CODE OF PRACTICE

ON

SEWERAGE AND SANITARY WORKS

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Water for All : Conserve, Value, Enjoy

Water Reclamation (Network) Department
Singapore

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ALL WORK PROCEDURES AND FORMS ARE AVAILABLE IN THE PUB WEBSITE AT URL ADDRESS: http://www.pub.gov.sg

INTRODUCTION

Singapore is characterised by abundant rainfall, high temperature and humidity. Coupled with high population density, waterborne diseases can spread easily and quickly unless a high standard of public health is maintained. Proper collection, treatment and disposal of domestic and industrial wastewater is therefore necessary to prevent the pollution of watercourses, reservoirs, rivers and the sea, and thus, the spread of diseases.

In Singapore, domestic and industrial wastewater is collected and conveyed by sewers to sewage treatment works for treatment before final discharge into the sea. Hence, it is essential that adequate care and precaution be taken to ensure that new development works do not affect the existing sewerage system. It is also important that the sanitary and sewerage system that are to be provided to serve new developments are designed and constructed properly to maintain the effectiveness of the entire sewerage system.

This Code of Practice on Sewerage and Sanitary Works is issued under Section 33 of the Sewerage and Drainage Act (Chapter 294). It aims to guide the Qualified Persons in the proper planning and design of the sanitary and sewerage system. In stipulating only the minimum and mandatory design requirements to be complied with, it is hoped that the Qualified Persons will exercise flexibility and creativity in the design of sanitary and sewerage system without compromising on functional and maintenance needs. In addition to the minimum requirements, some good engineering practices in the planning, design and construction of the sanitary and sewerage system are also given in this code.

Director
Water Reclamation (Network) Department
Public Utilities Board
Singapore

TERMINOLOGY

"Central Building Plan Unit (CBPU)"	refers to the Central Building Plan Unit of the Planning and Development Department, National Environment Agency (NEA);
"Department"	refers to the Water Reclamation (Network) Department (WRN) of the Public Utilities Board (PUB); *(Addendum No.2-Nov 2004)*
"discharge pipe"	means a pipe which conveys the discharges from a sanitary appliance or a floor trap;
"discharge stack"	means a main vertical discharge pipe;
"drain-line"	means any pipe which is connected to the sewerage system;
"fittings"	means any apparatus or parts used for any sanitary facility or drain-line of any premises;
"public sewerage system"	includes- (a) sewerage system which were vested in the Government before the appointed day under the repealed Water Pollution Control and Drainage Act (Cap. 348) or any other written law; (b) sewerage systems with respect to which a declaration of vesting has been made under Section 9 of the Sewerage and Drainage Act; (c) sewerage systems constructed by the Government or the Public Utilities Board on behalf of the Government on any private property at the expense of the Government or acquired by the Government; and (d) sewerage systems constructed on any private property and maintained by the Public Utilities Board;
"public sewer"	includes- (a) sewers which were vested in the Government before the appointed day under the repealed Water Pollution Control and Drainage Act (Cap. 348) or any other written law; (b) sewers with respect to which a declaration of vesting has been made under Section 10 of the Sewerage and Drainage Act; (c) sewers constructed by the Government or the Public Utilities Board on behalf of the Government on any private property at the expense of the Government or acquired by the Government; and (d) sewers constructed on any private property and maintained by the Public Utilities Board;
"qualified person"	in relation to any sewerage works, means a qualified person appointed under section 6(3) or 9(2)(b) of the Building Control Act (Cap. 29) in respect of works which include the sewerage works, and those whose qualification is appropriate to the nature of those works;

"sanitary appliances"	includes wash basins, bath tubs, sinks, urinals, toilet bowls and other appliances which connect, directly or otherwise, to a private sewage treatment plant or a public sewerage system;
"sanitary drainage system"	means a network of underground pipes comprising drain-lines, branch drain-lines, fittings and inspection chambers for the conveyance of sewage within any premises to a sewerage system;
"sanitary facilities"	includes bathrooms, toilets, facilities for washing and sanitary appliances, together with the associated pipe-work, whether above or below the ground, which connect, directly or otherwise, to a private sewage treatment or a public sewerage system;
"sanitary plumbing system"	means a system of sanitary pipework above the ground comprising one or more discharge pipes, discharge stacks, ventilating pipes, ventilating stacks and fittings for the conveyance of sewage from premises to a sanitary drainage system;
"sanitary works"	include works on any sanitary plumbing system or sanitary drainage system and the fixing, alteration and repair of a sanitary appliance, and other works connected therewith;
"septic tank"	means a tank through which sewage flows and the deposited organic matter is wholly, or partially broken down anaerobically;
"sewage"	includes water-borne domestic waste and trade effluent;
"sewage treatment plant"	refers to sewage treatment works, septic tank, imhoff tank, percolating filter, sludge digestion tank, or any tank designed for the pretreatment, treatment or the stabilisation of sewage
"sewerage system"	means a system of sewers, pumping mains, pumping stations, sewage treatment plants and treatment works for the collection, treatment and disposal of sewage and recovery of industrial water and includes any industrial water main and pipe, drain-line, grease trap, cesspit, septic tank, privy and any appurtenance thereof;
"sewerage works"	includes engineering works for the construction, alteration and maintenance of any sewerage system;
"ventilating pipe"	means a pipe provided to limit the pressure fluctuations within any sanitary plumbing system;
"ventilating stack"	means a main vertical ventilating pipe.

PART 1

PLANNING & DESIGN REQUIREMENTS FOR DEVELOPMENT WORKS

1.1 INTRODUCTION

It is essential that adequate measures are taken during the planning, design and construction of all new building and infrastructure developments to ensure that they do not affect or undermine the integrity of the existing sewerage system. It is also important that good design and engineering practices are adopted in the planning, design and construction of new sanitary drain-lines and sewers to ensure that they can perform effectively and with minimal maintenance.

1.2 PLANNING REQUIREMENTS

1.2.1 All new developments shall be served by an internal sanitary plumbing and drainage system. This internal sanitary plumbing and drainage system shall be connected to public sewers by an internal drain-line maintained by the owner or occupier of the development. In the planning and design of the internal drain-line and its connection to the public sewers, the following requirements shall be complied with:

(a) A development shall make use of the existing sewer connection that is located within the development site. If an existing connection is not available, the connection shall be made to the nearest public sewer as advised by the Department.

(b) For high density housing developments, such as condominiums and apartments, the internal drain-lines shall be connected to the public sewers via manholes.

(c) For single unit housing development, the drain-line connection can be made to the public sewers via raised junction or 'Y' junction connections. In this case, the last inspection chamber within the development site shall be located not more than 2.5m away from the development boundary.

(d) Where a new minor sewer is laid to pick up flow from the drain-lines from a row of single unit housing development, the new sewer can also be connected to the public sewer via raised junction or 'Y' junction connections, subject to the following criteria:

(i) the last manhole that is located within the last housing unit shall not be more than 50m away from the point of connection.

(ii) the connecting sewer from the last manhole to the existing sewer shall follow the size of the existing sewer, or 200mm diameter, whichever is smaller. The new minor sewer upstream of the last manhole shall, however, remain at the minimum size of 200mm diameter. (Note: For connection to an existing sewer via a manhole, the connection sewer from the last manhole shall also be 200mm diameter. This is regardless of the size of the existing sewer).

(iii) Only up to 10 single unit housing development is allowed to be connected to the public sewer via junction connections. When there are more than 10 units in the row of housing development, the new minor sewer shall be connected to the existing sewer via a manhole.

(e) In the event when one of the units along a row of single unit housing development proposes to carry out extension work which involves diversion of sewer similar to the design layout as shown in the Drawing No. 5-1 in Annex B of Part 5, the proposed sewer diversion work must include advance connections to the lot boundaries. The pipe ends are to be sealed as part of the sewer diversion work. *(Addendum No.1-Feb 2001)*

1.2.2 It is essential that the sewers shall remain readily accessible at all times so that any maintenance works to the sewers can be carried out expeditiously. For this, no building or structure shall be allowed to be erected over and across any sewers.

(a) Building and structure shall mean any structural elements such as permanent extension to existing buildings, balconies, retaining walls, boundary walls overhead bridges etc.

(b) Exemption to this requirement shall only be applicable to structures that do not form an integral part of the building and which are light and easily removable, such as awnings, planting troughs, covered linkways, compound drains etc.

(c) In addition, building or erection of structures over and across minor sewers may be allowed on the condition that the building structures are modified or designed such that the sewers remain accessible for maintenance below the structures. The design of the structures may include the erection of a trench that encloses and yet allow free access to the sewers. The trench shall be designed to meet the following requirements:

(i) It shall be made of reinforced concrete or other sturdy material.

(ii) Provision shall be made to allow access into the trench via the top, such as removable pre-cast concrete slabs or other hard covers.

(iii) The minimum width of the trench shall be 750mm to allow a man to work within. For minor sewers that are more than 3m deep, the width of the trench required shall be as advised by the Department.

(iv) The trench shall be backfilled with sand or other approved granular materials.

1.2.3 All buildings or structures shall be erected away from sewers/pumping mains. However, if there is a need to build near sewers or pumping mains, adequate separation distance shall be provided between the structures and the sewers/pumping mains, as follows:

(a) All buildings and structures shall be built at the following minimum lateral distances away from sewers:

Sewer Size (mm diameter)	**Sewer Depth (m)**	**Minimum Distance (m)**
150 to 600	≤ 3	1.0
	> 3 and ≤ 5	1.5
	> 5	2.0

(b) All buildings and structures shall be built at the following minimum lateral distances away from pumping mains:

Pumping Main Size (mm diameter)	**Pumping Main Depth (m)**	**Minimum Distance (m)**
100 to 600	≤ 3 > 3 and ≤ 5 > 5	1.0 1.5 2.0

(c) The minimum distances shall be measured from the outer most edge of the building structure, including footings and overhangs, to the centreline of the sewer/pumping main.

(i) In the event that the minimum distances cannot be met, an access trench to the sewer/pumping main as stated in clause 1.2.2 (c) shall be provided.

(ii) For main sewers and pumping mains that are greater than 600mm in diameter, the minimum separation distance required shall be as advised by the Department.

1.2.4 In the planning, design and construction of any development, it is vital to have a clear knowledge of the existing sewerage system, if any, within the development site. A thorough investigation of the development site shall be carried out to determine the existing sewerage system within the site, and all practical measures shall be taken to ensure that the proposed development will not disrupt or affect any sewer/drain-line that is serving adjacent lots/premises.

1.2.5 As far as possible, sewerage works shall be carried out within the limit of the development site. If there is a need to lay sewers and to carry out the sewerage works beyond the limit of the development site, the developer shall obtain the consent from the owner of the land on which the sewerage works is to be carried out. This shall include State Land or any other land that is managed by other Government Agencies.

1.2.6 For an existing or a new sewer that is located within a development site, the owner of the site shall allow future connection to the sewer within the site as and when required by Department.

PART 2

SEWERAGE WORKS

2.1 DESIGN REQUIREMENTS FOR SEWERS

2.1.1 Objective

Sewers shall be planned and designed to be as simple and as direct as practicable for effectual conveyance of sewage. They shall also be laid at the correct grade using approved materials to ensure minimal maintenance requirement and maximum durability.

2.1.2 Design Flow

The design flow is based on the amount of sewage discharged per person. The average domestic sewage daily flow shall be taken as 230 litres per person per day for public housing and 345 litres per person per day for private housing. The design flow shall be 3 times the average flow i.e. 690 litres per person per day and 1035 litres per person per day respectively. A single dwelling unit shall be taken to comprise 5 persons.

2.1.3 Size

The minimum size of all new sewers shall be 200mm in diameter. The only exception to this requirement is for junction connections into existing minor sewers that are 150mm in diameter. In such cases, the connecting new sewer from the last inspection chamber or manhole of a new development site shall follow the size of the existing 150mm diameter sewers. In all other cases, the sewers shall not be smaller than 200mm in diameter.

2.1.4 Permissible Velocities and Grades

a) The minimum and maximum velocities and grades of the 200mm diameter sewer flowing full shall be as follows:

Flow condition	**Minimum velocity**	**Minimum Grade**	**Maximum velocity**	**Maximum Grade**
> Half Bore	0.8 m/s	1 in 250	2.4 m/s	1 in 30
≤ Half Bore	0.9 m/s	1 in 120	2.4 m/s	1 in 20

The Qualified Person is however advised not to use the limiting gradients in his sewer design so as to allow for tolerance during construction. For small development sites, such as single unit developments, small condominiums and factories, sewage flow is likely to be low. In such cases, new sewers including the last connecting sewers for these developments shall be laid at a minimum grade of 1 in 120. This is to prevent the sewage in the sewers from turning septic under low flow condition. For large developments, the Qualified Person shall determine the appropriate gradient to achieve the minimum gradient for the sewers from his flow calculations.

b) The minimum and maximum velocities in sewers above 200mm diameter flowing full shall not be less than 0.8 m/sec or more than 2.4 m/sec.

2.1.5 Materials

All materials used for sewer pipes shall conform to the following requirements:

(a) Vitrified Clay
All vitrified clay pipes and fittings shall comply with EN 295. The crushing strength of vitrified clay pipes laid by open trench method shall not be less than the values for Class number 160 as given in table 5 in EN 295. Vitrified clay pipes for microtunnelling or pipe jacking shall also comply with the same standard, however, the crushing strength of the vitrified clay pipes shall not be less than the values for Class number 240.

(b) Ductile iron
All ductile iron pipes and fittings shall comply with EN 598. They shall be internally lined with high alumina cement (HAC) mortar in accordance with EN 598 or alternatively, sulphate resisting cement (SRC) that comply with the type test for chemical resistance and abrasion resistance as specified in EN 598 for HAC. They shall also be externally coated with a layer of metallic zinc and covered by a finishing of a bituminous coating.

(c) Thickwall Reinforced Concrete
All thickwall reinforced concrete pipes shall have an internal sacrificial layer of 38mm in addition to the normal cover for reinforcement as provided for in the design of reinforced concrete pipes and in compliance with SS 183.

(d) PVC or HDPE Lined Reinforced Concrete
All PVC or HDPE lined reinforced concrete pipes shall be manufactured in compliance with SS 183 and shall be internally lined with a minimum thickness of 1.5mm PVC or HDPE lining. The lining shall be fixed to the concrete surface by mechanical keys and cover not less than 330° of the internal circumference of the pipes.

2.1.6 Sewer Sections

All sewers laid in open trenches shall be properly protected and backfilled with approved backfilling materials. Depending on the ground conditions and the type of the sewer material used, the sewer shall be laid in accordance to 4 main section types, viz. Type 'A', Type 'B', Type 'C' and Type 'D'. The details of these sections can be found in the Department 's Standard Drawings. For section type that requires concrete haunching, the concrete shall be placed right to the sides of the excavation.

2.1.7 Sewer Manholes

(a) All sewer manholes shall be constructed using pre-cast circular units or chamber rings in compliance with the Department's Standard Details of Manholes. These details are found in the appropriate Standard Drawings produced by the Department.

(b) For manholes that exceed 10.5m in depth, special reinforced concrete chambers shall be constructed. The design of these chambers shall be carried out by a Qualified Person and the details shall be submitted to the Department for approval prior to commencement of work.

(c) The minimum depth of manholes, measured from the top of their covers to their inverts, shall be 1.5 metres.

(d) The distance between manholes shall not be more than 120m.

(e) The underside of all intermediate platforms and roof slabs of manholes/ chambers shall be lined with PVC or HDPE lining.

(f) All manhole frames and covers shall be of the type approved by the Department and shall comply with SS 30. These approved standard manhole frames and covers are shown in the Department's Standard Drawings.

2.1.8 Other Appurtenances

(a) Backdrop

A backdrop connection to manholes shall be provided when the incoming sewer is more than 1.5m higher than the receiving sewer.

(b) Tumbling Bay

When the incoming sewer is less than 1.5m higher than the receiving sewer, a tumbling bay shall be provided.

(c) Vortex Drop

When the difference in levels between the incoming and the outgoing sewers is more than 6m at a manhole, a vortex drop shall be provided. Vortex drop shall also be provided for sewers that are more than 450mm diameter. This is regardless of the difference in levels between the incoming and outgoing sewers.

(d) The standard design for the backdrops, tumbling bays and vortex drops can be found in the Department's Standard Drawings. For backdrops and tumbling bays, the incoming sewers shall be laid such that the velocity of the flow within will not exceed 1.2 m/sec to prevent sewage from shooting through the drop pipes. For 200mm diameter sewer, the maximum grade shall not exceed 1:120.

2.1.9 Sewer Joints and Connections

(a) All sewer pipes shall be connected using approved flexible joints.

(b) All sewer pipes connecting to manholes shall be joined at soffit levels. In the case of a new 200mm diameter sewer connecting to an existing 150mm diameter sewer downstream, the connection shall be made at invert levels at the manhole.

(c) All connection points where sewer pipes are built into manhole walls shall be made watertight. No leaks shall be permitted at these points.

(d) Sewer pipes connecting at the same levels at manholes shall not form acute angles with the pipes that lead away from the manholes. The channels and the benching in the manholes shall be smoothly rendered to reduce turbulence in the sewage flow.

2.1.10 Sewer Pipe Jacking Operations

(a) Only approved vitrified clay jacking pipes and precast concrete reinforced pipes shall be used for jacking. For precast concrete pipes, they shall be manufactured by a centrifugal or other equivalent process and shall comply with the S.S.183, B.S.556, A.S.1342 or other acceptable Standards.

(b) The joints of the sewer pipes shall be made of the double spigot type. The jointing sleeves shall be made of Stainless Steel Type 316. Pressure transfer rings shall also be attached to the face of one of the spigot ends before jointing.

(c) Jacking operations shall only be carried out by skilled pipe jacking contractors and using proper pipe jacking equipment.

(d) A jacking ring and a jacking frame shall be used in all jacking operations. The jacking ring shall be designed to allow the jacking pressure to be distributed evenly around the wall of the jacking pipes. Likewise, the jacking frame shall be designed to distribute the stresses from the jacks evenly onto the jacking ring.

(e) The maximum tolerance allowable in the displacement of the centreline of the jacked pipe from the design centreline is 50mm in the horizontal plane and 25mm in the vertical plane. There shall be no backfall at any point along the sewer laid.

2.1.11 Testing of Water-tightness of Sewers *(Addendum No.1-Feb 2001)*

(a) All sewers below 600 mm in diameter before being surrounded and covered shall be tested by filling with water. The pressure shall be measured from the highest point of the pipeline under test and shall be 1.5 metre head of water. Pipelines should not be accepted until they have withstood the required pressure for 30 minutes without a loss in excess of 1.5 litres for 100 m for each 300 mm in diameter.

(b) Sewers of 600 mm and above in diameter need not be hydraulically tested. They shall be inspected by CCTV inspection or for man-entry sewers, manual inspection shall be carried out.

2.1.12 Good sewer and pumping mains laying practice *(Addendum No.1-Feb 2001)*

The guide on good sewer and pumping mains laying practice is at Part 5.

2.2 DESIGN REQUIREMENTS FOR PUMPING MAINS

2.2.1 Minimum Size

The minimum size of pumping main shall be 100mm diameter.

2.2.2 Minimum and Maximum Velocities Permissible

The minimum and maximum velocities in pumping mains shall be 1.0m/sec and 2.4m/sec respectively.

2.2.3 Materials

All pumping mains shall be made of ductile iron and shall conform with the following requirements:

(i) All ductile iron pipes and fittings for pumping mains shall be internally lined with sulphate resisting cement and coated externally with metallic zinc coating and with bituminous coating as a finishing coat, all in accordance with EN 598.

(ii) Ductile iron pipes with spigot and socket joints shall be class K9 in compliance with EN 545. All bolts, nuts and studs used in the installation of the pipes shall be hot dipped galvanised to BS 729 and be rilsan nylon coated for protection against corrosion.

(iii) Where the ends of the pipes are described as "plain-ended", they shall be joined using flexible couplings/flange adaptors.

(iv) The flexible couplings/flange adaptors used shall be gasketted. They shall fit tightly onto the pipes/flange forming permanently tight joints under all reasonable conditions of expansion, contraction, shifting and settlement of the pipes. The gasket shall be made of nitrile butadiene or equivalent rubber compound suitable for use in pipelines conveying sewage or industrial water.

(v) The flexible couplings/flange adaptors shall be made of rolled mild steel conforming to BS 4360:1986 Grade 43A and shall be internally and externally coated with rilsan nylon to protect against corrosion. The thickness of the rilsan nylon finishing coat shall not be less than 300 microns.

(vi) The pumping mains shall be wrapped around with green polyethelene sleeves before laying. All pipe joints shall be wrapped with waterproof wrapping tape over a length of 600mm before sleeving. The polyethelene sleeves and 150mm wide water proofing tape shall be used to provide continuous protection of the pipes and fittings. The sleeves shall also be free from tears and pinholes and other continuities. The nominal thickness of the sleeves shall not be less than 200 microns.

(vii) Where direct pipe jacking is adopted, the outside surface of the ductile iron pipe shall be covered with reinforced concrete. The pipes shall be connected by means of flexible joints which may be jointed by bolts. The bolts shall be designed to break to achieve flexibility in the joints.

2.2.4 Pumping Main Section

(a) Pumping mains shall, in general, be laid on granular bedding i.e. Type A Section (see Standard Drawings on Bedding Type), except at very shallow sections, such as at thrust blocks and at river crossings, or when the pumping mains are laid by direct jacking or microtunnelling.

(b) Thrust blocks shall be provided at all bends along the pumping mains.

(c) The minimum depth of a pumping main measured to its invert shall be 1.5 metres.

2.2.5 Appurtenances

(i) All pumping mains shall be provided with access chambers, vents, air valves and wash-out chambers.

(ii) Access chambers shall be provided along the pumping main for maintenance purposes. The distance between the access chambers shall not be more than 200m apart.

(iii) Air valves shall be installed in chamber at all high points along the pumping main. The air valve shall be of the dual orifice type and come complete with isolating valves. The valve shall be gas tight at atmospheric pressure.

(iv) Wash-out chambers shall be provided at all the lowest points along the pumping main.

2.2.6 Testing of Pumping Mains *(Addendum No.1-Feb 2001)*

All pumping mains of 600 mm or less in diameter shall be tested hydraulically in convenient lengths before being covered up. The test pressure shall be 1.2 N/mm^2 for all classes of pipes.

2.2.7 Good sewer and pumping mains laying practice *(Addendum No.1-Feb 2001)*

The guide on good sewer and pumping mains laying practice is at Part 5.

2.3 REQUIREMENTS FOR SEWAGE TREATMENT PLANT

2.3.1 Introduction

All developments shall be connected to public sewers. However, if no public sewer is available for connection, a sewage treatment plant may be provided subject to the approval of National Environment Agency (NEA) and PUB. Such provision shall be clearly shown on the development control plan.

2.3.2 Capacity of Sewage Treatment Plant

(a) For housing development, the capacity of the sewage treatment plant shall be in accordance with the following schedule:

No of houses or residential units	**Capacity of plant**
1-2	10 persons
3-4	20 persons
5 & above	5 persons per residential unit

(b) For the specific type of development listed, the following factors shall be used in ascertaining the capacity of the sewage treatment plant.

Type of Development			**Factor**
i)	Church:	Hall - Seating capacity No of Residential Staff	0.01 1.00
ii)	School:	Primary & Secondary School - No of students and staff per session	0.25
ii)	Institution of Higher Learning	No of students and staff	0.50
iv)	Community Centre:	No of staff and workers No of residents Kindergarten - No of students and staff per session Maximum gathering	0.50 1.00 0.08 0.01

Type of Development			**Factor**
v)	Factory:	No of Workers - One shift per 24 hours Two/Three shifts per 24 hours.	 0.50 1.00
vi)	Market:	No of hawkers and employees	0.25
vii)	Hawker / Cooked Food Centre:	No of stalls	1.75
viii)	Cinema:	Hall - seating capacity No of staff	0.03 0.50
ix)	Bar & Snack Bar, Coffee-House, Restaurant:	Seating capacity	0.20
x)	Hotel:	No. of beds No of staff	0.70 0.50
xi)	Office:	No of staff	0.50
xii)	Park	Maximum no of persons expected to use the park	0.02

2.3.3 Location of Sewage Treatment Plant

Sewage treatment plants shall be sited as far away as possible from the residential houses. The recommended minimum distance between the sewage treatment plants and the nearest building is given in Table A.

TABLE A: MINIMUM DISTANCE BETWEEN SEWAGE TREATMENT PLANTS AND NEAREST BUILDINGS

Capacity of Sewerage Treatment Plant (equivalent persons)	Minimum Clearance in Metres	Remarks
10 - 40	-	
50 - 100	10 - 15	
200	20	
300	25	
400	30	
500	35	
600 - 2000	35 - 40	
Above 2000	-	Distance will depend on the design of the treatment works

2.3.4 Shielding of Sewage Treatment Plant

Trees, bushes and shrubs of full foliage shall be planted around the sewage treatment plants to make them less obtrusive and to soften their impact on the neighbourhood. Alternatively, walls with good architectural and aesthetical treatment may be erected around the treatment plants. Any superstructure to the treatment plants shall also be similarly treated for aesthetics to ensure that they do not look out of character with its surrounding.

2.3.5 Separate Plot and Fencing

Sewage treatment plants of 50-persons capacity and above shall have a separate fenced-in plot with 2.4 m high PVC-coated chain-link fence. It shall be free of encumbrances and shall be provided with a 4.0m wide gate and a 4.0m wide direct access road in accordance with the Department's Standard Drawing. A different type of fence may be erected for aesthetical reasons. Where a sewage treatment plant is to be located within a fenced area of a development, exemption may be given for the erection of the fence. The owner or the occupier of the development however, shall be responsible for the security of the plant and its equipment.

2.3.6 Outlet for Final Effluent

(a) The discharge point of the final effluent from the sewage treatment plants shall be any suitable watercourse such as an outlet drain, canal, stream or river.

(b) The Qualified Person shall ensure that there is a suitable watercourse in the vicinity of the sewage treatment plant for the discharge of the final effluent at the planning stage. The discharge point for the final effluent shall be clearly indicated in the detailed plans.

2.3.7 Temporary Septic Tank

(a) The provision of temporary septic tank in water and urban river catchment areas is strictly prohibited. Temporary septic tanks may be permitted in non-water and urban river catchment areas where there is no sewer in its vicinity subject to the approval of NEA & PUB. The use of temporary septic tanks shall not be more than three years.

(b) Where a temporary septic tank is permitted, the tank shall be designed based on a flow rate of 270 litres per person per day and with a minimum capacity of 2700 litres. The retention time shall be 24 hours.

(c) The temporary septic tank shall be maintained by the owner or occupier of the development.

2.3.8 Design Guidelines for Sewage Treatment Plants

(a) Unless otherwise required, the sewage treatment plant shall be designed with physical and biological treatment processes, capable of producing a stable final effluent to the satisfaction of the NEA & PUB. The standard for the final effluent quality shall be:

Biochemical Oxygen Demand (BOD_5)	:	20 milligrams per litre
Suspended Solids (SS)	:	30 milligrams per litre

(BOD_5 is defined as the Biochemical Oxygen Demand of the effluent in 5 days measured at 20°C).

The sewage treatment plant shall have sludge treatment and pre-disposal storage facilities. The methods of treatment and disposal of the final effluent shall be subject to the approval of NEA & PUB.

(b) No chemical treatment processes shall be used for the treatment of sewage to the required standard.

(c) In specific cases, tertiary treatment and/or disinfection processes to obtain a higher grade effluent quality may be required by the PUB or NEA.

(d) The sewage treatment plant shall be designed in compliance with the requirements herein and endorsed by a Qualified Person.

(e) The design loading criteria of each and every component treatment process units shall be set out and supported with design calculations (for structural, process and hydraulics engineering), and detailed hydraulics and process line schematic drawings endorsed by a Qualified Person.

(f) The sewage treatment plant shall be supported on a permanent foundation.

(g) The sewage treatment plant shall be designed to the following design requirements:

(i) Hydraulic conveying capacity based on design peak factor of 3 times the design average daily flow.

(ii) The incoming sewage shall be lifted up by pumping, and thereafter carried through the treatment process units and finally discharged all by gravity flow. No pumping of final effluent is allowed.

(iii) There shall be an overflow pipe located at an appropriate level in the inlet chamber or pump well to allow sewage overflow to the outlet drain in the event of plant upsets or power failure.

(iv) The plant, its appurtenances and the effluent outlet pipe shall be set above the minimum platform level stipulated by the Drainage Management Division, 3P Network Department (PUB).

(v) The sewage treatment plant shall have facilities to ensure that the treatment processes operate effectively throughout all diurnal variations of sewage flow into the plant.

(vi) Sludge retention in the primary settling or other significant sludge producing process units shall be not less than 30 days design sludge production rate. This shall be complete with sludge draw-off pipeline. No sludge drying beds are to be used.

(vii) The plant shall be self-operating, based on simple settings that are self-adjusting as far as possible and which require periodic and infrequent monitoring and resetting.

(viii) Airtight covers shall be installed over the whole plant to contain odour and prevent the breeding of insects. These covers shall be of segments of lightweight material and be easily removed and reinstalled without the need of heavy lifting equipment to facilitate plant maintenance work.

(ix) The plant material used shall be made of corrosion resistant type or be adequately coated with protective material to withstand and endure the sewerage environment.

(x) Sampling pipelines shall be provided at strategic locations of the individual treatment process units to facilitate representative sampling for analysing the performance of the treatment process units.

(xi) A dosing chamber shall be provided for the dosing of sodium hypochlorite to disinfect the final effluent. It shall be designed with 2 minutes retention time of the daily peak flow rate.

(xii) The plant design shall be proven with a track record of operation in the previous 5 years.

(h) Upon commissioning, the sewage treatment plant shall be test-run and performance tested and certified to be performing in compliance with the design criteria to achieve the standard for the final effluent quality. Test analyses shall be carried out at an accredited laboratory. The Qualified Person shall duly endorse all tests and certification.

(i) The requirements on Mechanical and Electrical equipment are set out in Section 2.4.

2.4 MECHANICAL & ELECTRICAL (M&E) REQUIREMENTS FOR SEWERAGE INSTALLATIONS

2.4.1 Mechanical Requirements

2.4.1.1 Pumps

(a) Pump bodies and impellers shall be of corrosion resistant material suitable for the pumped media (e.g. cast iron or stainless steel).

(b) Reflux and isolating valves shall be provided for the pumping system.

(c) A minimum of two pumps, comprising the duty and standby pumps, shall be provided for the sewerage installation. Where two pumps are provided, one shall be the duty pump and the other the standby pump. The standby pump shall be activated in the event the duty pump fails or during high level.

(d) The pumps shall be capable of automatic starting and stopping. Controls shall also be provided for automatic interchange of duty and standby pumps after each cycle of operation.

2.4.1.2 Sewage Pumps

(a) Sewage pumps shall be capable of passing long fibrous materials.

(b) Sewage pumps of up to 2.2 kW shall be capable of passing solids of 64 mm in diameter without chokage and shall be with discharge pipes of minimum 75 mm diameter.

(c) Sewage pumps above 2.2 kW shall be capable of passing solids of 75 mm in diameter without chokage and shall be with discharge pipes of minimum 100 mm diameter.

2.4.1.3 Sewage Ejector / Solids Divertor

(a) The pit for the sewage ejector or solids divertor installation shall be adequately sized to accommodate the tanks, pumps, dewatering sump pump, valves, pipework etc. and shall include working space for maintenance. Generally, a room shall be provided and the pit shall be of minimum 3m x 3m size. This provision enables the following functional requirements to be met:

(i) A safe working environment;

(ii) Adequate security and protection from vandalism; and

(iii) Free from obstructions at all times for maintenance purposes.

However, for cases where a room is not provided, the functional requirements shall nevertheless be complied with as follows:

(1) Adequate forced ventilation system shall continue to be provided for the safe working environment of workers operating and working in the sewerage installation;

(2) The pit shall be located away from driveway;

(3) Measures shall be provided all round the pit to prevent water flowing into it and to prevent vehicles or other items from obstructing access and maintenance.

(4) The pit shall be securely covered with lockable doors or covers;

(5) The access opening for the pit shall extend over the whole of the ejector/ divertor tank and pumps;

(6) Lifting equipment shall be provided for the installation.

(b) Where pumping equipment are needed to handle waste discharge from restaurants, food centres and markets located at basements, solids divertors shall be provided. However, for cases where grease traps are provided upstream of the sewage pumping installation, sewage ejectors may be provided in lieu of solids divertors.

(c) Sewage ejector / solids divertor tank shall be made of corrosion resistant material suitable for the pumped media (eg. stainless steel). The tank shall be mounted on a concrete plinth.

(d) Access opening shall be provided directly above the sewage ejector / solids divertor tank and pumps for ease of maintenance.

(e) For solids divertor, a minimum clearance of 1.8 m between levels of the pipe invert and the solids divertor floor is required to ensure that the incoming pipe invert is always higher than the outlet / bypass pipe of the solids divertor.

(f) Air release pipes with isolating valves and air release valves shall be provided for the separating chamber and the two-way valves of the divertor tank.

(g) Dewatering submersible sump pump in the sewage ejector / solids divertor pit shall be provided and shall pump into the ejector / divertor discharge pipe.

(h) Dewatering sump pump shall be provided with reflux and isolating valves.

(i) Access ladders and handholds of suitable material (e.g. aluminium alloy or glass reinforced plastic) shall be provided for the ejector / divertor pit.

(j) Adequate lighting and a water tap shall be provided for the ejector / divertor installation.

(k) Perforated strainer plate and cone baffle of the solids divertor shall be made of stainless steel. Strainer plate shall be of the removable type.

(l) Vent pipe of not less than 75mm shall be provided for the ejector / divertor tank. It shall be connected to the main vent stack.

2.4.1.4 Pump Sump

(a) A screen chamber shall be provided before the pump sump (except for car park pump sump). The screen shall be made of aluminium alloy or stainless steel.

(b) Access opening shall be provided directly above the pumps for ease of maintenance.

(c) Ladders installed within pump sump and screen chamber shall be of suitable material (e.g. stainless steel or GRP).

(d) An overflow pipe to the downstream sewer shall be provided, where possible.

(e) Lifting equipment, of safe working load, shall be provided.

(f) Adequate ventilation system shall be provided for the installation.

(g) Adequate lighting and a water tap shall be provided.

(h) When the depth of pump sump or screen chamber exceeds 6 m, intermediate platforms shall be provided. Aluminium alloy (or superior material) handrail and safety chain shall be provided at the intermediate platform.

2.4.1.5 Sewage Treatment Plant (STP)

(a) Where pumps are required, the STP shall be designed so that the pump is used to lift crude sewage or settled sewage.

(b) The STP shall comply with the following:

(i) The requirements for pump sump as detailed in Clause 2.4.1.4.

(ii) A switchroom to house the switchboard shall be provided with adequate lighting and one power point.

(iii) A high sewage level indicating system comprising a float activated revolving / flashing light and reflective sign plate with hotline number shall be provided and installed in a prominent location.

(c) For dosing siphon, cleaning eye shall be incorporated in the discharge pipe bend.

(d) Mercury seals shall not be used.

2.4.1.6 Screening

Screens of suitable corrosion resistant material (e.g. stainless steel) shall be provided to prevent large objects from entering the installation so as not to cause damage to the pumping equipment and disruption to the pumping system.

2.4.1.7 Lifting Equipment

(a) Lifting equipment of adequate safe working load shall be provided for the maintenance and replacement of equipment in the sewerage installation. The lifting equipment shall be able to traverse the installation and be able to reach the equipment required for lifting with ease. The lifting equipment shall be inspected by an approved person and shall be registered with the Factory Inspectorate, Ministry of Manpower.

(b) Generally, two chain blocks shall be provided. The chains shall be of adequate length of not less than 5m and shall be capable of lifting safely the heaviest equipment or plant.

2.4.2 Electrical Requirements

(a) The electrical installations shall comply with the latest Singapore Standard (SS) CP 5, SS CP 16 and other relevant CPs.

(b) An electric switchroom shall be provided with the switchboard/motor control centre of enclosure rating exceeding or equal to IP41. Where approved, an open shelter with a weatherproof switchboard may be allowed. The switchboard shall be provided with an outer enclosure to not less than IP54 rating and made of non-corroding material such as stainless steel or aluminium alloy material.

(c) The electrical provisions shall include the following items:

(i) Main isolating fused switch or circuit breaker.

(ii) Separate fused switch or circuit breaker for each pump.

(iii) Automatic motor starters with motor overload protection incorporating single-phase protection and automatic control of pump motors. Each motor starter shall be provided with indicating lights, start-stop and hand reset push button and manual/automatic selector switches.

(iv) Automatic starting and stopping of pumps using level sensing float switches or electrodes. The standby pumps shall also operate when the level is high and with regular automatic interchange of duty and standby pumps. To disallow "hunting" of the pumps, a separate float switch or electrode shall be provided for each level. An earth-return electrode shall be provided for the electrode control system. The float switches shall be shackled to a stainless steel chain.

(d) A standby generator or an alternate power source with automatic electricity changeover shall be provided.

(e) The level control system shall be operated with voltage not exceeding 24-volt AC system.

(f) Adequate lighting shall be provided for the sewerage installation. Fluorescent lamp(s) with corrosion resistant fittings shall be provided.

2.4.3 The owner/developer/occupier of the sewerage installation to be taken over by PUB shall pay the cost of all repairs to the installation, fencing etc. for a period of one year from the date of taking over.

2.4.4 For installations to be taken over by PUB, the following shall also be provided and complied with:

(i) Elevated break water tank made of approved fibreglass or stainless steel.

(ii) Separate electricity and water meters, which shall be located within the compound of the installation.

(iii) 2.4 m high PVC-coated chain link fencing and 4.0 m wide separate vehicular access road with gate, complying with the Department's Standard Drawings.

(iv) Disintegrators or channel screen disintegrators.

(v) Inlet, channel and dividing wall rising spindle penstocks.

(vi) Fixed supply and exhaust ventilation systems for the wet well and supply ventilation system for the dry well.

(vii) Handrailing, ladders, safety cages and hand holds.

(viii) Standby generator with automatic transfer system and daily fuel tank.

(ix) Standby generator building or a containerised standby generator.

(x) Underground bulk fuel tank.

(xi) Odour and acoustic control facilities.

(xii) Toilet facilities.

(xiii) 400V electrical Motor Control Centre MCC.

(xiv) Spares for the equipment (In the case of sewage treatment plants, spares shall be sufficient for 2 years of operation.)

(xv) Operation & Maintenance manuals (process and equipment etc.).

(xvi) Other equipment and requirements as imposed by the Department, which can be obtained from the Internet Website at URL Address: http://www.pub.gov.sg.

2.4.5 For all installations to be taken over by PUB, a Remote Telemetry Unit (RTU) shall be installed. The requirements for the RTU system are available in the Internet Website at URL Address : **http://www.pub.gov.sg**

PART 3
SANITARY WORKS

3.1 SANITARY DRAINAGE SYSTEM

3.1.1 Objective

The sanitary drainage system shall be designed, installed, and maintained so as to convey and discharge wastewater into the sewerage system without causing a nuisance or danger to health arising from leakage, blockage or surcharge.

3.1.2 Design Criteria

(a) The system shall convey only wastewater from within the premises to the sewerage system. Rainwater shall not be discharged into sanitary drainage system.

(b) The size, length and material shall be chosen to facilitate maintenance and reliable service.

(c) Bends or kinks are to be avoided in any branch/main drain-line.

(d) The branch/main drain-line shall be of the same diameter and laid using the same material throughout its entire length.

(e) The branch/main drain-line shall have a constant gradient. The size and gradient of the drain-line shall be chosen to provide adequate carrying capacity and also allow for adequate ventilation.

(f) In addition, the choice of gradient for the branch/main drain-line shall be such as to maintain self-cleansing velocity (0.9 m/sec) and not to exceed scouring velocity (2.4 m/sec) under normal discharge condition.

(g) The drain-line laid shall be watertight and subjected to a water test under a static head of not less than 1.5 metre of water at the upstream end of the line. The water test shall be done after pipe laying and before placing concrete for haunching or encasing. *(Addendum No.1-Feb 2001)*

(h) Main drain-lines shall not be sited within road reserve and drainage reserve.

(i) A floor trap shall be provided to receive connection from waste appliances before discharging into the branch drain-line. The trap shall have a minimum water seal of 50mm for exclusion of foul air from the sanitary drainage system.

(j) As required by NEA, adequate measures, such as installation of anti- mosquito devices at the floor trap, shall be taken to prevent mosquitoes from breeding in the water seal of the floor trap.

(k) Food shops shall be provided with grease trap/interceptor of adequate capacity so as to prevent discharge of oils, fats and grease directly into the sewerage system. The grease traps shall be maintained such that the effluent from the grease traps shall meet the standards for discharging into the sewerage system.

(l) For commercial/shopping complex, separate grease waste discharge pipe connected to a separate discharge stack for future connection to grease trap shall be provided in advance to serve commercial units which are expected to be used as food shops. In addition, sufficient space shall be allocated for siting the grease traps which are to be provided in future to serve the future food shops.

(m) No uPVC pipe shall be used for sewer connection. The connecting drain-line from last inspection chamber to an existing/new manhole shall not be smaller than 200mm in diameter. This is regardless of the size of the existing sewer.

(n) For drain-line connection from the last inspection chamber to an existing 150mm diameter sewer via raised junction or 'Y' junction, it shall follow the size of the existing 150mm diameter sewer.

(o) The drainage system serving the following areas shall be connected to surface storm-water drains.

(i) Common corridors/common verandahs
(ii) Covered areas (void deck except wash area)
(iii) Covered play areas
(iv) Multi-storey car parks (except car washing areas)
(v) Open areas in backyards/courtyards/airwells and other uncovered paved areas within premises where rainwater flows are expected
(vi) Pump islands at petrol stations
(vii) Footbaths, open shower points in public and private swimming pools

3.1.3 Acceptable Design/ Practices

(1) Numerals in parenthesis in this Code of Practice refer to the corresponding drawings.

(2) All text shall be read in conjunction with drawings that provide guidelines for recommended practices.

3.1.3.1 Branch Drain-line (3-1) (3-2)&(3-3)

(a) The branch drain-line shall have a minimum diameter of 100mm. The length shall preferably not exceed 10 metres.

(b) Where the depth of branch drain-line to an inspection chamber exceeds 1.5 metres the provision of backdrop/ tumbling bay is recommended and the minimum diameter of the branch drain-line shall be 150mm.

(c) The branch drain-line shall be connected obliquely in the same direction of flow as the main drain-line within an inspection chamber. The invert of the branch drain-line at the inspection chamber shall be above the horizontal diameter of the main channel.

3.1.3.2 Main Drain-line [3-1]

(a) The main drain-line shall have a minimum diameter of 150mm and distance between inspection chambers shall not exceed 50 metres.

(b) Inspection chambers shall be provided at all bends, junctions, at changes to the direction of flow or gradient and at changes in pipe diameter or materials.

(c) Where there is any significant difference in invert levels between incoming drain-line and the inspection chamber, a backdrop [3-4] or tumbling bay [3-4] connection shall be made at the inspection chamber.

3.1.3.3 Drain-line under Building [3-5]

(a) Every sanitary drain-line shall be laid outside buildings wherever practicable.

(b) Where a drain-line passes under a building, it shall be of heavy duty material (e.g. Ductile iron pipes) and laid in a straight run for the whole distance and shall be encased in concrete of adequate thickness [3-5].

(c) If the drain-line has to pass through a basement wall or lay within basement slab, it shall be of heavy-duty material (e.g. ductile iron pipes). Provision in the design shall be made to take care of differential settlement, to reduce the risk of shear fracture, to ensure water tightness and reliable service.

3.1.3.4 Drain-line under Driveway and Car park [3-5]

The drain-line under driveway and car park shall be of heavy-duty material (e.g. Ductile iron pipes) and appropriately designed to withstand vehicular loading. (e.g. concrete encasement can be provided for the pipes to increase its strength).

3.1.3.5 Bedding, Haunching and Backfilling to Drain-line [3-5]&[3-7]

The design of bedding and haunching for drain-lines depends on the diameter of the pipe, the depth at which it is laid, the trench width, the traffic or other super-imposed loading and the prevailing site conditions. The bedding and haunching increase the drain-line ability to carry the loading. On soft or yielding ground, piling has to be designed. The bedding details are shown in Drawing No 3-5.

3.1.3.6 Inspection Chamber and Ventilation [3-7]

(a) Inspection chamber shall be of brickwall or reinforced concrete construction and be watertight. It shall also be designed to minimise the risk of blockage, facilitate maintenance and prevent flotation in ground where the water table is high. It shall have adequate depth to allow ease of maintenance.

(b) The first inspection chamber shall be ventilated except when there is a discharge/ventilating stack of not less than 100mm diameter or where provision of the ventilation stack would cause odour nuisance to the surroundings.

(c) Details of construction of inspection chamber are shown in Drawing No 3-7. Where the inspection chamber exceeds 2.5 metres deep, it has to be specially designed. Heavy-duty cast iron frame and cover shall be used in every drive-way and car park.

(d) At the inspection chamber, branch drain-line shall be connected to the main drain-line at a level above the invert level and not less than half the diameter of the main drain-line to ensure smooth flow.

(e) Measures shall be taken to protect the inspection chamber sited within 2.5 m of the top or bottom of an embankment where its slope is steeper than 1:1.5 (e.g. retaining wall).

(f) The last inspection chamber shall be located within 2.5 metres of the lot boundary.

(g) For food shop, no inspection chamber shall be sited within the areas where food is prepared, cooked, stored or served; or other areas where they are likely to give rise to nuisance, health or hygiene hazards during maintenance.

3.1.3.7 Floor Trap at Ground /First Storey Level (3-6)

(a) The minimum internal diameter of the outlet of the floor trap at ground/first storey level connecting directly to an inspection chamber shall be 100mm.

(b) The waste pipe shall be connected to a floor trap at the riser below grating and above the water seal of the trap.

(c) Where the floor trap is intended to receive sullage water, it shall be located within covered areas and not subject to surface water runoffs from rain. The floor trap shall be fixed with a frame and grating slightly below the paved floor.

(d) Where a floor trap is sited in a location likely to receive rainwater or on unpaved ground, it shall be fixed with a frame and an unperforated cover.

(e) The maximum depth for a floor trap shall not exceed 600mm to facilitate maintenance. A sump may have to be provided for deeper floor trap.

3.1.3.8 Wash Area (3-8)

The wash area shall be constructed under a roof and appropriately kerbed and designed so that no rainwater can enter the sewer. It shall be provided with either a floor waste connecting to floor trap or a floor trap connecting directly to an inspection chamber. The details are shown in Drawing No 3-8.

3.1.3.9 Provisions for Sullage Water Discharge (3-6)(3-10a)& (3-11a)

(a) Sullage water discharge is required to be connected to sewerage system. The specific requirements for sullage water discharge are as follows: -

Connection via Floor Trap(3-6)

(i) Backwash from swimming pool filter

(ii) Boiler blowdown via cooling pit

(iii) Covered wash area/service yard within building

(iv) Steam condensate via cooling pit

(v) Waste water from cooling tower

Connection via Cast Iron Gully Trap with Strainer (Standard Drawing No. PUB/WRN/STD/044)

(vi) Bin centre(3-11a)

(vii) Refuse chute(3-11a)

Connection via Cast Iron Garage Gully Trap with Strainer (Standard Drawing No. PUB/WRN/STD/043)

(viii) Basement car park

(1) For Basement car park which is not exposed to rain, the drainage system for the car-parking areas may be connected to sewerage system. In such case, adequate numbers of floor waste shall be provided to convey wastewater into the sewerage system so as to prevent flooding or stagnation of water. A cast iron gully trap (Standard Drawing No. PUB/WRN/STD/043) shall be provided before connection to the inspection chamber. At the entrance/exit to the basement car park, minimum crest level shall be provided to prevent any ingress of rainwater.

(2) For Basement car park which is partially exposed to rain or the car-parking areas are likely to subject to surface water runoffs from rain, the drainage system serving the car parking areas (except car washing areas) shall be connected to surface storm-water drain via an oil interceptor if necessary. In such case, no floor wastes are required. The water discharging into open drain shall meet the discharge standards as specified by NEA.

Connection via Petrol and Oil Interceptor (Standard Drawing No. PUB/WRN/STD/042)

(ix) Lubrication bay and car washing bay of petrol station

(x) Motor garage

(b) Waste sumps may be provided at multiple junctions of the waste discharge pipes to facilitate ease of maintenance. Details of waste sump are shown in Drawing No 3-10a.

3.1.3.10 Provision of Grease Trap for Food Shop (3-9a)

(a) The grease trap shall be sited at locations to facilitate maintenance and will not give rise to nuisances, health hazards and hygiene problems during its operation and maintenance. It shall not be sited within areas where food is prepared, cooked, served or stored.

(b) Standard circular grease traps (Standard Drawings No PUB/WRN/STD/040 and PUB/WRN/STD/041) shall be provided.

(c) Portable grease interceptor may be used where the provision of standard grease traps is not feasible. The portable grease interceptor is allowed to be installed within the individual food shops provided that it must be of a suitable design to allow for easy removal for maintenance.

(d) All portable grease interceptors shall incorporate a mechanical oil-skimming device for automatic removal of free-floating grease and oil to a separate grease/ oil container.

(e) Sufficient floor waste/floor trap shall be provided for the discharge of the sullage water from the kitchen into the grease trap.

3.1.3.11 Sanitary Drainage System for Market (3-12a)

(a) Specially designed floor sump (3-13) shall be provided to collect the sullage water from the scupper drains within the stalls and at the service corridors and the common passageways. The details are shown in Drawing No. 3- 12a.

(b) Waste sump (3-10a) shall be sited at service corridors and away from the main public areas. Inspection chamber shall be sited outside the market proper.

3.1.3.12 Sanitary Drainage System for Shower/Bathroom Compartment/ Wash Area at Beach Site/Construction Site/Other area where silt discharge is expected (3-14)

(a) Sullage water from shower/bathroom compartment/wash area shall be discharged into a silt trap before connection to an inspection chamber. This is to prevent the sand/silt from entering the sewerage system.

(b) Temporary septic tank is not allowed to serve the temporary work site facilities for developments located in sewered areas and within the water and urban river catchment areas. In such cases, temporary sewer connection to existing sewer is to be provided.

(c) If sewer is not available and the development is located within the water and urban river catchment areas, Developer will have to bring forward the extension of public sewer to serve the construction site. During the interim, temporary holding tanks (i.e. no discharge to sewer/drain) of sufficient capacity (design flow is 200 litres per person per day and minimum capacity is 2000 litres) for sullage water and portable chemical toilets are to be provided. Licensed Waste Contractor shall empty the temporary holding tanks/chemical toilets regularly.

3.1.3.13 Sewer Connection (3-4)

The connection from the last inspection chamber to the sewer/manhole shall be constructed in accordance with the Department's Standard Drawing PUB/WRN/STD/007.

3.1.4 Material and Component *(Addendum No.1-Feb 2001)*

The following materials that comply with the stipulated standards are acceptable for use in sanitary drainage system viz:

(a) Pipes and Pipe-fittings

(i) uPVC	-	SS 272 : 1983
(ii) Ductile iron	-	BS EN 598 : 1995
(iii) Heavy-duty cast iron	-	BS 4622 : 1970
(iv) Vitrified Clay	-	BS EN 295 : 1991
(v) Reinforced concrete	-	SS 183 : 1978

(b) Manhole/Inspection chamber frames and covers - SS 30 : 1999

3.2 SANITARY PLUMBING SYSTEM

3.2.1 Objectives

The sanitary plumbing system for any premises shall be designed, installed and maintained so as to carry away wastewater from the building into the sewerage system quickly without creating any nuisance or risk of injury to health.

3.2.2 Design Criteria

(a) No sanitary plumbing system shall be used to convey rainwater.

(b) The sanitary plumbing system shall comprise the minimum pipework and be designed to provide adequate capacity to cater for the discharge from the sanitary appliances to which it is connected.

[Reference may be made to the British Standard (BS 5572), U.S - National Standard Plumbing Code or other acceptable standards for the sizing of pipework to provide reliable service. However, the minimum sizes for discharge stacks/ pipes and ventilating stacks/ pipes to be provided shall be in accordance with the requirements laid down in this Code]

(c) The sanitary plumbing system shall be designed to exclude foul air from the discharge pipes or stacks from entering the buildings. In this connection, water seals of sufficient depth (not less than 50 mm) are required to be provided at sanitary appliances and floor traps. The system shall be designed and installed to avoid water seal loss in trap arising from pressure fluctuations through the provision of ventilating pipes/stacks or adequate sizing of discharge stacks as appropriate, for the sanitary plumbing system.

(d) In the case of residential buildings where the sanitary appliances are closely grouped around a discharge stack, the "single stack system" may be adopted for buildings up to six storeys high and the "ventilated stack system" for buildings up to thirty storeys high.

(e) In the design and installation of the sanitary plumbing system, attention shall be given to the need to facilitate access for maintenance and repairs. Access cover and/or cleaning eyes shall be appropriately positioned to enable cleaning, clearing of chokages and inspection to be carried out.

(f) The discharge pipe shall not be located in places where it can cause health and safety hazards such as locating the discharge pipe above any potable water storage tank and electrical transformer/ switchgear.

(g) The discharge pipe shall also not be located in places where it can give rise to nuisance conditions during maintenance. In particular, for buildings under the Land Titles (Strata) Act, discharge pipes shall not run above bedrooms, living room, dining room or kitchen areas of the strata unit below. Where such routing cannot be avoided, suitably designed service duct to allow access for maintenance shall be provided.

(h) As required by NEA, adequate measures, such as installation of anti- mosquito devices at the floor trap, shall be taken to prevent mosquitoes from breeding in the water seal of the floor trap.

(i) For sewage collected below ground level, sewage ejector, solids divertor or other appropriate pumping installation will have to be provided.

(j) The sanitary plumbing system shall be tested for water and air tightness either by means of an air test, smoke test or water test for soundness of the installation. Reference can be made to BS 5572 for details.

3.2.3 Acceptable Design / Practice

3.2.3.1 Fully Ventilated Sanitary Plumbing System (3-15a)&(3-16a)

(a) The fully ventilated system is used where there are large numbers of sanitary appliances in range or where they have to be widely dispersed.

(b) In the fully ventilated system, separate discharge and ventilating stacks have to be provided and be extended to the atmosphere. Individual traps/soil sanitary appliances connected directly to the discharge pipe or stack need to be provided with branch ventilating pipe which is connected to ventilating stack.

(c) The discharge stack shall have a uniform diameter of not less than 100mm throughout its entire length.

(d) The trap connecting directly to a discharge pipe shall be provided with a branch ventilating pipe of not less than 50mm in diameter.

(e) The ventilating pipe shall be constructed upwards individually and be connected to a main ventilating stack. Such connection shall be above the spill over level of the soil sanitary appliance or floor trap served by such ventilating pipe. The details are shown in Drawings No. 3-19 & 3-20.

(f) The top end of every ventilating stack shall either terminate as high as the discharge stack or connect into the discharge stack at a point not less than 150mm above the spill over level of the topmost soil sanitary appliance or floor trap.

(g) For multi-storey buildings of seven-storey or higher (3-16a), the discharge pipe serving the second storey shall be connected to a secondary discharge stack of diameter not less than 100mm. This stack shall be extended to serve as ventilating stack but may be reduced to 75mm diameter.

(h) Cross venting between the ventilating stack and the discharge stack shall be provided at every ten storeys.

3.2.3.2 Single Stack Sanitary Plumbing System (3-17b)

(a) The single stack system may be used for buildings up to six storeys high where there are single appliances connected to a discharge stack or where the sanitary appliances/ fittings are closely grouped round a discharge stack which is large enough to limit pressure fluctuations without the need for a ventilating stack.

(b) The main discharge stack shall have a uniform diameter of not less than 150mm without offset throughout its entire length. However, for conventional housing, a main discharge stack of 100mm diameter may be provided.

(c) The length of the discharge pipe connecting to the discharge stack shall not be more than 2.5m and there shall be not more than two connections made to the discharge pipe.

3.2.3.3 Ventilated Stack Sanitary Plumbing System (3-18b)

(a) The ventilated stack system may be adopted in situations where there are close groupings of sanitary appliances around the discharge stack in buildings up to thirty storeys high.

(b) The main discharge stack shall have a uniform diameter of not less than 150mm throughout its entire length.

(c) Separates discharge stack (secondary discharge stack) of diameter not less than 100mm shall be provided to serve the second and third storeys. This secondary discharge stack shall be extended to serve as ventilating stack.

(d) Cross venting between the ventilating stack and the discharge stack shall be provided at third, sixth, ninth, twelfth, fifteenth, eighteenth, twenty-first, twenty-fourth and twenty-seventh storeys.

(e) The length of a discharge pipe connecting to the discharge stack shall not be more than 2.5m and there shall be not more than two connections made to the discharge pipe.

3.2.3.4 Discharge Pipe/Stack, Ventilating Pipe/Stack for Sanitary Plumbing System (3-15a) to (3-21)

Unless otherwise indicated, the following clauses are applicable to all the above 3 types of sanitary plumbing systems:

(a) The discharge pipe shall have a minimum size of 100mm and be made of the same material throughout its entire length. The pipe shall not be reduced in diameter in the direction of flow.

(b) In the case of the "fully ventilated system" and "ventilated stack system", the discharge stack shall, as far as practicable, not form any offset throughout its entire length. Where offset is to be made, large radius bends of at least 200mm radius shall be used and cross venting between the ventilating stack and the discharge stack is required above and below the offset (3-21).

(c) Swept branch connections from discharge pipe to discharge stack are recommended. Directly opposite discharge pipes without swept entries shall be at least 200mm vertically apart so that discharge from one branch into the other is avoided.

(d) The discharge pipe and discharge stack shall be securely supported or fixed to the wall or roof slab of the building.

(e) The discharge pipe and discharge stack shall be easily accessible. Access covers for cleaning eyes shall be positioned to allow cleaning and maintenance equipment to be easily inserted into the pipework and to permit cleaning or clearing of all parts of the system. Access cover on the invert of pipe shall be avoided. Access for rodding and testing shall be provided at or near the foot of the discharge stack and at junctions of discharge pipe/stack.

(f) The ventilating pipe shall be fixed as close to the crown of the trap as practicable. Other aspect of the construction of ventilating stack, cross venting, termination of discharge stack and ventilating stack are shown in Drawing No. 3- 15a, 3-16a, 3-17b, 3-18b & 3-21.

(g) The ventilation stack shall not be terminated in any private premises or private roof area that is designed for use by the occupants. To avoid termination of ventilation stack in private premises or roof areas, the ventilating stack may be offset or connected to a common pipe of adequate size and extended for termination in the open air at the highest point of the building or other suitable location that will not cause smell nuisance or health hazard to the occupants. The recommended height of the ventilating stack above roof is shown in Drawing Nos. 3-15a, 3-16a, 3-17b & 3-18b. *(Addendum No.1-Feb 2001)*

3.2.3.5 Connection of Discharge Stack to Branch Drain-line (3-22)

(a) The discharge stack shall be connected directly to the inspection chamber. Where individual connections of discharge stacks are impracticable, a common pipe of adequate size to serve the discharge stacks may be provided to suit connection to a branch drain-line.

(b) In the case of multi-storey buildings of 7-storey or higher, both discharge and ventilating stacks are to be connected to inspection chamber. The invert of the discharge end of the ventilating stack shall be at least one diameter above that of the discharge stack.

3.2.3.6 Access to Pipework Enclosure

(a) No pipe other than the ventilating pipe or ventilating stack and waste pipe shall be encased in columns, beams, walls, or floor slabs.

(b) Discharge pipes or stacks may be accommodated in enclosures such as ducts which shall be of suitable size and provide ready access openings for maintenance and testing.

(c) Access openings shall preferably be provided to joints or junctions of discharge pipes/stacks and other fittings that may require maintenance.

3.2.4 Material and Component *(Addendum No.1-Feb 2001)*

The following materials that comply with the stipulated standards are acceptable for use in sanitary plumbing system viz:

(i) uPVC	-	SS 213 : 1998
(ii) Ductile iron	-	BS EN 598: 1995
(iii) Hubless cast iron	-	CISPI : 301 : 1995
	-	CISPI : 310 : 1995
	-	BS 6087 : 1990
	-	ASTM C 564 : 1995
(iv) Spigot/Socket cast iron	-	SS 33 : 1975

3.3 SANITARY APPLIANCES AND FITTINGS

3.3.1 Objectives

Sanitary wares, sanitary pipes and fittings are part of the sanitary plumbing and drainage system for the conveyance of wastewater from within the premises to the sewerage system. Its design and construction have a great impact on the proper functioning of the sanitary plumbing system. The proper selection and installation of sanitary wares, pipes and fittings will reduce the risk of danger to health arising from blockage, leakage or surcharge.

3.3.2 Selection/ Design Criteria

(a) The sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers used in the sanitary plumbing and drainage system shall be of a type, size, quality and workmanship as specified in the Code and shall comply with the Standards prescribed in this Code of Practice. *(Addendum No.1-Feb 2001)*

(b) Sanitary appliances shall be secured in position and installed in a manner that facilitate disconnection to the sanitary piping when required. The supports and brackets used for fixing of the sanitary appliances to wall shall be of adequate strength to withstand the fully loaded weight of the appliance. In no circumstances should any pipework be relied upon for support or fixing the appliance.

(c) Connection of Soil Sanitary Appliance

(i) Soil Sanitary Appliance is for the reception and discharge of excretory matter. Examples of soil sanitary appliances are water closet pan, urinal and bidet etc.

(ii) Direct connection from any water service pipe shall not be made to any part of a soil sanitary appliance other than a connection through the flushing cistern or flush valve as detailed under Clauses 3.3.3.2 and 3.3.3.4 of this Section respectively. This is to prevent contamination of the potable water system.

(iii) The soil sanitary appliance shall have at least one trap with a water seal of not less than 50 mm before connecting directly to a separate branch drain-line to an inspection chamber on first storey level or to a discharge pipe on upper storey level.

(d) Connection of Waste Sanitary Appliance

(i) A waste sanitary appliance is for the reception and discharge of water for ablutionary, cleaning or culinary purpose. Examples of waste sanitary appliances are sink, basin, bath and shower tray etc.

(ii) The waste sanitary appliance may be provided with a waste fitting trap for connection to the waste pipe.

(iii) Waste pipes serving waste sanitary appliances are to be adequately sized to handle the anticipated flow. The waste pipe shall connect above the water seal of the floor trap.

(iv) The waste sanitary appliance which is suspended shall be fixed to the wall by means of brackets which are built or screwed into the wall. All installation screws shall be corrosion resistant.

(v) Loop venting [3-24] is required where a group of 3 or more wash basins are connected in series. However, the loop venting shall be terminated separately to the atmosphere. The minimum diameter of loop venting pipe shall be 25 mm. Alternatively, Air Admittance Valve may be used.

3.3.3 Acceptable Practices on Installation of Sanitary Appliances

3.3.3.1 Water Closet Pan

(a) General

(i) The water closet pan shall be of a design suitable for use with low capacity flushing cistern or flush valve and shall conform to the functional requirements and tests in the relevant Singapore Standard SS 379 (1996).

[Under the Public Utilities (Water Supply) Regulations, a flushing device for a water closet shall deliver not more than 4.5 litres of water per flush.]

(ii) The water closet pan shall be securely installed by an approved method of fixing [3-23]. The details are shown in Drawing No. 3- 23.

(b) Oriental Water Closet Pan (Squatting type)

(i) The oriental water closet pan installed in a combined bath and water closet compartment shall be fixed at least 75mm above floor level.

(ii) The oriental water closet pan shall be installed within a specially designed recessed reinforced concrete floor slab such that no part of the pan shall protrude below the floor slab. The pan shall then be bedded in sand and concrete over to provide an impervious surround. The floor surrounding the pan shall also be graded to drain off any water into the pan [3-26].

(c) Pedestal Water Closet Pan [3-23]

The jointing of the outlet of the water closet pan to the branch drain-line or discharge pipe shall be done either with a purpose made flexible connector (pan collar or floor flange) or other approved method of jointing.

(d) Wall Hung Water Closet Pan

Wall hung water closet pan shall be fixed with stainless steel bolts and nuts or other approved means to an independent support frame such that no strain is transmitted to the water closet pan connector or any other part of the plumbing system. The support frame, depending on the design, should be securely fixed within the structure of the building.

3.3.3.2 Flushing Cistern

(a) The flushing cistern serving a water closet pan shall be of the low capacity type and shall conform to the specifications, tests and installation requirements in the relevant Singapore Standard SS 378 (1996)

[Note: Under the Public Utilities (Water Supply) Regulations, a flushing flushing for a water closet shall deliver not more than 4.5 litres of water per flush.]

(b) The flushing cistern, except when it is of a self supporting close-coupled water closet suite, shall be installed abutting and firmly fixed to the wall by either stainless steel bolts and nuts, stainless steel brackets (or support pads) or other approved means.

(c) The connection of the flush pipe of the flushing cistern to the water closet pan and the urinal shall be made using a purpose made connector or bush to ensure a robust and watertight joint.

(d) The high level flushing cistern shall be fixed to an oriental water closet pan with a flush pipe of height not less than 1.5 metres between the bottom of the cistern and the top of the water closet pan. The flush pipe shall not be less than 32 mm in diameter.

(e) For low level flushing cistern the minimum internal diameter of the flush pipe shall be 35 mm.

3.3.3.3 Urinal (3-25)

(a) The urinal shall be of the individual stall or wall hung units. The urinal shall be more than 300 mm wide and the collection area shall project from the wall by at least 300 mm.

(b) The individual urinal shall be firmly fixed to the wall by either stainless steel bolts and nuts or other approved means. There shall be a minimum of three support points for wall hung urinal to provide support for uneven loading or side loading situations.

(c) The urinal shall be provided with a fitting trap of at least 40mm in diameter. The connection (by means of a urinal trap of at least 75 mm in diameter) shall be made directly to an individual branch drain-line to an inspection chamber on first storey or to a discharge pipe on upper storey level.

(d) A urinal trap shall be provided to serve a maximum of 10 urinals. For more than 10 urinals, more than one trap shall be provided.

(e) Where a group of urinals are connected in series, loop venting is required (see Drawing No 3-25). Alternatively, Air Admittance Valve may be used.

(f) The flush pipe for urinal flush valve shall be made of either stainless steel or chrome-plated copper alloy and shall preferably be concealed.

3.3.3.4 Flush Valve [3-26]

(a) The flush valve shall conform to the requirements in the SS CP 48 - Code of Practice for Water Services.

[Note : Under the Public Utilities (Water Supply) Regulations, (1) a flush valve for a water closet shall deliver not more than 4.5 litres of water per flush and a flush valve for urinal shall deliver not less than 1.5 litres and not more than 2.5 litres of water for individual urinal unit; (2) Flush valve shall not be used in residential premises.]

(b) Only water closets and urinals in non-domestic buildings/premises may be fitted with flush valves.

(c) The flush valve shall be preferably activated by depressing a push-knob. All adjusting mechanisms shall be temper proof and securely concealed. Flush valve with only the activating knob exposed to the user is preferred.

(d) The flush pipe shall be made of either stainless steel or chrome-plated copper alloy and preferably concealed.

(e) The connection of the flush pipe of the flush valve to the water closet pan and urinal shall be made using a purpose made connector to ensure a robust and watertight joint.

3.3.3.5 Automatic Flushing Devices

(a) As required by NEA, all water closets and urinals in public toilets shall be fixed with sensor flush valves.

(b) All automatic flushing devices shall be activated by sensors. Automatic flushing devices that can be used are either:

(i) Sensor devices/mechanisms that can activate an approved manual flush valve; or

(ii) A fully integral sensor-operated flush valve.

3.3.3.6 Bidet

(a) The bidet shall be provided with a spray nozzle fixed above the spill over level of the bidet pan and shall conform to the requirements in the SS CP 48 - Code of Practice for Water Services.

(b) Water for the flushing of the bidet shall not be supplied directly from the water supply unless through an approved vacuum breaker and check valve or other approved means for preventing backflow or back-siphonage and controlled by approved stop-valve.

(c) The bidet shall be provided with a fitting trap of at least 40 mm in diameter. The connection by means of a bidet trap of at least 75 mm in diameter shall be made to an inspection chamber on first storey level or to a discharge pipe on upper storey level [3-25].

(d) The bidet shall be installed in accordance with the pedestal water closet pan or the wall hung water closet pan as specified in Clause 3.3.3.1(c) or 3.3.3.1(d).

3.3.3.7 Special Sanitary Appliance *(Addendum No.1-Feb 2001)*

Approval of PUB should be obtained for the use of any special sanitary appliance not covered under this Section. This includes the special soil sanitary appliances for hospital.

3.3.3.8 Bath and Shower Unit

(a) The supports for the bath/shower unit shall be of sufficient strength to obviate strain on any pipework connection.

(b) The joints between the edge of the bath/shower unit and the wall shall be watertight.

(c) Where a dwarf wall is to be erected to support the bath, an access opening is to be provided in the wall to facilitate maintenance of the waste pipe under the bath.

3.3.3.9 Floor Trap (3-6)& (3- 8)

(a) The waste pipe shall be connected above the water seal of the floor trap and shall be as short as possible.

(b) The minimum internal diameter of the outlet of the floor trap shall be 75mm.

(c) The trap with an outlet of 75mm in diameter shall have a water seal of not less than 75mm.

(d) The floor trap at upper storey level shall be connected to a discharge pipe.

(e) The riser to the floor trap shall be of the same diameter as the opening of the trap.

(f) Adequate number of floor traps shall be provided for bathroom or shower compartment. The floor trap shall be positioned as near to the tap point/shower point as possible and the floor appropriately graded/designed so as to enable quick drainage of the wastewater from tap points or shower points to the floor traps to avoid wetting of the whole toilet floor area.

(g) For group showers, a floor trap shall be provided to serve a maximum of 5 showers. A floor waste or channel of adequate capacity shall be provided in the shower compartments to convey the sullage water to the floor trap.

3.3.3.10 Floor Waste

(a) Floor waste shall be connected to a floor trap above the water seal of the trap and the length of the waste pipe between the floor waste and floor trap shall be as short as possible.

(b) The minimum internal diameter of the floor waste shall be 50mm. However, where the floor waste also serve a waste sanitary appliance, the minimum internal diameter shall be 75 mm.

(c) The floor waste shall be covered with a grating.

3.3.3.11 Grating and Cover for Floor Trap and Floor Waste

(a) The grating and cover shall be constructed of suitable approved material like durable plastic and stainless steel.

(b) The grating and cover shall be of an approved design so as to enable them to be secured to deter the unwarranted opening of the grating or cover and hence introduction of garbage or other solid waste into the sewerage system.

3.3.4 Shallow Floor trap for Prefabricated Toilet Unit

Approval of PUB shall be obtained for the use of shallow floor traps for Prefabricated Toilet Unit.

3.3.5 Material and Component *(Addendum No.1-Feb 2001)*

(a) Sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers that comply with the Singapore Standards or other Standards as prescribed in this code and certified by a conformance assessment body or certification body accredited to the relevant authority (SAC-SINGLAS) or bodies under its Mutual Recognition Agreements (MRAs) are acceptable for use in sanitary work/sewerage works. Separate approval from PUB for their use is not required. The Department may require such certificates/test reports to be submitted for verification.

(b) Sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers for use in sanitary works/sewerage works may be listed in the "Product Listing Scheme" (PLS) administered by the PSB Corporation Pte Ltd . The PLS directory of approved products is obtainable from PSB at 1 Science Park Drive or can be downloaded from PSB Website at URL Address: http://www.psbtest.com

(c) Approval of the Department shall be obtained for the use of other types/designs of sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers not specified in this Code. These sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers must comply with the Singapore Standards or other acceptable Standards if no Singapore Standard is available.

(d) All sanitary wares, pipes and fittings, manhole/ inspection chamber frames and covers shall be legibly marked with the manufacturer's name/brand name or mark and the standards under which the product conform to. The markings may be cast-on, cold stamped or painted on the product. Alternatively, labels may be affixed or attached to the product

3.4 STANDARD DRAWINGS FOR SANITARY WORKS

NOTE: The above standard drawing for sanitary works Nos. 3-1 to 3-26 can be downloaded from the Internet Website at http://www.pub.gov.sg

PART 4
LIST OF STANDARD DRAWINGS AVAILABLE FOR DOWNLOAD FROM INTERNET WEBSITE AT URL ADDRESS :

http://www.pub.gov.sg

Serial No.	Drawing Number	Description
1	PUB/WRN/STD/001	Standard Details of Main Sewers and Manholes
2	PUB/WRN/STD/002	Standard Details of Minor Sewers and Manholes
3	PUB/WRN/STD/003	Precast Concrete Manhole Parts
4	PUB/WRN/STD/004	Standard 45 Degrees Bend Manhole for 1050mm Dia. & Above
5	PUB/WRN/STD/005	Standard Manhole for Sewer 1050mm Dia. and Above
6	PUB/WRN/STD/006	Standard Details of Deep Precast Concrete Manhole with one Intermediate Platform
7	PUB/WRN/STD/007	Standard Details of Sewer Connections
8	PUB/WRN/STD/015	Standard Heavy Duty Manhole Fame & Cover
9	PUB/WRN/STD/016	Standard Medium Duty Manhole Frame & Cover
10	PUB/WRN/STD/017	Standard Light Duty Inspection Chamber Frame & Cover
11	PUB/WRN/STD/018	Recessed Type Light Duty Inspection Chamber Frame & Cover
12	PUB/WRN/STD/040	Standard Circular Grease Trap for Canteens, Restaurants & Eating Stalls
13	PUB/WRN/STD/041	Standard Grease Trap for Small Eating Stalls
14	PUB/WRN/STD/042	Standard Grease, Petrol & Oil Interceptor- Three Compartments
15	PUB/WRN/STD/043	Cast Iron Gully Trap for Motor Workshop
16	PUB/WRN/STD/044	Cast Iron Gully Trap for Bin Centre/Refuse Centre
17	PUB/WRN/STD/045	Cast Iron Gully Trap for Markets
18	PUB/WRN/STD/046	Standard Aluminium Alloy Strainer Bucket & C. I. Gully Trap
19	PUB/WRN/STD/103	Standard 8 Metres & 4.8 Metres Wide Gates
20	PUB/WRN/STD/104	Standard 4 Metres Wide Gate for Sewage Treatment Plant
21	PUB/WRN/STD/105	Standard 2.4 Metres High Chain Link Fence
22	PUB/WRN/STD/111	Security Grilles for Pumping Station

(Addendum No.1-Feb 2001)

PART 5

LIST OF ANNEXES

ANNEX A - GOOD SEWER AND PUMPING MAINS LAYING PRACTICE

5.1 Connection to Existing Manholes

(a) Every care shall be taken to ensure that the connections of pipelines to existing manholes are watertight and the existing sewers and manholes are not damaged.

(b) In connecting the pipeline to the existing manhole, a circular hole large enough to accommodate the pipeline shall be made in the wall and the cut end of the pipe neatly rendered to form a smooth bore.

(c) Every care shall be taken to ensure that there is no interruption to existing flows during connection works. No debris shall be allowed to fall or be discharged into the existing sewers.

5.2 Abandoned Sewers, Pumping Mains, Manholes and Chambers

(a) Ends of the abandoned sewers/pumping mains shall be sealed watertight with 225mm thick brick plugs and rendered with cement mortar. The abandoned sewers/pumping mains of 300mm diameter and above on public roads shall be filled with concrete or cement grout.

(b) All abandoned manholes/chambers are to be demolished and manhole frames and covers removed.

5.3 Connection to Existing Pipes

A compatible fit between new and existing pipes shall be ensured whenever connections are to be made to existing pipes. Where such a fit is not possible, specially manufactured piece for the transition will have to be used.

5.4 Pipe jacking

(a) Prior to pipe jacking, a comprehensive soil investigation along the route of the pipeline shall be carried out. Stable soil conditions at the jacking face shall be maintained at all times to prevent loss of ground above the jacking operation and movement of the surrounding earth. Maintenance of face stability and prevention of ground movement and subsidence shall be by methods where fluid slurry or earth pressure is applied to the tunnel face. Unstable ground ahead of the jacking face may be stabilised by the injection of suitable chemicals. Methods used shall not lead to significant ground loss.

(b) Methods which require workmen to carry out excavation either manually or semi-mechanically in pipes or tunnels smaller than 1200mm in diameter shall not be used.

(c) Measures shall also be taken to ensure that there are no voids outside the pipes.

5.5 Diversion of Existing Sewers

(a) Whenever manholes are to be constructed onto existing sewer, precautionary measures are to be taken to ensure that there is no interruption to the flow in the existing sewer. Care shall also be taken to prevent any debris from falling into the sewer and being carried downstream. Any debris falling into the sewer must be removed immediately. No existing sewer shall be sealed off until the new line has been completely inspected and certified fit for use. For such cases, the ends of the newly constructed sewer shall be plugged up until diversion of flow can be implemented.

(b) No drain-lines/sewers affected by the work shall be sealed off without prior and proper diversion of the affected drain-lines/sewers.

5.6 Advanced Sewer Connections

The ends of advance sewer connections and Y-junctions for which future connections are provided for are to be satisfactorily sealed with approved material. Where applicable, markers (timber or otherwise) are to be labelled clearly and erected accurately to mark the ends of advance connections and Y-junctions. The markers are to be fixed into the ground in a manner that they will not be easily removed.

5.7 Safe Working in Confined Spaces

(a) All safety requirements for workmen working in sewers, pumping mains, chambers, sumps and other confined spaces, including the provision of adequate ventilation and necessary apparatus, as stipulated by the Ministry of Manpower shall be strictly complied with.

(b) Approval from Water Reclamation (Network) Department (PUB) shall be obtained prior to carrying out any sewer connection works in the public sewerage system.

5.8 Setting Out

The sewer shall be properly set out before any work commences.

5.9 Pipe Bedding with Granular Material

(a) The bedding for the pipes shall be thoroughly compacted. The pipes shall be laid evenly on the barrel at the required level. There should be no hollows, voids or foreign materials under the pipe. Any concrete blocks or wedges should be removed on completion of bedding.

(b) Particular care must be taken to ensure that proper bedding is obtained at and on either side of the pipe joints. Where pipe jointing holes are left in the bedding, particular care must be taken to ensure complete and proper filling of the holes after pipe testing.

5.10 Concrete Bed, Haunching and Surround to Pipe

(a) The concrete used for the concrete bed foundation shall be well rammed or vibrated and worked under and around the pipes.

(b) At approximately every four pipes or 6 metres whichever is the less interval, a joint shall be formed in the concrete bed or surround by vertically shuttering the bed or surround with 25 mm thick fibreboard, timber or other approved materials. The shuttering material shall be left in to form a permanent joint. Where the concrete bed is required to be reinforced, all reinforcement shall stop on either side of the joint.

5.11 Pipe laying

(a) All pipes shall be carefully brushed out inside and shall be tested for soundness before being laid. The pipes shall be laid separately to true inverts, straight lines and falls, each pipe being separately boned between sight rails and bearing evenly upon the solid ground or concrete for its full strength.

(b) Where pipes are laid without a concrete bed, holes shall be cut in the bottom of the trench of such size and depth as to allow the joints to be properly made and the barrel of the pipe to bear evenly on the solid ground for its full length.

(c) Where pipes are to be laid on rock formation, the excavation shall be taken down to 100mm below bed level and great care shall be taken to ensure that there are no projecting pieces of rock on which the pipe will ride. The bed will then be made up to its true line and level by refilling with either 100 mm of consolidated, selected material from the excavations, well rammed and watered if necessary, or with 100mm of concrete grade 15.

(d) All blocks and wedges are to be of sufficient size and strength to prevent settlement of the pipes.

5.12 Testing of Water-tightness of Sewers

(a) All gravity pipelines and sewers below 600 mm in diameter before being surrounded and covered shall be tested by filling with water. The pressure shall be measured from the highest point of the pipeline under test and shall be 1.5 metre head of water. Pipelines should not be accepted until they have withstood the required pressure for 30 minutes without a loss in excess of 11/2 litres for 100 m for each 300 mm in diameter.

(b) Sewers of 600 mm and above in diameter need not be hydraulically tested. They shall be inspected by CCTV inspection or for man-entry sewers, manual inspection shall be carried out.

5.13 Testing of Water-tightness Pumping Mains

(a) All pumping mains of 600 mm or less in diameter shall be tested hydraulically in convenient lengths before being covered up. Water shall be forced into the pipes by means of a force pump, fitted with a pressure gauge to indicate the pressure at the lowest point of the section under test. The test pressure shall be 1.2 N/mm^2 for all classes of pipes.

(b) Before any test commences, the trench if the pipeline is underground, is to be partially backfilled to cover the pipes but leaving the joints exposed for inspection and repairs or remedial work where necessary. Any joints not passing the test shall be refitted, cut out or replaced. No mechanical caulking shall be allowed. Where the pipelines are above ground, anchor blocks and other supports shall be provided prior to testing.

(c) The method of filling the pipes and arranging the test must ensure that all the air is expelled from the pipeline and joints before any pressure is applied. Air and pressure release cocks shall be provided wherever necessary.

(d) The testing pressure shall be provided with an isolating valve which, when closed, shall leave the pressure gauge connected to the length of pipeline under test, and at the same time isolate the pump. When the specified pressure has been reached, the isolating valve shall be closed and remain closed for 30 minutes. At the end of that time, if the pressure has dropped the isolating valve shall be opened and the loss of water determined by pumping into the main a measured quantity of water, sufficient to bring that pressure up again to the initial pressure.

(e) If the loss of water so determined is at a rate less than 10 cc per mm diameter per km of pipeline for 30 minutes, the test shall be considered satisfactory.

5.14 Manhole Construction

(a) Chamber and shaft rings may be supplied in different lengths and each section will be provided with lifting holes. The tapers to be used will be of a fixed length. The joints between the sections shall be of an ogee form. Each section shall be set up accurately in position making the ogee joint with cement mortar to form a watertight joint. Before completion of the manhole, all the lifting holes, ogee and other joints shall be neatly pointed.

(b) The reinforced concrete slabs covering the chambers and the shafts of the manholes shall be set and pointed in cement mortar to form watertight joints.

(c) At all points where pipes are built into concrete walls, or floors, great care shall be taken that the joint is watertight. If found to be otherwise, the concrete shall be cut away and replaced with concrete, to make a watertight joint.

(d) Manhole covers and frames are to be set in cement mortar and surrounded with grade 20A concrete and covers left flush with the surrounding ground or road surface as the case may be and shall be set on two courses of 225mm brickwork. The fine adjustment of cover levels shall be effected by creasing courses of hard burnt tile. Care shall be taken to ensure that the cover is level and sloped to any fall or grade in the surrounding surfaces.

5.15 Backdrops and Tumbling Bays

Where Backdrops/Tumbling Bays are used, the pipes are to be built in the walls of the manhole by cutting a neat hole in the precast concrete rings sufficient for building in the pipes and pointed in cement mortar. The joint shall be finished flush with the inside of the manhole and neatly splayed on the outside to form a watertight joint.

5.16 Inspection of Completed Sewers

(a) All completed sewers are to be inspected to ascertain that the pipes are entirely clear of obstruction, that the invert is smooth, that the joints are properly constructed, that there are no defects etc.

(b) In cases where the pipes cannot be inspected from the inside, generally under 600mm in diameter, a loose plug shall be passed through each pipeline to ensure that the pipes are entirely clear of obstruction and that the invert is smooth. The loose plug shall be in the form of a cylinder with solid ends made of timber not less than 25mm in thickness.

(c) In cases where the sewers are 600mm and above but lesser than 900mm in diameter, CCTV inspection shall be carried out to inspect the completed sewer. Where the sewers are greater than 900mm, visual inspection from the inside of the pipes shall be carried out.

ANNEX B – STANDARD DRAWING ON PROVISION OF ADVANCE CONNECTIONS TO LOT BOUNDARIES FOR SEWER DIVERSION WORK (DRAWING NO. 5-1)