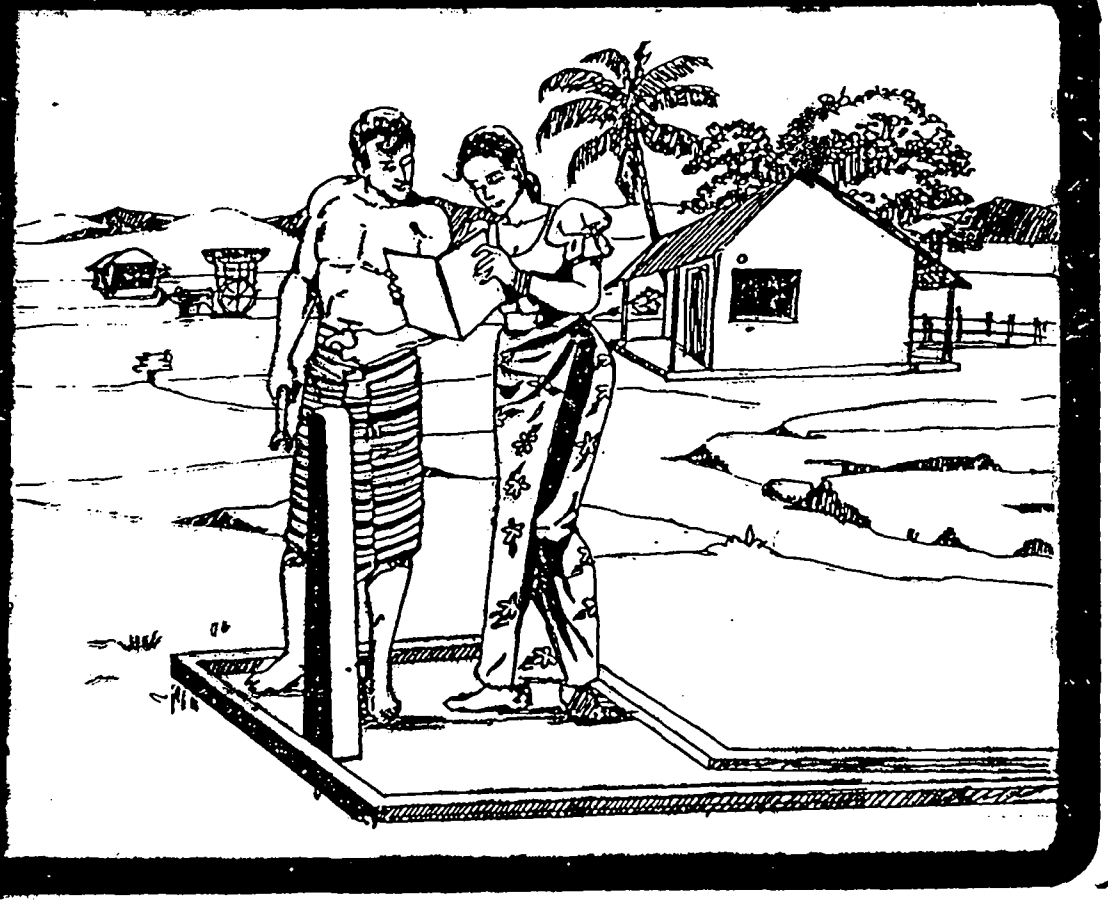
A MANUAL ON OPERATION AND MAINTENANCE FOR COMMUNITY WATER SUPPLY SYSTEMS



PREPARED BY THE NATIONAL WATER SUPPLY AND DRAINAGE BOARD SRI LANKA.

SPONSORED BY THE INTERNATIONAL REFERENCE CENTRE FOR COMMUNITY WATER SUPPLY AND SANITATION, NETHERLANDS.

C O N T E N T S

DRAWINGS

CHAPTER 1

INTRODUCTION

Background

With the introduction of the International Drinking Water Supply and Sanitation Decade Programme in 1980, Sri Lanka endeavoured to provide safe drinking water supplies to 50 percent of the rural sector by 1990 and full coverage for urban, rural and estate sectors by 1995. Adequate sanitary disposal facilities are expected to reach full coverage for the total population of Sri Lanka by 1990.

Many bilateral and international agencies extended their full support in numerous ways towards the realisation of the targets set by the Government of the Democratic Socialist Republic of Sri Lanka. Amongst the many donor agencies who provided support to the National Water Supply and Drainage Board of the Ministry of Local Government, Housing and Construction, the contribution of the International Reference Centre for Community Water Supply in Netherlands, assumed a different dimension wherein the donors placed heavy emphasis on community standpost water supply systems in the rural and urban fringe communities. These systems were to be designed, installed, operated and maintained not only by giving high priority, but also treating community participation and health education as key approaches.

Establishment of the Project Coordination Institution

For the purpose of overall responsibility for the implementation of the Project, a multi-disciplinary team of members representing The Ministry of Local Government, Housing and Construction, Ministry of Health, UNDP and WHO was established with the Chairman, NWSDB functioning as the Head of the Team. This body of officials and Project staff were designated as the Project Management Committee.

The creation of the Project Coordination Institution was one of the requirements under the agreement and the NWS&DB assumed this responsibility and managed the project activities through the Project Management Committee, which was actively involved in project planning, implementation and monitoring the progress through its monthly meetings since it was established.

Coordination with the Health Ministry both at National and grass-root level was maintained very effectively particularly in respect of the implementation of the sanitation programme.

Health education intervention with community based approaches in planning rural community water supply systems, was a novel experience to the NWS&DB. Planning of the water supply system with the community involved, had heavy emphasis on operation and maintenance aspects. Through this challenging task, whereby community commitment was created, it was possible to reinforce the methodologies adopted to generate revenue for operation and maintenance. The sense of responsibility thus created helped to eliminate irresponsible handling and vandalism of Board's property.

The Project Area

The Project had four demonstration areas out of which the Haldummulla rural water supply system, which was completed, was taken up for the purpose of developing a Manual for operation and maintenance.

Haldummulla is in the Haputale electorate on the Balangoda-Badulla road. The water supply system serves a population of 3100 and is under the administration of Regional Manager, Bandarawela.

Objectives of the Project

1. To develop appropriate strategies, methods and techniques for the planning, implementation and management of public stand-post water supply systems and sanitation in the rural sector in Sri Lanka

2. To evolve processes which are socially acceptable and technically feasbile to rehabilitate public standpost water supply systems that have failed in the rural sectors of Sri Lanka.

3. To develop low cost sanitation models within easy manufacturing potentials of rural communities formulated on the basis of self-help and self-reliance and promote sanitation programmes in the rural sector of Sri Lanka.

The Project Strategy

Available knowledge and experience was utilised to develop the first draft plan which embraced both technical and social dimensions with major emphasis on community participation and health education. Along with programme implementation, suitable modifications were effected in consultation with the Project Management Committee, which had major responsibility in monitoring the programme. Experiences gained from the community interactions helped to strengthen the process.

The Strategy for Operation and Maintenance

It was the consensus of all implementing agencies of the water supply systems that the mere construction of a system does not ensure a successful completion, unless suitable measures were instituted for the operation and maintenance of the system with revenue generating mechanisms. Even though during pre-feasibility and feasibility stages, the operation and maintenance aspects were discussed and pinpointed with recommendations for operation and maintenance, our experience is that water supply systems have never acquired the desired income from the benefitting communities.

Project Strategy for Operation and Maintenance

The project approach envisaged 12 major steps* in which operation and maintenance aspects were held integral to the total process.

During the planning stage with the community, major interventions were sought in the leadership of the community and the representatives of the District Development Council were informed of the detailed operation and maintenance costs. During these community consultations, they were involved in discussions and were required to recommend steps for cost recovery to ensure operation and maintenance. Their attention was drawn to all aspects of revenue generation with particular emphasis on standpost users.

Based on the economic status of the community and the amount each family could afford to contribute so as to meet the estimated cost of operation and maintenance, decisions were made regarding the amounts beneficiaries need actually pay.

Who should collect these revenues and how they need be managed remain to be worked out.

Community education to make the community understand the value of operation and maintenance was planned and carried out, to support revenue generation. This was done during community consultations and group meetings.

In order to ensure the efficient functioning of the system and to avoid unnecessary breakdowns, caretakers were selected by Stand post Committees, purely on a voluntary basis and trained by Board staff to undertake minor repairs and look after the system. They were required to coordinate by bringing to the notice of the technical staff any major breakdowns in the system.

* Refer Guidelines for Planning Community Participation in Water Supply and Sanitation.

Water Tariff as agreed by the Community

Generally, the idea of paying for water is not favoured by communities. This is mainly due to the prevailing notion that water is freely available and that it need not be paid for. These obstacles have been overcome by intensive education and the community has agreed to pay Rs. 5/- per family using the standpost water.

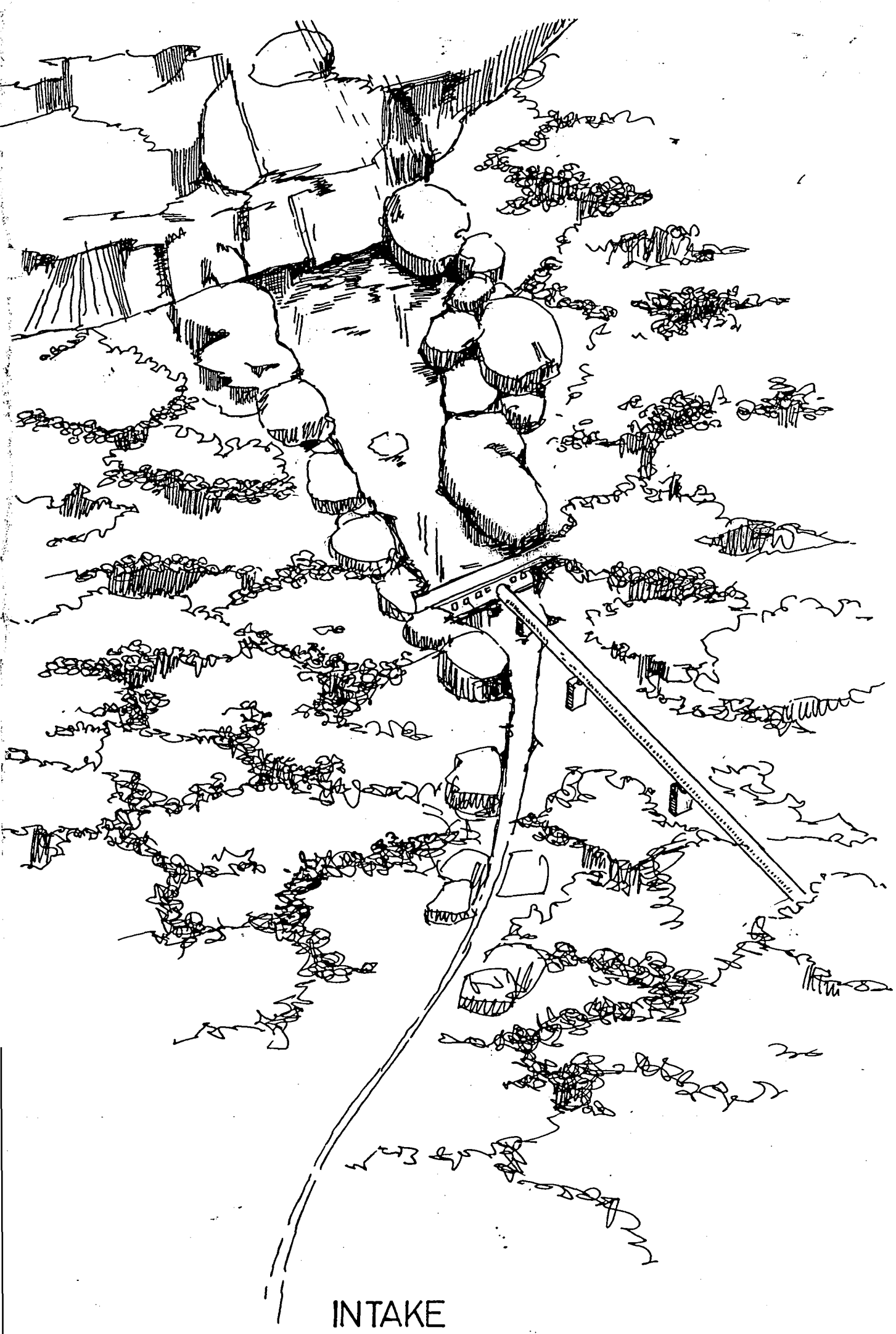


Figure 1

CHAPTER 2

HALDUMMULLA WATER SUPPLY SCHEME

DESCRIPTION OF THE WATER SUPPLY SYSTEM

Source and Intake

The source of the Haldummulla water supply scheme is the Kathiresan stream which originates from the hills of Idalgashinna and Ohiya and flows across the Needwood Estate and crosses the Colombo-Badulla main Highway around the 114th mile post..

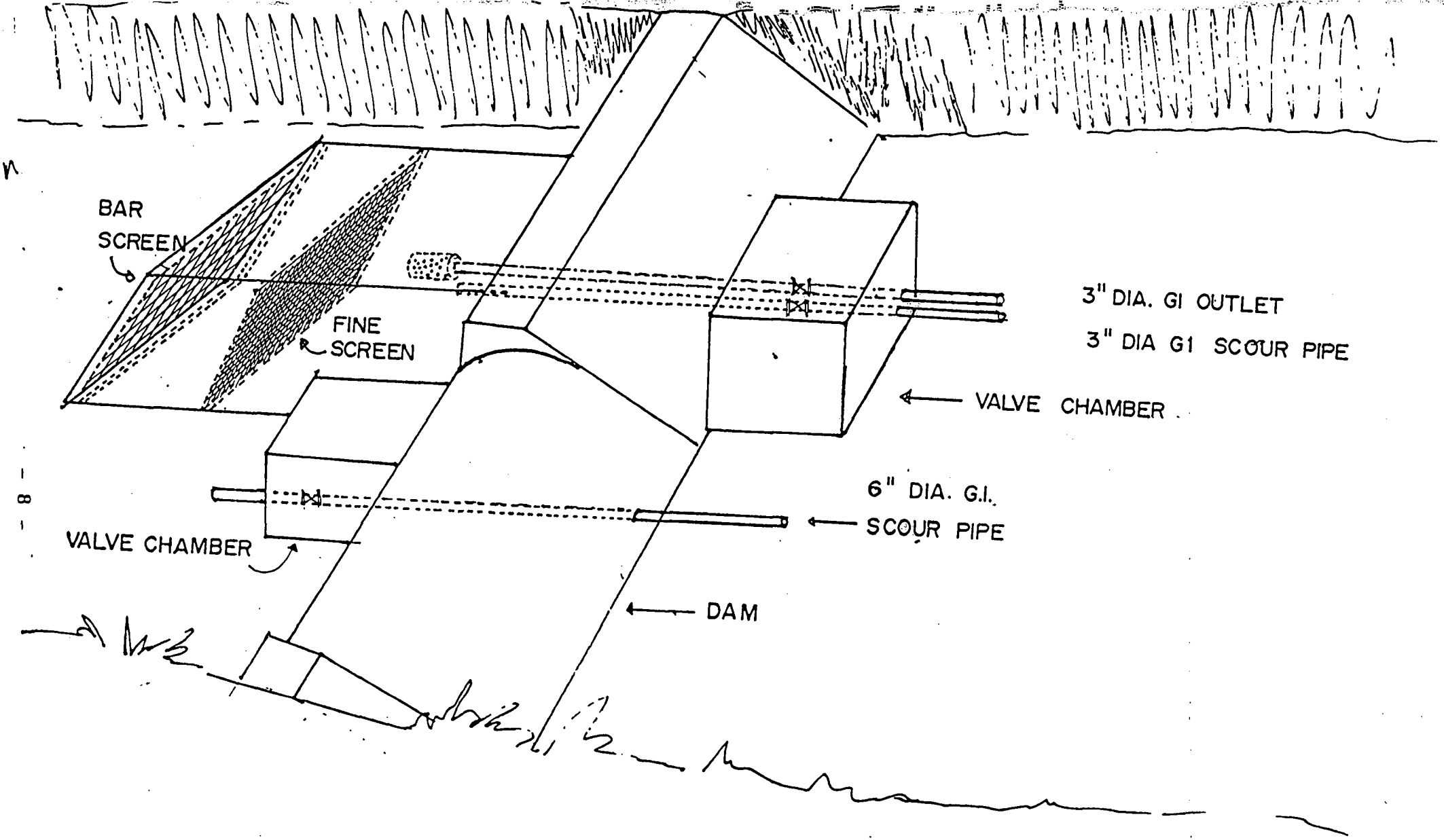
This stream was chosen in preference to numerous other smaller streams which flow in this area, due to its perennial nature, purity and quantity of flow.

The water quality sampled from the Kathiresan stream showed that the chemical quality of water is satisfactory for human consumption and does not require any form of extensive treatment. During certain rainy periods the turbidity of the water rises marginally and to remedy this aspect, it is proposed to construct a slow sand filter at a later stage.

Bacteriological tests carried out on the water from this source at the intake point also revealed that there is no contamination of the water. However, pollution could take place during the rainy season.

The intake point for the water supply scheme was selected above the human settlement area so as to avoid any possible human contamination.

The flow of water at the location was measured over a long period of time and the minimum quantity measured, which was 181 cubic metres per day (140,000 gallons per day) was found to meet the requirements of the Haldummulla and Halatutenna area upto the year 2000 except in the very dry periods, where there could be a small



ISOMETRIC VIEW OF INTAKE DAM

Figure 2

shortfall; The year 2000 requirements of those areas are given in Appendix to Chapter 2.

An inlet chamber is provided with two screens coarse and fine to ward off floating debris. The inlet chamber also contains an inlet pipe fitted with a strainer.

Two valve chambers are also provided, with one valve chamber housing the scour valve of the intake and the other valve chamber, housing the scour valve of the inlet chamber and the control valve of the outlet pipe.

The actual location of the dam was decided, taking into account the presence of strong rock abutments on either side to anchor the dam.

Pipe lines

The gravity main comprises mainly of PVC and GI pipes originating from the dam and reaching the reservoir located below.

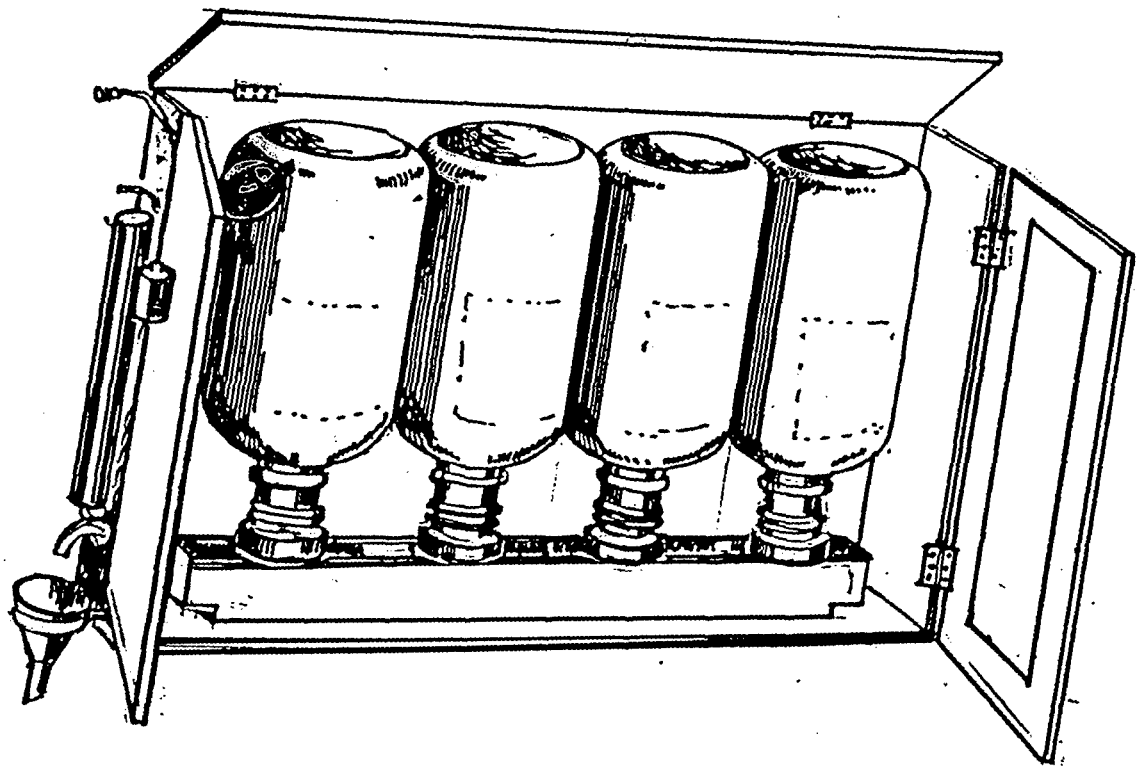
Two break pressure tanks are provided between the intake point and the reservoir.

Treatment

There is no conventional treatment plant provided for the scheme at the moment. However, in the future it is proposed that a slow sand filter should be constructed of 120 m^2 square area.

However, at the present juncture, only chlorination is provided in the form of a Belco solution feed type chlorinator installed in a structure housing the office room, a store room, chlorinator house and a toilet.

This structure is located adjacent to the reservoir and the chlorine solution is fed into the reservoir.



BELCO CHLORINATOR — 4 BOTTLE MODEL

Figure 3

Chlorinator

The chlorinator installed is a four bottle 'Belco' chlorinator. The chlorine solution is fed into the reservoir from the chlorinator situated in the office block. The chlorine solution is fed into the storage reservoir.

Storage Reservoir

A storage reservoir of 113.6 cubic metre (25,000 gallon) capacity is provided just below the office block to serve the storage requirement of the Haldummulla water supply scheme.

The reservoir is so constructed that it is partially below ground.

Distribution System

The distribution system consists mainly of PVC pipes ranging from 160 mm (6") to 63 mm(2"). The distribution is mainly on the Colombo-Haputale Road, but also extends along a few by-roads.

There is one break pressure tank to take care of the excess pressure on the distribution system.

Standposts

A total of 22 standposts are provided with the maximum distance being 0.4 km (0.25 miles) between the standposts.

Hours of Supply

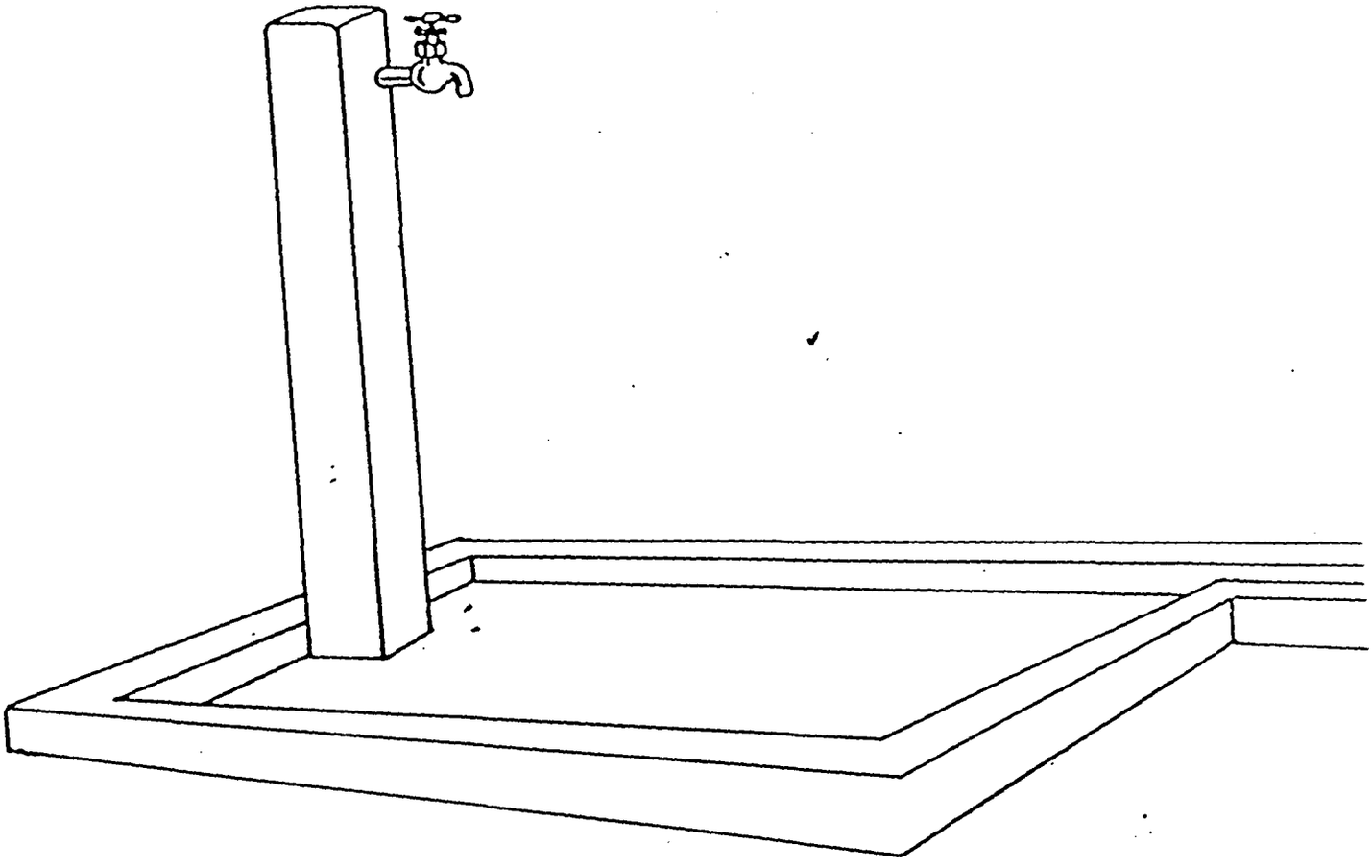
This scheme is designed for a continuous 24 hour supply to the consumer

Water Quality

The quality of water observed in the Kathiresan stream is found to conform to Sri Lanka Standards for potable water.

However, a seasonal variation of water quality is observed with respect to certain physical characteristics such as turbidity and colour.

Typical water quality reports are included in Annexure 2 for reference.



STAND POST WITH BIB TAP

Figure 4

CHAPTER 3

OPERATION AND MAINTENANCE

The objective of a standpost is to supply safe water. The proper operation and maintenance of the system is to keep the standpost producing water efficiently. The users of the standpost must be assured of a continuous supply of safe water. They should feel that the operating staff is responsive to their complaints and repairs will be carried out without delay, when such needs are reported. Revenue collection is also a part of operation. When there is an efficient system of maintenance and effective line of communication with the users, they may be cooperative in the matter of revenue collection. However, if the water supply is not reliable, the system is badly maintained and the operating staff is not responsive to consumer complaints, then revenue collection will be a difficult task.

OPERATIONAL PROCEDURES

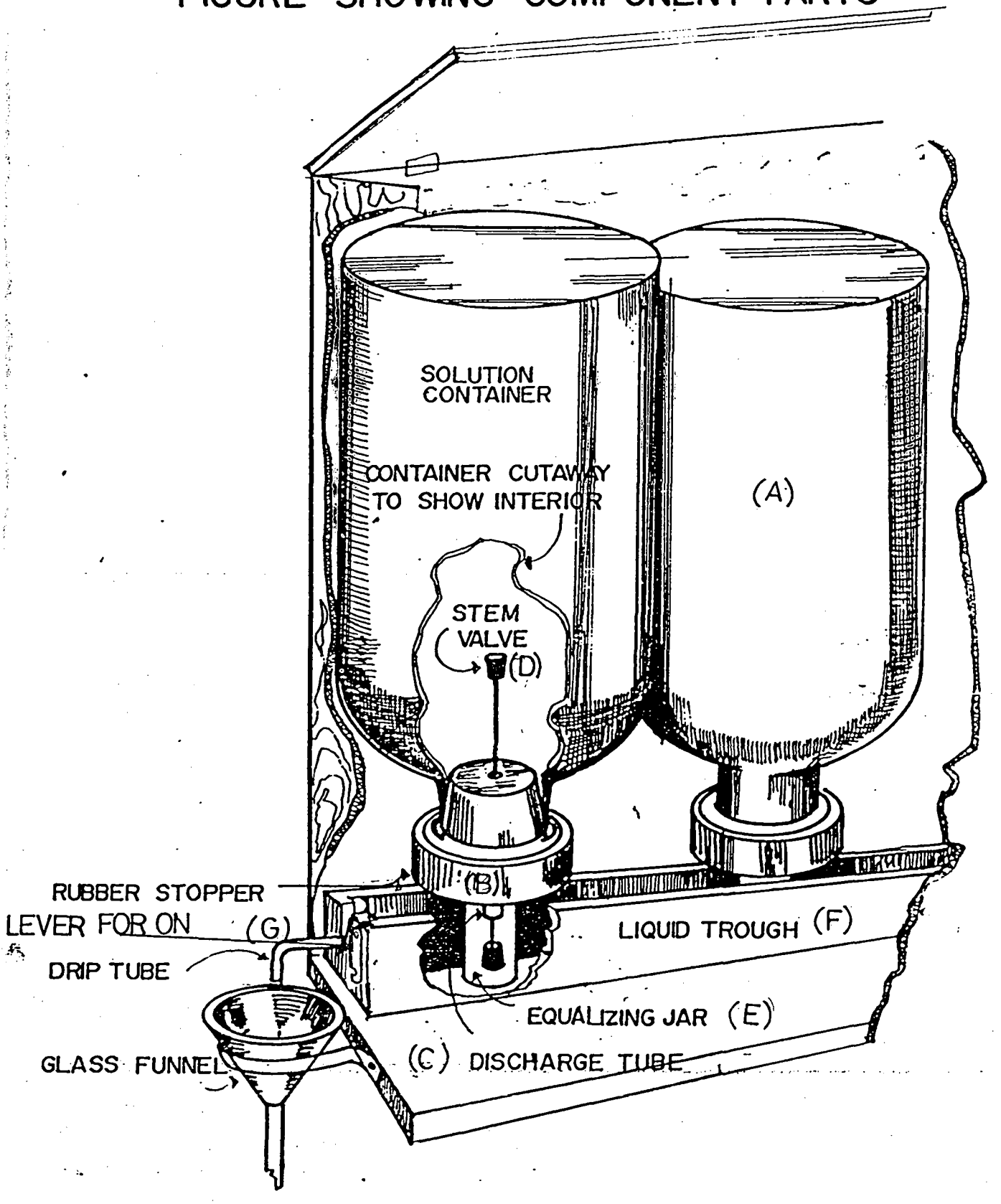
Intake

The concrete dam built across the Kathiresan stream forms the intake pond. It is essential that there is sanitary protection to prevent contamination of the intake. The area is fenced to prevent trespassing by people and animals. The water may be full of silt or colloidal matter immediately after the rains. Hence, desilting the intake at regular intervals is required. The screens at the inlet chamber should be kept clean of algae and other aquatic vegetation. The strainer at the inlet pipe should also be cleaned at regular intervals. Proper operation of all valves should be ensured by regular preventive maintenance. The area surrounding the intake should be well kept, beautiful in appearance and a distinctive feature of the landscape.

The normal operation procedure includes the opening of the valve in the inlet pipe line for the transmission of water from the Intake dam to the reservoir through the gravity main.

The silt collected in the inlet chamber is disposed by opening the scour valve fitted to the 75 mm scour pipe of the inlet chamber.

FIGURE SHOWING COMPONENT PARTS



BELCO CHLORINATOR

Figure 5

The silt collected in the main dam area is cleaned by opening the valve fitted to the 150 mm. scour pipe of the intake dam.

Main Pipe Lines and Appurtenances

The mains consist mainly of PVC pipe lines. The pipes should be in the ground where they are protected against mechanical damage. They should be properly settled on the trench bed and uniformly supported along its entire length. The pipe trace should be inspected regularly, more frequently in the rainy season to ascertain whether any soil-erosion has taken place exposing the pipe lines. Leaks should be attended to promptly. All appurtenances should be maintained ensuring proper functioning.

Treatment and Storage

The only treatment used in this system at present is disinfection. Water supplies are usually disinfected by adding chlorine. In small water supply schemes, it is obtained from Bleaching Powder. Bleaching Powder rapidly loses its strength when exposed to the atmosphere or to sunlight. It should be carefully stored in sealed containers in a cool dark place. Chlorine kills pathogenic organisms. A simple chlorinator which dispenses a chlorine solution at a constant rate is used in this water supply scheme.

The Belco Chlorinator - Model 03 (4 bottle)

The Belco Chlorinator consists of a cabinet with a hinged top and door as shown in figure 5. There are four solution containers (A) each fitted with a chlorine proof rubber stopper (B) through which is inserted a glass tube (C) which acts both as liquid and air tube. Inside this discharge tube is a stem valve (D) having a tapered rubber plug on the inner end and a rubber cushion on the outer end. This valve closes the glass tube preventing leakage when the container is reversed for inserting into position in the cabinet. Upon the rubber cushion coming into contact with the equalizing jar (E) the valve opens automatically. The inverted containers rest over a liquid trough (F). Placed inside the liquid trough are found equalizer jars having a small leak hole close to the bottom in each. A

glass drip tube (G) bent at both ends and operated by syphonic action rests in a niche in the liquid trough and open end dipping into the liquid, the opposite end being closed to a fine orifice, and projecting through the side wall of the cabinet. There is a lever (H) adjustable to vertical movement on which the tube rests on the inside of the wall of the cabinet. This lever is used to set the rate of discharge. An empty container can be removed and a full one inserted at any time independently of the others without affecting continuous operation.

Preparation of a Stock Solution of Approximately 1% Available Chlorine

Bleaching Powder when fresh, contains 35% chlorine. 1/3 part by weight of chlorine could be obtained from 1 part by weight of Bleaching Powder. Measure 5 gallons of water to a plastic container. Add 1½ lbs. of Bleaching Powder and stir thoroughly and allow the sediment to settle. This solution contains approximately 1% available chlorine.

In the alternative measure 20 litres of water and dissolve 0.6 Kg. of Bleaching Power to obtain a 1% solution.

Notes

* Solution containing 1% available chlorine is recommended although concentrations upto a maximum of 5% may be prepared without much loss of chlorine in the sediment.

* Solution should be prepared in a container which will not be affected by chlorine.

* The lime sludge should be allowed to settle to the bottom of the container and only the supernatant liquid should be withdrawn.

COMPONENT PARTS

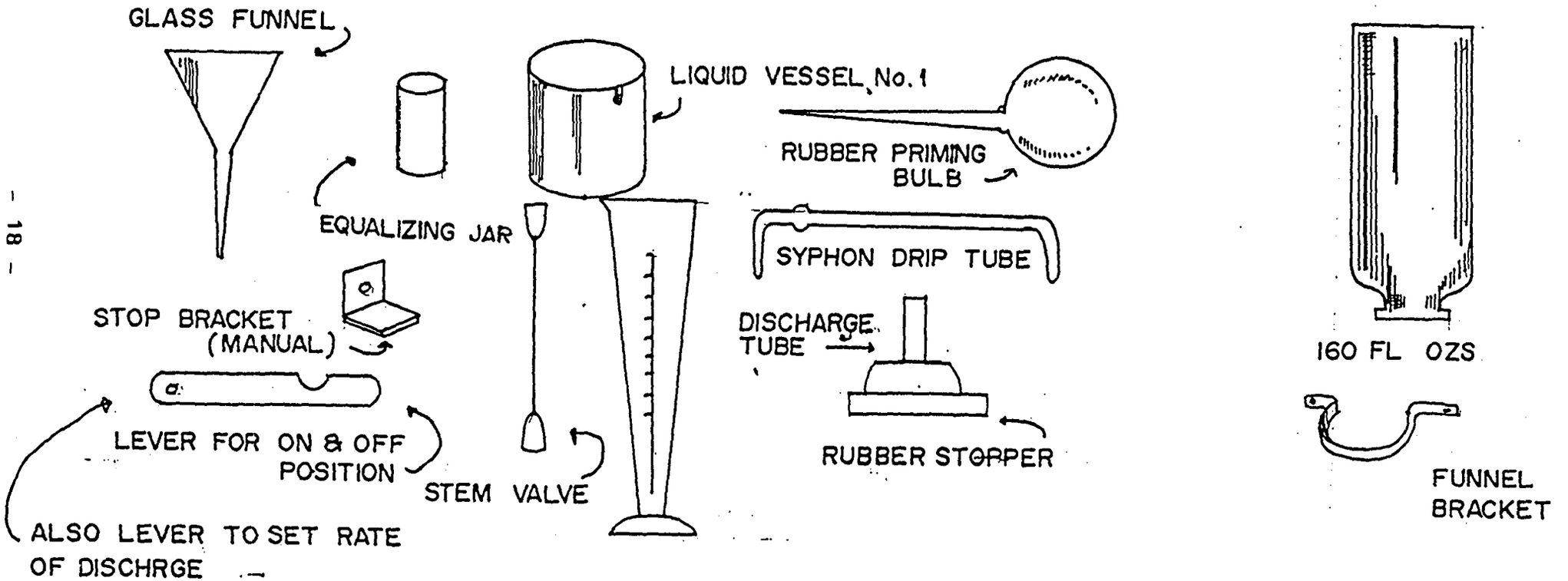


Figure 6

Setting of Chlorine Dosage

The chlorine dosage applied to the water should produce a residual of 0.2 p.p.m (0.2 mg/l) at the furthest standpost. Generally a dosage of 1 p.p.m at the reservoir should be adequate to maintain this residual.

Fill the containers with 1% stock solution of chlorine and place in position. Using the rubber priming bulb provided, prime the syphon drip tube. Upon lowering of the syphon drip tube a steady drip of solution will commence. When the level of liquid in the liquid trough is sufficiently reduced to unseal the discharge tube, a further quantity of solution is discharged into the equalizing jar. The solution passes through the leak hole into the liquid trough. From the liquid trough the solution is conducted through the drip tube.

The drips are collected into a glass funnel and conducted through a tube to the point of application (reservoir inlet). When the supply of water into the reservoir is stopped, the drip tube is lifted to a position slightly above the horizontal level and dripping stops. The flow is now completely suspended until the drip tube is again lowered.

Typical Calculation for Setting of Dosage

Daily demand = 50,000 gls.

Period of Supply = 10 hrs.

Average flow = $\frac{50,000}{10}$ = 5000 gls/hr:

The inflow into the reservoir is set at 5000 g.p.h

Dosage = 1.0 p.p.m

For 100000 gls. of water the quantity of chlorine required is 1 lb.

For 5000 gls. of water the quantity of chlorine required - $(1 \times \frac{5000}{100000})$

= 0.05 lbs. of chlorine

Strength of stock solution = 1% available chlorine

To get 01 lb. of chlorine quantity of stock solution required

= 100 lbs.

= 10 gls. (Approx.)

To get 0.05 lbs. of chlorine the quantity of stock solution required

$$= 10 \times \frac{.05}{1}$$

= 0.5 gls . of stock solution

= 3 bottles

i.e. 3 bottles in 60 minutes

½ bottle in 10 minutes

The drip tube should be adjusted to give a drip rate of ½ bottle in 10 minutes.

This will give a chlorine dosage of 1 p.p.m when added to a flow rate of 5000 gls. of water per hour.

Specimen Calculations

Preparation of Stock Solution

Strength of solution required = 1% available chlorine

Strength of Bleaching Powder = 33% available chlorine

Quantity of solution required = 10 gallons

What is a 1% solution ?

A solution containing one pound of available chlorine in 100 lbs. of solution or one gram of chlorine in 100 grammes of solution.

i.e. : 100 lbs. of solution contains 1 lb. of chlorine

Taking 1 gallon of solution weighs 10 lbs (approx.)
(1 gallon of water weighs 10 lbs).

10 gallons of solution contains 1 lb. of chlorine

∴ To prepare 10 gallons of solution, 1 lb. of chlorine is required. But Bleaching Powder contains only 33% chlorine

∴ Quantity of Bleaching Powder required to prepare 10 gallons of 1% solution $= 1 \times \frac{100}{33}$

= 3 lbs.

∴ 3 lbs of Bleaching Powder in 10 gallons of solution has a strength of 1% available chlorine.

1.5 lbs. B.P. in 10 gallons of solution = 0.5% available chlorine
1.5 lbs. B.P. in 5 gallons of solution = 1.0% available chlorine

Dosage of Bleaching Powder Solution - Specimen Calculations

Rate of flow of water = 5000 g.p.h.
Strength of B.P. stock solution = 0.5% available chlorine
Dosage of Cl_2 = 1.5 p.p.m
Dasage Rate =

1,000,000 lbs. of water should contain 1.5 lbs. of Cl_2
∴ 100,000 gls of water should contain 1.5 lbs. of Cl_2

Flow of water per hour = 5000 gallons
∴ 5000 gls. of water should contain $(1.5 \times \frac{5000}{100000}$ lbs of Cl_2
= 0.075 lbs. of Cl_2
Strength of stock solution = 0.5%

i.e. To get 0.5 lbs. of Cl_2 the quantity of Solution required is 100 lbs. (say 10 gallons of Solution)

∴ To get 0.075 of Cl_2 the quantity of Solution required is

$$\frac{(10 \times 0.075)}{0.5} \text{gls.}$$

= 1.5 gallons

Dose Rate = 1.5 gallons of B.P. Solution per hour
i.e. 9 bottles per hour
or 3 bottles in 20 minutes
or 1 bottle in 6.7 minutes (say 6½ minutes)

NOTE * Gallons stated above are Imperial Gallons

* One Imperial gallon = 6 bottles = 4.54 litres

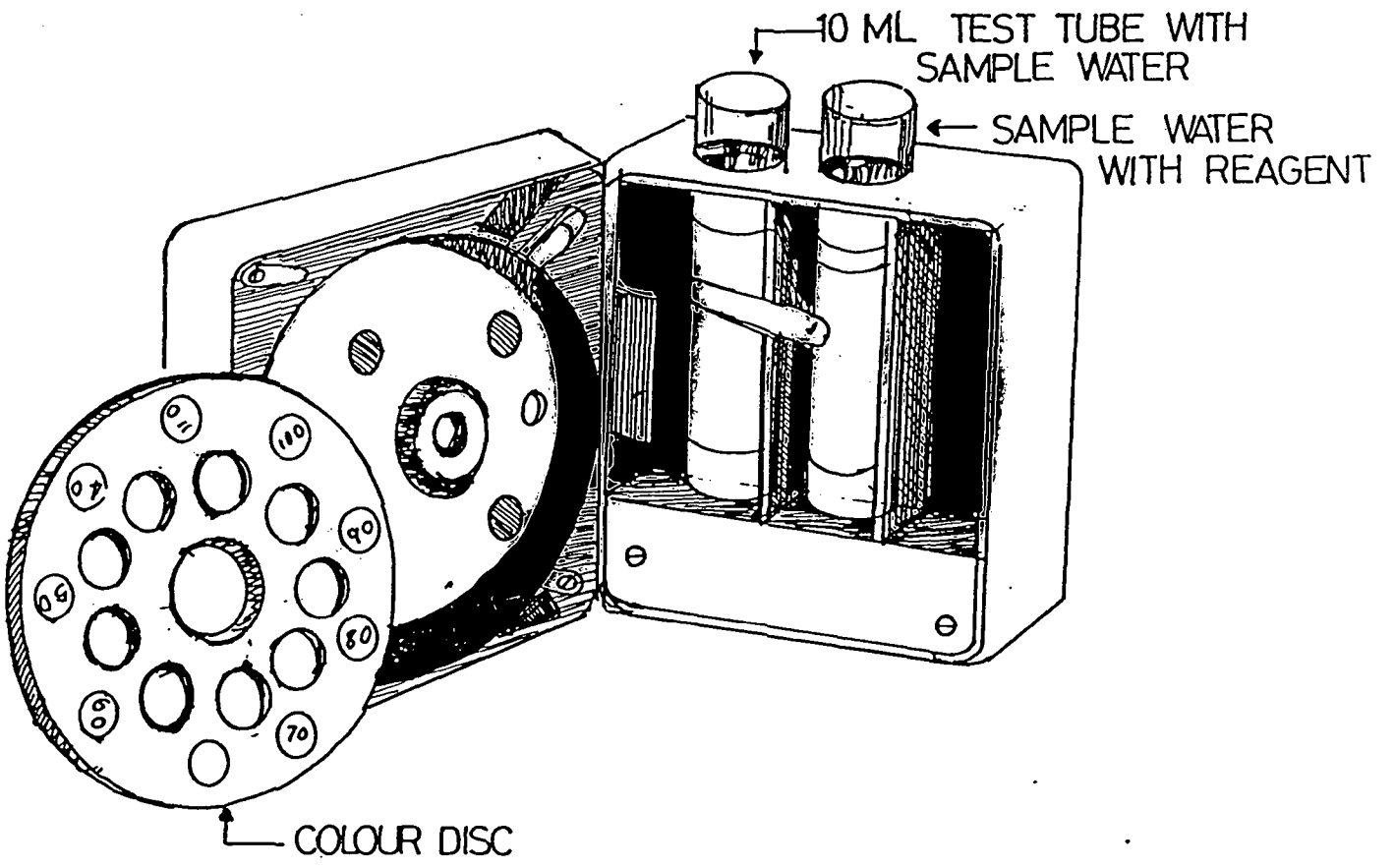

LOVIBOND COMPARATOR
10 ML TEST TUBE WITH SAMPLE WATER
SAMPLE WATER WITH REAGENT
COLOUR DISC

Figure 7

Measurement of Residual Chlorine

Equipment in use : (a) Lovibond Comparator
(b) "Hach" Test Kit

Determination of Residual Chlorine

(A) Using acid ortho-toladine and Lovibond Comparator for 5 ppm and below.

Procedure

1. Fill both tubes with samples water upto the 10 m.l mark .
2. Add 4 drops of reagent to the right hand tube.
3. As rapidly as possible hold the instrument facing north day-light .
4. Rotate the disc until colours match and read concentration from the indicator window. (Use ortho-toladine and not DPD disc.
5. This is the "Free Chlorine".

   Note : * The action below to be carried out only if instructed so.

6. Leave for 5 minutes and record reading.
7. If the concentration has increased leave for another 15 minutes.
8. Now read concentration from indicator window and this is the combined chlorine.

(B) Using 'Hach' chlorine test kit

Procedure

1. Fill one colour viewing tube to the 5 m.l mark with the water sample.

2. Add 7 drops of 'O-Toliver' chlorine reagent and swirl to mix.

3. If chlorine is present a yellow colour will develop. Allow two to five minutes for full colour development.

4. Insert the prepared colour viewing tube in the right opening of the colour comparator.

5. Fill the other colour viewing tube with the original water sample and insert in the left opening of the colour comparator.

6. Hold the colour comparator to a light such as the sky, a window or a lamp and view through the two openings in the front. Rotate the chlorine colour disc until a colour match is obtained.

7. Read the mg/l chlorine through the scale window.

Desired Residual

* Generally 0.5 to 0.8 ppm at the plant after contact time.
* 0.2 ppm at the stand posts.
* 0.1 ppm at the furthest standpost in the distribution system.

Determination of Residual Chlorine Using DPD - (diethyl-p-phenylene diamine or Palin DPD

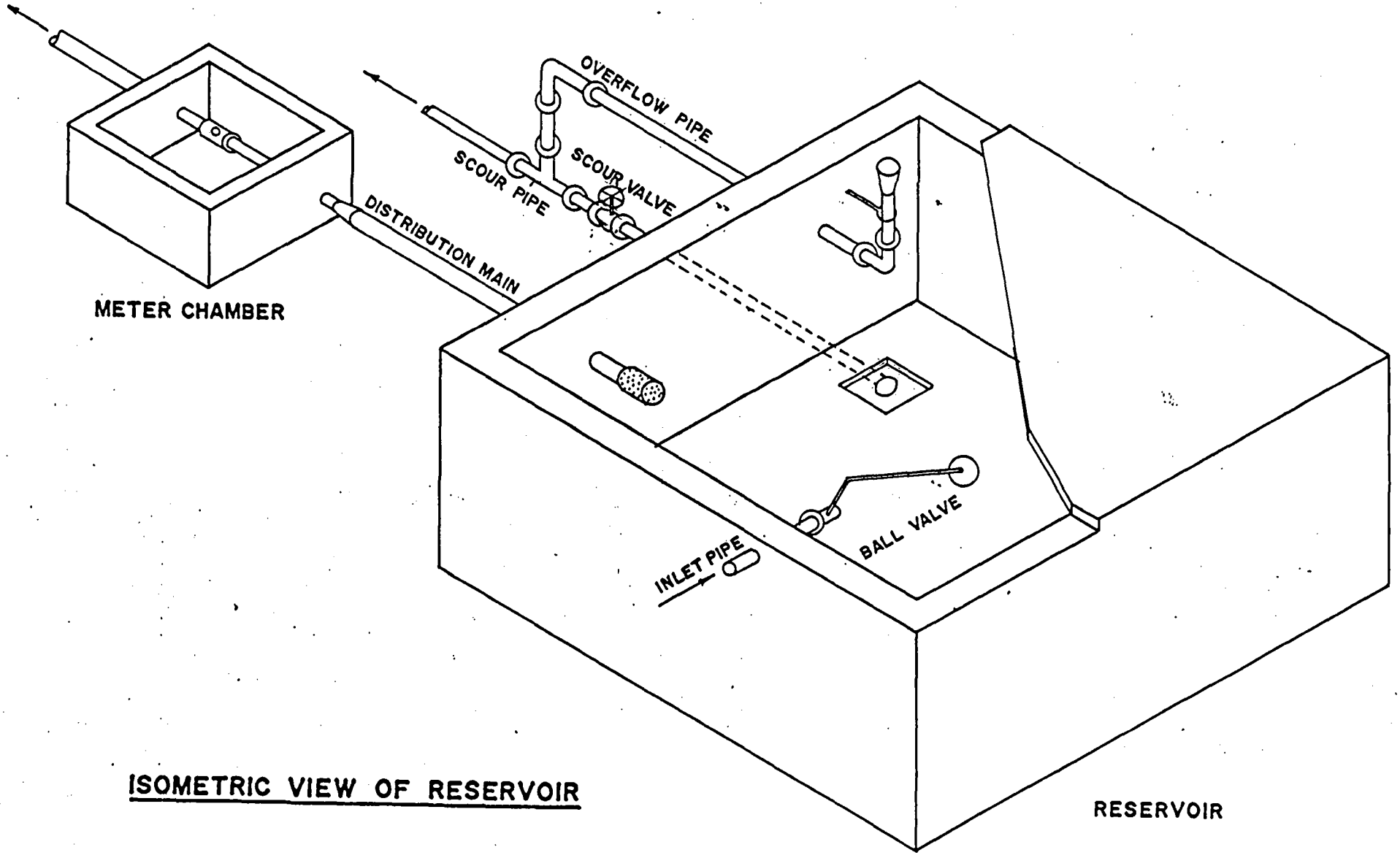
Procedure

1. Fill the left hand tube with sample water.

2. Rinse the right hand tube with sample water and leave sufficient water to just cover a DPD tablet.

3. Drop in one table of DPD No. 1

4. Observe that tablets are disintegrated - if not crush them with a glass rod.



ISOMETRIC VIEW OF RESERVOIR

Figure 2

5. Add sample water upto the 10 ml. mark and mix rapidly to dissolve the remains of the tablet.

6. Place the cell in the right hand compartment of the comparator.

7. Match with disc without delay (use DPD Disc)

8. The figure in the counter is the 'Free Residual Chlorine.'

Records

The following records should be kept in the Plant :

(a) Daily record of chlorine used
Bleaching Powder - quantity mixed in Kilogrammes

(b) Chlorine dosage - mg/l or ppm

(c) Free residual chlorine - at least once every 3 hours

(d) Monthly summary of chlorine consumption (quantity of Bleaching Powder used)

Storage Reservoir

The reservoir stores and facilitates the distribution of water. It helps to supply the user without interruption, the instantaneous and daily demands for water. The gravity main brings water to the reservoir at a constant rate. The level of water in the reservoir varies according to the demand. When the demand is less than the input, the water level in the reservoir builds up and when the demand exceeds the inflow the level drops. Action should be taken to maintain the level of water in the reservoir close to the top water level. The reservoir should be protected from any source of contamination, cleaning of reservoir at regular intervals and disinfection is essential.

The operation of the reservoir is mainly automatic with the inflow of

water into the reservoir being controlled automatically by the 75 mm. ball valve installed in the inlet pipe.

The water inflow could, however, be controlled by using the 75 mm. inlet valve.

The water flows directly into the distribution through the 150 mm. distribution pipe. Valves provided on the outlet could control the supply when required.

A 75 mm. dia. Helix water meter records the total water flow.

A scour is provided in the reservoir to clean any silt that may collect on it. An overflow is also provided for any overflow that may occur in the reservoir.

Distribution System

The function of the water distribution system is to deliver a sufficient quantity of water at adequate pressure to meet all of the water needs of the consumer, while maintaining the quality of the water it receives. The operations of the distribution system include bacteriological sampling, cleaning and flushing of pipe lines, leak detection handling of customer service line problems and handling of water quality problems.

Maintenance Procedures

The foundation of a successful maintenance programme is preventive maintenance. Effective preventive maintenance will enable staff to spend less time on corrective maintenance resulting in significant increase in productivity through better planning.

Preventive maintenance implies a regular or routine check of all structures, equipment and installations. It also involves the replacement of parts which appear to be worn out and seem to be approaching the end of their working life. With regular preventive maintenance, the need for corrective maintenance or repair will be greatly reduced.

The suggested maintenance procedure for this standpost water supply system is given in the annexed maintenance schedules. The maintenance tasks have to be performed at regular intervals, namely, daily/ weekly/monthly/in 03 months/in 06 months/yearly and in every 02 years.

Safety

Safety is freedom from danger or hazards. Safety should be the concern and responsibility of everyone in order to achieve a safe working environment.

The areas of safety should include :-

(a) Prevention of injury to workmen

(b) Prevention of injury to general public.

Clearing of Shrub Jungle

* Special foot protection should be available. Rubber boots (Gum Boots) should be provided to the crew.

Trenching for Pipe Lines

* Work area should be well protected with barricades and traffic safety signs.

* Hand diggers (pick-axes, Mammoties) should be properly spaced to prevent injury to other workmen.

* Excavations in sandy or loose soil should be protected with Timber shoring.

* Pick-axes, Mammoties and shovels should have good handles and good blades.

Use of Hand Tools

* Tools should be in good condition, replaced if wornout or broken, and used for the purpose for which they were intended.

* All hand tools should have burred or sharp edges removed.

* Wrenches should be of the proper size for the job.

Storage and Handling of Materials

* Personnel handling materials should be instructed in the proper method of lifting.

* Storage space in store rooms should be adequate clear, orderly and free from sharp projections or other hazards.

* Pipes should be stored in an accessible area, properly and securely stacked, providing continuous support.

* Good house keeping must be maintained in the store rooms allowing for proper handling and movement of materials.

* Bleaching Powder drums should be stored in a cool dry place, with their lids secured airtight.

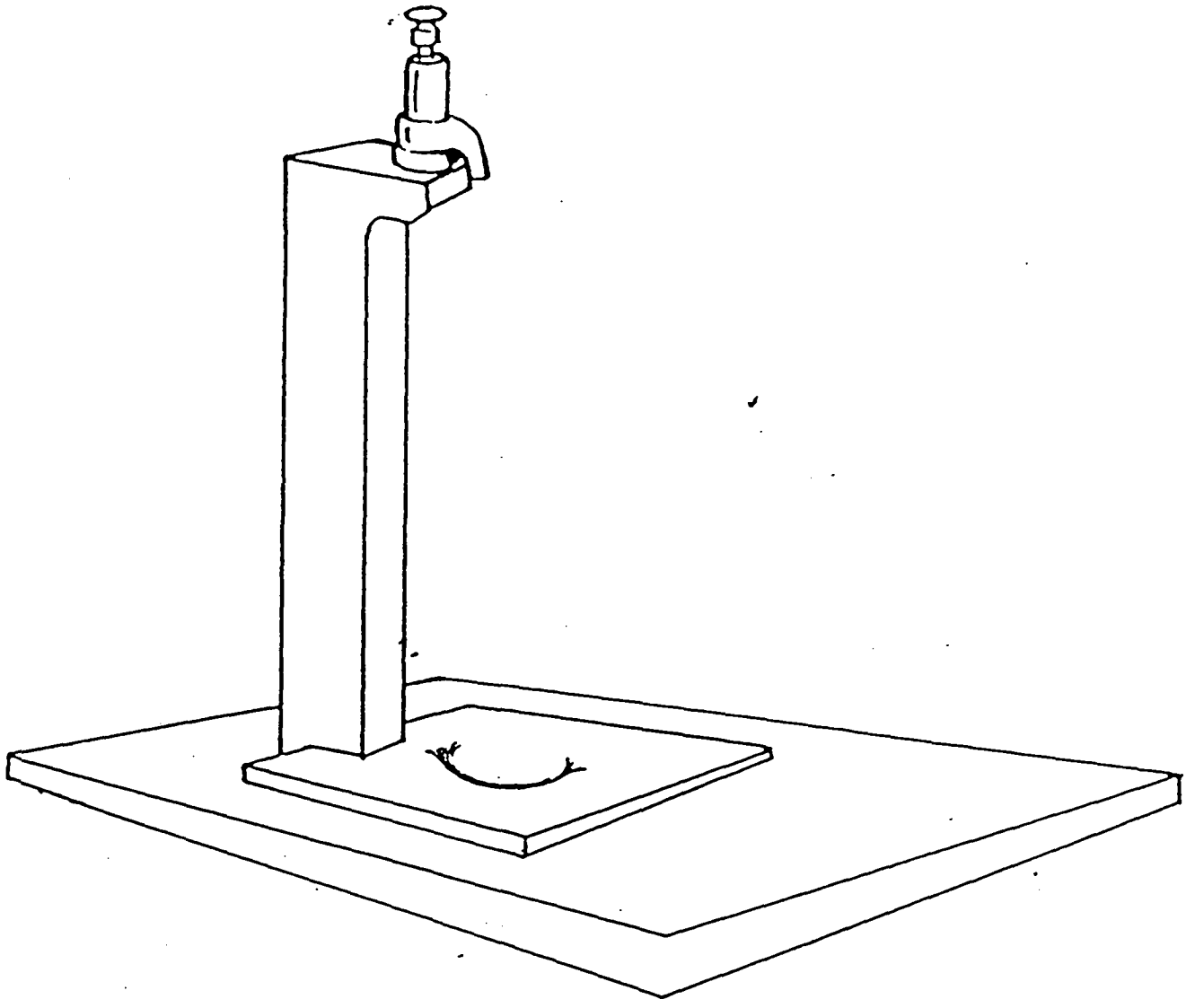
* Fire extinguishers should be placed in easily accessible locations.

Office Safety

* Working areas should be adequate, well ventilated and properly lighted.

* Good housekeeping is important.

* Electric extension cords, waste baskets or other equipment should be safeguarded to prevent fall or other injuries.



STAND POST WITH FORDILLA VALVE

Figure 9

CHAPTER 4

MAINTENANCE OF PUBLIC STANDPOSTS

It has been the practice to undertake operation and maintenance by the authority responsible for construction or the local authority taking over the responsibility of operation and maintenance. It has also been the unpleasant experience to take charge of the system once the construction is over. Later, studies and demonstration projects have adduced quite a good number of reasons for this sort of slackness on the part of the organisation taking over.

The question who should take over the responsibility of a 'public standpost' required further 'clarification' as to whom it is meant for. If it is the public, certainly the community would not want to take over the headaches (popular local term) of others, for 'public' means anyone who comes that way for use of such a public facility. The authorities (whoever they may be) have made attempts to impose water tariffs to people using standposts with absolutely no results in the authorities favour. This is because the communities would not be willing to pay for others. Users of a public standpost are not specifically known. It is something like a street light post.

The Haldummulla experience has been able to change this 'concept' and give meaning to standposts, illustrating how communities are to be involved in operation and maintenance.

Decision on the Distribution of Pipe Network and Number of Standposts

The representative leadership of the community* should be involved in a series of consultation sessions. Participatory planning techniques

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* Karunadasa H I. Planning for Community Barticipation in Rural Water Supply and Sanitation.

should be applied in involving this representative group. The need to be given a thorough understanding of the proposed water supply system and its technical constraints, with major emphasis on future operation and maintenance and the community's roles and responsibilities. This representative group should be involved in planning the distribution network of the proposed water supply system in consultation with the project staff. They should also be requested to decide the number of standposts on a mutually agreed set of criteria. The concept of this involvement makes them feel that it is their system which is planned with their support and commitment.

Decisions on the Location of Standposts

As has been mentioned above, the representative group of leadership of the community should be involved in making this decision. The following procedure has been proved a success.

* Select leaders from the representative group of leaders so as to represent the total area. Consult the local staff and influential members of the community so as to the correctness of this representation. If any area or part of area is omitted, modify the list bringing in new names and strengthening the group further.

* Involve them in a group session. (Briefly explain what a group session is).

* Get an Engineer with experience in community work to act as resource person with support of a social scientist.

* Supply them in advance the background information of the proposed water supply system.

* More effective results could be obtained if this group could be orientated prior to this discussion session.

* Guidelines to the group discussion session should be planned by the project staff. It should be highly flexible.

* Change guidelines when group feels during group discussion sessions, that some areas need be changed.

* Supply them with all support materials (map of area, stationery etc.).

* Develop with them the distribution network of pipelines and location of standposts, keeping in mind technical and financial limitations and community potentials.

* Develop with them the tentative cost of the water supply system and work out the cost of operation and maintenance.

* In working out cost details, identify with them how they are going to work the role of the community and their responsibilities.

* In developing the distribution network of pipe line and location of standposts, avoid public standposts unless the local authority taking over pledges to standby the costs of operation and maintenance.

* Get the report of the group presented at the plenary and get it approved by the total group. If modifications are suggested take note of them.

* Make many copies and distribute them to all group members and other organisations including the political leadership.

Criteria for the Selection of the Location of Standposts

It should be kept in mind that all the standposts planned with the representative group are community standposts and not public standposts. If public standposts are to be planned, they are to be planned with the local authority. By experience it has been found

that the communities would not be willing to take over such responsibilities.

* No standposts are to be located on road sides unless there are no alternatives due to severe space or geographical limitations.

* No standposts are to be located if the community or groups of families disagree with such locations.

* There should be a reasonable distance between two standposts.

* A minimum of 25 families or a population of 150 will have to be there as a standard measure for a standpost, however, under exceptional circumstances this needs to be changed.

* The absence of other alternative sources of water supply.

* The availability of a volunteer caretaker to take charge of the standpost.

* The agreement of the families served by the standpost for the location.

* The road access to the standpost.

* The involvement of the community for excavation of pipelines and supply of locally available materials.

Revenue Generation for Operation & Maintenance

Revenue generation in public standpost water supply systems has been a failure. Very often this burden falls either on the NWS&DB or the Local Authority taking over this responsibility.

Revenue generation in a community standpost water supply system has been tried out at Haldummulla.

As has been mentioned under criteria for the selection of the location

of standposts, the representative groups of the community need be orientated and involved in consultations where costs of operation and maintenance should be worked out in consultation with the project staff. The need that every family utilising the standpost should pay a fee has got to be stressed and this has got to be done by the representative group and not by the project staff. The Haldummulla experience is that every family agreed to pay Rs. 5/= per month and the community stood by this decision.

In the case of public standposts, who should bear the metered cost should first be resolved before planning to construct any public standposts. The experience is that the community is reluctant to undertake this responsibility and nowhere was it found that revenues were successfully collected. Since it is the DDC that takes the responsibility for welfare services, they should be consulted before planning the construction of any public standpost.

CHAPTER 5

OPERATION AND MAINTENANCE COSTS

The total estimated operating costs per annum are as follows :

		Rs.
Cost of Chemicals (estimated annual consumption is 489 kg of Bleaching Powder costing Rs. 10/kg)	=	4,800/=
Cost of repairs (excluding labour)	=	2,500/=
Salary of Caretaker (including housing allowance)	=	18,000/=
Power Costs	=	1,200/=
Contingencies	=	2,500/=
Total direct operating cost	=	29,000/=

The operation and maintenance cost for the system has been worked out based on the scheme being maintained by a Caretaker. The Caretakers salary has been worked out at the rate of Rs. 1,500/= per month taking into account that the Caretaker would be required to have his own accommodation.

The cost of repairs has been estimated at Rs. 2,500/= and this provides for the material costs only. It is proposed that the community should participate in all major activities which require manual labour such as excavation for the repair of pipelines, cleaning of the intake and cleaning of the reservoir and other structures.

It is expected that the Caretaker will function as the liaison officer of the Board in the collection of revenue, coordinating needs of the consumer by organising the water connections, if required and also organising the maintenance activities of the scheme so as to avoid any breakdown of the scheme.

The scheme will not initially have any meters installed and the revenues will be collected based on certain flat rates as stated in Chapter 6. Hence, the cost of reading meters, documentation and billing will not arise. This is considered appropriate for a scheme with such a rural setting.

CHAPTER 6

Community's Share of Operating cost

The object of collecting revenue from the community is to cover the direct operating cost of the scheme.

The flat rates of payment proposed for the Community are as follows ;

Government Institutions	Rs. 100/=	per month
Bakeries	Rs. 75/=	per month
Laundries	Rs. 50/=	per month
Tea Boutiques	Rs. 50/=	per month
Other Commercial Institutions	Rs. 25/=	per month
Households with private connections	Rs. 15/=	per month
Families served by standposts	Rs. 5/=	per month

Based on this scheme, the revenue generated per year is as floows ;

Government Institutions (2 Nos. @ Rs.100/=)	Rs.2,400/=
Bakeries (3 Nos. @ Rs.75/=)	Rs.2,700/=
Laundries (1 No. @ Rs.75/=)	Rs. 900/=
Tea Boutiques (5 Nos. @ 50/=)	Rs.3,000/=
Other Commercial Insitutions (10 Nos. @ Rs. 25/=)	Rs.3,000/=
Households with private connections (30 Nos. @ Rs.15/=)	Rs.5,400/=
Households served by standposts	Rs.13,500/=
	Rs.30,900/=

With regard to the non-payment of water rates, the following procedure should be adopted.

Individual Connections

Three reminders, one for every second, third and fourth month of arrears shall be sent to the respective individuals by the Caretaker requesting for payment. A final notice shall be sent by the regional

CHAPTER 6

Community's Share of Operating cost

The object of collecting revenue from the community is to cover the direct operating cost of the scheme.

The flat rates of payment proposed for the Community are as follows :

	Rs.
Laundries	150/= per month
Bakeries	100/= per month
Government Institutions	100/= per month
Tea Boutiques	75/= per month
Other commercial institutions	50/= per month
Households with private connections	15/= per month
Families served by standposts	5/= per month

Based on this scheme, the revenue generated per year is as follows :

	Rs.
Laundries (1 No. @ Rs. 150/=	1,800/=
Bakeries (3 Nos. @ Rs. 100/=)	3,600/=
Government Institutions (2 Nos.@ 100/=)	2,400/=
Tea Boutiques (5 Nos. @ 75/=)	4,500/=
Other commercial Institutions (10 Nos. @ Rs. 50/=)	6,000/=
Households with private connections (30 Nos. @ Rs. 15 /=)	5,400/=
Households served by standposts (225 Nos. @ Rs. 5/=)	13,500/=
	37,200/=

With regard to the non-payment of water rates, the following procedure should be adopted.

Individual Connections

Three reminders, one for every second, third and fourth month of arrears shall be sent to the respective individuals by the Caretaker requesting for payment. A final notice shall be sent by the regional

authority at the end of the 5th month requesting payment. If no payment is received, the supply could be disconnected at the end of the 6th month.

Standpost Connections

It is unlikely that prohibitive action could be taken against any one individual being served by a standpost connection for non-payment of bills. The best approach to this problem is to mobilize the rest of the community against such an individual. However, if the majority of the community being served by any particular standpost refuses to pay their dues, action could be taken to send reminders at the end of the 2nd, 3rd and 4th month of arrears followed by a notice by the regional authority at the end of the 5th month. Action may be taken by the Regional Office to close down this particular standpost at the end of the 6th month of arrears in consultation with the community.

CHAPTER 7

Responsibility of Service

The responsibility of providing the service initially will be by the Board and subsequently by the District Development Council.

The Caretaker will be the Agent of whatever organisation that operates the scheme and it will be the Caretaker's responsibility to see that the scheme continues to function without deficiencies.

The Caretaker will also act as the collecting agent for the money to be collected from the community. The method to be used for payment is as follows : The Caretaker will be issued with a set of printed stamps by the controlling organisation. The stamps will be denominations of Rupees 25/=, 15/=, 10/= and 5/=. Each family of the community will be issued with a printed booklet containing particulars and stamps. The community will be required to purchase stamps from the Caretaker equivalent to the amount to be paid in respect of each month. These stamps will be pasted on the book and will be franked by the Caretaker with the appropriate seal.

The Caretaker at the end of every two weeks will settle the accounts with the controlling organisation's regional office.

With regard to the new connections required, the member of the community will hand over the necessary application forms to the Caretaker who will then hand over the forms to controlling organisation's regional office.

With regard to the new connections required, the member of the community will hand over the necessary application forms to the Caretaker who will then hand over the forms to controlling organisation's regional office and obtain the necessary connections.

All payments could be made to the Caretaker at the Water Supply Office during a specified period of time each day. The Caretaker is required to maintain a register giving one page for each household and record the payments.

CHAPTER 8

Resource Development

Out of all the resources available to the management of any project, manpower is the most vital resource. Human Resources Development embraces planning, skill development and training and human resources management. The planning of a community standpost water supply must include the development of an organisation capable of operating, maintaining and expanding the system. This will involve training people in the necessary technical and managerial skills. The standpost caretakers, supervisors, technical and administrative staff should be provided with training so that they may acquire the necessary knowledge, skills and attitudes. The training programmes will need to include social, health, financial and management aspects as well as technical skills. On-the-job training should be provided to the relatively unskilled local caretakers.

Training

The need for training should be identified at all levels. Emphasis should be placed on the operation and maintenance of the standpost water supply system. Staff should be trained on the standard operational and maintenance procedure. The other areas of training are revenue collection, accounting, house-connections and metering, extensions to distribution and health education.

Health Education

The health benefits of a community standpost water supply providing safe water are most unlikely to be attained to any significant degree unless the health related behaviour of the community is changed. This should start with the way the water is handled at the time of collection from the tap and extend up to the point of consumption. Community involvement in the process of health education is very important if these changes are to be effected. Knowledge of the ways in which water borne and water related diseases are spread under conditions with existing behaviour patterns, should be imparted to the Community. Services of Health Volunteers, Public Health Inspectors, Family Health Workers and school teachers should be utilised for this purpose. They

should be provided with additional training on health education so that they will be able to spread throughout the community the understanding of the ways in which local habits could be changed to reduce the transmission of water borne diseases. Behavioural change could also be brought about through strengthening the existing health education programmes mobilising school systems and local leaders through formal and non-formal methods of health education. Communication material support and curriculum for instructional training should be developed.

Planning for Future Development

The immediate objective of a standpost water supply is to give as many people as possible the benefit of access to safe water. This will mean that the system may be extended and upgraded at a later date. The planning for this should be done so that the wants and the needs of the local people are met. The views of the users should be obtained through discussion with community leaders, public meetings and surveys. Sufficient and reliable funding must be available to cover capital expenditure in respect of the envisaged developments. Funds must be assured before construction begins. Potential sources of funds that could be considered are :-

(a) Contributions from community to be served
(b) Funds generated by existing supply
(c) Grants from decentralised budgets (District Development Councils)
(d) Loans on easy payment terms

Funds also should be assured for any increased operation and maintenance costs due to developments.

Collection of Resources

Materials, tools and equipment have to be purchased and stored for the operation and maintenance of the existing scheme and for future developments. Having determined how these costs are financed and the extent of inputs at various levels, it is advisable to draw-up a plan of action. The plan of action would detail the objective of

of the programme, the nature of the inputs and by whom, the division of responsibility and the time frame. The materials that should be procured and stored for maintenance work are P.V.C. pipes and fittings, valves, taps, leather washers for taps, packing material for sluice valves and air valves, bleaching powder and reagents for testing residual chlorine and glass drip tubes and stem valves for Belco chlorinator. A sufficient quantity of tools such as spanners, hacksaws, blow lamps, beveling reamers for P.V.C. pipes, hammers mammoties, pickaxes, alavangoes, cane baskets, bass brooms, ekel brooms, coir brooms, wire brushes and paint brushes should also be procured and stored.

APPENDIX TO CHAPTER 2

Technical details of Haldummulla Water Supply Scheme

1. Water demand (in year 2000)

Domestic demand	-	136 cubic metres per day (30,000 gallons per day)
Commercial and Institutional demand	-	92 cubic metres per day (20,000 gallons per day)
Total demand of water	-	228 cubic metres per day (50,000 gallons per day).

2. Source

Source of water	-	Kathiresan Ela
Minimum flow of water	-	181 cubic metres per day (40,000 gallons per day)

3. Intake

3.1 Details of dam

Type of dam	-	Concrete gravity type on rock foundation anchored by dowels
Height of dam	-	2.4 metres (8 feet)
Length of dam	-	9.1 metres (30 feet)
Length of spillway	-	3 metres (10 feet)
Height of spillway	-	1168 m (3831 feet above M.S.L.)

3.2 Details of collecting chamber

Collecting chamber	-	2.85 x 1.2 metres (9.3 x 4.0 feet)
Coarse Screen	-	16 mm. iron bars spaced at 50 mm. centre to centre welded to an angle iron frame of dimension 1.25 x 0.90 metres.

TYPICAL SLUICE VALVE

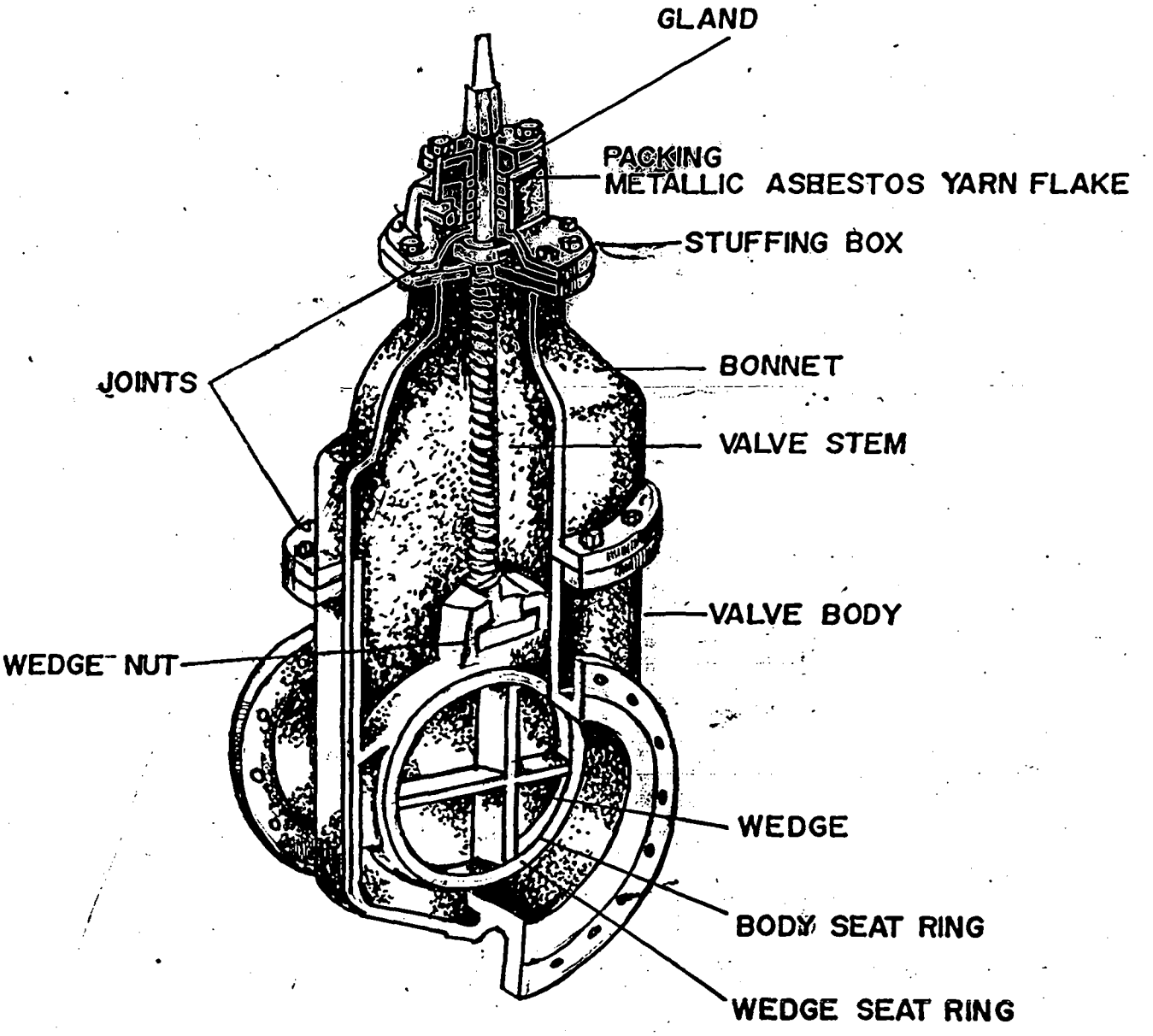


Figure 10

Fine Screen	-	Fine mesh No. 10 welded to an angle iron frame of dimension 1.25 x 0.90 metres
Height of Inlet pipe	-	1168.65 metres (3833.18 feet) above M.S.L.
Details of inlet pipe	-	75 mm. (3 inch) cast iron strainer fitted to a 75 mm. Galvanized iron pipe.

3.3 Scour

Scour pipe of inlet Chamber	-	75 mm (3 inch) galvanized iron pipe
Scour pipe of reservoir	-	150 mm (6 inch) galvanized iron pipe

3.4 Valve Chamber

Valve Chamber I (in reservoir)

Dimensions	-	900 mm. x 750 mm (3'-0" x 2'x 6")
Valve	-	1 No. double flanged 150 mm (6 inch) dia. sluice valve for reservoir scour

Valve Chamber II (downstream of reservoir)

Dimensions	-	1200 mm x 900 mm (4'-0" x 3'-0")
Valves	-	1 No. 75 mm (3 inch) dia. sluice valve for scour of inlet chamber
	-	1 No. 75 mm (3 inch) dia. sluice valves for outlet pipe.

4 Pipe Lines

4.1 Gravity Main

Type of pipe	-	90 mm (3 inch) dia. Type 1000 PVC pipe with GI pipe provided over rocky terrains

Total length of pipe line	-	1036 metres (3399 feet)
Length of G.I pipe	-	320 metres (1050 feet)
Length of P.V.C. Pipe	-	716 metres (2349 ffet)
Elevation of Pipe at Intake point	-	1167.20 metres (3828.40) above m.s.l.

4.2 Break Pressure Tanks

Break Pressure Tank 1 (B.P. 1)

Length from Intake point to BP 1	-	338.41 metres (1110 feet)
Elevation of pipe at BP 1	-	1116.94 metres (3663.57 feet above m.s.l.)
T.W.L. of BP 1	-	1123.48 metres (3685 feet above m.s.l.)

Break Pressure Tank 2 (B.P. 2)

Length from intake point to BP 2	-	1091.46 metres (3880 feet)
Elevation of pipe at BP 2	-	1096.51 metres (3508 feet above m.s.l.
T.W.L. of BP 2	-	1075 metres (3526 feet above m.s.l.

4.3 Air Valves

2 Nos. 25 mm (1") single orifice air valves are provided on the gravity main.

4.4 Scour Valve

2 Nos. 75 mm. (3") scour valves are provided on the gravity main.

5.0 Chlorinator, Office Room and Store

Dimensions of construction	-	7 m x 5 m (21 feet x 6 feet)
Dimensions of office room	-	3.10 m x 3.0 m (10' x 1½' x 9' - o')
Dimensions of store room	-	3.05 m 1.85 m (10' x 6' - 1½')
Dimensions of Chlorinator House	-	3.05 m x 2.45 m (10" x 8')
Type of construction	-	Brick masonry construction on rubble masonry foundations
Type of chlorinator	-	'Belco' No. 3 model chlorinator solution capacity 640 fl.ozs.

6.0 Storage Reservoir

Construction	-	Reinforced concrete
Dimensions	-	7.60 m x 6.70 m x 3.0 m (height)
Inlet	-	75 mm (3 inch) G.I. pipe
Outlet	-	150 mm. (6 inch) G.I. pipe fitted with a strainer
Overflow	-	75 mm (3 inch) G.I. pipe
Scour	-	150 mm (6 inch) G.I. pipe

Valves

Inlet	-	75 mm (3") dia. C.I. Ball valve
Outlet	-	150 mm(6") dia. Butterfly valve
Scour	-	150 mm (6") dia. Sluice Valve

7.0 Distribution Details

Details of distribution pipe line (PV.C)

Colombo Haputale Road

In direction of Haputale	-	160 mm dia (6") - 30.49 metres (100 feet)

	-	63 mm dia (2") - 1158.54 metres (3800 feet)
In direction of Colombo	-	160 mm dia (6") - 457.32 metres (1500 feet)
		110 mm dia (4") - 304.88 metres (1000 feet)
		90 mm dia (3") - 289.63 metres (950 feet)
		63 mm dia (2") - 503.05 metres (1650 feet)
Soragune Road	-	63 mm dia (2") - 243.90 metres (800 feet)
Ranwanguhawa Road	-	63 mm dia (2") - 152.44 metres (500 feet)
Sudharmarama Vihara Road	-	63 mm dia (2") - 243.90 metres (800 feet)

7.2 Standposts

Number of standposts provided - 22

Maximum distance between standposts - 0.4 km (0.25 metres)

7.3 Break Pressure Tanks

One Break Pressure Tank provided at the turn off to Soragune Road on the Colombo-Haputale main road. T.W.L. of the break pressure tank is 993.90 metres (3260 feet) above m.s.l.

Culvert Crossings

Several culvert crossings are encountered and crossing types A B and C are provided as necessary

Scour Valves

A total of six scour valves are provided on the distribution system. These consist of 75 mm dia (3") and 50 mm dia (2") scour valves.

APPENDIX TO CHAPTER 3

MAINTENANCE SCHEDULES

ONCE EVERY DAY

(A) **Treatment Works - Chlorination**

1. Wipe cabinet of Belco Chlorinator
2. Wash Glass Drip tube with water
3. Mop floor below Chlorinator
4. Flush Chlorine Discharge line

(B) **Office and Stores Block**

1. Clean and sweep floor
2. Wipe and clean pipe lines walls

(C) **Standposts**

1. Clean apron and drain

ONCE EVERY WEEK

(A) **Belco Chlorinator**

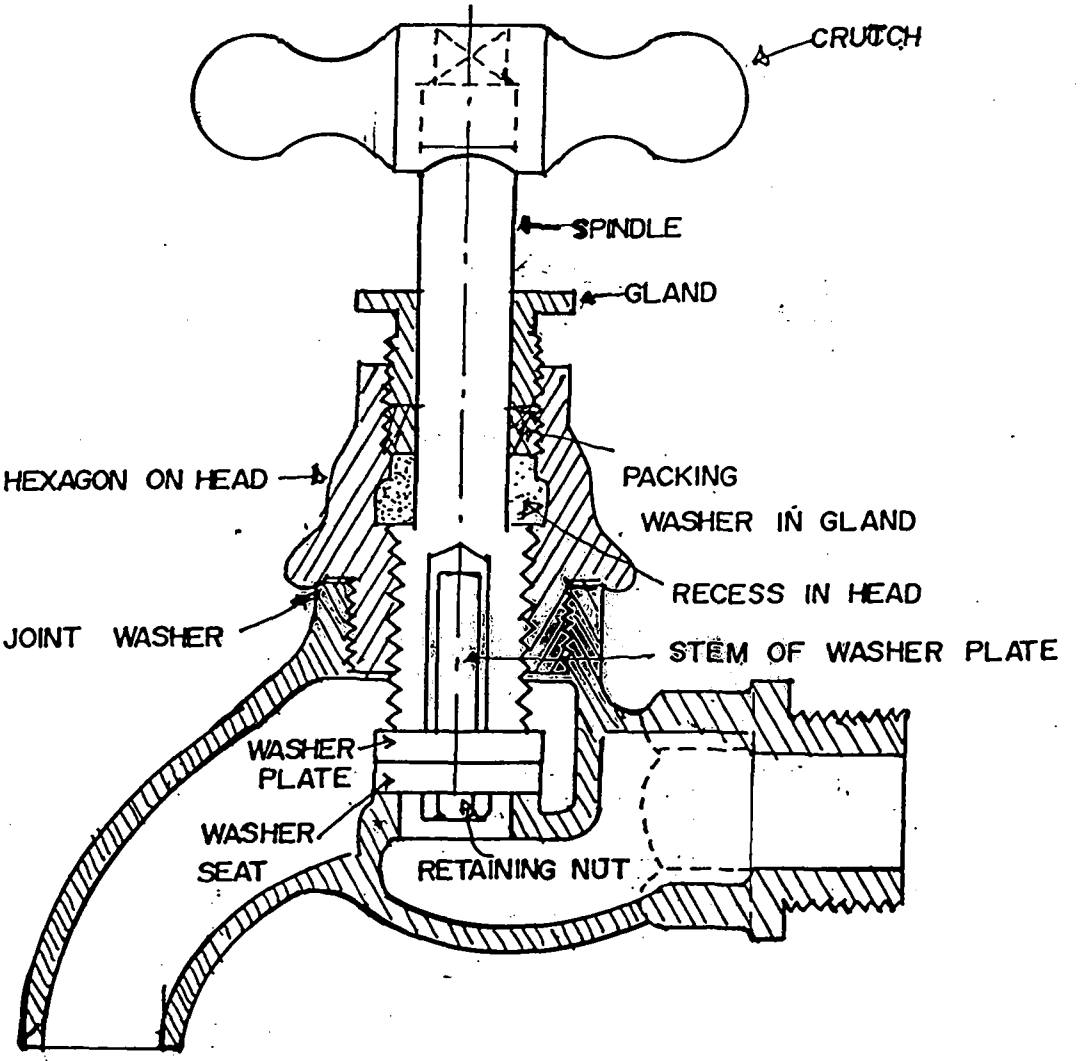
1. Clean drip tube with acid or vinegar
2. Clean glass funnel with soap and water

(B) **Chlorine Test Kit**

1. Wash and clean chlorine test kit

(C) **Standpost**

1. Check the taps/Fordilla valves for leaks and fix



SECTION OF BIB TAP

Figure 11

if necessary.

2. Clean surrounding area by weeding and draining only water colleted around the standpost.

Effecting Repairs to Bib Tap

(A) **How to re-washer a Bib-Tap**

1. Cut off the water supply to the tap by closing the stopcock on the supply line.

2. Fit an adjustable spanner to the hexagon on head of tap.

3. Unscrew (turn anti-clockwise) head of tap using the spanner and remove.

4. Take off the Jumper (Washer plate) resting on the valve seating.

5. Unscrew the small retaining nut to release the washer.

6. Fit the new washer and reassemble tap.

7. Open stop cock and check tap for water-tightness.

NOTE :

I. If the retaining nut will not unscrew, loosen it with a little penetrating oil.

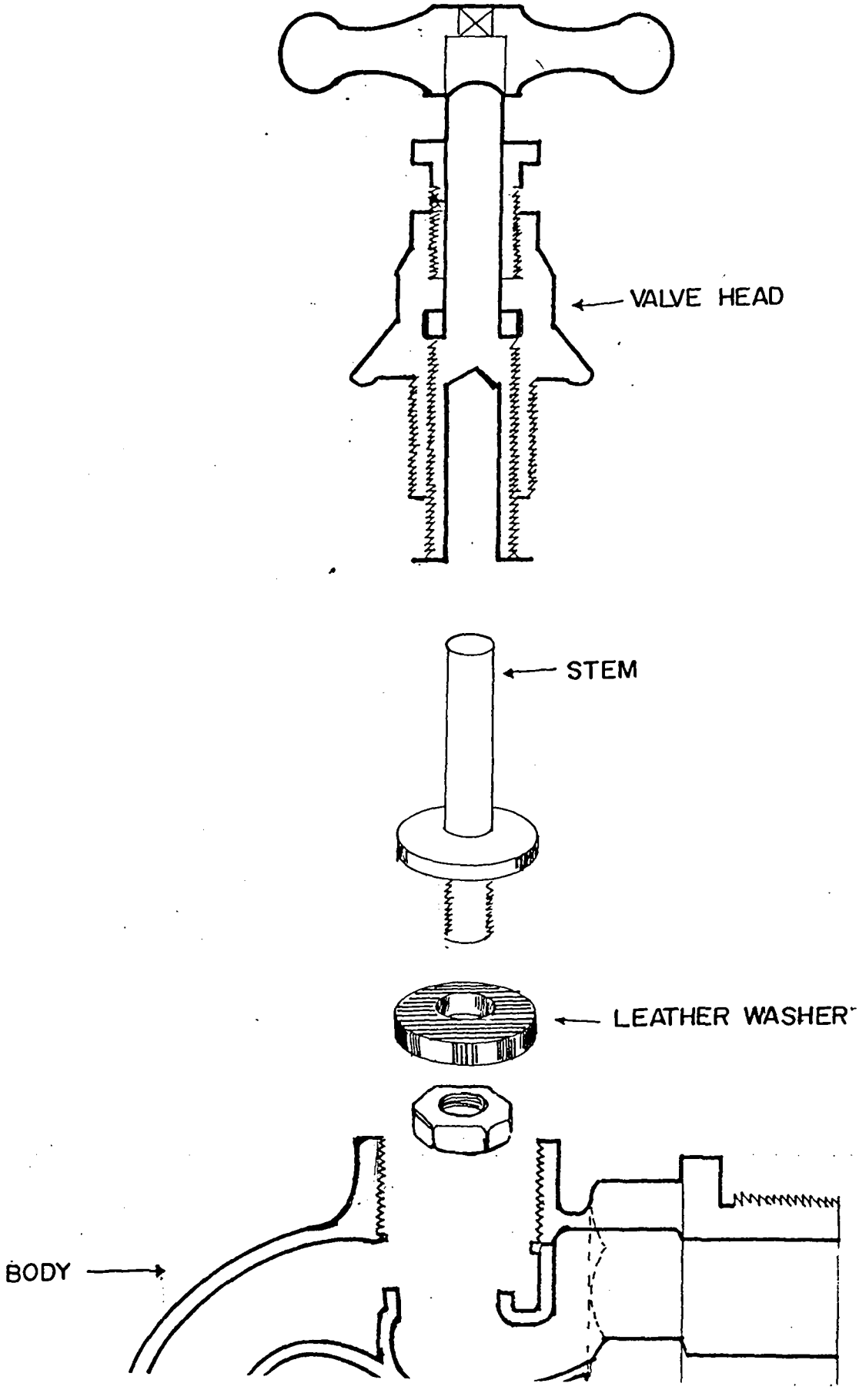
II. The complete jumper and washer section may be replaced, if necessary.

(B) **Repair of Gland Failure**

Water leaking from the spindle of a tap is a sign of gland failure. Another symptom of this problem is a tap which can be turned on and off very easily.

The remedy is to adjust the gland or renew it.

BIB TAP COMPONENTS



Procedure

1. Check for slack in the gland-adjusting nut and if possible turn it in a clockwise direction.

2. If all the allowance for adjustment has been taken up and the nut cannot be turned, the gland packing has to be renewed.

2. Unscrew and take out the gland packing nut.

3. Remove what is left of the packing with a pen-knife or screw driver.

4. Press strands of hemp yarn into the gland stuffing box.

5. Reassemble tap and check for water tightness at gland.

MAINTENANCE SCHEDULES

ONCE EVERY MONTH

(A) **Intake**

1. Desilt impounding Reservoir *
2. Flush inlet chamber *
3. Weed surrounding area *

* To be done every 03 months in the dry season

(B) **Break Pressure Tank**

1. Check float valve and water level

(C) **Treatment Works (Chlorination)**

1. Deassemble chlorinator unit, wash and clean all parts

(D) **Office & Stores Block**

1. Check and repair water leaks in wash basins, water lines, drainage lines.

(E) **Storage Reservoir**

1. Check float valve and water level

MAINTENANCE SCHEDULES

ONCE EVERY 3 MONTHS

(A) **Intake**

1. Weed/clear shrub jungle in adjacent area
2. Desilt impounding reservoir (manual removal of silt.)
3. Flush inlet chamber
4. Inspect screens in inlet chamber, inlet pipe strainers and clear any debris collected. Clean with wire brush if necessary.
5. Clean valve chambers
6. Check valves for easy operation. Open and close several times each valve. Check for inner leaks and repair if necessary.

(B) **Gravity Main**

1. Inspect gravity main for leaks. Inspect joints/connections, check for leaks and repair leaks if found necessary
2. Clean shrub jungle along pipe trace
3. Check Air valves for proper functioning and leaks. Repair if necessary.
4. Flush gravity main by opening scour valves, valves to be kept open until water runs clear and close commencing from intake end.

MAINTENANCE SCHEDULES

ONCE EVERY 3 MONTHS

(C) **Break Pressure Tanks**

1. Drain tank and flush.
2. Check carefully each and every valve. Open and close each valve several times. Check for inner leaks and repair if necessary.

(D) **Storage Reservoir**

1. Check carefully each and every valve. Open and close each valve several times. Check for inner leaks and repair if necessary.

(E) **Distribution System**

1. Check and repair leaks in pipes/joints
2. Check carefully each and every sluice valve/gate valve, scour valve in the distribution system. Open and close each valve several times. Check for inner leaks and repair, if necessary.

3. 3. Inspect all culvert crossings, repair any defects.

MAINTENANCE SCHEDULES

ONCE EVERY 6 MONTHS

(A) **Intake**

1. Inspect sanitary conditions, look for any sources of pollution

*2. Collect water samples for bacteriological and chemical analysis and despatch to Laboratory. (Procedure given separately.)

3. Inspect protective fence and effect any repairs necessary.

* Water quality to be checked more often during extreme dry seasons, wet seasons and when there is an out-break of bowel diseases.

(B) **Break Pressure Tanks**

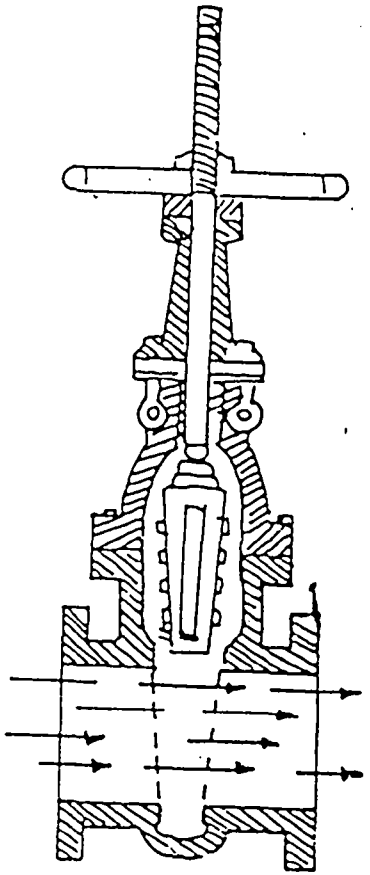
1. Drain tank, clean and wash by hand, inside and outside of tank. Use bass broom or wire brush.

2. Disinfect floor and walls using 30 p p m chlorine solution.

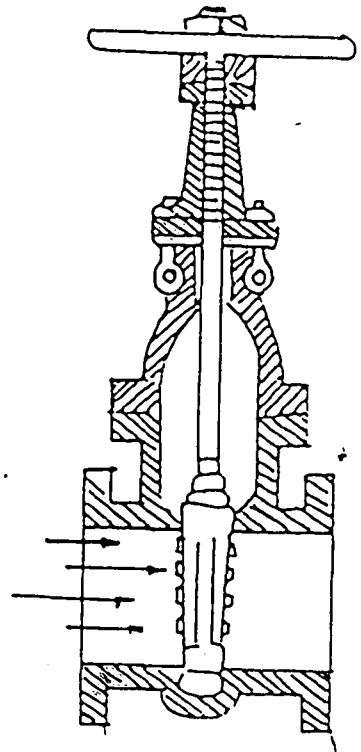
(C) **Chlorinator**

1. Replace drip tube and stem valves, if defective

SLUICE VALVE SHOWING OPENED AND CLOSED POSITIONS



OPEN



CLOSED

Figure 13

MAINTENANCE SCHEDULES

ONCE EVERY 6 MONTHS

(D) **Storage Tank**

1. Drain the tank. Clean and wash by hand, inside and outside of tank.
2. Clean outlet pipe strainer
3. Disinfect floor and walls using 30 ppm. chlorine solution.

(E) **Distribution System**

1. Drain distribution system using scour valves and refill lines again. Scour valves to be kept open until they run clear and to be closed commencing from reservoir end.

ONCE EVERY YEAR

(A) **Intake**

1. Inspect structures, look for cracks or defects in the dam/inlet chambers/valve chambers. Repair any defects.
2. Wash and clean sign board. Re-paint if necessary
3. Re-paint all metallic parts/structures

MAINTENANCE SCHEDULES

ONCE EVERY YEAR

(B) **Break Pressure Tank**

1. Re-paint metallic structures

(C) **Chlorinator**

1. Deassemble all units completely, clean and replace any defective parts.

(D) **Storage Tank**

1. Paint outside of pipe lines

2. Paint all metallic structures

(E) **Distribution System**

1. Overhaul all main water meters. Deassemble completely, clean each unit and replace all defective parts.

2. Overhaul all domestic water meters. Deassemble completely, clean and replace all defective parts.

(F) **Stand posts**

1. Inspect post and apron for cracks/defects, repair if any.

2. Paint all Metallic parts

(G) **Office and Stores Block**

1. Check and repair any leaks in roof
2. Paint inside and outside walls
3. Paint pipe lines and all metallic fixtures

Annexure 1

PROCEDURE FOR COLLECTION OF WATER SAMPLES

1. For Chemical Analysis

1.1.1 Collect 2½ litres into a clean bottle. Before filling the bottle wash it several times with the water that is to be tested.

1.1.2 Collect sample direct from the source. Do not use funnels or any other device to fill the bottle

1.1.3 When collecting sample do not allow foreign matter to come into contact with the source thus preventing pollution of source.

1.2 Method of Collection of Sample

1.2.1 From a Tap

Open tap fully, allow water to flow out for 2 minutes, wash bottle with sample water and collect sample.

1.2.2 From Stream/Reservoir

Tie a string onto the lid of the bottle, close the bottle with the lid, dip it under the water with the mouth facing up, pull the string and open the lid. When dipping the bottle into the water, avoid stirring any sludge or deposits in the bottom of the source.

NOTE * After collecting sample, the lid should be washed with water from the source and then the bottle closed.

* Affix a label onto the sample bottle giving the following information.

1. Source
2. Date of collection of sample
3. Time of collection
4. Name of person collecting sample
5. Name and address of person requiring test report

2. **For Bacteriological Analysis**

2.1 Instructions to be followed

Use 250 ml, wide mouthed, sterilized bottles with a tight fitting lid with a paper cover over it.

When collecting chlorinated water request for a sterilized bottle with 5 mg. of Sodium Thiosulphate introduced into it before sterilizing. The sterilizing should be done in an oven at 160°C for one hour.

* Do not open the bottle until the time of collection of sample.
* Do not wash the bottle with water
* Do not fill the bottle completely

2.2 **Method of Collection**

2.2.1 **From a Tap**

* Open tap fully and allow water to flow out for 2 minutes
* Close tap.
* Burn the mouth of the tap using cotton wool dipped in spirit

* Cool it by allowing water to flow out for some time.

* Remove string on paper cover on lid. Hold bottle close to its bottom with one hand and remove lid with the paper cover with the other hand, fill 3/4 of the bottle with water, replace lid and tie paper cover. Do not place the lid anywhere or allow it to come into contact with any object.

2.2.2 **From Stream/Reservoir**

* Remove lid with paper cover, dip bottle into the water about one foot below surface with the mouth facing downwards. Turn the mouth towards the flow of water and fill the bottle. Replace lid and tie paper cover.

NOTE : The sample should be handed over to the Laboratory within 3 hours of collection. If it takes a longer time the sample bottle should be packed with ice around it. However, the sample should be handed over for analysis within 24 hours of collection.

* Affix label giving following information.

  1. Source
  2. Date of collection
  3. Time of collection
  4. Name of person collecting sample
  5. Name and address of person requiring report

* The collection of samples should be planned by the Caretaker in consultation with the Regional Chemist of the National Water Supply & Drainage Board.

Annexure 2

OPERATION AND MAINTENANCE MANUAL

Haldumulla Water Supply Scheme

Typical Chemical Quality
of Kathiresan Ela

Date of Sampling	-	May 4, 1987
Appearance	-	Clear
Turbidity	-	2.8 N.T.U.
pH	-	8.1
Electrical Conductivity	-	120 Microsiemens
Chloride	-	10 Milligrams per litre
Total Alkalinity	-	14 Milligrams per litre as $CaCO_3$
Total dissolved solids	-	80 Milligrams per litre
Nitrates	-	Trace
Nitrites	-	Minute Trace
Iron	-	0.48 Milligrams per litre
Colour	-	3 Hazen Scale

Annexure 2 (Contd.)

Date of Sampling	-	July 4, 1987
Appearance	-	Clear
Turbidity	-	2.2 N.T.U.
Electrical Conductivity	-	3.00 Microsiemens
Chlorides	-	44 Milligrams per litre
Total Alkalinity	-	64 Milligrams per litre as $CaCO_3$
Total dissolved solids	-	80 Milligrams per litre
Nitrates	-	Trace
Nitrites	-	0.004 Milligrams per litre
Iron	-	0.16 Milligrams per litre
Colour	-	5 Hazen Scale

Annexure 3

DAILY ISSUES FORMS

Year :- Month :-

Day	Materials Used	Unit	Used for		New Connections	Signature
			Operation	Maintenance		
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						
Saturday						
Sunday						

.....
Signature of Caretaker

Annexure 3 (Contd.)

WEEKLY REPORT

Year :- Month :-

Day	Rainfall mm	Quantity of supplied Litres	Quantity of Bleaching Powder used Kg.	Interruptions to supply (hrs.) with reasons	New connections
Monday					
Tuesday					
Wednesday					
Thursday					
Friday					
Saturday					
Sunday					

.....

Signature of Caretaker

MONTHLY ATTENDANCE RECORD

Name :-

Days worked for the month :-

Leave taken for the month :-

Type of Leave :-

Casual Leave	Medical Leave	Annual Leave	Lieu Leave	No-pay Leave

.....
Signature of Caretaker

Annexure 3 (contd.)

NATIONAL WATER SUPPLY AND DRAINAGE BOARD

Monthly Maintenance Record

Water Supply Scheme :

Month :

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Litres supplied per day																																
Chemical used Bleaching Powder (Kg.)																																
Interruptions to supply	1. Pipe Bursts																															
	2. Others																															
Chlorine Dosage Milligrams/litre																																
Residual Chlorine	1. At the reservoir																															
	2. At the first standpost																															
	3. At the last standposts																															
New connections 1. Domestic 2. Commercial 3. Industrial 4. Public/Community Standpost 5. Others																																

.....

Signature of Caretaker

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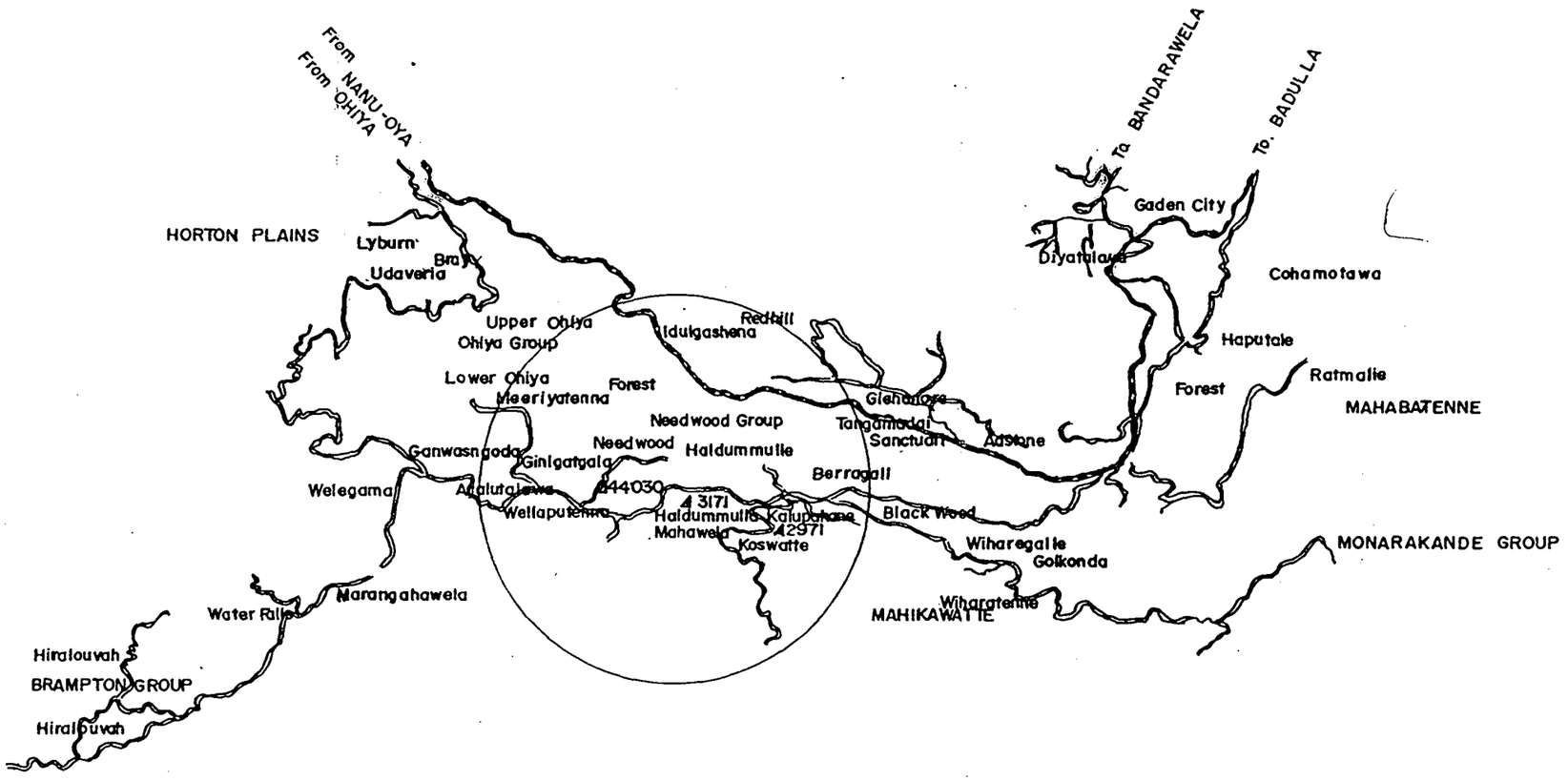
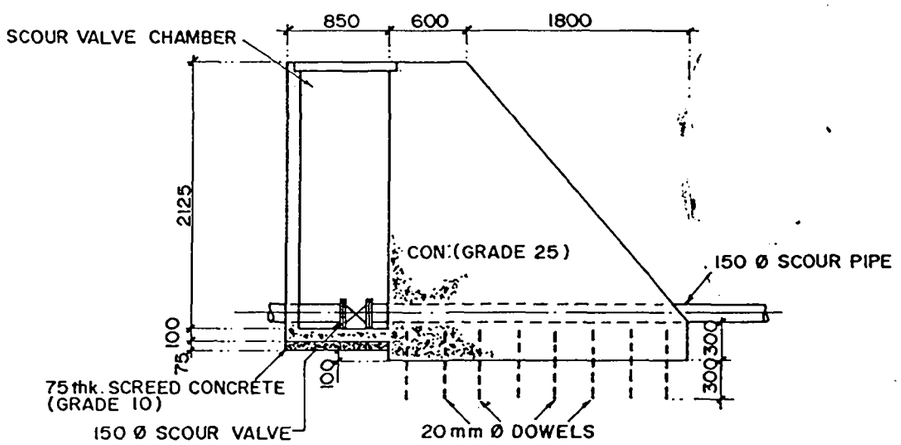


OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

LOCATION MAP OF SCHEME

1
Drg No



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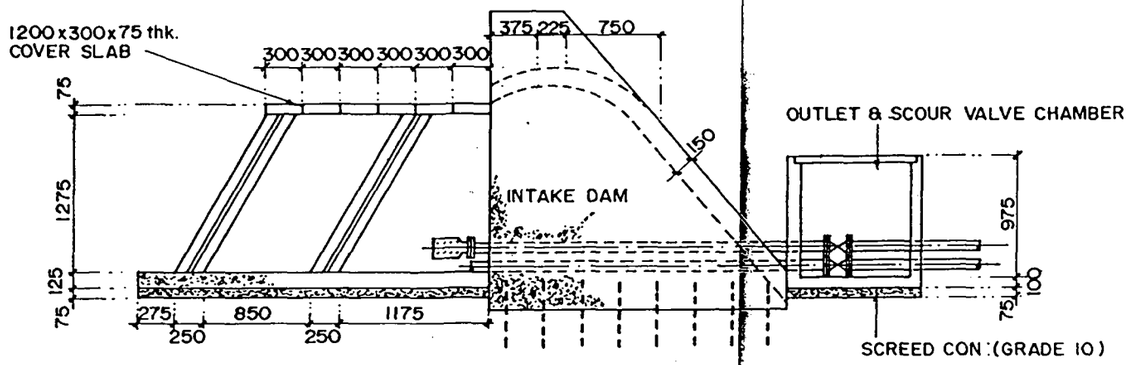

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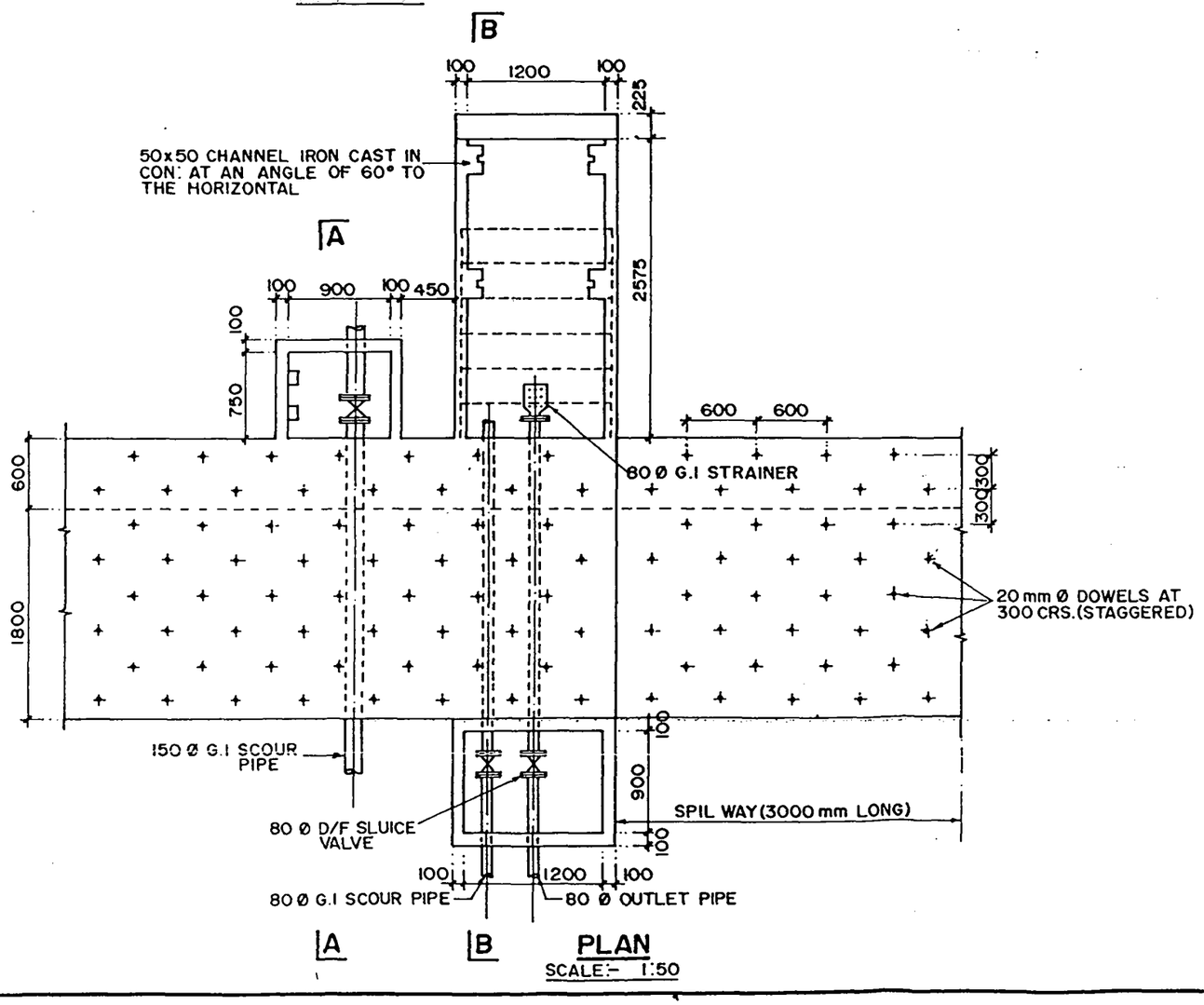


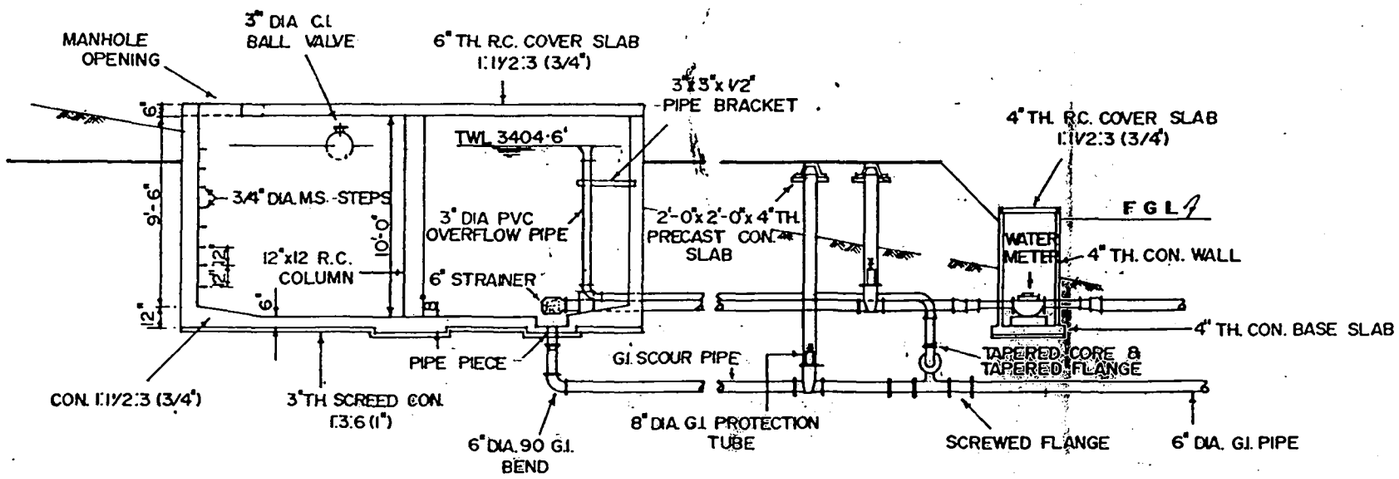
PLAN
SCALE :- 1:50

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

DETAIL OF INTAKE DAM

2
Drg: No



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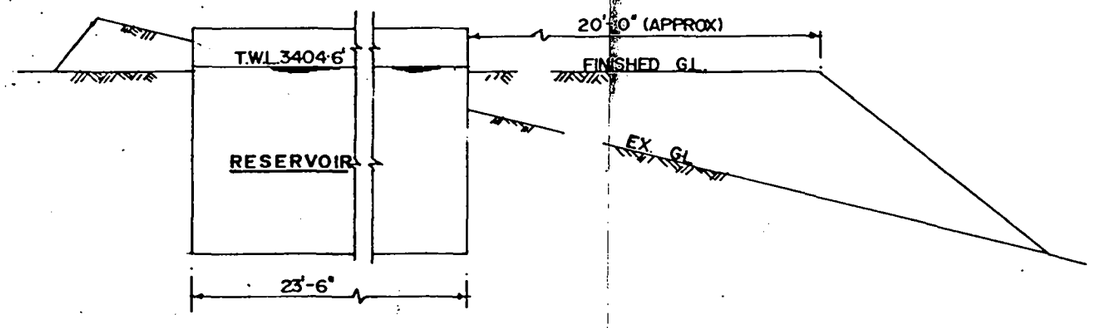

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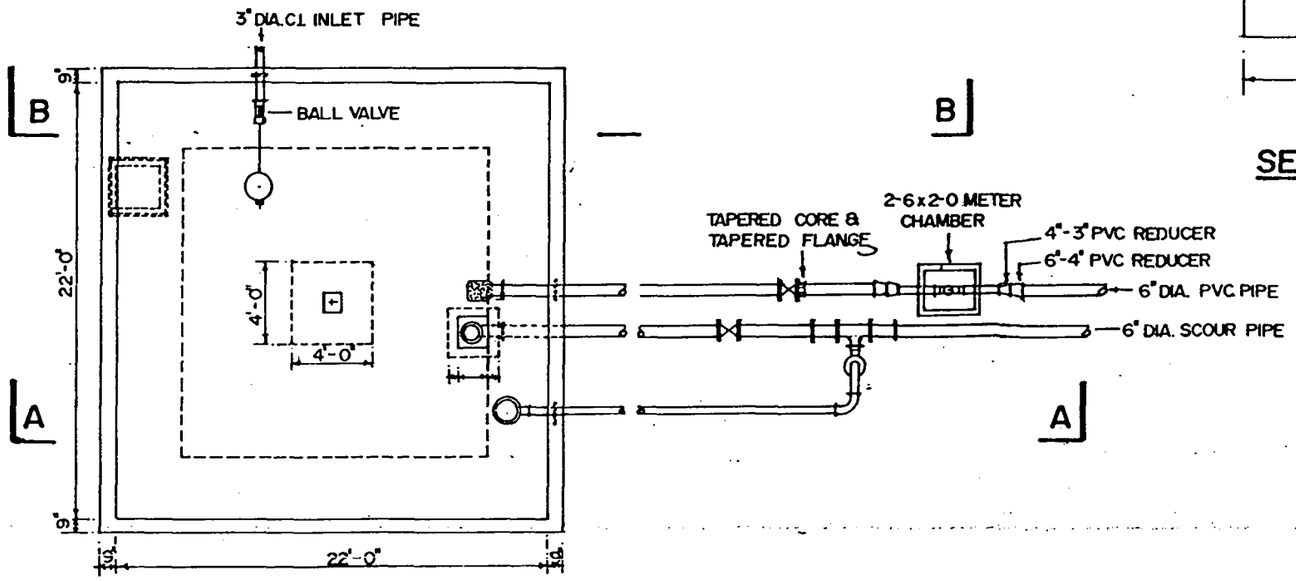


PLAN OF RESERVOIR

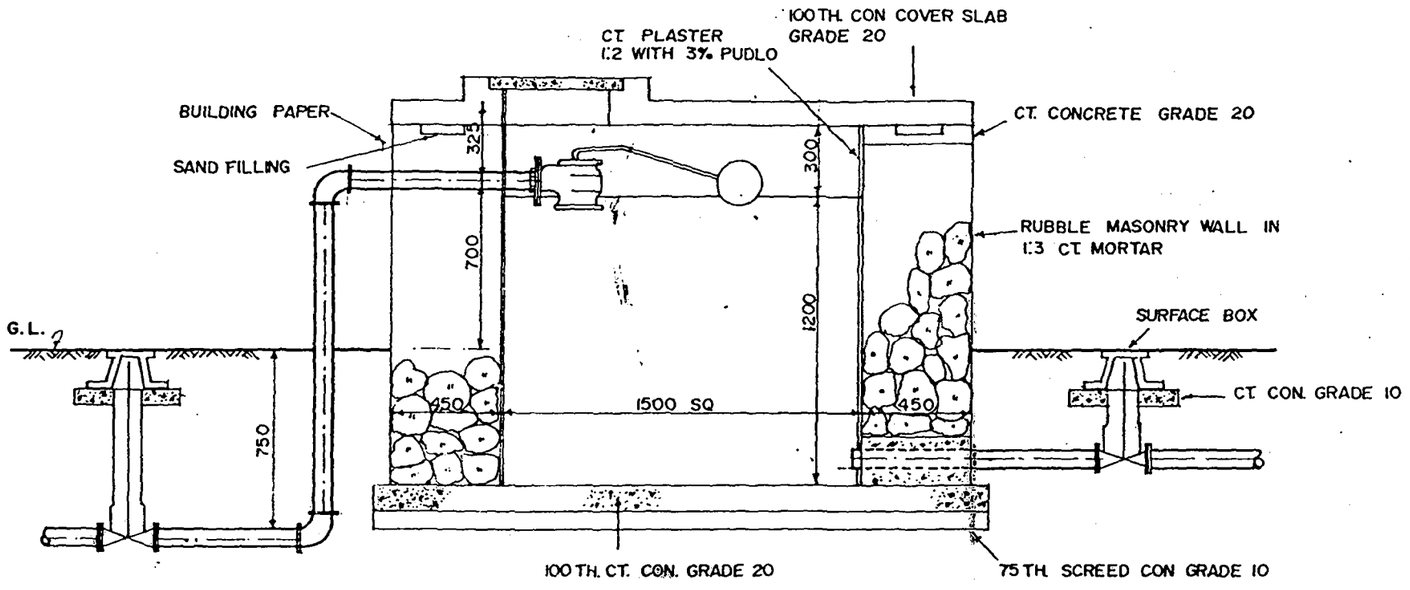
SCALE: 8 FT. TO AN INCH

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

DETAIL OF RESERVOIR

3
Drg No.



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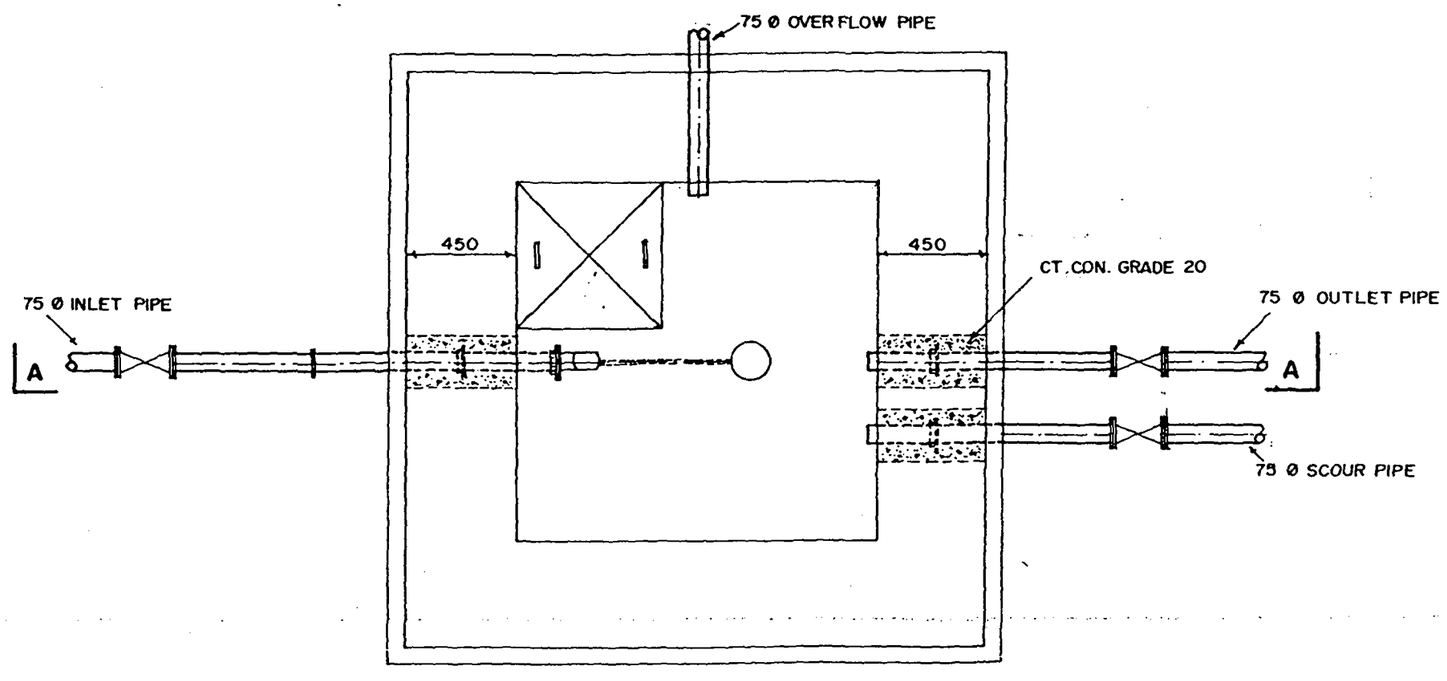

PLAN

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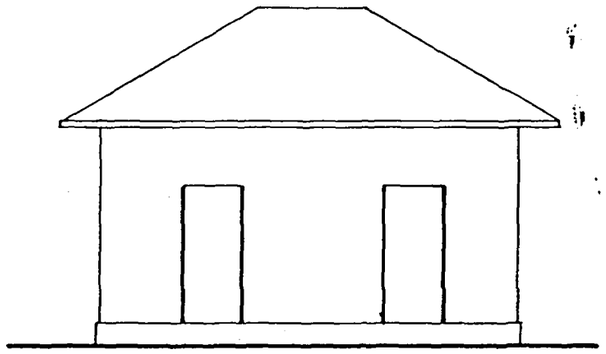
OPERATION & MAINTENANCE MANUAL

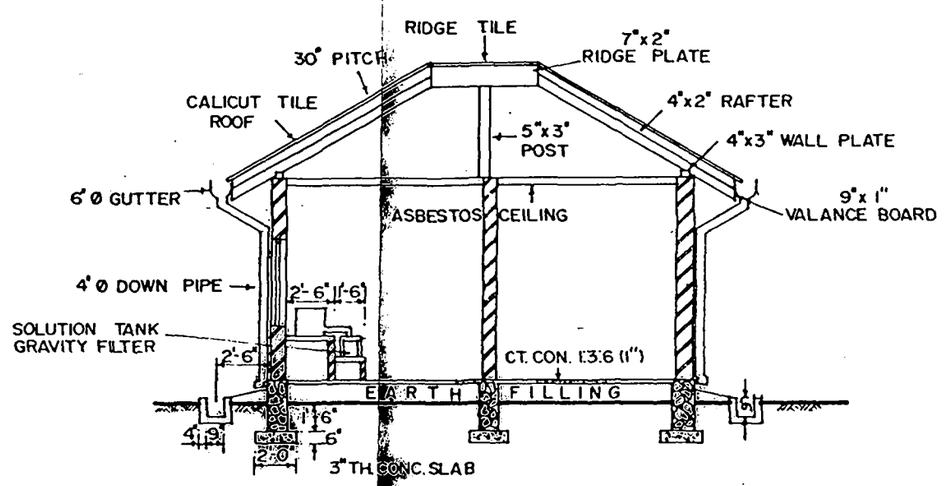
HALDUMMULLA WATER SUPPLY SCHEME

DETAIL OF BREAK PRESSURE TANK

4
Drg No



FRONT ELEVATION



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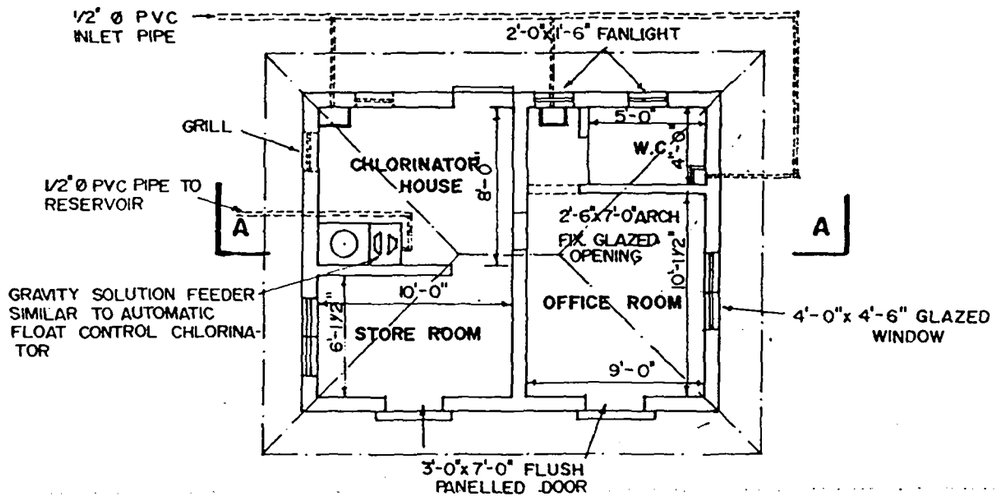


PLAN

SCALE: 8 FT TO AN INCH

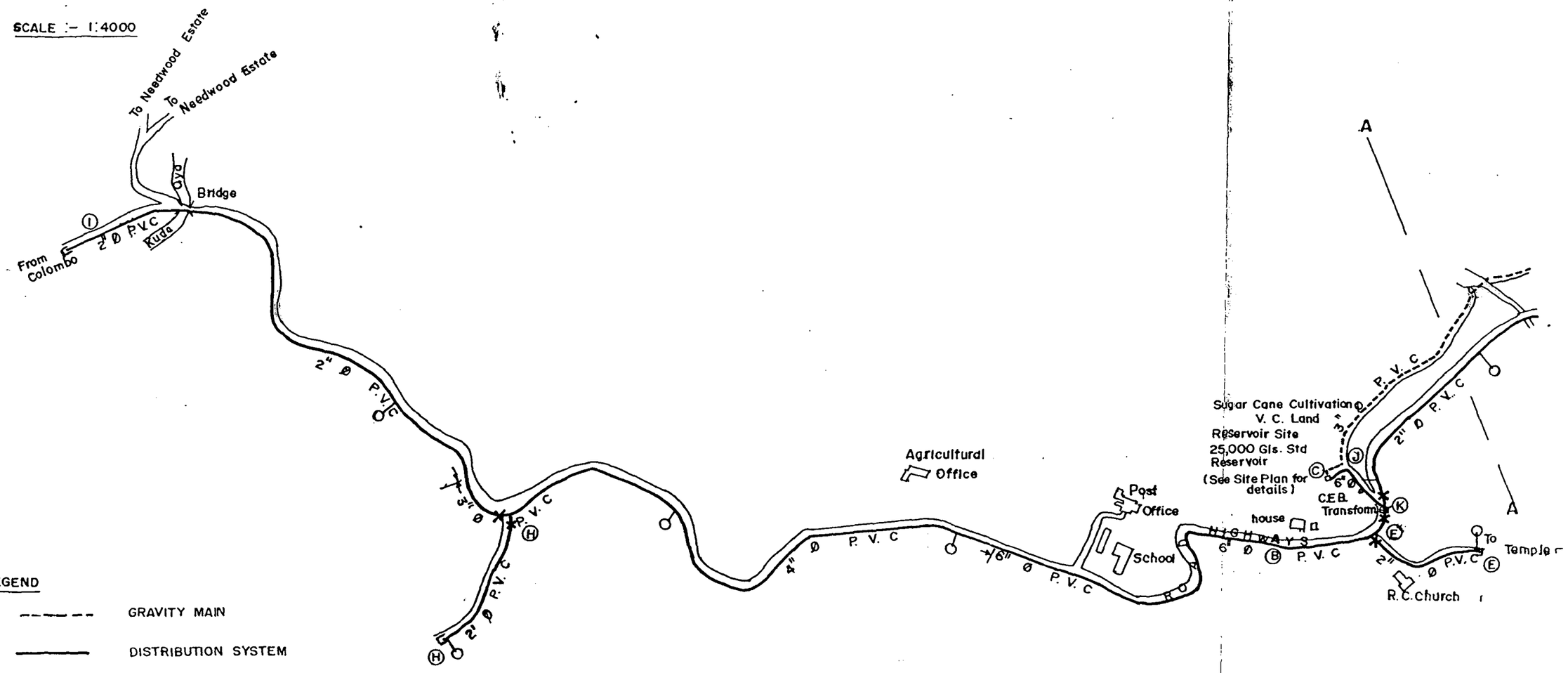
OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

DETAIL OF CHLORINATOR HOUSE & OFFICE

5
Drg Nº

SCALE :- 1:4000



LEGEND

----------	GRAVITY MAIN
————	DISTRIBUTION SYSTEM
——×——	SLUICE VALVE
——⊥——	SCOUR VALVE
——O——	STAND POST
——|	END CAP
22	No. OF STAND POSTS
90	No OF HOUSE CONNECTIONS

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

KEY PLAN OF GRAVITY MAIN AND DISTRIBUTION MAIN

6A
Drg No

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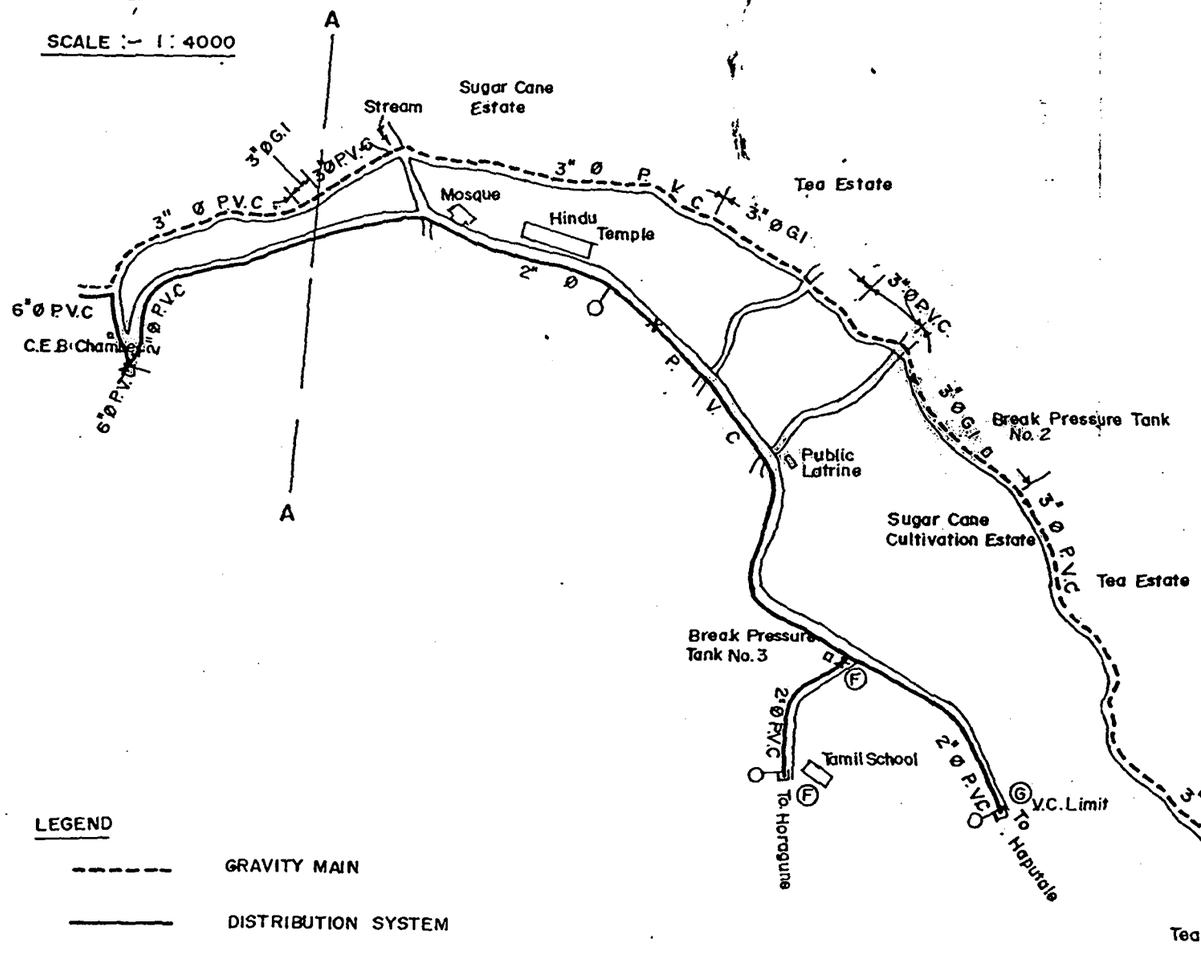
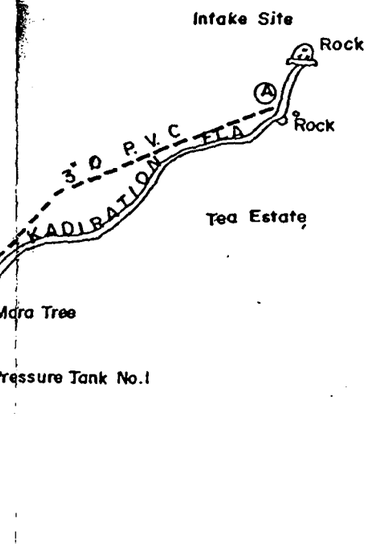




LEGEND

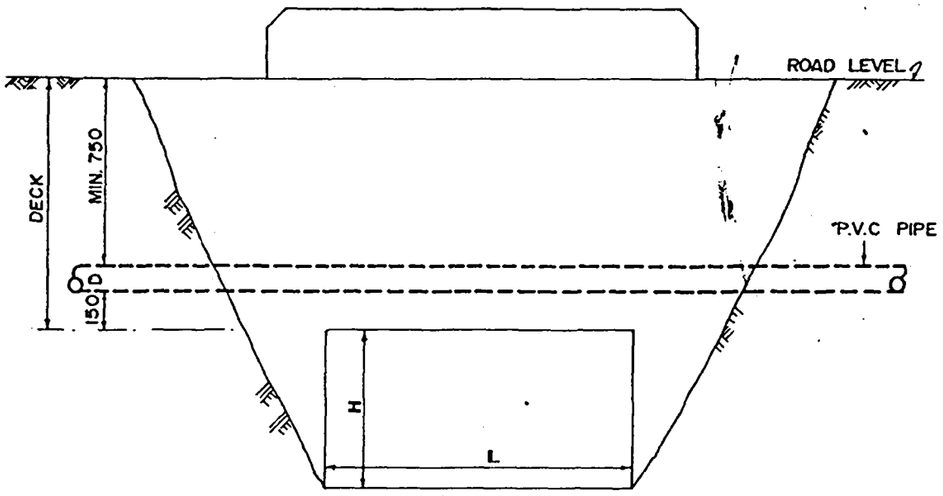
- GRAVITY MAIN
- DISTRIBUTION SYSTEM
- SLUICE VALVE
- SCOUR VALVE
- STAND POST
- END CAP
- 22 — No. OF STAND POSTS
- 90 — No. OF HOUSE CONNECTIONS

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

KEY PLAN OF GRAVITY MAIN AND DISTRIBUTION MAIN

6B
Drg No



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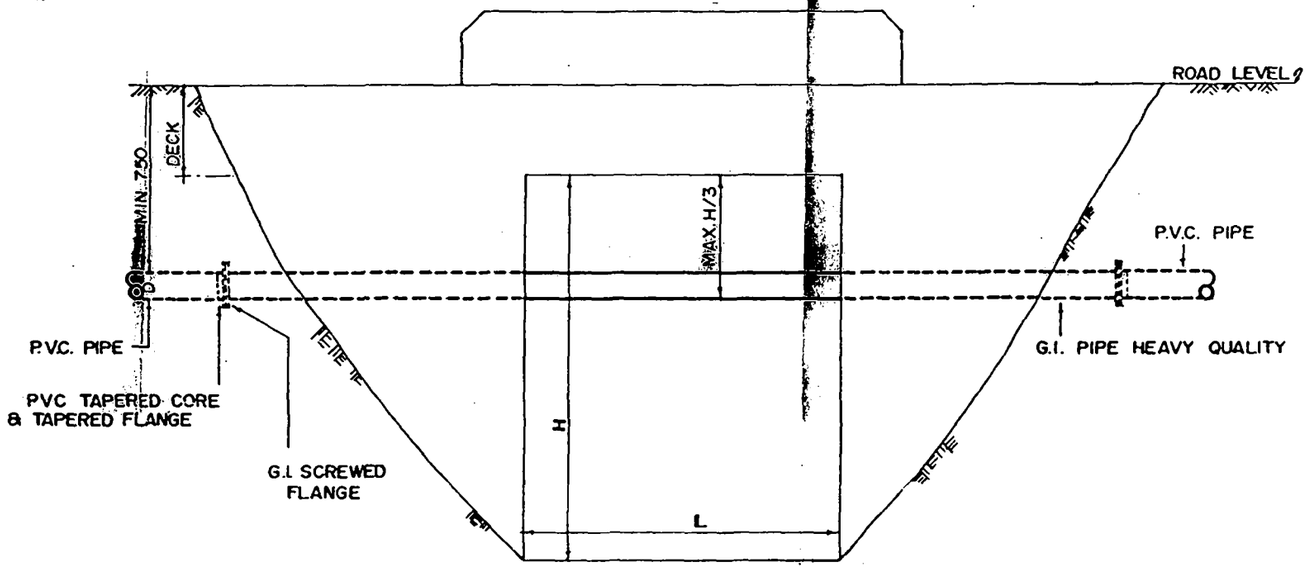

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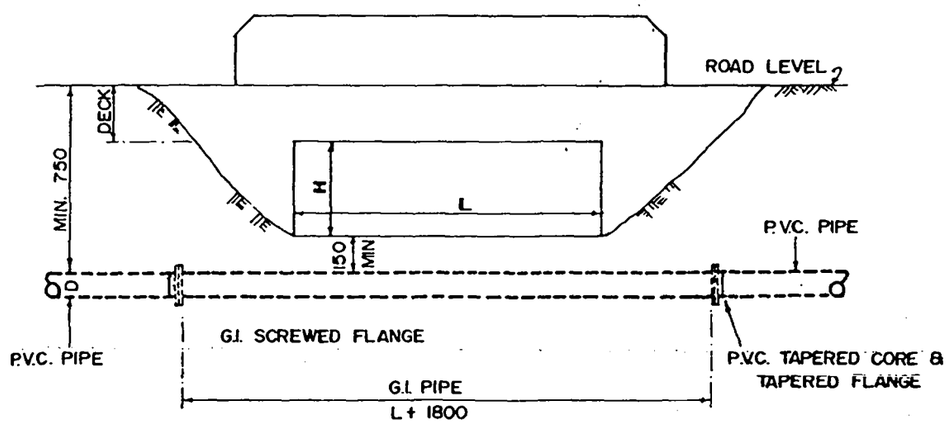


TYPE 'B'

NOTE

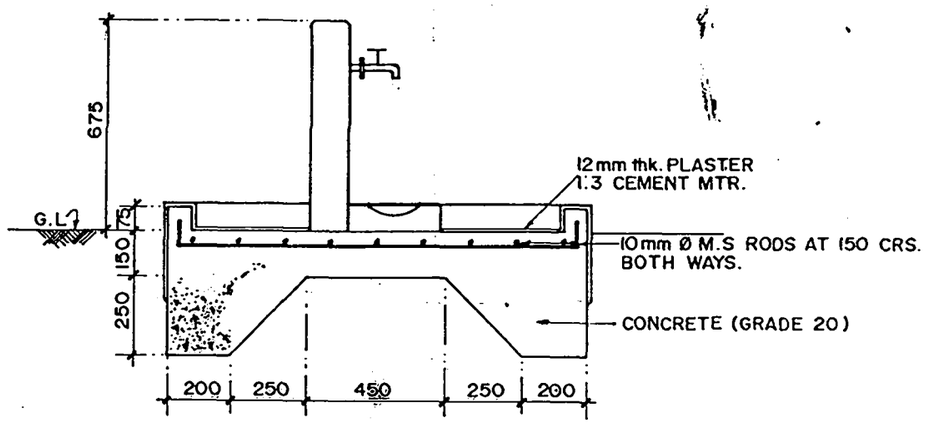
1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. LENGTH OF G.I. PIPE IS L + 1800

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

TYPICAL DETAILS OF CULVERT CROSSINGS

8
Drg No



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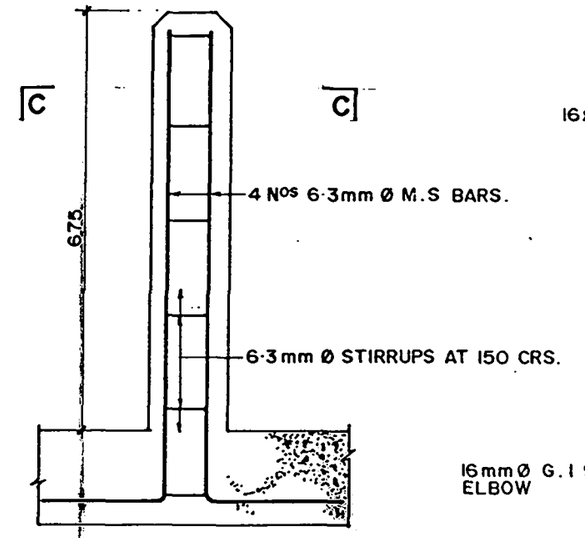
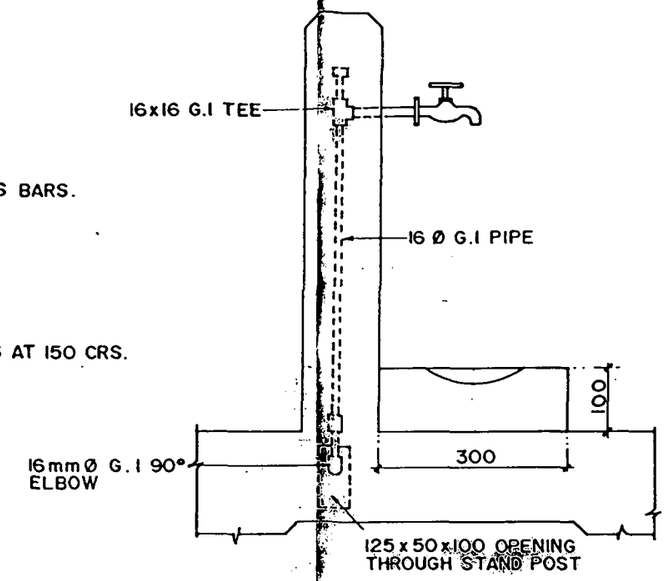
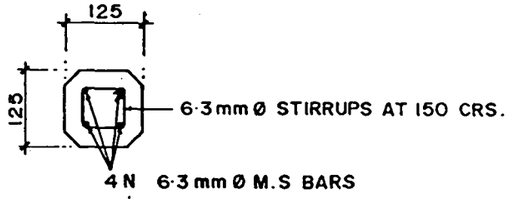




R.C DETAILS OF STAND POST



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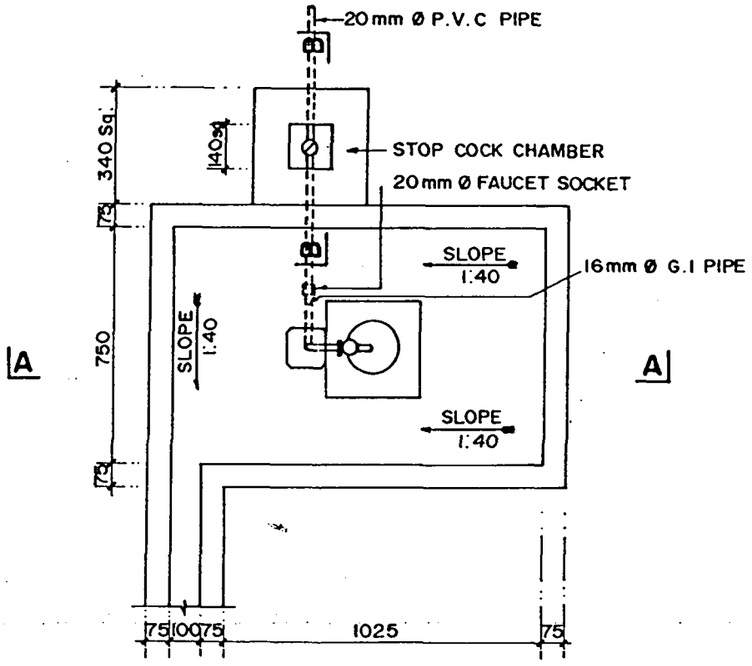

PLAN

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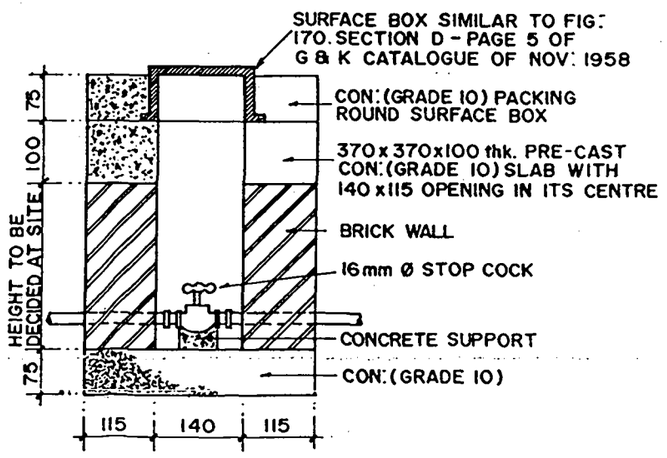

SECTION B-B

SCALE :- 1:10

OPERATION & MAINTENANCE MANUAL

HALDUMMULLA WATER SUPPLY SCHEME

DETAIL OF TYPICAL STANDPOST

7
Drg: No