

6. Proposed O/M Frameworks for Urban Drainage and Sewerage Development

6.1 Basic Directives for Establishing the O/M Framework

6.1.1 Basic Directives

The basic directives for establishing the O/M framework are as follows:

- 1) The O/M system and its organization will be made at the simplest structure but for a highest efficiency.
- 2) The assigned O/M Staff will be made of professional persons basically working in full time. The whole O/M Staff will be sufficiently trained for performing smoothly their routine works based on the corresponding manuals.
- 3) Safety is considered as the highest priority and each staff member will be responsible in his/her scope of work. In case one staff member is absent, he/she will be replaced by another staff trained as substitute.
- 4) The whole O/M Staff will check their routine daily works after each working day and to be in good preparations for starting.
- 5) TQC activities will be promoted in circles in each facility for assuring and improving O/M works

6.1.2 Factors for Setting Up Basic Directives

In order to set up these basic directives, the three (3) following factors should be properly implemented:

- 1) Setting up a proper organization for carrying out the specified O/M works
- 2) Setting up the principles and regulations for effectively carrying out these O/M works
- 3) Establishing the corresponding programs for training skill workers and supporting the smooth works in O/M.

(1) Set Up of a Proper Organization for O/M Works

With the completion of the project construction works and the management organization,

all the subjected drainage and sewage treatment facilities will be technically operated by an O/M organization to be designated as the terminal part of the Management Agency of Operation and Maintenance for the Project.

This O/M organization, therefore, should be basically made into 2 parts for urban drainage facilities and sewage treatment facilities (Ref: Fig. G.6.1: Proposed O/M Organization for M/P Project).

The envisaged organization is proposed as follows:

- 1) The basic institutional organization on O/M will be, in principle, made into two stages, an integrated O/M management at central level and a control of O/M works at field level for separate facilities, i.e. the pumping stations, the sewage treatment plants etc.
 - 2) For the aspect of controlling O/M works at field level, the organization for specific facilities on Urban Drainage Improvement and Sewerage Development was considered. Based on the related technical facilities such as the drainage pumping stations on the aspect of urban drainage, and the sewage facilities such as the interceptor, the conveyance, the sewage pumping station and the sewage treatment plant, the O/M Organization of each facility was planned accordingly.
- (2) Set Up of Principles and Regulations for O/M Works

The general directives for development of O/M works are summarized as follows:

- 1) Low cost but for high effectiveness
- 2) Simple organization and clear routines
- 3) Ability to proceed smoothly all related works in all circumstances
- 4) Allocation of responsibility at each step
- 5) Periodical reporting on performance conditions

The general regulations for carrying out O/M Works are as follows:

- 1) Safety will be the first principle for carrying out the O/M.
- 2) Good preparations in equipment, materials, utilities, technical staff and working schedules/ programs for smoothly proceeding O/M works

- 3) Work volumes on operation and maintenance should be kept in balance. The operation schedules/ programs/ methods, therefore, will be made on the basis of a proper maintenance system for equipment and utilities, and for the safety as well as the working capacity of the technical staff in operation and maintenance

(3) Establishing Training and Supporting Programs

The technical training and supporting programs will be properly carried out at field level for the assigned operators and technicians by the equipment suppliers (contractors) so that they can perform their jobs efficiently without problems. The training and supporting programs will be covered in contracts with these contractors along with the guarantee period of the equipment.

6.2 Basic Proceedings for Implementing O/M Works:

The proceedings for implementing O/M works in each facility are as follows:

- 1) Classification of working types (daily routine, night-time routine and special cases) for Operation and Maintenance
- 2) Establishing principles and procedures for the safe and smooth working flows in Operation and Maintenance.
- 3) Descriptions of the methods to proceed in full details the detailed works in each working flow in Operation and Maintenance
- 4) Preparations of manuals for checking on daily basis and in urgent cases as well as proceedings of trouble shootings
- 5) Preparations of manuals for repairing works

6.3 Proposed O/M Framework for Urban Drainage

As mentioned in the Chapter of Urban Drainage Improvement, the major part (581.51 km²) of the whole Study area (650 km²) was proposed to divide into six (6) drainage zones with corresponding drainage evaluations as follows:

- 1) Central City Drainage Zone: This zone consists of 14 main Districts (1, 3, 4, 5, 6, 7, 8, 10, 11, Phu Nhuan, Go Vap, Binh Chanh, Binh Thanh and Tan Binh) with an area of 106.41 km² but a present population of 3.19 million inhabitants (population density of about 30,000 persons/km²) or about 75 % population of the Study Area (4.5 million inhabitants).

The combined sewer network is mainly found in this Central City Drainage Zone. These sewers collect the stormwater together with the domestic sewerage to drain out into canals and rivers such as Doi, Te, Nhieu Loc -- Thi Nghe, Tau Hu -- Ben Nghe, Tan Hoa -- Lo Gom etc. through 94 UDC outlets (or about one half of 200 UDC outlets).

Since this zone covers the area of utmost socio-economic activities in HCMC. But, due to the characteristic of uneven topographic land configuration and various social conditions, many places in this zone has been found in a malfunctioning drainage effect. The improvement works in urban drainage for this zone, therefore, should be considered in the highest priority.

From this background for the utmost important area in HCMC, this zone, therefore, was selected as the Priority Project Area for covering the total drainage effect in the Study Area of the M/P Project also.

For other zones, the evaluation on drainage is as follows:

- 2) Northern City Drainage Zone: This zone covers Districts 12, Go Vap, and some parts of Districts Tan Binh, Binh Chanh and Binh Thanh. There are a sewer pipe system for the right bank of Tham Luong – Ben Cat canal of Go Vap District, ditches and channels to the main canals such as Tham Luong – Ben Cat, Rach Dai Han, Rach Ben Da – Ba Hong etc.. This zone covers an area of 136.18 km² with a population of 422,000 inhabitants (population density of 3,103 persons/km²) or about 10 % population of the Study Area.

Regarding the present socio-economic aspect, this is the second important zone in the Study Area. This zone, however, has a relatively high elevation, effectively making a good drainage effect.

- 3) Western City Drainage Zone: This is the westernmost region of the Study Area, mostly covering the Rural District Binh Chanh and some parts of Districts 6, 8 and Tan Binh. There are some sewers being constructed for the newly urbanized areas in Binh Chanh District. The rainfall drainage has been mainly gone into the main canal of Rach Chua – Rach Nuoc Len through ditches and canals to drain into Ben Luc River and discharged into Nha Be River through Can Giuoc River.

This zone covers an area of 72.91 km² with a population of 176,000 inhabitants (population density of about 2,414 persons/km²) or about 4.1% population of the Study Area.. Despite its relatively low elevation, this zone is considered an area of outer city, the improvement in urban drainage, therefore, is considered not so important.

- 4) Southern City Drainage Zone: This zone is basically an agricultural land with some recent economic developments with some limited sewers for urban areas made by developers/ investors. Main rainfall drainage collected by small natural canals will be drained into the trunk canals such as Rach Ba Lao, Rach Xom Cui, Rach Cay Kho, Rach Dia, Muong Chuoi River etc. for finally discharging to Nha be River.

This area of a relatively high elevation covers partly Districts 7, Nha Be and Binh Chanh for an area of 81.74 km² with a population of 127,000 inhabitants (population density of 1,554.persons/km²) or about 3% population of the Study Area. Concerning the future urban development plan for this region, this zone will be important for the development of urban drainage also.

- 5) North-Eastern City Drainage Zone: This zone has no sewers except a small part along National Road No.1. Rainfall drain has been gone into the western and eastern canals such as Rach Go Dua, Rach Nhum, Rach Cau, Rach Go Cong to be discharged to Saigon River and Dong Nai River. This zone covers 64.91 km² with the present population of about 174,000 inhabitants (population density of 2677 persons/km²) or 4.1% population of the Study Area.

As this zone consisting of Districts 9 and Thu Duc, it is considered important in future development. The urban drainage is presently performed through a dense canal network.

- 6) South Eastern City Drainage Zone: This zone has no UDC sewers but very dense canal network. Rainfall drain through ditches and channels into the trunk canals such as Rach Chiec, Rach Ong Hong, Rach Kieu, Rach Ong Nhieu, Rach Trau Trau, Tac River, Saigon River and Dong Nai River. This zone covers an area of 119.37 km² with a present population of approximately 160,000.inhabitants (population density of 1350 persons/km²) or 3.8% population of the Study Area as this zone is considered a relatively remote zone with a dense canal network, the urban drainage is not important at the moment.

From this background, among these 6 proposed drainage zones, only the Central City Drainage Zone (C) is subjected to planning the future O/M framework in urban drainage proposed for the M/P Project. For the other 5 drainage zones, only rehabilitation works for the existing drainage facilities are subjects to be carried out accordingly.

The proposed organization chart for O/M works, therefore, is shown in the related figures of Proposed O/M Organizations notified in this Appendix.

Besides, according to this proposed organization chart, and with the new situation of O/M works for drainage improvement, OWM, UDC and District Public Service Enterprizes will be basically subjected to continue their assigned routine O/M works for

the aspect of drainage as up to now but under the control of an integrated O/M Management Control Office and a mutual collaboration among them. The application of the newly introduced sophisticated equipment will largely support the proceedings of related O/M works mentioned below:

1) For the Existing Sewer Network:

- i) The O/M works for the existing sewer network, in principle, consist of :1. Management of O/M works, 2.Observation and Survey, 3. Cleaning and Dredging and 4 Repairing works (excluding the sewer replacement works).
- ii) For the cleaning/dredging works, at present this work is mainly done by a group of about 10-20 workers using the small bucket with wire rope for dredging and cleaning to remove the sediment deposited in the sewer network. These manual works, however, could not give a high efficiency as observed, resulting in limited performances (for maximum 100m per group per day) and difficulties in removals of hard sedimentation etc. Besides, no efficient checking and monitoring systems for assuring the work efficiencies have been applied for up to now.
- iii) The processing of detailed data on the present conditions of the sewer network for all Grades including gates should be made for technically controlling the system and categorizing necessary works at each place in each district. These works should be integrated in the Office of O/M Management Control.
- iv) Instead of manual cleaning/dredging works being conducted at now, the introduction of modern equipment such as Bucket-Typed Cleaning Machine, High Compressor Cleaning Car, Vacuum-Typed Cleaning Car, Transportation Van and related Observation Tools for checking will be implemented. In principle, each district will have one set of these above equipment for the maintenance of its sewer network. This means, in principle, 22 sets will be needed for 22 districts (including 9 sets for the Priority Project Area) (Table G.6.1: List of proposed O/M Equipment)
- v) UDC District representatives will be assigned for working closely with District Public Service Enterprises to conduct the proper schedule of maintenance for assuring the good drainage operation of each sewer network in each District (Ref. Fig. G.6.6: Sewer/Gate Maintenance Record and Fig. G.6.7: Maintenance Work Package Record).

2) For the Drainage Pumping Stations

- i) The O/M works for the drainage pumping stations, in principle, consist of :1. Field management of O/M works at these installations, 2.Operation of the pompages and, 3. Maintenance works of the installations (including repairing works for damaged

equipment).

- ii) For the field management of O/M works at these installations, training programs supplied by the contractor(s) will be sufficiently performed for the technical personnel of the stations. The prepared O/M manuals will be submitted properly.
- iii) As these pumping stations are subjected to operate during the rainy seasons only, the administration section and the maintenance team for all three stations will be placed at Ben Me Coc 1 Station. Other two stations will have only the station manager and the operation team including guardian (s). During the dry seasons, the pumps will be run times to times for maintenance purposes only. The personnel organization chart is shown in the figures of Manpower Allocation for Drainage Pumping Stations (Ref. Fig. G.6.3: Drainage Pumping Station, O/M Manpower Organization).

6.4 Proposed O/M Framework for Sewerage Development

Based on the proposed sewerage basin division, the proposed O/M framework for sewerage development in the Study Area will be basically based on the aforementioned figures of Proposed O/M Organizations (Ref. Fig. G.6.1: Proposed O/M Organization for M/P Project and Fig. G.6.2: Proposed O/M Organization for priority projects)

According to this proposed framework, there are 9 sewage treatment plants subjected to the M/P Project. Each unit of sewerage development is composed of one treatment plant, the related sewage pumping station(s) and corresponding piping works (interceptors and conveyances). (Ref. Fig. G.6.4: Sewage Pumping Station, O/M Manpower Organization and Fig. G.6.5: Sewage Treatment Plant, O/M Manpower Organization).

The situation of composed facilities for these 9 units is as follows:

- 1) TLBC Sewerage Development Unit: 1 Treatment Plant, 1 Pumping Station, 1 Intercepting Sewer and related existing drainage facilities.
- 2) NLTN Sewerage Development Unit: 1 Treatment Plant, 5 Pumping Stations, 1 Intercepting Sewer System and related existing drainage facilities
- 3) THLG Sewerage Development Unit: 1 Treatment Plant, 3 Pumping Stations, 1 Intercepting Sewer System and related existing drainage facilities
- 4) THBNDT Sewerage Development Unit: 1 Treatment Plant, 1 Pumping Stations, 1 Intercepting Sewer System and related existing drainage facilities
- 5) SS Sewerage Development Unit: 1 Treatment Plant, 2 Pumping Stations, 1

Intercepting Sewer System and related existing drainage facilities

- 6) SE Sewerage Development Unit 1 Treatment Plant, 3 Pumping Stations, 1 Intercepting Sewer System and related existing drainage facilities

Based on this framework, the general scope of O/M works for sewerage development will be made into three (3) parts which are the O/M works for 1) the piping works (interceptors and conveyances), 2) the pumping station(s) and 3) the sewage treatment plant.

(1) O/M Works for the Piping Works:

The O/M works for the piping works (interceptors and conveyances) are recommended to be carried out as follows:

- 1) Daily checks of the normal flows of the fluids entering the interceptor(s), flowing through the interceptor(s) and conveyance(s) to the pumping station(s) and treatment plant(s). A monitoring system through devices installed at the specific places such as inlets/entrances of the interceptor(s), the conveyance(s) and the pumping station(s). A monitoring group in the Survey Section stationed at a pumping station will permanently take care of this work for assuring this normal operation and for carrying out prompt countermeasures in case of improper flows.
- 2) Cleaning works, in principle, will be done twice a year. The cleaning equipment and labour will be officially procured from the cleaning team(s) of the nearest districts i.e. through annual contracts (Fig. G.6.8: Proposed sewer cleaning System)
- 3) In cases of emergency, the cleaning team(s) of the concerned districts will be asked for urgent assistance under the guidance of the Survey Section.
On the part of local communities, along with the direct connection of combined sewerage from houses to city sewers, the local piping works should be properly made for avoiding any chocking up and backward flow.

(2) O/M Works for the Pumping Station(s):

- 1) The O/M works of the pumping station(s), in principle, will be carried out by the two teams (Operation Team for the operation works and Maintenance Team for the maintenance works) in each pumping station.
- 2) The operation of equipment (Pumps) will be done as routine works by three (3) shifts of operators in a day. The operators of the three operation shifts have professional training from the equipment suppliers (contractors) for properly

performing the operation and basic maintenance of the equipment.

- 3) If the pumping station(s) are constructed nearby the residential areas, measures for noise and nuisance prevention will be properly applied. Apart from the daily technical checks on the conditions of equipment in collaboration with the operation team, the maintenance team shall pay concerns on these pollution related matters. Periodical maintenance schedules will be strictly carried out, based on the instructions and training from the equipment suppliers (contractors).

(3) **Basic Principles for Proceeding O/M works in a Sewage Treatment Plant:**

The basic principles for conducting O/M works of a sewage treatment plant are as follows:

- 1) Essentially checking the equipment periodically for assuring structures and equipment in the sewage treatment plant are always in a good operation situation.
- 2) Frequently supervising and assuring proper operation conditions for related structures and equipment.
- 3) Formulating schedules for periodical checking and repairing structures and equipment.
- 4) Discovering at once any breakdowns and resolving quickly.
- 5) Checking periodically the chemical characteristics of the influent and the effluent. A proper measure for throughout checking the effluent characteristics i.e. by making the outlet through a passage containing living fish.
- 6) Determining exactly and timely the sufficient amounts of chemicals used for sewage treatment by each phase in the year
- 7) Checking the measuring equipment periodically
- 8) Preparing carefully and fully for works and equipment that are going to be operated in the most peak duration in the year.
- 9) Disinfecting the related structures and equipment by period
- 10) Seriously obeying productive processes, regulations on working safety and systematically arranging the system of frequent productive check
- 11) Making out plans for training, enhancing the technical knowledge of the technical staff and strengthening their working responsibilities.

7. Scope of O/M Works for Facilities Envisaged in the Project

7.1 Scope of O/M Works for Drainage Pumping Stations

7.1.1 Commissioning of the Installation(s)

With the completion of the installation(s), the commissioning works for the installation(s) will be carried out promptly and orderly to check whether there are any problems in installation and operation or not in order to secure a smooth operation and management of the installation(s) afterwards.

The commissioning works, therefore, will be made by two stages: checking of installations/structures, and trial operations without load attempt at first and real load attempt afterwards. For the case of without load attempt, water is pumped then discharged outwards or into a tank. For this process, the following points should be secured:

- 1) The entire installation works well with a smooth sound and without any shakings.
- 2) No leakages are found in the portions of lubrication, cooling, and joints.
- 3) Assembly of seals must work in normal way.
- 4) The lubrication system works well (oil temperature is not heated)
- 5) No frictions are found for more than one-hour trial operation.

For the trial operation with load attempt, the pumping installation will be tested in working condition of four (4) hours in continuous operation of real works. During this period all parties concerned in installation, technical engineering and operation team will be present to observe this examination.

The following cases should be called for emergency stops to find out immediately the cause(s) and to readjust properly the subjected equipment until a normal operation can be achieved.

- 1) Unusual sound or some machinery knockings during operation.
- 2) Some part of the equipment or the lubrication system becomes very heated
- 3) The working condition of the equipment or some specific part is not evenly proceeded.

7.1.2 Daily Operation of the Pumping Unit(s)

The daily operation works for the pumping unit(s) are as follows:

To switch on for operation:

Before switching on, the engine should be checked carefully. If necessary, the nuts/bolts at the joints of the induction manifold, the joints of the repulsion manifold and the benches should be tightened. Then, the pressures and the temperatures of water in the cooling system and oil in the lubrication system should be checked. These factors must be appropriate with the factors notified in the machine specifications. When the process of priming pump finishes, the electric motor of the pump will be made for full operation.

When the number of revolution is up to the fixed level and the manometer shows an appropriate value (specified by each pump), the next operation works will be proceeded properly with the manuals.

Necessary Observations during Daily Operation

During the daily working time, the pump must work smoothly and throughout without any shakings. The discharge capacity and the pressure column of the pump must meet the measuring figures required. These working conditions will be checked spontaneously by the corresponding measuring equipment. Besides, main working parts of the pump such as wheels, ball bearings, thrust collars/washers which are portions of easy wear /tear, therefore, should be paid with more attention.

To switch off the engine:

When switching off the engine, the order, in principle, will be proceeded in the contrary to the operation process with the confirmation of each equipment stoppage at step by step. At the final stage, the main electrical switched will be turned off.

7.1.3 Maintenance Works and Overhauls

Daily maintenance works consist mainly of the after-daily-operation dismantling of the subjected parts of the equipment for daily cleaning. Before cleaning, all electrical switches should be turned off and locked for safety control. After cleaning and drying, the dismantled parts will be assembled properly, and, after an overall checking, the equipment will be switched on for a moment for checking its normal operation conditions and cleaning efficiencies. If any defect/damage is identified at some place during this proceeding, the operators should inform the situation to the maintenance team for repairing.

When everything is ready for a normal operation, the person-in-charge will sign his name on the Daily Maintenance Check Sheet and put the signboard of " Already Checked for Normal Operation " on the corresponding equipment. In case of 3-shift operation, the cleaning will be scheduled in a specific shift where the standby unit will be put in operation during the cleaning procedure.

Periodical overhauls and grand overhauls will be carried out by the maintenance team in collaboration with the corresponding operators. Grand overhaul is to apply once a year for the entire equipment, or after 8,000-10,000 hours of operation. The whole process is to dismantle totally the equipment in order to check in pieces for repairing or replacing. The process of periodical overhauls and grand overhauls should be carried out, based on the manuals or instructions from the suppliers/contractors.

7.1.4 Safety Conditions at Pumping Stations

Working safety is a very important matter at pumping stations that operator(s) must follow the manuals strictly, which ensure safe conditions for labors, equipment and, therefore, enhance the working effectiveness of machinery and equipment.

Regulations on safe working conditions for pumping stations are stipulated clearly as follows:

Pumping stations:

- 1) Pumping stations must have the manuals for the operating system of pumping stations when normal operation as well as when happening breakdowns and in cases of maintenance and repairs. Manuals are required to clearly notify the orders of implementing manipulations, authorities and responsibilities of operator(s).
- 2) Before turning on the pumps, operators should conduct the following works:
 - Checking again all parts of pumps, lubricant, pipes of the lubrication or cooling system.
 - Checking motor and earth wire
 - Operating pumps
- 3) Strictly forbidding to operate the pumps once operators have not got enough safe equipment as thermometer, pressure gauge, reducing valves at suction heads.
- 4) Regularly checking and tightening the foundation bolts, bolts at joints and couplings.
- 5) Immediately turning off the pumps once pumps are shaken or have extraordinary noises, water is not pumped up, and the temperatures of shaft and lubricant are exceeding the permissible standards.
- 6) Couplings should have covers

- 7) After installing new pumps or overhauling existing pumps, it is essential to make a trial run before operating.
- 8) Before transporting, and lifting up or bringing down equipment on the installation base, it is necessary to carefully check the safety of hoisting equipment and hauling rope.

Machinery and equipment are transported and craned safely. Minimum height from the bottom of hoisting equipment to the highest summit is 0.5m. Moving speed by horizon direction of hoisting equipment must be below 15m/minute.

Electricity:

Electricity safety is an important matter. Operators and technicians, therefore, must be throughout trained on this matter.

The most basic matters on electricity safety techniques are as follows:

- 1) The electrical installations should be made into three separate systems: lighting system, control board system and other electrical apparatus.
- 2) The switching systems should be installed at proper places and at each pump for supporting convenient working operation.
- 3) When electricity is cut off, we must turn off the main switch for electrical apparatus in order to prevent pumps starting up suddenly once electricity is turned on.
- 4) Insulators should be installed inside the metal boxes to disconnect with the corresponding electrical apparatus.
- 5) To turn off immediately the motor out of the electricity network in the following cases:
 - When appearing smoke at the motor or the equipment in operation.
 - When happening a working accident
 - When the motor is found shaking
 - When overheat is found in some part.
 - The number of revolutions is reduced considerably.
 - Pumps are broken down.

7.2 Scope of O/M Works for Sewerage Pumping Stations

In general, the scope of O/M works for the sewerage pumping stations is similar to that

for the drainage pumping stations. However, due to their specific characteristics of non-stop operation for 24 hours a day and a large volume of high colloidal fluid to be handled everyday, the O/M works for the sewerage pumping stations, therefore, should be carried out with a more strict procedure.

7.2.1 Commissioning of the Installation(s)

This part could be totally referred to the procedure applied for the drainage pumping stations mentioned in the above

7.2.2 Daily Operation of the Pumping Unit

In this part, due to the specific characteristic of a non-stop operation, the system of operation observation should be made integrated at the control board with following proceedings:

- 1) To be proceeded successively by three (3) shifts of technician staff. Each shift will have at least two (2) technicians responsible for the operation observation. At the timing of changing shifts, the leaving shift should report exactly the operation conditions to the coming shift with all necessary reports. In case the coming shift is late, the leaving shift should continue normally the works until their arrival while reporting the case to the Station Manager or to the Office of O/M Management for obtaining optimum measures.
- 2) When a pumping unit has a technical problem detected through operation observation and could not be readjusted at once, this pumping unit should be stopped and the change of operation to a standby unit will be done immediately. This means that the standby unit should be prepared permanently for this case. By doing this, the observation staff should report to the Station Manager and to the maintenance staff for prompt repairing measures.
- 3) Cause(s) of the technical problem(s) should be clearly identified and proper repairing works should be done immediately through the corresponding manuals. In case repairing works could not be done through prepared manuals or lack of stocked spare-parts, immediate assistance from the equipment supplier(s) (contractor) should be requested accordingly. After repairing works and a smooth trial operation, the full operation of this pumping unit will be restarted. The provisional operation by the standby unit will be stopped for cleaning and waiting for any next emergency case.

7.2.3 Daily Maintenance Works and Grand Overhauls

In general, the daily maintenance works for the equipment in the sewerage treatment

plant will be applied, based on the principle of section-wise and the similar procedure as applied for the pumping station mentioned in the above.

Periodical overhauls and grand overhauls are subject to be carried out, based on the manuals or instructions prepared by the suppliers (contractors). Grand overhaul is to be carried out for the entire installation once a year or after 8000-10000 hours of operation.

7.2.4 Safety Conditions at Sewage Pumping Stations

This part could be, in principle, referred to the safety conditions mentioned in Drainage Pumping Stations. Due to a large-scaled work loading in the sewage pumping stations, a system of alarm with speakers and a system of telephone should be installed throughout in the premises so that every staff can be clearly informed even during equipment operation. Proceedings in urgent cases are mentioned in manuals.

7.3 Scope of O/M Works for the Sewerage Treatment Plants

7.3.1 Basic O/M Works

The basic O/M works in the sewerage treatment plants are as follow:

- 1) Essentially checking equipment by period, assuring structures and equipment in sewage treatment plant are always in good operation situation.
- 2) Frequently supervising and assuring logical operation regime for works and equipment.
- 3) Formulating plans for checking and repairing equipment by period.
- 4) Discovering timely and resolving quickly breakdowns
- 5) Checking sewage quality by period in both before and after sewage treatment processes
- 6) Determining exactly and timely the sufficient amount of chemicals was used for sewage treatment by each phase in the year
- 7) Checking measuring equipment by period
- 8) Preparing carefully and fully for works and equipment that are going to be operated in the most peak duration in the year.
- 9) Disinfecting works and equipment by period

7.3.2 Proceedings of O/M Works

1) Preparations for Proceeding O/M Works

- All the works and equipment in the sewerage treatment plant must be checked properly before starting the operation.
- After a large-scale repair, works and equipment must be rechecked fully and comments on the repair schedule must be recorded in a notebook. After that, it is needed to make a trial run only in that division.
- Before the official operation of works and equipment, it is needed to make a trial run until the quality of effluent reaching to the regulated standard.

2) Periodical checking works

- Technicians are responsible for regular checking of the following equipment:

For mixing tanks and reaction tanks, when checking, it is needed to observe thoroughly the inside of tanks, partitions and underground valves, discharging valves.

For sedimentation tanks, balance tanks, careful observation of total tank structure, foundation structures and valves is needed.

Aeration tank is an important structure. It determines the treatment effect of the whole plant. Therefore, when checking structures and equipment by period, the following works should be checked:

- Checking the thickness of filter material bed and observing the surface of filter material bed at least 3 months a time
- Before cleaning, attention should be paid to the polluted concentration at the filter grit through the thickness of sediment bed accumulating on the surface of filter material bed, the routine distribution of polluted sediments on the surface of filter material bed, the existing sediments accumulating in funneled chambers and shake marks on the surface of filter material bed
- After cleaning: checking filter grit bed, discovering places that are not met requirements of cleaning and remaining polluted concentration. Observation is implemented after discharging water until the water level lowering little bit

than the surface of filter grit. Checking time is at least one month a time.

- Checking works are conducted in accordance with positions to be marked, the thickness of layers, exploration by sampling tool depending on cleaning duration at least 6 months a time.
- Taking grit samples for analyzing polluted concentration at least a time per year
- Checking the amount of filter grit is diminished by measuring the distance which is from the surface of filter grit to the margin of cleaning tank, which is compared with that of design. If it is needed to pour more filter grit, we must throw away a polluted grit bed on the surface with the thickness of 3 ÷ 5 cm, at least 6 months a time.
- Checking the plane of margin of canals/channels receiving cleaning water, if it is not planed by horizon, we must sharpen the margin of canals/channel a time per year
- Checking cleaning duration and intensity, determining the amount of remaining polluted sediments in cleaning water, steady distributed washing degree, the steady receiving degree of influent into canals/channels, at least 3 months a time.

Fresh water storage tank: when conducting periodical checking works, we should observe thoroughly inside of tank, valves and pipe conveying water in and out the tank, one year a time.

Alkalinity mixed equipment: standing person will check it daily, observing the outside of equipment and pipe

Chlorine processing equipment: frequently observing equipment and chlorine pipe, if having strange signals, we must test seepage degree.

Other equipment: it is also needed to observe frequently in order to discover technical mistakes and timely resolve it

7.3.3 Periodical Maintenance Works

For the mixing tank and the reaction tank, the cleaning of sediments sticking on walls and partitions, the checking of seepage degree and operating situation of works, stop valves, and pipes are subjects to be carried out at least once a year

For the sedimentation tank and the sludge digestion tank, the cleaning of walls, partitions, pipes and distribution ditches is subject to be carried out periodically.

The periodical checking of the operating situation of valves and pipes is done.

The periodical checking of the seepage degree is done at least once a year.

Aeration tank: checking operating situation of stop valves and pipes, checking filter grit diminishing situation, testing seepage degree at least one year a time; cleaning daily walls and partitions by cleaning period and frequently cleaning, repairing, letting out sediments and repainting equipment and pipes.

7.3.4 Control Works for Related Apparatus and Equipment

(1) Control works for the chemical apparatus

For hard chemicals such as alum, lime etc...it needs to pay attention to the distribution department for solution. Chemical solutions have high concentration running through pipes that must be attained the velocity of over 0.8m/s. In case of assuring minimum flowing velocity, we must dilute more water into pipe by special funnels.

For liquid chemicals as chlorine: we must check the full level of chlorine in standard bottle and storage bottles by weight. After using out of liquid chlorine, chlorine gas still remaining in standard bottle must be rinsed by water sprinkler. Chlorine pipe must be resistant to corrosion and pressure. Chlorine pipes must be dismantled and blew by dry air. Joints and tributary pipes must be observed and repaired timely when necessary. After blowing by dry air, liquid chlorine must be fed fully.

(2) Control works of receiving tank and sedimentation tank

Receiving tank and sedimentation tank must be checked and drained away sediments every year, whether the bed of sediments is thick or not.

When cleaning the tanks, we should spray water from walls to the bottom of the tanks and use scrubber to brush the tanks, and then cleaning again by detergent.

(3) Control works of thickening tanks

Thickening tanks must be checked and drained sediments after discharging all sediments into discharging pipe at least one time per year. Then, tanks must be cleaned by fresh water. After that, tanks must be washed again by sulfate solution 5%. Finally, they must be disinfected by chlorine solution.

The thickness of bed of suspended solids must be stabilized in range of 2 ÷ 2.5 m. We must observe the steady distribution degree of water on the whole area of inner

sedimentation tank and receiving pipes, the discharge of excessive sediments into compressed storage compartment which stores sediments and pipes.

(4) Control works for aeration tanks

In order to keep stability aeration velocity, in fact, people must use adjusting equipment. In aeration tanks must be equipped aerators. The aerators could be joined directly on aeration tanks or installed into controlling compartments for aeration tanks. Measuring equipment must be checked by period, at least 6 months a time.

The cleaning process for aeration tanks: it will be implemented when once the filtered water quality shows the signals of starting deterioration. The point of time for cleaning will be determined by automatic announced measuring equipment or by observing the different level of water level before and after aeration when managing manual operation.

Before cleaning the aeration tanks, we must closed water valves leading water into aeration tank in order to reduce water level in aeration tanks entering down cleaning tank, after that close water valves leading water into storage tank and open discharging valves.

The self-cleaning process will be implemented as follow:

- At this time, we should observe whether grit overflows to receiving tanks or not, if it happens, we must close some water valves.
- A good aeration will show steady distribution of influent and effluence qualities.
- Besides, in the process of management, people must formulate plans for periodical checking works for the parts of aeration tanks as follow:
 - Checking existing conditions of aeration by observing the surface of aeration tank at least one time per month; before cleaning, observing the pollution of surface bed and the steady distribution of polluted sediments on the surface of aeration tank.
 - Observation will be conducted after draining water until the water level in aeration tank is lower than the bottom face of aerators.
 - When aeration tanks must be stopped for repair, after every time of repair, aeration tanks are washed cleanly and soaked by detergent solution within 24 hours. After that aeration tanks will be washed cleanly by fresh water until washing water only is the fresh water.

(5) Control works for the effluent

Determining the proper amount of chlorine for treatment is very necessary.

When using the javel solution or chlorine solution for sanitation purposes, after diluting these solutions to reach a permissible concentration, ensuring that these solutions will be effective enough for the sanitation purpose but unharmed to the environment contacting the final discharged effluent.

Ensuring that the chlorine solution must be mixed steadily with the effluent and the contact duration is not less than 30 minutes.

The chlorine solution can be made contacting with the effluent in discharging balance tank or in discharging pipe, assuring a contact duration of at least 30 minutes.

Chlorine mixing equipment must be installed in well-ventilated places in order to avoid the evaporation process of chlorine that causes hazards to workers and nearby equipment/structures.

8. Estimation on O/M Cost for the Master Plan Project

8.1 Conception of Estimation on O/M Cost for the Master Plan Project

The estimation of O/M costs for the Master Plan is totally proceeded based on the construction costs, including the construction cost of the THBNDT portion (which is selected as the Priority Project afterwards) estimated at the Master Plan stage. Besides, the method used for the estimation of O/M cost in this case is based on the global percentage calculation, specific characteristics of each case on the economic aspect of materials procurement and the technical methods applied for the construction/installation will largely effect the true O/M cost. The estimation of O/M cost in this case, therefore, is considered as a parameter figure for reference purpose only.

Basically, the O/M cost for the Master Plan Project is made by 2 parts, the O/M cost for the sewerage development and the O/M cost for the urban drainage development.

From this background and based on the reference figures of construction costs at the Master Plan stage, the proceedings for this estimation are as follows:

8.1.1 Wastewater Treatment Facilities

The estimation of annual O/M costs of sewage treatment plant is used the cost function formula that Japan Sewage Works Association proposes.

The cost function formula for estimation of annual O/M cost for conventional activated sludge process without sludge incineration facility is as follows.

$$M_t = a \times Q_t^{b_1}$$

[Where]

- M_t : Annual O/M costs in million VND
 Q_t : Design wastewater in 1,000 m³/day
 a, b_1 : coefficient $a = 267.41, b_1 = 0.697$

8.1.2 Pumping station (for Sewerage)

The annual O/M cost of pumping station is estimated by the following formula.

$$M_p = C \times Q_p^d$$

[Where]

- M_p : Operation and Maintenance costs in million VND
 Q_p : Wastewater Rate in M³/minute
 C, d : coefficient $C = 24.2, d = 0.69$

8.1.3 Pipeline

- (1) The annual O/M cost for pipeline is assumed to be 0.3% of the pipeline construction cost.
- (2) However, it is assumed to be 0.6% of the pipeline construction cost only in C-zone of drainage area, because of the existing sewer covering rate of more than 50%.
- (3) The annual O/M cost for the canal is assumed to be 0.5% of the canal improvement cost.
- (4) The annual O/M cost for the pumping station for the storm water drainage is assumed to be 0.5% of the pumping station construction cost.

8.2 Estimation on Annual O/M Costs for Sewerage Development

8.2.1 Construction Cost for Sewerage Development

Based on the above principles for O/M cost estimation, construction costs for the M/P Project are identified as follows:

Sewerage Zone	Construction Cost (billion VND)			Total
	Sewerage Pump Station	Sewerage Pipeline etc.	Treatment Plant	
1. TLBC	68.5	116.04	866.8	1,051.34
2. NLTN	607.7	433.40	2,184.9	3,226.00
3. THLG	301.2	207.05	1,378.9	1,887.15
4. THBNDT	233.8	674.47	2,247.7	3,155.97
5. SS	94.0	1,159.35	679.0	1,932.35
6. SE	167.2	1,375.77	1,027.0	2,569.97
7. SN-I	151.2	1,662.26	895.0	2,708.46
8. SN-II	70.8	888.04	486.7	1,445.54
9. SW	107.2	1,054.31	777.9	1,939.41
TOTAL	1,801.6	7,370.69	10,543.9	19,916.19
(%)	(9.05%)	(38.01%)	(52.94%)	(100%)

8.2.2 Annual O/M Cost of Sewerage Development

From the procedure mentioned in the above, the annual O/M costs for the portion of sewerage development are calculated as follows:

Sewerage Zone	Annual O/M Cost (million VND)			Total
	Sewerage Pump Station	Sewerage Pipeline	Treatment Plant	
1. TLBC	667	359	7,985	9,011
2. NLTN	9,574	1,696	20,377	31,647
3. THLG	3,185	650	12,250	16,113
4. THBNDT	2,778	2,495	20,700	25,973
5. SS	555	215	6,110	6,880
6. SE	1,019	421	9,478	10,918
7. SN-I	907	351	8,348	9,606
8. SN-II	408	138	4,356	4,902
9. SW	629	279	7,118	8,026
TOTAL	19,722	6,634	96,722	123,078

The O/M cost for the part of sewerage development is estimated at 123,078 million VND per annum.

8.3 Estimation on Annual O/M Costs for Urban Drainage Improvement

(1) Annual O/M Costs for Urban Drainage Improvement

Based on the figures notified in 8.1.3, the annual O/M costs for urban drainage improvement per drainage zone are estimated as follows:

(Unit: million VND)

Drainage Zone	C	N	W	S	NE	SE	Total
Total O/M Cost	12,100	7,900	3,700	2,700	4,700	3,100	33,800

The O/M cost for the part of urban drainage improvement is estimated at 33,800 million VND per annum.

8.4 Estimation of O/M Costs for the Master Plan Project

(Unit: million VND)

Item	Sewerage Development	Drainage Improvement	Total Cost
Annual Cost	123,078	33,800	156,878

The estimation of the total O/M costs for the Master Plan Project showed an amount of 156,878 million VND per annum will be considered as a reference figure on this aspect.

9. Estimation of O/M Costs for the Priority Project

9.1 Composition of O/M Costs for the Priority Project

Based on the proposed O/M frameworks, in general, the composition of O/M costs for the Priority Project is made from the two (2) following parts:

- 1) Cleaning and dredging costs of the existing sewer network and related canals/channels. These costs, which have been spent up to now by the existing organizations in charge of the urban drainage task, will be renewly reviewed.
- 2) O/M costs for the newly constructed facilities (for drainage improvement and sewerage development) envisaged in the Priority Project. These costs are new O/M costs for the new facilities of the Priority Project.

The O/M costs calculated in the below, therefore, do not cover the expenses for the management and equipment replacements by whole units. Expenses for repairing works of the equipment are included in the miscellaneous costs of each item.

On the aspect of urban drainage improvement, the O/M costs will consist of 2 parts: (1) the cleaning/dredging costs of the existing sewer network and related canals/channels including the O/M costs for newly introduced equipment for this work, and (2) the O/M costs of the newly installed drainage pumping stations.

On the aspect of sewerage development, the O/M costs will consist of 2 parts: (1) the O/M costs for the newly installed sewerage conduiting facilities envisaged in the

Priority Project (Sewage Pumping Station including the interceptor and the conveyance), and (2) the O/M costs for the envisaged Sewage Treatment Plant. (As the present septic tank system is proposed to be omitted, due to the introduction of sewage treatment, the present expenses for desludging septic tanks, therefore, will be neglected in the Priority Project).

9.2 O/M Costs for Urban Drainage Improvement in the Priority Project

9.2.1 The Cleaning/Dredging Costs of the Existing Sewer Network and Related Canals/Channels

These costs will consist of (1) the labour cost involved in cleaning/dredging works, and (2) the O/M costs for the newly introduced equipment for performing these works.

(1) Labour Cost for Cleaning/Dredging Works

The sewers covered in the Priority Project Area are enumerated as follows:

District	Area (ha)	Sewer 2&3 (m)	Sewer 4 (m)	In Priority Area (ha)	% in D.Area	Est. Sewer 2&3 (m)	Est. Sewer 4 (m)	Remark
1	760	79,246	23,450	565.0	75.0	95,130 m for Ben Nghe - Saigon Portion and for Doi Te Portion.	22,702	Only 8 districts are covered in the Priority Project Area
3	480	58,208	40,780	51.8	11.0		14,679	
5	410	30,514	23,330	410.0	100.0		33,342	
6	700	34,561	47,880	157.0	22.0		29,064	
4	400	19,540	39,430	354.1	90.0		42,974	
8	1,880	21,190	39,730	744.1	40.0		56,753	
10	570	67,470	38,140	288.9	51.0		26,049	
11	500	34,549	3,430	181.1	36.0		33,289	
Fan Binh	3,850	59,895	59,090	117.7	3.0			
Total	9,550	405,173	315,260	2,869.7	30.0		236,820	

The total sewers of Grades 2 and 3 controlled by UDC in the Priority Project Area have a total length of about 236.82 km or 44.7 % of 530 km for all sewers of Grades 2 and 3 of HCMC. And the sewers of Grade 4 controlled by Districts in the Priority Project have a total length of 258.85 km or 57.5 % of 450 km for all sewers of Grade 4 in HCMC.

Based on the proposition in this O/M framework, the cleaning of the sewer network will be carried out 2 times a year, and the dredging of related canals/ channels for once a year. The labour costs used for this aspect, therefore, are calculated as follows:

Item/ Sewer	Length in the Priority Area (m)	Cleaning Times per Year	Total Operation Length (m)	Perform. Per Manday (m)	Mandays needed for cleaning (md)	Labour Unit md Price (VND)	Total Annual Labour Cost (Mill. VND)
Grade 4	258,853	2 times	517,706	100	5,177	100,000	518
Grade 3 & 2	236,820	2 times	473,640	100	4,736	100,000	474
Grade 1 (Canals)	100,000	1 time	100,000	10	10,000	100,000	1,000
Total	595,673		1,091,346		14,913		1,992

Note: Cleaning/dredging works carried out by mechanical means with supporting labour force.

The cleaning/dredging works will need an annual labour of about 15,000 mandays for an annual cost of 1,992 million VND for both Phases 1 and 2.

(2) O/M Costs for the Newly Introduced Equipment

With the introduction of the sophisticated equipment for supporting the above works, the annual O/M costs for the newly introduced equipment are as follows:

Item	Annual Fuel Cost (mil.VND)	Annual Maintenance (mil.VND)	Annual cost per district (mil.VND)	Annual cost for nine districts (mil.VND)
1.Vaccum car	40*	96**	136	1,224
2.Compr. Car	40*	96**	136	1,224
3.Bucket clean	40*	80**	120	1,080
4.Van	40*	40**	80	720
5.Miscellaneous	10	40	50	450
Total	170	352	522	4,698

Note : * Fuel cost for 5000 VND/l x 40 l/day x 200 days/year

** Annual maintenance cost as 8% of the corresponding equipment cost

The annual O/M costs for the newly introduced equipment for this work will be 4,698 million VND for both Phases 1 and 2.

The total costs for cleaning/dredging works of the existing sewer network and the related canals/channels in the Priority Project Area, therefore, will be 6,690 million VND (1,992 + 4,698 = 6,690) for both Phases 1 and 2.

9.2.2 O/M Costs for the Drainage Pumping Stations

The O/M costs for the drainage pumping stations consist of (1) the personnel cost, (2) utilities cost (electricity and city water), and (3) other miscellaneous expenses.

(1) Personnel Cost

The personnel costs for 3 pumping stations in the Priority Project in 2 phases are calculated as follows:

Staff	Salary (Mill. VND)	Phase I		Phase II		Remark (+ in Ph.2)
		No.	Personnel Cost (Mill. VND)	No.	Personnel Cost (Mill. VND)	
1. Manager	3	2	78.0	3	117.0	+1
2. Dept. Manager	2.5	2	65.0	3	97.5	+1
3. Operator	2.0	2	52.0	5	130.0	+3
4. Technician	2.0	2	52.0	2	52.0	+0
5. Secretary	1.8	1	23.5	1	23.5	+0
6. Guardian	1.1	2	29.0	3	43.0	+1
7. Worker	0.8	3	31.5	5	52.0	+2
8. Others			19.0		35.0	
Total		14	350.0	22	550.0	+8

Note: Annual salary calculated as 13 monthly salaries

The annual personnel costs for the drainage pumping stations are estimated at 350 million VND in Phase I, and 550 million VND in Phase II.

(2) Utilities Cost

The utilities used in these pumping stations are electricity and city water. These costs in 2 phases are calculated as follows:

	Phase I Cost (mil.VND)			Phase II Cost (mil.VND)		
	Electricity	Water	Total	Electricity	Water	Total
B. Mecoc 1	5.70	0.30	6.00	11.10	0.35	11.45
B. Mecoc.2	0	0	0	8.30	0.20	8.50
Thanh Da	2.90	0.10	3.00	2.90	0.10	3.00
Total	8.60	0.40	9.00	22.30	0.085	22.95

Notes: 200 hrs of pump operation per year (5.5 hr x 36 days/year)

Phase I: Thanh Da: 18.5 kw x 200 hrs x @ 736 VND = 2.72 mil.VND etc.

Ben Me Coc 1: 37 kw x 200 hrs.x @ 736 VND = 5.45 mil.VND etc.

Phase II: Ben Me Coc 1: 74 kw x 200 hrs.x @ 736 VND = 10.90 mil.VND etc.

Ben Me Coc 2: 55.5 kw x 200 hrs.x @ 736 VND = 8.17 mil. VND etc.

The annual utilities costs for the drainage pumping stations are estimated at 9 million VND in Phase I, and 22.95 million VND in Phase II.

(3) Other Annual Miscellaneous Costs for the Pumping Stations:

Pumping Station	Phase I Annual Miscellaneous Cost	Phase II Annual Miscellaneous Cost
For all 3 stations	35 million VND	55 million VND

Note : As 10% of the personnel cost

The annual miscellaneous costs for the drainage pumping stations are estimated at 35 million VND in Phase I, and 55 million VND in Phase II.

(4) Total Annual O/M Costs for the Pumping Stations:

The total annual O/M costs for the drainage pumping stations in 2 phases are calculated as follows:

(Unit: million VND)

Phase	Phase I O/M Cost				Phase II O/M Cost			
	Staff	Utilities	Misc.	Total	Staff	Utilities	Misc.	Total
Cost	350	9	35	394	550	23	55	628

The annual O/M costs for the drainage pumping stations are estimated at 394 million VND in Phase I and 628 million VND in Phase II.

(5) Total O/M Costs for Urban Drainage Improvement

From the above figures, the total O/M costs for urban drainage of the F/S Project, therefore, are summarized as follows:

(Unit: million VND)

Phase	Phase I Total O/M Costs			Phase II Total O/M Cost		
	Cleaning Dredging	Pumping Station	Total	Cleaning Dredging	Pumping Station	Total
Cost	6,690	394	7,084	6,690	628	7,318

The total annual O/M costs for drainage improvement in the F/S Project are estimated at about 7,084 million VND for Phase I, and about 7,318 million VND in Phase II.

9.3 O/M Costs for Sewerage Development in the Priority Project

The O/M costs for sewerage development in the Priority Project consist of 2 parts:

- (1) O/M costs for the Sewerage Conduiting System, and
- (2) O/M costs for the Sewerage Treatment Plant.

9.3.1 O/M Costs for the Sewerage Conduiting System

The sewerage conduiting system for the Project is composed of two main parts: (1) The interceptor-conveyance portion, and (2) The sewerage pumping station. The O/M costs, therefore, are calculated as follows:

(1) O/M Cost for the Interceptor-Conveyance Portion

The O/M costs of the interceptor-conveyance portion are the labour cost and the miscellaneous cost to be used for cleaning/dredging of these facilities. In the proposed O/M framework, these works are to be carried out twice per year.

a) Labour Cost:

In Phase I:

Item	Length (m)	Cleaning Times per Year	Total Length (Operation) (m)	Perform. Per manday (m)	Mandays needed	Labour Unit md.Price (VND)	Labour Cost (Mill. VND)
Interceptor	5,500	2	11,000	50	220 md.	100,000	22.0
Conveyance	6,400	2	12,800	50	256 md.	100,000	25.6
Total	11,900		23,800		476 md.		47.6

In Phase II :

Item	Length (m)	Cleaning Times per Year	Total Length (Operation) (m)	Perform. Per manday (m)	Mandays needed	Labour Unit md.Price (VND)	Labour Cost (Mill. VND)
Interceptor	28,200	2	56,400	50	1,128 md.	100,000	112.8
Conveyance	11,800	2	23,600	50	472 md.	100,000	47.2
Total	40,000		80,000		1,600 md		160.0

The labour cost used for cleaning the interceptor conveyance portion is about 47.6 million VND for Phase I and about 160 million VND for Phase II.

b) The annual miscellaneous costs

The miscellaneous cost is assumed at 10% of the personnel cost.

Cleaning/dredging Works	Phase I	Phase II
	Annual Miscellaneous Cost	Annual Miscellaneous Cost
Annual Cost	4.76 mil. VND	16.00 mil. VND

The annual miscellaneous costs for the maintenance of the interceptor-conveyance system are estimated at about 4.76 million VND in Phase I and about 16.00 million VND in Phase II.

c) Annual O/M Cost for the Interceptor-Conveyance Portion:

The annual O/M costs for the interceptor conveyance portion are as follows:

For the Interceptor Conveyance System	Phase I Annual O/M Costs	Phase II Annual O/M Costs
1. Maintenance Cost	47.60 mil. VND	160 mil. VND
2. Miscellaneous Cost	4.76 mil. VND	16 mil. VND
Total :	52.36 mil. VND	176 mil. VND

The total O/M costs for the interceptor and conveyance system are estimated at 52.36 million VND in Phase I and 176 million VND in Phase II.

9.3.2 O/M Costs for the Sewage Pumping Station

The O/M costs for the sewage pumping station will include (1) the personnel cost, (2) the utilities cost, and (3) miscellaneous costs.

(1) The personnel costs

The personnel costs in 2 phases are calculated as follows:

Staff	Monthly Salary (Mill. VND)	Phase I		Phase II		Remark (+ in Ph.2)
		No*	Personnel Cost (Mill. VND)	No.	Personnel Cost (Mill. VND)	
1. Manager	3.0	1	39.0	1	39.0	
2. Deputy Manager	2.5	1	33.0	1	33.0	
3. Operator	2.0	3	78.0	4	104.0	+ 1
4. Technician	2.0	2	52.0	4	104.0	+ 2
5. Secretary	1.8	1	23.5	1	23.5	
6. Driver	1.5	2	39.0	2	39.0	
7. Guardian	1.1	2	29.0	2	29.0	
8. Worker	0.8	4	41.5	6	63.0	+ 2
9. Part-timer	0.5	4	26.0	8	52.0	+ 4
10. Others			24.0		28.5	
Total		20	385.0	29	515.0	+ 9

Notes : 1. Number of staff as notified in Fig. G 6.4 : O/M Manpower Organization

2. Monthly salaries for Manager (3 mil.), Department Manager (2.5 mil.), Operator and Maintenance Staff (2 mil.), Secretary (1.8 mil.), and Guardian (1.1 mil.).
3. Annual salary is calculated as 13 monthly salaries

The annual personnel cost for the sewage pumping station is estimated at 385 million VND in Phase I and 515 million VND in Phase II.

(2) The utilities costs

The utilities costs in 2 phases are calculated as follows:

Utilities	Phase I Cost (mil.VND)			Phase II Cost (mil.VND)		
	Electricity	Water	Total	Electricity	Water	Total
Annual cost	**			**		
	1,360	6	1,366	5,229	11	5,240

Notes: ** Refer to list of Required Power Supply for Equipment

Hour of pump operation per year (hr x days/year)

Phase I : $422 \text{ kw} \times 0.5 \times 24 \times 365 \times @ 736 \text{ VND} = 1,360 \text{ mil. VND}$

Phase II : $1,622 \text{ kw} \times 0.5 \times 24 \times 365 \times @ 736 \text{ VND} = 5,229 \text{ mil. VND}$

The annual costs for utilities in the sewage pumping station are estimated at about 1,366 million VND in Phase I and about 5240 million VND in Phase II.

(3) The annual miscellaneous costs

The miscellaneous costs are assumed at 10% of the annual personnel cost.

Pumping Station	Phase I Annual Miscellaneous Cost	Phase II Annual Miscellaneous Cost
Cost Amount	38.5 mil. VND	51.5 mil. VND

The annual miscellaneous costs for the sewage pumping station are estimated at 38.5 million VND in Phase I and about 51.5 million VND in Phase II.

(4) Total O/M Costs for the Sewerage Pumping Station

* The total annual O/M costs for the sewage pumping station, therefore, are as follows:

(Unit: mil. VND)

Item	Phase I O/M Cost				Phase II O/M Cost			
	Staff	Utilities	Misc.	Total	Staff	Utilities	Misc.	Total
Cost/year	385	1,366	38.5	1,789.5	515	5,240	51.5	5,806.5

The annual O/M costs for the sewage pumping station itself are estimated at 1,789.5 million VND in Phase I and 5,806.5 million VND in Phase II.

(5) Annual O/M Costs for the Whole Sewerage Conduiting System :

O/M for the Sewerage Conduiting System	Phase I Annual O/M Costs	Phase II Annual O/M Costs
1. For Pumping St.	1,789.5 mil. VND	5,806.5 mil. VND
2. For Interceptor- Conveyance	52.36 mil. VND	176.0 mil. VND
Total :	1,841.86 mil. VND	5,982.5 mil. VND

* The total annual O/M costs for the sewerage conduiting system, therefore, are estimated at 1,841.86 million VND in Phase I and 5,982.50 million VND in Phase II.

9.3.3 O/M Costs for the Sewerage Treatment Plant

The O/M costs for the sewerage treatment plant will include 4 parts: (1) the personnel cost, (2) the utilities cost, (3) the chemical cost and (4) miscellaneous costs.

(1) The personnel costs:

The personnel costs for the sewage treatment plant in 2 phases are calculated as follows:

Staff	Monthly Salary (Mill VND)	Phase I		Phase II		Remark (+ in Ph 2)
		No.*	Personnel Cost (Mill. VND)	No.	Personnel Cost (Mill. VND)	
1. Manager	3.0	1	39.0	1	39.0	
2. Department Manager	2.5	2	65.0	2	65.0	
3. Operator	2.0	12	312.0	20	520.0	+ 8
4. Technician	2.0	11	286.0	17	442.0	+ 6
5. Secretary	1.8	3	71.0	5	117.5	+ 2
6. Driver	1.5	2	39.0	3	58.5	+ 1
7. Guardian	1.1	2	29.0	4	58.0	+ 2
8. Worker	0.8	17	177.0	31	322.5	+14
9. Part-timer	0.5	20	130.0	35	227.5	+15
10. Others			32.0		50.0	
Total		70	1,180.0	118	1,900.0	

Notes : * Number of staff as notified in Fig G7 sewage Treatment plant O/M Manpower Organization
 Monthly salaries for Manager (3 mil.), Department Manager (2.5 mil.), Operator and Maintenance Staff (2 mil.), Secretary (1.8 mil.), and Guardian (1.1 mil.).
 Annual salary is calculated as 13 monthly salaries

The annual personnel cost for the sewage treatment plant is estimated at 1,180 million VND in Phase I and 1,900 million VND in Phase II.

(2) The utilities costs:

The utilities applied in the sewage treatment plant are electricity and water which costs in 2 phases are calculated as follows:

Utilities	Phase I Cost (mil.VND)			Phase II Cost (mil.VND)		
	Electricity	Water	Total	Electricity	Water	Total
Annual cost	** 6,818	62	6,880	** 24,318.5	121.5	24,440

Notes : ** Refer to List of Required Power Supply for Equipment

Hours of pump operation per year (hr x days/year)

Phase I : $2,115 \times 0.5 \text{kw} \times (24 \times 365) \text{ hrs.} \times @ 736 \text{ VND} = 6,818 \text{ mil.VND}$

Phase II : $7,543.7 \text{ kw} \times 0.5 \times (24 \times 365) \text{ hrs.} \times @ 736 \text{ VND} = 24,318.5 \text{ mil. VND}$

The annual utilities costs for the sewerage treatment plant are estimated at 6,880 million VND in Phase I, and 24,440 million VND in Phase II.

(3) The chemicals costs:

The chemicals used in the treatment plants are polymer, chlorine and detergents which annual costs are calculated as follows:

(Unit : million VND)

	Phase I				Phase II			
	Polymer	Chlorine	Detergent	Total	Polymer	Chlorine	Detergent	Total
Annual Cost	*** 8,511.8	*** 1,080.7	*** 219.0	9,811.5	*** 29,404.4	*** 3,599.9	*** 503.7	33,508.0

Notes : *** Refer to List of Required Chemicals for Sewerage Treatment Operation

Phase I : Polymer: @ 80,000 VND x (291.5) x 365 = 8,511.8 million VND

Chlorine: @ 7000 VND x (423) x 365 = 1,080.7 million VND

Detergent: @ 12,000 VND x (50) x 365 = 219.0 million VND

Phase II : Polymer: @ 80,000 VND x (1007) x 365 = 29,404.4 million VND

Chlorine: @ 7000 VND x (1409) x 365 = 3,599.9 million VND

Detergent: @ 12,000 VND x (115) x 365 = 503.7 million VND

The chemicals costs for the sewerage treatment plant are 9,811.5 million VND for Phase I and 33,508 million VND for Phase II.

(4) Annual miscellaneous costs

The miscellaneous are assumed at 10% of the personnel cost:

Sewage Treatment Plant	Phase I Annual Miscellaneous Cost	Phase II Annual Miscellaneous Cost
	118 million VND	190 million VND

The annual miscellaneous costs for the sewerage treatment plant are estimated at 120 million VND in Phase I and 190 million VND in Phase II.

(5) Total O/M Costs for the Sewerage Treatment Plant

The total annual O/M costs for the sewerage treatment plant, therefore, are as follows:

(Unit: million VND)

Item	Phase I O/M Cost					Phase II O/M Cost				
	Staff	Utilities	Chemicals	Misc.	Total	Staff	Utilities	Chemicals	Misc.	Total
Annual Cost	1,130	6,880	9,811.5	118	17,989.5	1,900	24,440	33,508	190	60,038

The total annual O/M costs for the sewerage treatment plant are estimated at 17,989.5 million VND in Phase I and about 60,038 million VND in Phase II.

9.3.4 Annual O/M Costs for Sewerage Development

The annual O/M costs for the sewerage development are as follows:

(Unit: million VND)

Item	Phase I O/M Cost for Sewage			Phase II O/M Cost for Sewage		
	Conduit System	Treatment Plant	Total	Conduit System	Treatment Plant	Total
Cost	1,841.86	17,989.50	19,831.36	5,982.50	60,038	66,020.50

The annual O/M costs for the part of sewerage development are estimated at 19,831.36 million VND for Phase I and 66,020.50 million VND for Phase II.

9.4 Total Annual O/M Costs for the Priority Project

The total annual O/M costs for the Priority Project in 2 Phases, therefore, are calculated as follows:

(Unit: million VND)

Item	Phase I			Phase II		
	Total Annual O/M Costs			Total Annual O/M Costs		
	Drainage	Sewerage	Total	Drainage	Sewerage	Total
Cost	7,084.00	19,831.36	26,915.36	7,318.00	66,020.50	73,338.50

The total annual O/M costs for the I/S Project are estimated at 26,915.36 million VND in Phase I, and 73,338 million VND in Phase II.

On the aspect of sewerage development, the daily cost for sewerage treatment is roughly calculated at 181 million VND/day or 386 VND per cubic meter.

Table G.2.1 (1/2) List of Waterways Controlled by Office of Waterway Management (As of 1998)

No	Name of Waterway	Distance (Km)	Category	Location
A CUCHI AREA				
A1	Son channel	3.5	6	Crossroad of Saigon river until the end of line
A2	Lang Tre channel	8.6	6	Crossroad of Saigon river until Lang Tre bridge
A3	Xang canal (Thay Cai canal)	30.8	4	Border of Tay Ninh until Xang bridge
A4	Duc Lap canal (Ba Ca Bay river)	18.5	6	Trung Lap Thuong commune - Crossroad of Duc Lap canal
A5	Quyet Thang canal (Gia Be river)	8.5	6	Trung Hung commune + Crossroad of Duc Lap canal
A6	Thai Thai channel	7	6	Crossroad of Saigon river + The end of line
A7	Bo Cap channel	1.5	6	Crossroad of Saigon river + The end of line
A8	Cay Xoai channel	1.3	6	//
A9	Ba Tai channel	0.8	6	//
A10	Cau Den channel	1	6	//
A11	Song Cu channel - Ba Nga bridge	3.5	6	//
A12	Dia Phan canal	10	6	Lang Tre bridge + Xang canal.
A13	Tra Lon channel	7	4	Crossroad of Saigon river + Xang bridge.
A14	Dua channel - Rua channel	7	6	Crossroad of Saigon river + The end of line.
		Total Category 4 = 2 lines Category 6 = 12 lines = 14 lines		Total Distance = 109 km
B HOC MON AREA (including District 12)				
B1	Xang canal (Hoc Mon)	25.5	4	Border of Long An + Xang bridge (Tra channel)
B2	An Ha canal	22	4	Xang bridge + Crossroad of Xang canal
B3	Ben Cat river	1.6	4	An Loc bridge + Ben Phan bridge
B4	Cau Xang river - Tra Nho channel	6	6	Crossroad of Tra Lon channel + Hoc Mon market.
B5	Ba Hong channel	3.8	6	Crossroad of Saigon river + Ba Nam bridge.
B6	Ben Cat channel - Menh bridge	9.9	6	Crossroad of Truong Day river + Crossroad of Tra Lon channel.
B7	Ba Ca Bon channel	4	6	Crossroad of Saigon river + Crossroad of Truong Day river.
B8	Ba Bep channel	2	6	Crossroad of Saigon river + The end of line.
		Total Category 4 = 3 lines Category 6 = 5 lines = 8 lines		Total Distance = 74.8 km
C THU DUC AREA				
C1	Tac river	11.5	4	Crossroad of Dong Nai river + Crossroad of Dong Nai river
C2	Go Cong channel - Cau channel	5.7	6	Crossroad of Tac river + Tan Phu commune
C3	Trau Trau channel - Chiec channel	11	4	Crossroad of Tac river + Crossroad of Saigon river
C4	Mon channel - Kinh river (Nuoc Duc channel)	3.6	6	Crossroad of Tac river + Crossroad of Dong Nai river
C5	Cay Cam channel	3.2	6	Crossroad of Tac river + Crossroad of Trau Trau channel
C6	Ba Da channel - Giang channel	4.5	6	Crossroad of Tac river - Crossroad of Dong Nai river
C7	Giong Ong To channel	7	4	Crossroad of Saigon river + Tac river
C8	Ba Cua channel	4.3	6	Crossroad of Dong Nai river + Crossroad of Giong Ong To channel
C9	Cau Ong Nhiu channel	5.2	4	Crossroad of Dong Nai river + Crossroad of Chiec channel
C10	Dat Set channel	3	6	Crossroad of Cau Ong Nhiu channel + Crossroad of Giong Ong To channel
C11	Ba Hien channel - Ngon Muong channel	3.2	6	Ong Nhiu bridge + Ba Cua channel
C12	Ky Ha river	4	6	Crossroad of Saigon river + TL 25 (Tan My Loi commune)
C13	Ba Do channel	2	6	Crossroad of Saigon river + The end of line
C14	Ca Tre channel	2.2	6	Crossroad of Saigon river + The end of line (Cho Hamlet)
C15	Go Dua channel - Nuoc Trong channel	6.2	6	Crossroad of Saigon river + The end of line (Dong Hamlet)
C16	Cau Dap river	2	6	Crossroad of Saigon river + Crossroad of Nuoc Trong channel
C17	Ong Dau channel - Dia channel	4.3	6	Crossroad of Saigon river + Crossroad of Go Dua channel
		Total Category 4 = 4 lines Category 6 = 13 lines = 17 lines		Total Distance = 82.9 km
D BINH CHANH AREA				
D1	Sang canal (Binh Chanh)	12.5	4	An Ha canal + Ben Luc river
D2	Ben Luc river	9.7	3	Crossroad of Doi canal + Border of Long An
D3	Can Giuoc river	15.6	3	Crossroad of Ben Luc river + Crossroad of Ba Lao channel
D4	Chua river	7	6	Crossroad of Sang canal + Nuoc Len channel
D5	Ba Goc - Cai Trung channel	4.5	6	Crossroad of Ben Luc river + The end of line
D6	Cau Sap channel (Ba Tang channel)	4	6	Crossroad of Can Giuoc river + Ba Lao channel
D7	Ong Vliocan channel	3	6	Crossroad of Ben Luc river + The end of line
D8	Ba Ty channel	3.5	6	Crossroad of Ben Luc river + The end of line
D9	Ong Giao - Ong De channel	2.8	6	Crossroad of Ben Luc river + The end of line
D10	Ong Den - Ba Dap channel	3.5	6	Crossroad of Can Giuoc river + The end of line
D11	Xom Cui - Go Noi - Ba Lao channel	12.2	4	Crossroad of Doi canal + Crossroad of Can Giuoc river
D12	Thu Dao channel	3	6	Crossroad of Can Giuoc river + Ba Lao channel
D13	Ba Lon channel - Chom channel	8.1	5	Crossroad of Doi canal + Cau Sap channel
D14	Chieu channel - Cau Ba Ca channel	4.2	6	Crossroad of Ba Lao channel + Thu Dao channel
D15	Xa Ton channel	2.3	6	Crossroad of Go Noi channel + TL 50
D16	Tac Ben Ro channel (inner city)	4.5	5	Xom Cui channel + Cay Kho channel
		Total Category 3 = 2 lines Category 4 = 2 lines Category 5 = 2 lines Category 6 = 10 lines = 16 lines		Total Distance = 100.4 km

Table G.2.1 (2/2) List of Waterways Controlled by Office of Waterway Management (As of 1998)

No	Name of Waterway	Distance (Km)	Category	Location
E INNER SAIGON AREA				
E1	Binh Trieu river	2.8	6	Crossroad of Saigon river + Lang channel
E2	Xuyen Tam channel (Lang channel-Cau Son)	6	6	Crossroad of Vam Thuan river + DaKao Sat bridge
E3	Thi Nghe - Nhiêu Loc channel	6.5	6	Crossroad of Saigon river + Hoa Hung station
E4	Thanh Da canal	1.3	3	Crossroad of Saigon river + Crossroad of Saigon river
E5	Van Thanh channel	2	6	Crossroad of Thi Nghe channel + Van Thanh bridge
E6	Canal line of inner belt (Vam Thuan river - Truong)	30	4+5	Crossroad of Saigon river + Crossroad of Cho Dam river
E7	Ben Nghe channel	3.1	5	Crossroad of Saigon river + intersection of Doi canal
E8	Tau Hu - Lo Gom canal	8.3	4 + 5	Intersection of Te canal + Ben Tue river
E9	Lo Gom - Ong Buong channel	2.5	6	Intersection of Tau Hu canal + Ong Buong bridge
E10	Ngang canal No 1	0.4	4	Doi canal + Tau Hu canal
E11	Ngang canal No 2	0.4	4	//
E12	Ngang canal No 3	0.4	4	//
E13	Ong Nho channel	2.4	6	Doi canal + Ong Lon channel
E14	Ruoi Ngua channel	5.7	6	Crossroad of Lo Gom canal + The end of line
		Total Category 3 = 1 lines Category 4 = 4 lines Category 5 = 2 lines Category 6 = 7 lines Total = 14 lines		Total Distance = 71.8 km
F NHA BE AREA				
F1	Thay Tieu channel	3.4	6	Rach Bang bridge + Dia channel
F2	Bang channel	2.5	6	Thay Tieu channel + The end of line
F3	Ap Chien Luoc channel	2	6	Ong Lon channel + Bang channel
F4	Phu Xuan - Muong Chuoi river	6	4	Nha Be river + Nha Be river
F5	Dia channel	6.5	4	Ong Lon channel + Phu Xuan river
F6	Cay Kho channel	4.8	4	Cay Kho canal + Phuoc Kieng river
F7	Tom channel - Phuoc Kieng river	5.2	5	Crossroad of Ba Lao channel + Muong Chuoi river
F8	Doi channel - Kinh river	8	4	Can Giuoc river + Nha Be river
F9	Ngang channel	2.2	6	Maong Chuoi river + Nha Be river
F10	Thay Cai channel - Thay Cai stretch	7.2	6	Tom channel + Doi channel
F11	Ong Be channel	3	6	Tac Ben Ro channel + Phu Xuan river
F12	Ba Thanh channel	3.2	6	Tac Ben Ro channel + Dia channel
F13	Ca Cam channel	2	6	Dia channel + The end of line
F14	Dua Sap channel	1.2	6	Thay Tieu channel + Dia channel
F15	Ong Tu Dinh channel	1.3	6	Ong Lon channel + Dia channel
F16	Giong channel	4.2	4	Nha Be river + Giong river (Long An)
F17	Muong Lon channel - Dinh channel - Bau Dua	6.5	5	Nha Be river + Kinh river
F18	Rach Rop river	3	6	Nha Be river + Bau Dua channel
F19	Dinh Ong channel	2.4	6	Rach Rop river + Kinh river
		Category 4 = 5 lines Category 5 = 2 lines Category 6 = 12 lines Total = 19 lines		Total Distance = 74.6 km
G CANG GIO AREA				
G1	Song Cha stretch	1.2	2	Nha Be river + Nha Be river
G2	Bong Gieng Lon channel	4.5	4	Nha Be river + La channel
G3	Duoc channel - Sau channel - Lap Doi channel	8.7	6	Long Tau river + Binh Khanh ferry
G4	La channel - Tan Den stretch	12	5	Nha Be river + Long Tau river
G5	Ong Nghia stretch	5.5	4	Long Tau river + Nha Be river
G6	Tac Roi channel	4	2	Long Tau river + Dua river
G7	Dinh Cau stretch	2.4	1	Tac Roi channel + Dua river
G8	Ca Dao stretch	6.5	6	Long Tau river + Dua river
G9	Dua river	11.8	1	Crossroad of Long Tau river + Dong Tranh river
G10	Dong Tranh river No 1	24	1	Crossroad of Long Tau river + Nga Bay river
G11	Dong Tranh river No 2	8.5	1	Mouth of South China Sea + Cat Lai river
G12	Cat Lai river - Vam Sat river	32.4	3	Dong Tranh river No 2 + Nha Be river
G13	Dan Xay - Dinh Ba - Lo Ren river	11.6	3	Long Tau river + Vam Sat river
G14	Dinh Ba - Loi Giang river	7.8	4	Crossroad of Lo Ren river + Long Tau river
G15	Go Gia river	8.5	1	Cai Mep river + Border of Dong Nai
G16	Bai stretch	7.4	1	Go Gia river + Dong Tranh river
G17	Lo Voi river	8	1	Dong Dinh river + Hao Vo river
G18	Dong Dinh - Bai Tien - An Hoa river	6.9	1	Can Gio mouth + Rach Cay ditch
G19	Dinh Ba river No 2	6	4	Can Gio mouth + Bai Tien river
G20	Ha Thanh river	10	4	Dinh Ba river No 2 + Mouth of sea
G21	Hao Vo - Mung Nam river	11	1	Mui Nai river + Dan Xay ferry
G22	Ca Gau - Ong Tien river	7	1	Can Gio mouth + Mung Nam river
G23	Buc May stretch	4.6	1	Dong Tranh river + Bai stretch
G24	Thieng Lieng channel - Doi No stretch	7	4	Nga Bay river + Bai stretch
G25	Cau Kho stretch	5.7	4	Dua river + Dong Tranh river
		Category 1 = 10 lines Category 2 = 2 lines Category 3 = 2 lines Category 4 = 8 lines Category 5 = 2 lines Category 6 = 1 line Total = 25 lines		Total Distance = 223 km

Table G.3.1 O/M System of UDC Drainage Network

Drainage Network		O.M System					Remark				
Facilities	Drain/ Sewer Grade	Function	Dimensions & Construction	Distance (m)	Culvert Box & Outlet	Present Situation		Operation Conditions	Maintenance Frequency	Method of Maintenance	Control System and Budget
Inner City Canals & Channels	1	To receive drainage from outlets of Sewer Grade 2 for draining into large rivers	Unspecified Mostly in natural conditions with	92.625	0	In deteriorated conditions with rubbish and sewage from both sides	Very bad	No maintenance in recent years (No budget)	Need of dredging and consolidation works	No control system due to no budget provided	* No proper Maintenance at now
Sewer of Grade 2	2	To connect the sewers of Grade 3 to drain out in canals and channel (Grade 1)	Root Brick RC Round Rectangular RC ----- Total	300.000 690.000 64.520 ----- 1.054.750	Culvert Box: 2106 Outlet: 215	Some parts damaged due to old construction and heavy transportation	All year round operation by a large amount damaged and outlets not good function due to rubbish	In principle maintenance should be done but very few	Manually clearing of outlets time to time	UDC obtained an annual budget of VND 25-30 billion for doing O.M of these UDC sewers	* Annual O/M programs based on annual budgets
Sewer of Grade 3	3	To connect the sewers of Grade 4	RC Pipe	4.250.000 Along main transport roads	Culvert box: 24.000	Very old Mostly in 1970 (French era)	All year round operation	In general One per year One per 2 years	Manually Group of about (10 workers doing for about 100 m per day)		

Note: . The total distance of drainage network handled by UDC is 5.397.375 m, of which 92.625 m of canals and channels of inner city handled by UDC are not in the scope of O/M

Source : UDC 1995

Table G.3.2 Network of Drainage Canals/Channels handled by UDC

No.	Name of Canal/Channel	Distance (m)	Drainage Area
1	Nhieu Loc - Thi Nghe canal Tributaries	9.470 8.716	Districts Tan Binh, Phu Nhuan, Go Vap, Binh Thanh, 10, 3, 1. Total area = 3.000 ha, with outlets
2	Tau Hu - Ben Nghe canal Tributaries	12.200 3.950	Districts 1, 4, 5, 6, 8 with outlets
3	Doi - Te canal Tributaries	13.200 7.300	Tau Hu - Ben Nghe canal, Districts 4, 8, and Nha Be north, with outlets
4	Tan Hoa - Lo Gom Tributaries	7.240 4.920	Districts Tan Binh, 11, 6, with outlets Total area = 3.110 ha
5	Tham Luong - Vam Thuat canal Tributaries	14.080 11.550	District Tan Binh, Go Vap, Binh Thanh, Hoc Mon. Total area = 9.000 ha, with outlets
Total Distance of Main Canals		56.190	
Total Distance of Tributaries		36.436	
Total Distance of Canals and Tributaries		92.626	

Source : UDC, 1994

Table G.3.3 (1/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert/Box		Present Situation	
						Inlet	Outlet			Type	Quantity		
1. Tran Khac Chan	Tran Quang Khai St.	Thi Nghe canal	f1000	794.4 397.2	Thi Nghe canal				Good	90x90x10	11	Good	
			f800	397.2				Average	90x110x6	2	Good		
			f600					Average	90x90x10	2	Good		
2. Nguyen Van Thu	House 150	Thi Nghe canal	f900	628.6	Thi Nghe canal	7505	3805	8	Average	100x100x10	4		
			f600	461.6	Nguyen Binh Khiem St	3805	2040	10.6	Average	90x90x6	1		
				167	Thi Nghe canal					90x110x6	1		
3. Tran Quoc Thao	Vo Thi Sau St.	Thi Nghe canal	f600	771	Thi Nghe canal				Average	90x90x10	53	Good	
				92	House 760				Average	75x75x10	4	Good	
										90x110x6	4	Good	
	House 760	Ky Dong St.	f600	310.5					Average	90x90x6	1	Good	
									Average	75x75x10	14	Good	
										90x110x6	14	Good	
	Ky Dong St.	Thi Nghe canal	f800	197.5					Average	90x110x6	6	Good	
			f900	158.2	Opposite 114				Average	75x75x6	2	Good	
										90x110x6	4	Good	
4. Nguyen Van Troi	Pham Van Hai St.	Nhieu Loc canal	f900	12.8					Average	90x110x6	4	Good	
				3502	Nhieu Loc canal				Average	75x75x10	4	Good	
				1751	Nhieu Loc canal	3793	1883	1.3	Average	90x110x6	14	Good	
	Pham Van Hai St.	Nguyen Trong Tuyen St.	f800	469		3963			Average	90x90x6	1	Good	
						3363	-0.382	3.1	Good				
			f1000									21	
5. Dang van Ngu	Nguyen Trong Tuyen St.	Nhieu Loc canal	f600	954	Nhieu Loc canal	4408	2328	3.6	Average	90x90x6	7	Good	
				497.5		2248	-0.277	5.2	Average	90x110x6	14	Good	
			f1000	456.5								30	
6. Pham Van Hai	Le Van Sy St.	Nhieu Loc canal	f800	1150	Nhieu Loc canal	1508	-0.062	4.3	Good	80x120x6	3	Flood	
				332.1	Nhieu Loc canal				Good	100x100x6	3	Flood	
										90x90x6	3	Flood	
	Cach Mang Thang 8 St.	Ong Ta brigade	f600	157.7	Nhieu Loc canal	1358	148	7.7	Average	90x90x6	2	Flood	
				38	Nhieu Loc canal	2698	2578	3.2	Good	90x110x6	2	Flood	
			f800							100x100x6	3	Flood	
	Lane 224	Ong Ta brigade	f600						Good	90x90x6	3	Flood	
										Good	90x90x6	3	Flood
			f800							Average	90x90x6	2	Flood
	House 31	House 56	f600	8	Nhieu Loc canal	718	858	7.5	Average	80x120x6	3	Flood	
				153		658	268	2.5	Average	100x100x6	1	Flood	
			f600							65x100x6	1	Flood	
	Vinh Son temple	Ong Ta brigade	f600						Good	90x90x6	3	Flood	
										Good	90x90x6	3	Flood
			f800							Average	90x90x6	2	Flood
	House 107	Ong Ta brigade	f600	325	Nhieu Loc canal	2578	718	5.7	Average	100x100x6	1	Flood	
				115	7779.2	558	28	4.5	Good	90x90x6	2	Flood	
			f800							90x110x6	2	Flood	

Table G.3.3 (2/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
7. Thuong Dinh												
	Xo Viet Nghe Tinh St.	Vo Van Tan St.	A16	1678	B. Binh canal	Non-specific	Non-specific		Average	There is not Culvert Box on main sewer	7	
	Vo Van Tan St	Ngo Thai Nhiem St	A16	47	B. Binh canal	Non-specific	Non-specific		Average			
	Ngo Thai Nhiem	Vo Thi Sau St.	A16	370	B. Binh canal	Non-specific	Non-specific		Average			
	Vo Thi Sau St.	B. Binh canal.	A15	449	B. Binh canal	Non-specific	Non-specific		Average			
	House 278	B. Binh canal.	f 1000	445	B. Binh canal	Non-specific	Non-specific	679	Average	90x90x6 90x90x10	1 6	
	Phan Dang Luu St.	Sai Gon traffic ring		367	B. Binh canal	Non-specific	Non-specific		Average	90x90x6 90x90x10	1	
	Phan Dang Luu St.	Bong brigade		1241	Non-specific					There is not Culvert Box		
8. Dinh Tien Hoang	Phan Dang Luu St.	Binh Thanh library	f 1000	946.5	Thi Nghe canal				Good	120x100x6	7	Good
	Binh Thanh library	Bong brigade	f 1000	271.8	Thi Nghe canal				Good	100x110x6	2	Good
	Nguyen Thi Minh Khai St.	Nguyen Dinh Chieu St.	f 600	674.7	Thi Nghe canal				Good	90x90x10	1	Good
	Nguyen Thi Minh Khai St.	Bong brigade		1186.4	Thi Nghe canal				Good	100x120x6	13	Good
	Nguyen Thi Minh Khai St.	Nguyen Dinh Chieu St.		610.5	Thi Nghe canal				Average	90x90x6	8	Good
	Nguyen Dinh Chieu St.	Bong brigade			Thi Nghe canal				Average	70x120x6	1	Good
	Nam-Kh-Nghia St.	Bong brigade	80x100	650.3	Thi Nghe canal				Average	80x110x6	1	Good
	Xo Viet Nghe Tinh St.	Thi Nghe canal	f 500	216.8	Thi Nghe canal				Average	90x110x10	1	Good
9. Nguyen D. Chieu	Nam-Kh-Nghia St.	Dinh Bo Linh St.	f 600	1692.5	Cau Son canal				Average	75x75x10	5	Good
10. Bach Dang	Xo Viet Nghe Tinh St.	Son brigade	f 1000	1380					Average	100x100x10	6	
	Le Quang Dinh	Nhieu Loc canal		277					Good	100x100x10	2	Good
	Cach Mang Thang 8 St.	Nhieu Loc canal		528					Good	90x90x6	1	Good
	Cach Mang Thang 8 St.	Railway	f 1000	166					Good	100x100x6	1	Good
	Railway	Nhieu Loc canal	f 200	166					Good	90x110x6	1	Cover is broken
11. Tran Van Dang	Pham Ngu Lao St.	Ben Cat canal	BT canal	196	Nhieu Loc canal				Good	Should be dredged		
	Pham Ngu Lao St.	Nguyen Van Bao St.	f 500	1200					Average	Broken, not in use	26	
	Nguyen Van Bao St.	Nguyen Van Nghi St.	f 800	240					Average	90x90x6	4	
	Nguyen Van Nghi St.	26/3 St.	f 600	80					Average	90x90x6	2	
	26/3 St.	Ben Cat canal	f 1000	50					Good	90x90x10	20	
	Five-crossroads	An Loc bridge	Ditch	580					Good			
13. Nguyen Oanh	Five-crossroads	Phan Van Tri	f 600	2750					Average	90x90x6	42	
	Five-crossroads	An Loc bridge		420					Average	90x90x6	8	Good
	Phan Van Tri St.	An Loc bridge	f 1000	2010					Average	90x90x6	7	Good
	An Loc bridge	Ben Cat canal	f 600	200					Good	90x90x6	20	Good
	Nguyen Thi Minh Khai St.	Cong Ly bridge		1795	Nhieu Loc canal				Broken, not in use		7	Good
14. Nam-Kh-Nghia.	Nguyen Thi Minh Khai St.	Vo Van Tan St.	KG	180							18	Culvert Box is filled
	Nguyen Thi Minh Khai St.	Vo Thi Sau St.	K4	690					Average	90x90x10	3	
	Vo Van Tan St.	Cong Ly bridge	C1	945					Average	90x90x10	12	
	Vo Thi Sau St.								Average	90x90x10	3	

Table G.3.3 (3/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert/Box		Present Situation	
						Inlet	Outlet			Type	Quantity		
15. Cong Hoa	Cach Mang Thang 8 St.	Dang Dinh Dang canal	f 600	2350					1.0	90x90x6	4	Good	
										250	90x90x6	6	Good
										325	90x90x6	8	Good
										400	90x90x6	10	Good
										632	90x90x6	17	Good
			f 600	743				0.6					
	Hoang Van Thu St.	Dang Dinh Dang canal.	f 1200	346				0.8	90x90x6	11			
				150				5.0	90x90x6	4			
				196				3.0	90x90x6	6			
16. Hoang Hoa Tham	Cach Mang Thang 8 St.	Ditch on Cong Hoa St.	f 1000	890									
Cong Hoa	Hoang Hoa Tham St.	Ditch on Cong Hoa St.	f 1000	280					Good	90x90x6	2	Good	
										804	90x90x6	1	Good
										402	90x90x6	1	Good
										402	90x90x6	2	Good
17. Tran Nhat Duat	Tran Quang Khai St.	Thi Nghe canal	f 1000	402					Good	90x90x6	1	Good	
											90x90x6	1	Good
											60x60x6	1	Good
											36x92x6	2	Good
											90x90x6	1	Good
18. Bac Hai	Le Thi Rieng garden	Nhiều Looc canal	2x2.2	711					Good	90x110x10	1	Good	
											90x110x10	1	Good
											90x110x10	1	Good
											90x110x10	1	Good
											90x110x10	1	Good
19. Hai Ba Trung	Bao Ngan canal	Nhiều Looc canal	2(2.5x2.5)	180x2					Good	90x90x6	1	Good	
											90x90x6	1	Good
											90x90x6	1	Good
											90x90x6	1	Good
											90x90x6	1	Good
	Nguyen Thi Minh Khai St.	Nhiều Looc canal.		1599					Good	90x90x10	16	Good	
											90x90x10	16	Good
											90x90x10	16	Good
											90x90x10	16	Good
											90x90x10	16	Good
	Nguyen Thi Minh Khai St.	Nguyen Van Thu St.	0.8x1.8	377				Non-specific	Average	100x100x6	1	Good	
											100x100x6	1	Good
											100x100x6	1	Good
											100x100x6	1	Good
											100x100x6	1	Good
20. Phan Dinh Phung	Nguyen Van Thu St.	Dinh Cong Trang St.	0.8x1.8	482				5045	6.2	5045	1	Average	
											2035	1	Average
											2035	1	Average
											2035	1	Average
											2035	1	Average
	Dinh Cong Trang St.	Nhiều Looc canal.		740				Non-specific	Average	120x120x15	1	Average	
											120x120x15	1	Average
											120x120x15	1	Average
											120x120x15	1	Average
											120x120x15	1	Average
	Phan Dang Luu St.	Nhiều Looc canal		68.7					Average	120x120x10	5	Average	
											120x120x10	5	Average
											120x120x10	5	Average
											120x120x10	5	Average
											120x120x10	5	Average
	Phan Dang Luu St.	Nhiều Looc canal.	f 500	729					Average	110x110x10	4	Average	
											110x110x10	4	Average
											110x110x10	4	Average
											110x110x10	4	Average
											110x110x10	4	Average
									Average	100x110x10	3	Average	
											100x110x10	3	Average
											100x110x10	3	Average
											100x110x10	3	Average
											100x110x10	3	Average
									Average	120x120x10	1	Average	
											120x120x10	1	Average
											120x120x10	1	Average
											120x120x10	1	Average
											120x120x10	1	Average
									Average	50x100x10	3	Average	
											50x100x10	3	Average
											50x100x10	3	Average
											50x100x10	3	Average
											50x100x10	3	Average
									Average	60x120x10	6	Average	
											60x120x10	6	Average
											60x120x10	6	Average
											60x120x10	6	Average
											60x120x10	6	Average
									Average	80x110x15	6	Average	
											80x110x15	6	Average
											80x110x15	6	Average
											80x110x15	6	Average
											80x110x15	6	Average
									Average	100x80x10	1	Average	
											100x80x10	1	Average
											100x80x10	1	Average
											100x80x10	1	Average
											100x80x10	1	Average
									Average	60x120x10	2	Average	
											60x120x10	2	Average
											60x120x10	2	Average
											60x120x10	2	Average
											60x120x10	2	Average

Table G.3.3 (4/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
21. Thich Quang Duc	Nguyen Kiem St. Nguyen Kiem St.	Ong Tieu canal. Railway.	Ditch 800x1000	1617 30	Black Spring				Average	90x90x10	2	
		House 60B	f1000	521	Ong Tieu canal	3200	3000	3100	Good	75x75x10	3	Good
	House 60B	Phan Dang Luu St.	f1000	142		3600	2600	6.8	Good	90x90x6	6	Good
	Phan Dang Luu St.	Ong Tieu canal	f1000	75	Nhieu Loc canal	1587	1193		Good	90x100x6	61	Good
22. Le Van Sy	Huynh Van Banh St.	Nhieu Loc canal	f800	2000		1193	498		Sewer is flooded			
	House 115	House 493	f600	307.6		418	-262				17	Good
	House 493	Tran Quang Dieu St.	f600	514		-162	-572				16	Good
	House 538	House 394	f800	302.4		498	Non-specific				11	
	House 394	Tran Quang Dieu St.	f800	189		0.572	Non-specific				11	
	Tran Quang Dieu St		f800	340							20	
23. Truong Dinh	Nguyen Dinh Chieu St.	Bung Binh canal.	f800	1135					Good	90x110x6	11	Good
	Nguyen Dinh Chieu St.	Ngo Thoi Nhiem St.	f1000	58.4					Good	90x90x6	9	Good
		Vo Thi Sau St.	G4	84.6								
	Ngo Thoi Nhiem St.	Ly Chinh Thang St.	G4	440						There is not Culvert Box		
	Vo Thi Sau St.	Bung Binh canal.	G2	234							68	
	Ly Chinh Thang St.	Nhieu Loc canal.		318	Nhieu Loc canal						65	Good
24. Tran Quang Dieu	Le Van Sy St.	Nhieu Loc canal		218.5								
	Le Van Sy St.											
25. Dinh Bo Linh St.	Bach Dang St.	Son bridge.	C1000	97.5								
26. Line 1 is excavated at Go Vap	To cross Nhieu Loc		f1000	119								
			f1000	275	Vam Thuat							
			f800	245								
27. Line 2 is excavated at Go Vap	To cross Nhieu Loc		f1000	15x2								
			f800	320								
			f1000	180								
28. Line 3 is excavated at Go Vap			f1000	180								
			f1000	300								
29. Line 4 is excavated at Go Vap			f1000	150x2								
			f1000	320								
30. Hoang Van Thu	217 Hoang Van Thu St.	Ong Tieu canal	f800	1580								
	217 Hoang Van Thu St.	307 Hoang Van Thu St.	f800	83					Average	110x110x6	2	Good

Table G.3.3 (5/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
	307 Hoang Van Thu St.	193 Hoang Van Thu St.	f 1000	156					Good	110x110x10	1	
	193 Hoang Van Thu St.	181 Hoang Van Thu St.	f 1500	96					Good	100x100x10	1	
	181 Hoang Van Thu St.	Ho Van Hue St.		41					Good	110x54x6	1	
	Ho Van Hue St.	P.Nhuan four-crossroads	1.8x1.5	518					Good	90x110x10	2	
	P.Nhuan four-crossroads	Phan Xich Long St.	1.8x2.25	336					Good	90x110x10	1	Good
	Phan Dang Luu St.	ONG Tieu canal	1.8x2.25	350								
	Mac Dinh Chi St.	Thi Nghe canal	Roof	721								
	Mac Dinh Chi St.	Nguyen Binh Khiem St.	0.8x1.4	616								
	Nguyen Binh Khiem St.	Thi Nghe canal	f 1000	105								
	Xo Viet Nghe Tinh St.	Sai Gon River		925					Average	There is not Culvert Box	11	
	Nguyen Du St.	Nguyen Du St.	f 800	313	Sai Gon River				Average	90x110x6	8	Good
	Nguyen Du St.	Le Thanh Ton St.	0.8x1.4	394	Sai Gon River				Average	90x90x6	2	Good
	Le Thanh Ton St.	Sai Gon River	0.8x1.4	218	Sai Gon River				Average	90x110x6	1	Good
	Le Lai St.	Ben Nghe canal.	f 1000	570	Ben Nghe canal		-0.200	0.5		90x110x6	3	
	Pham Ngu Lao St.	Tran Hung Dao St.	f 1200	850	Ben Nghe canal		-0.866	0.57	Good	90x90x6	4	
	House T34.	Ben Nghe canal.	f 1000	850	Ben Nghe canal		-1.181		Good	90x90x9	7	
	House 82	Ben Nghe canal.	f 800	300			0.230	-0.025		90x90x10	5	
	House 82	Te canal.	f 800	350	Te canal		0.390	-0.020		70x110x6	1	
	Xo Viet Nghe Tinh St.	Ben Nghe canal.		1590						90x110x6	3	
	Xo Viet Nghe Tinh St.	Nguyen Du	0.8x1.2	418			4.326	3.363	Average			
	Nguyen Du St.	Ben Chuong Duong St.	0.8x1.2	1078			3.363	-0.645	Average			
	Ben Chuong Duong St.	Ben Nghe canal.	0.8x1.2	94					Average			
	Quach T.Trang traffic ring	Sai Gon River.		1598	Sai Gon River				Average			
	Quach T.Trang traffic ring	Sai Gon River.	0.8x1.2	780					Average			
	Six-crossroads	Ben Ham Tu St.	0.8x1.2	818					Average			
	Ton That Thiep St.	Ben Chuong Duong St.	0.8x1.2	112	Tau Hu canal					There is not Culvert Box		
	Ton That Thiep St.	Huynh Thuc Khang St.	0.8x1.6	69			-0.445	-0.859	Average			Good
	Ham Nghi St.	Ham Nghi St.		250			-0.859	-0.499	Average			Good
	Nguyen Cong Tru St.	Ben Chuong Duong St.		81			-0.499	-0.568	Average			Good
	Ben Chuong Duong St.	Ben Nghe canal.	f 1000	125			-0.568	-0.599	Average			Good
	Ton That Thiep St.	Ben Nghe canal.		600			-0.032	-0.074	Average			
	Ton That Thiep St.	Huynh Thuc Khang St.	0.8x1.35	42			-0.074	-0.323	Average			
	Huynh Thuc Khang St.	Ngo Duc Ke St.	0.8x1.35	181			-0.323	-0.394	Average			
	Ngo Duc Ke St.	Ham Nghi St.		101			-0.394	-0.435	Average			
	Ham Nghi St.	Ton Duc Thang St.		58			-0.435	-0.075	Average			
	Ham Nghi St.	Ben Nghe canal.		160								
	Ton Duc Thang St.	Ben Nghe canal.		58								
	Nguyen Du St.	Ben Nghe canal.		1070								
	Nguyen Du St.	Ham Nghi St.	1.0x2.2	564	Ben Nghe canal				Good			
	Ham Nghi St.	Ben Nghe canal.		506	Ben Nghe canal							

Table G.3.3 (6/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
42. Calmette	Pham Hong Thai St.	Ben Nghe canal.	f 2000	636					Good		10	
	Le Thanh Ton St	Ben Nghe canal.		981	Ben Nghe canal				Good		2	
	Le Thanh Ton St	Cao Ba Quat St.	0.8x1.4	175					Average	90x90x10	1	
43. Thi Sach									Average	100x100x10	1	
									Average	100x100x10	4	Good
									Average	90x90x6	2	Good
									Good	90x90x8	1	
44. Nguyen Hue	Le Thanh Ton St.	Sai Gon River		801	Sai Gon River						12	
				914							2	
45. Ky Con	Le Thanh Ton St.	Le Loi (North)	0.8x1.4	131					Average	90x90x6	2	
	Le Loi (North)	Le Loi (South)	0.8x1.4	10					Average	90x90x6	2	
									Average	90x90x6	1	
46. Yersin	Ton That Thiep St.	Sai Gon River.	0.8x1.8	433					Average	f 1400	2	
	Le Thanh Ton St.	Ngo Duc Ke St.	0.8x1.2	246					Average	90x90x6	1	Good
	Le Thanh Ton St.	Sai Gon River.	0.8x1.5	265					Average	90x90x6	4	Good
	Tran Hung Dao St.	Ben Nghe canal.	1.0x1.4	991	Ben Nghe canal				Average	90x90x10	4	
									Average	90x110x8	1	
47. Nguyen Canh Chan	Pham Ngu Lao St.	Le Lai St.	1.0x1.4		Ben Nghe canal				Average	100x90x8	1	Good
										90x90x10	5	
48. Pasteur	Nguyen Trai St.	Ben Nghe canal.		679	Ben Nghe canal.					Form 7	1	Good
	Nguyen Trai St.	Tran Hung Dao St.	f 800	335.5					Average	90x90x6	9	Good
	Tran Hung Dao St.	Ben Nghe canal.	f 800	343.5					Average	90x90x6	1	Good
										90x110x6	4	Good
										90x90x10	1	Good
49. Ton Duc Thang St		Ben Nghe canal.		1597							15	
		Ly Tu Trong St.	K4	605			6.211	2.430	Average	90x90x6	4	
		Ben Nghe canal.	K4	992			2.430	-0.869	Average	f 740	2	
Dinh Tien Hoang	Ly Tu Trong St.										8	Good
	43 Dinh Tien Hoang St.	Sai Gon River.		1090	Sai Gon River.				Average	f 740	1	
									Average		16	
	43 Dinh Tien Hoang St.	Le Duan St.	f 800	165					Average	90x90x6	4	Good
50. Ton Dan	Le Duan St.		f 800	165					Average	90x90x6	4	Good
	Le Duan St.	Sai Gon River.	0.8x1.2	760					Average	90x90x6	5	
										110x110x6	1	Good
51. Nguyen Thanh Hien	Cau Chong canal.	Te canal.	f 800	840	Te canal.		-0.052	-1.018	Average	90x90x6	2	Good
	Nguyen Tai Thanh St.	Te canal.	f 800	480	Te canal.		0.225	-0.006	Average	90x90x10	6	Good
52. Doan Van Bo	Ton Dan St.	Ben Nghe canal.		1084							22	Good
	Ton Dan St.	Hoang Dieu St.	f 800	487							44	
53. Xom Chieu	Hoang Dieu St.	Ben Van Don St.	f 600	281							3	
	Doan Van Bo St.	Te canal.	f 800	316							10	
			f 1000	700			-0.025	-0.725	1.00	Good	90x90x10	10

Table G.3.3 (7/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
54. Roof in Command	3/2 St.	Bung Binh canal.		945	Bung Binh canal.				Good		15	
	3/2 St.	Road behind Ky Hoa lake	1.5x1.5	312					Good	90x90x10	5	Should be dredged
	Road behind Ky Hoa lake	Bung Binh canal.	1.6x1.6	505					Good	90x90x10	12	
55. Nguyen Van Cu			1.6x1.9	120								
			1.6x1.9	8								
	Tran Phu St.	Ben Chuong Duong St.		1237	Ben Nghe canal.				Average	90x90x10	1	Good
									Average	90x110x8	13	Good
	Tran Phu St.	An Duong Vuong St.	f 600	479					Average	90x90x8	8	Good
	An Duong Vuong St.	Nguyen Trai St.	f 800	193					Average	90x110x8	6	Good
	Nguyen Trai St.	Tran Hung Dao St.	f 600	297					Average	90x90x6	3	Good
									Average	70x110x6	3	Good
	Tran Hung Dao St.	Ben Chuong Duong St.	f 600	328					Average	90x90x6	1	Good
										90x110x6	2	Good
56. Cong Ouyh										75x75x6	1	Good
	Tran Phu St.	Ben Chuong Duong St.	f 600	1374					Average	75x75x6	52	Good
	Tran Phu St.	House 221		322					Average	90x90x6	7	Good
										90x90x6	3	Good
	House 221	An Duong Vuong St.	f 500	144					Average	90x90x6	5	Good
	An Duong Vuong St.	Nguyen Trai St.	f 500	193					Average	90x90x6	5	Good
	Nguyen Trai St.	Tran Hung Dao St.	f 800	397					Average	90x110x6	10	Good
										90x90x6	12	Good
	Tran Hung Dao St.	Ben Chuong Duong St.	f 800	118					Average	90x110x6	9	Good
										90x90x6	1	Good
57. Nguyen Bieu St.												
59. De Tham.												

Table G.3.3 (8/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
60. Tran Dinh Xu.	Nguyen Trai St.	Ben Nghe canal.	f 800	752	Ben Nghe canal.				Average	90x110x6	37	Good
	Nguyen Trai St.	Opposite house 104.	f 800	92					Average	90x90x6	10	Good
	Opposite house 104.	Tran Hung Dao St.	f 1000	248					Average	90x110x10	1	Good
61. Hai Ba Trung	Tran Hung Dao St.	Ben Nghe canal.	f 1000	412					Good	90x90x10	14	Good
	Nguyen Thi Minh Khai St.	Le Thanh Ton St.		1152						90x110x6	1	Good
	Le Thanh Ton St.	Dong Du St.	0.8x1.6	982					Average	90x90x6	4	Good
	Dong Du St.	Me Linh Site.	0.8x1.4	170					Average	90x90x6	3	Good
	Quoc Te Site.	Sai Gon River.		1529.6							16	
62. Dong Khoi	Quoc Te Site.	Nguyen Du	0.8x1.2	586.6					Average	90x90x6	6	Good
										90x90x10	1	Good
63. Nguyen Tat Thanh	Nguyen Du St.	Mac Thi Bui St.	0.8x1.4	652						90x90x6	6	Good
	Mac Thi Bui St.	Ngoc Duc Ke St.	0.8x1.6	189					Average	90x90x6	1	Good
	Ngoc Duc Ke St.	Sai Gon River.	f 1000	102					Good	90x110x6	1	Good
	Ton Dan St.	Ben Nghe canal.		779							17	
	Ton Dan St.	Le Van Linh St.	f 600	256					Average	70x110x6	2	Fail
64. Le Quoc Hung	Le Van Linh St.	Hoang Dieu St.	f 800	122					Average	90x110x6	2	Good
	Hoang Dieu St.	HCM Museum.	0.8x1.4	286					Average	90x90x6	3	Good
	HCM Museum.	Ben Nghe canal.		115							45	
	Le Van Linh St.	Ben Nghe canal.	0.8x1.6	795					Average	90x90x6	8	Good
	Le Van Linh St.	Hoang Dieu St.	f 600	359					Average	90x110x6	7	Good
65. Da Tuong	Hoang Dieu St.	Ben Nghe canal.	f 1200	326					Average	90x90x10	8	Good
										90x90x6	9	
										90x110x6	1	
										100x100x10	1	
										75x75x6	1	
66. Chanh Hung			f 500	36.5						90x110x6	8	
										90x90x6	1	
										75x75x6	1	
67. Nguyen Che Nghia	Ben Ba Dinh St.	Doi canal.	f 800	351	Doi canal.	-0.217	-0.506	0.90	Average	90x90x6	26	Good
	Ben Ba Dinh St.	Doi canal.	f 600	390.5	Doi canal.	0.441	-0.061	1.30	Average	90x90x6	20	Good
			f 600	170.5		-0.015	-0.321	1.30	Average	90x90x6	8	Good
68. Ben Xom Cui	Duy Ly Vuong St.	Doi canal.	f 800	195.5					Average	90x90x6	8	Good
	Duy Ly Vuong St.	Tau Hu canal.	f 600	202.5					Average	90x90x6	6	Good
	Tung Thien Vuong St.	Cha Va bridge	f 400	30					Average	90x90x6	7	Good
			f 600	197	Tau Hu canal.	-0.014	-0.167	0.7		90x90x6	6	Good

Table G.3.3 (9/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
69. Nguyen Quyen	Ben Binh Dong St.	Tung Thien Vuong St.	f 600	931.7	Chu Y bridge.	-0.560	-0.660	0.6	Average			
		Height-mark 1224	f 400	94.1					Average			
			f 400	24.1						Average		
			f 400	81.4						Average		
70. Vinh Nam	Tung Thien Vuong St.	U Cay canal.	f 600	65.2					Average			
			f 600	10.5					Average			
			f 600	13.5						Average		
			f 600	42	U Cay canal.	0.151	0.109	1.00	Average			
71. Xom Cui	Chanh Hung St.	Ben Binh Dong St.	f 600	135.5		-0.474	-0.659	1.18	Average			
			f 800	262	U Cay canal.	-0.349	0.361	1.90	Average			
72. Hung Phu	Chanh Hung St.	Nguyen Duy St.	f 600	461	U Cay canal.	0.390	-0.357	1.90	Average			
			f 600	980								
73. Can Giuoc	Binh Hoa St.		f 600	250	U Cay canal.	0.280	-0.515	1.50	Average			
			f 600	186								
74. Phong Phu	Tung Thien Vuong St.	Nguyen Duy St.	f 600	390	U Cay canal.	0.010	-0.595	1.30	Average			
			f 400	60					Average			
			f 800	340	U Cay canal.	-0.515	-0.785	0.70	Average			
			f 400	80						Average		
75. Binh Hoa	Tung Thien Vuong St.	Ben Binh Dong St.	f 800	190		-0.515	-0.785	0.70	Average			
			f 600	220					Average			
			f 1200	570	Hai Thuong Lan Ong St.	-0.115	-0.343	0.40	Average			
										Average		
76. Tung Thien Vuong	Nguyen Quyen St.		f 600	979	Tau Hu canal.	-0.345	-0.455	0.40	Average			
			f 400	225	Tau Hu canal.				Average			
			f 1000	160	Tau Hu canal.	-0.204	-0.394	0.50	Average			
			f 500	380	Tau Hu canal.				Average			
77. Chau Van Liem	Thuan Kieu St.		f 800	210	Tau Hu canal.				Average			
			f 800	130	Tau Hu canal.				Average			
			f 800	720	Tau Hu canal.	0.331	-0.749	1.50	Average			
			0.8x1.0	210	Tau Hu canal.				Average			
78. Nguyen Thi	Hai Thuong Lan Ong St.	Tran Van Kieu St.	0.8x1.4	962	Tau Hu canal.				Average			
			f 600	672	Tau Hu canal.	0.516	-0.516	1.0	Average			
			f 400	290	Tau Hu canal.				Average			
			f 1000	2348								
79. Mac Cui	Trinh Hoai Duc St.	Mac Cui St.	f 800	200	Lo Gom canal	0.020	-0.680	1.40	Average			
			f 400	320	Lo Gom canal	0.030	-0.778	1.40	Average			
			f 1000	450	Lo Gom canal	0.330	-0.210	1.20	Average			
			f 800	630	Lo Gom canal	0.650	-0.786	2.28	Average			
80. Van Tuong	Mac Cui St.	Van Tuong St.	f 800	748	Lo Gom canal	-0.538	-0.736	1.00	Average			
			f 800	320	Lo Gom canal	-0.468	-0.876	0.30	Average			
			f 600	1097								
			f 800	152								
81. Trinh Hoai Duc	Mac Cui St.	Van Tuong St.	f 800	335		-0.039	-0.098	0.90	Average			
			f 1000	610	Lo Gom canal	-0.400	-0.949	0.90	Average			
82. Go Cong	Bai Say St.	Tran Van Kieu St.	f 800	190								
			f 800	190								
			f 800	220								
			f 1200	570								
83. Binh Tien	Gia Phu St.	Tran Van Kieu St.	f 800	190								
			f 800	190								
			f 800	220								
			f 1200	570								
84. Tan Da	Bai Say St.	Tran Van Kieu St.	f 800	190								
			f 800	190								
			f 800	220								
			f 1200	570								
85. Van Kiep	Tran Hung Dao St.	Hai Thuong Lan Ong St.	0.8x1.0	190								
			0.8x1.4	190								
			f 500	672	Tau Hu canal	0.516	-0.516	1.0	Average			
			f 800	290	Tau Hu canal				Average			
86. Trang Tu - Hai Thuong Lan Ong	Trieu Quang Phuoc St.	Ham Tu St.	f 500	672	Tau Hu canal	0.516	-0.516	1.0	Average			
			f 800	290	Tau Hu canal				Average			
			f 800	2348								
			f 800	200	Lo Gom canal	0.020	-0.680	1.40	Average			
87. Hau Giang	Nguyen Van Luong St.	Hau Giang bridge.	f 800	320	Lo Gom canal	0.030	-0.778	1.40	Average			
			f 800	450	Lo Gom canal	0.330	-0.210	1.20	Average			
			f 800	630	Lo Gom canal	0.650	-0.786	2.28	Average			
			f 800	748	Lo Gom canal	-0.538	-0.736	1.00	Average			
88. Hung Vuong	Thai Phien St.	Ong Buong canal.	f 600	320	Lo Gom canal	-0.468	-0.876	0.30	Average			
			f 600	1097								
			f 600	152								
			f 800	335								
89. An Duong Vuong	House 61	Ong Buong canal.	f 600	152		-0.039	-0.098	0.90	Average			
			f 800	335		-0.098	-0.400	0.90	Average			
			f 1000	610	Lo Gom canal	-0.400	-0.949	0.90	Average			

Table G.3.3(10/10) List of Grade 2 Sewer in Ho Chi Minh City

Location	From	To	Type	Length	Destination	Elevation		Average Elevation	Present Situation	Culvert Box		Present Situation
						Inlet	Outlet			Type	Quantity	
90. Ong Ich Khiem Hoa Binh St.	Binh Thoi St.	Tan Hoa canal.	f 800	1117					Average	90x90x6	30	Good
	Binh Thoi St.	Lac Long Quan St.	f 1200	436		0.268	0.004	0.60	Average	90x90x6	15	Good
	Lac Long Quan St.	Tan Hoa canal.	f 1500	681	Tan Hoa canal.	0.004	-0.200	0.30	Good			Good
91. Trieu Quang Phus	Ba Trieu St.	Tran Van Kieu St.	f 8x1.0	840	Tau Hu canal				Average			Good
92. Luong Nhu Hoc	Nguyen Trai St.	Tran Van Kieu St.	f 8x1.0	390	Tau Hu canal				Average			Good
93. Phung Hung	Trinh Hoai Duc St.	Tran Van Kieu St.	f 8x1.0	160	Tau Hu canal				Average			Good
94. Chu Van An	Le Quang Sung St.	Tran Van Kieu St.	f 6x0.8	240	Tau Hu canal				Average			Good
95. Mai Xuan Thuong	Le Quang Sung St.	Phan Van Khoa St.	f 8x1.2	390	Tau Hu canal				Average		5	Good
96. Van Than	House 146	Lo Gom wharf	f 600	210	Lo Gom canal				Average	90x90x6	43	Good
97. Tan Hoa	Lac Long Quan St.	Tan Hoa canal.	f 800	1214					Average	90x90x6	6	Good
	Hoa Binh St.	Tan Hoa canal.	f 800	1054	Tan Hoa canal.	1.599	-0.509	2.00	Average	90x90x6	37	Good
98. An Binh	Tran Phu St.	Tau Hu canal.	f 800	486	Tau Hu canal				Average	90x90x6	24	Good
99. Bach Van	An Binh St.	Tau Hu canal.	f 8x1.4	270	Tau Hu canal				Average	There is not Culvert Box		Good
100. Phu Lam	Hung Vuong St.	Lo Gom canal.	f 800	466					Average			Good
			f 1200	254					Good	90x90x6	53	Good
101. Dien Bien Phu	Hang Xanh four-crossroads	Dien Bien Phu bridge	f 600	1440	Shieu Loc canal.				Average			Good
		Transformer station	f 800	430					Average			Good
		Dien Bien Phu bridge	f 1000	540					Good			Good
102. Don Dat	Ly Tu Trong St.	Bach Dang Wharf	f 8x1.4	470	Sai Gon River				Average	90x110x6	36	Good
	Ly Tu Trong St.	Dong Du St.	f 1000	596					Average			Good
	Dong Du St.	Sai Gon River.	f 500	434					Average			Good
103. Nguyen T.M.Kha	Hai Ba Trung St.	Thi Nghe canal.	f 600	122	Thi Nghe canal				Average	90x90x6	50	Good
	Hai Ba Trung St.	Mac Dinh Chi St.	f 600	1140					Average			Good
	Mac Dinh Chi St.	Nguyen Binh Khiem St.	f 600	250					Average			Good
	Nguyen Binh Khiem St.	Thi Nghe canal.	f 600	610					Average			Good
104. Hoang Dieu	Doan Van Bo St.	Cau Chong canal.	f 800	280	Sai Gon River				Average	90x110x6	28	Good
	Doan Van Bo St.	Sai Gon River.	f 600	135					Average	90x90x6	6	Good
105. Huynh Man Dat	Tran Phu St.	Ham Tu St.	f 800	735					Average			Good
			f 1000	135					Good			Good
			f 600	600					Average	90x90x6	22	Good
			f 800	1632	Tau Hu canal.				Average	90x90x6	79	Good
			f 600	810					Good			Good
			f 600	12					Average			Good
106. Nguyen Van Dung	Tran Hung Dao St.	Ham Tu St.	80x140	810					Average			Good
107. Bui Hui Nghia	Tran Hung Dao St.	Ham Tu St.	80x145	220	Tau Hu canal.				Average			Good
108. Phan Phu Tien	Tran Hung Dao St.	Ham Tu St.	80x140	220	Tau Hu canal.				Average			Good
109. Phan Huy Chu	House 12	Ham Tu St.	60x110	203	Tau Hu canal.				Average			Good
110. Binh Tay	Bai Say wharf	Tran Van Kieu St.	f 800	84	Tau Hu canal.				Average	90x90x10	13	Good
111. Pham Phu Thu	Binh Tien St.	Tran Van Kieu St.	f 1000	310	Tau Hu canal.				Good	90x90x6	30	Good
112. Pham Van Chi	Binh Tien St.	Lo Gom wharf.	f 800	756	Tau Hu canal.				Average	90x90x6	74	Good
113. Ba Dinh	Chanh Hung St.	Phat Trien bridge.	f 600	1300	Lo Gom canal.				Average	75x75x6	24	Good
114. Doc Lap	Road 14.	Tan Hung canal.	f 1000	650	U cay canal.				Good			Good
115. Huong Lo 14	Tan Phu Three-crossroads	Cau Tre	f 1000	750	Tan Hoa canal.				Good			Good
			f 1000	2225	Tan Hoa canal				Good			Good

Table G.3.4 O.M System of The Drainage Network controlled by Districts

Drainage Network							O.M System				Remark
Facilities	Drain/ Sewer Grade	Function	Dimensions & Construction	Distance (m)	Culvert Box/ Manhole	Present Situation	Operation Conditions	Maintenance Frequency	Method of Maintenance	Control System and Budget	
Sewer of Grade 4	4	To bring the drainage and domestic sewage from the inside of District to sewer of Grade 4	Mostly RC Type	Each District has a different distance (50000~150000m) But rural Districts have no sewer network		Some old Some new Construction	Fair except for some low areas	Normal: 1-8 times per year (By reporting) Urgent: Depending on clogging situation	Manually Group of 10 workers for about 100m per day (Generally sublet to contractors)	No surveillance from PCHCMC but District control only. Budget provided from PCHCM based on cost estimate and negotiations	consistent system of annual budget from PC HCMC to subjected Districts for O.M works
Open drains/ channels	4	To connect to sewer of Grade 4 or for open evaporation/ infiltration	Natural or artificial drains	Unspecified and no check	No	No Maintenance	Medium but unhygienic conditions	Unspecified Almost maintenance	Almost unavailable	No control and no budget	No care for O.M

Table G.3.5 (1/15) List of Outlets controlled by UDC

District 1

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Nguyen Van Cu	Ø 800	01-01	Nguyen Van Cu	Outlet, flap gate in good condition, behind outlet there is a small canal, the flow is not in good condition.
2	Nguyen Canh Chan	Ø 800	02-01	Nguyen Canh Chan	Outlet in good condition, the upper part is encroached by housing construction, flow is obstructed.
3	Tran Dinh Xu	Ø 1500	03-01	Tran Dinh Xu	Outlet has just constructed, flow in good condition.
4	Ho Hao Hon	Box 2m x 2m x 2	04-01	Ho Hao Hon	Outlet and flow in good condition, the upper part of outlet is encroached by housing construction.
5	De Tham I	Ø 1000	05-01	De Tham I	Outlet has just constructed, flow in good condition
6	De Tham II	Ø 800	06-01	De Tham II	Flap gate under the Ong Lanh bridge, outlet is broken, the flow is obstructed
7	Nguyen Thai Hoc	Ø 1000	07-01	Nguyen Thai Hoc	Outlet is encroached by housing construction, outlet is damaged, flow is not good condition
8	Yersin	Ø 1200	08-01	Yersin	Outlet is encroached by housing construction, the flow is obstructed
9	Ky Con	Ø 1500	09-01	Ky Con	Outlet is encroached by housing construction, the flow is obstructed
10	Camette	Ø 2000	10-01	Camette	Outlet under the Camette bridge is damaged, the flow is obstructed
11	Pho Duc Chinh	Ø 2000	11-01	Pho Duc Chinh	Outlet, flap gate in good condition, the flow is in good condition
12	Nam Ky Khoi Nghia	Roof 0.8m x 1.8m	12-01	Nam Ky Khoi Nghia	Outlet, flap gate in good condition, the flow is in good condition
13	Pasteur	Roof 0.8m x 1.8m	13-01	Pasteur	Outlet in good condition
14	Ton That Dam	Ø 1000	14-01	Ton That Dam	Outlet in good condition
15	Ho Tung Mau	Roof 0.8m x 1.3m	15-01	Ho Tung Mau	Outlet in good condition
16	Ham Nghi I	Roof 0.8m x 1.4m	16-01	Ham Nghi I	Outlet in good condition
17	Ham Nghi II	Roof 0.8m x 1.6m	17-01	Ham Nghi II	Outlet in good condition
18	Nguyen Hue I	Roof 0.8m x 1.2m	18-01	Nguyen Hue I	Outlet, flap gate in good condition, the upper part has a wharf, the flow is in good condition
19	Nguyen Hue II	Ø 1000	19-01	Nguyen Hue II	Outlet in good condition
20	Dong Khoi	Ø 1000	20-01	Dong Khoi	Outlet, flap gate in good condition, the flow is in good condition
21	Hai Ba Trung	Roof 0.8m x 1.6m	21-01	Song Sai gon	Outlet, flap gate in good condition, the upper part has kiosques, the flow is in good condition
22	Me Linh circle	Ø 1200	22-01	Song Sai gon	Outlet in good condition
23	Don Dat	Ø 1000	23-01	Don Dat	Outlet, flap gate in good condition, the upper part has fence of harbour, the flow is in good condition
24	Ton Duc Thang	Ø 1000	24-01	Ton Duc Thang	Outlet, flap gate in good condition
25	Ton Duc Thang II	Ø 1000	25-01	Ton Duc Thang II	Flag gate and flow in good condition
26	Nguyen Thi Minh Khai	Ø 600	26-01	Thi Nghe	Outlet is damaged, the upper part is encroached by housing construction, flow is not good condition
27	Nguyen Dinh Chieu	Ø 800	27-01	Thi Nghe	Outlet, flap gate and flow is in good condition
28	Nguyen Van Thu	Ø 600	28-01	Nguyen Van Thu	Outlet, flap gate and flow is in good condition
29	Dien Bien Phu I	Ø 1000	29-01	Thi Nghe	Sewer is good condition
30	Dien Bien Phu II	Ø 600	30-01	Thi Nghe	Outlet and flow in good condition.
31	Bui Huu Nghia	Ø 600	31-01	Bui Huu Nghia	Outlet is closed by housing construction, flow is not in good condition
32	Dinh Tien Hoang	Roof 0.8m x 1.4m	32-01	Nhieu Loc	Outlet, flap gate and flow is in good condition
33	Tran Khac Chan	Ø 1000	33-01	Thi Nghe	Outlet is closed by housing construction, flow is not in good condition
34	Tran Nhat Duat	Ø 1000	34-01	Tran Nhat Duat	Outlet, flap gate and flow is in good condition
35	Hai Ba Trung	Roof 0.8m x 1.8m	35-01	Nhieu Loc	Outlet, flap gate and flow is in good condition
Total					35 outlets, of which 8 damaged/maifunctioning outlets

Table G.3.5 (2/15) List of Outlets controlled by UDC District 3

No	Outlet Name	Dimension	Mark	Notes
1	Cách Màng Thang 8-I	Roof 2.5m x 2m	01-03	Bung binh
2	Cách Màng Thang 8-II	Box 2m x 2m	02-03	Bao Ngan
3	Cách Màng Thang 8-III	Ø 1000	03-03	Bung binh
4	Ba Thang 2	Box 1.9m x 1.6m	04-03	
5	Bao Ngan	Box 2.5m x 2.5m	05-02	
6	Ba Xep pipe	Concrete 4m x 2m	06-03	
7	Tran Van Dang	Ø 600	07-03	C. Ba Xep
8	Tran Quang Dieu I	Ø 600	08-03	
9	Tran Quang Dieu II	Ø 800	09-03	Nhiều Loc
10	Le Van Sy I	Ø 800	10-03	Nhiều Loc
11	Le Van Sy II	Ø 800	11-03	Nhiều Loc
12	Tran Quoc Thao	Ø 300	12-03	Nhiều Loc
13	Truong Dinh	Ø 300	13-03	Bung binh
14	Ba Huyen Thanh Quan	Ø 600	14-03	Bung binh
15	Nguyen Thong	Ø 1500	15-03	
16	Nam Ky Khoi Nghia	Roof 0.8m x 2.1m	16-03	Nhiều Loc
17	Huynh Tinh Cua	Ø 800	17-03	Thi Nghe
Total				

17 outlets, of which 9 damaged/malfunctioning outlets

Table G.3.5 (3/15) List of Outlets controlled by UDC District 4

No	Outlet Name	Dimension	Mark	Location	Overseer Conditions
1	Nguyen Tat Thanh I	Ø 800	01-04	Ben Nghe	Outlet and flag gate in good condition.
2	Nguyen Tat Thanh II	Ø 800	02-04		
3	Ben Van Don	Roof 0.9m x 0.6m	03-04	S.Sai Con	Outlet in good condition.
4	Nguyen Truong To	Ø 600	04-04	Ben Nghe	Outlet is damaged, it is encroached by housing construction, the flow is not in good condition.
5	Le Quoc Hung	Ø 1000	05-04	Ben Nghe	Flag gate is damaged, outlet is encroached by housing construction, the flow is in good condition.
6	Doan Van Bo	Ø 800	06-04	Ben Nghe	Outlet in good condition, under the Carmette bridge, the flow is in good condition.
7	Fertilizer company	Ø 1000	07-04	Ben Nghe	Outlet in good condition, the upper part has housing construction, the flow is in good condition.
8	Khanh Hoi I	Ø 800	08-04		
9	Khanh Hoi II	Ø 800	09-04		
10	Nguyen Khoai	Ø 800	10-04	Ben Nghe	Outlet is good, the upper part has storage location of cajuput, the flow is in good condition.
11	Nguyen Khoni	Ø 800	11-04	Kenh Te	Outlet and flow is in good condition, the upper part has housing constructions.
12	Ton Dan	Ø 300	12-04	Kenh Te	Outlet and flag gate is damaged, flow is not in good condition.
13	Xom Chieu	Ø 1000	13-04	Kenh Te	Outlet and flag gate is in good condition, behind outlet is closed by earth, flow is not good condition.
14	Nguyen Thanh Hien	Ø 800	14-04	Kenh Te	Sewer is damaged, flow is in good condition.
15	Nguyen Tat Thanh III	Ø 1500	15-04		
16	Ton Thai Thuyet	Ø 800	16-04		
17	Nguyen Tat Thanh IV	Ø 600	17-04		
18	448/911 Nguyen Tat Thanh	Ø 800	18-04	S.Sai Con	Outlet is not investigated.
19	448B Nguyen Tat Thanh	Ø 800	19-04	S.Sai Con	Outlet is not investigated.
20	286 Nguyen Tat Thanh	Ø 500	20-04	S.Sai Con	Outlet is not investigated.
21	324 Nguyen Tat Thanh	Roof 0.8m x 0.8m	21-04	S.Sai Con	Outlet is not investigated.
22	Ngo Van So	Ø 800	22-04	S.Sai Con	Outlet is in good condition.
23	Khanh Hoi III	Ø 600	23-04		
24	Khanh Hoi IV	Ø 600	24-04		
25	Khanh Hoi V	Ø 600	25-04		
26	Khanh Hoi VI	Ø 600	26-04		
27	Khanh Hoi VII	Ø 600	27-04		
28	Khanh Hoi VIII	Ø 600	28-04		
29	Khanh Hoi IX	Ø 600	29-04		
Total					29 outlets, of which 5 damaged/malfunctioning outlets

Table G.3.5 (4/15) List of Outlets controlled by UDC District 5

No	Outlet Name	Dimension	Location	Operation Conditions
1	Nguyen Bieu	Ø 1000	Tau Hu	Roof outlet, flag gate is good condition, the upper part has housing construction
2	Tran Binh Trong	Roof 2.5m x 2.5m		
3	Huyth Man Dat	Ø 1000		
4	Huyth Man Dat II	Ø 1000		
5	132A Ham Tu	Ø 600		
6	400E Ham Tu	Ø 600		
7	706 Ham Tu	Ø 600		
8	Bach Van	Roof 0.8m x 1.4m		
9	Bui Huu Nghia	Roof 0.8m x 1.4m		
10	An Binh	Ø 1300	Tau Hu	Outlet in good condition, the upper part is encroached by housing construction
11	Nguyen Tri Phuong	Roof 2m x 2.2m	Tau Hu	Roof outlet is good condition, flow is in good condition
12	Phan Phu Tien	Roof 0.8m x 1.4m		
13	Tan Da I	Roof 0.8m x 1m		
14	Tan Da II	Ø 600	Tau Hu	Outlet and flow is in good condition, the upper part is encroached by housing construction.
15	Phan Huy Chu	Roof 0.6m x 1.4m		
16	Hai Thuong Lan Ong	Ø 600		
17	Hai Thuong Lan Ong	Roof 2m x 2.5m	Tau Hu	Roof outlet and flow in good condition, the upper part is encroached by housing construction
18	Trieu Quang Phuc	Roof 0.6m x 1m	Tau Hu	Roof outlet is encroached by housing construction
19	Luong Nhu Hoc	Roof 0.6m x 1.4m	Tau Hu	Roof outlet is encroached by housing construction
20	Trinh Hoa Duc	Ø 1000		
21	Van Kiep	Roof 0.8m x 1.4m		
22	Mac Cui	Roof 0.8m x 1.6m		
23	Nguyen Thi	Roof 0.8m x 1.4m		
24	Phung Hung	Roof 0.8m x 1m		
25	Van Tuong	Ø 1000	Hang Bang	Outlet and flow in good condition, the upper part of outlet is encroached by housing construction
26	Go Cong	Ø 800		
	Total			26 outlets of which 6 damaged/nonfunctioning outlets

Table G.3.5 (5/15) List of Outlets controlled by UDC

District 6

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Go Cong	Roof 0.7m x 1.4m Ø 600	01-06	Hang Bang	Outlet and flag gate in good condition. flow behind outlet is good condition.
2	Ngo Nhan Tinh	Ø 600	02-06		
3	Chu Van An	Ø 400	03-06	Ben Nghe	Outlet in good condition, the upper part is encroached by housing construction, flow is not in good condition.
4	Chu Van An	Ø 600	04-06		
5	Huyh Thoi Yen	Roof 2m x 2.5m Ø 600	05-06	Hang Bang	Flag gate is encroached.
6	Nguyen An Khuong	Ø 600	06-06		
7	Binh Tay	Ø 800	07-06	Ben Nghe	Outlet and flow in good condition, the upper part of outlet is encroached by housing constructions.
8	Cao Van Lau II	Roof 0.8m x 1.2m Ø 800	08-06		
9	Cao Van Lau I	Ø 800	09-06		
10	Mai Xuan Thuong I	Ø 1500	10-06		
11	Mai Xuan Thuong III	Ø 800	11-06	Ben Nghe	Outlet and flag gate is in good condition, flow is in good condition
12	Pham Phu Thu	Roof 0.7m x 1.5m Ø 800	12-06	Ben Nghe	Outlet, flag gate and flow is in good condition, the upper part of outlet is encroached by housing construction
13	Binh Tien	Ø 800	13-06	Hang Bang	Flag gate is encroached.
14	430A Tran Van Kieu	Ø 1000	14-06		
15	Pham Van Chi	Ø 800	15-06		
16	Van Than I	Ø 600	16-06	Lo Gom	Outlet and flow is in good condition.
17	Van Than II	Ø 600	17-06		
18	Bai Say	Ø 600	18-06	Lo Gom	Outlet and flow is in good condition.
19	Nguyen Van Luong I	Ø 600	19-06		
20	Nguyen Van Luong II	Ø 600	20-06		
21	Pham Van Khoe	Ø 500	21-06	Lo Gom	Outlet and flow is in good condition.
22	Hau Giang I	Ø 800	22-06	Ong Buong	Outlet and flow is in good condition.
23	Hau Giang II	Ø 500	23-06	Ong Buong	Outlet and flow is in good condition.
24	Hau Giang III	Ø 600	24-06	Ong Buong	Outlet and flow is in good condition.
25	Lo Quang Sung	Ø 800	25-06	Lo Gom	Outlet and flow is in good condition, the upper part has housing constructions.
26	Ben Phu Lam	Ø 1200	26-06	Lo Gom	Outlet is light damage.
27	Hau Giang IV	Ø 600	27-06		
28	Hau Giang V	Ø 1000	28-06		
29	An Duong Vuong	Ø 800	29-06	Ruot Ngua	Outlet and flag gate is in good condition, flow is not in good condition.
30	Hung Vuong I	Ø 800	30-06	Ong Buong	Sewer is in good condition, flag gate is damaged, outlet is encroached by housing construction, flow is not in good condition.
31	Hung Vuong II	Ø 1500	31-06	Ong Buong	Outlet, flag gate and flow is in good condition.
32	Phu Lam circle	Ø 1000	32-06		
33	Nguyen Van Luong III	1 N Ø 1000 2 N Ø 1000	33-06		
Total					33 outlets, of which 8 damaged/malfunctioning outlets

Table G.3.5 (6/15) List of Outlets controlled by UDC

District 7

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Tran Xuan Soan	Ø 1500	01-07		
2	Road No.22	Ø 600	02-07		
3	Communal road No.34	Ø 600	03-07		
4	Road No.1 - II	Ø 600	04-07		
5	Road No.1 - III	Ø 600	05-07		
6	Road No.1 - I	Ø 800	06-07		
7	Interprovincial road No.15 - 7/108	Ø 800	07-07		
8	Tau Cuoc	Ø 600	08-07		
	Total				8 outlets, of which 0 damaged/mafunctioning outlets

Table G.3.5 (7/15) List of Outlets controlled by UDC

District 8

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Pham The Hien	Ø 600	01-08		
2	Duong Ba Trac	Ø 800	02-08		
3	Au Duong Lan	Ø 1000	03-08		
4	Chanh Hung I	Ø 800	04-08	Kenh Doi	Outlet is closed by garbage, outlet has not flag gate, flow is jammed.
5	Bong Sao	Ø 600	05-08		
6	Pham The Hien	Ø 800	06-07		
7	Chanh Hung II	Ø 800	07-08	Kenh Doi	Outlet flow and flag gate is in good condition.
8	Da Tuong	Ø 1000	08-08	Kenh Doi	Outlet is in good condition, there is not flag gate, flow is not good condition
9	Ba Dinh	Ø 600	09-08	Kenh Doi	Outlet is in good condition.
10	U Cay		10-08	R. U Cay	
11	Can Giuoc	Ø 800	11-08		
12	Can Giuoc	Ø 600	12-08		
13	Dinh Hoa III	Ø 800	13-08		
14	Vinh Nam I	Ø 600	14-08		
15	Nguyen Quyen	Ø 600	15-08		
16	Nguyen Quyen				
16	(Tung Thien Vuong)	Ø 600	16-08		Outlet is closed by housing construction, outlet has not flag gate, flow is not in good condition
17	Tung Thien Vuong	Ø 600	17-08		
18	Vinh Nam II	Ø 600	17-08		
19	Ben Can Giuoc	Ø 800	19-08		
20	Tuy Ly Vuong	Ø 800	20-08		
21	Dinh Hoa I	Ø 800	21-08		
22	Dinh Hoa II	Ø 1600	22-08		
23	Phong Phu	Ø 800	23-08		
24	Dinh Hoa	Ø 800	24-08		
25	Tran Nguyen Han I	Ø 800	25-08		
26	Tran Nguyen Han II	Ø 800	26-08		
27	Ben Xom Cui	Ø 600	27-08	Ben Nghe	Outlet and flag gate is in good condition, the upper part of outlet there is a garbage-bin
28	Mac Van		28-08		
29	Nguyen Che Nghia	Ø 600	29-08		
30	Nguyen Quyen (Binh Dong)	Ø 600	30-08	Kenh Doi	Outlet is closed by housing construction, outlet has not flag gate, flow is jammed.
31	Nguyen Che Nghia	Ø 800	31-08		
Total					31 outlets, of which 4 damaged/malfunctioning outlets

Table G.3.5 (8/15) List of Outlets controlled by UDC District 10

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	To Hien Thanh	Ø 1500	01-10	Bac Hai	Outlet is in good condition.
	Total				1 outlet, of which 0 damaged/malfunctioning outlets

Table G.3.5 (9/15) List of Outlets controlled by UDC District 11

No	Outlet Name	Dimension	Mark	Location	Operation Condition
1	Tan Hoa I	Ø 600	01-11		
2	Tan Hoa II	Ø 800	02-11		
3	Communal road No.14	Ø 1200	03-11		Sewer and outlet is in good condition
4	Hoa Binh	Ø 1200	04-11	Tan Hoa	
5	158 Lac Long Quan		05-11		
	Total				5 outlets, of which 0 damaged/malfunctioning outlets

Table G.3.5(10/15) List of Outlets controlled by UDC Phu Nhuan District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Phan Dinh Phung I	Ø 1000	01-PN	Nhieu Loc	Outlet and flow is in good condition.
2	Phan Dinh Phung II	Ø 800	02-PN		
3	Dang Van Ngu I	Ø 1000	03-PN	Nhieu Loc	Outlet is in good condition, the upper part has housing construction.
4	Dang Van Ngu II	Ø 600	04-PN		
5	Nguyen Van Troi I	Ø 800	06-PN	Nhieu Loc	Outlet and flow is in good condition, but outlet there is not flag gate.
6	Nguyen Van Troi II	Ø 800	07-PN	Nhieu Loc	Outlet and flag gate is damaged, flow is not good condition.
	Total				6 outlets, of which 2 damaged/malfunctioning outlets

Table G.3.5(11/15) List of Outlets controlled by UDC Binh Thanh District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Xo Viet Nghe Tinh I	Ø 800	01-BT	Thi Nghe	Outlet and flage gate is in good condition.
2	Xo Viet Nghe Tinh II	Ø 600	02-BT	Thi Nghe	Sewer is enroached by housing construction, sewer is closed by garbage.
3	Nguyen Huu Thoat	Ø 600	03-BT	Thi Nghe	Outlet and flow is in good condition.
4	Pham Viet Chanh	Ø 600	04-BT		
5	Phan Van Han	Ø 600	05-BT		
6	Ngo Tat To	Ø 800	06-BT		
7	Dien Bien Phu III	Ø 1000	07-BT		
8	Dien Bien Phu IV	Ø 600	08-BT		
9	Dinh Tien Heang	Ø 1000	09-BT		
10	Xo Viet Nghe Tinh	Ø 800	10-BT		
11	Dien Bien Phu VT1	Ø 1000	11-BT		
12	Dien Bien Phu VT2	Ø 600	12-BT		
13	Xo Viet Nghe Tinh (Saigon bridge)		13-BT		
14	Xo Viet Nghe Tinh (Military)	Ø 800	14-BT		
15	Xo Viet Nghe Tinh (Cau Kinh)	Ø 1000	15-BT	Cau Kinh	Outlet is damaged, flow is in good condition.
16	National road 13 - I (Binh Trieu)	Ø 800	16-BT		
17	National road 13 - II	Ø 800	17-BT		
18	Xo Viet Nghe Tinh (Cau Do)	Ø 800	18-BT		
19	Chu Van An I	Ø	19-BT		
20	Chu Van An II	Ø	20-BT		
21	Chu Van An III	Ø	21-BT		
22	Bui Dinh Tuy I	Ø 800	22-BT		
23	Bui Dinh Tuy II	Ø 400	23-BT		
24	Bui Dinh Tuy III	Ø 400	24-BT		
25	Dinh Bo Linh I	Ø 800	25-BT	Cau Son	Outlet has just constructed, Outlet is in good codition.
26	Dinh Bo Linh II	Ø 800	26-BT		
27	Dinh Bo Linh III	Ø 800	27-BT		
28	Dinh Bo Linh IV	Ø 800	28-BT		
29	Xo Viet Nghe Tinh (Son bridge) I	Ø 600	29-BT	Cau Son	Outlet is closed by garbage, flow is not good in condition.
30	Xo Viet Nghe Tinh (Son bridge) II	Ø 600	30-BT	Cau Son	Outlet is not investigated.
31	Bach Dang I	Ø 1500	31-BT	Cau Son	Outlet is in good condition, the upper part has housing constructions, flow is not good condition.
32	Bach Dang II	Ø 600	32-BT	Cau Son	Outlet is in good condition, the upper part has housing constructions, flow is good condition.
33	Bach Dang III	Ø 1000	33-BT	Cau Son	Outlet is in good condition, the upper part has housing constructions, flow is good condition.
34	Bui Huu Nghia	Ø 600	34-BT	Cau Son	Outlet is in good condition, the upper part has housing constructions, flow is good condition.
35	Vo Tung	Ø 800	35-BT		
36	Chu Van An IV	Ø 400	36-BT		
37	Chu Van An V	Ø 400	37-BT		

Table G.3.5(12/15) List of Outlets controlled by UDC Tan Bin District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Pham Van Hai	Ø 800	01-TB	Nhieu Loc	Outlet is in good condition, garbage is discharged too much behind outlet.
2	Pham Van Hai	Ø 800	02-TB	Nhieu Loc	Outlet is in good condition, garbage is discharged too much behind outlet.
3	Pham Van Hai	Ø 800	03-TB	Nhieu Loc	Outlet, sewer and flow is in good condition.
4	Pham Van Hai	Ø 600	04-TB	Nhieu Loc	Outlet, sewer and flow is in good condition.
5	Bui Thi Xuan	Ø 800	05-TB		
6	Au Co	3 x Ø 800	06-TB	Doc Lap	Outlet is in good condition.
7	Au Co	3 x Ø 800	07-TB		
8	Au Co	Ø 800	08-TB		
9	Doc Lap	Ø 1000	09-TB		
10	Doc Lap	Ø 1000	10-TB		
11	Communal road No.11	Ø 500	12-TB		
12	Huynh Van Chinh	Ø 800	12-TB		
	Total				12 outlets, of which 2 damaged/mafunctioning outlets

Table G.3.5(13/15) List of Outlets controlled by UDC Go Van District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Quang Trung I	Ø 1000	01-GV		
2	Quang Trung II	Ø 1000	02-GV		
3	Nguyen Canh	Ø 1000	03-GV	S. Vam Thuat	Outlet is in good condition.
4	Nguyen Thai Son	Box 1m x 1m	04-GV	R. Ben Cat	Outlet is in good condition.
5	Line No.1	Box 1.8m x 2m	05-GV		
6	Line No.2	Ø 1000	06-GV		
7	Line No.3	3 x Ø 1000	07-GV		
8	Line No.4	Ø 1000	08-GV		
9	Go Vap District I	Ø 1000	09-GV	R. Dua	Outlet is in good condition.
10	Go Vap District II	Ø 1000	10-GV	R. Dua	Outlet is in good condition.
11	Go Vap District III	Ø 1000	11-GV	R. Dua	Outlet is in good condition.
12	Military area	Ø 1000	12-GV		
13	Phan Van Tri	Box 2.1m x 1.8m	13-GV	R. Ben Cat	Outlet is in good condition.
14	Forestry Company No.7	3 x Ø 1000	14-GV	S. Vam Cat	Outlet is in good condition.
15	Ong Bang channel	Ø 1500	15-GV		
Total					15 outlets, of which 0 damaged/malfunctioning outlets

Table G.3.5(14/15) List of Outlets controlled by UDC Thu Duc District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Ong Dau channel (National road No.13)	Ø 600	01-TD		
Total					1 outlet, of which 0 damaged/malfunctioning outlets

Table G.3.5(15/15) List of Outlets controlled by UDC Binh Chanh District

No	Outlet Name	Dimension	Mark	Location	Operation Conditions
1	Hung Vuong	Concrete open sewer	01-BC		
2	Hung Vuong I	Ø 1200	02-BC		
3	Hung Vuong II	Ø 1200	03-BC		
4	Communal road No.5 - I	Ø 600	04-BC		
5	Communal road No.5 - II	Ø 800	05-BC		
Total					5 outlets, of which 0 damaged/malfunctioning outlets