THE PROJECT
FOR
UPGRADING OF
SEWERAGE SYSTEM
IN
LAAMU ATOLL

Tender Documents (Technical Specifications)

VOLUME-II SPECIFICATIONS

PART-A GENERAL SPECIFICATIONS

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SECTION 1 GENERAL

1.1 Outline of the Project

There are three areas for the Project in Isdhoo island. One is Isdhoo-Kalaidhoo area located southern part of the island and another is Isdhoo area located northern part of it. Between two areas connected with one main road and in the centre of the island, there is the health centre with 6 beds and construction office with work field which include in the Project.

The summary of the Project is described as below:

Item	Site1 Isdhoo-Kalaidhoo Area	Site2: Isdhoo Area	Site3: Health Centre Area
1. Sewerage System			
(1) Home type septic tank	130 pcs	184 pcs	
(2) Communal type septic tank No.1	1 pc	1 pc	1 pc
(3) Communal type septic tank No.2	6 pcs	7 pcs	-
(4) Conveyance sewer piping	Covered above area	Covered above area	Covered above area
(5) Intermediate pump station	14 pcs	14 pcs	1 pc
(6) 2nd Septic tank with pump	7 pcs	7 pcs	1 pc
(7) Mounted Leach Field (Double Soil Treatment Bed)	7 pcs	7 pcs	1 pc
(8) Drying Bed	-	-	2 pcs
(9) Slanted soil treatment system	137 pcs	190 pcs	2 pcs
2. Vacuum car			
(1) Vacuum car	1 unit		
(2) Spare parts	1 lot for two (2) years		

The Project is to be implemented on the basis of the following policies:

(1) Maldives Water and Sanitation Authority (hereinafter referred as MWSA) under the Ministry of Environment, Energy and Water (hereinafter referred as End-User) is the responsible organization for the implementation of the Project in Isdhoo Island.

(2) The Project is defined not only as a project for improvement of the sewage treatment system but as a project for contributing to the aqueous environment system as well as improving groundwater conditions of the island.

(3) The objectives of the Project and to establish sewerage treatment system and improve ground water condition by means of replacing old septic-tank and soak-pit system.

(4) The major components of the Project consist of constructing the following facilities and thereby improving the situation of the sewage treatment system.

- Replacement of the existing deteriorated septic tanks to new one,
- Construction of sewerage conveyance piping network as a collecting system of sewage water,
- Construction of pump station to convey sewage water,
- Construction of 2nd septic tank as an aeration chamber
- Construction of Mounted Leach Field that compose double treatment system for sewage water,
- Construction of drying bed for desludging system,
- Provision of desludging equipment with vehicle,

(5) "Engineer" shall be the Organization appointed by the Employer and have been engaged or designated by the Employer to provide professional services in supervision of the Work which the Contractor shall carry out in accordance with the Contract.

1.2 Work Demarcation

Shown below is the work demarcation of the responsible organizations of End-User (MWSA) and the Contractor.

No.	Item	MWSA	Contractor
1.	**Construction of Facilities**		
(1)	Construction of septic tank		◘
(2)	Construction of sewer piping network		◘
(3)	Construction of intermediate pump station		◘
(4)	Construction of mounted leach field		◘
(5)	Construction of 2nd septic tank with pump station		◘
(6)	Demolish of existing septic tank if necessary	◘	
(7)	Connection from existing toilet to installed septic tank	◘	
(8)	Construction of new water treatment facility		◘
(9)	Construction of sludge drying bed		◘
(10)	Installation of pumps		◘
(11)	Connection work between the existing pipes and newly installed pipes	◘	
(12)	Land clearance for the facilities	◘	
2.	**Provision of Equipment**		
(1)	Equipment for water quality test		◘
(2)	Equipment for sludge discharge		◘
(3)	Equipment for charcoal production		◘
3.	**Others**		
(1)	Acquisition of approval, permission or etc. for the following issues from the Authorities; - Road crossing work - Electricity work - Water supply - Any other work which require approval, permission etc.	◘	
(2)	Land acquisition for treatment facilities and temporary office	◘	
(3)	Grass-cutting in the water treatment plant	◘	
(4)	Construction of fence encircling the temporary facilities		◘
(5)	Water cutoff, when necessary	◘	
(6)	Information of buried facilities or materials before excavation work by the Contractor and attend to the excavation work	◘	
(7)	Trial excavation		◘
(8)	Pipe-flushing work including water supply		◘

No.	Item	MWSA	Contractor
(9)	Leak-detection tests of septic tanks and piping network		◘
(10)	Capacity building of the new organization in 2 villages that shall secure the maintenance of the new sewerage system	◘	
(11)	Permission to use the existing desalination plant for concrete work free of charge	◘	

1.3 Standards and Regulations

All work and equipment shall be in accordance with the appropriate provisions and/or regulations of International Organization for Standardization (ISO), Japanese Industrial Standard (JIS), Australian Standard (AS), New Zealand Standard, or the major industrial standards or equivalents which are internationally authorized, unless otherwise specified or instructed by the Engineer. Prior to commencement of the work to which the specified standards will be applied, the Contractor shall provide the Engineer with a copy of the standards as required by the Engineer.

The Engineer may substitute the specified standard with equivalent standards for cases where he deems it equivalent and appropriate for the work to do so.

1.4 Employment of Local Personnel

The Contractor shall employ staff and labor from sources within Maldives, especially in Isdhoo Island to get knowledge of the system through On-the-Job-Training Expected number of staffs is 3 from both village, Isdhoo and Isdhoo-Kalaidhoo in consultation wirh the island comittee.

1.5 Safety

(1) The Contractor shall, at his expense, fully comply with all the fire and safety laws, rules and regulations of Maldives, and shall adopt such other measures as shall be deemed necessary or as may be required by the Engineer, to ensure safe working conditions for the Contractor's and his sub-contractor's employees, while they are engaged on or in connection with the Work and for the protection of the general public.

(2) The Contractor shall, if any serious accident would happen at or near the site in connection with the execution of the Work, report such accident to the Engineer with the immediate effect. The Contractor shall also report any such accidents to the competent authority of Maldives whenever such report is required by the regulation.

(3) The Employer shall not be liable for any damage or compensation payable at the regulations in respect of or in connection with any accident or injury to any workman in the Work or to the general public, in connection with the execution of the Work.

1.6 Protection of Work

The Contractor shall, at his own expense, cover up and protect all materials and work liable to be stained or injured or stolen from any cause, and shall make good any such damage to the entire satisfaction of the Engineer.

1.7 Protection of Environment

The Contractor shall ensure that all construction activities are well-planned and undertaken with due cognizance of the potential impact on the environment from those activities, and follow the Engineer's guidance or instructions oral or written.

1.8 Temporary Work

The Contractor shall be solely responsible for the sufficiency, stability and safety of all Temporary Work. The Contractor shall, at his own expense, supply detailed drawings and calculations of the stability of such Temporary Work as the Employer may direct. Approval given or implied by the Employer shall not relieve the Contractor of his responsibilities in connection with Temporary Work.

In the definition for "Temporary Work", the following is understood to be for, but not limited to:

1) The Contractor's office
2) Warehouse
3) Safe guard facilities
4) Water supply and sanitation facility
5) Power supply (and its facilities) for the Temporary Work
6) Miscellaneous work relevant to the Temporary Work

The Recipient shall arrange lands to be used by the Contractor as the site area (for site office, lay-down area, stock materials, etc.) during the construction period as shown an example in the Drawings. The Contractor shall remain the facilities according to End-user's decision as a office and workshop of the maintenance department.

1.9 Setting Out

The Contractor shall be responsible for accurate setting out of all the works, and he shall, at his own expense, make good any defects arising from errors in the lines or levels. He shall also provide the Engineer for his use throughout the period of the Contract with a modern and accurate theodolite and precision level, both of approved type and make, complete with all ancillary equipment, steel and linen tapes, poles, pegs, standings, templates, profiles, etc., necessary for setting out and measurement of the Work, and the services of an experienced staff.

1.10 Use of Public Road

The Contractor shall take all reasonable measures to prevent deposits of mud, filth or rubbish on the road and shall, from time to time, or as instructed by the Engineer, remove from the roads at his own expense any mud, filth or rubbish which the Contractor has deposited.

1.11 Control of Water

Water used, developed or otherwise occurring within the site shall be appropriately controlled and disposed of when necessary for the proper execution of the Work.

1.12 Communication

The Contractor shall keep good communication with End-user, the Employer and the Engineer in connection with the Work through the period of the Project. If the Contractor's duty personnel who reside in the Project would leave Maldives by right reason while the Project is proceeding, he shall inform the Engineer in advance in writing.

1.13 Plant and Tool

The Contractor shall provide all labor, materials, stockyards, tools, etc., necessary for the satisfactory completion of the Work at his cost.

1.14 Medical Facility

The Contractor shall, at his cost, make arrangements for treatment of casualties on the site by such first-aid units as may be thought necessary. The first-aid service shall cover the Employer's and all subcontractors' personnel as well as the Contractor's own personnel.

1.15 Advertising

The Contractor shall treat the Contract and everything within it as private and confidential. In particular, the Contractor shall not publish any information, drawings or photographs relating to the Work and shall not use the site for advertising purposes, except with written consent of the Employer and subject to such conditions as he may prescribe.

1.16 Material and Workmanship

All materials and components shall be of good quality, appropriate to the class of work involved, and be in full accordance with the Contract requirements. Workmanship shall conform to the detailed requirements of the specifications and the appropriate standard.

1.17 Inspection and Tests

(1) All work is to be performed and all materials and products as well as equipment to be supplied and furnished to the Project under the Contract may, at any time and at any location where they are being manufactured or situated, be subject to inspection and test by the Engineer or End-user on the following conditions:

1) Raw Materials

The raw materials to be used for the civil and building work and equipment installation shall be subject to visual and dimensional inspections or tests by the Engineer at the Project site as required by the Engineer.

The Contractor shall submit complete manufacturing certificates of the raw materials to the Employer before shipment for approval. Samples of the materials, such as concrete, water-stoppers and paints, etc. shall be submitted to the Engineer as instructed by the Engineer. All samplings shall be carried out at the Contractor's expense.

2) Standard Products

Standard products which are manufactured or assembled under standard and ordinary processes such as ordinary pipes, ordinary valves, small-size pumps and small-size compressors, etc. shall be subject to the Contractor's or manufacturer's own shop inspection in routine work.

The Contractor shall submit complete written statements of the shop inspection for those products with the manufacturers' catalogues to the Employer before shipment for approval.

3) Major Products

Major mechanical and electrical products and equipment to be furnished to the Project, which shall be designated as major by the Engineer, shall be inspected or tested by the Contractor as shop inspection.

The Contractor shall submit complete written statements of the inspections or tests with relevant technical data to the Engineer within one (1) week after the inspection or test for approval.

The Contractor shall give the Engineer an adequate notice, in writing, of date, time and location fixed for such inspection or test, at least one month in advance. Inspections or

tests by the Engineer may be promptly conducted so as to interfere as little as possible with the Contractor's working schedules.

4) Final Report

The Contractor shall submit final report to the effect that the raw materials, the standard products and the major mechanical/electrical products mentioned in the above 1), 2) and 3) shall be of the same products and/or the same quality as described in such statements to the Engineer before installation.

(2) All stockyards are to be subject to inspections and/or tests at the site as specified or as required by the Engineer. The inspections or tests are to include those detailed hereafter, but is not necessarily restricted to these.

The Contractor shall give every facility to enable the Engineer to carry out the inspection and witnessing of test. The Engineer shall at all times have right of entry to all places where the materials and/or stockyards are being manufactured, fabricated, erected, tested or stored.

The Contractor shall provide all things necessary for carrying out the inspections and tests including water, electric power, instruments, temporary connections, fuel, etc. All instruments to be used in the inspections and tests shall perform within the limits of error necessary to carry out the inspections and tests satisfactorily. All instruments are to be subject to the approval of the Engineer.

Costs of the inspections and tests in accordance with the requirements of this clause shall be included in the price tendered for supplying and installing the respective items of equipment as set forth in the said Contract.

1.18 Shop Drawing and Document

The layouts and general arrangements of the drawings in the Tender Documents may be changed in accordance with the site condition or as approved or as instructed by the Engineer.

Field verification as to the real dimensions shall be carried out by the Contractor since the dimensions shown on the Tender Documents' drawings may vary in accordance with the actual site conditions.

The Contractor shall carefully examine the civil, architectural, electrical and mechanical drawings in the Tender Documents' drawings in order to avoid possible installation conflicts. Should any change from these drawings become necessary to resolve such conflicts, the Contractor shall notify the Engineer for written approval of the change prior to commencement of the related work.

The Contractor shall submit, to the Engineer, for his approval in sufficient advance to allow him to examine, three sets of shop drawings giving details of layout and/or equipment, fixtures, piping, wiring, proposed installation indicating the methods and locations, and technical data necessary for the Work, to the Engineer's satisfaction.

The Contractor shall not commence work on the items covered by the shop drawings before the Engineer's written approval on the shop drawings.

Notwithstanding any approval by the Engineer of the Contractor's shop drawings, calculations or specifications, the Contractor shall remain wholly responsible for errors made therein.

1.18.1 Documents to be submitted for approval

The Contractor shall submit not only the plans and documents shown below, but also others as required by the Engineer for his approval for the proper execution and completion of the Work.

Unless otherwise specifically described in this specification, the Contractor shall submit three (3) copies of the said documents and drawings to the Engineer for approval and one (1) copy to End-user as advance copy. One (1) copy each of said documents and drawings would be returned to the Contractor with approval notice or comments, if any. However, the approval by the Engineer does not mean releasing the Contractor from his contractual obligations to comply with Specifications and particular conditions in the Maldivian Islands.

The Contractor shall also submit five (5) copies of the said documents and drawings as "Final" to End-user after obtaining approval of the Engineer, unless otherwise specified in the Specifications.

All documents and drawings shall be prepared in clear, legible from with a documents list in a unified format. The Contractor shall also prepare hard files for filing all of the documents and drawings to be submitted by the Contractor in a unified format acceptable to the Engineer.

Plan/Document	Date of Submission	Remarks
A: Manufacturing Stage	Date of submission be count from the signing date of the Contract unless otherwise mentioned	
1. Master schedule	Immediately	Master Schedule and Bar Chart
2. Detail schedule	within 30 days	Detail Schedule and Bar Chart
3. List of Sub-Contractors and manufactures	within 30 days	
4. Submission schedule of document and drawings	within 30days	
5. List of origin of Equipment and Materials	within 40 days	
6. Organization chart with curriculum vitae of the representative and key staff at site	within 30 days	including dispatching period
7. List of Contractor's employees at the site	15 days before dispatch to the Project site	
8. Detailed list of Construction plant and Equipment	within 30 days	
9. Basic documents	within 30 days	-General arrangement -Key single line diagram -General technical doc.
10. System design drawings	within 30 days	
11. Temporary facilities plan	within 60 days	

Plan/Document	Date of Submission	Remarks
12. Shop and working drawings for Civil Works	60 days before commencing each construction work	As required by the Engineer
13. Detailed description, engineering calculations, specifications and/or shop drawings of the permanent Equipment and Materials	within 90 days	
14. Lists of (1) Drawing list (2) Equipment list (3) Motor list (4) Load list (5) Instrument list (6) Valve list (7) Lubricating oil list	within 120 days	
15. Contents of construction billboard and commemorative plate	within 90 days	
16. Spare parts and tools list	within 120 days	Together with description and type
17. Factory inspection and test (1) Notice and procedure (2) Test report	 (1) 1 month before test (2) within 14 days after the Test	
18. Manuals (1) Storage manual (2) Installation Manual (3) Commissioning Manual (4) O & M manual (5) On- the- Job training (OJT) Manuals	 (1) within 30 days before FOB (2) within 30 days before FOB (3) 60 days before commissioning (4) 60 days before OJT at site (5) 60 days before OJT at site	 (5) Including training program, schedule
B: Site construction stage		
1. Request for the examination of work before earth covering	within 3 days before commencing respective work	For each applicable section of the work
2. Minute of meeting	within 48 hours after the respective meeting	
3. Daily report	Next day of the concerned	
4. Weekly progress reports	Middle of the next week	
5. Monthly progress reports and Color progress photographs	The end of the first complete week in the succeeding month	Form and photos requested by the Employer
6. Return notice of foreign employees	7 days before departure	
7. Acceptance test report	within 2 days after the completion of the acceptance test	

Plan/Document	Date of Submission	Remarks
8. Final completion report	At the same time of the application for the certificate of completion	Including color progress photographs
9. As- built drawings	within 30 days after the approval date of the acceptance test report	With CD

1.19 Program

The Contractor shall submit the program to the Engineer. The initial program and all subsequent programs will be in such a form that the critical path of construction can be readily identified.

The Contractor shall, from time to time, modify the program only when required by the Engineer, however, shall not modify it without the Engineer's written approval. The Contractor shall, at all times during the progress of the work, endeavor to adhere to the program as required and approved by the Engineer.

1.20 Record

The Contractor shall maintain accurate records, plans and charts showing the dates and progress of operations, and the Engineer shall have access to this information at all reasonable times. Records of tests made shall be submitted to the Engineer within the testing day. The Contractor shall also maintain records and charts of all materials. The Engineer shall be supplied with a copy of those records as and when required.

1.21 Operation and Maintenance Manual

The Contractor shall submit to End-user through the Engineer five (5) sets each of the operation manual and the maintenance-manual of all the major equipment and systems provided to the Project under the Contract.

The manuals shall be written clearly, in English, and shall contain major information to be required by End-user's operation and maintenance personnel to the satisfaction of both the Employer and the Employer. The manuals are to be indexed and divided into sections so that the information can be located quickly and easily. Separate manuals shall be required for each system. The manuals shall contain, but not to be limited to, the following:

a) The complete and accurate technical description of the systems and all equipment contained in both drawings and texts. The manufacturers' technical literature may be included if appropriate.

b) The function of major parts of the equipment and the whole system.

c) A complete list of all major modules, components and parts of all major equipment within the system giving the original manufacturer's name, address and part number and type.

d) A complete list of all consumable parts and a list of suitable alternative spare-parts with their supplier's or manufacturers' name and address.

e) Manufacturers' recommendations for routine trouble-preventive operations and maintenance.

f) Fault finding procedures for the equipment and the whole system of the Project on a step-by-step basis.

g) Comprehensive set of drawings of the system and the equipment and the whole system as built and installed.

1.22 Statement of Construction Method

One month prior to each commencement, or whenever directed by the Employer, of each major construction work such as earthwork, concrete work, building work, pipeline work, equipment-installation work, mechanical work, electrical work and the like, the Contractor shall submit, for the Employer's approval, the Statement of Construction Method for these jobs. The statement shall be written as concretely as possible and shall fully describe how to control quality and progress in compliance with the specifications and the shop drawings.

The statement shall supplement detailed specifications to GENERAL SPECIFICATIONS and SPECIAL SPECIFICATIONS mentioned hereinafter.

1.23 Report

The following reports of major importance among those required shall be submitted by the Contractor to the Employer with three (3) copies. The Contractor is required to cooperate with the Employer in the submission of these reports within the times indicated hereafter, in order to carry out smooth and satisfactory progress of the Project.

1) Time-Program of the Project;
   to be submitted within 14 days after the signing of the Contract.
2) Shop Drawings for the construction and installation work with supporting data of the materials and equipment to be used for the Project;
   to be submitted within two months after the signing of the Contract.
3) Test Reports on the materials and equipment;
   to be submitted periodically for each work task as requested by the Employer.
4) Master List of materials and equipments to be imported from abroad for the Project with the country's name of origin;
   to be submitted within 30 days after the verification of the Contract in order to enable the Employer to prepare the necessary procedures for tax-exemption for those to be imported.
5) Shipping Documents of those to be imported;
   to be submitted within 45 days prior to shipment in order to enable the Employer to arrange procedures for tax-exempted customs clearance for those to be imported.
6) Monthly Progress Report;
   to be submitted by the 3rd day of every month after commencement of the construction work at the site. Such progress report shall be submitted and should include papers and pictures as required by the Employer, in 3 copies or more as required by the Employer.
7) Final Completion Reports;
   to be submitted upon request for the issue of the completion certificate. Completion reports shall consist of the papers describing the completion of the Project in detail, the field test-reports, and other documents/records/pictures required by the Employer.

After receiving those reports mentioned above, the Engineer will give his approval to the same, within 7 days unless he has any objection. In case the Engineer has any objection, he will notify the Contractor of the reason for the objection within 7 days from the receipt. The Contractor shall keep the submittal logs whenever he submits any report in such way that both the Engineer and Contractor can trace the record of submittals with the date of the submittals, the expected date of approval and the date of approval.

1.24 Trial Operation

(1) The Contractor shall carry out trial operations of the operational equipment installed at the site as soon as they become operative, and shall thereby check whether the installed

equipment and the whole system of the Project will perform in strict conformity with the specifications, as deemed necessary and/or when required by the Engineer.

(2) The Contractor shall prepare the necessary tools, equipment, personnel and power for such trial operations at his own expenses.

(3) The Contractor shall inform the Engineer of the time-program and contents of such trial-operations, in writing, with reasonable advance notice.

1.25 Technical Training

(1) The Contractor shall carry out technical training for the island committee for the Operation & Maintenance of the facilities of sewerage system and a vacuum car to be provided under the Project. The period of training shall be minimum two (2) weeks, in parallel with the trail operations (mentioned in the above clause 1.24) to the Employer's and Engineer's satisfaction, at the Contractor's expenses, in order to give the Employer sufficient knowledge and technique on how to operate and maintain the installed equipment and the whole system of the Project.

(2) Such training shall be carried out on the basis of the operation manual and maintenance manual for the installed equipment, which shall be prepared by the Contractor at his expenses (as mentioned in the above clause 1.21).

SECTION 2 MOBILIZATION AND DEMOBILIZATION

2.1 Mobilization of all Staff and Equipment

In the description for "Mobilization", the following are understood to be for, but not limited to:

Transport of mixing plants, and their installation;

Construction of the Contractor's offices, houses workshops, stores, water supply and sewage treatment facility etc.

The Contractor shall submit a mobilization program to the Engineer. The mobilization shall be completed as soon as reasonably possible.

2.2 Demobilization and Removal

In the description for "Demobilization", the following are understood to be for, but not limited to:

Cleaning-up and restoration of the site(s) and demobilization and removal of all the stockyard machines, facilities, equipment and all the temporary work.

2.3 Procurement of Test Equipment for Earth, Concrete and Metal Work

The Contractor shall be equipped and maintain, for the duration of the Contract, an approved test facility for earth, concrete and metal work testing for his own use and that of the Employer. The facility shall be equipped with all the necessary apparatus and materials for the performance of all the standard tests required for earth, concrete and metal work of which test item shall be submitted to the Engineer for approval.

The Contractor shall submit all the apparatus and materials necessary for tests required under the Contract for the Engineer's approval. The Contractor shall also submit a list of all equipment to be procured and details of suppliers.

All equipment used for the testing shall be of standard type and approved by the Engineer.

In any case, where material or workmanship is specified by one testing standard, and alternative testing methods are allowed, the method used to determine compliance with this Specification will be at the absolute discretion of the Engineer.

SECTION 3 TEMPORARY WORK

3.1 General

In the description for "Temporary Work" the following are understood to be for, but not limited to:

1) The Contractor's office, warehouses and site laboratory
2) Access road
3) Temporary power, water supply and sewage treatment facility
4) Security guards' hut
5) Miscellaneous work

The Contractor shall provide, maintain and remove, as the work progresses, all necessary temporary facilities. The Contractor shall make them safe and suitable in every respect to operate all stockyard machines required for the Work or for providing access or for any other purpose connected with the Work, to the satisfaction of the Engineer. Complete details of the temporary facilities proposed shall be submitted to the Engineer for his approval.

The Recipient shall arrange the land be used by the Contractor as the site area (site office, lay down area, etc.) during the construction period. The Employer shall make necessary and possible advice to End-user in connection with this arrangement.

The Recipient also shall arrange the necessary land for the soil disposal close to the site area.

3.2 The Contractor's Office and Warehouse

The Contractor shall provide, erect, construct and equip all offices, warehouse, and stores. These shall be complete with all machines and equipment and all services, access roads and the like, required by him or his principals, employees or agents directly or indirectly for the construction or maintenance of the Work.

The Contractor shall keep all temporary facilities clean and litter free.

3.3 Temporary Water Supply and Sanitation system

The Contractor shall prepare temporary water supply and sanitation system for temporary facilities. In case the temporal sewerage treatment system adequately suitable to the standard of permanent facility, the Contractor could use it as the permanent facility.

3.4 Security Guard

The Contractor shall execute his work with most considerable safety measures in order to avoid accidents to the workers as well as the residents.

The necessary security guards shall be provided by the Contractor.

3.5 Miscellaneous Work

The Contractor shall execute the miscellaneous work for preceding the main work, such as de-watering, cleaning, road-closing etc.

SECTION 4 SITE SURVEY AND INVESTIGATION

4.1 Local Condition

End-user and the Engineer, when necessary, will make available to the Contractor upon his request, all information about the geography, climate, cyclone, earthquake and the natural surroundings that they may have, but End-user and the Engineer are not responsible for these data. When the Contractor further acknowledges this information, the Contractor shall investigate at his own expense.

4.2 Investigation of the Existing Facilities

All the existing communal facilities and household shall be thoroughly investigated and surveyed by the Contractor to his own satisfaction. The Contractor shall take appropriate measures, if he would find what seems harmful to the performance of the Work. Information on the existing facilities, when necessary to the Contractor, will be made available by the Employer.

4.3 Site Survey

The Contractor shall undertake field surveys required for the performance of the Work. The Engineer will provide the data on initial lines and grades including a stationed center line, benchmarks, essential control points, for structures and other principle control points, at the Contractor's request.

4.4 Establishment of Setting Out Points and Benchmarks

The Engineer shall supply the Contractor with the reference points provided with concrete landmark and metallic plates or their equivalents. The Contractor shall carry out a check survey to verify elevations and established locations.

If the differences arise between the Contractor's survey and the Employer's, the Contractor shall supply the data and information in writing to analyze and verify. If there would be differences in the field pertaining to the coordinates and elevations, the Employer then shall verify such argued points until satisfactory results are obtained.

SECTION 5 EARTH WORK

5.1 Scope of Work

The work specified in this section includes the supply of all labor, equipment, tools, and materials to carry out the required work.

This work shall consist of the following (but not limited to)

(a) Cleaning, demolishing and closing the land and existing roads,
(b) Stripping top soil,
(c) Excavating ground and the existing roads,
(d) Cutting and banking for the land grading,
(e) De-watering,
(f) Removing, loading, transporting and disposing of surplus materials,
(g) Back-filling and compacting of ground and/or roads.

The Contractor shall take care of the underground water. No over-excavation shall be permitted. The elevation of excavation bottoms, as shown on the Drawings, shall not be disturbed.

All surplus materials accruing from excavation shall be transported by the Contractor to the area(s) that will be arranged and/or provided by End-user.

Back-filling materials shall be selected from excavated materials approved by the Engineer, before back-filling work starts.

5.2 Excavation

5.2.1 For Facilities

The Contractor shall carry out all excavations required for the work. Excavation shall be carried out in a safe manner to the proper lengths, widths and depths required for the work or such dimensions as directed by the Engineer. Excavated material shall be disposed of in the area designated by the Employer, or may be used for back-filling when approved by the Engineer.

5.2.2 For Pipeline's Trenches

Trenches shall be of a width necessary of the proper laying of pipes, with slant cutting face as nearly vertical as practical. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length, except for portions or sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints. Bell holes and depressions for joints shall be dug after the trench bottom has been graded.

In order that the pipe may rest on the prepared bottom for as much of its full length as practicable, bell holes and depressions shall be only as long, deep and wide as is required for making the particular type of joint properly. Except where rock is encountered, care shall be taken not to excavate below the depth required.

Whenever wet or otherwise unsuitable soil is encountered in the trench bottom and is incapable of properly supporting the pipe such soil shall be remove to the depth required and the trench shall be back-filled to the proper grade with coarse sand, fine gravel, or other suitable material, as approved by the Engineer.

5.2.3 For Cutting and Banking

Cutting for land grading shall be carried out after clearing trees, grasses and debris in the site, and these removed materials shall not be used for banking materials. Banking also shall be allowed

after clearing trees, grasses and debris in the banking area of the land, and forming ground surfaces into terrace cuts. Banking materials are formed with cut soil or other soil materials approved by the Engineer. Banking shall carry out with layer of each applicable spreading depths and compacting to a certain degree of compaction with the proper equipment. Surface cutting and banking slope shall be measured some protection approved by the Employer for avoiding erosion of slope causing rainfall.

5.3 Back-filling

5.3.1 For Facilities

Back filling of excavation shall be formed with excavated soil or other material approved by the Engineer. The materials shall be thoroughly compacted and trimmed to the levels as required for the work.

5.3.2 For Pipeline's Trenches

The trenches shall be carefully back-filled with the excavated materials approved for back filling, consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials, free from large clods or stones, and spread in 20 cm layers and carefully rammed. The remainder of the back-fill material shall then be thrown into the trench in 30 cm layers and tamped. Using water to settle the back-fill shall be permitted or required as directed by the Engineer. Any trenches improperly back-filled or located in settlements shall be reopened to the depth required for proper compaction, then refilled and compacted, with the surface restored to the required grade and compaction, mounded over, and smoothed off. Open trenches across roadways or other areas to be paved shall be back-filled as specified above, except that the entire depth of the trench shall be back-filled in 20 cm layers, and each layer shall be moistened and compacted in a such manner as to permit the rolling and compacting of the filled trench with adjacent earth to provide the required bearing value for paving of the area immediately after back-filling is completed. Along all other potions of the trenches, the ground shall be graded with reasonable uniformity. Mounds over the trenches shall be left in a uniform and neat condition, to the satisfaction of the Engineer.

5.4 Damage and Restoration of Roads or Other Installations

The Contractor shall repair and restore any and all damages and/or deterioration incurred on the existing roads, boundary wall, curbs, vegetation, structures and/or installations which shall include telephone lines, electric lines, water pipes, regardless of public use or private use, in the Contractor's operations by back-filling, grading compacting, surfacing, paving, repairing and restoring to original conditions with the same kind of materials, unless otherwise specified or instructed by the Engineer.

SECTION 6 CONCRETE WORK

6.1 Scope of Work

This work shall consist of furnishing, placing, finishing and curing concrete in structure and miscellaneous structures in accordance with these specifications and in conformity to the lines, grades, and dimensions shown on the Drawings.

The concrete shall consist of Portland cement, fine aggregate, coarse aggregate, additives (when required) and water mixed in the proportions specified or approved by the Employer.

6.2 Materials

All the materials in this work shall be in conformity with Japan Industrial Standard (JIS) or Australian Standard (AS) or New Zealand Standard or equivalent.

6.2.1 Portland Cement

Portland cement shall be used and conform to the requirement of JIS R5210 or equivalent.

6.2.2 Water

Water used in mixing and curing of concrete shall be fresh or desalinated water that shall be subject to approval by the Engineer and shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished work. Water shall be tested in accordance with, and shall meet the suggested requirements of JIS A5308 or equivalent. Water known to be of drinkable quality may be used without testing. Where the source of water is relatively shallow, the intake shall be enclosed so as to exclude silt, mud, grass, or other foreign materials.

6.2.3 Fine Aggregate

Fine aggregate for concrete shall conform to the following requirements:

JIS A1102 or equivalent that stipulates the gradation below;

Gradation of Fine Aggregate

Sieve Size (mm)	Percentage of Weight Passing
10	100
5	90 - 100
2.5	80 - 100
1.2	50 - 90
0.6	25 - 65
0.3	10 - 35
0.15	2 - 10

Sea sand will be used as the fine aggregate. So that it will not have a bad influence on the quality of the reinforced concrete, it will be washed with fresh water or rainwater in order to remove harmful chloride ions and other substances before being used.

The Contractor will be allowed to use sea sand after eliminate solid foreign materials for plain concrete if he submits to and get approval from the Employer prior to use.

6.2.4 Coarse Aggregate

Coarse aggregate for concrete shall conform to the following requirements:

JIS A1102 or equivalent that stipulates the gradation below;

Gradation of Coarse Aggregate

	Amounts Finer than Each Standard Sieve Percentage (%) by Weight									
Size of Coarse Aggregate	60	50	40	30	25	20	15	10	5	2.5
40-5 mm		100	95-100	-	-	35-70	-	10-30	0-5	-
20-5 mm					100	90-100	-	20-55	0-10	0-5

6.3 Classes of Concrete

Two classes of concrete are specified in these specifications. Each class of concrete shall be used in the part of the structure called for on the Drawings or where designated by the Employer. The classes are as follows:

Design Compression Strength (at 28 days by test of cylinder 15 cm dia. × 30 cm long)

Class A: 20 MPa (210 kgf/cm^2) or more

Class B: 15 MPa (160 kgf/cm^2) or more

The classes of concrete shall be used as follows:

Class A: Class A shall be used for foundations, structures and valve pit's walls and top slab.

Class B: Class B shall be used for leveling and lining concrete.

6.4 Care and Storage of Concrete Aggregates

The handling and storage of concrete aggregates shall be such as to prevent mixture with foreign materials. The Employer may require that aggregates be stored on separate platforms at satisfactory locations.

6.5 Storage of Cement

All sacked cement shall be stored in suitable weatherproof buildings, however, if approved, sacked cement on small jobs may be stored in the open upon a raised platform provided that ample waterproof covering is provided.

1) Store on pallets or other facilities raised not less than 30cm above the floor
2) Stacking exceeding 13 bags high not permitted

Cement shall be stored in such a manner as to prevent deterioration or inclusion of foreign matter. Cement, which has deteriorated or is damaged, shall not be used in the concrete.

6.6 Proportioning of Concrete

The concrete mixture shall be proportioned so as to secure a workable, finish able, durable, watertight, and wear resistant concrete of the desired strength.

The Contractor shall consult with the Employer as to the mix proportions at least thirty (30) days prior to beginning the concrete work. The actual mix proportions of cement, aggregates, water, and admixture, (if necessary), shall be determined by the Contractor under supervision of the Employer in an authorized laboratory.

Any class of concrete shall not be prepared or placed until its job-mix proportions have been approved by the Employer. Composition of concrete for use in this Project:

Class of Concrete	Maximum Water /Cement Ratio	Consistency (range in slump)	Air Content (with no admixture)
	Percent (%)	mm	Percent (%)
A	60	30~ 120	1.5 ± 1.0
B	65	30~ 120	1.5 ± 1.0

6.7 Trial Mixing

Prior to the start of the concrete work, to meet with requirements of the specified concrete, the test mixing for each class of concrete shall be carried out. Checking the results of the 28day compressive test and other tests shall clear the specified limit; the Engineer shall approve the mix proportion of the concrete for use to the work.

6.8 Sampling and Testing

Samples for strength tests of each class of concrete shall be taken once for every 50 cubic meters of concrete or once for each major pour. Strength tests of field-cured specimens may be required for concrete used in other parts of the structure. Each strength test result shall be the average of at least two cylinders from the same sample test of 28day or the specified earlier age. Not less than four strength tests shall be made for each class of concrete on any project unless waived by the Employer. The cylinders shall be cured under conditions that are no more favorable than the most unfavorable conditions for the portions of the concrete that they represent. Type of test and its frequency shall be follows.

Type of test	Frequency of test	Remarks
Sampling	Every 50 cubic meter	
Slump	Every sampling	
Concrete Strength	Every 50 cubic meter	3 pieces/1test

6.9 Mixing Concrete

(1) The concrete shall be mixed only in the quantity required for immediate use. Concrete that has developed an initial settlement shall not be used.

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat the inside of the drum without reducing the required mortar content of the mix. Upon the cessation of mixing for a considerable period, the mixer shall be thoroughly cleaned.

Concrete may be mixed at the site of construction, at a central point, or wholly or in part in truck mixers. The production of site-mixed concrete shall meet the applicable requirements of JIS A5308 or equivalent, with the following additional requirements.

Re-tempering concrete by adding water or by other means shall not be permitted. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixture for increasing the workability or for accelerating the settlement shall be permitted only when specifically provided for in the Contract, or when directed.

(2) The organization supplying concrete shall have sufficient concrete mixing capacity and transporting apparatus to ensure continuous delivery at the rate required. The rate of delivery of concrete during concrete work operations shall be such as to provide for the proper handling, placing, and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The methods of delivering and handling the concrete shall be such as that which will facilitate placing with the minimum of re-handling and without damage to the structure or the concrete.

6.10 Protection of Concrete against Hot Weather

The temperature of the concrete mixture just before placement shall be less than 35 °C. When the average daytime ambient temperature is above 35 °C, the Contractor shall take measure against concrete works under hot weather such as using the appropriate admixture, cooling of cement and aggregate or keeping cool and wet around placed concrete.

6.11 Handling and Placing Concrete

(1) Sawdust, chips, and other construction debris and extraneous matter shall be removed from the interior of the forms before placing the concrete. Struts, stays, and braces, serving temporarily to hold the forms in the correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be removed entirely from the forms and not buried in the concrete.

(2) Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. In case an inferior quality of concrete is produced by the use of such conveyors, the Employer may order discontinuance of their use and the substitution of a satisfactory method of placing.

(3) Open troughs and chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. No chutes, troughs, or pipes made of aluminum shall be used for depositing concrete. Chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete. Water used for flushing shall be discharged clear of the structure.

(4) When placing operations would involve dropping the concrete more than 1.5 m, it shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial settlement of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcing bars.

(5) All concrete shall be thoroughly consolidated during and immediately after depositing. This shall be accomplished by mechanical vibration.

6.12 Curing Concrete

The concrete in substructures and, superstructures, roadways slabs shall be cured with appropriate material. The exposed concrete after finishing shall be covered with wet cotton mats or double thick wet burlap blankets. The cotton mats or burlap blankets shall be kept continuously and thoroughly wet.

6.13 Finishing Concrete Surfaces

(1) Following the removal of forms, fins and irregular projections shall be removed immediately from surfaces, except from those, which are not to be exposed, or are not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, broken corners or edges, and other defects shall be thoroughly cleaned, and after having been thoroughly saturated with water, shall be carefully pointed and true with a mortar or cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall be not more than 1 hour old. The concrete shall then be rubbed if required or cured as directed. The resulting surfaces shall be true and uniform. The repaired surface, if the appearance of which is not satisfactory, shall be "rubbed" as directed.

(2) Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a wood float to a true and flat surface. The use of additional mortar to provide a grout finish will not be permitted. The top of the concrete surface shall be finished with a steel trowel or ground to a smooth finish and true slope at the proper elevation.

6.14 Form Work

6.14.1 Forms

(1) Forms shall be of wood, metal, or other approved material and shall be built mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the concrete work and maintained so as to prevent warping and the opening of joints due to shrinkage of the lumber.

(2) The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.

(3) Forms of exposed surfaces shall preferably be lined with metal or plywood. Forms shall be chamfered at all sharp corners and shall be given a bevel or draft in the case of all projections, such as girders and copings, to ensure easy removal. The size of chamfer shall be 3 cm or less.

(4) Metal ties or anchorages within the forms shall be removed without injury to the concrete. All wires, upon removal of the forms, shall be cut back at least 1 cm from the face of the concrete with chisels or nippers; for clean concrete, nippers are necessary. Fittings for metal ties shall be of such design that, upon their removal, the cavities that are left will be of the smallest possible size. The cavities shall be filled with cement mortar and the surface left sound, smooth, even, and uniform in color.

(5) Forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for periods that shall be determined as hereinafter specified.

(6) The shape, strength, rigidity, water tightness, and surface smoothness of reused forms shall be maintained at all times. Any warped or bulged lumber must be re-sized before being reused. Forms that are unsatisfactory in any respect shall not be reused. For narrow walls and columns, where the bottom of the form is inaccessible, the lower form boards shall be left loose so that they may be removed for cleaning out extraneous material immediately before placing the concrete. Forms shall be treated with oil immediately before placing the concrete. Material that will adhere to or discolor the concrete shall not be used.

6.14.2 Removal of Form Work

Forms shall be removed as soon as possible to enable the earliest practicable repair of surface imperfections, but in no case shall they be removed before the approval of the Employer. Any repairs or treatments shall be performed upon removal of the forms, and be followed immediately by the specified curing. Forms shall be removed with care so as to avoid injuries to the concrete and any concrete so damaged shall be repaired to the satisfaction of the Employer. The removal of forms and supports shall be governed by the following:

Time of Removal after the Last Pouring and Concrete

Type of Structure	Compression Strength
Walls, columns and others	4.9MPa(50kgf/cm^2 (Min))
Slabs, beams	13.7MPa (140kgf/cm^2 (Min)).

6.14.3 Construction Joints

Construction joints shall be provided only at the places indicated on the Drawings or directed by the Engineer through the initiative of the Contractor.

The construction joint's surface shall be formed constructed with a wire brush or hacker or appropriate means, until the hard part of concrete without loosing coarse aggregate is attained. Construction joints shall be carefully executed to prevent water leakage.

6.14.4 Expansion Joint

This work shall consist of supply and installation of the expansion joint in accordance with the requirements shown on the Drawings. The material shall be of good quality and free from bubbles, cracks, and injury as approved by the Engineer.

6.14.5 Water-Stop and Filler Plate

Water-stops and filler plates shall be installed at the correct position indicated on the Drawings to prevent water leakage. While passing concrete joint, water stops and filler plates shall be maintained until the concrete is covered. The material for water stops and filler plates shall be referred to in the Drawings.

6.15 Reinforcement Bar

This work shall consist of furnishing and placing reinforcing bars in accordance with these Specifications and in conformity with the Drawings.

6.15.1 Materials

Reinforcing bars shall be deformed and shall meet the requirements of Japanese Standard JIS SD295A or equivalent. No reinforcing steel shall be delivered with a certificate guaranteeing the yield stress. Reinforcing bars shall be stored above the surface of the ground on platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

If it is necessary for the Employer to ascertain the quality of the reinforcing bars, the Contractor shall test the reinforcing bars, at his own expense, by means as directed by the Engineer.

6.15.2 Construction Method

(1) Cutting and Bending

Qualified men shall be employed for cutting and bending, and proper application shall be provided for such work.

Bars shall be cut and bent cold to the dimension indicated.

Reinforcing bars shall be accurately formed to the shapes and dimensions indicated on the Drawings, and shall be fabricated in a manner that will not injure the material.

(2) Bar Arrangement

Reinforcing bars shall be accurately arranged in proper position, and so that they may be firmly held during the placing of the concrete. Election reinforcing bars shall be used when needed.

Bars shall be tied at intersections by using annealed iron wires or suitable clips.

Distances from the forms shall be kept correctly by metal hangers, mortar blocks, metal supports or other supports.

Reinforcing-bars shall be inspected by the Employer after arranging. When a long time has elapsed after arranged reinforcing bars, they shall be cleaned and inspected again by the Employer before the placing of the concrete.

6.15.3 Splicing and Joints

When it is necessary to splice reinforcing-bars at points, the positions and methods of splicing shall be determined based on the approved Drawings. In lapped splices, the bars shall be lapped by the required length, and wired together at several points. Unless otherwise approved by the Employer, the length of the lapped splices shall be more than 25 times of the bar diameter. Exposed reinforcing bars, which are intended to extend in future, shall be effectively protected from injury and corrosion. Oxyacetylene welding joints of reinforcing steel bars shall be done only if authorized by the Employer in writing.

6.15.4 Tolerances for Concrete Work

(1) General

Permissible surface irregularities for the various classes of concrete surface finishes shall be approved by the Engineer and are to be distinguished from tolerances that are consistent with modern construction practice, yet governed by the effects that permissible deviations will have upon the structural action or operational function of the structure. Deviations from the prescribed lines, grades and dimensions will be permitted only to the extent set forth herein.

Where tolerances are not stated in the Specifications and Drawings for any individual structure thereof, permissible tolerances shall be interpreted as provided in the provisions of this paragraph. Concrete work that exceeds the tolerance limits specified herein under shall be rejected and shall be corrected or removed and replaced, as may be ordered by the Employer and shall be performed by the Contractor at his own expense.

(2) Tolerances

1) Structure:

Deviation from specified alignment:
Plain surface..... ±4 cm
Curved surface..... ±6 cm
Deviation from specified width:
At any depth..... ±4 cm
Variation from established depth..... ±5 cm

2) Foundations:

Deviation in dimensions in plan;
Minus.....3 cm
Plus .....5 cm
Deviation from established depth;
Minus.....2 cm
Plus .....3 cm

c. Tolerances for Arranging Reinforcing Bar

Deviation from specified protective cover;
For 5 cm cover..... ±1 cm
For 10 cm cover..... ±2 cm
Variance from specified spacing..... ±3 cm

SECTION 7 PIPE LAYING WORK

7.1. General

Pipe laying work shall be composed of laying pipes and installing fittings. The length, diameter, materials and route alignment of the pipeline shall be referred to the Drawings and the Bill of Quantities. The pipeline route is determined based on the site investigation during the Detail Design Study. Prior to start the Work, the Contractor shall investigate the existing pipeline and other underground facilities, and draw up the working drawings, which shall be submitted to the Engineer for his approval. In case the pipeline to be laid on the ground, the Contractor shall design the detail alignment with the anchor foundation and submit to the Engineer for his approval. Most of the pipe laying works is proposed to replace deteriorated pipes with new pipes. The existing pipes, which shall be replaced, shall be abandoned at the present position. The permission for construction of the pipe laying work shall be required from relevant authority. The Contractor shall be responsible for obtaining the permission, prior to start of the construction work.

7.2 Materials

All pipes, fittings, valves, mechanical couplings, bolts, nuts, jointing materials and appurtenances required for the execution of the pipe laying work shall be of good quality and manufactured and furnished in compliance with the standards specified below or equivalent.

The performance of the material to be used should be simple and excellent in terms of durability, and should be easy to maintain.

7.2.1 PVC Pipe

(1) General

PVC pipes and fittings shall be supplied in accordance with the details shown on the drawings and specified herein.

(2) Standard

PVC pipes and joints/fittings shall be based on New Zealand Standard or Australian standard, or their equivalent if approved by the Employer.

(3) Pipe Data

Pipes shall be rigid polyvinyl chloride (PVC) pipe and shall be suitable for field cutting, welding, bending and coupling. Outside diameter and minimum wall thickness shall conform to the following schedule.

1) Pipe Pressure Class

The specified hydrostatic working pressure at 20 °C of the various pressure classes of pipe is as follows.

I n this Project, PVC pipes of Class C or D shall be used, but mainly Class C.

CLASS	WORKING PRESSURE		MARKING COLOR
C	900 kPa,	90 m head	BLUE
D	1200 kPa,	120 m head	GREEN

2) Nominal Diameter and Wall Thickness of Polyvinyl Chloride Pipe (New Zealand Standard 7648)

Nominal Dia (mm)	MEAN OD (mm)	Pressure Class	MEAN BORE Dia.	MEAN WALL Tp	Weight (kg/m)
50	60.35	C	55.05	2.65	0.71
		D	53.35	3.50	0.86
65	75.35	C	68.90	3.25	1.04
		D	67.00	4.20	1.33
80	88.90	C	81.30	3.80	1.44
		D	79.00	4.95	1.86
100	114.30	C	104.60	4.85	2.37
		D	101.50	6.40	3.11
125	140.20	C	128.20	6.00	3.57
		D	124.60	7.80	4.64
150	160.25	C	146.80	6.75	4.63
		D	142.55	8.85	5.99
200	225.30	C	208.30	8.50	8.18
		D	203.00	11.15	10.58
250	280.40	C	259.40	10.50	–
		D	252.90	13.75	18.6
300	315.40	C	291.90	11.75	–
		D	284.40	15.50	27.3

7.3 Construction of Pipeline

7.3.1 General

The Contractor shall construct the pipelines as well as the fittings and, after the completion, restore roads as they were. The Contractor shall execute the hydrostatic pressure test and after the confirmation of the performance, the Engineer will issue a certificate of completion for the completed work.

7.3.2 Trench Construction

The width of the trench should be the same as the standard Drawing P-21, and must be sufficient to permit the pipe to be laid and jointed properly and allow the backfill to be placed as specified. Additional width may be required to permit placement of the timber supports, sheathing, bracing, and appurtenances. Trees, shrubs, fences, and all other property and structures must be protected during construction, unless their removal is shown on the plans or required in the specifications. Temporary supports, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work must be provided. All disturbed properties must be restored as nearly as is practical to their original condition.

7.3.3 Pipe Installation

All materials must be carefully examined for damage and defects immediately before installation. Proper implements, tools, and facilities must be provided and used for the safe and proper performance of the work. Pipe, fittings, valves, and hydrants must be carefully lowered into the trench with a backhoe, crane, ropes, or other suitable equipment, to prevent damage to the materials and to their protective coatings and linings. Under no conditions should these materials be dropped or dumped into the trench. If necessary, the trench should be dewatered before pipe installation.

All lumps, blisters, and excess coating must be removed from the socket and plain end of each pipe, and the outside of the plain end and the inside of the bell must be clean, dry, and free of dirt, sand, grit, or other foreign materials before the pipe is installed. Foreign material must be prevented from entering the pipe while it is being installed. No debris, tools, clothing, or other materials should be left placed in the pipe at any time.

As each length of pipe is placed in the trench, the joint should be assembled and the pipe brought to correct line and grade. The pipe should be secured in place with the approved backfill materials.

The pipeline laid on the ground shall be anchored to concrete foundation block by steel band. The interval of concrete foundation blocks is less than each pipe length and depends on shape of the ground

When pipe installation is not in progress, the open ends of the pipe should be closed with a watertight plug or other means as approved by the Employer. The plug should allow venting and remain in place until the trench is pumped dry. Care must be taken to prevent pipe flotation in case the trench is filled with water. Air or water pressure in the pipeline must be released before removing the plug for any reason.

7.3.4 Pipe Joint Assembly

The joining of one pipe to another may be performed using various methods. Gasket joints and solvent cement joints are covered in the following paragraphs.

(1) Assembly of Gasket Joints

The assembly of the gasket joint should be performed as recommended by the pipe manufacturer.

In all cases, the Contractor shall clean the gasket, the bell or coupling interior, especially the groove area (except when the gasket is permanently installed), and the spigot area, using a rag, brush, or paper towel to remove any dirt or foreign material before the assembling.

The Contractor shall inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. When gaskets are not factory-installed, it is necessary to use only gaskets that are designed for and supplied with the pipe and then insert gaskets as recommended by the manufacturer.

Lubricants should be applied as specified by the pipe manufacturer. Damage to the gaskets or the pipe may result from the use of unapproved lubricants. It is necessary to use only lubricant supplied by the pipe manufacturer for use with gasket PVC pipes in water supply systems.

After lubrication, the pipe is ready to be joined. The Contractor shall correct alignment of the pipe is essential for ease of assembly and align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. The Contractor shall not swing or "stab" the joint; that is, shall not suspend the pipe and swing it into the bell.

The pipe should be pushed into the bell or coupling either by hand or with the use of a bar and block. Construction machinery should be used only at the direction of the manufacturer. The reference mark (a distinct circumferential line) should be placed on the pipe's spigot end by the manufacturer to indicate the correct depth of spigot penetration into the pipe's gasket joint. If undue resistance to insertion of the pipe end is encountered, or if the reference mark does not position properly, the joint and the position of the gasket will be checked.

If the gasket is twisted or pushed out of its seat, inspect components, repair or replace damaged items, clean the components, and repeat the assembly steps. It should be assured that both pipe lengths are in concentric alignment. If the gasket is not out of position, it is necessary to verify the proper location of the reference mark and relocate the reference.

To join field-cut pipe, it is first necessary to prepare the pipe end. A square cut is essential for proper assembly. The pipe should be cut with a PVC pipe cutter. It is recommended that the pipe be marked around its entire circumference prior to cutting to ensure a square cut. It is necessary to use a factory-finished beveled end as a guide for beveling in the field to ensure; a proper bevel angle, a correct depth of bevel, and a proper marking of the insertion reference mark. The end may be beveled using a pipe beveling tool or wood rasp that will cut the correct taper. A portable sander or abrasive disc may also be used to bevel the pipe end. It is necessary to round off any sharp edges on the leading edge of the bevel with a pocketknife or a file.

(2) Assembly of Solvent Cement Joints

In special applications, solvent-cemented joints may be required. Solvent cemented joints should be made in accordance with the manufacturer's recommendations or in accordance with ASTM D 2855, "Standard Recommended Practice for Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings." Proper training of installation crews in the technique of solvent cementing is necessary to ensure reliable joints. Techniques must be modified to accommodate significant changes in the environment. (For example, wind, moisture, dust, and temperature require proper consideration.)

Solvent cements used in assembly of PVC pipe should meet requirements established by ASTM D 2564, "Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings." When making solvent cement joints, safety procedures should be followed as established in ASTM F 402, "Safe Handling of Solvent Cements Used for Joining Thermoplastic Pipe and Fittings."

7.3.5 Fitting Installation

Prior to installation, fittings should be inspected for tightness, cleanliness of seating surfaces, handling damage, and cracks.

Fittings, plugs, and caps should be set and connected to the pipe in the same manner as specified for cleaning, laying, and jointing pipe.

All dead ends on new mains must be closed with suitably restrained plugs or caps to prevent separation under pressure. All dead ends should be equipped with suitable blow off or venting devices.

7.3.6 Thrust Restraint

Wherever the connection of pipes seems to be off and disconnected, thrust blocks will be provided with the Engineer's direction or the Contractor deems necessary. Thrust blocks shall be made of concrete and shall have an area large enough to resist such a thrust. The dimensions are shown in Drawings.

7.3.7 Backfilling

Backfilling must be done in accordance with the laying conditions specified in Drawings. All backfill material must be free from cinders, ashes, reuse, vegetable or organic material, boulders, rocks or stones, or other unsuitable material.

From the bottom of the trench to the 100 mm above the top of the pipe shall be backfilled with sand as specified in the Drawings. From the top of the sand layer to the sub grade of the pavement, the excavated soil may be used for the backfill material, provided that such material consists of loam, clay, and, gravel, or other materials suitable for backfill. If there is a shortage as a result of rejection of a part of this material, the required amount of sand, gravel, or other approved material must be provided by the Contractor.

In the backfill soil, a "Warning Tape", indicating the existence of a water supply pipeline below the tape, shall be installed approximately 30 cm above the top of the pipes. In case the existing road pavement would be demolished and or removed by the Contractor in the pipe laying work or other work in this Project, the pavement shall be restored to its original state by the Contractor within the contract period.

7.3.8 Flushing

Foreign material left in the pipelines during installation often results in valve or hydrant seat leakage during pressure tests. Every effort should be made to keep lines clean during installation. Thorough flushing should be accomplished, prior to a pressure test, by partially opening and closing valves and hydrants several times under expected line pressure with flow velocities adequate to flush foreign material out of the pipe, valves, and hydrants.

7.3.9 Hydrostatic Pressure Test

Test pressures should meet the following criteria:

Working Pressure Range	Factor	Pressure drop 10% of the test pressure
0-1.2 Mpa	1.5	0-0.18 MPa

Test pressure = Working pressure * Factor

- The test pressure shall not to exceed the design pressures of pipe, fitting, or thrust-restraint.
- Be at least 2 hours in duration
- Vary by no more than 10% of the test pressure for the duration of the test
- Exceed no more than twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed metal-seated valves
- Valves should not be operated in either direction at differential pressure exceeding the rated pressure
- Exceed neither the rated pressure of the valve when the pressure boundary of the test section includes closed, resilient-seated gate valve

Each valve section of pipe shall be slowly filled. The specified test pressure, based on the elevation of the lowest point of the line or section under the test and corrected to the elevation of the test gauge, is applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The test pressure shall be stabilized before conducting the leakage test.

Before applying the specified test pressure, the air must be completely expelled from the section of the pipe being tested. If permanent air vents are not located at all high points, a corporation cock shall be installed at such points so that the air can be expelled as the system is filled with water. After all the air has been expelled, the corporation cocks are to be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks should be removed and plugged or left in place as required by the Engineer.

Any exposed pipe, fittings, valves, hydrants, and joints should be carefully examined during the pressure test. Any damaged or defective pipe, fittings, valves or hydrants discovered as a result of the pressure test should be repaired with sound material and the test repeated until satisfactory results are obtained.

SECTION 8 MECHANICAL WORK

8.1 General

8.1.1 Scope of Work

The Contractor shall provide all labor, materials, equipment and incidentals to furnish and install the complete mechanical work at the water treatment plant and pumping station as shown on the Drawings and/or as specified herein. It is the intent of these specifications, that when completed the mechanical work shall be suitable in every respect for the service intended, and the Contractor shall, at no extra cost, supply all the materials and equipment, and do all the work which may be reasonably implied as being incidental to the work. The Contractor shall be responsible for all piping, and testing and placing the complete mechanical work in satisfactory operation to the approval of the Employer.

8.1.2 Standard

Where items of equipment are specified by the name of the manufacturer, it is for the purpose of establishing a standard of quality, construction, and acceptable experience. Substitute equipment will be acceptable if it can be demonstrated to the Engineer. that the substitute is in accordance with the Specifications and equal in quality to those models specifically named. Manufacturers listed as "equal" have been determined by the Employer for a specific style and model. However, this shall not relieve the named manufacturer from the responsibility of meeting all specified requirements. All mechanical equipment furnished shall be new and of current design.

8.1.3 Routing of Pipelines

It is the responsibility of the Contractor to route all piping. Piping shall be routed in such a way as not to interfere with other piping, equipment, instrumentation, electrical work or structures. Pipeline routing shall be in accordance with the guidelines presented in the Drawings. Minor changes due to differences in equipment, size or configurations will be permitted provided that such changes do not interfere with other work. Any major deviations from the layouts shown on the Drawings will be considered substitutions and shall require approval as such. All piping layouts shall be subject to approval by the Engineer. prior to installation. All exposed piping shall be located against walls, under ceilings, or in floor trenches. If floor trenches are used, gratings shall be installed to cover the trench. Piping shall not be routed under floor slabs unless specifically shown as such on the Drawings.

8.1.4 Materials

Materials to be used for manufacturing and installation of the equipment herein specified shall be selected from the best available for the purpose of use considering strength, ductility, durability, and on the basis of the best current engineering practice. Materials shall be (1) new, unused and of the first quality, (2) free from defects and (3) suitable for the application and not overstressed mechanically or electrically.

8.1.5 Equipment

All equipment furnished under this Contract shall be new and guaranteed against defects in materials, design and workmanship. It shall be the Contractor's responsibility to determine the conditions and service under which the equipment will operate, and to warrant that operations under those conditions shall be successful. All parts of the equipment shall be amply proportioned for all stresses that may occur during fabrication, erection, and intermittent and continuous operation. All equipment shall be designed, fabricated, and assembled in accordance with the best modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that replacement parts, furnished at any time, can be installed in the field. Like parts of

duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests. Materials shall be suitable for service conditions.

8.1.6 Lubrication

A complete schedule of recommended lubricants, which shall be available in Maldives, and the name of manufacturers and suppliers and comparable products shall be submitted to the Engineer. for approval. The number of different types of lubricants shall be kept to a minimum. The equipment lubrication systems shall be provided such that they do not require attention more often than weekly during continuous operations, donor requires attention during start-up shut down, and do not waste lubricants. Grease lubricant systems shall preferably be of the pressure type. Grease application points shall be easily accessible and where needed, extension piping shall be provided. When a number of such points can be grouped, they shall be brought to a rigidly constructed battery plate and each point shall be clearly labeled. A grease gun shall be supplied for each type of grease required and each type of nipple fitted. Oil lubrication shall preferably be of the recalculating reservoir type, which automatically maintains the correct oil, level and shall be designed for continuous normal operation for long periods. Sight glass level indicators shall be fitted on all oil reservoirs, and the levels shall be easily read over the maximum operating range. The level indicators shall be simple to dismantle for cleaning, clearly marked with the minimum, normal, and maximum oil levels at normal running temperature, and shall show the normal oil filling level at design ambient temperature. The sight glass shall be protected against mechanical damage.

The Contractor shall provide lubricants of types approved by the Engineer. in quantities sufficient for consumption up to and including completion, testing and final acceptance.

8.1.7 Equipment Bases and Bedplates

Equipment assemblies shall be mounted on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Bases and bedplates shall be provided with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Seams and contact edges between steel plates and shapes shall be continuously welded and welds shall be ground smooth. No bedplates to support machinery or piping shall be used other than that which is factory installed.

8.1.8 Anchor Bolts

The Contractor shall furnish anchor bolts, nuts, and washers of adequate design as required for proper anchorage of the bases and bedplates to the concrete bases. The Contractor shall furnish anchor bolts, nuts, washers, and sleeves of adequate design as required for proper anchorage of the bases and bedplates to the concrete bases. Anchor bolts, nuts, washers and sleeves used under submerged or intermittently submerged conditions shall be stainless steel, Class 304.

8.1.9 Safety Guards

Belt or chain drives, fan blades, couplings, exposed shafts and other moving or rotating parts on all slides shall be covered with safety guards conforming to all local safety codes and regulations and conform to the most restrictive requirements. Guards shall be designed for each installation and removal, complete with necessary supports, accessories, and fasteners.

8.1.10 Sample Cocks, Meters and Gauges

Sample cocks shall be provided on the discharge of each pump installed under this Contract. Meters and gauges shall read in metric units with graduations as approved by the Engineer..

8.1.11 Name Plates

Equipment nameplates shall be engraved or stamped on metal plates and fastened to the equipment in an accessible location.

Nameplates shall indicate:

(1) Name of manufacturer;
(2) Type of unit and model number;
(3) Serial number; and
(4) Rated capacity, voltage, amperage, and other pertinent information.

8.1.12 Tools

The Contractor shall supply one (1) complete set of special tools necessary for the assembly, adjustment, and dismantling of the equipment for every piece of equipment. All tools shall be of the best quality. Each set of tools shall be neatly mounted in a painted steel tool case of suitable design and identified on the outside with an itemized list of contents.

8.1.13 Spare Parts

The Contractor shall furnish spare parts specified hereinafter and spare parts supply and check list. All spare parts shall be properly preserved and packaged for a long period of storage before use, and in a hot and humid climate and shall be properly marked in the English language on the outside to permit easy identification of the contents without opening and exposing the contents to the atmosphere.

8.1.14 Equipment Protection

All equipment shall be boxed, crated, or otherwise completely enclosed and protected for overseas shipment, handling and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times. Pumps, motors, electrical equipment, and other equipment having antifriction or sleeve bearings shall be stored in weather-tight storage facilities, such as warehouses.

8.1.15 Painted Surfaces

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces, which are damaged prior to acceptance of the equipment, shall be repainted.

8.1.16 Equipment Installation

The Contractor shall install all equipment specified herein in full accordance with the Drawings, Specifications, equipment manufacturer's recommendations and good practice.

All parts to be installed shall be cleaned thoroughly. All packing compounds, rust dirt, grit and other foreign matter shall be removed. All holes and grooves for lubrication shall be cleaned. All enclosed chambers or passages shall be examined to make sure that they are free from injurious materials. For major equipment items specified hereinafter the equipment manufacturer's factory trained service personnel shall be on-site to supervise the installation.

The Contractor shall have an experienced, competent, and authorized representative of the manufacturer or supplier of each major item of equipment visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment manufacturer's representative shall be present when the equipment is placed in operation.

8.2 Pipes and Fittings

8.2.1 General

(1) Scope of Work

All pipe, fittings and accessories for the mechanical work shall be furnished by the Contractor. In addition, the Contractor shall furnish all labor, materials, equipment and incidentals required to install the piping, fittings and accessories appurtenances as shown on the Drawings. The completed installation shall be fully functional as shown on the Drawings. The fittings where shown are as a convenience to the Contractor. It may be necessary to supply and install additional fittings in different locations.

Also included under this Section is the supply and installation of certain miscellaneous items and accessories as hereinafter specified. Work to be done shall include hauling, laying, installing, jointing, welding, insulating, wrapping, testing and all other work necessary to produce a completed facility. The Contractor shall furnish and install couplings, fittings, gaskets, insulation, flanges, bolts, nuts, wall sleeves, wall pipes, harnesses and all other materials necessary to properly install the work shown on the Drawings and as specified.

Certain piping systems are shown diagrammatically as an indication of the work to be installed. The Contractor shall coordinate the work such that all work may be installed in the most direct and workmanlike manner, and so that interference between piping ducts, equipment, architectural and structural features and accessories and other work will be avoided.

(2) Pipe and Fittings

(a) General

Pipes and fittings for the mechanical work shall be compatible and have equal or higher-pressure ratings as specified.

Pipes, fittings and accessories shall be installed in full conformance with the manufacturer's recommendations.

Bedding, hanger details, supports and wall and floor penetrations shall be as shown on the drawings, or specified hereinafter.

When cutting of the pipe is required, the cutting shall be done by machine or arc in a neat and workmanlike manner without damage to the pipe, coating or lining. Cut ends shall be smooth and at right angles to the axis of the pipe.

(b) Handling

Care shall be taken during loading, transporting, and unloading to prevent injury to the pipes, fittings, or coatings. Under no circumstances shall pipe or fittings to be dropped or rolled against one another. All pipes or fittings shall be examined and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer..

8.2.2 Polyvinyl Chloride Pipe (PVC Pipe)

The materials of pipes and fittings for the mechanical work shall be followed with the clause 7.2.2. of this Specification.

8.2.3 Pipe Hangers and Supports

The Contractor shall provide all labor, materials, equipment, and incidentals necessary to furnish and install pipe hangers and supports, including, in general, all metallic hanging, supporting devices, all concrete pipers and supports for supporting piping.

Hangers and supports shall be of approved standard design where possible and shall be adequate to maintain the supported load in the proper position under all operating conditions.

Pipe hangers and supports shall be designed based on pipe weight, including water, and support spacing which are tabulated in the following table.

Nominal Pipe Diameter (mm)	Support Spacing	
	Steel Pipe or Cast (m)	PVC Pipe (m)
40 & smaller	2.0 - 3.0	1.0 - 2.0
50	2.0 - 3.0	1.0 - 2.0
65	2.0 - 3.0	1.5 - 2.0
80	2.0 - 3.0	1.5 - 2.0
100	4.0 - 5.0	1.5 - 2.0
125	4.0 - 5.0	2.0 - 3.0
150	4.0 - 5.0	2.0 - 3.0
200	4.0 - 5.0	2.0 - 3.0
250	4.0 - 5.0	2.0 - 3.0
300	4.0 - 5.0	2.0 - 3.0

SECTION 9 ELECTRICAL WORK

9.1 Scope of Work

The work shall include the supply, installation, testing and commissioning of the electrical services as further detailed on the Drawings and in this Specifications. The work includes, but is not limited to, the following:

Power supply from existing public distribution board to pump stations.

All distribution boards switches, cables and wiring devices for the systems in the chlorine dosing room.

9.2 Drawings

Layout and general arrangement drawings may be changed in accordance with the site conditions as approved by the Engineer.

Field verification of the real dimensions shall be determined by the Contractor since the dimensions shown on the Drawings may vary with the actual site conditions.

The Contractor shall carefully examine the architectural, structural and mechanical drawings to avoid possible installation conflicts. Should major changes from the drawings become necessary to resolve such conflicts, the Contractor shall notify the Engineer for written approval prior to variation of the work.

The Contractor shall submit to the Engineer Shop Drawings giving details of the layout, wiring and proposed conduit installation indicating the method and location of all termination. Such drawings shall be submitted in ample time for checking and no work shall be carried out until the drawings have been approved by the Engineer.

9.3 Approval of Materials, Fittings and Equipment

The electrical products shall comply with the appropriate standards stated in "1.3 Standards and Regulations" of the Specifications, unless otherwise specified. Before starting installation of any electrical product the Contractor shall submit to the Engineer for approval layout drawings and available information to be incorporated in the work, such as catalogues, diagrams and other data published by the manufacturer.

9.4 Tests and Adjustments

Every installation shall, on completion and before being energized, be inspected and tested in accordance with the requirements of local regulations by the Contractor at his own expense.

The method of the tests shall be such that there is no possibility of danger to persons or property or damage to equipment can occur.

The Engineer. shall be given the option of being present at such tests, and the Contractor shall give in reasonable advance a notice in writing before such tests are carried out. If during the tests, the installation fails to comply with the specified requirements, the Contractor shall make such alterations and adjustments at his own cost as may be necessary to make the installation comply with the Specifications.

9.5 Balancing, Phasing and Color Code

The load shall be balanced over the three phases as evenly as possible. The Color code of all wiring shall follow the AS 3000 - 1986 Section-3/or practice or its equivalent.

9.6 Grounding

An earth-electrode with a grounding earthling lead shall be provided at each distribution board to effectively ground all electrical equipment. Details of the grounding system including the grounding resistance and connection method shall be strictly in accordance with the local regulations.

A combination of green and yellow colored grounding wires shall be enclosed with their respective circuit runs throughout their length.

9.7 Power Distribution Board

The Contractor shall supply and install power distribution board(s) as further detailed and as shown on the Drawings. The distribution board(s) shall be of totally enclosed metal clad, self-standing type and/or wall mounting type, fabrication from a minimum of 1.5 mm sheet steel using folded sections and/or angle iron bracing where necessary for stiffeners and all joints welded with continuous seam welds. The distribution boards shall consist of one main circuit breaker, ground bars and links, and associated items as shown on the distribution board schedules.

9.8 Conditions and Conduit Fittings

Conduits to be used in this work shall be PVC.

Conduits, flexible conduits and conduit fittings shall comply with appropriate standards stated in "1.3 Standards and Regulations" of this Specification, unless otherwise instructed by the Engineer.

The internal radius of every bend shall be not less than 6 times the conduit diameter. The total cross-sectional area of the cables in the conduit shall not exceed 40 percent of the cross-sectional area of the conduit.

Junction boxes shall be securely mounted and fastened.

Conduits, where they are connected to the distribution board(s), pull boxes or other enclosures shall be perpendicular to the enclosure surface and shall be provided with appropriate fittings such as locknuts and bushings.

For the purpose of adjustment of position and prevention of vibration, conduits connected to an electric motor or other apparatus shall be flexible conduits of the same internal diameter as the conduit.

The Contractor shall obtain the End-user's prior approval for conduit location before commencing the work. The Contractor shall provide a combination of green and yellow colored 2. 5-mm2 PVC insulated wire in all empty conduits required for the work.

PART-B TECHNICAL SPECIFICATIONS

PART-B TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

1. GENERAL

This section covers the general requirements for all sewerage system to be constructed under the Contract and the specific requirements for the construction of the home type septic tank, communal septic tank, secondary septic tank, pump station, manholes, mounted leach field, conveyance sewer works and additional system for grey water that called slanted soil treatment system.

2. SCOPE OF WORK

The Work to be completed by the Contractor consists of the following:

(a) Home type septic tank – comprising the construction of the complete septic tank with two anaerobic chambers including the up-flow filter filling with aggregate. Three manholes are to be set on to two anaerobic chambers and up-flow chambers. Total volume of chambers is $1.5m^3$. In the Detail Design the home type septic tank is designed made of concrete or the Contractor may select an FRP model.

(b) Communal septic tank No.1 and No.2 – comprising the construction of the complete septic tank with two anaerobic chambers including the up-flow filter filling with aggregate. Three manholes are to be set on to two anaerobic chambers and up-flow chambers. Total volume of chambers of No.1 is 25 m^3 and No.2 is 2.5 m^3.

(c) Conveyance sewer piping – comprising a complete sewage water drainage system from septic tank through the intermediate pump station to the soil treatment bed or through 2^{nd} Septic to the Mount Leach Field.

(d) Intermediate pump station – comprising a complete pump pit with submersible pump that suck sewage water from pump pit and convey water from intermediate pump station up to the Mounted leach field or to 2^{nd} Septic tank through conveyance piping.

(e) 2^{nd} septic tank with pump – comprising a complete septic tank that has one aerobic chamber and pump pit with submersible pump that suck treated water from pump pit and convey water to the secondary Mounted leach field for terminal treatment.

(f) Mounted Leach Field – comprising a concrete retaining wall filled with sand, charcoal and gravel filter for soil treatment bed that is separated into two parts by wall. One part is Primary treatment bed and the other is secondary treatment bed. These two treatment beds comprise dual soil treatment system. At first about 60% of collected effluent from septic tanks poured into Primary treatment bed through pump station submersible pump. Through soil bed, sewage water will be treated by aerobic bacteria and then flow out from bottom of the bed to 2^{nd} septic tank. In this 2^{nd} septic tank 40% of remaining collected sewage water and the treated water will be mixed and in the aerobic chamber of 2^{nd} septic tank mixed two kind of water will be treated again by aerobic bacteria. Using submersible pump of 2^{nd} septic tank, treated water will be pump up to the Secondary treatment bed that will be tertiary treatment.

(g) Drying bed – comprising in-let pit, drying bed and out-let pit. Drying bed is filled with coral sand and coral rock filtration and onto the bottom of bed there will be geo-textile filtration. This part will be covered by transparent polycarbonate folded roof that should be able to open when one want to use the soil for fertilizer.

(h) Slanted soil treatment system – comprising three slanted plastic trays size 1000mm long 500mm width, cover box and out-let pit under the box. This system is just for high-loaded grey water that flow out from kitchen basin and cloth washing basin. After treated water stay in the bottom out-let pit once and flow out into existing permeable pit for grey water.

(i) Vacuum car – 2.0ton Truck Vehicle with 1,600l Vacuum car.

1) 2.0ton Truck Vehicle with flat deck
Length: 4,690±30mm, Width: 1,690±30mm, Engine: 2000cc
Spare tires: 4 pcs, Standard tool kit

2) 1,600l Vacuum car with engine
Total Length: 3,000mm±30mm, Width: 1,390mm±30mm,
Height at the highest point with truck vehicle from the ground level: 3,000mm or less
Tank Volume: 1,600l or more, Steel body
Vacuum Pump: -0.067Mpa (50cmHg) or less, 0.06Mpa(0.6kg/cm2) or more
Pump Capacity: Sack 1,000l/min or more, Discharge 700l/min or more
Engine: 2.9~4.4kW (4PS~6PS)
Hose: Sacking hose 20m, Discharge hose 4m

The Work shall be constructed in accordance with the Drawings, the Specifications and the directions of the Engineer.

Particular attention shall be given to the general obligations of the Contractor when working in the vicinity of existing utility services.

3. WORKS SPECIFIED ELSEWHERE

Care of Water shall be in accordance with Section 2

Demolition shall be in accordance with Section 2

Earthworks shall be in accordance with Section 3

Concrete work shall be in accordance with Section 4

Metal work shall be in accordance with Section 5

Roadworks shall be in accordance with Section 6

4. SUBMITTAL

The Contractor shall prepare a method statement for each division of the Work in which shall be submitted for the Engineer's approval in accordance with the procedures in Clause 1.3.5

The method statements shall provide comprehensive descriptions of the materials, equipment, construction methods, quality control procedures, environmental management and safety measures to be used and shall be supported by material specifications, detailed drawings of temporary works and calculations of their structural and functional adequacy. Particular attention shall be given to illustrating how the Contractor will manage public safety, accommodation of traffic and care of water pursuant to his obligations stated elsewhere in the Contract.

Working drawings and shop drawings shall be submitted in accordance with the requirements of Clause 1.3.

5. MATERIALS

5.1 Concrete

Concrete shall be of the following classes in accordance with the requirements of Section 4:

Cast in-situ concrete: - Class E

Plain Concrete: - Class F

Precast Concrete Sewer and Stormwater Drainage Pipes: - Class D

Precast Concrete Jacking Pipes: - Class A

5.2 Reinforcement

Reinforcement shall be deformed bars of the sizes shown on the Drawings.

5.3 Earthworks Materials

Earth fill, sandy soil fill and sand bedding shall be in accordance with the Drawings.

5.4 Manhole Covers

Manhole covers shall be of the following types

- All manhole covers shall include rubber seals between removable and fixed components to prevent the ingress of water into the manholes.
- All manhole covers and their respective frames shall be made in accordance with the Drawings, the directions of the Engineer and the Specification.

5.5 Non-Ferrous Pipes and Fittings

(a) PVC Pipes

PVC pipes and fittings shall conform to the requirements of the following standards:

JIS K 6739 Unplasticized Polyvinyl Chloride pipe fittings for drains

JIS K 6741 Unplasticized Polyvinyl Chloride (uPVC) pipes.

Pipes and fittings shall be of uPVC (Unplasticized Polyvinyl Chloride) with socket and spigot rubber ring joints.

uPVC pipe fittings shall be produced by injection moulding in one-piece integral with socket and spigot joints.

(b) Polyethylene Pipes

PE pipes and fittings shall be Class 1 as specified in JIS K 6761, Polyethylene Pipes for General Purpose.

5.6 Timber Piles

Timber Piles (Wooden Piles) shall be cut from Paper Bark or other locally available timber which, subject to the Engineer's approval, is suitable for the intended application. Piles shall be of single length, not shorter than 4,500 mm, with diameter 80 mm to 100 mm at the head and not less than 45 mm at any other section and shall be straight to a tolerance of 20 mm over their full length, stripped of any branches and of sound condition. Piles which do not conform to the foregoing requirements shall be removed from the Site. Splicing shall not be permitted.

6. CONSTRUCTION OF SEWERS BY OPEN CUT METHOD

6.1 General

Preparatory works, excavation, bed preparation and backfilling shall be carried out in accordance with the referenced specifications in Clause 7.3 of Part-A.

All reinforced concrete sewer pipes shall be laid to the lines and levels as shown on the Drawings or as directed by the Engineer. Laying of pipes shall start from the downstream end unless otherwise agreed to by the Engineer. Pipes shall be laid to a tolerance of + or - 15 mm from the given grade line of the invert and without low points.

All work shall be carried out in the dry and the Contractor shall keep excavations dewatered in accordance with his obligations for care of water under Section 2.

The method of pipe bedding shall differ according to the type of pipe support as shown on the Drawings.

6.2 Pipes with Sand Bedding and Surround

Where sand bed and sand surround is to be provided, after bottoming up the trench, sand bedding material shall be carefully placed and compacted in layers not exceeding 100 mm thickness to the required thickness for the full width of the trench. The material shall preferably be compacted by vibrating plate type plant using a minimum of one pass per layer. Should hand tamping be allowed by the Engineer the Contractor shall demonstrate by means of in-situ test to the approval of the Engineer that his proposed method of compaction will achieve a minimum of 90% of the maximum dry density as determined by the AASHTO T 99 test or equivalent.

The bedding shall be constructed so as to ensure even and continuous support throughout the length of the barrel of each pipe. Recesses shall be formed in the bedding to accommodate pipe sockets.

After laying and jointing pipes, the bedding shall be placed and hand compacted in layers not exceeding 100 mm thick. Care should be taken that the bedding material is well rammed into the cavities under the two lower quadrants of the pipe and that the bedding is brought up simultaneously and evenly on both sides of the pipe. Sand bedding shall be placed and compacted up to a minimum of 200 mm above the crown of the pipe.

Backfilling of the trench above this level shall be performed in accordance with the requirements of Section 7.3 of Part-A.

6.3 Pipes with Concrete Base or Concrete Encasement

Where the Drawings call for concrete base (120 deg or 180 deg) or concrete encasement, a sand bed shall be constructed up to 200 mm below the final invert level of the pipe to be laid in the manner described in Clause 7.3.2 above.

Pipes shall be jointed and accurately laid to the required level and gradient with supporting chocks, wire cradles or wedges.

Concrete bedding (Concrete Class F) or reinforced concrete (Concrete Class E) as the case may be, shall then be placed in accordance with the requirements of Section 6 of Part-A, taking care that concrete fully supports the pipe and that the pipe is not dislodged during casting. Concrete cover to reinforcement shall be 50 mm.

Where the design calls for concrete base support (120 or 180 deg) backfilling shall be carried out in the manner specified in Clause 7.3.2 of Part-A. Such backfilling shall not commence until the concrete has reached an age of at least 7 days or as otherwise approved by the Engineer.

Where pipes are fully encased backfilling of the void between the concrete encasement and the trench walls shall be carried out using hand tamping in layers not thicker than 100 mm up to the top of the encasement. Above this level backfilling shall be in accordance with the requirements of Section 7.3 of Part-A.

6.4 PVC Sewer Pipes

The general requirements stated in Clause 7.3.1 of Part-A shall apply to uPVC sewer pipes.

After bottoming up the trench, sand bedding material shall be carefully placed and compacted in layers not exceeding 100 mm thickness to the required thickness for the full width of the trench. The material shall preferably be compacted by vibrating plate type plant using a minimum of one pass per layer.

The bedding shall be constructed so as to ensure even and continuous support throughout the length of the barrel of each pipe. Recesses shall be formed in the bedding to accommodate pipe sockets.

After laying and jointing pipes, the sand backfill shall be placed. Care should be taken that the sand material supports the two lower quadrants of the pipe and that it is brought up simultaneously and evenly on both sides of the pipe. Sand shall be placed and tamped up to a minimum of 200 mm above the crown of the pipe.

Backfilling of the trench above this level shall be performed in accordance with the requirements of Section 7.3 of Part-A.

7. CONSTRUCTION OF SEWER BY PIPE JACKING METHOD

7.1 General

(a) The Contractor shall construct sewer pipelines using the jacking method for the sections of the main interceptor sewer so indicated in the Drawings or as otherwise approved by the Engineer to the lines and grades as shown on the Drawings or as directed or approved by the Engineer.

(b) Excavation shall be carried out by equipment capable of maintaining and adjusting alignment as necessary.

(c) Equipment and systems shall be designed to provide the forces necessary for the installation of the full pipe string between driving and receiving pits

(d) Provision shall be made for closing up the exposed excavation face at all times.

(e) The pipe jacking procedure described in the Contractor's method statement shall be made in full consideration of the ground and groundwater conditions along the pipeline route and shall be discussed with, and shall have the approval of, the Engineer prior to implementation.

7.2 Sealing and Packing

(a) Pipe joints shall comply with all relevant provisions of JSWAS-A2-1999.

(b) Joint packing material, in accordance with the pipe manufacturer's recommendations shall be inserted at each pipe joint and at any jacking station.

(c) After completion of jacking, cavities behind jacked pipes shall be filled with grout injected under pressure, unless otherwise agreed with the Engineer. All lifting holes and grouting holes shall be sealed with a 1:3 cement: sand mortar with plasticizer, or a purpose-made plug.

7.3 Monitoring and Instrumentation

(a) The Contractor shall survey, monitor and record all work as it proceeds so as to form a complete record of the work which shall include records of level measurements. Copies of all records shall be supplied to the Engineer at agreed intervals.

7.4 Disposal of Spoil

The Contractor shall dispose of spoil in accordance with the requirements of the Engineer.

7.5 Connection with Manholes

Laying pipes shall be cut back such that the ends of pipes will be embedded in the wall of the manhole 50 mm beyond the inner face.

8. CONSTRUCTION OF MANHOLES

Preparatory works, excavation, bed preparation and backfilling shall be carried out in accordance with the referenced specifications in Clause 7.3 of Part-A.

Manholes and diversion chambers shall be constructed in the locations and to the lines and levels shown on the Drawings or as directed by the Engineer. Care shall be taken to ensure a complete seal of the cast-in-situ concrete of the manhole or diversion chamber with the PE or PVC pipes which join into, or are constructed within, the structures.

All manholes and diversion chambers shall be constructed such that they are watertight.

Benching consisting of plain concrete (Concrete Class F) shall be placed in the bottom of manhole or diversion structures as shown on the Drawings. A 20 mm thick granolithic topping shall be provided to the surface of the concrete benching. Granolithic coating shall consist of cement: granite mix approximately 1: 2 by weight. The granite chips shall be hard, non-weathered granite, free of clay or other deleterious matter of maximum size 6 mm. Prior to application the benching surface shall be wire brushed to remove all laitance and loose material and the surface thoroughly wetted. The granolithic topping shall be steel trowel finished to produce a smooth surface and shall provide a uniformly graded channel though the manhole from inlet to outlet.

Block-outs for guide frames for trash screens and stop logs shall be allowed for during placement of concrete. Metalwork items including embedded guide frames, ladder rungs, trash racks shall be placed in accordance with the requirements of Section 5 of Part-A.

Certain diversion chambers, as shown on the drawings, require the installation of pipework and a valve for regulation of the discharge to the interceptor sewer. Such pipe work and valve shall be installed as shown on the Drawings. A concrete pedestal (Concrete class F) shall be formed to support the weight of the valve. Pipes shall be embedded in the walls of the manholes during casting of the manholes. The floor of valve chambers shall be sloped at not less than 1:100 to a 100 mm deep sump as shown on the drawings.

Where water level alarms are shown on the Drawings, the high level and low level electrodes shall be installed in the diversion chambers or manhole, as the case may be, at the levels indicated or instructed by the Engineer. The method at fixing shall be in accordance with the manufacturer's recommendations and be such that it is readily accessible for checking and maintenance. Cabling for water level electrodes shall be run in galvanized steel conduit to the guard kiosk where the control and annunciation equipment is to be installed.

Manhole frames shall be solidly bedded in 1:3 sand cement mortar so that the covers, when in position, are fair and even with the adjacent finished surfaces.

9. CONSTRUCTION OF CONVEYANCE SEWER

9.1 General

The Contractor shall construct the portion of the conveyance sewer from the outlet from the Septic tanks in household and communal facilities up to the treatment facilities including Mounted Leach field and 2nd septic tank as shown on the Drawings.

Works shall be carried out in accordance with the requirements of other sections of the Specification as noted in Clause 7.3 of Part-A, as specified in this Clause and the directions of the Engineer.

9.2 Programming of Activities

The Contractor shall not commence work on the construction until adequate temporary office site has been provided to.

9.3 Precast Concrete Cover Slabs

Precast concrete cover slabs shall be made to the dimensions shown on the Drawings and shall be regular, flat and without defects such as porosity.

All slabs which are do not pass the Engineer's visual inspection shall be removed from the site.

Concrete shall be Class D as specified in Section 4 of Part-A.

Slabs shall be stored and handled such that they are not damaged or chipped.

10. INSPECTION, TESTING AND CLEANING OF SEWERS

10.1 General

All sewers, including manholes shall be tested, inspected and cleaned.

Should the visual inspection or tests fail, the Contractor shall, at his own cost, replace defective pipes, make good any leaking joint, or otherwise re-execute defective work, after which cleaning, inspection and testing shall be repeated.

Only sewers which have undergone inspection and testing and have received the Engineer's approval shall be approved for payment.

The Contractor shall provide all equipment and personnel for carrying out tests and assisting the Engineer or his Representative in performing inspections.

All costs incurred by the Contractor in complying with the requirements of this Clause shall be deemed to be included in the unit rates for the respective sewer elements.

10.2 Scope of Inspection and Testing

Testing and inspection shall be performed in accordance with the following schedule:

Sewer Type or Element	Size	Test(s) and Inspections to be carried out
RC Pit RC Septic tank	All	Visual Inspection Leakage Test
uPVC and PE internal pipes	All	Visual Inspection
Manholes	All	Visual Inspection

Expected reduction rate of BOD for the system will be more than 90%.

10.3 Visual Inspection

All joints, including joints between pipes and manholes or septic tanks, shall be subject to inspection by the Engineer or his Representative.

10.4 Leakage Test

After completion of backfilling and restoration of normal sub-soil conditions, all sewers, manholes and septic tanks shall be inspected for infiltration. Acceptance criterion for this test is infiltration not exceeding 0.5 litres per linear metre per metre of nominal bore (for circular sections) or 0.5 litres per linear metre per metre width (for rectangular sections including manholes and septic tanks).

10.5 Cleaning and Inspection of Sewers

The Contractor shall at all times take reasonable measures to prevent the ingress of solid matter into sewers. Such steps shall include, but not be limited to the provision of temporary plugs where appropriate.

Following completion of sewers and manholes, the interior of pipelines and box culvert sections shall be cleaned of all silt and debris and inspected by the Engineer.

Pipelines of 150 mm diameter or smaller shall be demonstrated to be clear or all obstructions by drawing a sphere 25 mm smaller than the internal diameter of the pipe throughout the length of the section under inspection.

Should the Contractor fail to keep an inspected sewer satisfactorily isolated after it has been inspected and shown to be free of obstruction, he shall repeat cleaning and demonstrate to the Engineer's satisfaction that it is clear of obstruction, all at his expense, shortly before taking over.

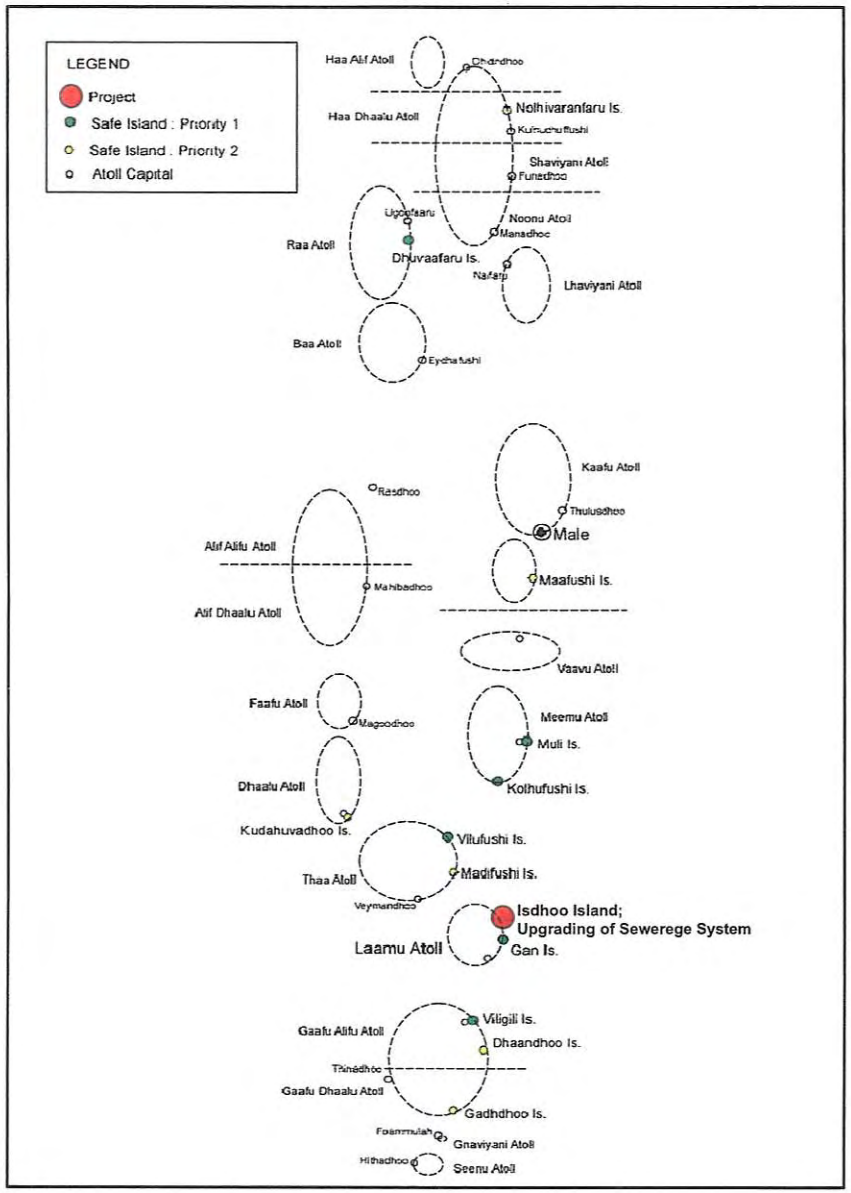
THE PROJECT FOR UPGRADING OF SEWERAGE SYSTEM IN LAAMU ATOLL IN MALDIVES

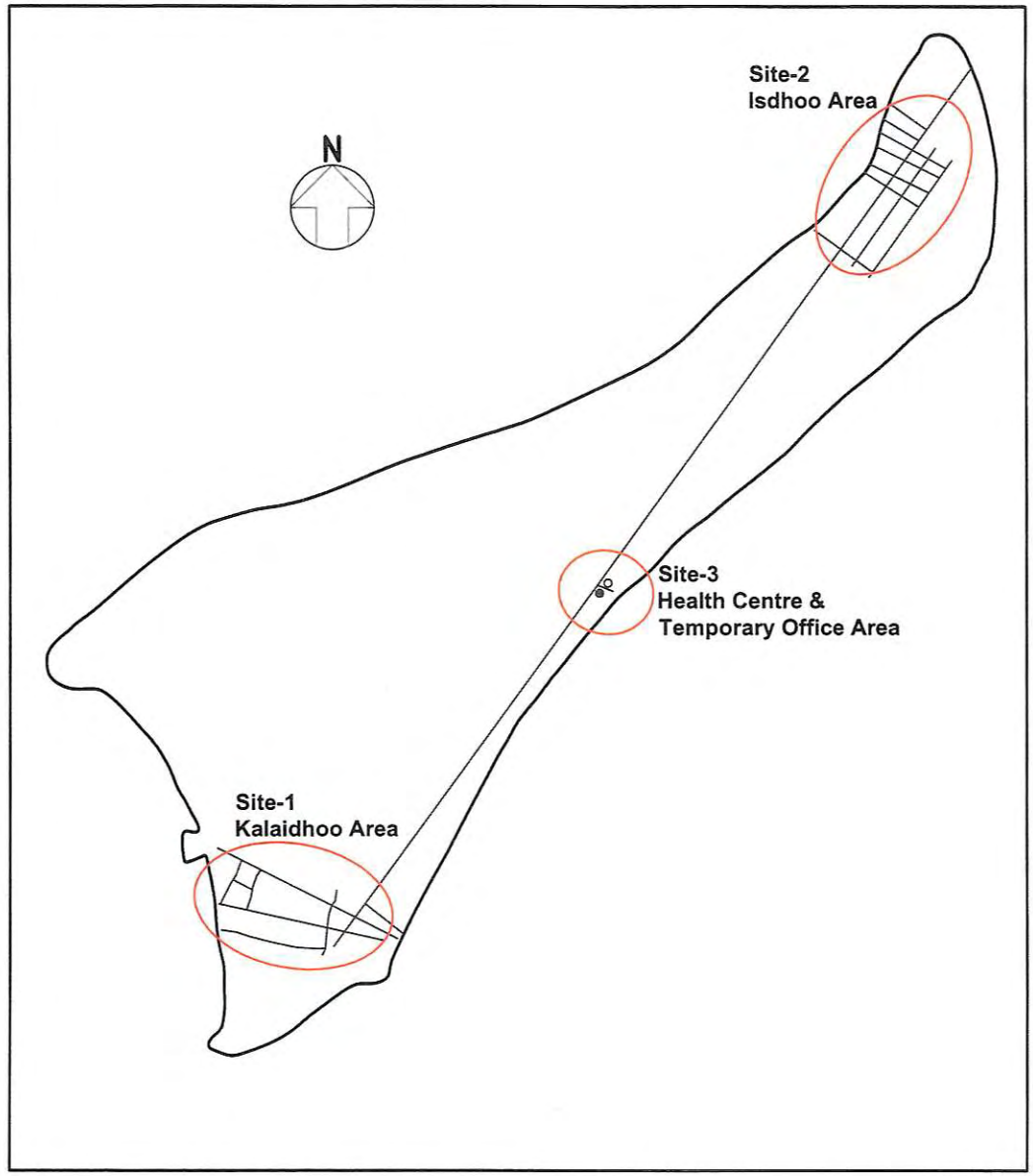
ISDHOO ISLAND

DRAWING LIST

Sheet Number	Sheet Title
P-01	Project Location
P-02	Layout Plan for SITE-1 Kalaidhoo Area (Overall)
P-03	Layout Plan for SITE-1 Kalaidhoo Area-1/4
P-04	Layout Plan for SITE-1 Kalaidhoo Area-2/4
P-05	Layout Plan for SITE-1 Kalaidhoo Area-3/4
P-06	Layout Plan for SITE-1 Kalaidhoo Area-4/4
P-07	Layout Plan for SITE-2 Isdhoo Area (Overall)
P-08	Layout Plan for SITE-2 Isdhoo Area-1/3
P-09	Layout Plan for SITE-2 Isdhoo Area-2/3
P-10	Layout Plan for SITE-2 Isdhoo Area-3/3
P-11	Layout Plan for SITE3 Health Center & Temporary Office Area
P-12	Home Type Septic Tank
P-13	Communal Type Septic Tank
P-14	Second Septic Tank with Pump
P-15	Mounted Leach Field (1) Dual Step Soil Treatment System
P-16	Mounted Leach Field (2)
P-17	Mounted Leach Field (3)
P-18	Dry Bed for Sewage Sludge
P-19	Typical Pump Installation
P-20	Standard Details for Sewage Manhole
P-21	Common Pipe Setting Detail
P-22	Charcoal Processing Device
P-23	Slanted soil treatment
P-24	The Sewerage System Facility List 1/2
P-25	The Sewerage System Facility List 2/2

Project Location Map - 2 : Isdhoo Island





JICA JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF MALDIVES
MINISTRY OF FOREIGN AFFAIRS
MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT

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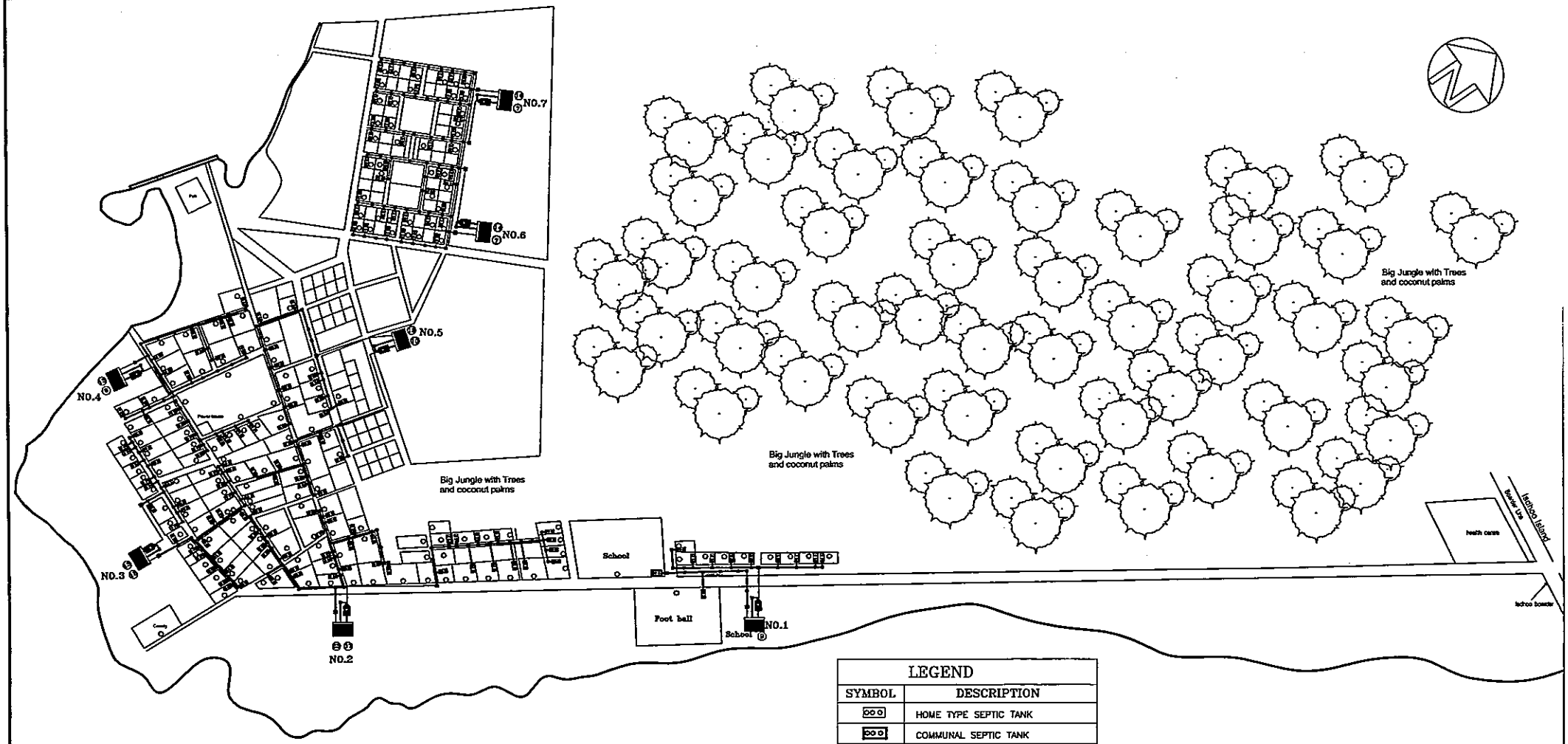
THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES

YEC YACHIYO ENGINEERING CO.,LTD.
NK NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Project Location

SCALE	SHEET NO.	REV. NO.
Not to Scale	P-01	



LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

NOTE:

1. VP 100ø – PIPING CONNECTION FOR 01 No. HOME TYPE SEPTIC TANK.
2. VP 150ø – PIPING CONNECTION FOR 2 Nos. & ABOVE HOME TYPE SEPTIC TANKS.

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yec YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE Isdhoo Island
Upgrading of Sewerege System
Layout Plan
for SITE-1 Kalaidhoo Area (Overall)

SCALE	SHEET NO.	REV. NO.
1 : 5000	P-02	

KEY PLAN

LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

NOTE:

1. VP 100ø – PIPING CONNECTION FOR 01 No. HOME TYPE SEPTIC TANK.
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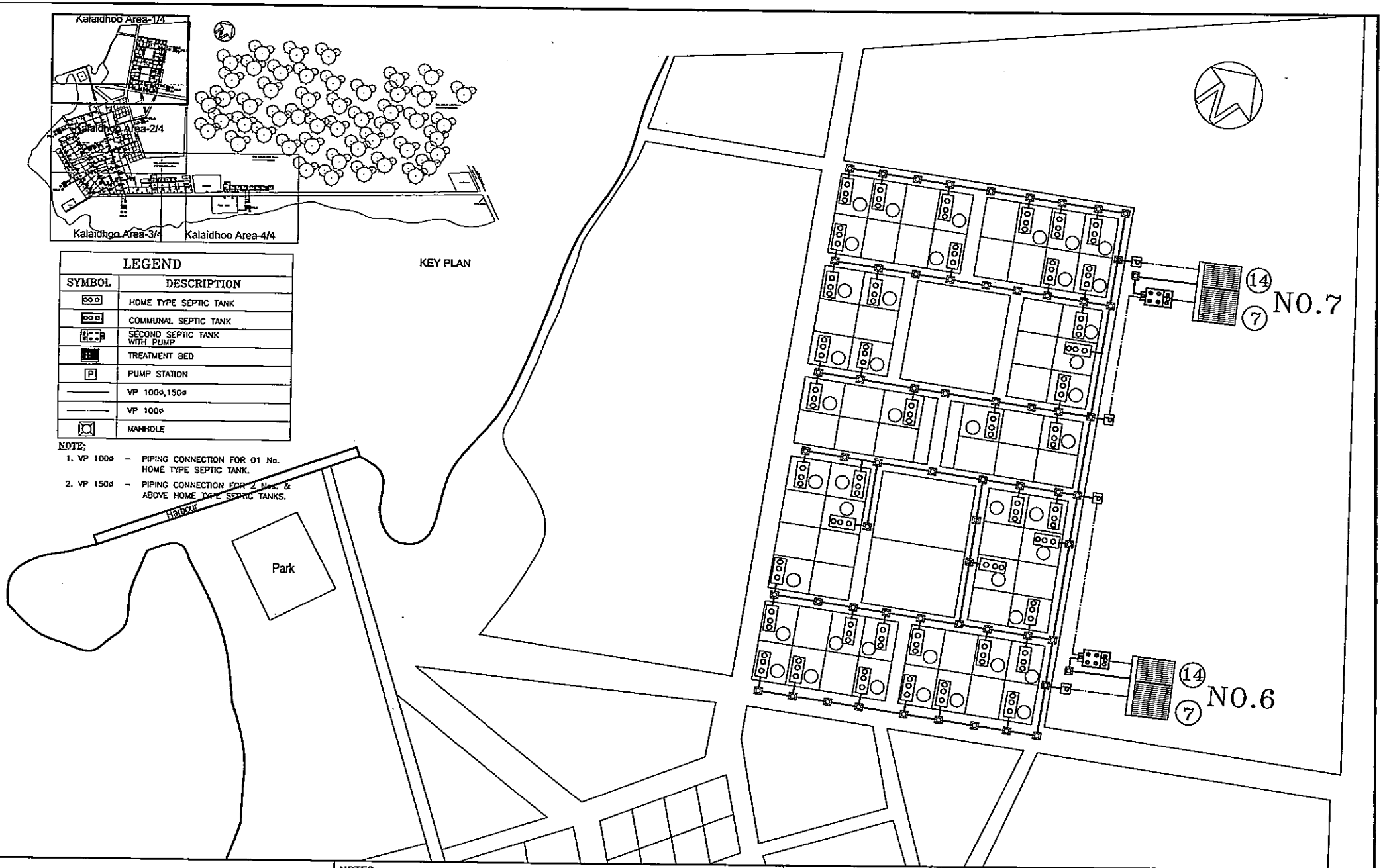

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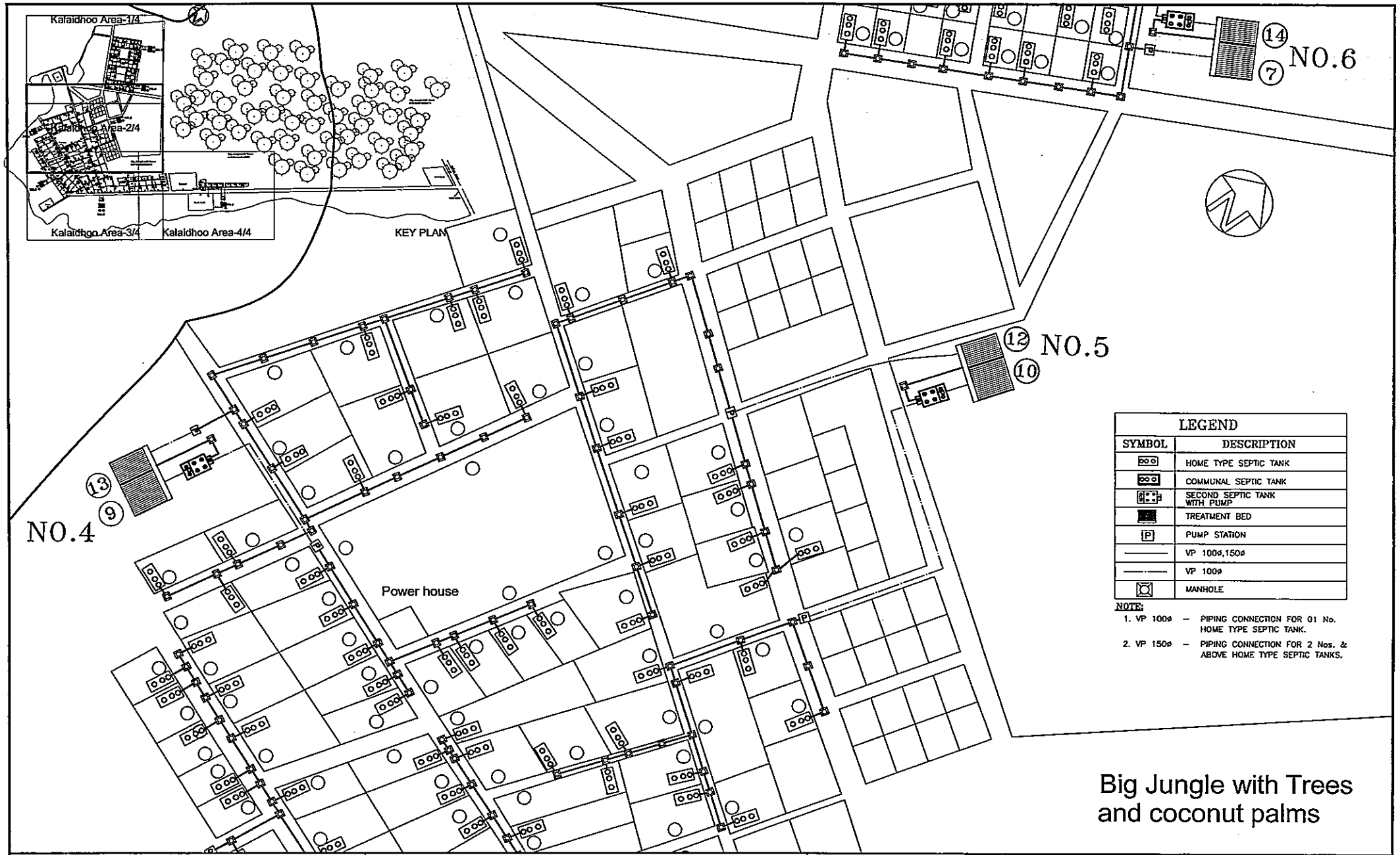
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-1 Kalaidhoo Area-1/4

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-03	



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NIPPON KOEI CO.,LTD.

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NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-1 Kalaidhoo Area-2/4

SCALE	SHEET NO.	REV. NO.
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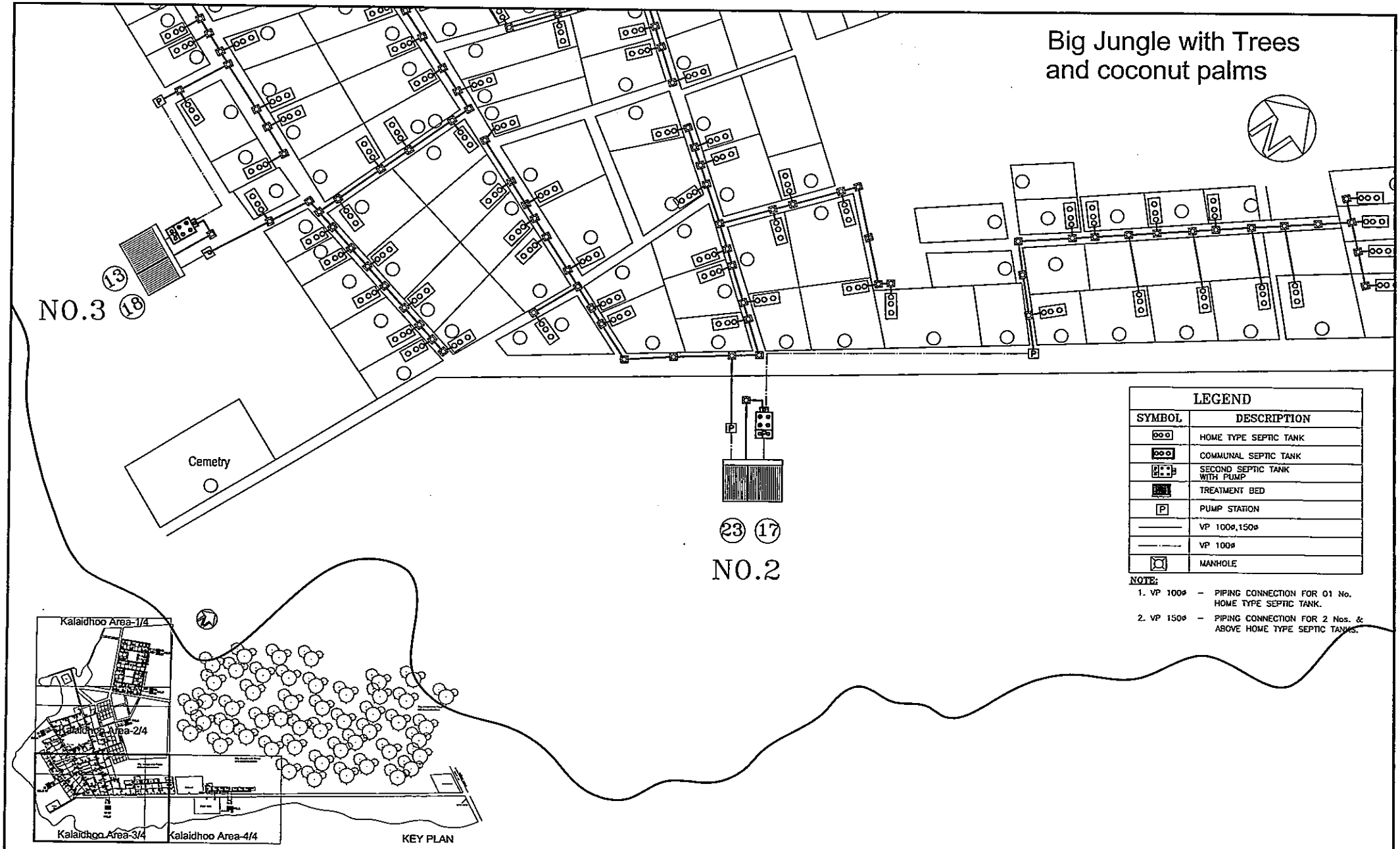

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NIPPON KOEI CO.,LTD.

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NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-1 Kalaidhoo Area-3/4

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-05	

Big Jungle with Trees
and coconut palms

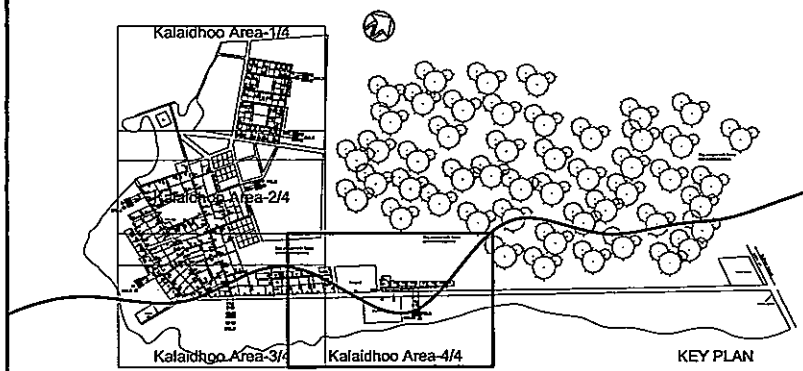
Big Jungle with Trees
and coconut palms

School

Green area

Foot ball

School ⑨ NO.1



KEY PLAN

LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

NOTE:
1. VP 100ø – PIPING CONNECTION FOR 01 No. HOME TYPE SEPTIC TANK.
2. VP 150ø – PIPING CONNECTION FOR 2 Nos. & ABOVE HOME TYPE SEPTIC TANKS.

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NIPPON KOEI CO.,LTD.

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NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-1 Kalaidhoo Area-4/4

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-06	

LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

NOTE:

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NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE: Isdhoo Island
Upgrading of Sewerege System
Layout Plan
for SITE-2 Isdhoo Area (Overall)

SCALE	SHEET NO.	REV. NO.
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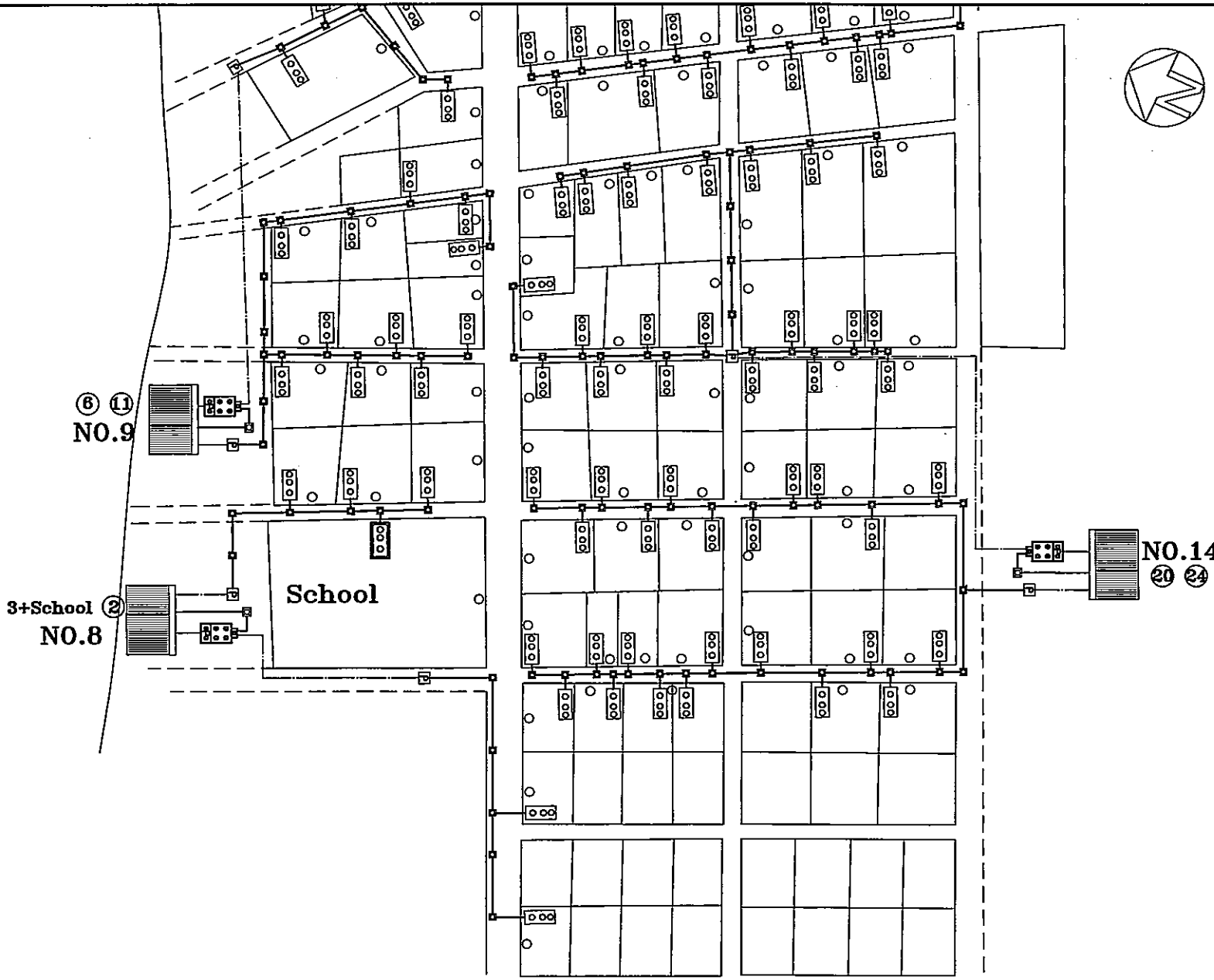

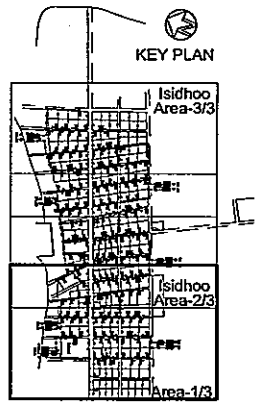

LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
———	VP 100ϕ,150ϕ
———	VP 100ϕ
	MANHOLE

NOTE:
1. VP 100ϕ – PIPING CONNECTION FOR 01 No. HOME TYPE SEPTIC TANK.
2. VP 150ϕ – PIPING CONNECTION FOR 2 Nos. & ABOVE HOME TYPE SEPTIC TANKS.

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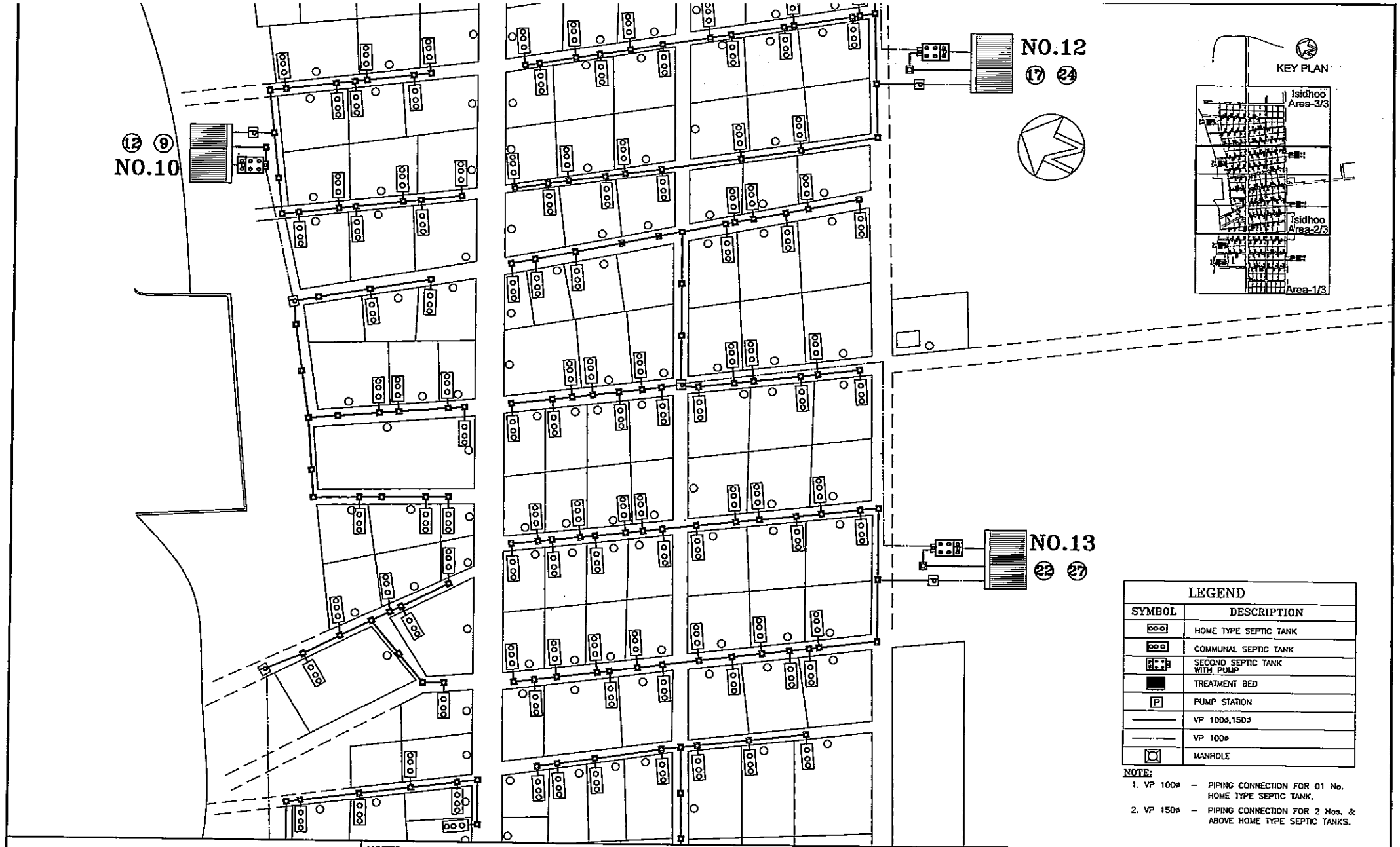
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-2 Isdhoo Area-1/3

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-08	



LEGEND	
SYMBOL	DESCRIPTION
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	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

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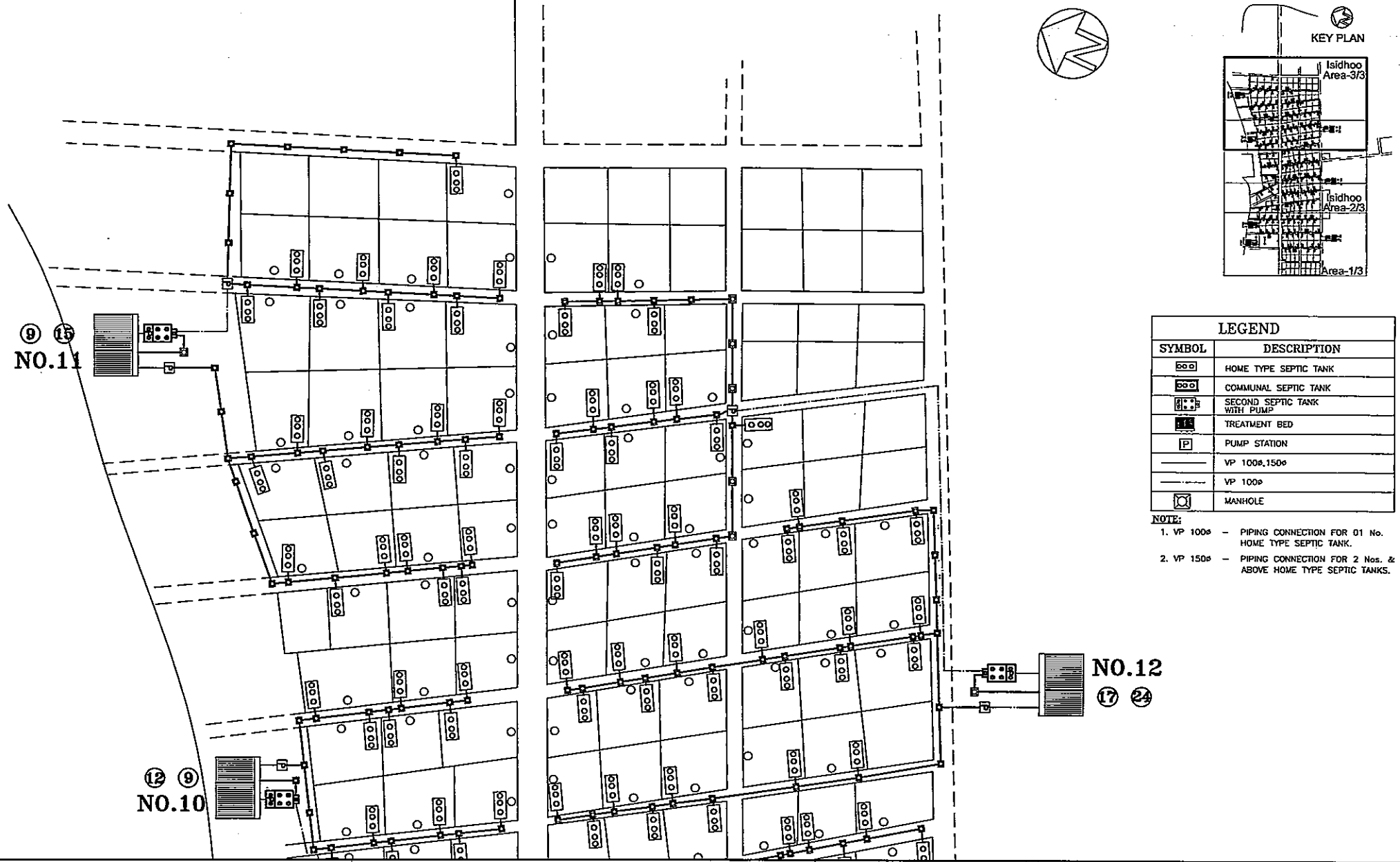
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-2 Isdhoo Area-2/3

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-09	



KEY PLAN

LEGEND	
SYMBOL	DESCRIPTION
	HOME TYPE SEPTIC TANK
	COMMUNAL SEPTIC TANK
	SECOND SEPTIC TANK WITH PUMP
	TREATMENT BED
P	PUMP STATION
	VP 100ø,150ø
	VP 100ø
	MANHOLE

NOTE:

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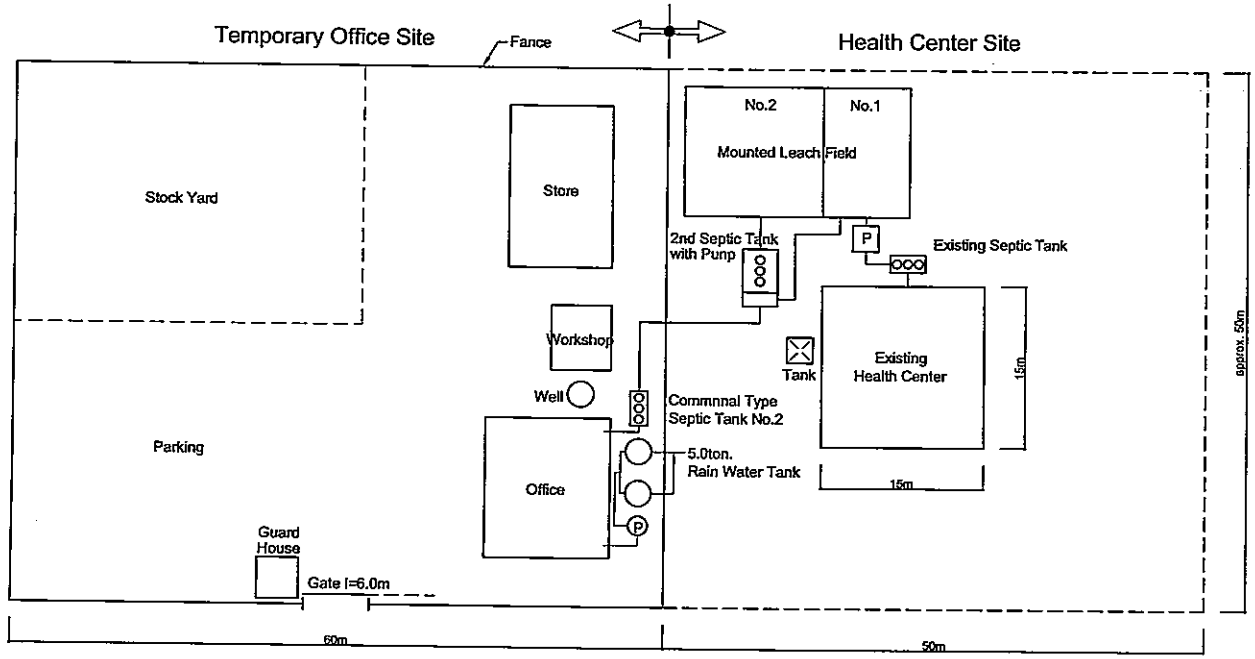
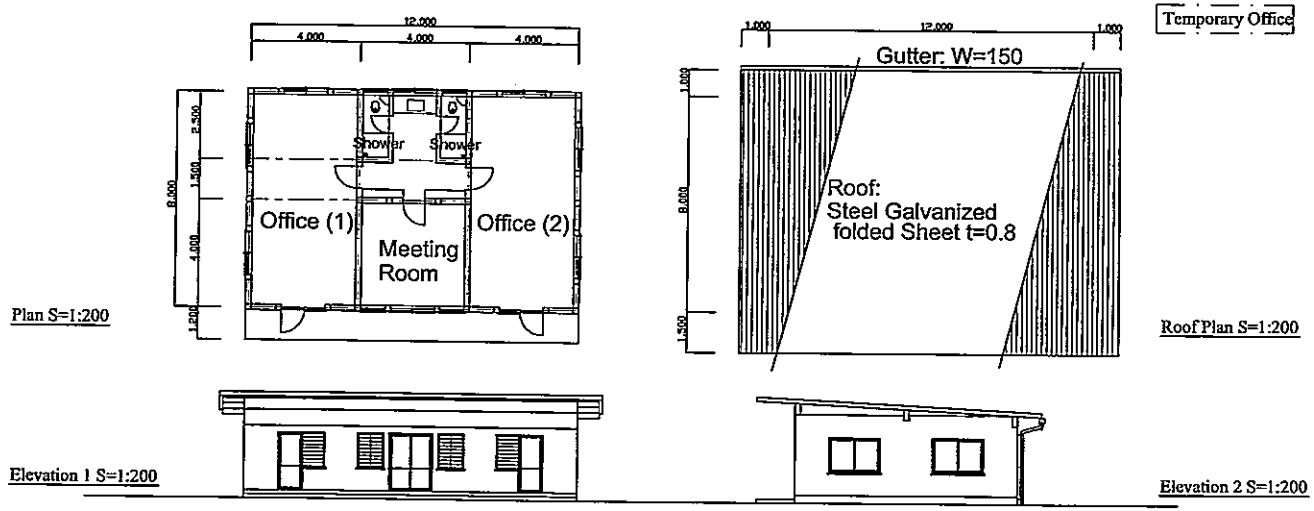
yec YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE-2 Isdhoo Area-3/3

SCALE	SHEET NO.	REV. NO.
1 : 1500	P-10	





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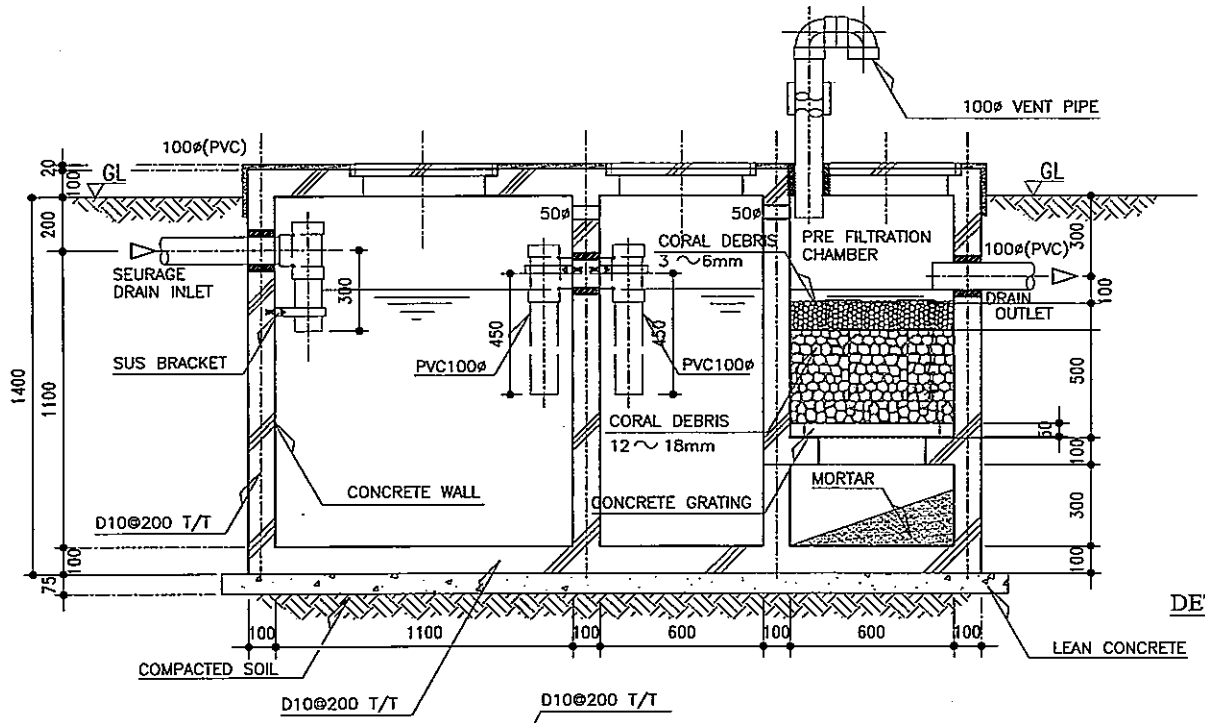
YEC YACHIYO ENGINEERING CO.,LTD.
NK NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE: Isdhoo Island
Upgrading of Sewerege System
Layout Plan for SITE3 Health Center & Temporary Office Area

SCALE	SHEET NO.	REV. NO.
1 : 500/1 : 200	P-11	

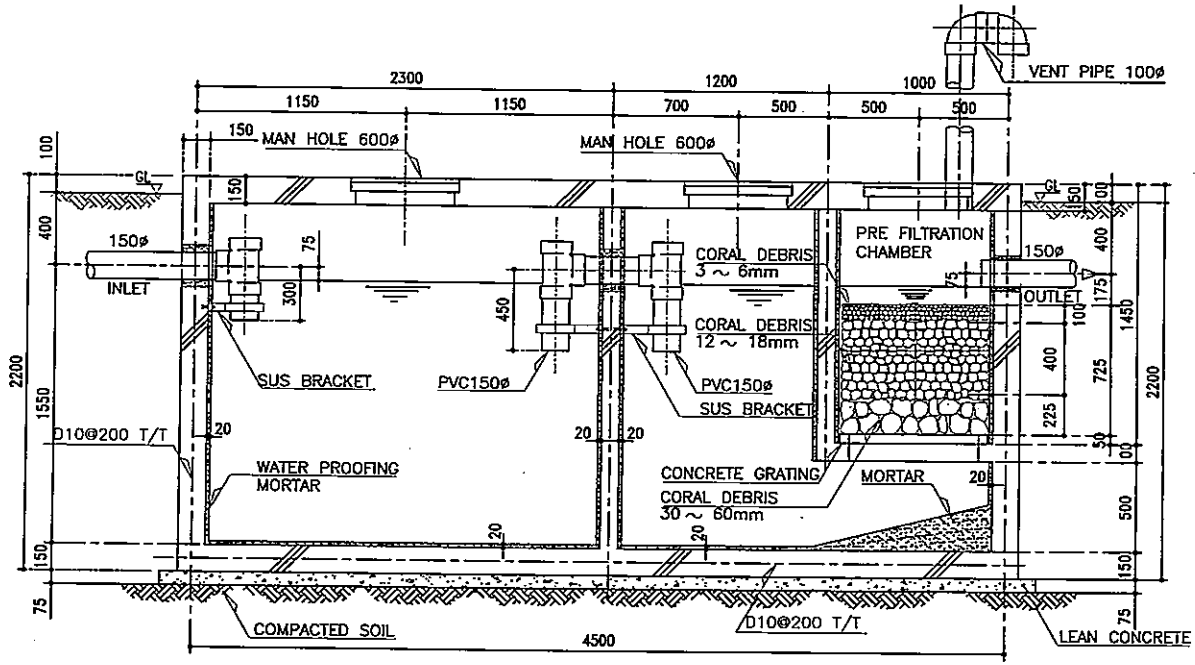


DETAIL SECTIONAL S=1:20

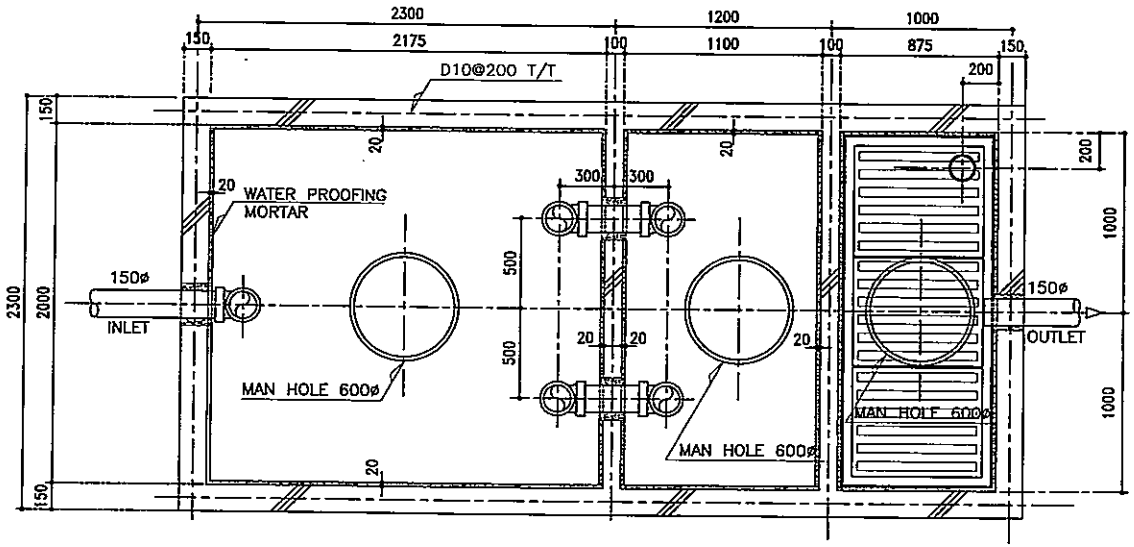
DETAIL PLAN S=1:20

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	NOTES:	THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES	
REPUBLIC OF MALDIVES MINISTRY OF FOREIGN AFFAIRS MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT		YEC YACHIYO ENGINEERING CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE Isdhoo Island Upgrading of Sewerege System Home Type Septic Tank

	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
NAME	Y. Horigome	Y. Horigome	M. Komiya	1 : 20	P-12	
SIGNATURE						
DATE	July 20, 2005	July 20, 2005	July 30, 2005			



SECTIONAL S=1:30



DETAIL PLAN S=1:30

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF MALDIVES
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MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT

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NIPPON KOEI CO.,LTD.

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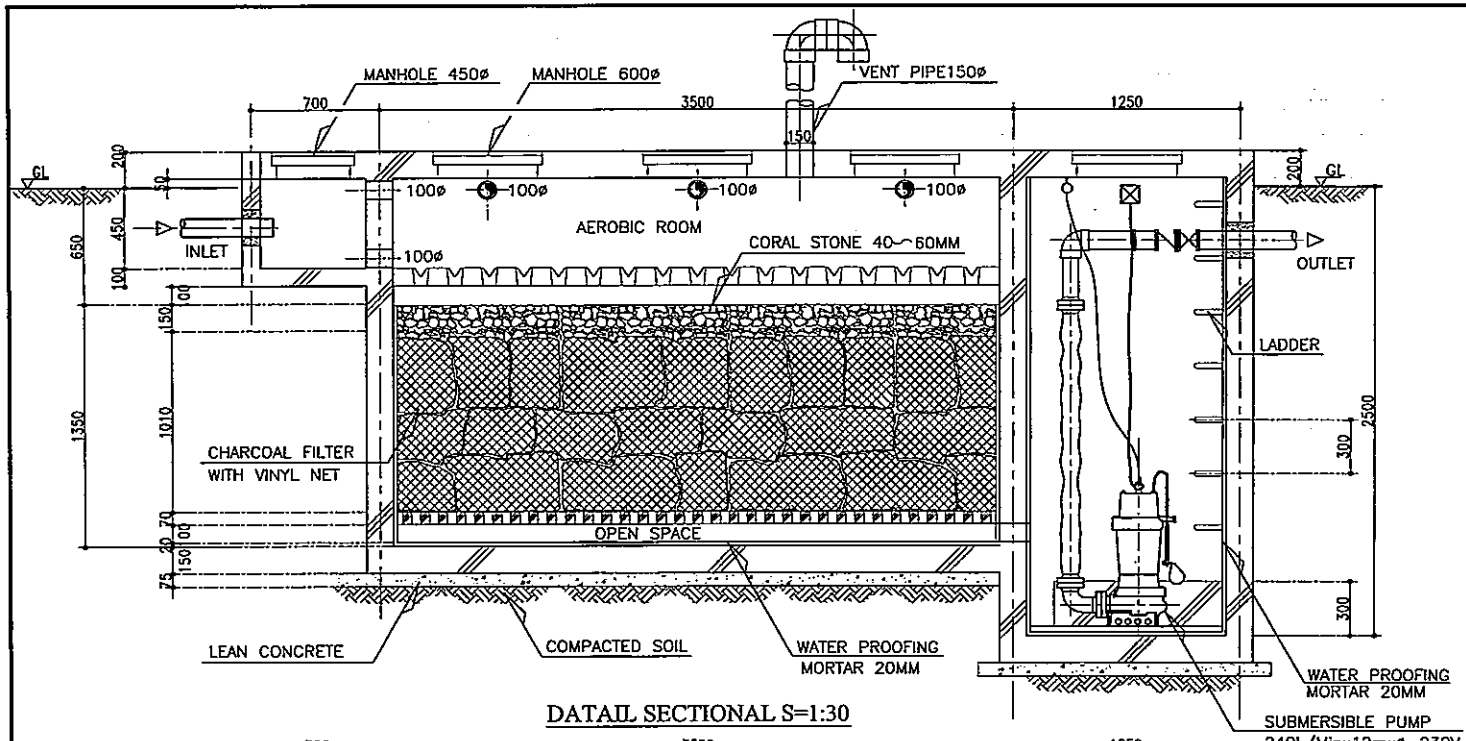
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Communal Type Septic Tank

SCALE	SHEET NO.	REV. NO.
1 : 30	P-13	



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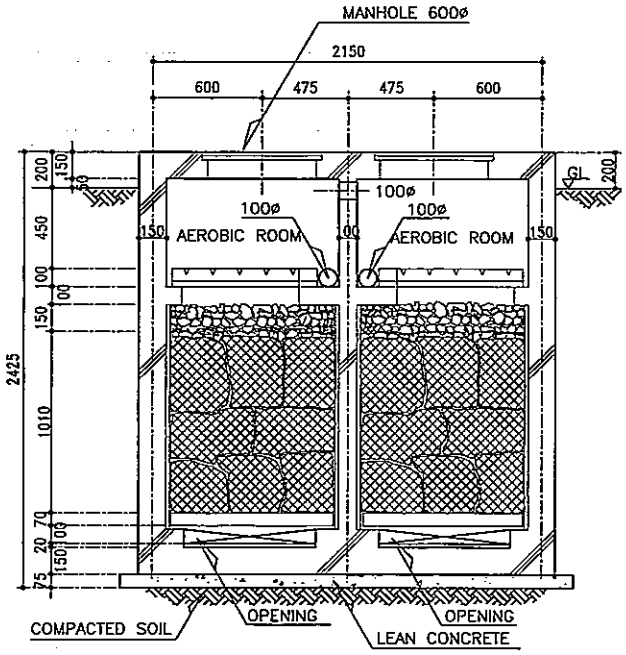

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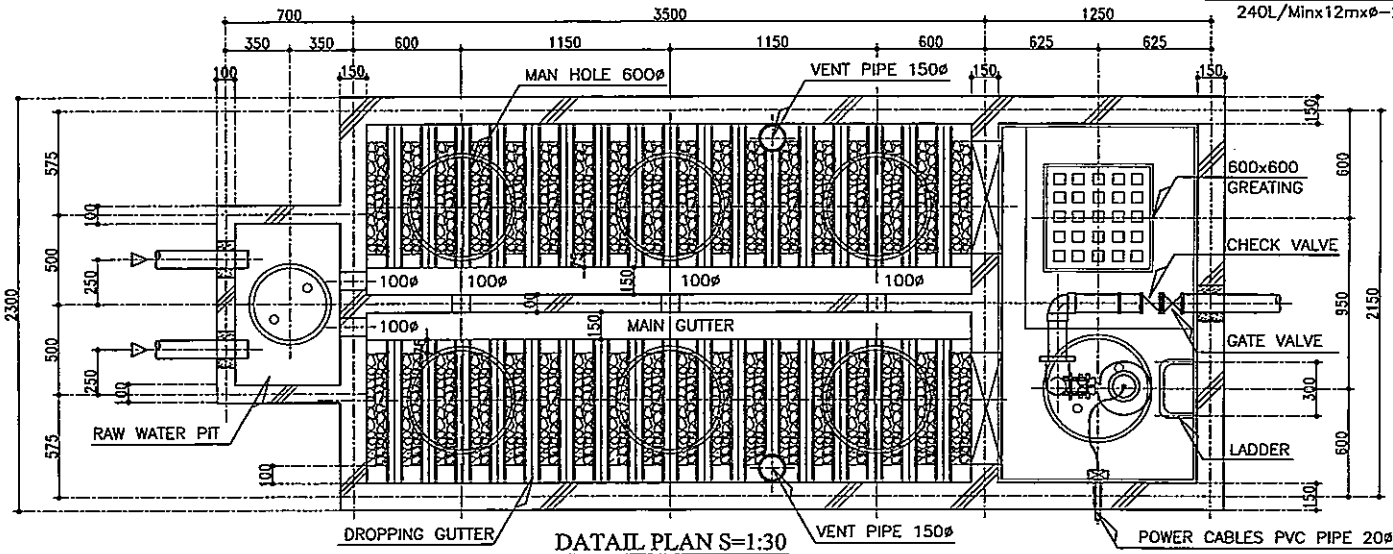

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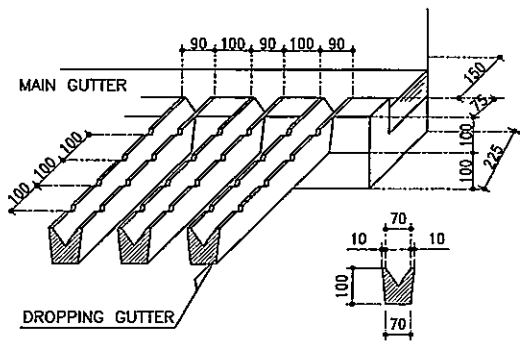

DETAIL OF DROPPING GUTTER

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MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT

NOTES:

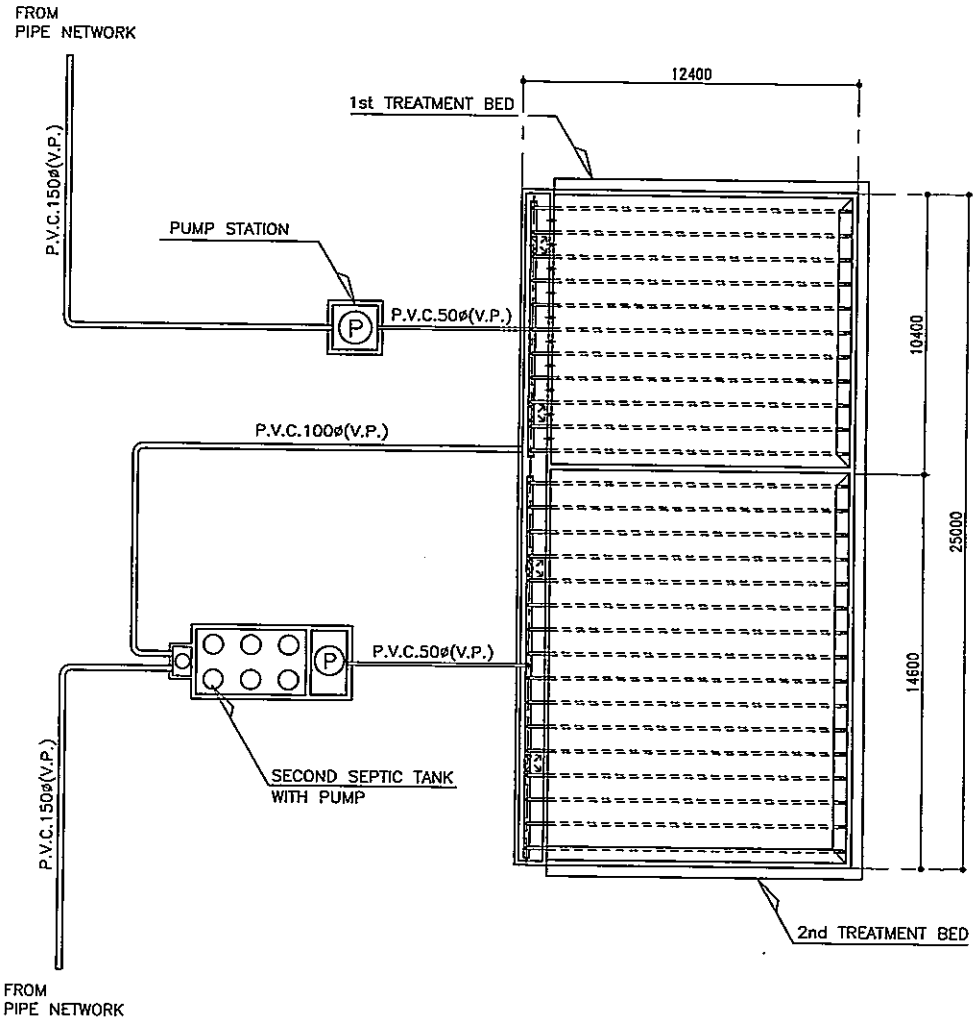
THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES

YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

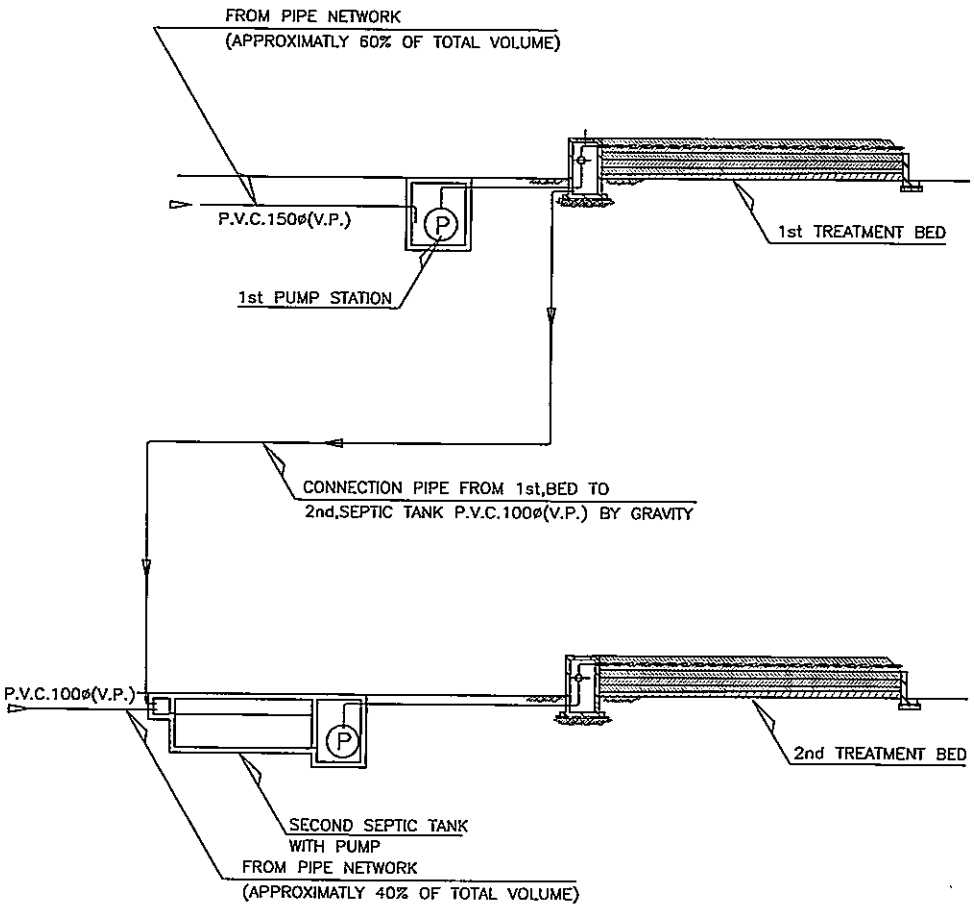
	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Second Septic Tank with Pump

SCALE	SHEET NO.	REV. NO.
1 : 300	P-14	



BLOCK PLAN S=1:200



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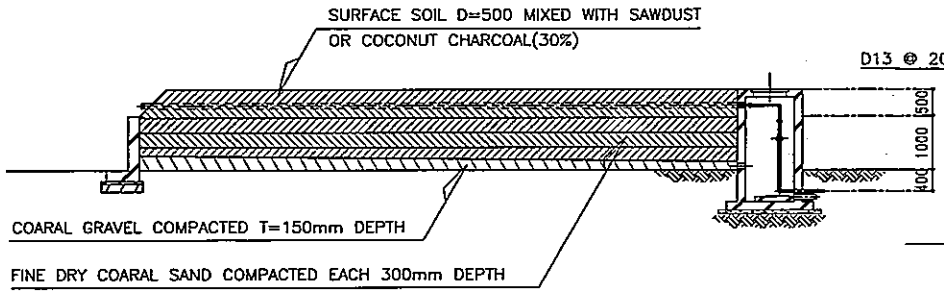
YEC YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

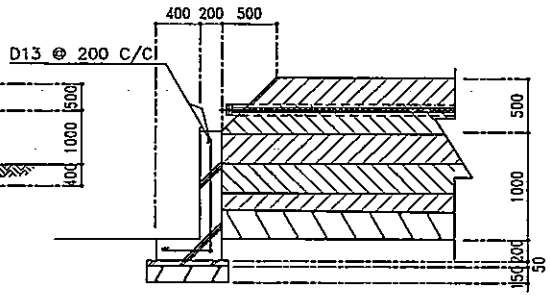
	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE: Isdhoo Island
Upgrading of Sewerege System
Mounted Leach Field (1)
Dual Step Soil Treatment System

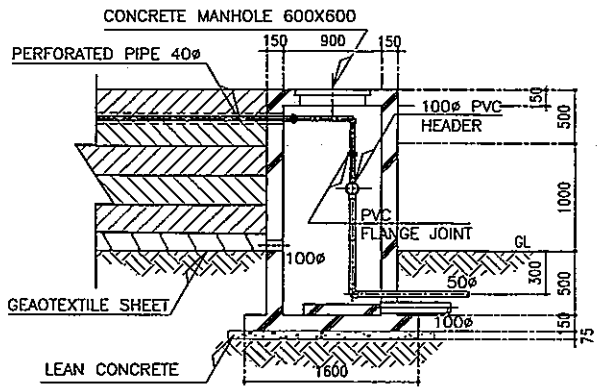
SCALE	SHEET NO.	REV. NO.
1 : 200	P-15	



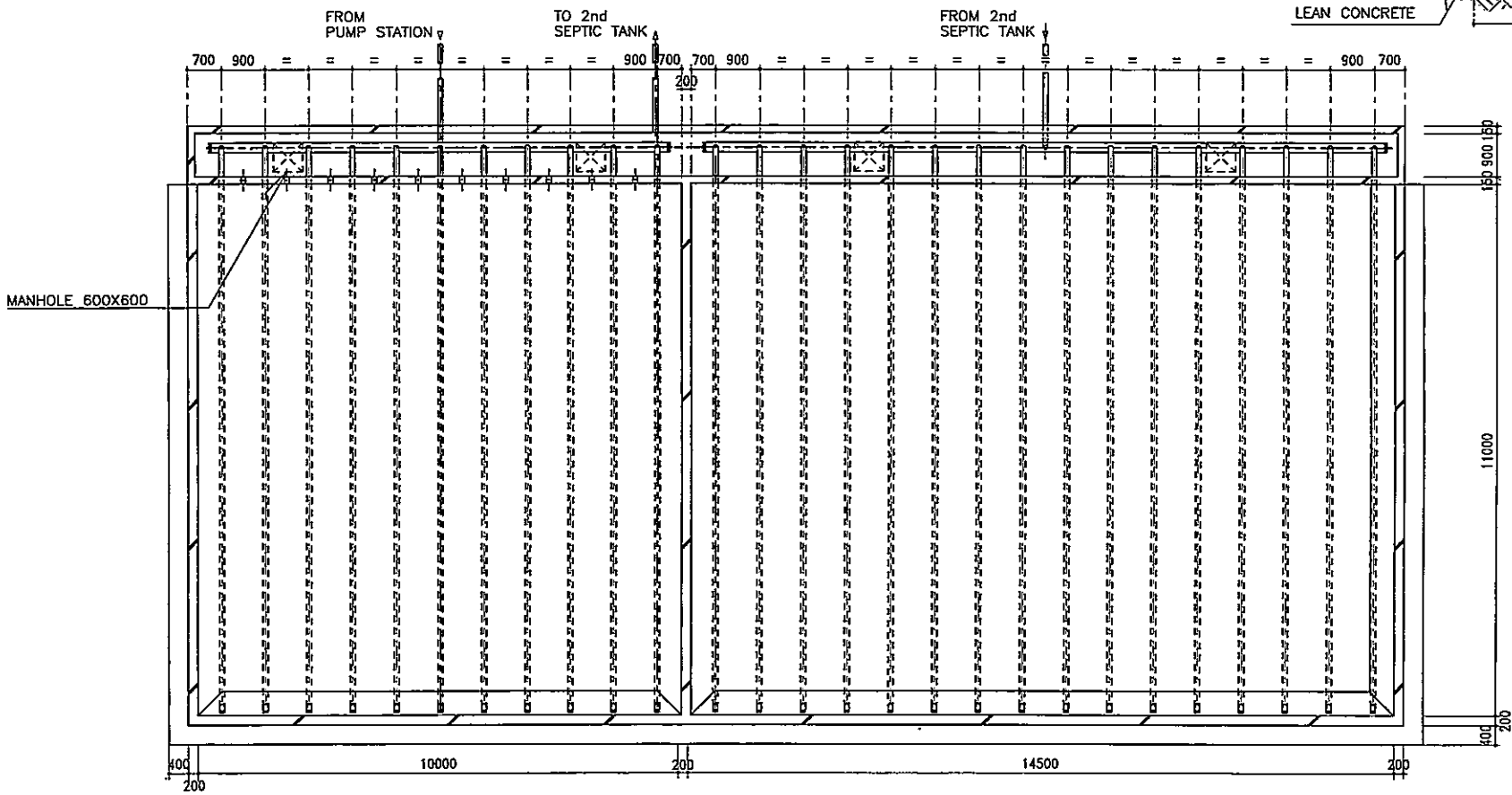
SECTION S=1:100



DETAIL SECTION (A) S=1:50



DETAIL SECTION (B) S=1:50



PLAN S=1:100

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NIPPON KOEI CO.,LTD.

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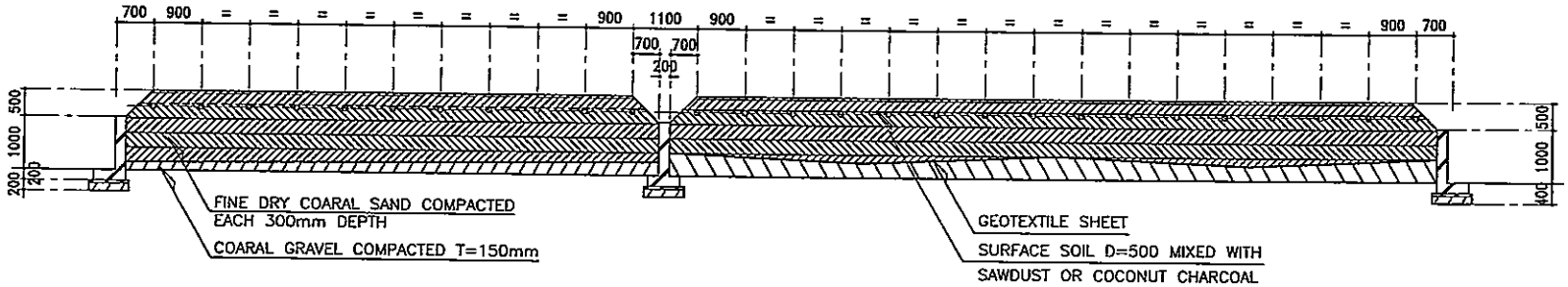
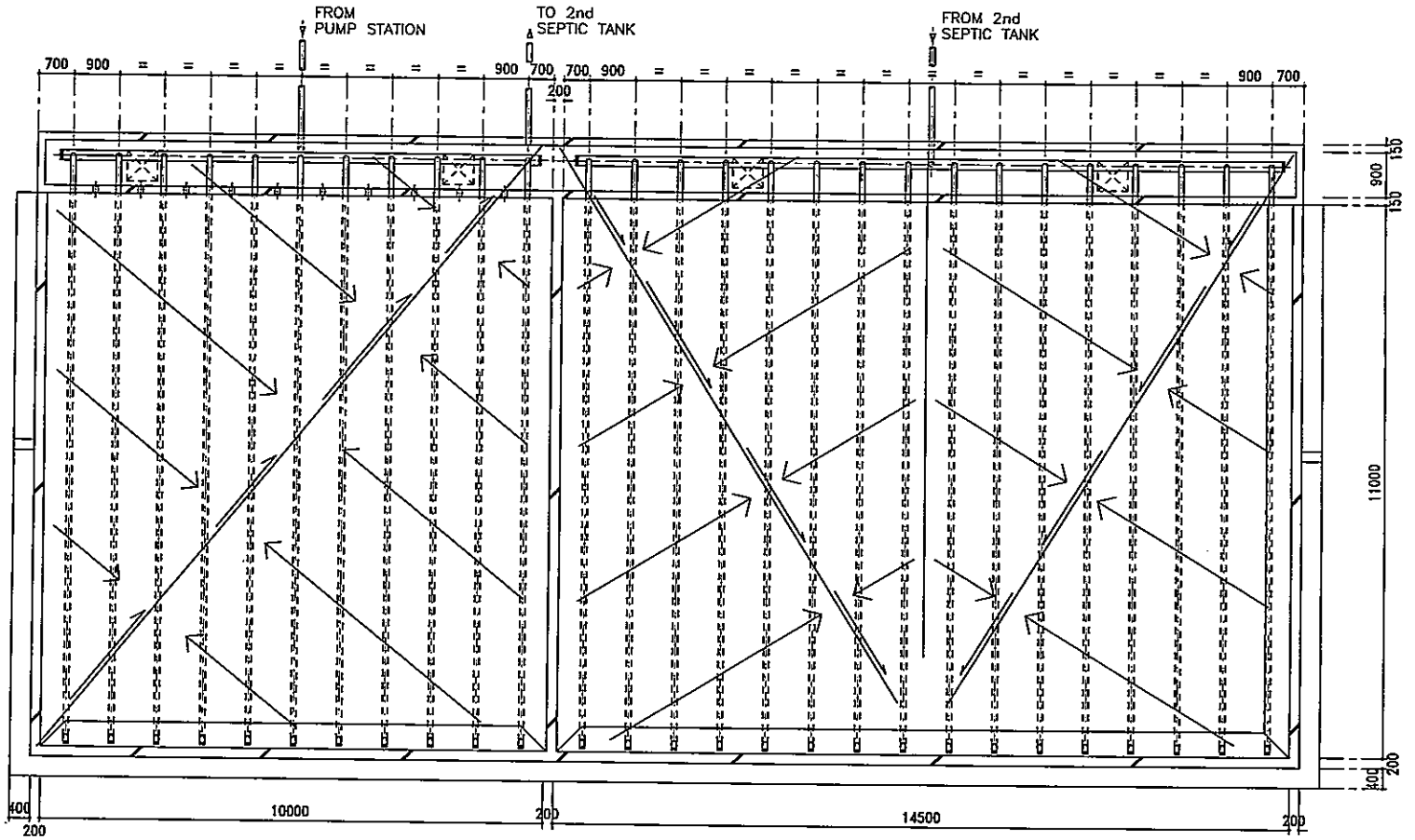
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Mounted Leach Field (2)

SCALE	SHEET NO.	REV. NO.
1 : 100	P-16	



SECTION S=1:100



BASEMENT FLOOR PLAN S=1:100

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NIPPON KOEI CO.,LTD.

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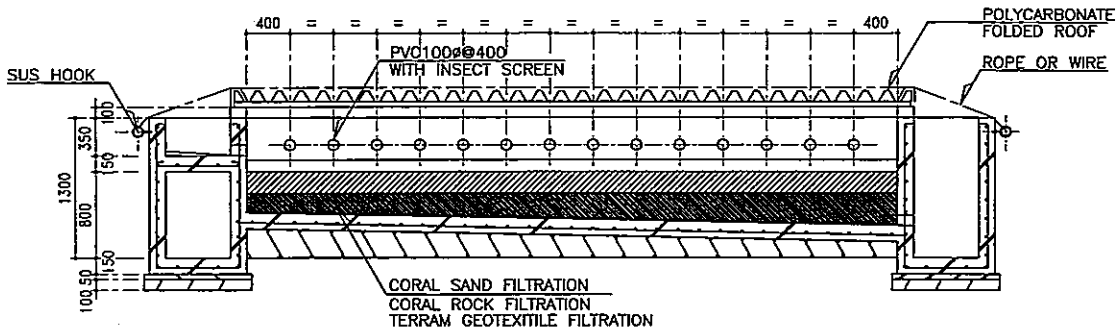
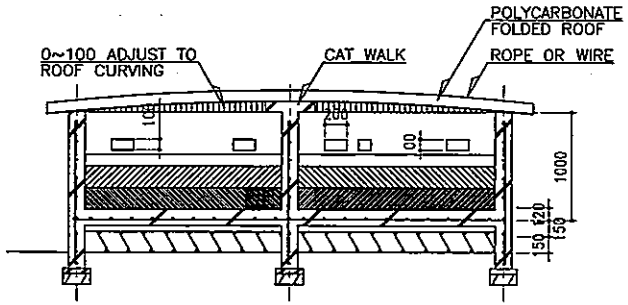
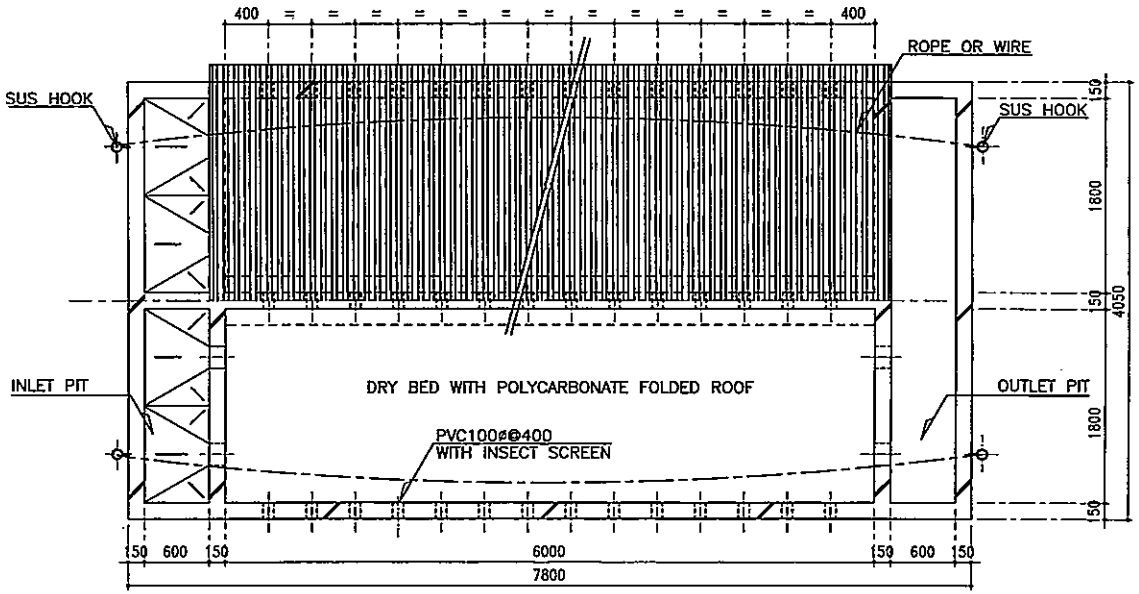
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Mounted Leach Field (3)

SCALE	SHEET NO.	REV. NO.
1 : 100	P-17	

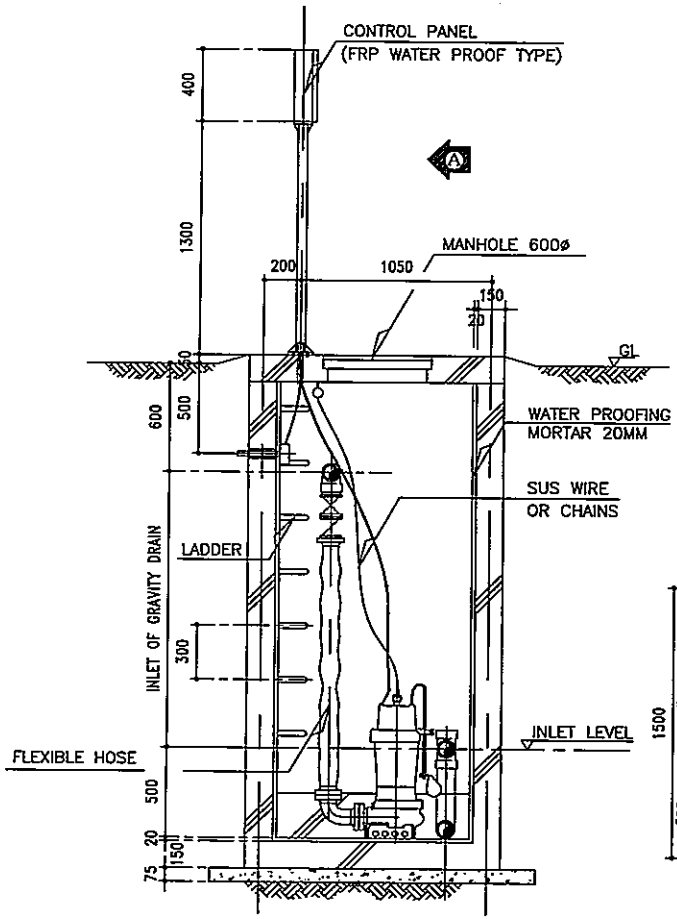




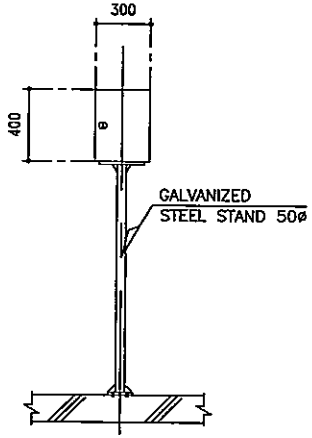


JICA JAPAN INTERNATIONAL COOPERATION AGENCY	NOTES:	THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES	
REPUBLIC OF MALDIVES MINISTRY OF FOREIGN AFFAIRS MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT		YACHIYO ENGINEERING CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE Isdhoo Island Upgrading of Sewerege System Dry Bed for Sewage Sludge

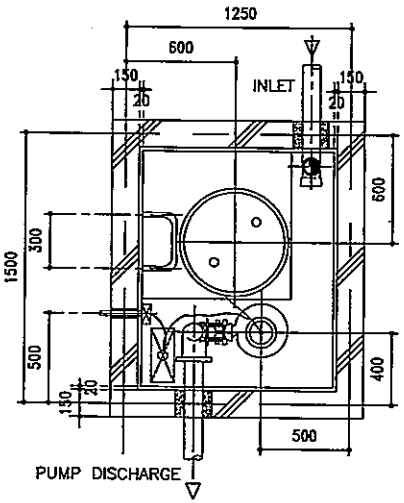
	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
NAME	Y. Horigome	Y. Horigome	M. Komiya			
SIGNATURE						
DATE	July 20, 2005	July 20, 2005	July 30, 2005	1 : 50	P-18	



SECTIONAL ELEVATION S=1:30



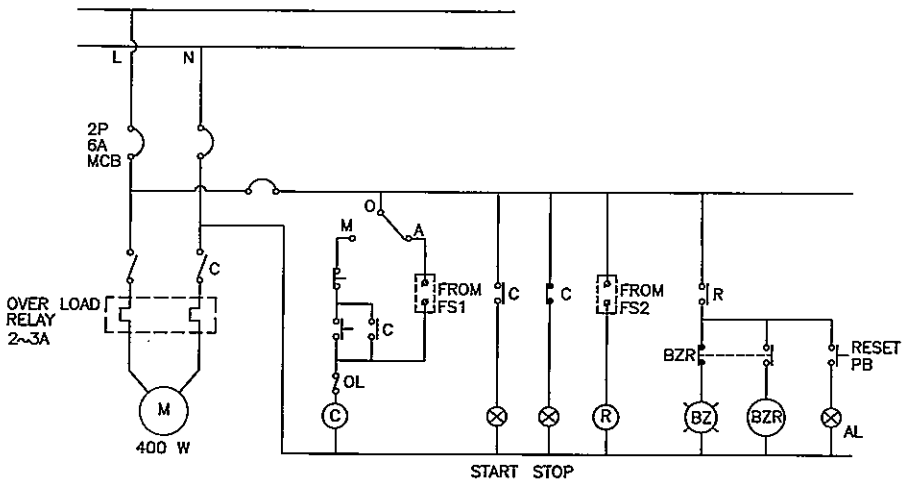
ELEVATION-A
(CONTROL PANEL)



PLAN S=1:30

ABBREVIATIONS

FS1 – PUMP ON LEVEL
FS2 – PUMP STOP LEVEL
BZ – BUZZER
BZR – BUZZER RELAY



CONTROL CIRCUIT FOR
SUBMERSIBLE PUMP

FLOAT SWITCH FUNCTONS

* HIGH LEVEL ALARM
* PUMP ON
* PUMP OFF

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YEC YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

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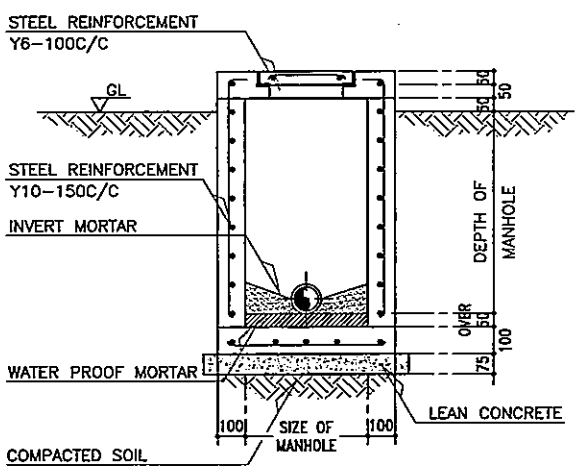
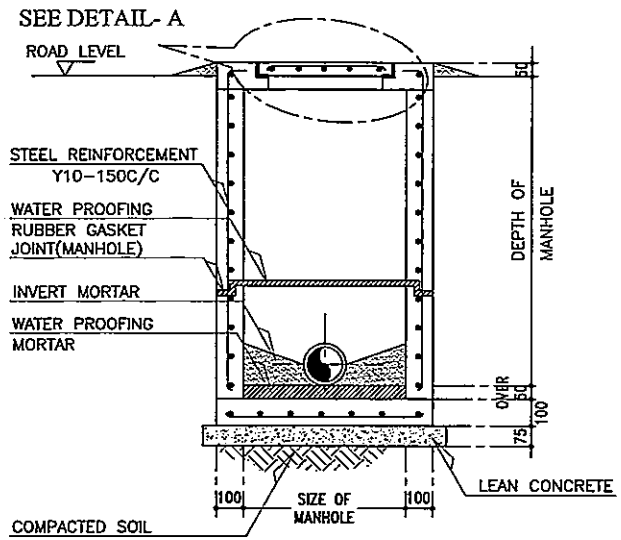
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Typical Pump Installation

SCALE	SHEET NO.	REV. NO.
1 : 30	P-19	



SECTIONAL ELEVATION

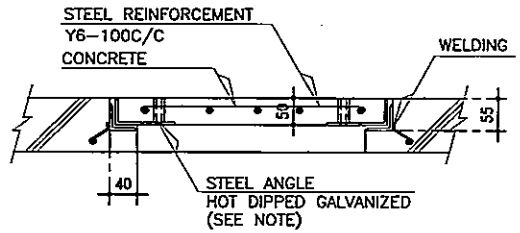


SECTIONAL ELEVATION

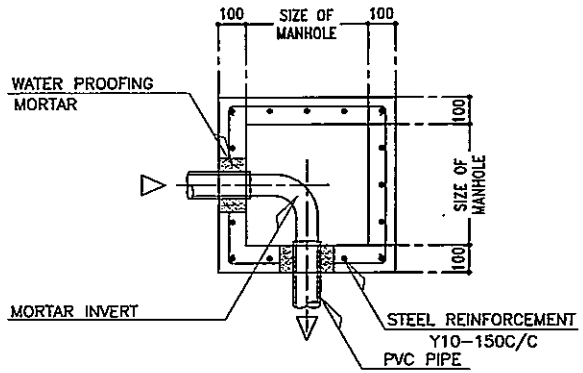
STANDARD SIZES OF CONCRETE MANHOLES

DEPTH (MM)	SIZE (MM)
UP TO 450	300 x 300
UP TO 1200	450 x 450
OVER 1200	600 x 600

NOTE:
1. ALL THE STEEL ANGLE SHOULD BE HOT DIPPED GALVANIZED

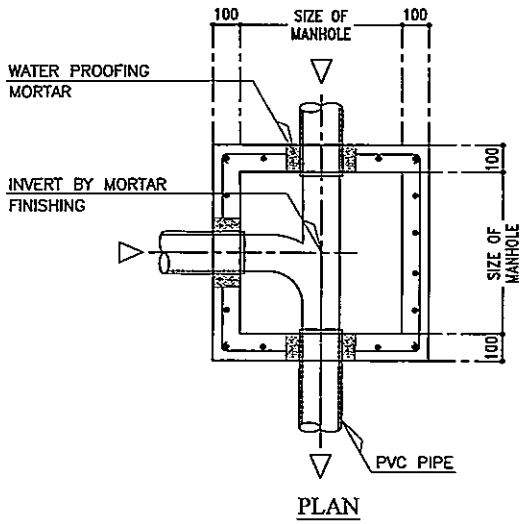


SECTIONAL ELEVATION
DETAIL-A



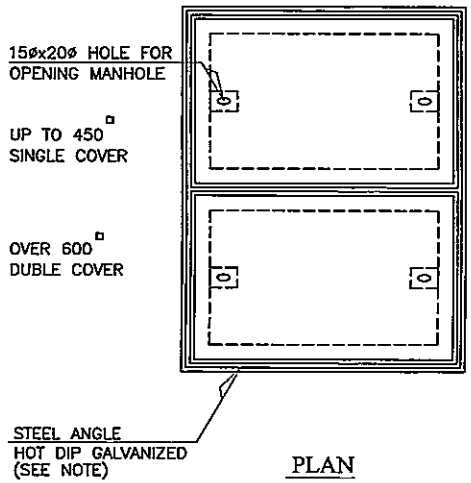
PLAN

SEWAGE MANHOLE FOR
PRIVATE AREA



PLAN

SEWAGE MANHOLE FOR
PUBLIC AREA



PLAN
DETAIL-A

DETAIL OF MANHOLE COVER
FOR PUBLIC AREA

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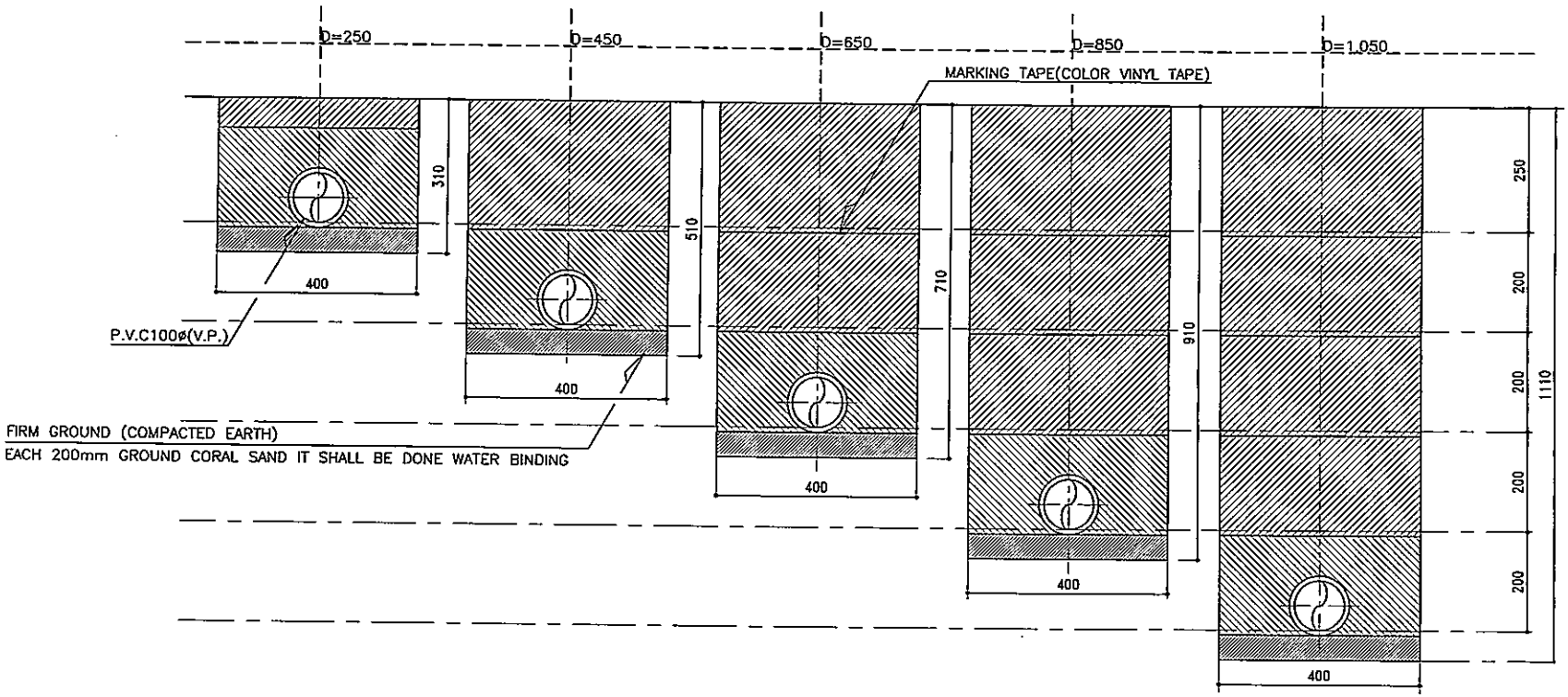
YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Standard Details for Sewage Manhole

SCALE	SHEET NO.	REV. NO.
1 : 20	P-20	



DETAIL SECTION S=1:10

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NIPPON KOEI CO.,LTD.

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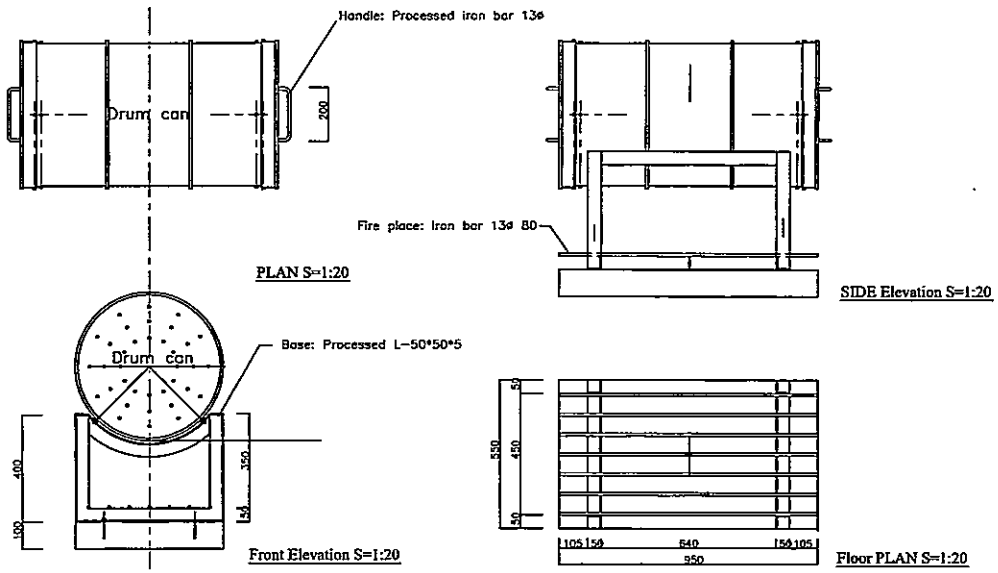
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Common Pipe Setting Detail

SCALE	SHEET NO.	REV. NO.
1 : 10	P-21	



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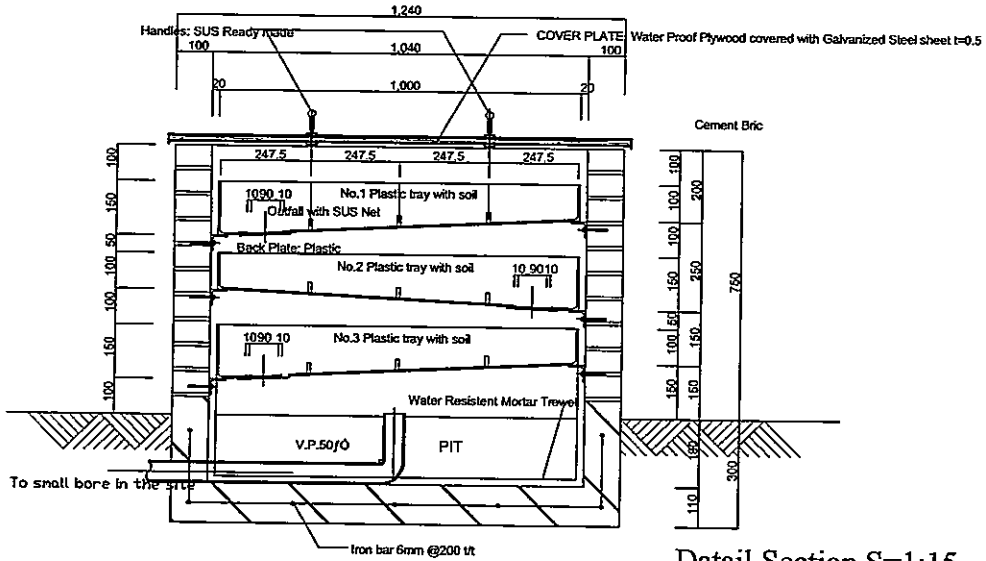
YEC YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

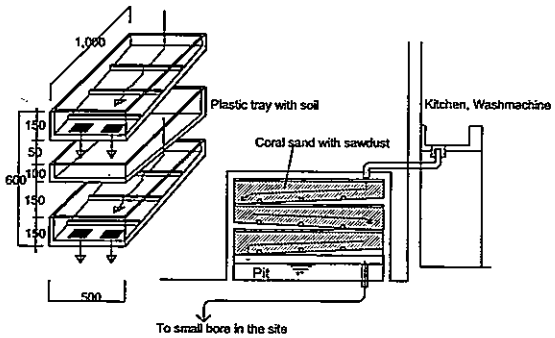
	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerege System
Charcoal Processing Device

SCALE	SHEET NO.	REV. NO.
1 : 20	P-22	

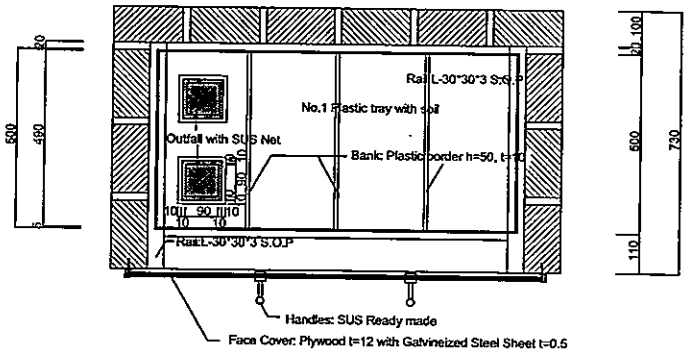


Datail Section S=1:15

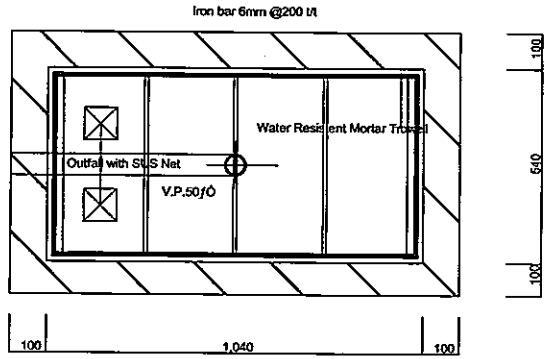


High loaded Gray-water Treatment System
(Slamted soil treatment System)

Consept of the System



Detail Plan S=1:15



Detail Basement Plan S=1:15

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	NOTES:	THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES	
REPUBLIC OF MALDIVES MINISTRY OF FOREIGN AFFAIRS MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT		yec YACHIYO ENGINEERING CO.,LTD. NIPPON KOEI CO.,LTD.	DRAWING TITLE Isdhoo Island Upgrading of Sewerege System Slanted soil treatment

	PREPARED BY	CHECKED BY	APPROVED BY	SCALE	SHEET NO.	REV. NO.
NAME	Y. Horigome	Y. Horigome	M. Komiya			
SIGNATURE				1 : 15	P-23	
DATE	July 20, 2005	July 20, 2005	July 30, 2005			

① The Sewerage System Facility List of Site 1 Isdhoo-Kalaidhoo Area (Except Relocation Area)			
	Items	Quantity	Note
1.	150 φ V.P. Pipe with connection, leveling 1/200 Refilling, Finishing of road surface	M	Existing road : Sand compaction finish
2	100 φ V.P.	M	From toilet until main piping using 100 φ
3	50 φ V.P.	M	From pump station to Reach Field
4	Junction box 150 φ	pc	
5	Home type Septic Tank 1.5ton	88pc	Concrete type or FRP type
6	Communal Septic Tank 2.5ton	7pcs	Concrete type only
7	Connection work to existing pipe	0pc	Recipient side matter
8	Communal Septic tank 25ton	1pc	School
9	Connection work to existing pipe	0pc	Recipient side matter
10	Sewage pump station with pit	20pc	
11	Sewage pump D40A-2, 220/250V, 50Hz, 3.5A, 1 φ 0.4kw	20pc	DAVEY40 or equivalent Sewage Pump
12	2nd Septic Tank with pump	5pc	Aeration chamber with charcoal filter
13	Mounted Leach Field Dual Step Treatment Bed	5pc	
14	Sludge Drying Bed with polycarbonate folded roof, 2 units	1unit	
15	Slant soil treatment system	88+8pcs	1pc for 1facility except school
16	Connection work to existing pipe	0pc	Recipient side matter
17	Electrical works	1unit	Power supply from existing distribution board to newly installed panel is recipient side matter
18	Vacuum car	0unit	
19	Others	1unit	

②The Sewerage System Facility List of Site 1 Isdhoo-Kalaidhoo Relocation Area			
	Items	Quantity	Note
1.	150 φ V.P. Pipe with connection, leveling 1/200 Refilling, Finishing of road surface	m	Existing road : Sand compaction finish
2	100 φ V.P.	m	From toilet until main piping using 100 φ
3	50 φ V.P.	m	From pump station to Reach Field
4	Junction box 150 φ	pc	
5	Home type Septic Tank 1.5ton	42pc	Concrete type or FRP type
6	Communal Septic Tank 2.5ton	0pcs	Concrete type only
7	Connection work to existing pipe	0pc	Recipient matter
8	Communal Septic tank 25ton	0pc	
9	Connection work to existing pipe	0pc	Recipient matter
10	Sewage pump station with pit	4pc	
11	Sewage pump D40A-2, 220/250V, 50Hz, 3.5A, 1 φ 0.4kw	4pc	DAVEY40 or equivalent Sewage Pump
12	2nd Septic Tank with pump	2pcs	Aeration chamber with charcoal filter
13	Mounted Leach Field Dual Step Treatment Bed	2pc	
14	Sludge Drying Bed with polycarbonate folded roof, 2 units	0pc	
15	Slant soil treatment system	42pcs	1pc for 1facility except school
16	Connection work to existing pipe	0pc	Recipient matter
17	Electrical works	1unit	Power supply from existing distribution board to newly installed panel is recipient side matter
18	Vacuum car	0unit	
19	Others	1unit	

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YEC YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
NAME	Y. Horigome	Y. Horigome	M. Komiya
SIGNATURE			
DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerage System
The Sewerage System Facility List 1/2

SCALE	SHEET NO.	REV. NO.
------	P-24	

③ The Sewerage System Facility List of Site 2 Isdhoo Area

	Items	Quantity	Note
1.	150 φ V.P. Pipe with connection, leveling 1/200 Refilling, Finishing of road surface	m	Existing road : Sand compaction finish
2	150 φ V.P.	m	From toilet until main piping using 100 φ
3	50 φ V.P.	m	From pump station to Reach Field
4	Junction box 150 φ	pc	
5	Home type Septic Tank 1.5ton	184pc	Concrete type or FRP type
6	Communal Septic Tank 2.5ton	6pc	Concrete type only
7	Connection work to existing pipe	0pc	Recipient matter
8	Communal Septic tank 25ton	1pc	School
9	Connection work to existing pipe	0pc	Recipient matter
10	Sewage pump station with pit	24pc	
11	Sewage pump D40A-2, 220/250V, 50Hz, 3.5A, 1 φ 0.4kw	24pc	DAVEY40 or equivalent Sewage Pump
12	2nd Septic Tank with pump	7unit	Aeration chamber with charcoal filter
13	Mounted Leach Field Dual Step Treatment Bed	7unit	
14	Sludge Drying Bed with polycarbonate folded roof, 2 units	1pc	
15	Slant soil treatment system	184+6pc	1pc for 1facility except school
16	Connection work to existing pipe	0pc	Recipient matter
17	Electrical works	1unit	Power supply from existing distribution board to newly installed panel is recipient side matter
	Others	1unit	

④ The Sewerage System Facility List of Site 3 Health Centre & Temporary Office Area

	Items	Quantity	Note
1.	150 φ V.P. Pipe with connection, leveling 1/200 Refilling, Finishing of road surface	m	Existing road : Sand compaction finish
2	100 φ V.P.	m	From toilet until main piping using 100 φ
3	50 φ V.P.	m	From pump station to Reach Field
6	Communal Septic Tank 2.5ton	1pcs	Concrete type only
10	Sewage pump station with pit	2pc	
11	Sewage pump D40A-2, 220/250V, 50Hz, 3.5A, 1 φ 0.4kw	2pc	DAVEY40 or equivalent Sewage Pump
12	2nd Septic Tank with pump	1pc	Aeration chamber with charcoal filter
13	Mounted Leach Field Dual Step Treatment Bed	1pc	
15	Slant soil treatment system	2pcs	
17	Electrical works	1unit	
18	Vacuum car	1unit	*
19	Others	1unit	

* Vacuum car – 2.0ton Truck Vehicle with 1,600l Vacuum car.

1) 2.0ton Truck Vehicle with flat deck

Length: 4,690mm, Width: 1,690mm, Engine: 2000cc

2) 1,600l Vacuum car with engine

Name: Vacuum car,

Total Length: 3,000mm, Width: 1,390mm, Height: 1,645mm

Tank length: 1,950mm, Width: 1,070, Height: 1,070

Tank Volume: 1,600l, Weight: 500kg, Total Weight: 2,100kg

Vacuum Pump: -0.067Mpa(50cmHg), 0.06Mpa(0.6kg/cm2)

Pump Capacity: Sack 1,000l/min, Discharge 700l/min

Engine: 2.9~4.4kw (4PS~6PS), Hose: Sacking hose 20m, Discharge hose 4m

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF MALDIVES
MINISTRY OF FOREIGN AFFAIRS
MINISTRY OF PLANNING AND NATIONAL DEVELOPMENT

NOTES:

THE STUDY ON TSUNAMI RECOVERY, REHABILITATION AND DEVELOPMENT OF ISLANDS IN MALDIVES

YEC YACHIYO ENGINEERING CO.,LTD.
NIPPON KOEI CO.,LTD.

	PREPARED BY	CHECKED BY	APPROVED BY
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DATE	July 20, 2005	July 20, 2005	July 30, 2005

DRAWING TITLE
Isdhoo Island
Upgrading of Sewerage System
The Sewerage System Facility List 2/2

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