radiology departments may contain silver and mercury. Wastewater is usually examined for BOD, COD total nitrogen, total phosphorus, solids, pH value, electrical conductivity and heavy metals.

6.14.1.15.2 Dental practices based on hospital sites generate aqueous wastes which are discharged into sewer. Typical aqueous wastes generated in dental areas include: Mouth rinses. Effluent from amalgam separators and Anaesthetic liquid from injections. The followings are requirement to discharge dentistry wastewater into the sewers.

6.14.1.15.3 Mouth rinses can be discharged to drain/ sewer via dental spittoons

6.14.1.15.4 Amalgam separators must be fitted to all outlets for waste water.

6.14.1.15.5 Excess liquid anesthetic in syringes must not be discharged into drains but left in the syringe and should be deposited into appropriate sharps box.

6.14.1.16 Pharmaceutically active medications and instruments

6.14.1.16.1 Medications containing pharmaceutically active ingredients, vaccines, serums, controlled drugs and patient own medications that may be brought onto the hospital site are not permitted to be discharged to sewer under any circumstances. Examples of hazardous properties associated with a number of pharmaceutically active medicines include: H2 (Oxidizing), H3A (Highly Flammable), H3B (Flammable), H4 (Irritant), H5 (Harmful), H14 (Ecotoxic).

6.14.1.16.2 Cleaning of medical instruments including items used in endoscopy typically consists of a number of wash cycles that clean, disinfect and rinse. As well as using chemicals to disinfect (chlorine dioxide) and enzymatic detergents to clean instruments, ultra clean water produced from reverse osmosis (RO) and ion exchange plants may also be used in the rinsing process. Sterilization can involve the use of steam and therefore high temperatures may be generated. Permission to discharge this wastewater shall be sought from entity in charge of sanitation

6.14.1.17 Radioactive Materials/X-Ray / Radiography

6.14.1.17.1 Radiography is used for fast, highly penetrating images, and is usually used in areas with high bone content whilst radiotherapy is a non-imaging application used to treat malignant cancer cells. Radio-contrasting compounds such as barium sulphate are often used to highlight the gastrointestinal tract, arteries or veins in radiography.

6.14.1.17.2 Recovered radio-contrasting compounds such as barium sulphate shall be collected and disposed of separately. They should not be disposed of to sewer as they are very dense and collect in traps and siphons and can cause blockages.

6.14.1.17.3 No radioactive aqueous discharges shall be permitted into sewer network.

6.14.1.18 Biodegradable waste from hospitals and health facilities

6.14.1.18.1 Most discharges from Mortuary processes are acceptable for discharge to the foul sewer. Care should be taken to ensure the levels of disinfectants and preservatives are not excessive.

6.14.1.18.2 In the post mortem facility bodily fluids, blood and urine, stomach contents and faecal matter may be removed from the body. Essentially the post mortem table and floor is washed with water and disinfected with biocide and virocide and discharges direct to foul sewer. In addition there will be some washing of body parts and organs

removed from the corpse for further analysis. The drainage system should have a fine filter installed to prevent any body tissue from being discharged.

6.14.1.18.3 The storage of cadavers at medical schools associated with hospitals use various chemicals to preserve bodies and body parts, usually formaldehyde is used but phenol, and methanol and glycerine are also in common use. When the cadaver is being used for training there will be a loss of preservative and some bodily fluids, which will be washed to sewer. In addition there will be some disinfection of the dissecting table and cleaning of the instruments all of which will give rise to a waste for disposal to foul sewer. The discharge is acceptable provided levels of formaldehyde do not exceed 100mg/l or 10mg/l phenol at the discharge point to the public foul drainage system

6.14.1.19 Photograph Film

6.14.1.19.1 Photograph film requires the use of a developer solution and a fixer solution as part of a number of stages. Used solutions should not be discharged to sewer as they contain silver ions. These solutions, along with empty concentrate bottles must be removed from site after use. Washings from the film process should only be discharged to foul sewer.

6.14.1.20 Laundry Services

6.14.1.20.1 Dependent upon the Healthcare organization this service can either be supplied and managed by the organization itself on site or be managed and operated on site by a third party or the service provided by an off-site contracted organization. The processes can be varied dependent upon the type of material/garments to be cleaned, the method of cleaning, for example heavily contaminated requiring sterilizing through to dry cleaning and the equipment used. In all cases discharges shall be to sewer and laundry departments shall contact the entity in charge of sanitation to confirm if consent is required.

SECTION 7. FINANCIAL FRAMEWORK

7.1 Authority to Collect All Charges and Payments

7.1.1 Entity in charge of Sanitation shall have the authority to use all legal means available to collect all assessments and charges for Wastewater services provided, including, but not limited to, capital maintenance, operational, and support costs and other payments from sewerage connection services as specified in the contracts, agreements, and amendments thereto, between the sewerage users and entity in charge of sanitation, when due, including the collection of delinquent payments.

7.2 Fees and Charges

7.2.1 Each user shall pay all fees, charges and surcharges as determined by the competent authority. Fee, charges and surcharges will be determined based on sewerage user categories notably residential and non-residential (commercial, institutional, health, industrial facilities, etc) and sewage load discharge. Further classifications of user categories and criteria for charges may be established by the Entity in charge of Sanitation.

7.2.2 The Entity in charge of Sanitation may adopt fees which may include, but not be limited to, the following:

a. Fees for all Sewerage services costs, including maintenance and operation.
b. Fees for reimbursement of costs of setting up and operating sewerage Pretreatment Program.
c. Fees for monitoring, inspections and surveillance procedures to include, but not be limited to, laboratory analysis.
d. Fees for reviewing accidental discharge procedures and construction.
e. . Fees for permit applications
f. Fees for filing appeals
g. Fees for consistent removal of pollutants otherwise subject to Pretreatment Standards.
h. Fees for impact.
i. Fees for repairs, connection and disconnection.
j. Fees for inspections and surveys.
k. Fees for development and expansion of Municipality facilities
l. Other fees as the Municipality may deem necessary to carry out the requirements contained herein.

7.2.3 The total annual cost of operation and maintenance shall include, but need not be limited to, labour, repairs, equipment replacement, maintenance, necessary modifications, power, sampling, laboratory tests, and a reasonable contingency fund.

7.2.4 The charges will be based upon the quality and quantity of user's wastewater expressed in sewage person equivalent, and operating costs to intercept, treat, and dispose of wastewater. The applicable charges may be adjusted from time to time to accurately apportion such costs among the users of Entity in charge of Sanitation.

7.2.5 The cost of making the connection(s) to the Public Sewer, and all applicable fees, shall be determined by Entity in charge of Sanitation.

7.2.6 The cost of any pumping devices to convey building sewage to the Public Sewer shall be borne entirely by the Owner.

7.2.7 The cost for engineering services to design a system to convey Wastewater of the Owner to the Public Sewer shall be borne entirely by the Owner, including determination of the capacity of the existing and/or new Public Sewer, pumping station, Sewer pipe and Sewer manholes, and all other appurtenances for a complete Sewer system.

7.2.8 Users shall be subject to a surcharge for excessive load of BOD, suspended solids, and other pollutants.

7.3 Combination Billings

7.3.1 Where the Entity in charge of Sanitation provides water or if there is way of collaboration with the entity in charge of water, wastewater collection and treatment charges may be combined for billing purposes with charges for water services rendered.

7.4 Charges for Discontinuing or Restoring Services

7.4.1 If Entity in charge of Sanitation service to any building or premises is physically disconnected from the sewerage system, an inspection fee may be charged because the physical disconnection must be inspected. An inspection fee may also be charged at the restoration of sewer service.

7.4.2 Sewer service shall not be restored until all charges, including the expense of termination and restoration of service, shall be paid.

7.5 Damage to Facilities

7.5.1 The user shall pay for all costs incurred by entity in charge of Sanitation if the user's discharge causes an obstruction or damage or increased pollution loads due to the nature of the wastewater discharged to sewerage system

7.5.2 Fees and charges levied for the damage to facilities or other harmful actions to the sewerage shall be a debt due to the Entity in charge of Sanitation.

7.5.3 If this debt is not paid within 30 days after billing, it shall, at the Entity in charge of Sanitation 's option, be deemed delinquent and subject to penalties and may be recovered by civil action, and the Entity in charge of Sanitation shall have the right to terminate sewer service and enter upon private property for accomplishing such purposes.

SECTION 8. SEWERAGE ADMINISTRATION

8.1 After establishment of sewerage (decentralized), if the system is not operated, maintained and managed properly, it may fail to provide the desired level of services on a sustainable basis. An efficient organization is very important for planning, design, and sustainable operation and maintenance of sewerage systems. Therefore, measures must be taken for Institution strengthening and internal capacity building so that the efforts made can be sustained over a period of time and the system put in place can be well managed. Institutional strengthening can be done by adequately decentralizing the administration, delegating adequate powers at the decentralized level inducting professionals into the administration and providing adequate training to the existing staff.

8.2 For the successful and smooth connection to the sewerage, it is of prime importance to clearly define roles and responsibilities of the different entity involved in the enforcement of guidelines and monitoring the sewerage. Table 8-1 summarizes the roles and responsibilities for the key institutional to be involved in the enforcement of sewerage guidelines.

8.3 No person other than an authorized agent of the competent organ shall attempt to make any type of connection to a sanitary sewer without permission of the competent Authority. To do so shall constitute a tampering violation which carries the penalty

Table 8- 1: ***Key Roles and Responsibilities***

Activities	Responsibility
Overall management of the sewerage connections	Entity in charge of sanitation
Enforcement of these sewerage connection guidelines	Entity in charge of sanitation
Capacity building, Policy formulation, amendment and awareness rising on connection guidelines	Institution in charge of sanitation,
Issuance Sewerage connection permits	Municipality
Establish the sewage discharge fees	Entity in charge regulation
Self-monitoring of the system	Entity in charge of sanitation
External monitoring of compliance to health and environmental norms	Entity in charge of environment protection
Safeguarding of the sewerage and Advisory for improved the service delivery	Municipality, Users committees

8.1 Institution in charge of sanitation

8.1.1 Coordination at the national level

8.1.1.1 The Institution of sanitation will be responsible for coordination all sewerage services and sanitation of Municipalities and for the overall guidance, coordination and interpretation of these Guidelines.

8.1.2 Capacity Building

8.1.2.1 Proper sewage collection and treatment form a sound basis for improvement in community health. Maximum health benefits will be achieved only when the sewerage facilities operate continuously and to full capacity in conformity with the acceptable standards of quantity and quality. If the sewerage tasks are to be carried out effectively and efficiently capabilities should be strengthened under Human resources capacity building by training.

8.1.2.2 The Institution in charge of sanitation shall identify the capacity need (number of staff, area and level of trainings) for proper planning, design, operation and maintenance of sewerage.

8.1.2.3 The Institution in charge of sanitation shall increase the capacity of human resources to fill the gap identified for the proper planning, design of sewerage systems, implementation and O&M. The areas that may need capacity building include but not limited to civil engineering, sanitary engineering, architecture, mechanical engineering, electrical/electronic engineering, wastewater treatment scientists, plumbing, planning and management).

8.1.3 Technical, financial and administrative support to sewerage Services

8.1.3.1 The Government of Rwanda through Institution in charge of sanitation, wherever possible, will explore possibilities of providing assistance for funding sewerage and sanitation projects proposed as part of Municipality Sanitation Plans, Technical and required administrative support.

8.14 Monitoring & evaluation at the central level

8.14.1 The Institution in charge of sanitation or other appointed entity will be responsible for monitoring and evaluation the performance sewerage services and sanitation of the Municipality levels.

8.2 Entity in charge of Sanitation

8.2.1 The followings are role and responsibilities of Entity in charge of Sanitation:

a. To establish, implement, manage and maintain sewerage and wastewater schemes for the provision of sewerage and wastewater services
b. To put in place a sewerage management unit to own and manage the sewage system. The unit will be responsible for maintenance of sewer system including property connection sewer junction and any extension required to reach the property boundary and pressure sewer service. However, the ownership and maintenance on the property side of the assets identified above is the responsibility of the property owner. The sewerage management should elaborate more on guidance for the proper operation of the sewerage.
c. Exercise any power provided for in these Regulations, and any other necessary or incidental power relating to the provision of sewerage and wastewater services, including the power to: establish, implement, manage and maintain sewerage and wastewater systems in designated areas;

d. Retain the services of consultants and contractors for the purpose of establishing and implementing sewerage and wastewater schemes in accordance with the financial procedures applying to the Authority;
e. In close collaboration with a Regulatory Agency, to establish, implement and review the sewer connection tariffs;

f. Recover costs and fees associated with the provision of sewerage and wastewater services in accordance with these Guidelines;

g. Subject to any requirement for approval applying under any law, use public lands for the purpose of establishing and implementing sewerage and wastewater schemes;

h. Arrange for lands to be taken for the purpose of establishing and implementing sewerage and wastewater schemes;

i. Registration of contractors and inspectors. The Authority may require that a person, who undertakes any work on sewerage and wastewater systems, including the making of connections to the systems, must be registered with the Authority under this regulation.

j. The Authority may impose and collect charges and fees under this regulation from owners of lands within designated areas who fail or refuse to make a connection to a sewerage and wastewater system, or who otherwise decline to make use of the available sewerage and wastewater services.

k. Authority to retain ownership of service connections and pumps, The ownership of all public sewers, service connections and sewerage pumps and related fittings remains vested in the Authority regardless of the ownership of the land on which they are installed.

8.3 Authority in charge of Regulation

8.3.1 To effectively implement and manage sewerage and wastewater services in accordance with these Guidelines, the Regulatory Agency may exercise regulatory powers to:

a. Prescribe, apply and enforce standards, specifications and codes of practice in accordance with these guidelines.

b. Enforce prohibitions and restrictions applying under these guidelines for the protection of public sewers and sewerage and wastewater systems;

c. to monitor and regulate permit and to enforce permit conditions;

d. To develop guidelines for the fixing of tariffs for the provision of sewerage services;

e. To develop guidelines for and provide advice on the cost-effective and efficient management and operation of sewerage services;

f. Exercise control over registered contractors and inspectors

g. to monitor and enforce conditions attached to permits for sewer use;

h. Maintain a system of registration of contractors and inspectors; and

.

8.3.2 Regulatory Agency may issue a notice to a registered contractor for de-registration, if the Managing Director has grounds to believe that:

a. The contractor or inspector has breached any standard, specification or requirement applying under these Regulations or a relevant code of Practice;

b. The contractor has performed work on a sewerage and wastewater system in an incompetent or unlawful manner;

c. Provide services, conduct inspections and otherwise implement the provisions and requirements of these Regulations for sewerage and wastewater schemes in designated areas;

8.4 Municipalities

8.4.1 The municipalities will have the following responsibilities:

a. To sensitize the communities on the content of the guidelines including awareness rising related to sewerage services
b. In close collaboration with the entity in charge of sanitation, to enforce the sewerage connection guidelines;
c. To ensure people in the coverage area are connected strategies considered
d. To enforce the connection guidelines for new buildings by requesting each new building to have a connection plan to the sewerage if applicable.
e. To enforce and monitor the compliance to easement guidelines
f. To monitor the compliance to environmental, social and health safety guidelines during sewer construction and repairs;
g. To issue the permits for new buildings after the building owner has shown how the building will be connected to the sewerage if applicable;
h. To monitor the sewage connection services and advise on how to improve the service delivery
i. To monitor and inspect the status of the sewerage connections

8.5 Authority in charge of Environmental Management

8.5.1 The Authority in charge of Environmental Management will be responsible:

a. To monitor the compliance to environmental, social and health safety guidelines during sewer construction and repairs
b. To monitor the compliance of the sewerage operation and maintenance to environmental guidelines (management of odours, leakages, quality of effluent, transportation and disposal of sludge, etc),

8.6 Users and other partners

8.6.1 The sewer users shall be responsible for the proper operation and maintenance of the sewer on property side of their assets. The sewerage management may propose more on guidance for the proper operation of the sewer within different properties.
8.6.2 Building sewers shall be installed by contractor licensed by Regulatory Body. All work shall be performed in accordance with these sewerage connection Guidelines and other applicable state regulations, requirements, laws, and codes.
8.6.3 Sewer service connections on public ways from the public sewer to the property line shall be built, repaired and maintained by the Entity in charge of Sanitation. Connection of the building sewer from the public sewer to the house or building or other premise shall be paid for, owned and maintained by the property owner.
8.6.4 People in the coverage area shall be trained, sensitized and committed to avoid trashes, chemicals, FOG and other incompatible materials in the sewer.

8.6.5 Industrials, garages, health centres and buildings with chemical wastes shall be trained, sensitized and committed to do pre-treatment of their liquid wastes and provision of screen and grease traps.

SECTION 9. MONITORING AND EVALUATION

9.1 A well performing system for the inspection of the sewerage shall be put in place by the Entity in charge of Sanitation to identify any deficiency including infiltration, deformation, leakage, illegal disconnection and any unwanted actions to the sewerage. All sanitary service lateral connections shall be inspected: pictures and videos recorded. A digital and hardcopy record of the video inspection along with written certification from the developer's consulting engineer confirming that the sanitary system has been constructed as per the approved design drawings and approved plans must also be provided.

9.2 Entity in charge of Sanitation shall inspect the whole sewerage including the user's premises at the user's expense. The work to be done include but not limited to sampling, flow measurement and/or internal drainage systems. There shall be ample room in or near such sampling manhole or facility to allow accurate sampling and preparation of samples for analysis.

9.3 The sampling and monitoring facilities shall be provided in accordance with the requirements and all applicable local construction standards and specifications.

9.4 Establishing sound system for detection of any defect (e.g. leakage, blockage, discharge, etc) at any point of the sewerage is very important for the successful monitoring of the sewerage. To achieve this, some sewerage components (discharge meters, manholes and joints) should be marked and sewage discharge and pressure measured. Any significant change in pressure and discharge at a marked sewerage component should help locating a defect or any unexpected issue in the system. Moreover, each marked component should be made accessible for the inspection or repairs. Table 9-1 illustrate the proposed Monitoring and evaluation framework for the sewerage. The framework identifies the most important indicators to be considered and where those indicators will be measured. Appendix 4 shows the parameters to be monitored according the type of wastewater.

Table 9- 1: ***Template for monitoring and evaluation of sewerage systems***

Indicators	**Relevance of indicator**	**Monitoring Point**	**Inspection Timeframe**	**Responsibility**
Pressure in the system	Indicate the possibility of leakage, blockage or illegal connection	Control room with telemetries, Marked discharge meters	Daily	Entity in charge of sanitation
Discharge	Indicate the possibility of leakage, blockage or illegal connection	Control room with telemetries, Marked discharge meters	Daily	Entity in charge of sanitation
Structural integrity	Indicate the possibility of damages or detrimental actions along the sewerage, Leakage, blockage or illegal connection	Control room with telemetries, Manholes, joints, valves, meters and accessories	Quarterly	Entity in charge of sanitation
Bad odours and sewage leakage	Indicate the possibility for pollution along the sewerage	The entire sewer line	Quarterly & daily	Entity in charge of Environment

SECTION 10. ENFORCEMENT

10.1 Enforcement Authority

10.1.1 The Entity in charge of Sanitation shall adopt procedures for the implementation, administration and enforcement of these National Sewerage Connection Guidelines.

10.1.2 If a property is found to be out of compliance with this guideline, the following enforcement actions may be implemented.

a. Verbal Notice of Non-Compliance
b. Written Notice of Violation
c. Fines
d. Water Service Shut Off
e. Shut of the business or services (commercial, industrial, institutional)

10.2 Powers and Authority of Inspectors

10.2.1 The Superintendent and other duly authorized employees of Entity in charge of Sanitation or municipality bearing proper credentials and identification shall be permitted to enter all properties for the purpose of inspection, observation, measurement, sampling, and testing in accordance with the provisions of these National Sewerage Connection Guidelines. This shall include the right to inspect building drains, building sewers, grease traps or interceptors, oil/water separators, or other facilities tributary to the Town's sewerage system. This inspection may occur at any reasonable time.

10.2.2 The Superintendent or his representatives shall have authority to inquire into any processes including metallurgical, chemical, oil, refining, ceramic, paper, or other industries beyond that point having a direct bearing on the kind and source of discharge to the sewers or waterways or facilities for waste treatment.

10.2.3 The Superintendent and other duly authorized employees of the Entity in charge of Sanitation /municipality bearing proper credentials and identification shall be permitted to enter all private properties through which the Town holds a duly negotiated easement for the purposes of, but not limited to, inspection, observation, measurement, sampling, repair, and maintenance of any portion of the sewerage works lying within said easement. All entry and subsequent work, if any, on said easement, shall be done in full accordance with the terms of the duly negotiated easement pertaining to the private property involved.

10.3 Protection of the sewerage

10.3.1 No unauthorized person shall maliciously, willfully, or negligently break, damage, destroy, uncover, deface, or tamper with any structure, appurtenance, or equipment which is a part of the sewage works. Any person violating this provision shall be subject to immediate arrest under the charge of disorderly conduct and shall be held financially responsible for said damages.

10.3.2 Entity in charge of Sanitation may suspend the wastewater contribution permit in order to stop an actual or threatened discharge which represents or may present an imminent or substantial endangerment to the environment or to the health and welfare of persons or which causes or may cause interference to the sewerage system which may result in the violation of any condition of the Authority.

10.3.3 Any permit issued under the provisions of this article is subject to be modified, suspended, or revoked in whole or in part during its term for cause including but not limited to, the following:

a. Violation of any terms or conditions of the wastewater discharge permit or other applicable law or regulation;
b. Obtaining of a permit by misrepresentation or failure to disclose fully all relevant facts; or
c. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

d. Failure of a user to factually report the wastewater characteristics of its discharge(applicable to non-domestic users);
e. Refusal of reasonable access to the user's premise for the purpose of inspection or monitoring.
f. Failure to notify the superintendent of significant changes to the wastewater prior to changed discharge;
g. Falisfying self-monitoring reports and certification statements;
h. Failure to pay any fees or charges;
i. Tampering with monitoring equipment;
j. Failure to comply with the requirements of an enforcement notice or order;
k. Operating with an expired wastewater discharge permit (unless timely application for renewal has been submitted); or
l. Failure to provide advance notice of the transfer of business ownership.

10.4 Offences against Guidelines

10.4.1 The ownership of all public sewers, service connections and sewerage pumps and related fittings remains vested in Entity in charge of Sanitation regardless of the ownership of the land on which they are installed.

10.4.2 It shall be an offence for any person to remove, interfere with or damage any public sewer, service connection or sewerage pump without the authority of the Managing Director Entity in charge of Sanitation or an authorised person.

10.4.3 All landowners of lands on which property of the Authority is sited, and all other persons on those lands must ensure that no activity, object or thing on the land interferes with the ordinary operation of service connections and sewerage pumps.

10.4.4 Any person who is obliged to comply with any requirement under these guidelines and who acts in any manner so as to fail to comply with any such requirement, commits an offence and shall be liable upon conviction.

10.4.5 It is an offence against these Regulations for a person to:

a. Fail to connect and apply to a sewerage system if required to do so under Guidelines.
b. provide any false or misleading information in any application under these Guidelines;
c. Make any illegal connection to a public sewer or service connection;
d. Breach any requirement under these Guidelines in relation to connection to public sewers or service connections;
e. fail to meet any prescribed standard, specification or codes of practice in relation to any work or other activity on or affecting a sewerage and wastewater system under these Guidelines; and
f. Forge any document, certificate, permit or registration provided for under these Guidelines.
g. Hinders or obstruct an authorised person in the performance of his or her duties, or the exercise of a power, under these Guidelines;
h. By words or conduct falsely represents that he or she is an authorised person, or otherwise impersonates an authorised person;
i. provides false or misleading information to an authorised person when required under these Guidelines

j. Removes, tampers with or damages any equipment, notice board or sign installed or erected pursuant to these Guidelines commits an offence, and shall be liable upon conviction to a penalty.

10.4.6 A court may order that any person convicted of an offence against these Guidelines pay compensation for any resulting loss or damage to the Authority, or to any other person affected by the offence

10.5 Civil Liability for Surcharge Expenses

10.5.1 Any person that violates any provisions of sewerage connection Guidelines shall be liable for all expenses, losses, damages, and surcharges incurred by the Authority as a result of the violation; including any increased costs for managing effluent or sludge which result from the user's discharge of toxic pollutants.

10.5.2 Entity in charge of Sanitation may terminate or cause to be terminated sewage collection service to any user for a violation of any provision of these sewerage connection Guidelines.

10.5.3 If any person discharges sewage, institutional waste, Hospital wastes, industrial wastes, domestic wastes or other wastes into the municipality's sewerage system contrary to the provisions of these National connection Guidelines or any order of the Country, the Country Prosecutor may commence an action for appropriate legal and/or equitable relief in the Country Court of Common Pleas.

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APPENDICES

APPENDIX 1: Public Consultation

1.1 Views from key informants

As Key project stakeholders, the informants for this project include MININFRA, WASAC, City of Kigali, REMA, RURA and districts. Their views are summarized in Table A-1.

Table 2- 1: ***Views for Key project informants***

No	Names and Contacts	Views and advises
1	**MININFRA**	• It is for WASAC and City of Kigali to issue the sewerage connection permits • The sewerage connection guidelines will be enforced jointly by WASAC, REMA and CoK • It is for RURA to establish the discharge fees • The management of the sewerage connection will fall under WASAC responsibility • The monitoring of sewerage will fall under the responsibility of WASAC (internal), REMA (public health and environmental issues), COK and MININFRA (external monitoring) • There are no subsidies to cover the connection and discharge to the sewerage • However, some people can be helped based on the social protection law • For efficient payment, it is possible to add sewage charges on the cost for power consumption (eg. pre-paid power) • The guideline should be clear that people in the sewerage coverage area should have flush toilet to make connection possible • Sanctions (power disconnection) to uncompliant properties should be enforced • For industries, only black and grey water will be accepted for discharge, otherwise treatment of industrial wastes should be done and monitoring done to ensure the compliance of the effluent to discharge • For roles and responsibilities of different entitys in the sanitation sector are discussed on page 39-44 in the National Sanitation Policy & Stratergy • MINIFRA, WASAC and COK should train people on characteristics of liquid waste and materials authorized and prohibited • The properties with well operated and compliant wastewater treatment systems may have option to not connect to the centralized system.
2	WASAC	• There is a unit in WASAC in charge of sewerage and its connections (Urban Water and Sewerage Services) • WASAC will give the permission to connect to the centralized sewage as it does for water supply • It is for Kigali City to enforce the connection guidelines • It is for WASAC to conduct a study on tariff and submit to RURA for approval • It is for WASAC to deal with damages and repairs of sewerage in public domain, but it is for the property owner to fix damages in his property • It is for WASAC to manage the sewerage • WASAC will internally monitor the system structural integrity and compliance to the effluent discharge norms • External monitoring of the structural integrity will be done by the City of

No	Names and Contacts	Views and advises
		Kigali • External monitoring of the compliance to the effluent discharge norms and other public health and environmental standards will be done by the REMA • The city of Kigali and WASAC could sensitize the communities the content of the guidelines • To ensure people in the coverage area are connected strategies will be considered including awareness rising, facilitation of payments • The connection and discharge fees should be fixed based on the sewage discharge and type of sewage (domestic, commercial and industrial) • Guidelines should elaborate more on the need to shift from using pit to flush toilets • Special pre-treatment should be considered for waste containing dangerous chemicals (garages, industries, health facilities, commercial buildings) • Guidelines should cater for easement for • Guidelines should capture the sensitization mechanisms • The guidelines should cater for prohibited discharges (trashes, bottles, chemicals, storm water, etc) • Uncompliant property (illegal discharge, unpayment) could be penalized (eg. fines, but not disconnection)
3	REMA	• REMA will intervene to enforce the compliance to environmental guidelines (management of odours, leakages, quality of effluent, transportation and disposal of sludge, etc), • The discharge (m^3/month) should be used to determine the sewage discharge fees • Agreement and decision still to be made on the location of maturation and polishing ponds and the issue of direct discharge of the effluent in the river. • REMA recommended to check the EIA report done for the Kigali centralized sewerage for more details
5	**City of Kigali**	• CoK will issue the connection permit based on Rwanda Building code 2019-06-12 (land lease, compatibility with other utilities like habitats, road networks, etc) • CoK will enforce the connection guidelines • Factors to be considered to ensure smooth connection include avoidance of trashes, storm water and other incompatible material like chemicals, FOG or provision of a pre-treatment of screens and traps • Factors to be used to determine the fees for sewage connection and discharge include the amount of discharge, type of sewage (residential, commercial and industrial, etc)
5	**Kicukiro in charge of Sanitation**	• To ensure people in the coverage area are connected it is necessary to do Community mobilization • The District will collaborate and advise WASAC on how to improve the service delivery • The district will monitor and inspect the status of the sewerage including connections • The district will do sensitization and mobilization of people • Connection and discharge fees should be determined based on the source of sewage, whether residential, commercial or industrial • Discharge fees could also be determined based on the sewage discharge (m^3/month)

No	Names and Contacts	Views and advises
		• The connection prerequisite is to have a flush toilet • Mobilization and sensitization is very important for people to avoid illegal connection and discharges • The district will enforce the connection guidelines • The district will monitor and inspect the connections • People in the coverage area should be trained, sensitized and committed to avoid trashes, chemicals, FOG and other uncompatible materials • Industrials, garages, health centres and buildings with chemical wastes should be trained, sensitized and committed to do pre-treatment of their liquid wastes and provision of screen and grease traps • For residential area there is no need for connection permits,

1.2. View form Potential Users

The target potential users were selected randomly from different user categories: low, medium and high-income housings, commercial buildings, Institutional buildings, health facilities and industrial buildings). These categories were referred to as strata. In total, 156 buildings were sampled: 64 Low income housings, 45 Medium income buildings, 17 high income housings, 17 commercial buildings, 6 Institutional buildings, 4 health facilities and 3 industrial buildings (Figure A-1).

1.2.1 Sample categories

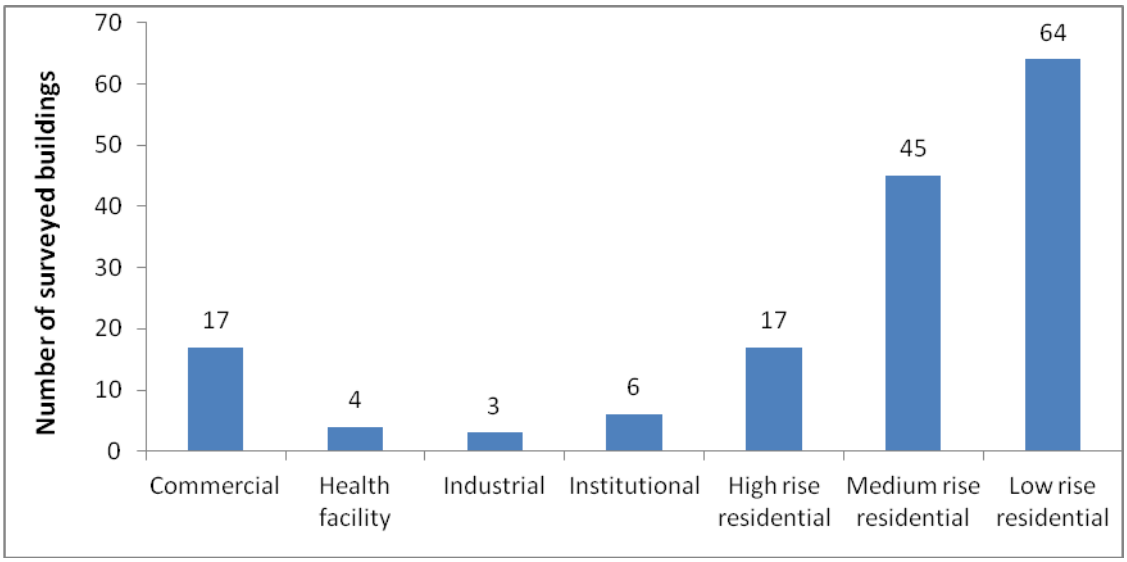

Figure 2- 1: ***Categories of sampled buildings***

1.2.2 Use of Type of flush toilets across the surveyed buildings

The field surveys showed that some categories of buildings mostly use flush toilets while others do not use them (Figure A-2).

- All surveyed commercial buildings (17 out 17 or 100%) used flush toilets;
- All surveyed health facilities (4 out 4 or 100%) used flush toilets;
- All surveyed industrial buildings (3 out 3 or 100%) used flush toilets;
- Five out of six of surveyed Institutional buildings (5 out 6 or 83%) used flush toilets;
- All surveyed high-income housings (17 out 17 or 100%) used flush toilets;
- 41 out of 45 of surveyed Medium income housings (41 out 45 or 91%) used flush toilets;
- Only 4 out 64 of surveyed Low-income housings (4 out 64 or 6%) used flush toilets

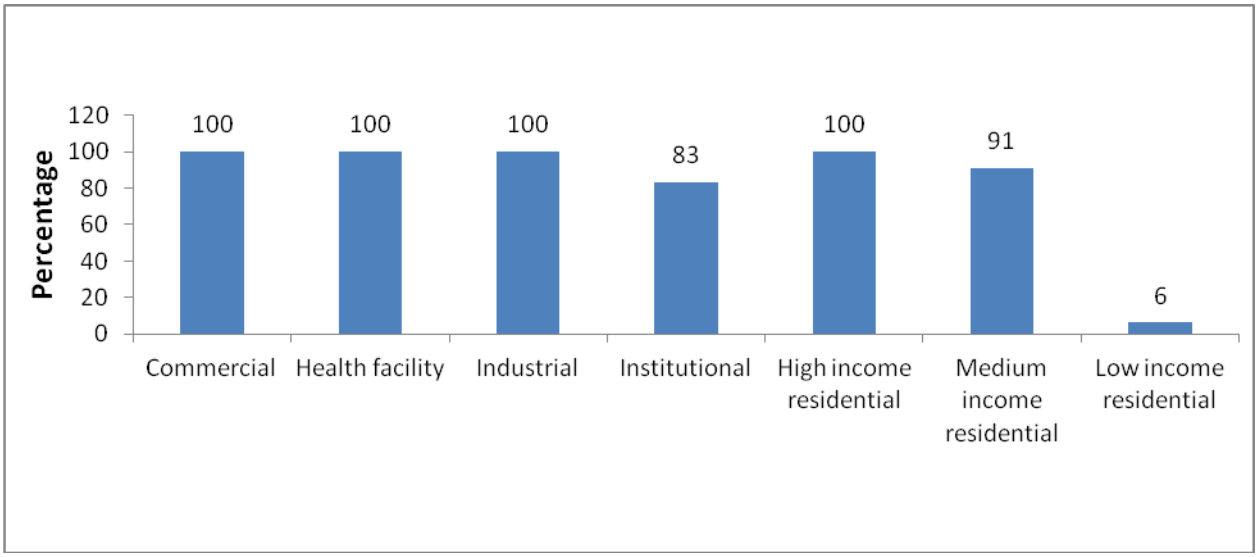

Figure 2- 2: ***Use of flush toilets in different surveyed buildings***

Having a flush toilet is prerequisite for connection to the centralized sewerage. From Figure 3-2, it is clear that the connection to the centralized sewerage in Low income housings will be problematic as most people do not use flush toilets. More efforts are to be made to promote the installation and use of flush toilets in low income housings.

1.2.3 Buildings using pit latrines

In contrast to flush toilets that were used in commercial, health facilities, industrial, Institutional and high- and medium-income housings that mostly used the flush toilet, pit latrines were mostly used in low income housings (Figure A-3).

- None (0%) of the commercial, health facilities, industrial buildings and high-income buildings used pit latrines;
- Only one out of six (1 out 6 or 17%) Institutional buildings used pit toilets;
- Only four out forty-five (4 out 45 or 9%) of Medium income housings used pit latrines
- Only 4 out 64 of surveyed low-income housings (4 out 64 or 6%) used flush toilets
- Sixty out of sixty-four (60 out 64 or 94%) used pit latrines.

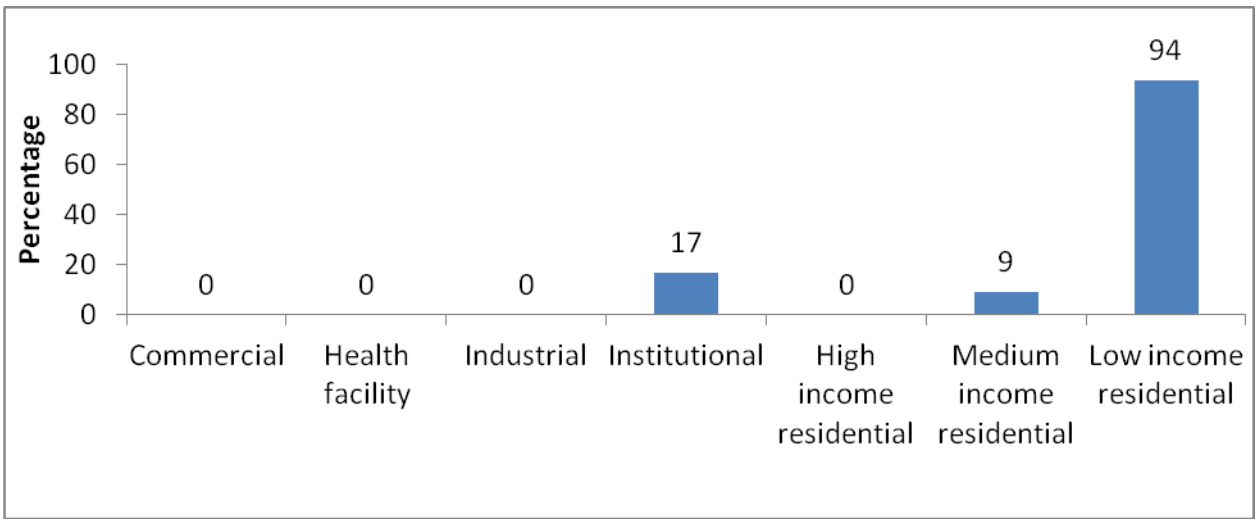

Figure 2- 3: ***Use of pit latrines in different buildings***

As previously discussed, there is no way for connection to the central sewerage when using pit latrines. Having a flush toilet is prerequisite for connection to the centralized sewerage. More efforts are to be made to replace pit latrines by flush toilets in low income housings, supplying water to every single household (water tap by household) and improving living and housing conditions.

1.2.4 Willingness to connect

The surveys showed that most of interviewed property owners or their representatives were willing to connect to the centralized sewerage (Figure A-4).

- All surveyed health facilities, industrial buildings, Institutional buildings, high income and Medium income housings wished to connect to the centralized sewerage;
- 88% (15 out of 17) of commercial buildings and 98% (63 out of 64) wished to connect to the centralized sewerage.

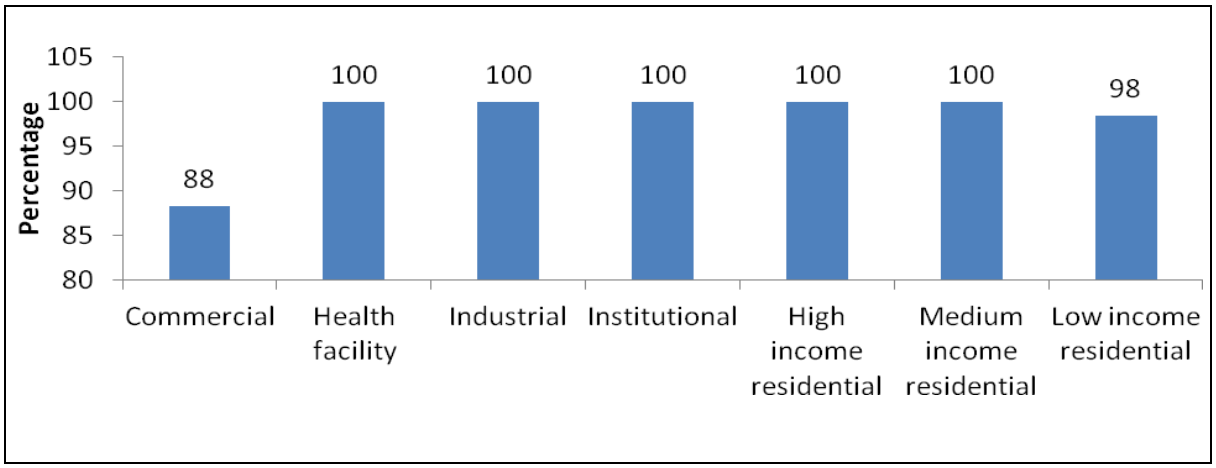

Figure 2- 4: ***Number of buildings expressed the willing to connect to the central sewerage***

However, people with properties with sewage treatment system wished to have option to not connect to the centralized system as long as their systems are still complying with the effluent discharge guidelines. They insisted they invested a lot of money in the installation of the sewage systems, so they need the investment return. Otherwise the fees for connection and discharge should be lower than the operation and maintenance cost of the existing sewage treatment systems.

1.2.5 Willingness to pay for sewage discharge to the centralized sewerage

Surveys have shown that the willingness to pay for sewage discharge to the centralized sewerage varied in the wide range (Figure A-5). The presented figures represent the average and standard deviation of the money different user categories wish to pay.

- 0-150,000 FRw (29,029 FRw on average) for commercial buildings'
- 10,000-30,000 FRw (18,750 FRw on average) for health facilities
- Industrials did not provide any figure;
- 5,000-50,000 FRw (27,500 FRw on average) for the Institutional buildings;
- 5,000-50,000 FRw (5,200 FRw on average) for high income residential housings
- 500-30,000 (3,369 FRw on average) for Medium income residential housings;
- 0-10,000 FRw (1,319 FRw on average) for low income residential housings;

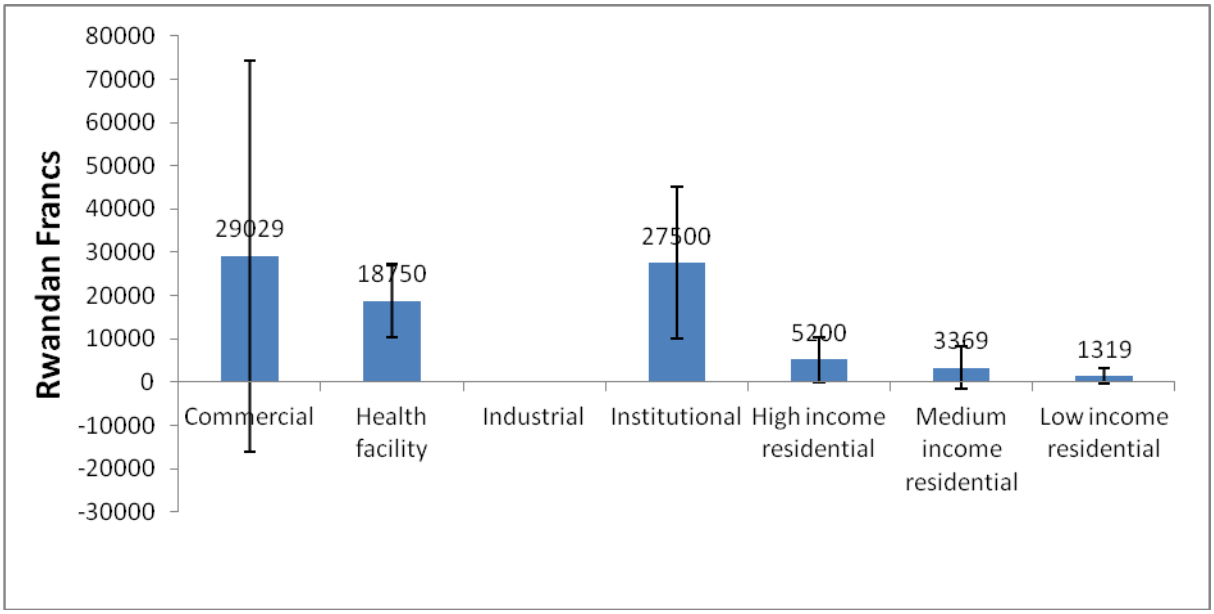

Figure 2- 5: ***Willingness to pay for sewage discharge to the centralized sewerage***

Figure 2-5 provides indicative figures on people's willngness to connect to the centralized sewerage. This means the sewage discharge fees should carefully be determined taking into account the building categories (low, medium and high income housings), Institutional, industrial buildings, health facility and commercial buildings) or by considering the income of people (e.g use of Ubudehe categories) and sewage discharge (m3/month).

1.2.6 Advantages for connecting to the centralized sewerage

Most of interviewed people (154 out of 156 or 99%) viewed the upcoming sewerage a solution for many problems (Figure A-6).

- 62 % said the upcoming sewerage will be more hygienic, no more emptying septic tanks or pit latrines, will save space and money for digging and construction of latrines and septic tanks;
- 37% expressed their positive views related the social economic development (reduced cost of sanitation, reduced collapse of pits, reduced diseases and employment) of the country;
- Only 1% (2 out of 156) viewed the sewerage useless for them as they are poor and will not be able to connect and use the system.

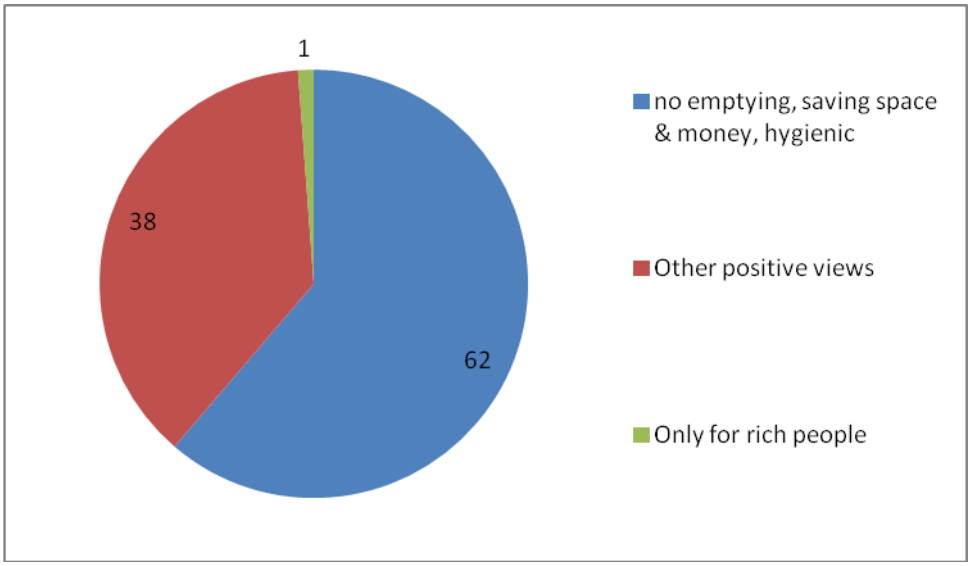

Figure 2- 6: ***Views of people about connecting to the central sewerage***

1.2.7 Recommendations from potential users

Although most people appreciated the sewerage connection services, most of interviewed people worried about the possibility of damages and sewage leakage and associated impacts to the environment and public health. They therefore recommended using certified and durable material and qualified technicians. Moreover, the following are wishes from consulted potential users.

- Need to used qualified staff and certified durable and high resistant materials to avoid periodic leakage of the sewage
- The sewer lines should be away from the public to avoid sewage nuisance and related inconveniences
- Avoid land take and destruction of buildings
- Should be constructed in such away to avoid contamination of water body and environment
- The sewerage management should put in place an emergency system for repairs or fixing problems in the system
- The sewerage management should put in place and implement a system for day to day maintenance to avoid hazards from the sewerage leakage
- Arrangements should be made for recycling the sewage in production of power and fertilizers
- The pipeline should be put deep enough to avoid interaction with the public
- The entity in charge should do all it takes to make water for toilet flushing available at any point of the city at affordable cost
- Incasing the sewerage pipeline to ensure sewage leaks do not reach the environment and the public
- Need to consider trash screen at the connection point to avoid blockage of the system
- Need to put in place a back up system in canalization that can work in case of the system failure
- Not enough to bring this system alone. Also needed is a system for the evacuation of storm water and solid wastes.

Appendix 2: Financial Analysis

2.1 Existing Financial Analysis of Sanitation sector in Rwanda

2.1.1 The National Sanitation Policy Implementation Strategy (NSPIS), Nov 2016, has estimated that the total public funding requirements for the Sanitation Policy implementation strategy are about RFW 130.7 billion (US$ 174 million) using an exchange rate of 1 US$ = 749 RWF) for the five-year period 2015/16 to 2019/20 (5 years). The bulk of investment needs is related to the infrastructure investments required for achieving 100% service coverage in both rural and urban areas. Out of the above, about RFW 43.96 billion (US$ 59 million) (about 33%) is for collective sewerage services.

2.1.2 The National Sanitation Policy Implementation Strategy (NSPIS), Nov 2016, has identified PPP as a valuable source of financing mechanism for the collective sewerage services, since it requires substantial upfront investments as well as operating funds that can be recovered in the best case only slowly over extended periods. Apart from PPP, the NSPIS mentions that part of collective sanitation works and services will be financed, built and operated by households and industries themselves, e.g. private connections inside the premises to the public sewer, new upper/ middle class condominiums or industrial pre-treatment plants.

2.2 Tariff

2.2.1 Guiding principle for tariff in sewerage sector

As per the National Sanitation Policy (NSP), November 2016, the guiding principle for tariff for the sanitation sector is as follows: *—Para 5 – Cost recovery and financial sustainability: Operation and maintenance costs of sanitation infrastructure shall be borne by the users. Affordability shall be addressed by the choice of appropriate technologies and by enhancing efficiency, not only by granting subsidies. The polluter-pays and user pays principles are to be applied in sewerage and waste management.*

As per Policy Direction – Objective 3 - Develop safe, well-regulated and affordable off-site sanitation services for densely populated areas; *—7.3.3 - Implement cost recovery for collective sewerage systems, Based on the user-pays principle, WASAC and other commercial operators shall recover operational costs for urban wastewater services by user fees. The principle shall be applied progressively starting to recover the full operating costs for wastewater collection networks and treatment plants.*

The recovery of investment costs of the fixed assets shall commence in a later stage taking into account the financial capacity of the clients (polluters). Communities shall be involved in the decision and implementing process with regard to project planning, construction and maintenance of simplified sewerage systems with the option to contribute in kind to reduce costs (lower tariffs).

Industries normally enjoy a higher financial capacity than households do and the polluter-pays criterion shall be fully enforced. Tariffs shall consider both wastewater volumes and the nature and level of toxicity.

Requirements regarding the standards of wastewater (pre-) treatment will be defined depending on the local conditions and enforced over time taking the financial capacity of the industry into account.

2.2.2 Principles for determination of tariff in sewerage sector

Present tariff - Based on the present understanding and best practices, there is no separate tariff for sewerage connections. The same is determined as a % of the water supply charges. The % can vary anywhere between 20% - 50% depending on the OPEX per connection and the intent to recover by RURA/ WASAC. These shall be decided based on the OPEX of the selected technology.

Sewerage tariff as a % of water tariff – It is recommended that the tariff for sewerage should be as a % of water tariff or a flat charge, based on the decision of RURA, as recommended by WASAC. It any circumstance, the range for tariff for sewerage over water tariff should be in the range of 20- 50%. It should not be less than 20% and not more than 50% in any year.

Cross-subsidization model – The tariff for sewerage needs to be determined as a % of water tariff, especially for domestic connections. In case of commercial or industrial connections, the tariff for sewerage can go up to 80%. Thus, the costs for domestic connections can be cross subsidized by high tariff of commercial and industrial connections.

Tariff based on quality of discharge - In case of high polluting industries, it is recommended that they should undertake primary treatment in their premises and then discharge the treated water in the sewerage system. However, the tariff may be more for such industries based on the level of toxicity and quantity of treated discharge.

Connection fees and monthly charges – WASAC may charge a onetime connection fees, as is being charged for water connections. This may be decided by WASAC based on the cost of connection incurred by them on a no profit, no loss basis, so as to incentivize households to undertake sewerage connections. Tariff for sewerage for recovery of O&M cost may be collected on a monthly basis, along with water tariff charges. It is suggested that sewerage charges should be included in the same bill/ invoice as issued for water. No separate bill/ invoice should be issued for sewerage charges.

Appendix 3: Community Awareness and Participation

3.1 Introduction

Community awareness and participation is the key to success for achieving 100% sanitation and to ensure personal hygiene in the community. A group of people living together with common interests and purpose may be called a community. There are certain common grounds amongst all the members and groups of any given community. These grounds are: locus, cast, creed, religion, customs, traditions, attitudes, gender, age group etc., because of these common interests. The local body can never be successful in urban sanitation without active community awareness and participation, whatever may be the investments made through municipal or Government funds.

The local body should consider involving the community in all programmes through a consultative process and variety of other communication approaches dealt with in this chapter and adopts strategies which are acceptable to the community. This chapter discusses the need for community awareness and participation for sanitation and sewerage services provided by the local body. It also covers various aspects that need to be considered to improve the community awareness and participation by involving individuals or voluntary organizations, and government agencies.

3.2 Need for Community Awareness and Participation

The objective of a sanitation and sewerage agency is to provide safe, hygienic sanitation facilities and adequate sewage collection, treatment, and disposal services to improve public health at a reasonable cost. The residents must realize that the quality of life depends on how and what the sewerage utilities serve and that sewage collection and treatment is not a free service but a value added service with cost implications.

The objective of any community awareness and participation programme is to develop an understanding of the benefits of sewage collection, treatment and disposal, improved sanitary conditions, better user understanding and involvement in terms of time and money, and enhanced acceptability of this concept and organizational credibility.

On the other hand, the community has responsibility for participating willingly in community awareness and involvement programmes, understanding the significance of sewerage system to achieve sanitized community, and bring about behavioural changes aimed at adoption of healthy sanitation practices.

3.3 Community awareness Program

For the successful implementation of any program involving the community at large in universal sanitation in urban areas, it is essential to spell out clearly and make known the manner in which the local body proposes to tackle the problem of urban sanitation and the extent to which community participation in urban sanitation is expected to make the city sanitized, healthy and liveable and improve the quality of life in the city. The scope of the community awareness programme includes the following:

- Enable the community to understand the need for the sewerage system
- Enable the community to understand the need for proper sewage treatment and disposal
- Enable the community to participate in planning

- Enable the community to appreciate that this service is not free because it is valuable and has direct impact on health and living environment

- Enable the community to understand what they get (tangible/intangible, long term/short term benefits) in return

- Inform and obtain approval of the community for various improvement measures thus creating a feeling of close participation

3.4 Process of Building Community Awareness and Involvement

For developing community awareness and involvement, the appropriate opinion leaders such as community leaders, teachers, and the public at large should be identified. Efforts should also be made to involve the sanitation inspector (Engineer) and other staff of the local government as also the chief health officer. Communication material should preferably be prepared to suit the target audience: house owners, Residents Welfare Associations, Government organizations, Government aided organizations, bus stands, etc. The communication policy for this purpose should involve the elected civic body, Consumer Action Groups, Residents Welfare Associations, local NGOs, local community workers, and so on. The agency should try new and imaginative ways to involve local communities in its plans and programmes, and thereby provide the public its due pride of belongingness and involvement.

3.4.1 Defining the Concerned Local Community

The following points need to be considered for defining the concerned local community:

- Geographic and administrative boundaries
- Major media in the concerned locality (newspaper, radio/television, local speakers and town meetings
- Residents (demographic and economic conditions)
- Stakeholders.

3.4.2 Identifying Existing Local Community Contacts

The following groups may be considered:

- Elected officials (city Council/Municipality Committee/ members of local government
- Prominent civic leaders
- Clubs and associations
- Voluntary organizations, Residents Associations, etc.
- Industrial users
- Shopping areas
- Schools/Colleges/Entitys
- Professional bodies (Doctors, Lawyers, entity of engineers etc.)

3.4.3 Listing out Messages to be communicated

The following items may be included in the list of messages to be conveyed:

- Health impacts due to lack of sanitation
- Prevention of open defecation
- Status and needs of onsite sanitation and sewerage works
- Avail of sewer connection and avoid open air defecation
- Accept pay and use principle while using toilets in public places
- Change in policy and launching of new schemes (including incremental sewerage)
- Messages related to quality assurance
- Rehabilitation and repair works
- Billing and collection procedures/queries, tariff related issues, collection drives and special camps, levy of surcharge, reconciling of accounts
- Need for sewage treatment and reuse
- Celebrations of national festivals, functions, Environment Day, World Water Day, etc.
- Need for community participation for achieving total sanitation

3.4.4 Selection of Communication Methods

A variety of media and communication methods exist, each with its own advantages and disadvantages. The use of a combination of several media at the same time can reinforce the messages. Person to person contact carried out through community members, who are already convinced of the truth of the message, is usually the most effective means of communication. The following are some user-friendly measures that could be effectively used in Community Awareness Program for attaining complete transparency in operations.

3.4.4.1 Use of Print Media

Advertisements may be given in a planned manner to educate the masses and local newspapers can also be requested to insert the given messages on sewerage system at regular intervals. They should also be encouraged to start a regular Suggestion Box from where good ideas can be picked up by the local body. Newspapers may be especially encouraged to report on successful initiatives that have overcome problems in sewerage systems

3.4.4.2 Use of TV /Radio/Web Site

These are very powerful media and can be used through local programmes to inform the citizens of new sewage collection systems constructed by the local body as and when they become operational and advise them to participate effectively in the prescribed manner. Contact numbers of the concerned officials for problem solving or reporting of sewerage system grievances may also be publicized. These media may be used to publicize successful efforts in some localities to motivate other citizens to perform likewise and get similar recognition for their efforts.

3.4.4.3 Use of Cinema Halls

Slides in cinema theatres can be displayed to inform and motivate the public.

3.4.4.4 Street Plays, Puppet Shows, etc.

Street plays and puppet shows play a significant role in bringing awareness among the people. This method of communication will work well in low-income population; more particularly in slums. Well-designed street plays/puppet shows can convey the messages effectively as such programs are well attended in slums.

3.4.4.5 Posters

Attractive posters with good photographs and messages with a very few words, readable from a distance, should be prepared and displayed in various parts of the city where awareness campaign is being taken up.

3.4.4.6 Use of Public Transport System

Brief messages can be painted on the rear of public buses or panels inside the bus. Public and private firms having their own bus fleets may be invited to support such efforts.

3.4.4.7 Communication through School Children and College Students

Children and college students are powerful communicators. Parents who do not listen to the advice of others often take their children seriously. Children are idealistic and would like to change their world for better. There should be regular meetings with principals, teachers and students to explain the need for change, and the usefulness to society of new ways to manage sewage. The message can be reinforced by holding essay, debate or drawing and painting competitions on the subject and publicizing the winning contestants. Social clubs can be encouraged to sponsor such events to keep the topic alive.

3.4.4.8 Involvement of Religious Leaders

Religious leaders play a significant role in bringing about a change in the mind-set of the people. If they advise their devotees/disciples to keep their surroundings sanitized by not defecating in the open anywhere and by managing their sewage as advised by the urban local body, it will go a long way in improving the situation in the urban areas.

3.4.4.9 Involvement of Medical Practitioners

Medical practitioners are held in high esteem by the citizens. A word from them to the patients or the community to practice appropriate sewage management at home, offices, shops and establishments would help substantially in bringing compliance with the directions of the urban local body to keep the city clean.

3.4.4.10 Involvement of Women Associations

Women are generally found more concerned in maintenance of health and hygiene and they are involved in domestic sewage management on day to day basis. The awareness among the women could be raised through Women Associations who could be given talking points and necessary literature in a very simple understandable language/graphics for creating awareness among women.

3.4.4.11 Door to Door Contact

Municipality, NGOs may be commissioned to do group messaging and door to door contact with special stakeholders like slum-dwellers, etc.

3.4.4.12 Provide Information over Hot-line

The key to success of any public-education, awareness and motivation program is to provide as many ways as possible for the public to interact, as promptly and conveniently as possible, with policy-makers, to seek clarification of doubts, share ideas or give suggestions which are constructively followed up. A telephone hot line or post box number for written communications could be one of the ways to have inputs from members of the public. The phone must be

attended during working hours by polite, responsive and dynamic persons who are well informed, interested in the subject and available at all stated times.

3.4.5 Budget for Community Awareness Programme

The authorities should list out various aspects of public awareness programme as mentioned above and work out the costs for implementing the awareness programme. With proper evaluation and modifications if necessary, the programme can be a success. Further, a form of planning and reporting is needed to monitor and control public awareness activities.

3.5 Courteous Behavior of Public Relations Staff

Since public relation staff and field staff serve as an interface between the community and the sewerage agency, they should be properly trained. Courteous behavior towards the community by the public relation staff will give a better image of the utility to the community. Since first impressions are very important and last longer, it is necessary to impress the citizen at the very first contact itself. Public relations staff should follow simple guidelines while answering telephone calls from consumers to create a positive image in the minds of citizens. It would be important to mention here that courteous behavior of the community towards the public relation staff is also expected to properly communicate their messages to the public

3.5.1 Suggested Guidelines for Answering Calls

The following key points should be considered when answering calls:

- The staff attending the telephone should answer the call
- The person picking up the call should identify himself/herself.
- The person taking the call should not conduct conversation on the side and should give full attention to the caller to avoid repetition of names, addresses, etc.
- The person taking the call should not transfer the calls to other concerned officers unless necessary.
- A complaint number should be given to every complaint of complainant for easy identification.

3.5.2 Answering Consumer Enquiries

The person taking the call at the Public Relations Counter should:

- Be familiar with the services and policies of the utility
- Learn to listen and try not to interrupt the caller
- Avoid technical jargon/unnecessary high-sounding terms while talking to the caller
- Summarize the caller's problem and repeat it to the caller for confirmation
- Make every effort to take specific action on the caller's complaint.

3.6 Need for Enforcement

While all efforts should be made to educate the people to effectively participate in the management of sewage, they also need to be told that they can be punished if they fail to discharge their civic duties. The provision of penalties may be made known to the people and details of those punished should be publicized widely to deter others. The enforcement should begin at the public places, market places, etc., and gradually extended to cover residential areas.

Appendix 4: Substances to be Monitored in Non Domestic Wastewater

Sector/Industry	BOD5	COD	N	P	SS	pH	T	EC	SO4	Metals	VOC	Oils	Fats	Other
Food industry														Typically a high BOD5, solids, phosphorus and nitrogen concentration, and changes in the pH value
Dairies	x	x	x	x	x	x	x						**x**	pH and T under continuous measurements if necessary
Slaughterhouses	x	x	x	x	x	x	x	**x**					**x**	pH and T under continuous measurements if necessary
Breweries	x	x	x	x	x		x							
Vegetable processing plants	x	x	x	x	x		x							
Bakeries	x	x	x	x	x								x	pH and T under continuous measurements if necessary
Fish Processing plants	x	x	x	x	x		x						x	pH and T under continuous measurements if necessary
Metal Industry														Can be the release source, mercury, cadmium and nickel
Surface Finishing Plants					x	x				x	x	x		CN and zinc if necessary*
Steel pickling plant					x	x	x			x				
Phosphating processing plants	x	x	x	x	x		x	x		x	x	x		
Chemical Industry														
Paint and Coating Industry	x	x	x	x	x		x			x	x			
Rubber Industry	x	x	x	x	x		x			x	x	**x**		
Explosive	x	x	x	x	x		x			x				
Pharmaceutical products	x	x	x	x	x		x	**x**			x			
Enzyme Production	x	x	x	x	x		x							
Sulphiric acid Production							x	**x**		x	x			
Printing inks	x	x	x	x	x		x	**x**		x	x			
Printing industry														Can be the release source

Sector/Industry	BOD5	COD	N	P	SS	pH	T	EC	SO4	Metals	VOC	Oils	Fats	Other
														especially for cadmium, lead and zinc
Offset	x	x	x	x				**x**	**x**		x			
Silk screen printing	x	x	x	x				**x**	**x**		x			
Forest Industry														High BOD7 and CODCr concentrations are typical
Paper and Pulp Industry	x	x	x	x	**x**		**x**	**x**		x				
Textile and leather industry														Organic substances
Textile (Textile printing)	x	x	x	x	**x**		**x**	**x**		x	**x**			
Leather Tanneries	x	x	x	x	**x**		**x**	**x**	**x**	x				hazardous substances if necessary
Laundries	x	x	x	x	**x**		**x**	**x**						
Manufacturing of mineral products														
Glassworks and fibreglass plants	x	x	x	x	**x**		**x**	**x**		x				
Concrete plant	x	x	x	x	**x**		**x**	**x**	**x**			**x**		
Waste management														
Waste treatment plants/landfill	x	x	x	x	**x**		**x**	**x**		x	**x**			chloride concentrations, and alkalinity if necessary
Composting/ Leachate	x	x	x	x	**x**		**x**	**x**		x				chloride concentrations, and alkalinity if necessary
Biogas plants	x	x	x	x	**x**		**x**	**x**		x	**x**			chloride concentrations, and alkalinity if necessary
Services														

Sector/Industry	BOD5	COD	N	P	SS	pH	T	EC	SO4	Metals	VOC	Oils	Fats	Other
Hospitals	x	x	x	x	**x**		**x**	**x**		x	**x**			
Car service stations	x	x	x	x	**X**		**x**	**x**		x	**x**	**x**		

Appendix 5. Sewerage Connection Form
Heading of the entity in charge of sanitation

Applicant Photo

1. Applicant information

1.1 Details of Applicant

Names……ID No……

Tel: ……..... Email: …… PoBox: ……

1.2 Location of the property

Province……District …… Sector ……
Cell ……Village……Street ……..

1.3 Type of request

Connecting the existing building ☐ connecting the existing building ☐

1.4 Property Type ☐

Residential ☐ Commercial ☐ Industrial ☐ Health Facility

Institutional ☐ Other (specify) ……..

1.5 Wastewater quantity and characteristics

Estimated quantity of Domestic wastewater (m^3/d)……

Estimated quantity of Non domestic (m^3/d) ……

Estimated population equivalents ……

Time and duration of discharge (temporal activities) ……

Type of Pre-treatment for the effluent ……

1.6 Property/building details

Number of floors ……Building ground surface area (m^2) ……
Number of beds in the properties (hotels/hospital) ……Number of persons accommodated by the building each day ……
Property hosting capacity ……

1.7 Water tariff (m^3/month) information from the previous months

Month 1 ..... Month 2 ..... Month 3

1.8 Description of activities, facilities and plant processes on the premises including all materials which are or could be discharged
.....
.....
.....
.....
.....

1.9 Declaration and commitment of the applicant
I/ We the undersigned as owner(s)/ occupier(s) of the above mentioned premises hereby apply to have a sewerage service connection tot he said premises subject to the provisions of sewerage guidelines

I/We the undersigned, do hereby agree to pay the Authority all expenses to be reasonably incurred in executing the work referred to above together with such sums/arrears as may be payable by way of sewerage connection rates in respect of the said premises and to conform with the rates and charges as may be prescribed by the Authority under and by virtue of the Sewerage Guidelines

We the undersigned, agree that I/ we shall not make any illegal connections and discharge or other practices that can negatively affect the proper operation of the sewerage

We understand that I/we are responsible for any statutory approvals which may be required for any building or construction on the premises and that satisfactory provisions have been made for drainage.

I agree that the connection fees and any other charges will be included on my first bill.

I/ We (Names of the Tenant) ..... the Tenant/ Agent/ Owner do hereby certify that the above information is true and correct to the best of my/ our knowledge and ability and that I/ We shall be liable to whatever penalty is prescribed in these guidelines.

Signature of the applicant

1.10 Attachment to the application form

- Photo of the building, toilets, bathroom, kitchen (for residential buildings)
- Photo or plan for effluent pre-treatment
- Site plans, floor plans, mechanical and plumbing plans and details to show all sewer connections and appurtenances by the size, location and elevation;
- List of chemicals (raw materials, end-products and by-products) used or to be used
- Physicochemical results of the effluent (for existing building) or Expected or Typical (for a new building) characteristics of effluent for non domestic wastewater
- Any other information as may be deemed by Entity in charge of Sanitation to be necessary to evaluate the permit application.

2. Licensed or Plumber's comment

Distance of the property to the centralized sewerage……..

Comment on the Easement Alignment Requirement ……..

Connection cost……..

Other comment ……

3. Comment of the entity in charge of sanitation

Request approved ☐ Request rejected ☐

Comment ……

Appendix 6: Manning's equation

$$Q = \frac{A\,x\,R^{\frac{2}{3}}\,x\,S^{\frac{1}{2}}}{n}$$

Where Q= Flow capacity of sewer (m^3/s)

s = hydraulic gradient (energy loss per unit length)
n = Manning's roughness coefficient, based on Manning's formula using an "n" value of 0.013

R = hydraulic radius (m)

Appendix 7. Concrete corrosion caused by the effects of substances in wastewater

Active substance	Corrosion intensity low	Corrosion intensity high	Corrosion intensity very high
acids (pH)	6.5-5.6	5.5-4.5	4.5
free" carbonic acid (mg/CO2/l)	15-30	30-60	60
ammonium (mg/NH4/l)	15-30	30-60	60
magnesium (mg/l)	100-300	300-1 500	1500
sulphates (mg/SO4 /l)	200-600	600-3 000	3 000

Appendix 8: Symptoms caused by different hydrogen sulphide concentrations

Symptom	Concentration (ppm)
Odour threshold, odour of a rotten egg	0.0005
Unpleasant smell	1.0
Headache, nausea, irritation in throat and eyes	10
Eye injury	50
Infection of the eye, irritation in respiratory tract, loss of the sense of smell, risk of death	100
Pulmonary oedema, risk of death	300
Convulsion, respiratory arrest	500
Blackout, cessation of breathing	1 000
Death	2 000