

VOLUME 3

SECTION 3

WATER AND SEWERAGE SERVICES BY THE NATIONAL WATER COMMISSION

**The Responsibility of
The National Water Commission
28-48 Barbados Avenue
Kingston5**

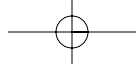
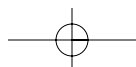
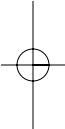
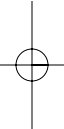


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CHAPTER I

NATIONAL WATER COMMISSION

1.0 LEGAL RESPONSIBILITIES OF THE NWC

The National Water Commission is responsible for the provision of water supply and sewerage services in Jamaica. The legal basis for this responsibility comes under the Second Schedule of the National Water Commission's Act, Paragraph 4 (2). This paragraph transfers power formerly vested in the Mayor and the Council of the Kingston & St Andrew Corporation (KSAC), to the Chairman of the National Water Commission (NWC) and the NWC respectively.

The power being transferred comes from Section 5 (3) and 8 (3) of the Local Improvements Act. Here, it is stated that the specifications for sewers and water pipes shall bear a certificate signed by the Mayor (now the Chairman of the NWC) stating that the specifications have received the approval of the Council (now the NWC), and that no sanctions shall be valid without the aforementioned approval.

1.0.1 Role of the NWC in Regulating Land Development

These legal responsibilities give rise to the Commission's role in the regulation of land development. The KSAC Local Parish Councils, the Town and Planning Authority and the National Environment and Planning Agency (NEPA) are responsible for development approval. The services of the National Water Commission, however, are required whenever a Developer makes an application to:

- i Sub-divide land, regardless of whether the division imposes a water demand or not.
- ii Supply water to a development, generally a sub-division, where more than one dwelling is to be erected and also to multi-storey buildings, commercial or industrial development; or
- iii Connect a single dwelling unit to an existing NWC supply line.

1.1 INPUT IN THE DEVELOPMENT PROCESS

The input of the Commission in the development process occurs in one or two ways, these are:

- i to advise on the availability of service to a contemplated development, and
- ii to regulate the interface between existing NWC water supply and sewerage systems and a new or proposed system.

1.2 ROLE OF THE NATIONAL WATER COMMISSION (NWC)

NWC plays a critical role in the development approval process for both water and sewerage services.

1.2.1 Water Services

NWC's role in relation to water services include:

- i Identifying whether NWC has water supply facilities near the proposed development;
- ii Reviewing whether existing water supply facilities have sufficient capacity to meet the ultimate water requirement of the proposed subdivision;
- iii Assessing whether the proposed subdivision can be developed without negatively impacting on NWC's sources (rivers, aquifers etc.); and
- iv Advising NEPA on NWC's position regarding the availability and sufficiency of water supply systems to meet the water needs of the development

1.2.2 Sewerage Services

NWC's role in the provision of sewerage services include:

- i Determining if the capacities of NWC's existing sewerage and sewage treatment and disposal facilities are sufficient to accommodate the sewage flows that will be generated in the proposed subdivision

- ii Reviewing designs of sewerage and sewage treatment facilities that are intended to be transferred to NWC, to ensure that these designs are in keeping with NWC's requirements.

I.3 RESPONSIBILITY OF THE DEVELOPER

While NWC is committed to making every effort to support development, it must be emphasized that it is the responsibility of a developer to ensure that adequate water, along with water supply and sewerage facilities are in place to adequately support the needs of his development.

I.4 SEWERAGE SERVICES

The NWC's role, in relation to sewerage services, is similar to that in relation to water supply, but with some important differences. The NWC's statutory responsibility with respect to sewerage services in the development process arises only in so far as the Commission owns and operates a system in the area of the development. If the development is within 90 meters/100 yards of a system owned by the NWC, there is a statutory obligation for the development to be connected to the system. This connection thereby becomes subject to the NWC's approval process as outlined in this document.

In addition, any development that includes a sewerage system is subject to the NWC's approval if there is an intention that the system is to be eventually turned over to the NWC to operate and maintain.

I.4.1 Sewerage Services needed by Developer

The Commission's services, with respect to sewerage, are needed by the Developer in any application to:

- i Connect a subdivision or development to an existing sewer main, where more than one dwelling is to be erected.
- ii Connect a single building to a proximate existing sewer main.
- iii Approve a proposed sewerage scheme for which there is an intention to hand it over to the Commission for operation and maintenance.

1.5` PURPOSE OF DOCUMENT

The purpose of this document is to describe, in a clear and concise manner, the approval process for each category of application outlined above. The document is structured along the lines of the application categories listed, and includes a number of definitions, standard drawings, specifications and sample bills of quantities. The document concludes with a section on minimum acceptable standards as they relate to settlement upgrading and previously serviced lots.

CHAPTER 2

DEVELOPMENT APPLICATIONS

2.0 APPLICATION SUBMISSION

Applications for land development or subdivision are to be submitted to the KSAC, Parish Council or Municipal Council in the parish in which the development or subdivision is proposed. The Parish Council will forward the application to the National Environment and Planning Agency (NEPA), which then takes on the responsibility of coordinating the approval process.

In undertaking its role in the development approval process, NEPA will request as considered necessary comments from various government agencies regarding the proposed development plans. The National Water Commission (NWC) is requested to comment on the availability of water for the proposed development.

The NWC will accept subdivision applications for water supply if they are submitted directly to this agency. This is normally done simultaneously with submission to the KSAC or Parish Council, in order to speed up processing of development the application. Subdivision applications for water and sewerage should be addressed to:

The Chief Engineer
National Water Commission
4 Marescaux Rd.
Kingston 5

Where it is contemplated to provide central sewerage for a development and this is to be connected to existing NWC's sewerage or it is proposed to construct sewage treatment and disposal facilities for the development that is to become the responsibility of NWC, a separate application and submission are necessary. These documents should be addressed as indicated above for water applications.

2.1 APPLICATION REQUIREMENTS

NWC's requirements for reviewing development plans/subdivision applications submitted for consideration, for water and sewerage services are detailed below. Requirements vary slightly according to subdivision size and specific features. All requirements **MUST** be strictly followed for the application to be considered.

2.2 SUBDIVISION APPLICATIONS

The following are required with application

2.2.1 Plan Drawings

Three (3) hard copies and one (1) digital copy of the subdivision plan are to be submitted.

i Hard Copy

Plans shall be drawn at a scale not smaller than 1:1,250 on a sheet size not larger than 86cm x 112cm/34"x44" (E-size). Where necessary, more than one sheet may be used. In such instances, a key map is required. Plans are to be referenced using the JAD (Jamaica Datum) 2001 coordinate system.

The Jamaica Fire Brigade must approve plans for fire-fighting, indicating the required locations for fire hydrants.

ii Digital Copy

The digital copy of the plan shall be submitted in a DXF, DWG or ArcView SHP file format, and shall likewise be referenced using the JAD (Jamaica Datum) 2001 coordinate system. The measurement unit of the plan is to be metric. Files are to be submitted on IBM-compatible 3½ inch floppy disk or CD. If required, files may be compressed using PKZIP for Windows, or WinZip. Disks/CD shall be labeled with the name of the legal landowner, subdivision applicant, and commissioned land surveyor.

iii Survey Accuracy

All line and arc segments in the digital drawing file must be drawn to survey accuracy and must close to form the perimeter of each lot or block. The distances and bearings of each line and arc segment in the digital file must coincide with the distances and bearings of each line and arc segment on the hard copy plan.

iv Lots layer/file

All line and arc segments that form lots or blocks must be drawn on a layer/file named 'LOTS'. These lots or blocks must be

identified with a text entity inserted on a separate layer/file named 'LOT_TEXT'. The plan may contain additional lines, arcs and text. These shall be drawn on other layers/files appropriately named.

v Text File

A text file is to be included on the disk/CD ROM with a listing of the files contained therein, and a description of the data in each file. A hard copy of this text file is also to be submitted.

2.2.2 Information Required on Plans

Plans (hard copy and digital) shall contain the information outlined below.

- i Date of the map, scale and name of the proposed subdivision.
- ii North arrow indicating grid north.
- iii An appropriate location map indicating the general subdivision location (hard copy only).
- iv Locations, description, sketches and coordinates (x,y,z) of tie-points (known ground control points) used to reference/orient the plan (a minimum of four such points are to be used).
- v Contour plan having contours at 3m/10' maximum intervals vertically or any topographic survey available for site. The values of benchmarks based on this datum and located at various points throughout Jamaica can be obtained from the Survey Department
- v Boundary lines of the proposed subdivision.
- vii Locations of adjoining property lines or subdivision boundaries, and names of adjoining property owners or subdivisions.
- viii Locations and dimensions of all proposed and existing lots.
- ix The name and contact address of the legal land owner, and the subdivision applicant as well as the name and contact address of the engineer and surveyor who made the plan.
- x The seal of approval of the Fire Brigade (hard copy only).

- xii The seal of approval of a Commissioned Land Surveyor (hard copy only). For a list of registered Commissioned Land Surveyors contact the Land Surveyors Association of Jamaica.
- xiii Layout of water distribution system with information of proposed pipe sizes, pipe types, valves, hydrant locations, location of pump stations and point(s) of connection to NWC's water supply system. Location, size and type of water storage facilities should also be included.
- xiii For sewerage the location of the sewerage system with information of proposed pipe sizes, pipe types, manholes, (inclusive of invert levels) laterals, location of pump stations and point(s) of connection to NWC's sewerage system or to proposed facilities for proposed sewage treatment plants. Location, size and type of sewerage storage facilities should also be included.

2.3 EXCEPTIONAL CASES

In all cases the NWC reserves the rights to request an Environmental Impact Assessment (EIA) as the NWC needs to be assured that there is no negative impact on local aquifers and surface waters.

2.4 LARGE SUBDIVISIONS (MORE THAN 30 LOTS / 8 ACRES):

The following are additional requirements for subdivision applications larger than 30 lots, or greater than 8 acres in size.

2.4.1 Plan Drawings

Drawings shall also include the following:

- i Lot and block numbers. Blocks shall be consecutively numbered or lettered in alphabetical order. Lots within each block shall be consecutively numbered.
- ii Locations and dimensions of all parcels of land to be set-aside for recreational purposes or other use by property owners in the proposed subdivision. Uses are to be indicated.
- iii Locations and widths of all existing and proposed streets.
- iv Street names (existing and proposed names to be differentiated).

2.4.2 Engineering Report

An engineering report is required that sets out the bases for designs of water supply and sewerage systems. Only engineering reports prepared by Professional Engineers registered with the Professional Engineer Board (PERB) with experience in the design of water and a wastewater system will be accepted.

For water supply, this report must include a proposal to supply the development with water and an assessment of the impact of this proposal on the existing supply systems. It should account for water demands, requirement for fire flows, pumping arrangements, pressure and also maximum and minimum service pressures.

The report for wastewater systems must include a proposal to collect and convey sewage to existing NWC's sewage treatment facilities, if this is contemplated. An assessment of the impact of the proposed arrangement on NWC's existing sewerage facilities must be done. Where it is proposed to construct new sewage treatment facilities, the details of the sewage treatment and disposal designs must be provided. This should include a list of all parameters and design standards used. Preliminary, primary, secondary and tertiary treatment options, design loads etc. must also be included in this report.

Pipe diameters, layout and specifications are to be included, along with justifications for the design for both water and wastewater systems. Technical details are also to be provided. The design and materials to be used must meet with NWC's approval.

2.4.3 Maps

A map of the same size and scale as the plan map is to accompany the engineering report (3 hard copies, 1 digital copy to be submitted). This map shall include the following:

- i Topography at 2 m contour intervals, or less.
- ii Where present, sinkholes, landslides (active or inactive), caves, springs, rivers or streams (perennial and intermittent), wells and any other water features.
- iii Size and location of existing and proposed water supply mains and their appurtenances and/or sewage disposal systems, storm water

drains and their appurtenances.

- iv Size, location and elevation of proposed tanks and manholes.

Separate engineering reports are required for water supply and sewerage services. These engineering reports must be submitted in a bounded form.

2.4.3 Reference Marks

The locations of a minimum of four (4) ground control points used to orient the plan are to be marked with permanent control reference marks. These reference marks shall be made of concrete, and shall be at least thirty (30) inches in height, and four (4) inches square or four (4) inches in diameter. The monument shall be marked on top with a cross, brass plug, iron rod, or other durable material securely embedded. The coordinate location and height (as determined by a professional surveyor) are to be indicated on the monument.

2.5 SUB-DIVISION WHICH REQUIRES SEWERAGE SYSTEM

For sub-division, which requires a sewerage treatment system where a NWC system does not exist or is unable to handle the quantity of sewage, a layout of the proposed treatment systems must be included with the proposed effluent discharge point. The system must be designed with the appropriate head works and an Engineering Report must also be submitted.

The Engineering Report must include a proposal for collecting, conveying, treating and disposal of sewage generated in the development. Where it is proposed to connect to an existing NWC system it must be shown that the capacity of the system is adequate to accommodate the additional sewage for conveyance and treatment. Details of lateral manhole locations, sewer size, slopes, expected sewage flows between manholes (for low, average and maximum flow conditions) and the direction of flows within the subdivision must be provided. A table which summaries these data should be included. A Topography map at 2m contours or less with profile drawings is required. See Sewerage Service (Chapter 5 and 6) for more information.

2.6 SUB-DIVISION REQUIRING PUMPING

For sub-divisions, having any point, which cannot be supplied by mains pressure, pumping is required. An engineering report prepared by a Professional Engineer registered with the Professional Engineers Registration Board must be submitted

along with the application.

This report should include a proposal to supply the development, account for water demands and flows for firefighting, and maximum and consider minimum service pressures. **Technical details should satisfy the specifications outlined in this manual.**

2.7 SUB-DIVISION REQUIRING PRESSURE ZONING

In instances where the topography of a proposed sub-division is such that the difference in elevation from one extreme to the next is greater than 30m, pressure zones should be established by pressure reducing valves or service tanks. Justification for locations and valve sizes for the pressure reducing valves should be included.

The technical details presented in this report should satisfy the specifications outlined elsewhere in this manual.

2.8 SUB-DIVISIONS NOT REQUIRING WATER SUPPLY FROM THE NWC

Applications for sub-divisions, which do not impose a water demand on the NWC's system, should not be sent to the NWC. In addition, if the proposed development is to be served by a water supply system other than one owned by the NWC, the NWC needs not be involved. Examples of these are where water supply is to be by way of catchment tank, contract filling and sub-division of land in fulfillment of the dictates of a Will.

2.9 PRIVATE WATER SUPPLY SYSTEMS

For developments where the Developer in the future intends to provide water by operating a private water supply system, it should be borne in mind that the NWC will not take over the responsibility for operating and maintaining this system, if requested, if we are not able to assure that it is satisfactory in all respects (i.e. conforming to established standards etc.).

The Developer should, therefore, advise the NWC of the intention to use the selected source prior to its construction. A report on the source development, by a Registered Engineer, must be presented to the NWC for review. Appropriate data related to the source such as water quality and reliable yield should be provided; for well, well lithology, well depth and the results of the yield development. Designs for intake facilities of the well should be in the report.

2.10 SUBDIVISION APPLICATION FORM

The Subdivision Application Form for water and sewerage services accompanying this handbook (see Appendix I) shall be completed in duplicate for both water and sewerage services and returned along with the required documents before the assessment process can begin.

2.11 PROCESSING APPLICATION

2.11.1 Criteria for Review

Application for developmental approval will be reviewed by NWC to determine if NWC can extend water and/or sewerage services to the proposed development. Estimates of the water demand and sewage flow from the new development will be used to determine if the available system is adequate to serve the development. In assessing the water supply system, the existing supply sources, transmission facilities and distribution network are considered. The essential criteria for determination for water supply include, but are not limited to, the following:

- i Capacity of the likely water supply source(s).
- ii Capacity of the existing water supply infrastructure
- iii Average and peak water demands of the existing served areas.
- iv Average and peak water demands of proposed development.
- v Commitments made to supply other approved proposed development within the last 24 months.

2.11.1 Certificate of Approval

Development applications, which are supported by the NWC, are so indicated by a Certificate of Approval duly endorsed by the Chairman as required by law. This position is communicated to NEPA or directly to the applicant, with the Certificate of Approval and appropriate conditions for approval.

In instances where a Certificate of Approval cannot be given, but the NWC has a well developed plan to improve or install a water supply system that could benefit the proposed development, then NEPA will be informed. NEPA may then decide whether the application is to be approved as well as the relevant conditions of this approval.

The NWC considers a “well developed plan” to mean a scheme which has

been engineered and for which funding is identified and secured.

The Commission recognizes that water supply and sewerage services are only two of the many factors considered in the planning process and that the NWC may not be the sole provider of these services.

However, in all instances where planning approval is contemplated for areas where the NWC cannot guarantee service; there shall be a public disclosure of such contemplation to the satisfaction of the NWC.

2.12 GENERAL CONDITIONS

The approval of the NWC's Board shall obligate the NWC to provide water service to a Property Owner and will be subject to the specifications and conditions of approval outlined in this manual. This approval is effective for twenty-four months. The approval, given to a Property Owner, shall not obligate the NWC to provide service to, or be relied on by any third party as a representation that the NWC is obligated to provide service to this third party.

The NWC may require the observance of special conditions and specifications in individual cases.

No construction work related to the provision of water supply and sewerage facilities for a subdivision should commence before obtaining a Certificate of Approval from NWC. Where work relating to the provision of water supply and sewerage facilities for such subdivision is to be done, the NWC is to be advised in writing **at least ten working days** prior to the commencement of any such work. The officer to whom this is to be directed will be stated in the Conditions of Approval.

During the course of any such work, the NWC should be allowed access for inspection of the work and any technical information related to it. Also the Work Schedule for construction of water and sewerage facilities must be submitted. The owner of the property shall inform the NWC, in writing, of the names of the Consulting Engineers and Contractors who are to be engaged for this work in order to facilitate communication throughout the work and avoid delays in the acceptance of the finished work.

The type and quality of the pipes and all materials used in the provision of water supply and sewerage facilities (including house sewers) are subject to the approval of the NWC. Approved types of pipe for water supply and sewerage are indicated in chapter 2 and 4 of this manual. In the regulations for the construction of sewers,

reference is also made to various types and classes of approved material.

Before specifying the type of pipe for use, the Property Owner shall ensure that standard fittings are available to him for use in the development. It will be appreciated because the NWC will indefinitely maintain the system after takeover, "make shifts" will not be approved.

NWC will inspect all material to be used in the construction of water supply and sewerage facilities. Technical data for such materials must be available to the NWC.

If the NWC approves the laying of a pipeline, other than under a public roadway, the owner of the property is required to ensure that the registered title of the land, through which the pipe is to be laid will have endorsed on it a wayleave in favour of the NWC and running with the land. The NWC shall decide on the width of the wayleave and on the conditions to be expressed.

The owner of the property shall define the limits of the wayleave by having survey monuments planted at the ends and at changes in direction of the wayleave.

The NWC requires that the layout, quality and the type of material used and the standard of workmanship applied in the provision of water and sewerage facilities throughout the island meet with its approval. However, in no circumstance whatsoever is the NWC liable for the safety of the workmen of the property owners or of public property, or persons in respect of injury or damage resulting from operations in connection with the development.

The NWC has the right to refuse connection and to deny the commencement of service to any property until the conditions of approval are fully met by the Property Owner.

The NWC shall inspect the installation of all water distribution and sewerage facilities prior to the start of service. Such inspection is done to ensure that these facilities are constructed in accordance with approved designs and are further consistent with the NWC's criteria and specifications governing the quality of such construction. A fee will be charged for these inspections.

Where a Property Owner has paid for the construction of a water distribution or sewerage collection system, either by the NWC or a contractor, approved by the NWC, and which extends parallel to properties to which, NWC does not provide, the Property Owner may be entitled to a refund of a portion of the cost of this construction should the NWC utilize this system to provide service to any such property within a period of five (5) years from the day service is first provided to the said Property Owner and a payment is collected by the NWC from the

owner(s) of the intervening property(ies) for this service. The payment of the refund will be in the form of a credit to the Property Owner's Water Supply Account.

All rates and charges applied by the Commission are published in the Jamaica Gazette.

2.13 AFTER APPLICATION – WHAT NEXT?

2.13.1 Response Time for Application

Within twenty-eight calendar (28) days after receiving a properly completed application form, along with all the required documents and fees, NWC will carry out its assessment and notify NEPA of its position regarding providing the development with water. If NWC's position is positive, NEPA will then direct the developer to collect a copy of the Certificate of Approval and plan, as well as any conditions of approval, from NWC.

NWC's comments/position on sewerage and/or sewage treatment and disposal will be provided to the developer within twenty (28) days.

2.13.2 Notice to Commence Construction

The Regional General Manager for the area in which the subdivision is located, must be given ten (10) working days notice of the intention to commence construction of water supply and/or sewerage facilities. Failure to do so could result in the development not being able to connect to NWC system. NWC must be given the opportunity to inspect material used for the works and to closely monitor pipeline installations, tank construction, etc., in order to be satisfied that they conform with NWC's requirements.

2.13.3 Modification of Plans

In the event that it becomes necessary to modify the plans, NWC shall be consulted and approval sought for the changes. The agreed changes shall then be provided in a revised set of drawings (both hard copy and digital).

2.13.4 Completion of Plans

On completion of all the works, the developer shall make arrangements with NWC to witness pressure testing of the system, to conduct system

disinfection, and thereafter to commission the system. Once all these are satisfactorily completed, NWC will then provide a Completion Certificate for the system.

2.13.5 Inspections and Tests

For sewerage, the general approach outlined above applies. This includes the inspection of all manholes and the witnessing by the NWC of all appropriate tests to be carried out on the sewer lines.

2.13.6 Points to Note!

- i NWC subdivision approvals are valid for a period not exceeding two (2) years.
- ii Specification details and further information are available in NWC'S Developer's Manual which may be purchased from our Subdivision Department (4 Marescaux Rd., Kingston 5) or from commercial offices.

CHAPTER 3

WATER SPECIFICATIONS

3.0 GENERAL

These specifications are prepared to make the Property Owner/Developer aware of the minimum quality of material and standard or workmanship which the NWC will approve subject to other conditions in this manual. They are not intended to be exhaustive.

Where particular standards or codes of practice are referred to, the phrase “or equivalent” should be presumed to be added.

The Property Owner/Developer should make himself thoroughly conversant with the manufacturers' recommended methods for handling, laying and jointing pipes and fittings of the particular material to be used.

In the event of conflict between the manufacturers' recommendation and these specifications or standards or codes of practice referred to herein, the manufacturers' recommendations must be given precedence.

The Developer must provide competent supervision of the work.

3.1 DESIGN OF MAINS

Pipelines should be sized to carry flows capable of servicing the maximum demand flow plus fire flows based on individual or group hydrant requirements. In urban sub-divisions street mains should be at least 100 mm (4”) diameter except for short dead ends where 51 mm (2”) diameter pipe running not longer than 45 m (150') are allowed at the discretion of the NWC.

Velocities in pipes should not exceed 1.2 m/s (4 f.p.s) under normal circumstances and at no time should exceed 3.0 m/s (10 f.p.s).

Where appropriate, allowance should always be made for future demands, head loss due to bends and other appurtenances and for reduction in carrying capacity due to encrustation or other deposits coating the internal surfaces of the pipes in the course of time.

To reduce friction, changes in diameters should be achieved by the use of standard tapers.

3.2 PIPES

3.2.1 Standards

Pipes to be used for water supply should conform to the requirements of the latest version of the relevant ISO Standards; for transmission and distribution pipeline, pipe materials should be either Steel, K9 Ductile Iron or uPVC, for service lines up to 12mm diameter, the pipe material must be Polyethylene (PE).

- i Buried pipelines should be laid with flexible joints to allow for settlement and ground movement. Flexible joints may be of the bell and socket rubber ring push fit type or mechanical joints.
- ii Flanged joints can be used for pipelines laid above ground and in pumping installations where the pipework is required to be self-supporting.

3.2.2 AWWA Standards

The following AWWA Standards set out below are acceptable for Cast Iron and Ductile Iron Pipes:

- i AWWA C106 Cast Iron Pipe Centrifugally Cast in Metal Molds for Water and other Liquids.
- ii AWWA C151 Ductile Iron Pipes, Centrifugally Cast in Metal Molds or Sand lined Molds for Water and other Liquids.
- iii AWWA C110 Grey Iron and Ductile Iron Fittings 50mm/2” through 1200mm/48” for Water and other Liquids.
- iv AWWA C101 Thickness Design of Cast Iron Pipe.
- v AWWA C150 Thickness Design of Ductile Iron Pipe.
- vi AWWA C104 Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water.
- vii AWWA C600 Installation of Gray and Ductile Iron Water Mains and Appurtenances.
- vii Where aggressive soil conditions exist, a tubular polyethylene

sleeve should protect the pipe, as described in AWWA C105.

- viii Where aggressive soil conditions exist, a tubular polyethylene sleeve should be used to protect the pipe, as described in the ISO standards for transmission of potable water.

3.2.3 Protection of Steel Pipes

- i Wherever possible, steel pipe should be factory protected with coal tar or bituminous material incorporating a wrapping and any size joints should be protected externally with insitu cast bitumen to provide a continuous external protection. Any deficiencies in this protection can be made good by cathodic protection if electrical continuity is provided during laying.
- ii Internal lining is generally bitumen or coal tar applied centrifugally at the factory. The internal protection at mechanical joints for pipelines carrying potable water should be completed by coating the pipe ends prior to making the joint.
- iii Coal tar protective coatings and linings are usually preferred for steel pipe as described in AWWA C203.
- iv Galvanized steel pipe, as used for small distribution schemes should conform to Schedule 40 for sizes 50 mm/2" and ends should be threaded to BS 21. The pipe may be laid unwrapped.

PVC and polyethylene pressure pipe should conform to JS 39. Pipe joints may be of the rubber ring push fit type for larger pipes. Alternatively, PVC pipes can be supplied in the smaller sizes with ends and couplings suitable for cement solvent joints.

3.3 VALVES

3.3.1 Standards for Valves

- i The water distribution system should contain a sufficient number of isolation valves to minimise the extent of disruptions in the network in cases where it is required to isolate from the remainder of the system.
- ii A ring main system should be used for the pipe network layout. The intersections should be comprehensively valved to facilitate

the use of alternative routes when mains are taken out of service for maintenance.

- iii Gate valves should be manufactured to the relevant ISO standards for valves up to 300 mm/12" diameter where operating pressures do not exceed 14 kg/sq cm (200 p.s.i.).
- iv If air is liable to be collected at summits under ordinary conditions of flow, small orifice air valves which discharge air under pressure should be provided.
- v Presently all valves for distribution system extensions in the Kingston Metropolitan Area open when turned in a clockwise direction. For all other areas valves are opened in an anti-clockwise direction. In order to standardize valves throughout the island all valves being installed should open in a clockwise direction.
- vi Nuts to all valve spindles are to be standard throughout Jamaica. The nut should be 41 mm/1.61" square at the base and should have 1 in 20 flat side taper, i.e. conforming to BS 5163. (Drawing No 4)
- vii All valves and fittings, unless housed in chambers, should be provided with surface boxes conforming to the relevant ISO standards or to the requirements of the NWC. Otherwise, surface boxes should be to the requirements of the NWC.
- viii Washout valves should be large enough to allow velocities greater than 76 cm/s (2.5 f.p.s) in the main being flushed, to allow the expulsion of solids. Washout valves are usually 100 mm/4" diameter or larger on urban street mains depending upon the size of the mains. Provision must be made to accommodate discharges from these washouts, such that they channel to gullies or drains.
- ix All air valves should be installed with isolating valves to facilitate easy maintenance. In the case of larger valves, a lock-off feature should be incorporated in the design to facilitate site maintenance.

3.4 HYDRANTS

Fire hydrants should be of the dry barrel pillar type conforming to the relevant ISO standards subject to the following specific requirements and additions (alternative internationally accepted standards can be substituted for the above-mentioned standard providing that the requirements are equal to or exceed the above):

- i Under hydrostatic test pressure of 21 kg/sq cm (300 p.s.i.) for a period of not less than 15 seconds, hydrants should not exhibit any leakage through nozzles, castings or joints of the fully assembled hydrant when nozzle caps are tightened by and applied torque not exceeding 13.8 kg.m (100 ft lbs).
- ii Outlet nozzles: Each hydrant should provide two hose outlets diametrically opposed. Hose outlets should be suitable for 63.5 mm/2 1/2" nominal diameter hose couplings and should be threaded with British London V threads, having 5.92 threads per cm (5 1/5 threads per inch). Connections to street mains should be at least 100 mm /4" nominal diameter. For hydrants required to carry a 115 mm/4 1/2" pumper outlet, outlet nozzles should be 115 mm/4 1/2" nominal diameter with British Standard Round Thread. These hydrants should be connected to street mains of at least 150 mm/6" nominal diameter.
- iii For consistency, all hydrant valves should open clockwise irrespective of their location in the island.
- iv For all hydrant valves, wrench nuts should be a square operating nut 41 mm/1.61" at the base with a 1 in 20 flat side, i.e. conforming to BS 5163. Similar nuts should be provided to the nozzle caps.
- v Hydrants should be able to deliver/400 i.g.p.m. with a loss of not more than 176 g/sq cm (2.5 p.s.i.) in the hydrant and a loss of not more than 352 g/sq cm (5 p.s.i.) between the street main and hydrant outlet.
- vi Flanges should be drilled to B.S. (as per Table E) Where water supplies are passed through a bulk meter, hydrants should not be connected downstream of the meter. A separate supply to the hydrants should be provided from a connection upstream of the bulk meter. Alternatively, a bulk meter with a headloss not greater than 176 g/sq cm (2.5 p.s.i.) at (400 g.p.m.) should be used upstream of hydrants.

3.5 CONSTRUCTION AND INSTALLATION

3.5.1 General

Adequate support should be provided for all pipes. Particularly in the case of PVC pipes, continuous and uniform bedding should be provided in the trench at all times. Stones found in the trench should be removed for a depth of at least 150 mm/6" below the pipe invert.

- i All pipes should be given pressure and leakage tests after installation in accordance with the requirements of the AWWA Standards: AWWA C603 or equivalent (See section 3.2).
- ii For installation, the manufacturers' recommended procedure should always be followed. All pipes should be disinfected ("sterilized") in accordance with AWWA C651 or equivalent standard before being put in service to carry potable water.
- iii The centre line of the pipe trench should be in the carriageway 0.8m/2' - 6' off the kerb line. The minimum width of the trench should be 0.5 m/18"; the width required for a particular pipe installation should enable the work to be done comfortably, yet not less than 30 cm/12' greater than the diameter of the pipe. The depth of the trench should be such that it provides the following minimum cover over the top of the pipe socket measured from the finished road surface.

TABLE NO. I

<u>PIPE DIAMETER</u>	<u>DEPTH OF COVER</u>
150 - 250 mm/6" - 10"	0.75 - 1.2 m/2'6" - 6'
250 - 500 mm/10" - 20'	0.75 - 1.8 m/2'6" - 6'
Over 500 mm/20"	0.9 m / 3' -

as specified from time to time

- iv The trench should be excavated in straight lines between changes in direction and be carefully graded so that there are a minimum number of substantially high points along its length. The Commission will require air valves to be installed at high points in the line. In any case, where the trench has been excavated too deep, it shall be filled to grade with thoroughly rammed approved

granular material, subject to section 3.5.8 below.

- v In situations where trench sides are unstable, suitable provision should be made for shoring to ensure the safety of the workers and to enable satisfactory backfilling and restoration procedures to be followed.
- vi Subject to Section 3.5.8, a 10 cm/4" depth of the bottom of the trench should be of selected material having no particle larger than that indicated below, for pipelines of the following material.

TABLE NO. 2

<u>PIPE MATERIAL</u>	<u>MAXIMUM PARTICLE SIZE OF SELECTED BACKFILL MATERIAL</u>
Grey Cast Iron or Ductile Iron	25.4 mm/1"
Steel or Copper	19.0 mm/3/4"

- vii In peaty or boggy ground the bottom of the trench should be excavated to an approved depth below grade and refilled with broken stone, and bedding, as in Table 2, and thoroughly rammed to grade.
- viii In poor soils and rock, the trench should be taken out 10 -15 cm /4" - 6" below the pipe invert to allow the placement of a suitable bedding for the pipe.
- ix Where trenches are to be cut in surfaced roadways, the wearing surface should be cut with suitable equipment prior to using any mechanical excavating plant for trenching.

3.5.2 Bedding

Pipe bedding factors for various types of bedding and estimated loads on buried pipelines are dealt with differently for various pipe materials. Reference should be made to the following codes and standards:

- i Cast Iron: AWWA C106 Cast Iron Pipe for Water and other Liquids.
- ii Ductile Iron: AWWA C401 Thickness Design for Ductile Iron Pipe.

- iii PVC Pipes:
- iv Steel Pipes: Since it can be assumed that steel pipes will only be used in small sizes and for pressure in excess of 25 kg/sq cm (350 p.s.i.) these pipes will have adequate wall thickness for the anticipated earth loads.

3.5.3 Pipe laying

Pipelaying must be done in keeping with good workmanship and plumbing practice. Pipes must be laid in straight lines between changes in direction. The entire length of the barrel of the pipe must be supported on the bottom of the trench, being provided with a suitable foundation either in the form of recommended bedding or in very bad ground conditions, of continuous concrete support to prevent damage due to settlement. Pipes should not bear on hard points as subsequent unequal settlement may result in pipe fracture or damage to the coating. Care must be taken to ensure that the inner surface of each pipe is left clean after laying. When pipe laying is not in progress the ends of the pipe being laid should be plugged to prevent ingress of foreign matter. Pipes laid under high ground water conditions may be backfilled between joints before testing so as to avoid floating of pipelines, the ends of which have been plugged. After final asphaltting pipes should not be less than .076m/30" below road surface.

i Surface water crossings

Surface water crossings, both over and underwater, culverts and other conduits present special problems, which should be discussed with the NWC before final plans are prepared.

For above-water crossings the pipe should be:

- adequately supported;
- above maximum flood levels;
- protected as best as possible from damage inadvertently or by vandals;
- accessible for carrying out repairs.

ii Underwater crossings

For underwater crossings culverts and other conduits, the following provisions should apply:

- The pipe should be of special construction, having flexible watertight joints. The use of a sleeve extending at least 0.9 m (3') on each side of the conduit beyond the sidewall of the conduit is also acceptable. The sleeve may be steel or ductile iron pipe.
- Valves should be provided at both ends of the water crossing so that the section can be isolated for testing or repairs. The valves should be easily accessible and not subject to flooding.
- Corporation stops should be available at each end of the crossing to facilitate sampling and testing.
- Where erosion might occur or where a plant may operate over the buried pipeline, an adequate concrete surround should be provided for the pipe.

iii Pipes under railways and conduits

Pipes laid under a railway should be treated in a similar manner as when laid under conduits and the Developer must consult with the appropriate Railway Authority and provide any special protection required by that Authority.

In addition, the pipes shall be given such other protection as may be required by the Railway Authority responsible for the maintenance of the conduit.

iv Other guidelines for pipe laying

Pipes should generally be laid uphill with sockets leading. Where this is not practicable, they may be laid with sockets downhill but suitable arrangements must be made for jacking.

Pipes of large diameters should be laid with the maximum possible rise or fall to ensure the air travels to the air valves. A gradient of 1 in 500 is the minimum permissible.

Long lengths of horizontally laid pipelines of any size should generally be avoided. When mains are lighter than the water they displace, a dry trench must be provided for construction.

Where it is not possible to provide adequate cover and if there will be heavy surface loading, mains laid with cover less than recommended by the manufacturer or relevant standards, should be protected. Steel and ductile iron pipes can be encased in concrete. PVC pipes should be protected by concrete or block wall on each side of the pipe barrel 10 -15 cm/4" - 6" above the crown. A reinforced concrete slab should then be placed across the top of the wall with the cavity around the pipe being filled with sand or selected material.

3.5.4 Jointing of Pipes

The Property Owner/Developer must conform to the manufacturers' instructions in regard to the procedure for proper laying and jointing of the particular type of pipe and joint being used in the development.

3.5.5 Anchoring of Pipes

Thrust blocks must be provided at tees, crosses, dead ends and at all bends (except concave vertical bends). The blocks should be located symmetrically with the pipe fitting, being symmetrical with the radial centre line in the case of bends. Typical examples of the location of thrust blocks are given in Drawing No. 1. The thrust blocks should be constructed of 1360 kg /3000 lbs concrete, reinforced if required by the NWC, and must rest firmly against solid ground. The required area of bearing on the solid earth bank will vary with the type of soil in the bank and the area of bearing on the pipefitting must be sufficient to safely transmit the thrust through the block and must be approved by the Commission.

A thrust block of sufficient size to reduce the soil pressure to three-quarters of the minimum bearing capacity of the undisturbed soil should be provided to resist downward vertical thrust.

For upward vertical thrust, an anchor block or sufficient weight to resist uplift should be provided.

In general, neither anchor nor thrust blocks should contact or encase the

pipe beyond the fitting joints, nor encase the joints if at all possible.

All pipes having joints in which horizontal movement is not positively restricted, require external anchorages to resist the thrusts developed at bends and blank ends.

At normal design velocities, the dynamic thrusts due to changes in direction of the flowing water are insignificant, but at high velocities, such as may be developed when washouts are operated, allowance should be made for this additional thrust.

3.5.6 Hydraulic testing of Pipelines and Joints

Pipelines should be pressure tested using a pump and pressure gauge to at least 50% greater than the working pressure intended for the pipeline, but not less than of 10.5 kg/sq cm (150 p.s.i.). Air vents must be provided at the upper end of the section of the pipeline to be tested and at other locations as required. The pipeline should be slowly filled, preferably from the lower end.

The pipeline should be pressurized to the specified test pressure and allowed to stand for 60 minutes without further pumping. At the end of the initial period the pressure should be noted.

During this initial period of 60 minutes, joints, anchors and thrust blocks should be inspected. For joints, the inspection should be for visual signs or leakage and for anchor and thrust blocks the inspection should be for movement. Any obvious defects should be fixed before leakage tests are continued when there.

The pipeline should then be repressurized to the specified test pressure and immediately reduced to the pressure pertaining at the end of the 60 minute period by venting water into a calibrated container. This quantity of water shall be deemed the leakage during the 60 minute test. The pipeline will be considered satisfactory if the leakage during the 60 minute test does not exceed 0.01 l/cm of pipeline diameter per 300 m of pipeline per 30 m of head of the average test pressure over the length under test for steel, iron or PVC pipelines.

At least 7 days' notice should be given for the carrying out of pressure tests so that the test may be witnessed by those responsible for the work and by the NWC. The record should be kept of all tests in a book which shall be available

for inspection and handed to those responsible for the work on demand.

In the event of the test failing, it will be necessary to open, cut, search for and make good, or replace, all defective pipes, joints, specials and fittings. Otherwise, pressure and leakage tests should be conducted in accordance with NWC's test procedures or equivalent ISO standard.

On the satisfactory completion of the test, the tapping for the pump connection should be sealed with a brass plug.

It is advised that the pipeline be tested, if possible, before joints are covered, to make sure that the final test will not fail through leaking joints.

3.5.7 Disinfections

The property Owner/Developer must provide a valve that is fixed of the same diameter as the pipeline, in a suitable location for effective flushing of the line. The developer should get an approved contractor to provide the necessary labour and material for the sterilization of the pipeline. The National Water Commission's laboratory provides supervisory participation for all sterilization at the property Owner/Developer's expense. The Commission will provide the necessary labour and material to lay a connection from the NWC's sterilization system to the valve fixed by the property Owner /Developer at the entrance to the development. The property owner/developer must thereafter ensure that his valve is not operated by anyone employed to him.

Provision should be made to adequately and safely lead away all discharge during the sterilization process.

All connection must be secure and the system must be pressure tested and be capable of returning water without losses for at least 72 hours before sterilization commences. The system will be flushed and then charged with chlorinated water with a concentration of greater than 50 parts per million (ppm). After 48 hours, the pipeline will be thoroughly flushed, after which sample will be collected and tested in the NWC's laboratory. If the laboratory's examination shows that the pipeline has not been sterilized, the Commission will require the property Owner/Developer to rid the pipeline of the foreign matter that is resisting sterilization. The sterilization shall be repeated until satisfactory samples have been obtained.

The property owner/developer will be required to pay the cost of carrying out the sterilization. A certificate will be issued upon successful completion

of the sterilization process. A detailed sterilization procedure is available at the Quality Control Assurance, Environmental and Chlorination (QCA,E&C) Department.

All disinfection methods shall be operational at all times. Emergency power supply systems shall be capable of running all pumps, motors, mixers, control systems, lamps, etc. to provide complete disinfection when the main power source is disrupted.

All disinfection facilities shall be capable of being drained for the purposes of being cleaned. This may include sloped floors, drains, sump pits, etc. for complete drainage. The effluent from such drains shall be directed back to the headworks or most appropriate treatment process for proper treatment. Redundant disinfection units shall be provided to ensure proper continuous disinfection during maintenance and cleaning.

3.5.8 Backfilling of Trenches

Selected material conforming to Table No. 2 on page 23 should be firmly tamped by hand rammers in layers not deeper than 23 cm (9"), particularly around the pipe and wet to aid compaction if necessary. Natural excavated material should then be tamped by hand rammers or very light mechanical tampers to a height of 61 cm (24") over the top of the pipe, thereafter, the remainder of the backfill comprising of natural excavated material may be tamped by a mechanical tamper.

Backfill material should exclude all deleterious material and no large stones should be allowed to rest directly on the pipe.

Where the pipe trench is on a steep incline, it is customary to form concrete stop walls across the trench at suitable intervals.

Drains and water courses crossing the pipeline should be carefully reinstated to ensure that subsidence is avoided.

3.5.9 Connection of Accessories

Method for connecting water pipes and fittings of dis-similar material are shown in Drawing No. 3C.

The methods of connecting the pipeline such things as service or communication pipes, hydrants, sluice valves and air valves, are shown in Drawings No. 3A to 5. Particular attention should be paid to the material

to be used and the method to be employed in backfilling the trench or supporting the accessory.

Service of communication pipes of 13 mm/1/2", 19 mm/3/4" and 25 mm/1" diameter may be laid by the Property Owner and may be either polyethylene or of PVC Schedule 40. The pipe shall be laid to a minimum depth of 46 cm/18" below the surface of the carriageway and terminate on the sidewalk, the end of the pipe being securely plugged pending final connection onto the premises to be supplied with water. After inspection by the Commission, the trench must be backfilled with appropriate selected material (see Table No. 2 on page 23). The backfill material should be thoroughly tamped by hand rammers.

Fire hydrants must be provided at locations as required by the relevant fire authority and shall be pillar type controlled by gate valves and shall conform to NWC Drawing No 4 herein. They must be painted with 3 coats of red, anti-corrosive paint, used by the Fire Department.

Air valves shall be either of the single or double orifice type as may be required by the Commission. They shall be fitted with a lock-off valve and shall be capable of withstanding a minimum test pressure of 122 m (400') head of water without leaking. Double air valves shall be fitted with flanges drilled to BS 10 Table E, and single air valves shall be fitted with a screwed inlet. The diameter of all valve inlets shall be subject to the Commission's approval. A typical method of setting double air valves is given in Drawing No. 5.

3.6 DISTRIBUTION STORAGE

The volume of storage required is best determined by detailed evaluation of certain parameters, location of the facility relative to the center of demand, the inter-relationship with distribution main sizes, fire flows and the diurnal variation of domestic demand. As a guide, the volume of storage may be based on the 24-hour average day supply or 30% of the 24-hour average day supply plus the requirement for fire-fighting where such flows are provided from storage, whichever is the greater.

Fencing, locks on access manhole and other necessary precautions should be provided to prevent trespassing, vandalism and sabotage.

Where tanks are drained by gravity, the drains should be discharged to open watercourses above flood level and not directly connected to sewers or closed storm drains. Storage facilities, which "float" on the distribution system, should be

designed to drain for cleaning or other maintenance without necessitating loss of supply to the distribution system. This may be achieved by constructing half-wall divisions with adequate valving to restrict flows to either side, or adequate bypass valving should be provided for the entire tank, so the storage facility can be completely isolated.

The floors of storage structures should be built with sufficient fall to allow easy drainage to the washout or drains sump. Floors should be laid to gradients preferably not less than 1 in 250, and for large reservoirs should be given a more generous fall to sumps. Manholes should be suitably placed relative to drain sumps to facilitate the easy lowering of suction hoses and foot valves to pump water for drainage.

In addition to the provision of high level alarms, indicators and control valves, as may be required by the NWC, overflow mains must be provided and suitably sized to safely drain away the maximum flow that may enter the tank at any time.

The overflow must not be connected directly to a sanitary sewer or closed storm water drain.

Manholes should be provided for entry to storage facilities and should be at least 76 cm/2'6" square in dimension. Where manholes are set on flat roofs to treated water storage facilities, they should be constructed on a plinth not less than 10 cm /4" above the normal level of the roof.

Suitable ladders, made of materials resistant to corrosion or adequately protected, should be provided from the manhole to the bottom of the tank. If step irons are used, these should conform to the requirements of BS 1247, BS 4211, or equivalent standard.

3.7 HIGH RISE BUILDINGS

The Developer for all buildings in excess of 2 storeys high must provide the following facilities: (See drawing # 13)

- i A tank at ground level, having a capacity of at least one day's supply for the building. The inlet to the tank should be fitted with a reflux valve. Air space must be provided between top water level in tank and the water discharge point to the tank. This is to prevent the possibility of back flow into the public water main.
- ii A roof tank of capacity not less than half a day's supply.

- iii Booster pumps in duplicate each capable of delivering into the roof tank not less than twice the minimum anticipated average daily water demand of the residents of the building. These pumps should draw water from the ground floor tank and shall, on no account, be connected directly to the public water main.

3.7.1 The Commission is prepared to consider having water supply contracts established for individual apartments on these buildings if the piping arrangement allows this. Individual metering of these apartments would be provided in cases, which are acceptable to the NWC.

The special supply contract which would be established with the apartment owner will clearly set out the conditions of this arrangement, which will include the assignment of the responsibility to maintain the pumps, tanks, etc. to the Property Owner or his designated representative, or the Management Committee established by the proprietors under the Strata Act.

Should this arrangement be contemplated, consultations should be held with the NWC at the Preliminary Engineering Stage of the project development.

3.8 RECORDS

Every water supply authority should have plans and records showing precisely where mains, valves, washouts and fire hydrants lie in roads and as constructed drawing of service reservoirs, pumping installations, etc. Since these plans and records can only be prepared with any degree of accuracy during construction, it is the responsibility of those constructing the works, to produce and hand over to the Property Owner. The property owner is required to provide NWC with the final plans and records.

Accurate records should be kept of the location, both in plan and elevation, of all distribution mains together with the details of all valves, etc. These records should be prepared on durable transparencies (hard copy) and a digital copy should be submitted as outlined in Section 2.2. Records should also be kept of all tests carried out on pipeline, pumps, etc.

CHAPTER 4

WATER SUPPLY CONNECTIONS

4.0 CONNECTION OF INDIVIDUAL DWELLINGS

Connection to an existing supply main can be accomplished in the following manner:

4.0.1 Procedures

- i An application can be made at any NWC office by completing the standard application form, "Application for Water" (Form V), available at any commercial office.
- ii Applicants should bring:
 - Proof of Ownership - This may be a copy of a registered title, or a letter from a Lawyer, Notary Public, Justice of the Peace or other such persons as may be specified from time, to time, attesting to the ownership of the premises.
 - Proof of Identification - A Passport, Driver's License, Electoral Registration Card or letter from a Justice of the Peace, Minister of Religion, School's Principal or Notary Public.
 - A Numbering Certificate - This can be obtained from the KSAC, Parish Council or Municipal Council. This certificate indicates the civic address of the property and is generally available for the Kingston and St Andrew area from Kinston and St. Andrew Corporation (KSAC) or relevant Parish Council/Municipal Council. These documents form part of the application and are kept by the Commission.
- iii A water supply account is established for the customer.
- iv A deposit representing the estimated cost of the connection is required at the time of application. Any subsequent difference between this deposit and the actual cost of the connection is debited or credited to customer's water supply account. Water is a charge against land, therefore, even if the account is established in the name of a tenant, the Landlord is ultimately responsible for

outstanding payments.

- v Cost estimates are required for connections larger than 25 mm/1" diameter. The NWC will normally have the estimate ready within 5 working days.
- vi The Commission's objective is to have the connection completed within 10 working days of the contract being signed.
- vii If the NWC is not able to provide the supply, for whatever reason, a refund will be made.

4.1 WATER FOR CONSTRUCTION

One of the most contentious subjects between a Developer and the Commission is 'Construction Water'. This relates to the supply of water by the Commission to a Developer for the purpose of construction, landscaping and other such activities. While the provision of water is fairly routine activity, the contracting procedures and the definition of liability is often problematic. The NWC is not obliged to provide water for construction, however the NWC is not averse to assisting developers on a case-by-case basis. The following procedures are intended to eliminate these difficulties.

- 4.1.1 An application for service is to be made as outlined in chapter 2. The applicant should be the Developer and all outstanding debt, if any, in respect of the subject property must be cleared at the time of application.
- 4.1.2 Services will be provided by the Commission as outlined in chapter 2.
- 4.1.3 At the end of the construction activity, the Developer should obtain discontinuance from the Commission in respect of the construction water account. This is the only mechanism by which further liability can be avoided.
- 4.1.4 Each purchaser in the development should then apply to the Commission for service in the usual manner. Water is a charge against land; therefore, even if the account is established in the name of a tenant, the landlord is ultimately responsible for outstanding payments.

4.2 STRAIGHT CONNECTION

Subject to the availability of meters and associated fittings, it is the Commission's policy to install each supply with appropriate meters. In instances where this is not possible for whatever reason, a 'straight' connection will be made and the customer billed at an estimated flat consumption. The amount of this estimate will be dependent on size of premises (number of bedrooms), location and use of premises.

4.3 INDIVIDUAL METERING IN MULTI-FAMILY DWELLINGS

4.3.1 General

The issue of providing individual meters to units in multi-family dwellings has taken on increased importance in recent times. The Commission supplies water at the normal mains pressure and therefore, it is generally not possible to accommodate metering above two storeys. In any event, maximum hydraulic efficiency is realised through bulk supply.

4.3.2 Conditions Governing Individual Metering in Multi-Family Dwellings

The following guidelines are established for consideration:

- i The premises subject of the application shall not be more than 8 meters above ground floor elevation. Premises above this elevation cannot be served without pumping.
- ii Application for service is to be made in the usual manner as described in chapter 2
- iii In instances where there is an outstanding water bill for the complex in which the premises is located, the Commission will normally require prior settlement of the said amount. The Commission may, under certain circumstances, contract with an individual property owner/developer on the written permission of the Management Committee of the Strata Corporation established for the management of the complex.
- iv All the necessary pipe work for the purpose of connecting individual units to the Commission's main shall be the responsibility of the property owner/developer and shall conform to the specifications outlined in this manual.

All supplies for individual premises shall originate in a receptacle capable of housing a 'meter bank' as illustrated by Drawing 14.

4.4 MULTI-FAMILY DWELLINGS OVER TWO STOREYS HIGH

The Commission has generally not provided individual metering to apartments which are located above two storeys high. The Commission is prepared to examine proposals for this arrangement on a case by case basis. The following are important considerations:

- 4.4.1 Provision of individual piping from pump discharge to the individual unit. This is the responsibility of the Property Owner.
- 4.4.2 Approval of designs for piping and tanks, and specifications for pumps and meters.
- 4.4.3 Acceptance of completed works by the Commission, as done in accordance with the approved designs and standard workmanship.
- 4.4.5 Acceptance of the conditions in the special supply contract for this arrangement that include:
 - i Responsibility for the operation and maintenance of the pumping facilities is that of the Property Owner or his representative or the Management Committee of the Strata Corporation established for the management of the complex.
 - ii Charge for an inspection fee for an annual inspection of supply facilities on the property by officers of the Commission. The charge will be borne by proprietors of the complex and will be applied to the monthly water bills. The charge will depend on the complexity of the supply system and will be reviewed annually.
 - iii The installation of a bulk meter at the property boundary to monitor the amount of water supplied. The Management Committee will be responsible for any difference between the total used by the proprietors of the complex and the amount supplied to the property. The contract outlines the duties and responsibilities of the Commission on one hand and the proprietors and the Management Committee on the other.

CHAPTER 5

SEWERAGE SERVICE

5.0 STATUTORY RESPONSIBILITY

The Ministry of Health as well as the local Health Boards have statutory responsibility for the regulation of sewerage systems in land developments. The regulations cover such general features as appropriate method of treatment and disposal systems, effluent quality, point of effluent discharge among other parameters. The National Environmental and Planning Agency (NEPA) plays an important role in regulating the effluent discharge from sewage treatment facilities. The Commission's involvement in the land development process derives primarily from Section 12 of the NWC Act, which requires premises proximate to an NWC sewerage system to be connected to the said system and for the Commission to regulate such connections.

All properties within 100 meters of a public sewer are required to be connected to the system, unless adverse gradient preclude such a connection.

The Commission in instances also regulates the provision of sewerage in subdivisions where there is an agreement for the Commission to take over the completed system for operation and maintenance. If there is no such arrangement, the Commission needs not be involved in the process. If there is the likelihood that the Commission may be requested to operate the system in the future, it is advisable that the Commission be involved in the process from inception. There is a charge for the NWC's input to this process. The decision to take over a system is at the Commission's discretion and will only be done after a full review of the technical and economic parameters are found to be satisfactory.

5.1 SPECIFICATION FOR SEWERAGE SERVICES

5.1.1 General

These specifications are prepared to make the Developer aware of the minimum quality of material and standard of workmanship for which the NWC will approve subject to other conditions in this manual. They are not intended to be exhaustive.

All design and construction for sewerage, sewage treatment and disposal must accord with NEPA's requirements.

Where particular standards or codes of practice are referred to the phrase “or equivalent” should be presumed to be added.

The Developer should make himself thoroughly conversant with the manufacturers recommended methods for handling, laying and jointing pipes and fittings of the particular material to be used.

In the event of conflict between the manufacturers’ recommendations and these specifications or standards or codes of practice referred to herein, the manufacturers’ recommendations must be given precedence.

For drawing specifications for submission application see chapter 2. All drawing submitted must be approved by a Registered Professional Engineer (Water or Wastewater), registered with the Professional Engineering Registration Board (PERB).

The Developer must provide competent supervision of the work.

Approval must be obtained from NWC before construction of sewerage, sewage treatment and disposal facilities is done.

5.1.2 Types of Systems

The National Water Commission prefers the use of the following types of secondary treatment systems:

- i Oxidation Ditch
- ii Stabilization Ponds
- iii Aerated Lagoons
- iv Trickling Filters

All Treatment systems will have to meet the current National Environment and Planning Agency (NEPA) Standards and as such a combination of systems, if required may have to be used in order to achieve the required effluent standards.

All systems should include the following basic components:

- i Screens
- ii Grit Chamber
- iii Flow measurement

All Treatment Systems with electro-mechanical components & pumping station must include a Standby Generator.

5.2 PRELIMINARY WASTEWATER TREATMENT FACILITIES.

Preliminary treatment refers to removing and handling large solids, grit and debris from the raw wastewater, e.g. bar screens, other screening devices, grit chambers, and shredding. Primary treatment refers to removal of large solids, grit, debris and settleable organic solids prior to secondary treatment. Primary treatment would typically consist of septic tanks or preliminary treatment plus primary clarification or lined settling basin.

5.2.1 Screens or Shredding Devices:

Screening devices shall be provided for all wastewater treatment facilities. The design shall include adequate ventilation. Units shall also be designed to eliminate the potential for plant flooding or bypassing to a watercourse. The purpose of these devices is to remove debris and nuisance material that is generally not capable of biological reduction from entering the downstream treatment processes. A shredding device is used to grind large debris, a screen or other suitable means of actually removing the debris (including materials that will tend to float in secondary clarifiers) must be installed.

- i Velocity: Design velocity shall be 0.3048 m/one foot per second at design daily average flow for manually cleaned screens. For mechanically cleaned screens, the maximum velocity shall be 0.75 m/2.5 feet per second.

The velocity shall be calculated from a vertical projection of the screen openings on the cross-sectional area between the invert of the channel and the flow line.

- ii Bar Spacing and Slope: Bar spacing for manually cleaned screens should be from 2.5 - 4.5 cm/1 to 1-3/4" clear openings at a slope of from 30° to 45° with the horizontal. Clear openings for mechanically cleaned screens may be as small as 6 mm/1/4" Adequate means shall be available to bypass the screens in the event of screen blockage or malfunction of cleaning equipment.
- iii Channel: The channel approach distance prior to screening devices shall be of sufficient length to provide a uniform flow cross-section at the screen. The entire channel shall be accessible for

- observation and cleaning.
- iv **Mechanical Bar Screen Control:** The cleaning device of a mechanically cleaned bar screen shall be field adjustable to accommodate variations in screening debris buildup.
 - v **Auxiliary Screens:** Where mechanically operated screening or comminuting devices are used, redundant units shall be provided, or auxiliary manually cleaned screens shall be provided. Design shall include provisions for automatic diversion of the wastewater flow through the auxiliary screens should the regular units fail.
 - vi **Fine Screens 6mm to < 16mm/1/4" to <5/8":**
Installing fine screens will be reviewed on a case-by-case basis based on the features peculiar to this equipment that can be demonstrated to provide a benefit. Coarse bar screens should precede fine screens. Fine screening material shall be washed, or other provisions must be made for a method of stabilization. The screened material must be disposed of in a sanitary manner.
 - vii **Screenings Handling:** Ample-sized facilities must be provided for removing, handling, storing, and disposing of screenings in a sanitary manner. Open area disposal is prohibited. Manually cleaned screening facilities shall include an accessible platform from which the operator may rake screenings easily and safely. Suitable drainage facilities shall be provided both for the platform and for storage areas.

5.2.2 Grit Removal

Grit removal facilities should be provided for all wastewater treatment facilities and are required for facilities receiving substantial amounts of grit. If a treatment facility is designed without grit removal units, the design shall include provisions for future installation. Provisions shall be made for draining each unit.

- i **Type and Number of Units:** Parallel units are encouraged, however, grit chambers with by-pass may be acceptable for small wastewater treatment facilities. Channel-type chambers shall be designed to provide controlled velocities, applied over the entire flow range, as close as possible to 0.3 meters/1 foot per second. The design shall be based on the size of the particle to be removed. The design should take into consideration undesirable

turbulence and velocities at inlets and outlets. Facilities other than channel types are desirable if provided with adequate and flexible controls for agitation and/or air supply devices and with grit collection and removal equipment.

- ii Grit Washing: All facilities not provided with positive velocity control should include means for grit washing to further separate organic and inorganic materials.
- iii Handling and Disposal: Facilities must be provided for removing, handling, storing and disposing of grit in a sanitary manner. Manually cleaned facilities shall include an accessible platform for the operator to remove the grit easily and safely. Suitable drainage facilities shall be provided.

5.2.3 Flow Equalization

Flow equalization facilities may be given consideration for all mechanical treatment plants. Equalization should be given special consideration for wastewater facilities without primary treatment and with peaking factors greater than 2:1. Equalization prior to secondary or advanced waste treatment should also be considered. Equalization basin designs shall include volume, air, mixing and pumping requirement calculations to ensure proper flow equalization. Provision shall be made to drain the equalization basin.

5.3 WASTEWATER PONDS AND LAGOONS

5.3.1 General

Wastewater lagoons are considered suitable for providing complete treatment for domestic sewage and certain industrial wastes and as a supplementary treatment facility for mechanical treatment plants. Effluent from the ponds must meet the applicable effluent requirements. The Division should be consulted for specific effluent limits for each location. In certain cases, waiver of the secondary treatment limits for suspended solids may be obtained; this will be handled on a case-by-case basis. In any event, the minimum design requirements will still have to be met; i.e., location, loading, multiple units, pond appurtenances, pond configuration and construction and detention time.

5.3.2 Location:

Wastewater lagoons must be located in conformance with NEPA and NWC Policies. Consideration should be given to current local land use plans, vector transport, odor, public safety, topography, and prevailing winds. Wastewater lagoons should be as far as practicable from habitation. Ponds should be located or designed to protect existing domestic water supply wells. Adequate geological and soil investigations must be conducted for any site to ensure adequate structural consideration and to prevent contamination of groundwater. Site selection shall be in accordance with NEPA regulations and NWC requirements

5.3.3 Multiple Units:

- i All mechanically aerated lagoon systems must consist of a minimum of three cells. All non-mechanical aerated lagoon systems (stabilization ponds) must have a minimum of two cells and should be designed to be operated both in series and in parallel.
- ii Piping and valves shall be provided so that flow can be discharged directly to or from any cell so that quantity of flow can be accurately controlled. (See Pond Appurtenances below :)

5.3.4 Pond Appurtenances:

- i Piping should be located to minimize piercing of the pond seal.
- ii An influent manhole or splitter box must be provided. This can be a common structure for several cells if the pond configuration permits such an arrangement. Influent manholes or splitter boxes should be designed so that positive flow control is maintained by weirs, stop gates, or valves, and the flow will be measured to ensure accuracy of each diversion to within 10% of the actual flow.
- iii The inlet point should be positioned to minimize short-circuiting.
- iv All pond systems constructed of natural soil materials utilizing positive seal methods such as soil additives, bentonite, native clay or soil cement must be designed with the primary pond inlet pipe situated to prevent pond bottom scouring. An example of such protection could be a concrete apron large enough so that scouring of the pond liner does not occur beyond the edge of the

- apron. For multiple discharge points, similar scour protection must be used for each influent discharge port.
- v Overflow structures of all cells should be designed so that pond levels can be maintained at 14 cm/6" increments from a 0.6 m/2 foot depth up to 0.15 m/6 inches below the maximum water level.
 - vi Adequate baffling to prevent scum or algae overflow and to provide a quiescent area is required.
 - vii A multiple level draw off or equivalent shall be provided at the discharge structure to prevent scum and algae discharges. The bottom pipe of the multi-draw off structure should be a minimum of 0.6 meters/2 feet above the bottom of the pond and located 3.048 meters/10 feet in from the elevation of the outlet structure. A flush pipe is allowed for completely mixed systems.
 - viii Facilities must be provided to completely empty pond contents (including sludge). Additionally the method of sludge removal and expected schedule for sludge removal should be described. Any drain or level control must be capable of being locked to avoid accidental or malicious discharge. Drains shall discharge to an adequately placed sump so other cells of the lagoon system can treat cell water prior to discharge.
 - ix The pond area shall be enclosed with an adequate stock-tight fence to preclude livestock and discourage trespassing, and be located so that mowing of dikes and travel on top of the dikes will not be obstructed. Security fencing or equivalent should be provided for lagoons near urban areas. A vehicle access gate of sufficient width to accommodate mowing equipment will be provided. All access gates will be provided with locks.
 - x Warning signs will be installed stating the nature of the facility with at least one sign on the access gates and one sign on each side of the fenced perimeter, but not less than one sign for each 60 m/200 feet on any one straight side.
 - xi A flow measuring device (e.g. v-notch weir) should be provided on all transfer structures between cells to aid in proper operation and documenting influent and effluent flows to and from each cell for the purpose of establishing a water balance.

- xii Providing for pond re-circulation (inter-pond and intra-pond) is encouraged.
- xiii Adequate erosion and flood protection must be provided as needed. Dikes located along stream banks must be properly rip-rapped to prevent erosion during the 100 year flood event.

5.3.5 Pond Configuration:

- i The cells should be shaped to minimize short-circuiting. The shape of all cells should be such that there are no narrow or elongated portions. Rectangular ponds with a length not exceeding three times the width are often most desirable, however, site geometry and lagoon system mixing design can also be considered.
- ii Interior corners must be rounded.
- iii Dikes should be constructed so that there is a minimum freeboard above the high water line of 1.0 m/3 feet for ponds that are not aerated. A 0.6 m/2 feet freeboard can be considered for aerated ponds. Site-specific conditions can also be considered in the design.
- iv The top width of the dike will be a minimum of 8 feet (2.5 meters). In general, dike slopes should not be steeper than three (3) horizontally to one (1) vertically nor flatter than six (6) horizontally to one (1) vertically. Where synthetic pond liners are used, a minimum slope of two (2) to one (1) should be provided.
- v The pond bottom shall be as level as possible. For ponds with synthetic liners, a slight bottom slope may be provided for proper liner venting and to encourage complete draining of the cells.

5.3.6 Construction and Materials:

- i The pond area, bottom and dikes, must be stripped of all vegetation and organic material. No stripped material or other organic material can be used in the embankment. This material can be spread on the outside of the dikes and above the water line on the inside of dikes.
- ii Embankments and dikes must be constructed of relatively impervious materials and compacted sufficiently to form a stable structure in keeping with standard embankment construction practices.

- iii All disturbed areas above the water line will be seeded with a densely growing perennial grass native to the area. The soil below the water line should be sterilized, unless covered with a synthetic liner.
- iv Ponds shall be constructed so the seepage out of the bottom or dikes (sides) will not exceed 10-6 cm/sec/1/32 of an inch per day. If the soil tests demonstrate that this cannot be obtained, then positive seal methods such as soil additives, bentonite, native clay, soil cement, asphalt, or synthetic liners must be used. Lagoons exceeding the exfiltration rate will require a ground water discharge permit from NEPA.
- v Synthetic liners shall be vented, and shall be bedded per manufacture's recommendation to prevent puncture.

5.4 NON-AERATED LAGOON (WASTE STABILIZATION POND) SYSTEMS

5.4.1 Non-Aerated Lagoon Criteria

These criteria apply to lagoons that are not mechanically aerated and do not apply to integrated pond systems utilizing an anaerobic pit in the first cell. Waste stabilization ponds are non-aerated lagoons and are primarily to be used for domestic wastes or organic industrial waste of similar strength. Industrial wastes containing toxic materials or high concentrations of organic or inorganic materials must be given special design considerations. The maximum water depth for a non-aerated lagoon is 1.5 m/5 feet.

The Process Design Report must contain sufficient detail to show that all the required design considerations have been satisfied. Soil investigations and percolation studies must be included. Design engineers should recognize that ponds may need added facilities to meet more stringent effluent limits or stream standards. The design criteria do not take these variables into consideration. Some of these are site specific and will depend on location and soil characteristics.

5.4.2 Loading

The area of the ponds will be governed by both organic and hydraulic loading limits. The entire pond system must be capable of holding the average design flow for 180 days taking into account allowable pond water losses and evaporation. The primary cell(s) will be designed for no more

than 0.25 kilograms per 100 square meters/0.5 pounds of BOD5 per 1000 square feet of water surface area per day. With any one cell out of operation, the system must be able to operate with the primary cell(s) not loaded more than 0.5 kilograms per 100 square meters/one pound of BOD5 per 1000 square feet of water surface area per day.

5.4.3 Operation

Waste stabilization ponds must be operated and maintained properly to obtain optimum effluent quality and to avoid nuisance conditions. A major advantage of ponds is the small amount of required maintenance and the minimum of technical skills needed for the operation. This advantage should not be used to minimize the basic O&M (operation & maintenance) needed. For small communities with new sewer systems and low initial water use, at least one cell must be pre-filled to avoid aquatic growth and resultant nuisances. Effluent limits or stream standards may require holding for extended periods with an intermittent discharge. This type of operation must be considered in the development of the operating manual.

5.5 MECHANICALLY AERATED LAGOON SYSTEMS

These criteria apply to completely mixed and integrated pond systems. Aerated ponds are acceptable treatment facilities almost anywhere. All aerated lagoon treatment systems must meet effluent limitations.

5.5.1 Loading:

The loading limits on aerated ponds depend upon such factors as the capacity of the aeration units, detention time, temperature, elevation, the settling pond, post chlorination, and many other parameters. Sufficient aeration equipment shall be provided to maintain an average minimum D.O. level of 2 mg/l in the aerated portion of the system at all hours of the day. Based upon the temperature effects in Jamaica the total detention time in the pond system including the polishing pond (excluding complete mix lagoon systems) may be in the range of 12-30 days.

5.5.2 Polishing Pond:

A polishing pond or a quiescent area shall be provided to settle out the suspended solids that are kept in suspension by the aeration system.

5.5.3 Detention Time:

The detention time for polishing ponds should not be more than 5 days nor less than 2 days at the average daily design flow of the facility. An exception to the detention time criterion may be made when some aeration is added to the upstream end of the polishing pond to prevent septicity during low flow times at the plant.

5.5.4 Sludge Removal

The polishing pond shall permit sludge removal.

5.5.5 Depth:

The minimum liquid depth of a polishing pond should be 2.4 to 3.6 meters/8 to 12 feet. However, the depth should be as great as is practical.

5.5.6 Miscellaneous:

Ponds may be used as “add on” treatment for mechanical plants, i.e., polishing ponds to capture solids. Detention time for polishing ponds for mechanical systems should not be more than 36 hours nor less than 12 hours anytime during the design life of the facility. Other design requirements will be based on desired levels of treatment or on storage time needed to meet effluent limits of stream standards.

Design criteria for polishing ponds installed as a result of the requirements in paragraph 5.5.7 are provided below.

- i Depth: The desirable depth for this type of polishing pond is 2.4 to 4.5 meters/8 to 15 feet.
- ii Discharge Structure: The discharge structure shall be designed to reduce the discharge of algae and scum in the effluent. This is most often accomplished by designing a multi-level draw off discharge structure.
- iii By-Passing: Provision shall be made to by-pass the polishing ponds and/or suspended solids removal unit for all plants utilizing the activated sludge process. This will allow effluent from the activated sludge facilities to be discharged directly when the quality meets or exceeds permit requirements.

5.5.7 Pond Configuration:

The pond system should be designed for series operation with the capability to bypass any pond and function with any single pond out of operation while still meeting discharge permit limits. (This is not meant to require installing additional ponds, it just means that for short periods, i.e. maintenance and sludge removal, the system must be able to operate within compliance of the discharge permit even if one pond is out of service). A minimum of three cells is required.

- i The first pond shall be aerated with dissolved oxygen to be dispersed throughout the aerated portion of the pond (excluding pond systems using an anaerobic pit in the first cell).
- ii The second pond shall be aerated and should, at a minimum, have dissolved oxygen dispersion in the aerated portion of the first 2/3 of the pond.
- iii The final pond shall be for settling and polishing.
- iv The pond system shall be designed to avoid short-circuiting and to permit sludge removal.
- v The recommended liquid depth for an aerated pond is from 2.5 to 6.0 meters/8 to 20 feet. The pond should be deep enough to prevent scouring of the liner by the aeration equipment. Adequate sludge storage must be provided in the design considering the sludge removal schedule specified in the plan of operation.
- vi The discharge structure from the pond system should be designed to vary the draw off level to discharge below the light zone and discourage thermal stratification while discharging the best quality effluent. This is most often accomplished by a variable depth draw off discharge structure or an equivalent design.

5.6 AERATION SYSTEMS

Mechanical surface aerators and subsurface diffused air systems may be used in aerated lagoon systems. Consideration for ambient summer and winter temperatures, elevation, oxygen demand, mixing requirements, oxygen transfer efficiency, type of aerated lagoon system (partially mixed or complete mix), water temperatures, etc. must be made in choosing the proper aeration system.

5.6.1 **Operation:**

Aerated lagoon systems must be operated and maintained properly to obtain optimum effluent quality and to avoid nuisance conditions. This system involves a little more technical skill than a waste stabilization pond for operation. Preventive aerator maintenance, prevention of aerator freezing (surface aerators), preventing diffuser clogging, and proper operating times should be addressed in the operation manual.

Like waste stabilization ponds, small communities with new sewer systems and low initial water use, at least one cell must be pre-filled to avoid aquatic growth and resultant nuisances. Effluent limits or stream standards may require holding for extended periods with an intermittent discharge. This type of operation must be addressed in the development of the operation manual.

5.7 **WETLAND SYSTEMS - GENERAL**

Wetlands may be used for treatment of primary treatment effluent, secondary treatment effluent or for polishing effluent from lagoon systems or mechanical systems. Free surface flow, Sub-surface flow and Aquatic plants systems may be used. Aquatic plant systems will be reviewed on a case-by-case basis.

5.7.1 **Location**

The location requirements specified earlier in this document generally apply to wetlands. The role of the wetland treatment system (i.e. secondary treatment versus primary treatment) and whether or not the wetland is subsurface will be considered in reviewing the proposed location relative to the requirements specified.

5.7.2 **Multiple Wetlands**

Multiple units shall be evaluated except where wetlands are used for effluent polishing. Units can be operated in parallel or series whichever is required for optimal performance and effluent quality. Consideration should also be given to step loading individual cells to more uniformly load the wetlands. Providing for re-circulation (inter-cell and intra-cell) is encouraged.

5.7.3 Primary Treatment

Wetlands must be preceded by primary treatment designed to remove settleable solids and floating material.

5.7.4 Flow Control

When utilizing multiple wetlands, some method of controlling flows to individual wetlands for by-pass, maintenance and optimal performance shall be provided.

- i An influent manhole or splitter box will be provided for multiple cell systems. This can be a common structure for several cells if the wetland configuration permits such an arrangement. Influent manholes or splitter boxes should be designed so that positive flow control can be maintained by weirs, stop gates, or valves, and the accuracy of each diversion will be within 10% of the actual flow.
- ii **Flow Measurement:** A flow-measuring device such as a v-notch weir shall be provided on all overflow structures or on the influent to each treatment train to ensure uniform loading to each cell or treatment train and aid in water balances for verifying liner integrity.
- iii **Inlets:** Inlets should be designed to dissipate the influent velocity, prevent freezing, distribute the flow equally across the inlet width of wetlands to prevent short-circuiting, and have large enough porosities to prevent clogging. Multiple inlets should be spaced across the width of the cell to ensure uniform loading. Inlet distributors should discharge onto 150 mm/6-inch -thick layer of coarse aggregate or equivalent design. Channels and piping should be designed to prevent deposition of solids.
- iv **Outlets:** All wetlands shall be equipped with variable level draw-off for effective water level control in the wetlands. Outlet collection areas shall be designed to collect evenly across the outlet width of the wetlands, prevent short-circuiting and have large enough porosities to permit balanced collection. Outlet collectors should be enclosed in a berm of course riprap 80-150 mm/3-6 inches in diameter in size or equivalent design. Provisions shall be made for individual inspection and sampling.

- v Media: Cleaned, washed, or dry-screened media must be initially installed so that the media is relatively free of fine solids that can interfere with the process.

5.7.5 Drains

Each wetland cell must have facilities for complete draining. Any drain or level control must be capable of being locked to avoid accidental or malicious discharge. Provisions shall be made to return the effluent to the appropriate part of the treatment facility for adequate treatment in the event of draining a cell.

5.7.6 Cell Lining

Wetlands treating primary effluent or lagoon effluent shall be lined with an impervious soil or synthetic material. For wetlands used for polishing, cell lining will be reviewed on a case-by-case basis. If the cells are not lined, a ground water discharge permit may be required from NEPA. Piping will be located to minimize piercing of the cell seal.

5.7.7 Construction and Materials

- i The wetland area, bottom and dikes, must be stripped of all vegetation and organic material. No stripped or organic material can be used in the embankment. This material may be utilized for wetland substrate if testing shows it is compatible with the chosen vegetation. For Subsurface flow wetlands stripped organic material may not be used as the substrate.
- ii Embankments and dikes must be constructed of impervious materials and compacted sufficiently to form a stable structure in keeping with standard embankment construction practices.
- iii The top width of the dike will be a minimum of 2.5 meters/(8) eight feet unless vehicles will not be driven on them or maintenance equipment can be utilized on smaller dikes. Dike slopes should not be steeper than two to one vertically nor flatter than four to one vertically.
- iv Interior corners must be rounded.
- v Adequate erosion and flood protection must be provided as needed.

- vi All disturbed areas above the water line will be seeded with a densely growing perennial grass native to the area.
- vii Wetlands should be designed so the seepage out of the bottom or dikes (sides) will not exceed 10-6 cm/sec/1/32 of an inch per day. If the soil tests demonstrate that this cannot be obtained, then positive seal methods such as soil additives, bentonite, native clay, soil cement, or synthetic liners must be used. Wetlands exceeding the ex-filtration rate will require a groundwater discharge permit from NEPA.
- viii Synthetic liners should be vented.
- ix Plantings should be made on 0.3 to 0.9 meters/1 to 3-foot centers with the recommended average density no less than one plant per .372m²/4 square feet through the length of the wetlands. Plants considered for constructed wetlands treatment should be native species and the basis (including site elevation) for their selection must be provided with the design. The plants may consist of Cattails (Typha), Bulrushes (Scirpus) and Reeds (Phragmites). Monotype plantings should not be used initially, and wetlands should be actively managed to prevent dominance of any single plant species. Plants considered for aquatic systems will be reviewed on a case-by-case basis. The design should also specify if any species, e.g. Cattails (typha), are to be actively managed for elimination as a noxious weed. Plants considered for free surface flow wetlands should be selected for water depth preferences. Plants considered for subsurface flow wetlands should be selected for facultative wetland conditions.
- x Free surface flow wetland areas shall be enclosed with an adequate stock-tight fence similar to provisions listed in (Pond appurtenances). Fencing requirements for sub-surface flow wetlands will be considered on a case-by-case basis. Safety criteria for disinfection facilities must still be met.

5.7.8 Temperature

Tropical temperatures and their effect on wetland vegetation and the treatment process must be taken into account.

5.7.9 Miscellaneous

Constructed wetlands are primarily to be used for domestic wastes. Industrial waste of similar strength may be considered for treatment by constructed wetlands. Industrial wastes containing toxic materials or high concentrations of organic or inorganic materials may not be suitable for this type of treatment but will be reviewed on a case-by-case basis. The engineer's report must contain sufficient detail to show that all the required design considerations have been satisfied. Verification of liner integrity or a statement that the entity has applied for a groundwater discharge permit must be included.

Wetlands may be used as "add on" treatment for mechanical plants similar to polishing ponds to capture solids. Applicability and detention time for this type of constructed wetlands will be reviewed on a case-by-case basis. Other design requirements will be based on desired levels of treatment or on storage time needed to meet effluent limits of stream standards.

5.8 FREE SURFACE FLOW WETLANDS

5.8.1 Loading

Loading rates should follow the parameters found in Table I at the end of this document.

5.8.2 Bed Slopes

Lateral bed slopes shall be zero, and longitudinal slopes from inlet to outlet should be from 0 to 1%. Slope should be sufficient to drain the cell if and when maintenance is required.

5.8.3 Substrate

Free surface wetlands should have substrate depths from 152 mm/(6) six inches to not greater than 0.3m/12 inches, depending on the type of vegetation used. The type of substrate may be top soil and organics from the area or sand and gravel.

5.8.4 Flow Control

Outlet control structures should be designed so that water levels can be maintained at virtually infinite increments from a 101mm/4-inch depth up to 0.6m/24-inch maximum water depth, but not greater than 76mm)/three-inch increments.

5.8.4 Wetland Configuration

- i The shape of all cells must ensure plug flow and limit short-circuiting. A length to width ratio of at least 10:1 may be considered with respect to this requirement. Attention should be given to head loss and hydraulic gradient considerations.
- ii Dikes will be constructed so that the maximum water depth is 0.6 m/two feet and there is a minimum freeboard of 0.3 meter/one foot.

5.8.6 Operation

- i Normal operating water depth should be 0.15m/six inches to .06m/24". Cold weather operating depth should be such that an ice cover will insulate the waste stream and permit continued treatment.
- ii Once the wetlands are established dead material should be regularly harvested to prevent effluent degradation due to plant decomposition.
- iii Operating depth changes from cold weather to warm, or warm to cold should take place over a period of time to reduce stress on the wetlands. Increments of three inches or less may be considered.
- iv Wetlands should be periodically monitored for parasites (animals, insects and fungi) to prevent disruption of wetland growth.

5.9 SUBSURFACE FLOW WETLANDS

5.9.1 Loading

Loading rates should follow the parameters found in Table I at the end of this document.

5.9.2 Bed Slopes

Lateral bed slopes shall be zero, and longitudinal slopes from inlet to outlet should be from 0 to 1%. Slope should be sufficient to drain the cell when maintenance is required.

5.9.3 Substrate

Subsurface wetlands should have substrate depths from 0.3m/12 inches to not greater than 0.91 meters/36 inches, depending on the type of vegetation used. Greater media depths will be considered with the appropriate references. Substrate type shall be gravel. The gravel size is recommended not to exceed 19mm/3/4 inches in diameter and not to be less than 10mm/3/8 inches in diameter. Cleaned, washed, or dry-screened media must be initially installed so that the media is relatively free of fine solids that can interfere with the process.

5.9.4 Flow control

Outlet control structures should be designed so that water levels can be maintained at virtually infinite increments from a 0.15m/6-inch depth up to a maximum water depth equal to the total substrate depth (not to exceed 0.91 meters/36 inches).

5.9.5 Wetland Configuration

- i Consideration should be given to promoting uniform loading and eliminating short-circuiting. The shape of all cells should be such that the length to width ratio is not greater than 4:1 and should more likely be in the range of 1:1.
- ii Dikes will be constructed so that the maximum water depth is the same as the substrate depth and there is a minimum freeboard of 0.15m/(6) six inches.

5.9.6 Operation

- i Normal operating water depth should be below the surface of the media.
- ii It is not necessary to harvest dead material in this type of wetland, however it is advisable.
- iii Operating depth changes from cold weather to warm, or warm to cold should take place over a period of time to reduce stress on the wetlands. Increments of three inches or less may be considered.
- iv Wetlands should be periodically monitored for parasites (animals, insects and fungi) to prevent disruption of wetland growth.

CHAPTER 6

SEWER MAINS, PUMPING STATIONS AND COMMISSIONING OF SYSTEMS

6.0 Design of Sewer Mains

In general, no sewer must be less than 200 mm/8" in diameter. However, the NWC may grant a waiver under special circumstances.

In general, sewers shall be sufficiently deep to receive sewage from all premises within the contributing area and resist damage due to traffic load. Recommended methods of bedding are detailed in Paragraph 6.2.3.

Sewers shall be designed and constructed to attain mean velocities, when flowing full, of not less than 60 cm/s/2.0 ft/s. Minimum slopes as hereunder are recommended. Being minimum recommended slopes, greater slopes are to be used whenever practicable.

Table No. 3

Sewer Size		Minimum Slope
mm	ins.	(m/100 m)
203	8	0.40
254	10	0.28
305	12	0.22
356	14	0.17
381	15	0.15
406	16	0.14
457	18	0.12
533	21	0.10
610	24	0.08
686	27	0.067
762	30	0.058
914	36	0.046

Slopes between manholes shall be constant and wherever slopes 1 in 5 or greater are contemplated, the sewers shall be anchored securely with concrete anchors.

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. A suggested method for achieving this is to place the 0.8 depth point of both sewers at the same elevation. Under no circumstances must the size of the sewer be decreased downstream.

When velocities greater than 370 cm/s/12 ft/s are expected special provision shall be made to protect against displacement by erosion and shock.

Force mains should enter the gravity sewer system at a point not more than 0.6 m/2' above the flow line of the receiving manhole.

Except otherwise approved by the President, sewers shall be laid along the centre line of the roadway, with manholes located at all changes in direction and at intervals not greater than 91 m/300' apart. At least one lateral shall be provided for each lot in the development. The method of connecting the lateral to the sewer is shown on Drawings No. 6A and 6B.

6.1 PIPES

Pipes to be used for sewerage service should conform to the requirements of the latest version of the relevant AWWA Standards or equivalent British or ISO Standard.

Buried pipelines should be laid with flexible joints to allow for settlement and ground movement.

Flexible joints may be of the bell and socket rubber ring push fit type or mechanical joints.

Flanged joints can be used for pipelines laid above ground and in pumping installations where the pipe work is required to be self-supporting.

6.2 CONSTRUCTION AND INSTALLATION

6.2.1 General

Adequate support should be provided for all pipes. Particularly, in the case of PVC pipes, continuous and uniform bedding should be provided in the trench at all times. Stones found in the trench should be removed for a

depth of at least 15 cm/6" below the pipe invert.

All pipes should be given pressure and leakage test after installation in accordance with the requirements of the AWWA Standards: AWWA C600 and C603 or equivalent.

For installation, the manufacturers' recommended procedure should always be followed.

6.2.2 Excavation

The trench shall be excavated true to line and grade. The width at the top of the trench will vary with the depth, but should not be wider than the minimum required to accommodate shoring when required and to provide adequate clear width for working. The clear width at the bottom of the trench should be 46 cm/18" minimum and otherwise the minimum width necessary to enable the work to be done, but not less than the diameter of the pipe plus 30 cm/12", for pipes of more than 15 cm/6" diameter.

The excavated material should be disposed of in such a manner as to leave a clear inspection path 0.9 m/3' wide along the top edge of the trench, on one side of the trench.

For the purpose of finishing the bottom of the trench true to grade, for laying the pipe accurately and to enable the Commission to conveniently and quickly check the gradient of the sewer when laid, the Developer should erect not less than 3 sight rails between manholes, the rails not being more than 15 m/50' apart. A boning rod of suitable length must also be provided and both the cross piece of the boning rod and the horizontal rails of the sight rail should be painted in bands of contrasting colours. The trench should be excavated to within about 15 cm/6" of finished grade, after which grade pegs should be firmly driven into the bottom of the trench at approximately 1.5 m/5' intervals. By using the sight rails and boning rod the tops of the pegs should be made to finish level with the proposed invert of the sewer. The grading of the trench should then be completed by hand excavation to finish accurately to the grade of the tops of the pegs.

If any portion of the trench has been excavated below grade it must be refilled by means of approved granular material, as defined under "Definitions", well rammed in 15 cm/6" layers. Adequate bedding must be

provided for as described in paragraph below.

If any portion of the trench is in rocky ground it should be excavated to a depth of 15 cm/6" below grade and refilled with approved bedding material as described in paragraph below.

If any portion of the bottom of the trench is in peaty or unstable ground which, it is considered, will not provide adequate support for the pipe, the trench should be excavated to a specified depth below grade and be refilled with well rammed 15 cm/6" layers of granular material to provide adequate support for the pipe. If required by the Commission, the above granular material shall terminate 15 cm/6" below grade, the pipe not being laid until the granular material is at least 4 days old, when the pipe should be laid on 13 mm/1/2" of 1.3 cement mortar. In this latter case, backfilling of the trench shall not commence until the concrete is at least 7 days old.

6.2.3 Bedding of the Sewer Pipe

Subject to what has already been said in the above section on "Excavation", and subject to the pipe manufacturers' requirements as regards bedding and pipe support, pipes made of the following material shall be laid on a bed not less than 10 cm/4" thick composed of material having no particle larger than as specified below.

6.2.4 Laying and Jointing of Pipes

The pipes shall be carefully laid in conformity with the manufacturers' requirements. The pipes shall be laid true to line and grade by using sight rails and boning rod or any other suitable equipment. After each section of sewer has been laid between successive manhole locations it shall be cleared of all foreign matter by passing through it a scraper or swage, slightly smaller in diameter than the sewer. At the end of each day's work, both ends of the pipe must be plugged to avoid entry of foreign matter. If the sewer is being laid in conditions of high ground water in order to avoid floating of the pipeline, backfill to a height of 0.6 m/2' over the pipe may be placed between joints immediately after the pipe has been laid.

In the event of an existing pipeline having been fractured, the damaged portion may be cut out and replaced by a length of plain end pipe, jointing being accomplished as shown on Drawing No. 7 that deals with the case of PVC pipes.

The method for connecting a PVC sewer to a cast iron sewer is described

on Drawing No. I2B.

The following are the chief criteria for successful jointing of the pipeline forming the sewer:

- i Cleanliness of all parts.
- ii Correct location of all components of the joint or coupling.
- iii Centralization of spigot and socket.
- iv Strict compliance with manufacturers' jointing instructions.
- v True alignment in vertical and horizontal planes.

6.2.5 Protection of Sewer Pipe

Sewers of any material (except ductile iron and steel, the protection of which will be subject to the Commission's instruction) which are unavoidably laid at a shallower depth than 107 cm/3' 6" to invert or top of pipe below road surface shall be completely surrounded with at least 153 mm/6" of 1360 kg/3000 lb concrete.

Except otherwise required by the Commission, and subject to the manufacturers' requirements sewers laid at greater than 107 cm/3' 6" below road surface shall be given Class B protection as described in Drawing No. 8.

Where, due to severe conditions of unstable ground, excessive depth below road surface or for any other special reason, the Commission or the manufacturers' requirements call for special protection for the pipe this should take the form of Class A protection as described in Drawing No. 8, subject to the President requiring the sewer to be completely surrounded with concrete.

6.2.6 Testing of Sewers

All sewers shall be tested by the Developer before being backfilled or surrounded with concrete. They shall also be retested after backfilling if so required by the President. Subject to the Commission requiring a special test to be made in any particular case, the test shall conform to the following procedure.

The sewer shall be tested in the presence of the Commission and in lengths between successive manholes. The pipe shall be slowly filled with water until the water surface is 1.2 m (4') above the invert of the pipe or above

ground water level, at the higher end.

6.2.7 Backfilling of Trench

Sewers which have been laid on a bed of concrete or which have been surrounded with concrete shall not be backfilled until the concrete is at least 7 days old.

The trench shall be backfilled to a height of 30 cm/12" over the pipe with approved granular material (see "Definitions") well compacted by hand rammer in 15 cm/6" layers. Thereafter the backfill material shall be selected, excavated material may be rammed up to road surface by mechanical means. In the case of sewers, which have been surrounded with concrete, the trench should be backfilled with selected excavated material thoroughly rammed in 15 cm/6" layers. To ensure satisfactory consolidation, the backfill material should be sprinkled with sufficient water while being placed in the trench.

6.2.8 House Laterals or Junctions

The requirements of sections 6.2.3 to 6.2.7 and the last 3 paragraphs of 6.2.2 apply equally to this section on laterals. In addition, laterals shall be laid as follows and as described in Drawings Nos. 6A and 6B.

The laterals shall be laid to a grade of 1 in 30, except where it is impracticable to do so, in which event it may be laid to a grade not flatter than 1 in 50 except by special approval of the President. The invert of the lateral at the lot boundary should be 0.9 m/3' minimum below ground.

The lateral shall be connected to the sewer by means of a 45° bend as shown in Drawings Nos 6A and 6B. A special fitting incorporating both angle branch and bend where available, may be used instead of the individual branch and bend, providing the manufacturer gives his assurance that adequate stocks of the special fittings will always be available.

Where the depth of the sewer is less than 2.7 m/9', but greater than 1.2 m/4', the President may, at his discretion, permit the lateral to be laid at a gradient steeper than 1 in 30.

Where the sewer is more than 2.7 m/9' deep, the lateral shall be connected to the sewer by a single or double vertical riser of the same diameter as the lateral. The riser shall be surrounded with 1360 kg/3000 lb concrete as shown on Drawing No. 6B and the connection between the vertical on the

sewer and a 45 bend connecting the riser to the branch.

6.2.9 Manholes

Manholes shall be provided at all horizontal and vertical changes in direction of the sewers and also on the straight sewers at maximum intervals of 91m/300'. Their internal dimensions shall generally be 107cm/3' 6" x 91cm/3', but the Commission may vary these dimensions in certain cases. They may be constructed either of precast sections or insitu. Their structural design shall conform to Drawings Nos. 9 and 10.

Circular manholes 1.22m/4'0" internal diameter will also be approved and should conform to Drawing Nos. 10A and 10B.

Channels and benching and all interior surfaces in manholes should be given a trowel finish.

Step iron conforming to JS 30: 1974 should be provided in all manholes not more than 3.05m/10' deep to invert. The step irons should be located and spaced as shown on Drawing Nos. 9B and 10A.

Manholes greater than 3.05m/10' deep should be provided with ladders constructed as shown on Drawing Nos. 9A and 10B.

Each manhole shall be provided with a heavy duty manhole frame and cover, with 457 mm/18" x 610 mm/24" clear opening, conforming to BS 497:1952. The frame shall be fixed to the manhole cover as shown on Drawing Nos. 9A and 10B.

Where the invert of the incoming sewer is more than 0.91 m/3' above the invert of the outgoing sewer, the incoming sewer shall enter the manhole by means of a backdrop which shall be surrounded by 1360 kg/3000 lb concrete at least 15 cm/6" thick as shown on Drawing No. 11. Except incoming sewer is of PVC pipe, a pipe joint shall be provided within 46 cm/18" of the face of the manhole less 0.91 m/3' above the invert of the outgoing pipe.

To ensure bonding of the pipe to the concrete, all PVC pipes passing through the walls of manholes should be roughened with a coarse file. Alternatively, a special lining or sleeve, as shown in Drawing No. 12A, may be employed.

6.2.10 Testing Manholes for Watertightness

All pipes entering and leaving the manholes shall be plugged and the manhole shall be filled with water to within 15 cm/6” of the underside of the cover slab and shall remain filled for 24 hours. Sufficient water shall then be added for the surface of the water to regain its original level. The level shall be observed for a period of 12 hours. The criterion for a satisfactory test is that the water level should not fall, in 12 hours, to a lower level than, in the opinion of the President, could be explained by evaporation. Should the test be unsatisfactory, the Developer shall correct the defects and the manhole shall be re-tested until a satisfactory test has been obtained.

6.2.11 Inverted Syphons

Incorporation of syphons for sewerage of developments will be given approval only in very exceptional circumstances or in circumstances on which their inclusion on the design is unavoidable. Individual specifications for their construction will be drafted in each case.

6.2.12 House Sewers

The single stack system of plumbing is permitted providing the installation conforms to CP 304.

This specification is prepared to make the Developer aware of the minimum quality and standard of workmanship of which the NWC will approve subject to chapter 7:

Minimum Acceptable Standards. It is not intended to be exhaustive, not to supersede the specifications prepared by a Registered Engineer.

Where particular standards or codes of practice are referred to, the phrase “or equivalent” should be presumed to be added.

The Developer should make himself thoroughly conversant with the manufacturers recommended methods for handling, laying and jointing pipes and fittings of the particular material to be used.

6.2.13 Grease Traps

In-order to protect NWC sewerage treatment system; it is advised that grease traps be installed in individual houses and commercial entities.

In general a grease trap contains two rectangular chambers. The inlet pipe into the first chamber ends in a dip pipe that travels at least 450 mm below top water level (TWL), while the chamber is a minimum of 1500mm deep from TWL. The dip is usually 100 mm dia and has a vertical pipe for rodding. This first stage chamber is usually W width and 2W length. The outlet pipe from the first chamber also consists of a dip pipe but the bottom of the pipe is a min. 300mm below TWL. The inlet pipe into the second chamber also ends in a dip pipe which travels down at least 450 mm below TWL, while the chamber is a minimum of 1500 mm deep from TWL. The dip pipe is usually 100 mm dia. min. and has a vertical pipe for rodding. The second stage chamber is usually W width and W length. The outlet pipe from the second chamber also consists of a dip but the bottom of the pipe is a min 300mm TWL.

6.3 CONSTRUCTION OF PUMPING STATION

Pumps Stations must be constructed insitu. All pumping stations must be equipped with a standby generator and housed in a reinforced concrete building. Pumps Stations should be equipped with suitable equipment as approved by the NWC. All Pumps must be installed above ground level. Pumps installed must be connected to a control panel equipped with voltmeters and ammeters. All pumping stations must be designed with the facilities for grit removal and flow measuring devises. A water supply must also be provided on the premises.

6.4 CONNECTION TO PUBLIC SEWER

Connection to the public sewer can be accomplished in the following manner:

- 6.4.1 Application is made by completing an "Application for Premises to be connected to NWC Sewer" form (See appendix 4) and submitting it to a NWC's Commercial Office.
- 6.4.2 Three copies of the drawing of the premises to be connected should accompany the application form. The drawings should detail:
 - i Floor plan of building showing all sanitary fixtures.

- ii A stack-plan showing all stories and down pipes with appropriate connections.
- iii Details of yard-sewers, showing sizes, grades and proposed connection to the street sewer.
- iv Details of all manholes, inspection chambers trap gully basins and such appurtenances.

Of the three copies provided, one is sent to the local Health Authority for processing, the Commission for records purposes keeps one and the other is returned to the applicant after processing.

- 6.4.3 The Commission will prepare an estimate of the cost of the connection if deemed necessary.
- 6.4.4 The Commission or a licensed sanitary contractor, upon payment of the established fee, makes the connection to the public sewer. Where a licensed sanitary contractor is engaged the Commission will supervise the work, for which the owner is required to pay the Commission for supervision. This supervision charge is separate from the processing fee that must be paid before the application is processed. See appendix 2 for fees.
- 6.4.5 A plumber's return is then sent to the Commercial Department so that the customer's account can be established.

6.5 COMMISSIONING OF SYSTEM

Completed systems are commissioned into service under the following conditions:

- 6.5.1 Systems to be commissioned must have the prior approval of the NEPA and NWC.
- 6.5.2 The NWC is allowed to visit and inspect the project at any time during the construction phase.
- 6.5.3 All equipment and machines are approved by the NWC in terms of specification and trade name. Manufacturer's warranty on all equipment

should be provided.

- 6.5.4 Adequate spare are provided for equipment.
- 6.5.5 A maintenance period ranging between 6-18 months may be required with the following taken into consideration:
- i The contractor will pay for the operation of the system for the maintenance period.
 - ii The contractor will make good all defects occurring during this period as a result of the manufacturer's fault.
 - iii Request by NWC for changes to equipment/structure due to best practice, during the commissioning period must be fulfilled.
 - iv The NWC reserves the right to accept or not a commissioned system into its operation, because of non-compliance to reasonable request or lack of operational integrity of the treatment plant.
- 6.5.6 Two (2) copies of the Operational and Maintenance manual must be provided.

CHAPTER 7

MINIMUM ACCEPTABLE STANDARDS

7.0 MINIMUM STANDARDS

Standards and specifications outlined in the preceding sections of this manual represent the usual engineering practice of the National Water Commission and are heavily influenced by British and American Standards.

In recent times, government as a major provider of housing solutions has suggested a need for a re-examination of standards with the objective of obtaining a more affordable outcome. Specifically, it has been suggested that standards for infrastructure should be lowered in the case of squatter upgrading, sites and services and other such low income developments.

While the Commission appreciates the motivation for such requests, it nevertheless, recognises the threat to health that might arise in relaxing water and sanitation standards. Furthermore, it is the Commission's experience that higher maintenance costs generally arise when 'cheaper' solutions are implemented. This is due primarily through vandalism and inappropriate use of facilities.

The following guidelines are recommended in the context of the preceding. In all instances where these guidelines are to be applied, prior written consent of the NWC shall be obtained.

7.1 SIZE OF DISTRIBUTION MAIN

Distribution mains may be sized less than 100 mm/4" and or below fire flow carrying capacity if the local Fire Department waives the requirement for fire hydrants. This waiver is to be given in writing.

7.1.2 Cover of Mains

Cover of water mains may be reduced to 40 mm provided the mains are located in pathways and other such access ways that are sized to preclude vehicular traffic.

7.2 SEWERAGE SYSTEMS

7.2.1 Size of Sewers

Sewer mains may be reduced in size to 15.24 mm/6" provided the carrying capacity so provided is adequate for the purpose and that adequate provisions are made for regular cleaning of the mains.

7.2.2 Cover of Sewers

Cover of sewer mains may be reduced to 610 mm/2' provided the mains are located in pathways and other such access way that are sized to preclude vehicular traffic.

7.3 CONTACT INFORMATION

For further information please contact:

The President
National Water Commission
28-48 Barbados Avenue
LOJ Building
5th Floor Kingston 5
Tel: (876) 929-5430-5
Fax: (876) 929-6285
Email: pr@nwc.com.jm
Website: www.nwcjamaica.com

Appendix I



NWC SUBDIVISION APPLICATION FORM

1) NAME OF PROPOSED SUBDIVISION		
2) INTENDED LAND USE		
3a) TOTAL AREA (SQ. KM)	3b) TOTAL AREA (ACRES)	3c) NO. OF LOTS PROPOSED
4) DESCRIPTION OF SUBDIVISION LOCATION		
5) ESTIMATED WATER REQUIREMENTS (gallons per day)		
Domestic Use:	_____ no. of lots/units	_____ gall/day
Commercial Use:	_____ no. of lots/ units	_____ gall/day
Other:	_____ use	_____ gall/day
6) PROPOSED SOURCE WATER SUPPLY		
_____ Connect to NWC		

Appendix I

<input type="checkbox"/> Non-NWC source to be developed and handed over	
If non-NWC, specify source type (spring, river, well etc.) and attach any relevant information on the propose source	
<hr/>	
7) TYPE OF SEWAGE DISPOSAL SYSTEM PROPOSED	
<input type="checkbox"/> On-site	<input type="checkbox"/> Engineered system to be connected to NWC
<i>Type:</i> _____	
<input type="checkbox"/> Engineered system (private)	<input type="checkbox"/> Other
FOR NWC USE ONLY!!	
<input type="checkbox"/> 3 Hard copies enclosed	<input type="checkbox"/> Recommended for approval
Payment made/Payment not made	
<input type="checkbox"/> 1 Digital copy enclosed	<input type="checkbox"/> Not recommended
Date received _____	
<input type="checkbox"/> Engineering report enclosed	Date _____
Received by _____	

Appendix 2**Processing Fee**

A Processing Fee is to be paid to NWC upon submission of the Subdivision Application Form. This is the only fee charged by the NWC for the processing of subdivision development application. As at July 2003, charges are as follows:

Water Development Application

SUBDIVISION SIZE	COST
1 st 10 lots (under 4 acres)	\$4,000
Up to 20 lots (up to 8 acres)	\$4,000 + \$350/additional lot
More than 20 lots (12 acres or more)	\$11,000 + \$300/lot

Sewerage Development Application

SUBDIVISION SIZE	COST
Single Dwelling	\$1,500
Commercial	\$5,000
Housing Development (1 st 10 lots)	\$5,000
Housing Development (more than 10 lots)	\$5,000 + 200/lot

******* *Charges above are subject to change without notice.*

Appendix 3

NWC Sewage Application Form

APPLICATION FOR CONNECTION OF PREMISES TO A NWC SEWER

Scheme

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Application No.

(for NWC use only)

1.	Address of Premises	_____ _____ _____
2.	Details of Owner	Name: _____ Tel. No. _____ Address: _____ _____
3.	Details of Tenant (if any)	Name: _____ Tel. No. _____ Type of Tenancy: Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Yearly <input type="checkbox"/> Date of Commencement _____ / _____ / _____ Day Month Year Other: <input type="checkbox"/> (please describe) _____ _____
4.	To who is NWC's bill addressed? (Refer NWC Bill)	Name: _____ Address: _____ _____
5.	NWC Account Details of (Refer NWC Bill)	Meter No. <input style="width: 100%; height: 20px;" type="text"/> Account No. <input style="width: 100%; height: 20px;" type="text"/>
6.	Number of persons normally LIVING on premises	<input style="width: 30px; height: 20px;" type="text"/>
7.	Description of premises	RESIDENCE ONLY <input type="checkbox"/> with <input style="width: 30px;" type="text"/> bedrooms and <input style="width: 30px;" type="text"/> bath/powder rooms OTHER <input type="checkbox"/>
IF APPLICATION IS FOR RESIDENTIAL PREMISES PLEASE GO TO SECTION 12 OVERLEAF ALL OTHER APPLICANTS MUST COMPLETE SECTIONS 8 TO 12 OVERLEAF		

Plan (Drawing) in triplicate is required with this Application showing all foul drain run, surface water draining, toilet and restaurant area including size and depth of pipe works.

Appendix 3

NWC Sewage Application Form

Additional Information to be provided by all the applicants OTHER THAN ONLY RESIDENTIAL PREMISES

8.	Description of Premises:	<p>LS <input type="checkbox"/> COMBINED RESIDENCE and RETAIL SHOP { with <input type="text"/> bedrooms and <input type="text"/> bath/powder rooms</p> <p>GH <input type="checkbox"/> GUEST HOUSE with <input type="text"/> guest rooms and <input type="text"/> bathrooms</p> <p>H <input type="checkbox"/> HOTEL with <input type="text"/> guest rooms</p> <p>R <input type="checkbox"/> RESTAURANT with seating for <input type="text"/> persons with <input type="text"/> toilets and <input type="text"/> urinals</p> <p>C <input type="checkbox"/> OTHER COMMERCIAL: school, church, etc. (please describe)</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>..... with <input type="text"/> toilets and <input type="text"/> urinals</p>
9.	Responsible person to contact for:	<p>SITE OPERATIONS: Name:</p> <p>Position Tel. No.</p> <p>PAYMENTS: Name:</p> <p>Position: Tel. No.</p>
10.	Connections Existing	Number <input type="text"/> Size <input type="text"/> inches/mm
11.	Connections Required	Number <input type="text"/> Size <input type="text"/> mm and <input type="text"/> mm

FOR ALL APPLICANTS

12. I DECLARE THAT THE INFORMATION PRESENTED ON THIS APPLICATION IS TO THE BEST OF MY KNOWLEDGE TRUE AND COMPLETE

Name: Signature:
 (Block Capitals)

OWNER TENANT OTHER (Please describe)

Date Tel. No.

Address of Applicant (Block Capitals)

.....

Appendix 3

NWC Sewage Application Form

FOR NWC USE ONLY (Comments on Note Sheet)								
Application received by: _____ Date: ____/____/____	Site Visited by: _____ Date: ____/____/____							
Application Receipt No. <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>								Dwg's recev'd by: _____ Date: ____/____/____ Dwg's Rejected <input type="checkbox"/> Approved <input type="checkbox"/>
Passed for Assistance to _____	Work Inspected and Final Connection Witnessed by: _____ Date: ____/____/____							

NOTE SHEET Re: APPLICATION No.

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Scheme

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Application No.

(for NWC use only)

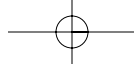
DATE	NOTES	INITIALS

Appendix 4**LIST OF DRAWINGS**

- DRG. NO. 1 - Location for Thrust Block
- DRG. NO. 2 - Available Adaptors for Connecting Water Pipes of Fittings of Dissimilar Material
- DRG. NO. 3A - Typical Service Connection Copper or PVC to AC or CI Water Main
- DRG. NO. 3B - Typical Service Connection Copper or PVC to AC Water Main
- DRG. NO. 3C - Typical Service Connection PVC to PVC Water Main
- DRG. NO. 4 - Typical Hydrant Connection and Method of Setting Valve Box
- DRG. NO. 5 - Method of Setting Double Air Valve
- DRG. NO. 6A - Method for Connecting Lateral to Sewer less than 9" - 0" deep
- DRG. NO. 7 - Method for Connecting Plain Ended Pipes
- DRG. NO. 8 - Protection for Sewer Pipe

Appendix 4

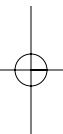
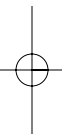
DRG. NO. 9A-	Rectangular Manhole with Walls poured in situ (STANDARD)
DRG. NO. 9A1-	Rectangular Manhole with walls poured in situ (METRIC)
DRG. NO. 9B-	Rectangular Manhole with Precast Walls (STANDARD)
DRG. NO. 9B1-	Rectangular Manhole with Precast Walls. (METRIC)
DRG. NO. 10A-	Circular Manhole with Wall poured in situ (STANDARD)
DRG. NO. 10A1-	Circular Manhole with Wall poured in situ. (METRIC)
DRG. NO. 10B-	Circular Manhole with Precast Wall (STANDARD)
DRG. NO. 10B1-	Circular Manhole with Precast Wall (METRIC)
DRG. NO. 11-	Backdrop connection to Manhole
DRG. NO. 12A-	Method for Connecting PVC Sewer to Manhole
DRG. NO. 12B-	Method for Connecting Sewer of Dissimilar material



Appendix 4

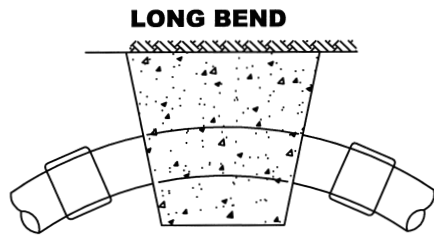
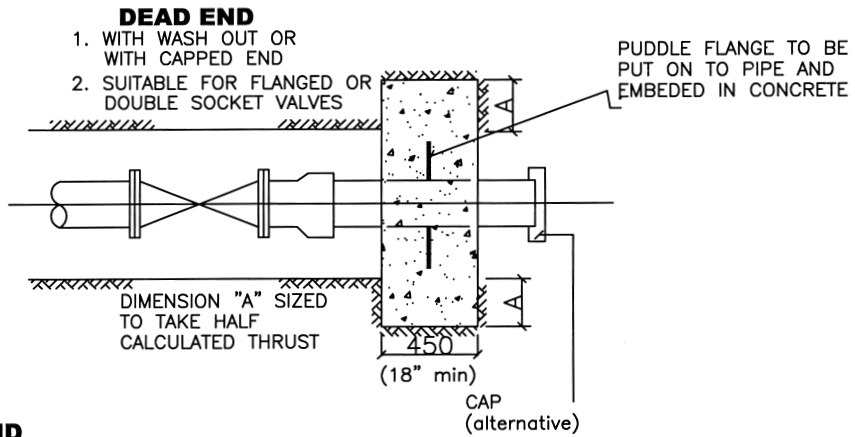
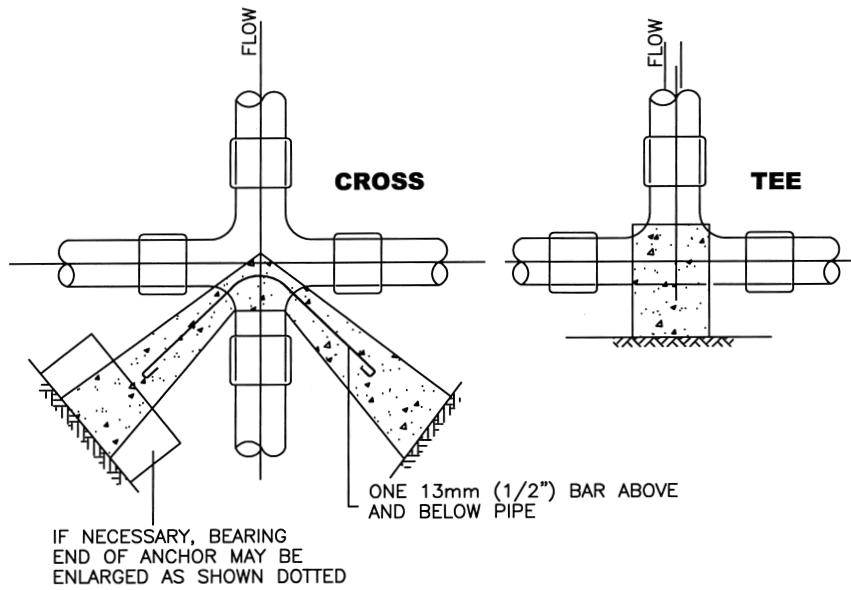
DRG. NO. 13 - Method for Connecting Buildings in excess of two storeys high

DRG. NO. 14 - Method for Connecting Multi-Unit Premises (METER BANK)



Appendix 4

DRAWING NO. 1



NOTES

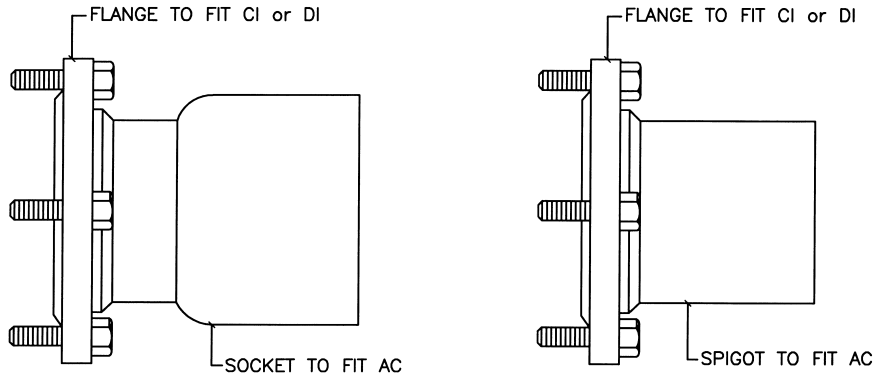
1. THRUST BLOCKS SHOWN IN PLAN
2. UPPER SURFACE OF THRUST BLOCKS TO BE 150mm (6") MINIMUM ABOVE TOP OF PIPE OR FITTING
3. THRUST BLOCKS TO BE OF 3,000lbs. CONCRETE

THE NATIONAL WATER COMMISSION

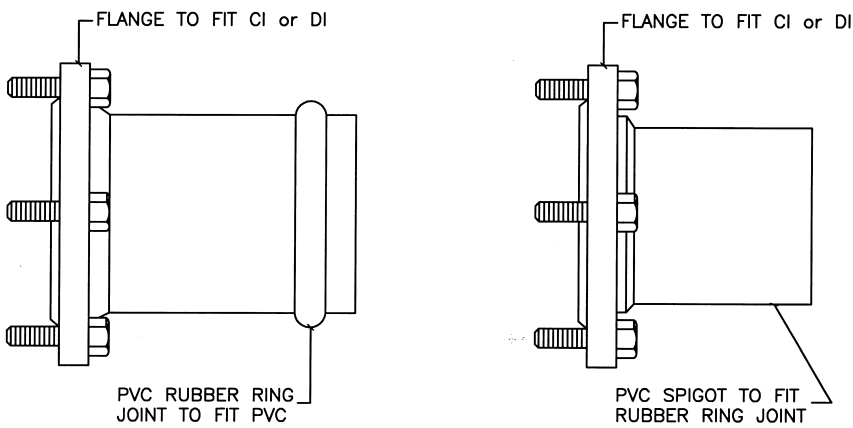
LOCATION FOR THRUST BLOCKS

Appendix 4

DRAWING NO. 2



ASBESTOS CEMENT IRON



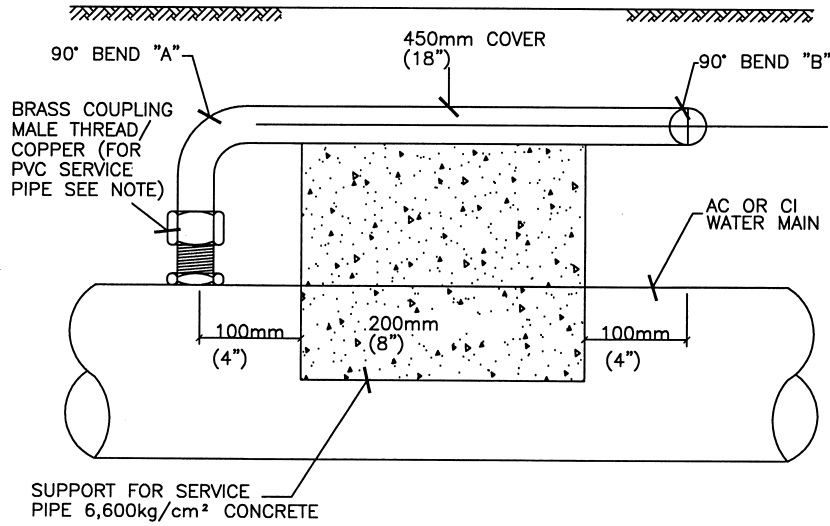
PVC / CAST IRON / DUCTILE IRON

**THE NATIONAL
WATER COMMISSION**

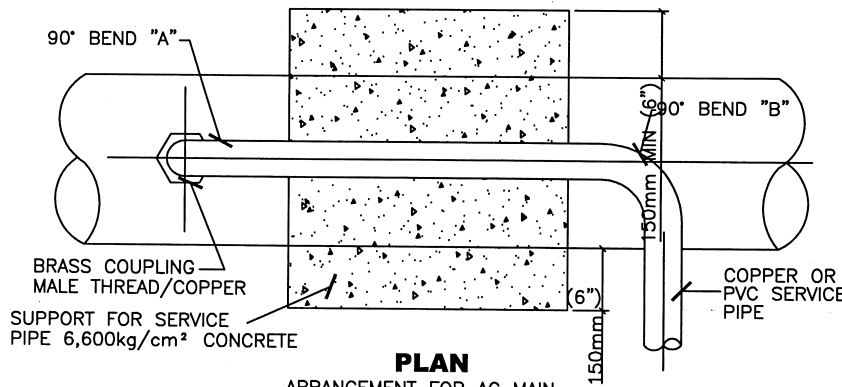
**AVAILABLE ADAPTORS FOR CONNECTING
WATER PIPES OR FITTINGS OF
DISSIMILAR MATERIAL**

Appendix 4

DRAWING NO. 3A



ELEVATION
ARRANGEMENT FOR AC MAIN
SEE NOTE FOR CI MAIN



PLAN
ARRANGEMENT FOR AC MAIN
SEE NOTE FOR CI MAIN

NOTE:

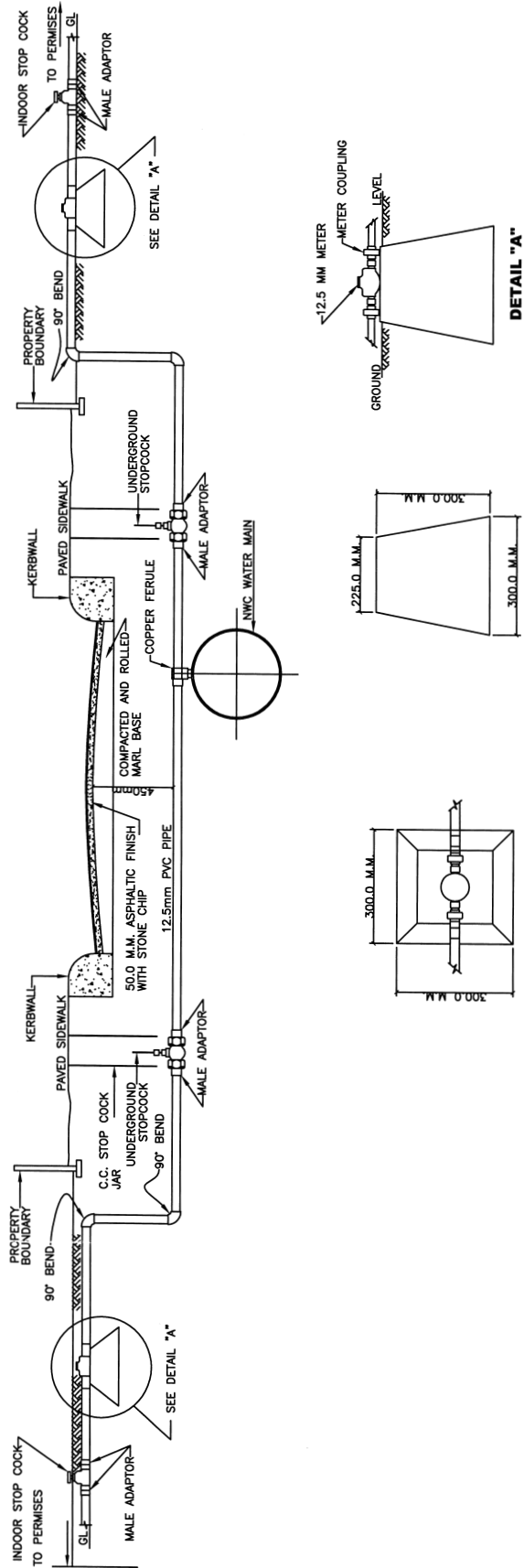
1. FOR CI MAIN THE 90° BEND "B" IS OMITTED AND THE 90° BEND "A" IS TURNED AT RIGHT ANGLE TO THE MAIN. NO CONCRETE SUPPORT FOR THE SERVICE PIPE IS PROVIDED IN THE CASE OF THE CI MAIN
2. FOR PVC SERVICE PIPE CONNECTION USE A PVC THREADED FITTING INSTEAD OF THE BRASS COUPLING
3. SEE ALSO DRAWING No. 3B

**THE NATIONAL
WATER COMMISSION**

**TYPICAL SERVICE CONNECTION COPPER
OR PVC TO AC OR CI / DI WATER MAIN**

Appendix 4

DRAWING NO. 3A1



PLAN SHOWING TYPICAL SERVICE CONNECTION

ELEVATION THRUST BLOCK N.T.S.

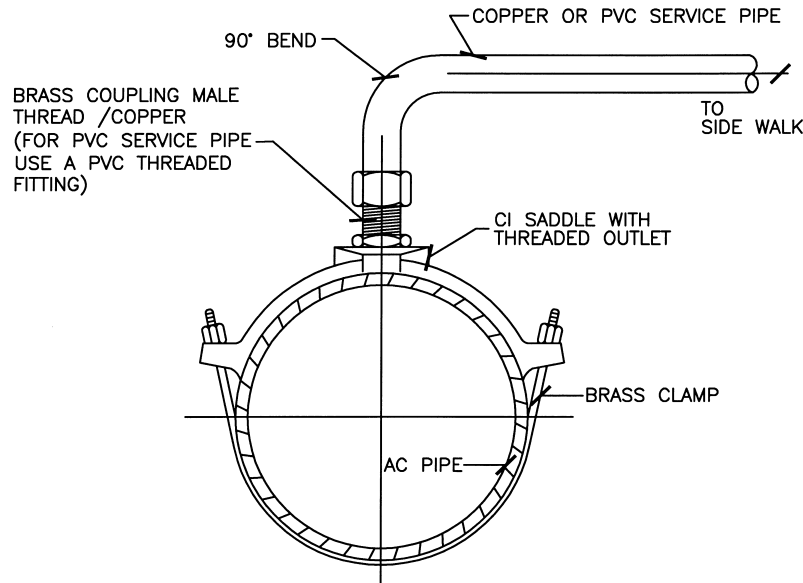
PLAN THRUST BLOCK N.T.S.

NB TAPPING ON WATER MAIN NOMINAL SIZE OF THE SERVICE IS TO BE A MAXIMUM OF QUARTER OF THE NOMINAL DIA. OF A WATER MAIN. E.G. 18.75mm SERVICE MAX. FOR 75mm MAIN, 25mm FOR 100mm ECT.

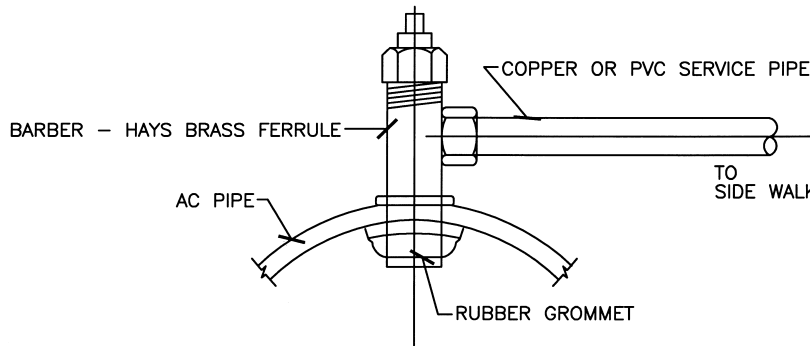
THE NATIONAL WATER COMMISSION

Appendix 4

DRAWING NO. 3B



ALTERNATIVE 1



ALTERNATIVE 2

NOTE

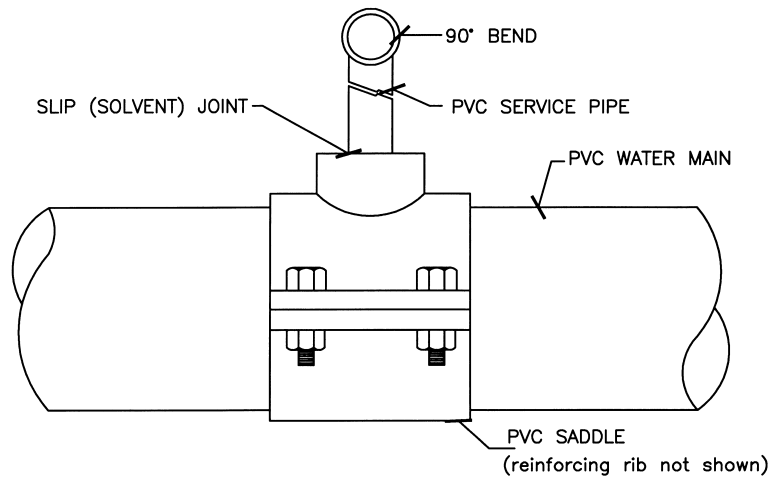
- 1. SEE ALSO DRAWING No. 3A

THE NATIONAL WATER COMMISSION

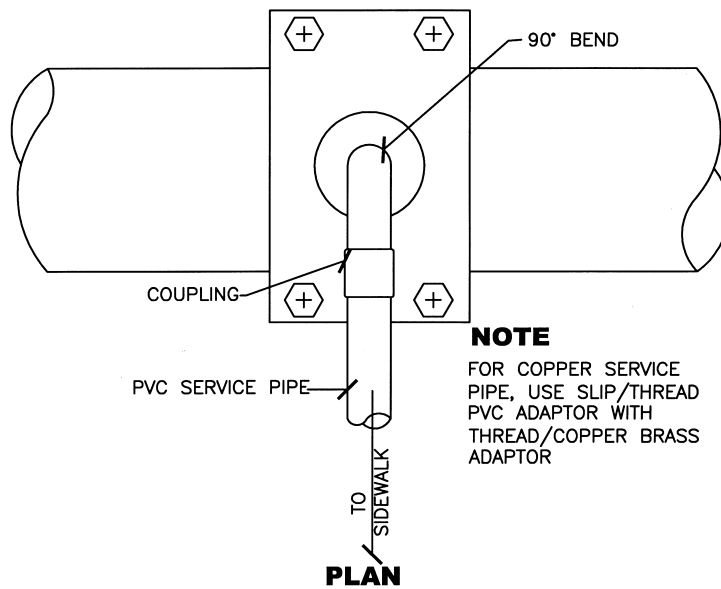
TYPICAL SERVICE CONNECTION COPPER OR PVC TO AC WATER MAIN

Appendix 4

DRAWING NO. 3C



ELEVATION



NOTE

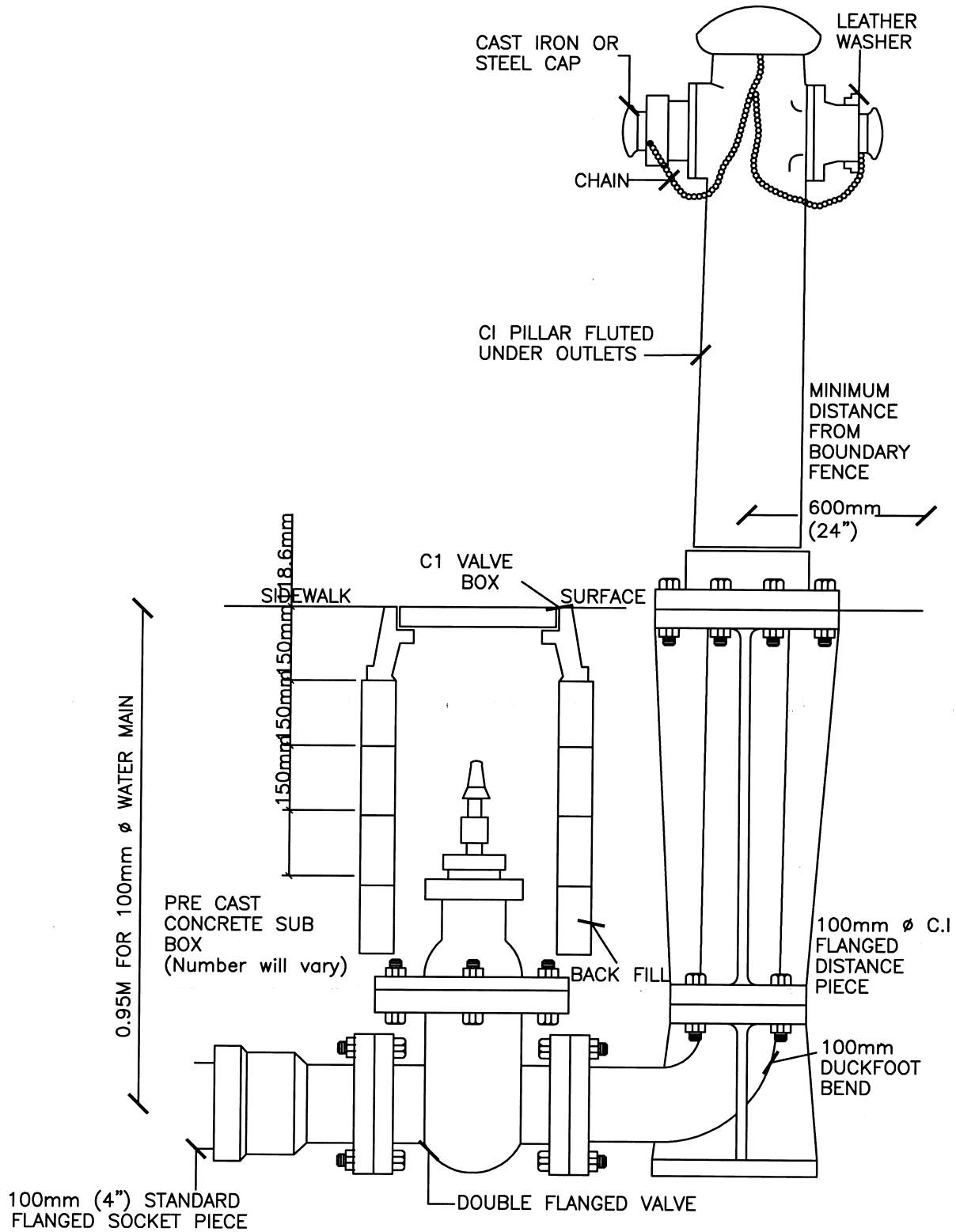
FOR COPPER SERVICE PIPE, USE SLIP/THREAD PVC ADAPTOR WITH THREAD/COPPER BRASS ADAPTOR

PLAN

THE NATIONAL WATER COMMISSION

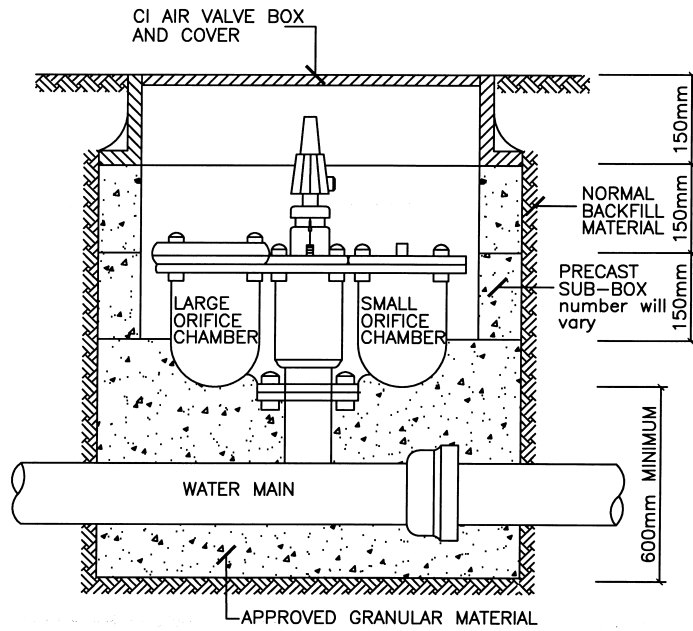
TYPICAL SERVICE CONNECTION PVC TO PVC WATER MAIN

Appendix 4

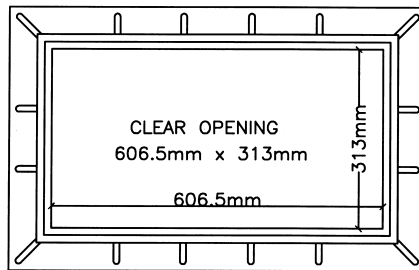


Appendix 4

DRAWING NO. 5



ELEVATION



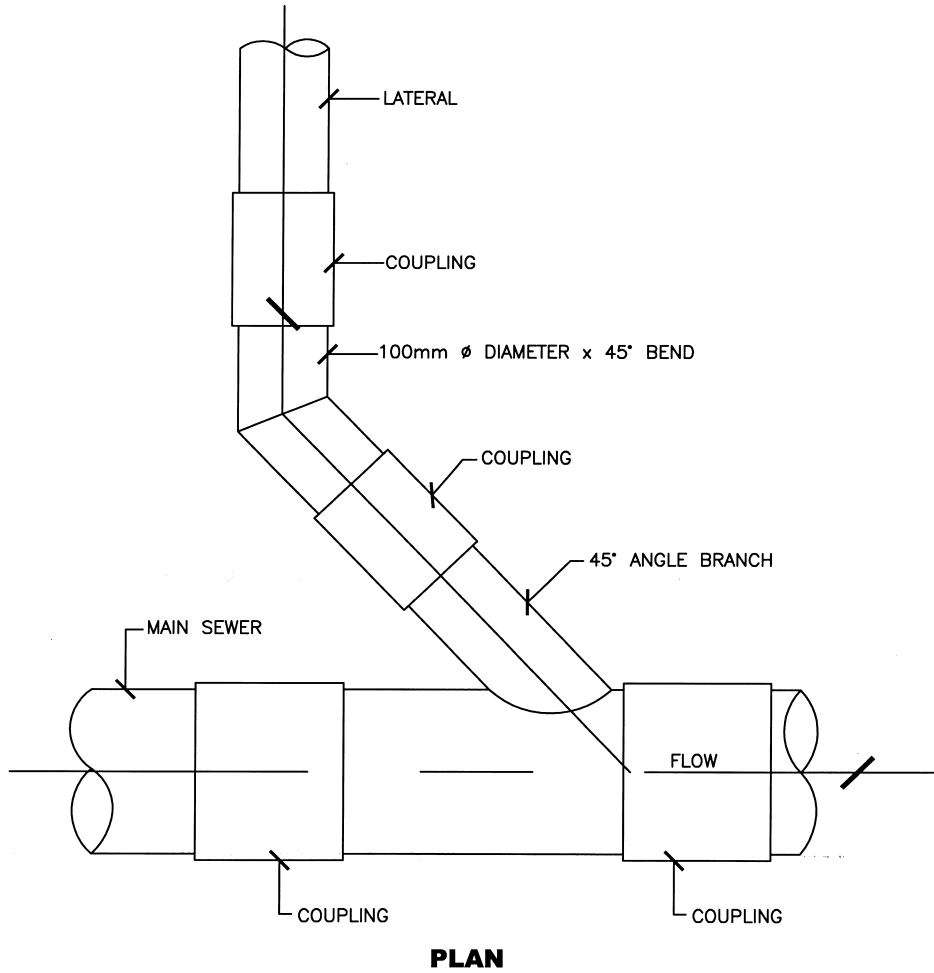
PLAN OF CI AIR VALVE BOX AND COVER

THE NATIONAL WATER COMMISSION

METHOD OF SETTING DOUBLE AIR VALVE

Appendix 4

DRAWING NO. 6A

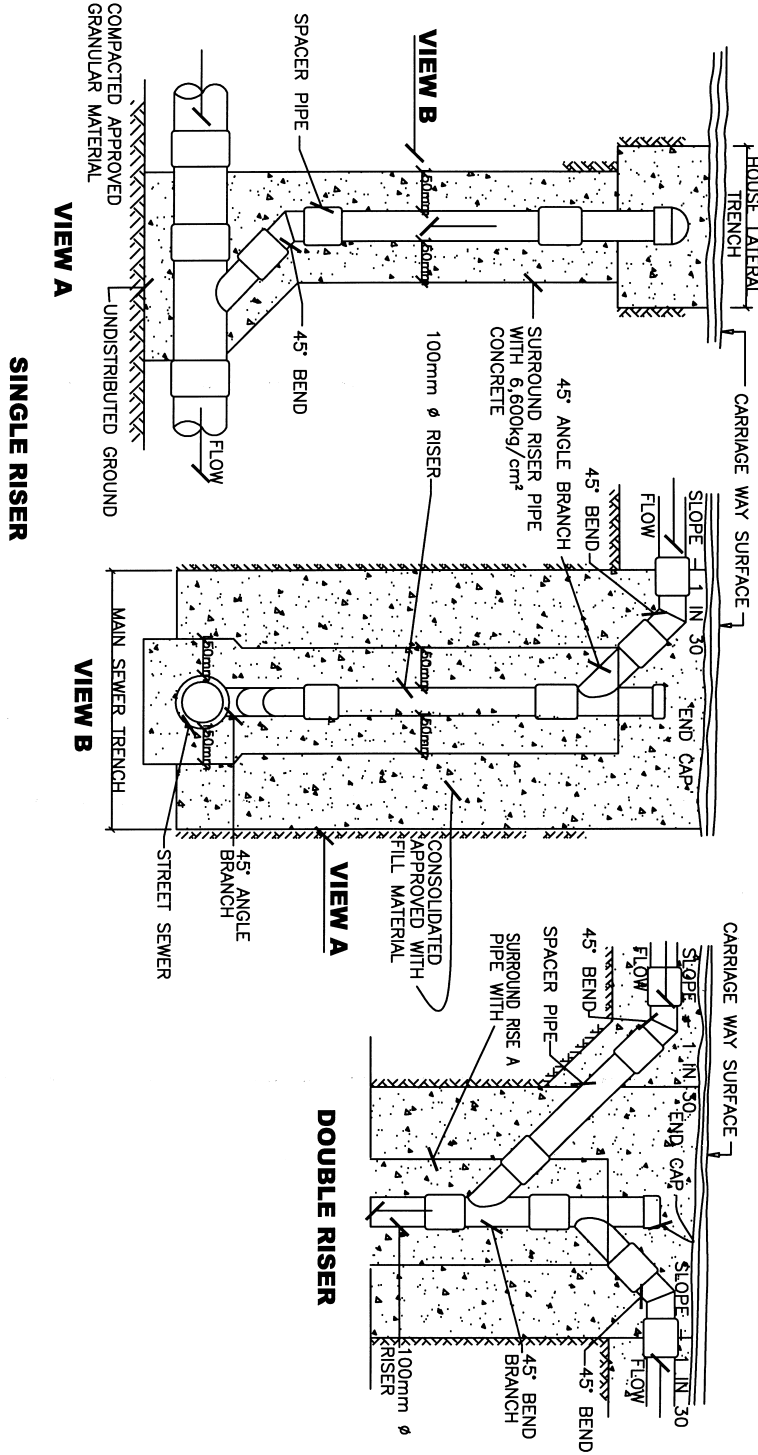


**THE NATIONAL
WATER COMMISSION**

**METHOD FOR CONNECTING LATERAL TO
SEWER LESS THAN 2.7M (9' - 0") DEEP**

Appendix 4

DRAWING NO. 6B

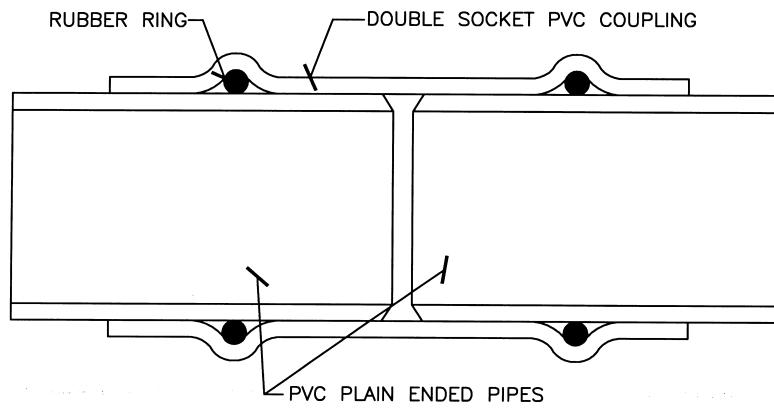


THE NATIONAL WATER COMMISSION

METHOD FOR CONNECTING LATERAL TO SEWER MORE THAN 2.7M (9' - 0") DEEP (9ft.)

Appendix 4

DRAWING NO. 7

**NOTE**

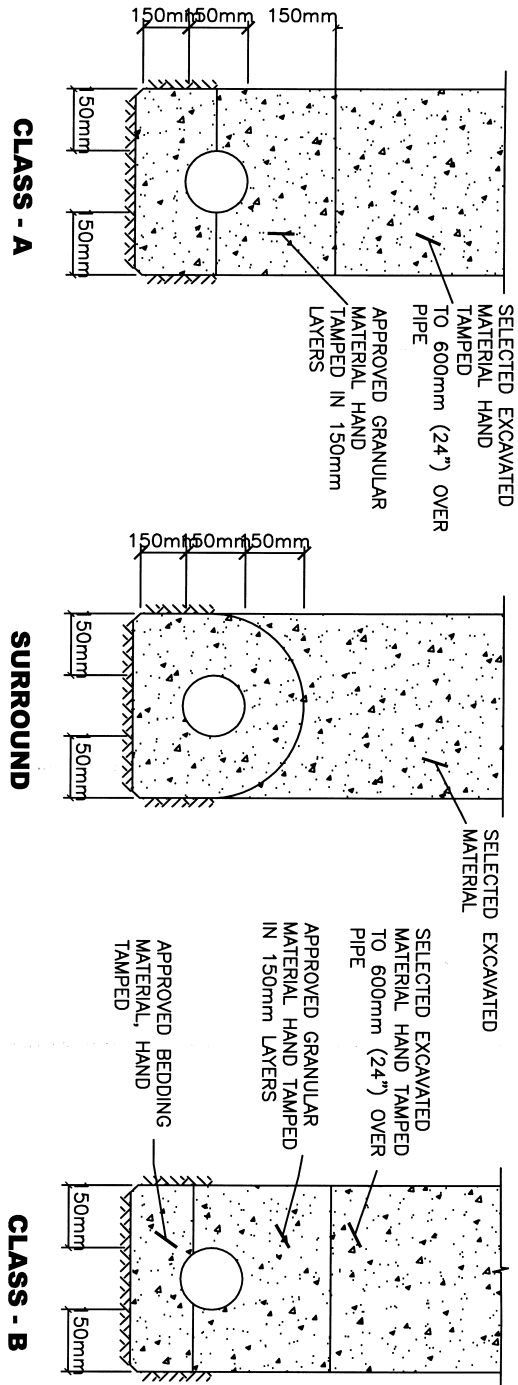
- (1) THE ABOVE DRAWING INDICATES THE METHOD FOR CONNECTING PVC PIPES
- (2) IN THE CASE OF ASBESTOS CEMENT PIPE GIBBAULT COUPLING OR JOHNSON COUPLING MUST BE USED
- (3) IN THE CASE OF C.I PIPES THE STANDARD COLLAR IS USED

**THE NATIONAL
WATER COMMISSION**

**METHOD FOR CONNECTING
PLAIN ENDED PIPES**

Appendix 4

DRAWING NO. 8



NOTES

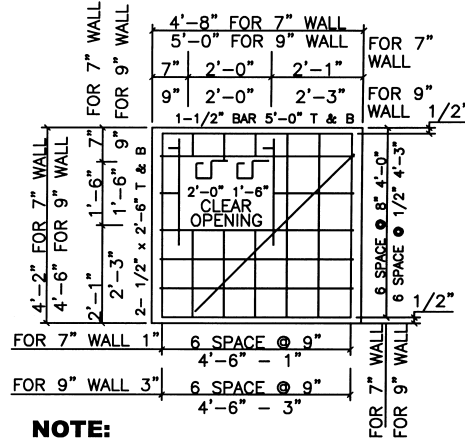
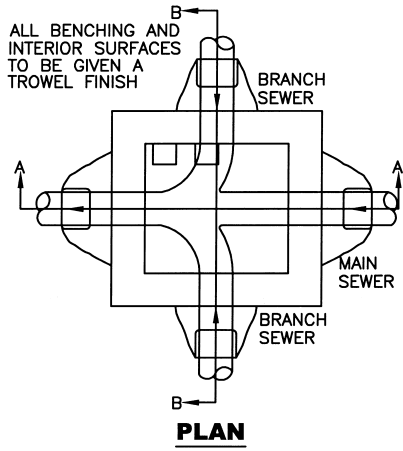
- (1) CONCRETE TO BE 6,600kg/cm² AT 28 DAYS
- (2) CONCRETE TO BE LAID AGAINST UNDISTURBED GROUND OR THOROUGHLY COMPACTED APPROVED GRANULAR MATERIAL ON SIDES AND BOTTOM OF TRENCH
- (3) FOR CLASS B PROTECTION, SHAPE APPROVED BEDDING MATERIAL TO FIT BOTTOM OF PIPE BARREL

**THE NATIONAL
WATER COMMISSION**

PROTECTION FOR SEWER PIPE

Appendix 4

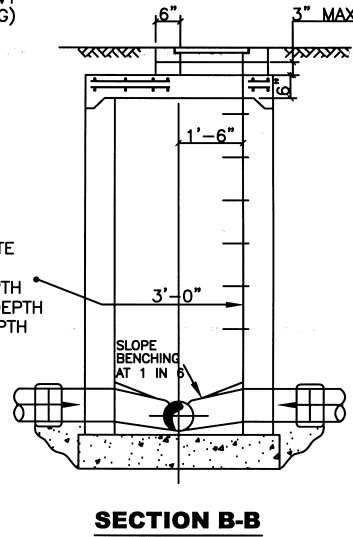
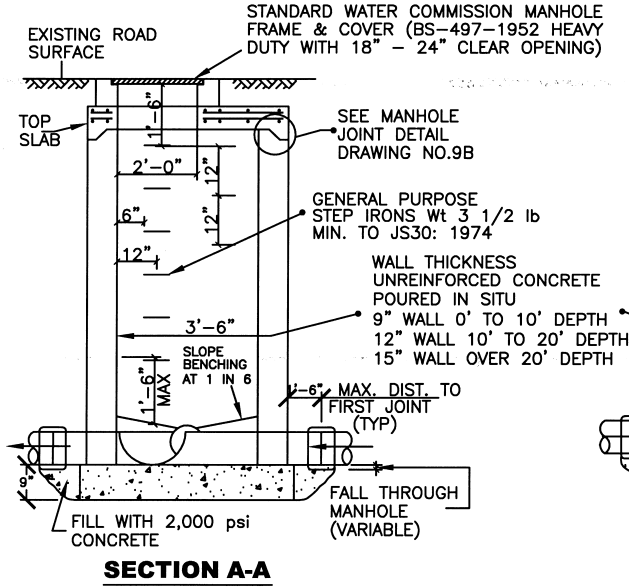
DRAWING NO.9A



NOTE:

1. 1/2" BARS @ CENTRE AS SHOWN EACH WAY TOP AND BOTTOM
2. ALL TOP BARS TO HAVE STANDARD HOOK EACH END
3. 1" MINIMUM COVER ON ALL REINFORCEMENT
4. ALL CONCRETE TO BE 3,000 psi

PLAN OF MANHOLE TOP SLAB



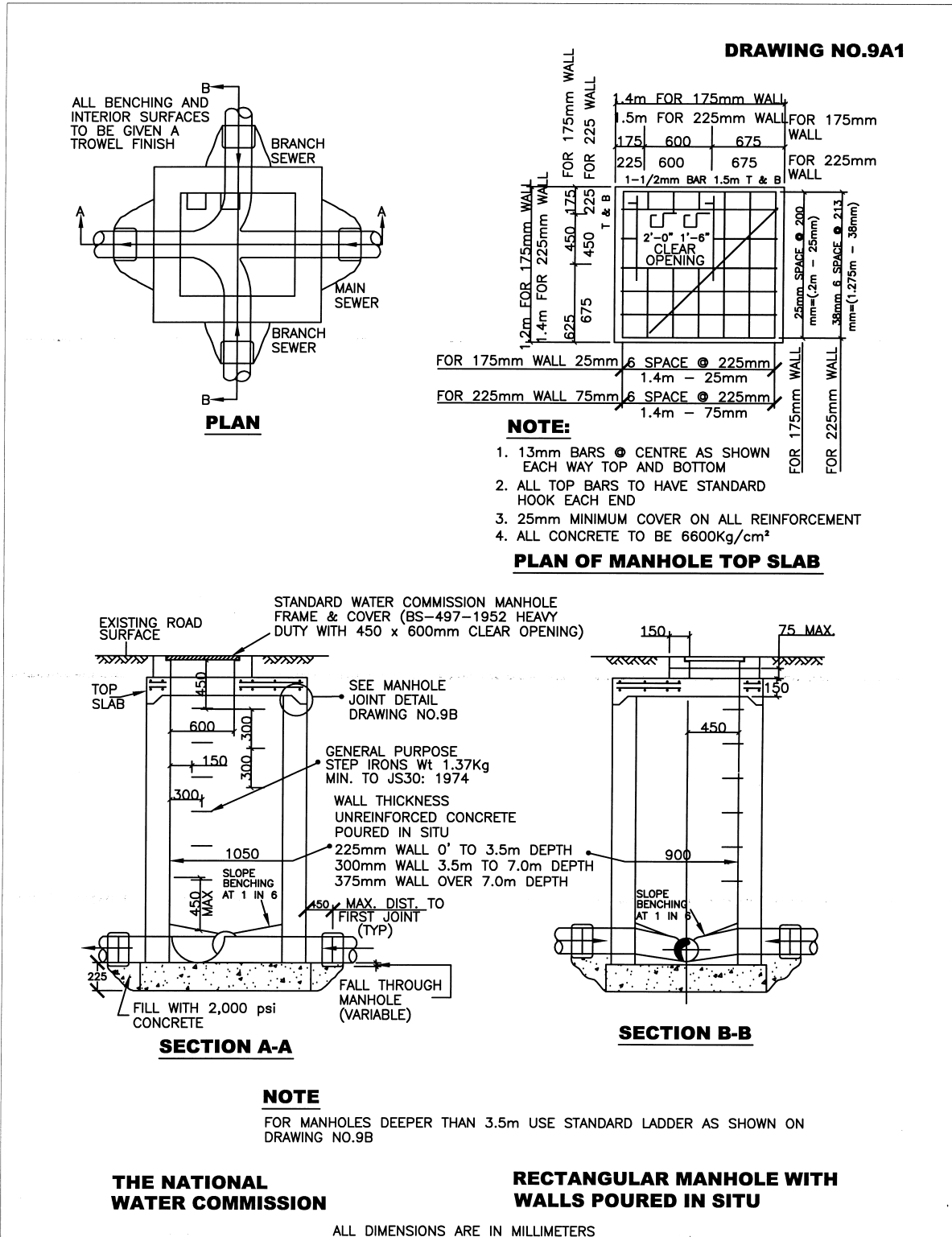
NOTE

FOR MANHOLES DEEPER THAN 10'-0" USE STANDARD LADDER AS SHOWN ON DRAWING NO.9B

THE NATIONAL WATER COMMISSION

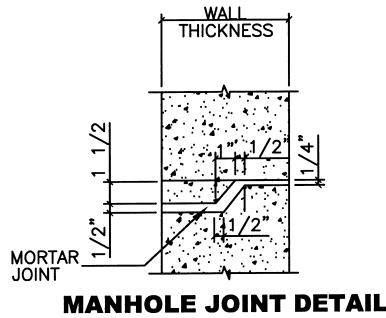
RECTANGULAR MANHOLE WITH WALLS POURED IN SITU

Appendix 4

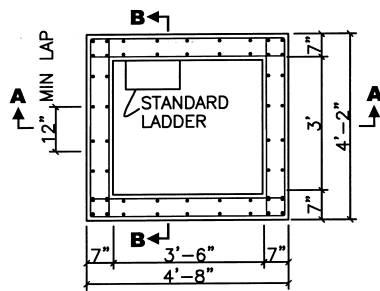


Appendix 4

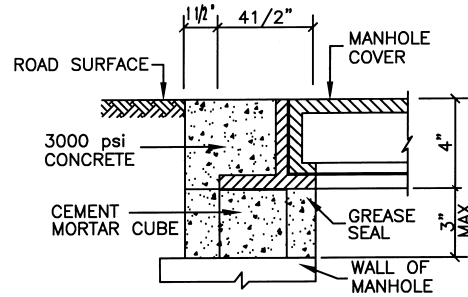
DRAWING NO. 9B



MANHOLE JOINT DETAIL



PLAN



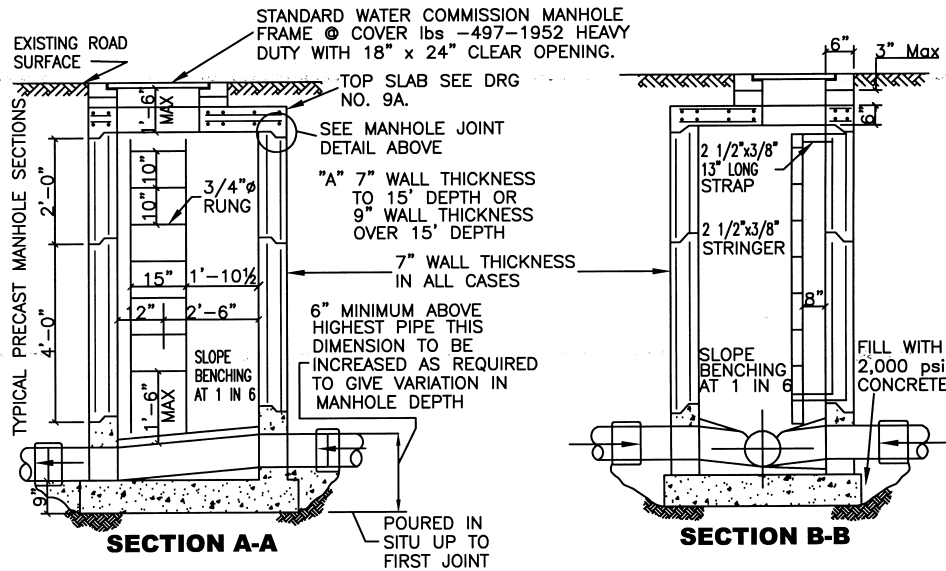
SETTING OF MANHOLE FRAME AND COVER

REINFORCED FOR PRE CAST SECTION

1. 3/8" BARS @ 9" CENTRES HORIZONTAL EACH FACE
2. 3/8" BARS @ 12" CENTRES VERTICAL EACH FACE
3. 1" MINIMUM COVER ON ALL REINFORCEMENT

NOTE

- (1) WHEN THE INVERT OF THE MANHOLE IS BELOW GROUND WATER LEVEL THE WALLS BELOW TOP SLAB MUST BE INCREASED IN THICKNESS IF NECESSARY TO AVOID FLOATING OF THE MANHOLE.
- (2) ALL CONCRETE TO BE 3000 psi.



SECTION A-A

SECTION B-B

NOTE:

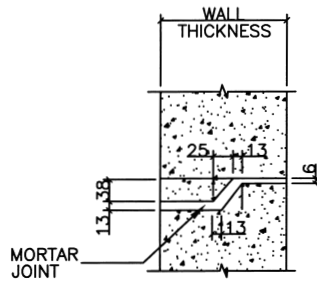
FOR MANHOLES LESS THAN 10'-0" DEEP USE STANDARD IRONS AS SHOWN ON DRAWING No. 9A

THE NATIONAL WATER COMMISSION

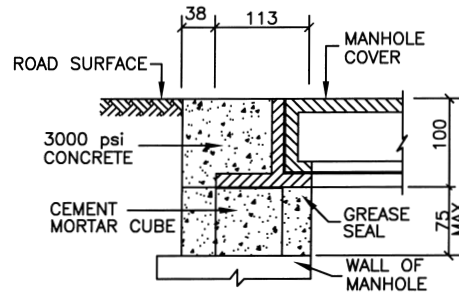
RECTANGULAR MANHOLE WITH PRECAST WALLS

Appendix 4

DRAWING NO. 9B1



MANHOLE JOINT DETAIL



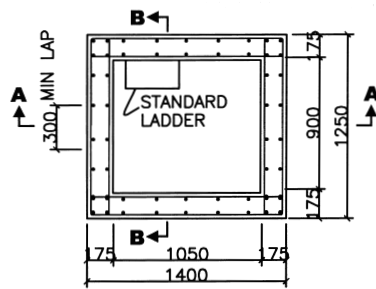
SETTING OF MANHOLE FRAME AND COVER

REINFORCED FOR PRE CAST SECTION

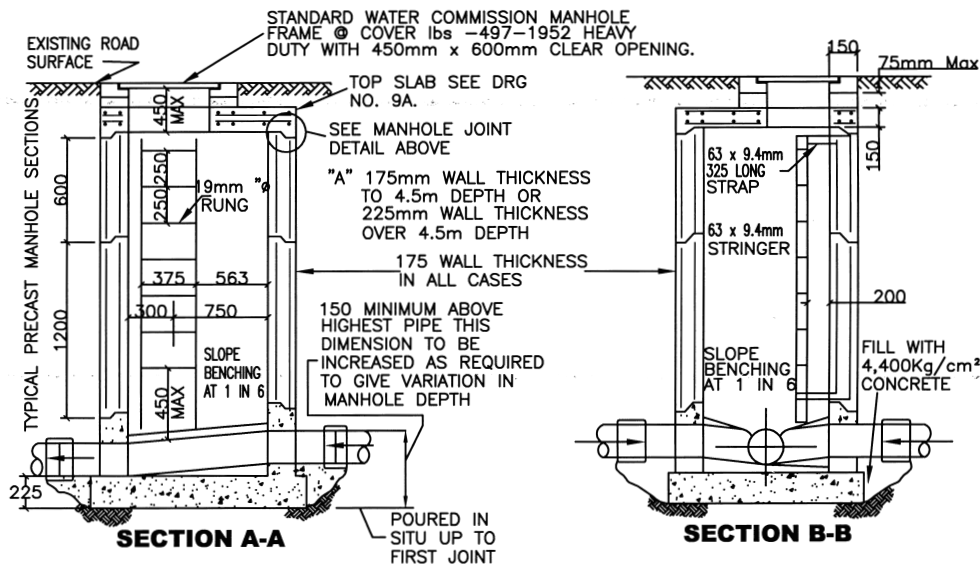
1. 9.4mm BARS @ 225 CENTRES HORIZONTAL EACH FACE
2. 9.4mm BARS @ 300 CENTRES VERTICAL EACH FACE
3. 25mm MINIMUM COVER ON ALL REINFORCEMENT

NOTE

- (1) WHEN THE INVERT OF THE MANHOLE IS BELOW GROUND WATER LEVEL THE WALLS BELOW TOP SLAB MUST BE INCREASED IN THICKNESS IF NECESSARY TO AVOID FLOATING OF THE MANHOLE.
- (2) ALL CONCRETE TO BE 6600Kg/cm²



PLAN



NOTE:

FOR MANHOLES LESS THAN 3.0m DEEP, USE STANDARD IRONS AS SHOWN ON DRAWING No. 9A

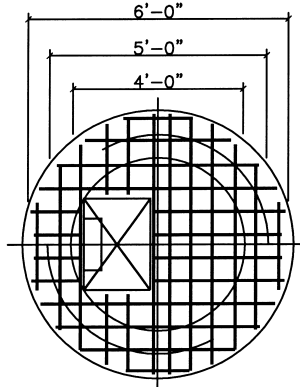
THE NATIONAL WATER COMMISSION

RECTANGULAR MANHOLE WITH PRECAST WALLS

ALL DIMENSIONS ARE IN MILLIMETERS

Appendix 4

DRAWING NO. 10A



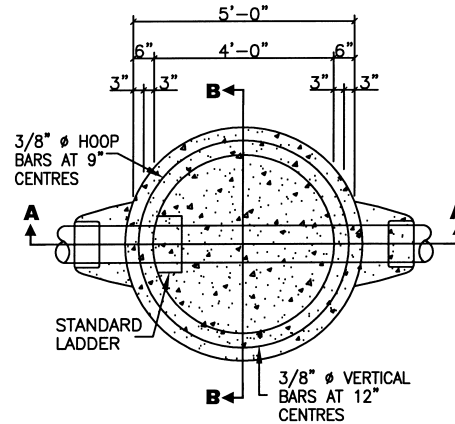
PLAN OF MANHOLE TOP SLAB

REINFORCEMENT FOR MANHOLE TOP SLAB

1. 1/2" ϕ BARS @ 6" CENTRES BOTHWAYS TOP AND BOTTOM
2. 1" MINIMUM COVER

NOTE:

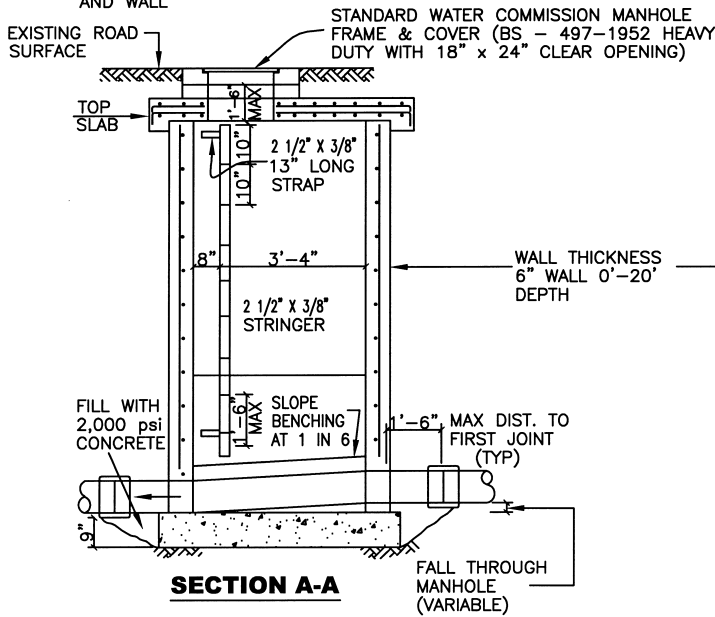
3,000 psi CONCRETE FOR TOP & BOTTOM SLABS AND WALL



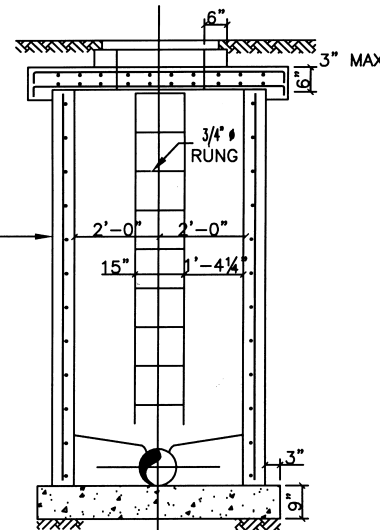
PLAN OF WALL

NOTE:

WHEN THE INVERT OF THE MANHOLE IS BELOW GROUND WATER LEVEL THE WALL BELOW TOP SLAB MUST BE INCREASED IN THICKNESS IF NECESSARY TO AVOID FLOATING OF THE MANHOLE.



SECTION A-A



SECTION B-B

NOTE:

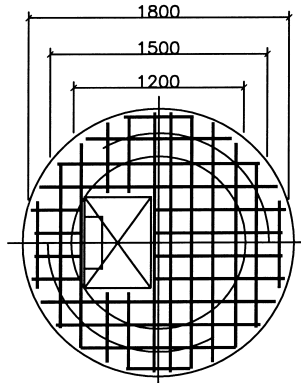
FOR MANHOLES LESS THAN 10'-0" DEEP, USE STANDARD STEP IRONS AS SHOWN ON DRAWING No. 10B

THE NATIONAL WATER COMMISSION

CIRCULAR MANHOLE WITH WALL POURED IN SITU

Appendix 4

DRAWING NO. 10A1



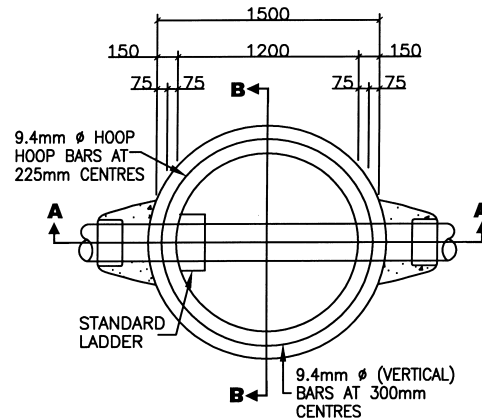
PLAN OF MANHOLE TOP SLAB

REINFORCEMENT FOR MANHOLE TOP SLAB

1. 13 \emptyset BARS @ 150mm CENTRES BOTHWAYS TOP AND BOTTOM
2. 25mm MINIMUM COVER

NOTE:

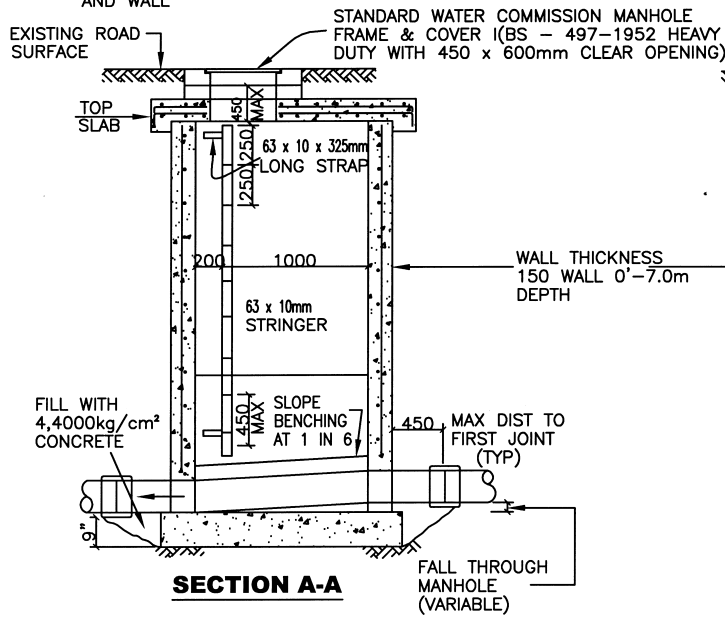
6,600Kg/cm² CONCRETE FOR TOP & BOTTOM SLABS AND WALL



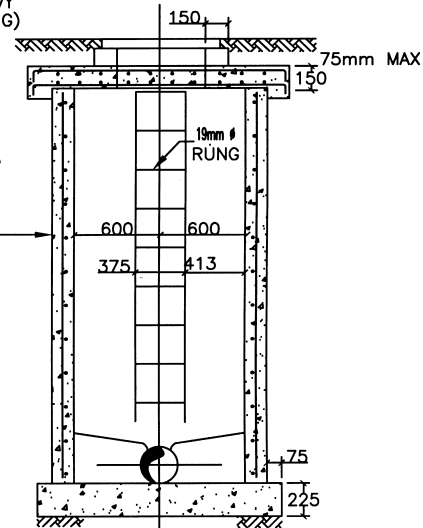
PLAN OF WALL

NOTE:

WHEN THE INVERT OF THE MANHOLE IS BELOW GROUND WATER LEVEL THE WALL BELOW TOP SLAB MUST BE INCREASED IN THICKNESS IF NECESSARY TO AVOID FLOATING OF THE MANHOLE.



SECTION A-A



SECTION B-B

NOTE:

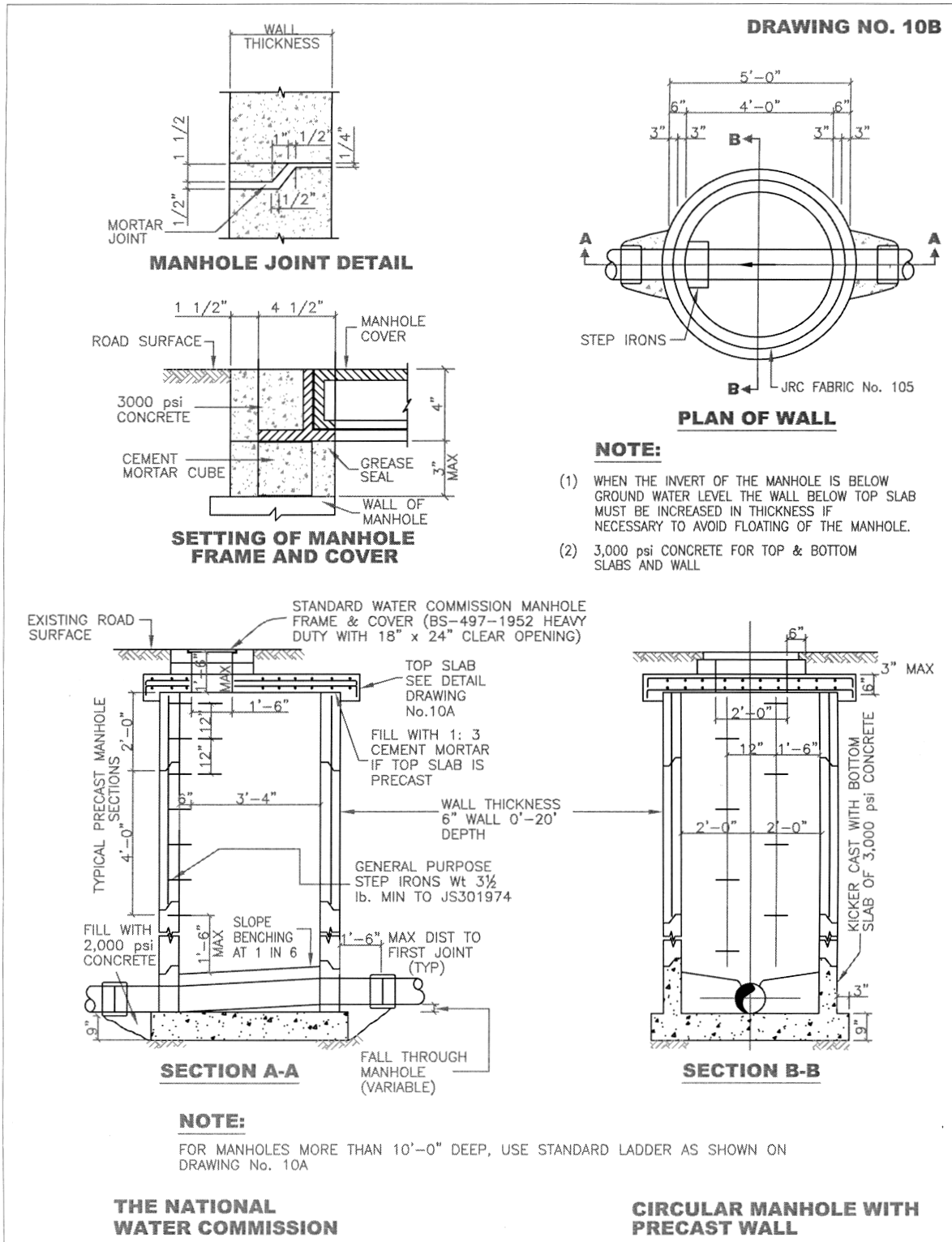
FOR MANHOLES LESS THAN 3.5m DEEP USE STANDARD STEP IRONS AS SHOWN ON DRAWING No. 10B

THE NATIONAL WATER COMMISSION

CIRCULAR MANHOLE WITH WALL POURED IN SITU

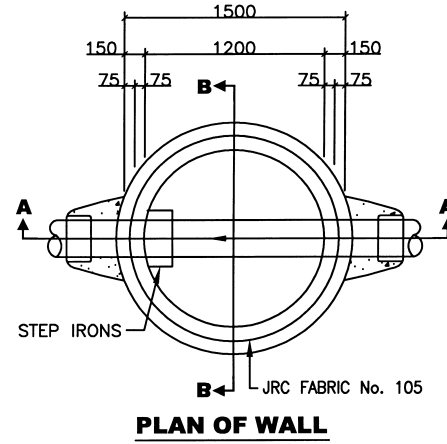
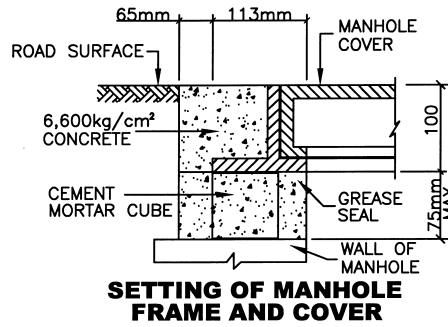
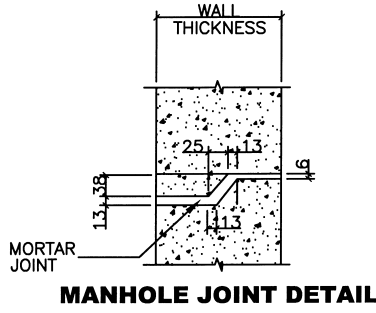
ALL DIMENSIONS ARE IN MILLIMETERS

Appendix 4



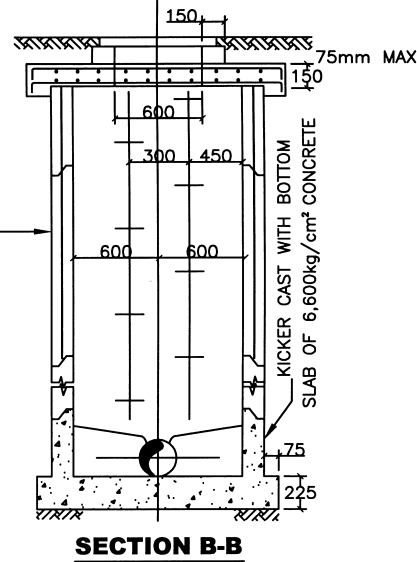
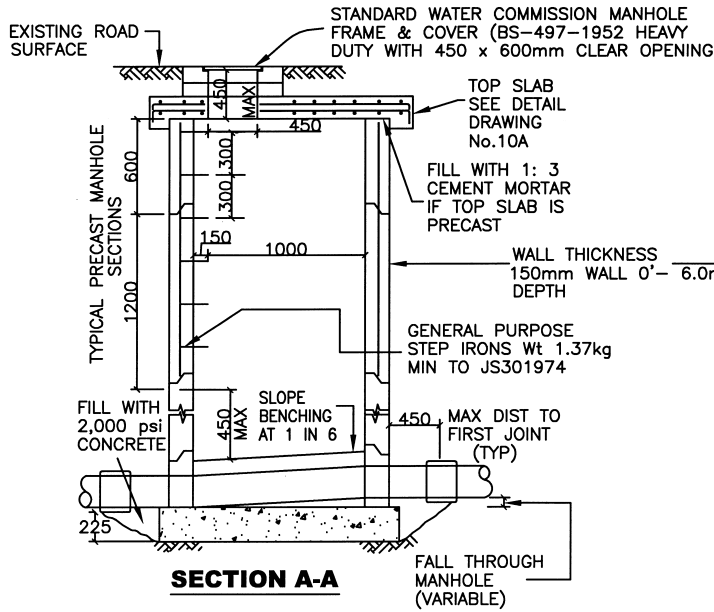
Appendix 4

DRAWING NO. 10B1



NOTE:

- (1) WHEN THE INVERT OF THE MANHOLE IS BELOW GROUND WATER LEVEL THE WALL BELOW TOP SLAB MUST BE INCREASED IN THICKNESS IF NECESSARY TO AVOID FLOATING OF THE MANHOLE.
- (2) 6,600kg/cm² CONCRETE FOR TOP & BOTTOM SLABS AND WALL



NOTE:

FOR MANHOLES MORE THAN 3.5m DEEP, USE STANDARD LADDER AS SHOWN ON DRAWING No. 10A

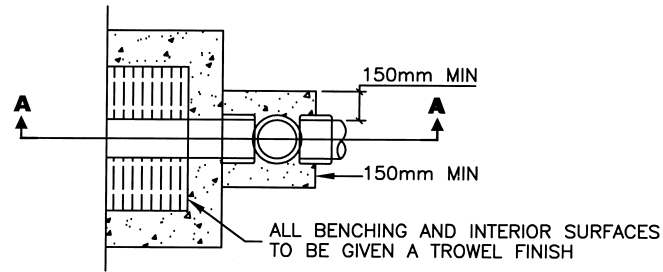
THE NATIONAL WATER COMMISSION

CIRCULAR MANHOLE WITH PRECAST WALL

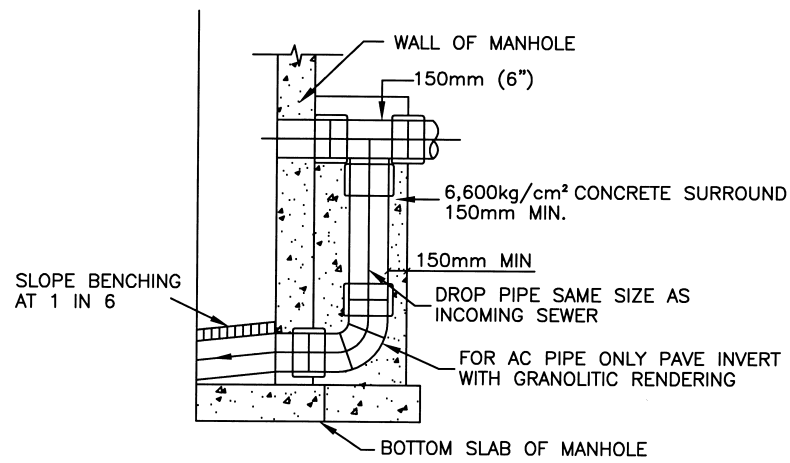
ALL DIMENSIONS ARE IN MILLIMETERS

Appendix 4

DRAWING NO. 11



PLAN



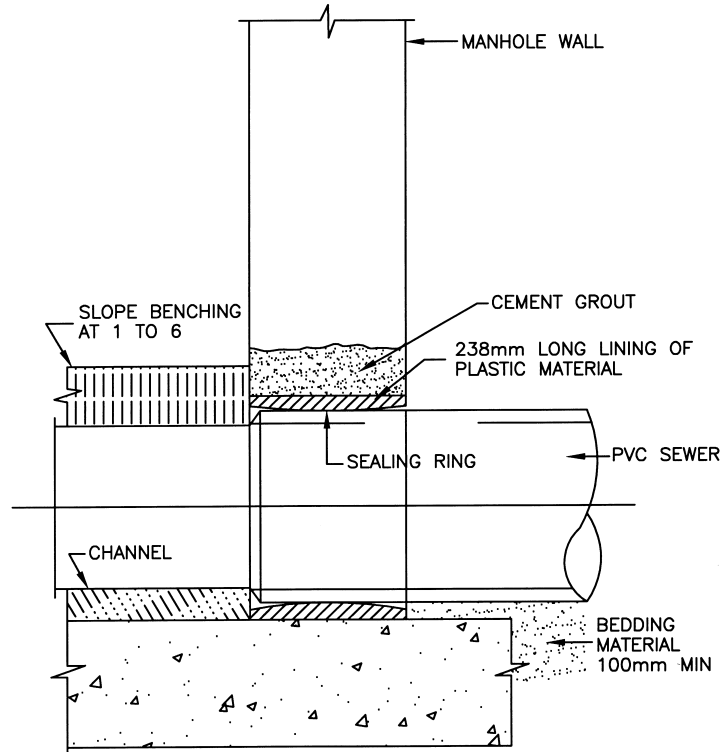
SECTION A-A

**THE NATIONAL
WATER COMMISSION**

**BACKDROP CONNECTION
TO MANHOLE**

Appendix 4

DRAWING NO. 12A

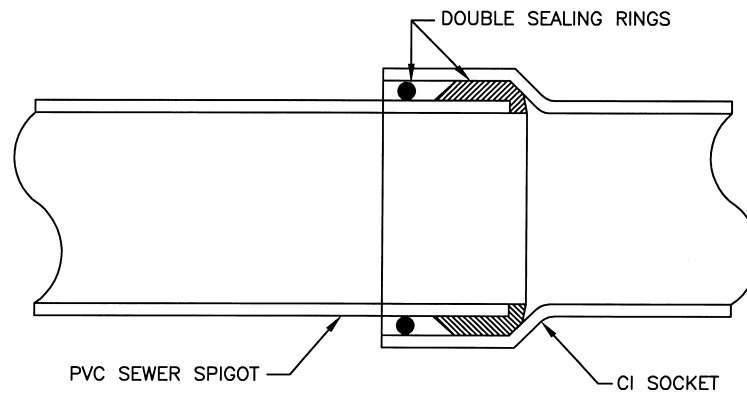


**THE NATIONAL
WATER COMMISSION**

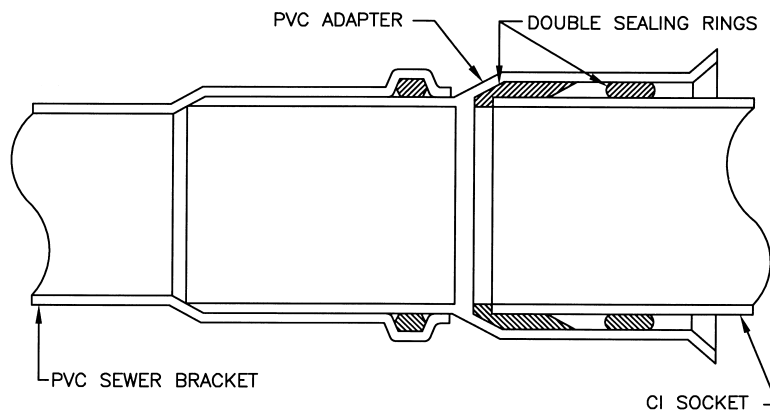
**METHOD FOR CONNECTING
PVC SEWER TO MANHOLE**

Appendix 4

DRAWING NO. 12B



PVC SEWER SPIGOT TO CI SOCKET



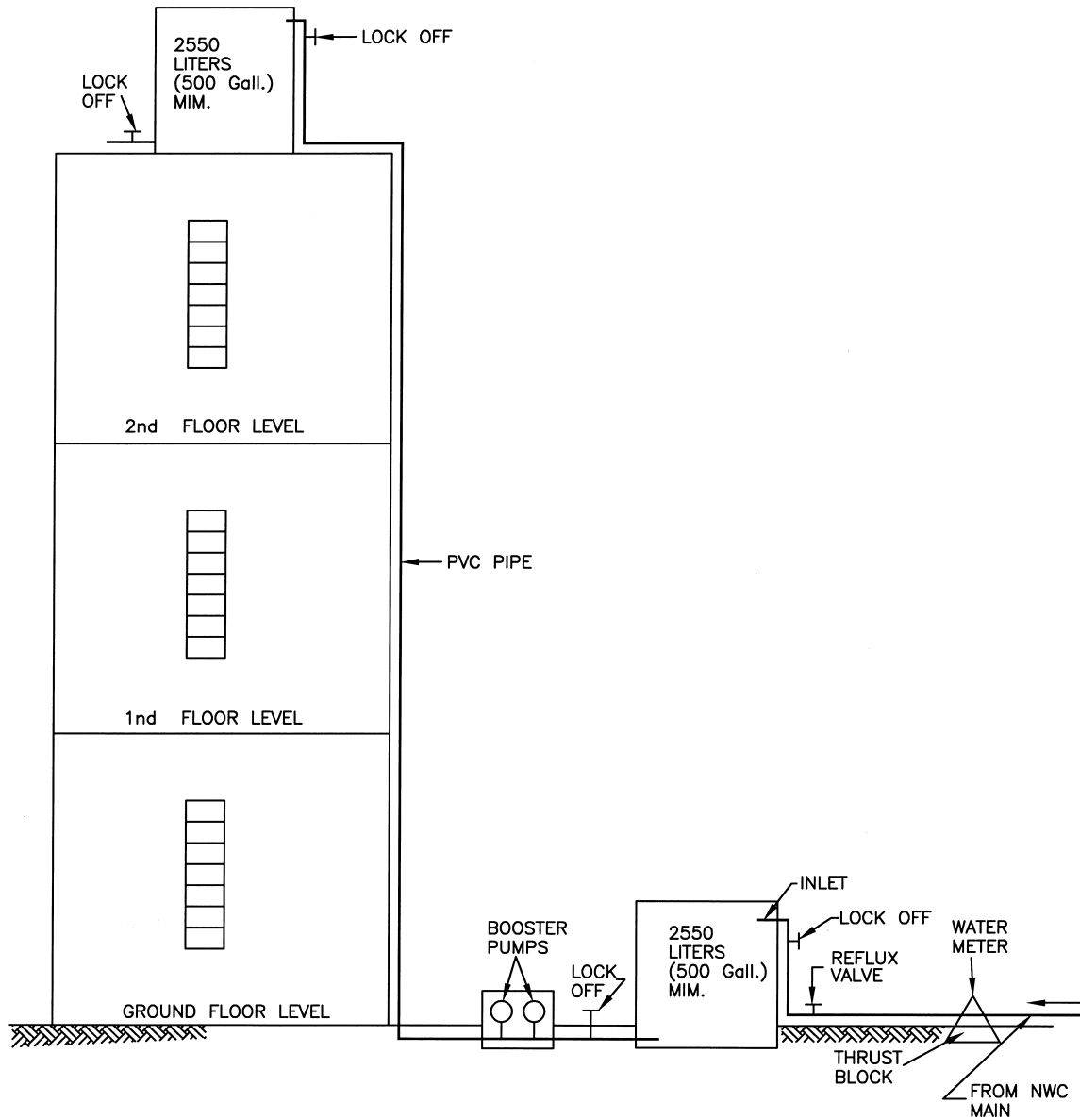
PVC SEWER SOCKET TO CI SPIGOT

**THE NATIONAL
WATER COMMISSION**

**METHOD FOR CONNECTING SEWERS
OF DISSIMILAR MATERIAL**

Appendix 4

DRAWING NO. 13

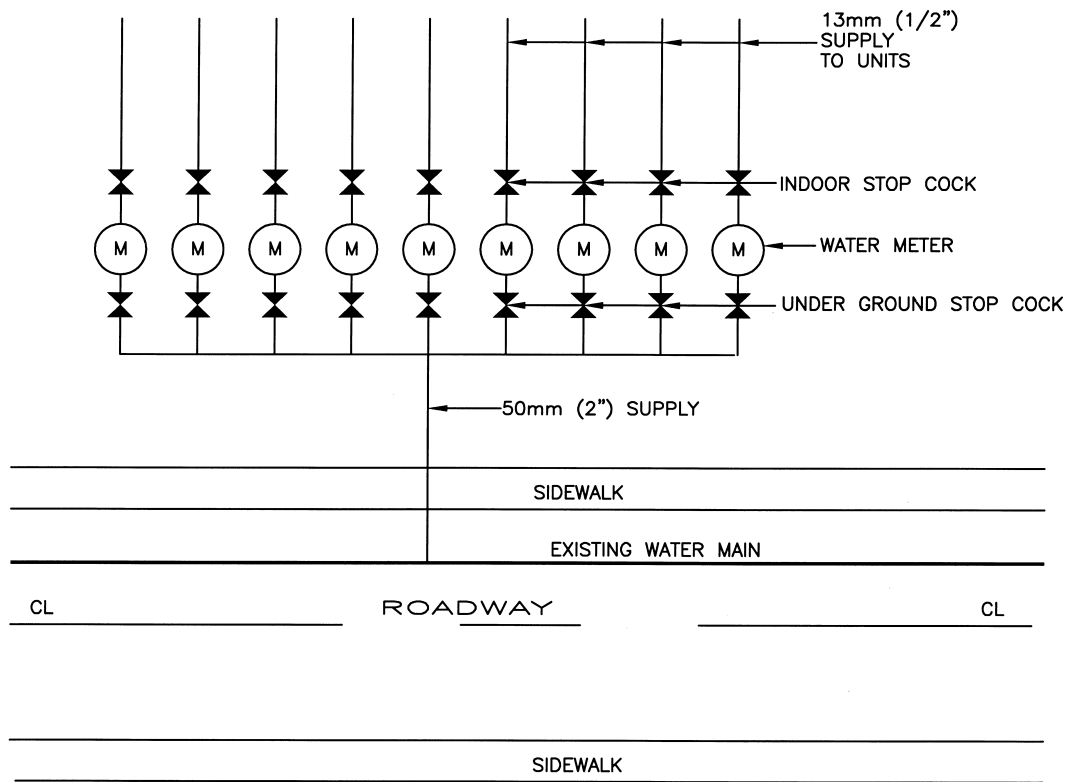


**THE NATIONAL
WATER COMMISSION**

**METHOD FOR CONNECTING
BUILDINGS IN EXCESS OF
TWO STORIES HIGH**

Appendix 4

DRAWING NO. 14



**THE NATIONAL
WATER COMMISSION**

**METHOD FOR CONNECTING
MULTI-UNIT PREMISES
(METER BANK)**