1st Edition

HANDBOOK FOR WATER CONSUMERS

Ministry of Water Supply & Drainage

National Water Supply & Drainage Board

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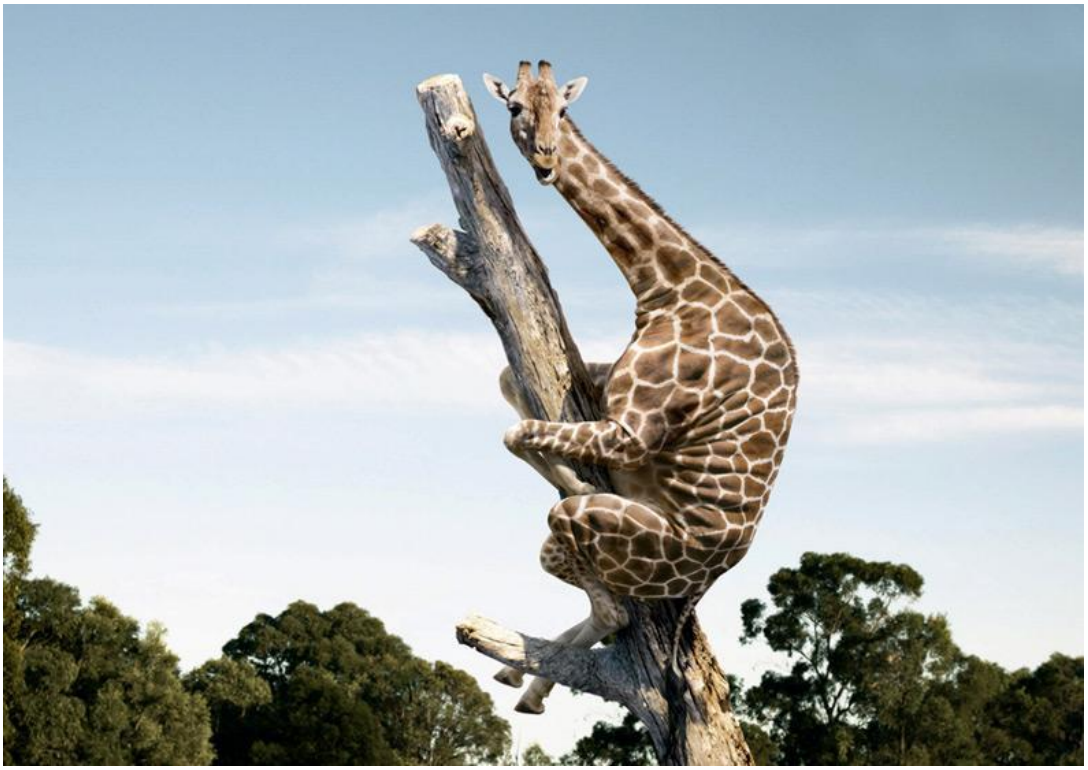

The things that we once thought as impossible can be done if tried differently. Small bruises may result in; however benefits outweigh the effort.

Our habits may be hard to leave by. However how many old habits have already been changed or completely forgotten; willingly or unwillingly?

Do we go to public wells for bathing anymore? Do you like to take a bath in a confined room called bath room? Do we collect our vegetables and fruits from our garden anymore? Do we have a choice for these? Only choice is to change to satisfy with what is available. This will be initially hard but with time things will be better.

Therefore think of water supply the same way. Clean water is getting scarce. Let's save water whenever and wherever possible. This booklet will give your insight in to this, as well as sound knowledge as to how drinking water supply is used effectively and efficiently.

Hand Book for Water Consumers

1st Edition – 2014

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Preface & Acknowledgement

Preparation of a hand book for consumer is a long felt need of the National Water Supply and Drainage Board (NWSDB) and this is the first time such was made possible after nearly 40 years of its operation. NWSDB is the semi government agency responsible for provision of pipe borne water supply for the population and it has a consumer database exceeding 1.5 million at the moment. Every year more than 100,000 new consumers are added to the database and the demand for pipe borne water is ever increasing. This is due to the pollution of water sources and increase in population who are getting use to live in smaller plots of lands, barring from going for dug wells of their own. NWSDB collects raw water from the sources, produces clean water, transmits it to the demand centers, stores and distributes to the domestic and various other users. NWSDB is the supplier; and the consumer is the buyer, in business terms. Any business, to be sustainable, needs to have a positive balance sheet and the NWSDB was providing water for free until 1982, free of charge. The institution is continuing to have a negative balance sheet even after the introduction of billing and there is a wide gap between production and selling prices. The production costs at now is exceeding Rs 150 while the average selling price is less than Rs. 25/= for majority of customers. The deficit has been coming from the state coffers and therefore every drop of water saved will be a saving to the nation and this is the core objective of preparation of this hand book.

This booklet is meant for providing wider understanding of water supply, costs involved, measures that can be taken by individual customers for saving even in smaller quantities, preservation of water sources from pollution and additional information such as managing wastewater, for providing knowledge to the customers for keeping their environment from polluting.

First and foremost thank goes to the Engineers and the staff of Greater Kandy Water Supply Project (GKWSP) and this book may have never been realized without the enthusiasm and dedication shown by them. Japan International Cooperation Agency (JICA) is the financier for the production of the hand book and heartfelt thank goes to Mr. T. Kikuta, Team Leader of NJS Consultancy of GKWSP from JICA for his assistance extended for this noble cause.

Also, special thank goes to Dr. Nadeeshani Nanayakkara of University of Peradeniya for translation of this booklet from English to Sinhala language and cartoonist Mr. Awantha Atigalla who prepared reader friendly and meaningful cartoons for easy understanding of the contents in the book. Finally special thank goes to Engineer Dayaratne Gamage, who drafted this book in English and the Non-Revenue Water NRW team members Mr. Dananjana Yapa, Miss Indumini Menikdiwela, Miss Ashika Weeratunga and rest of the staff of the project for dedication that resulted in preparation of this valuable booklet.

Eng. P H Sarath Gamini, Project Director
Greater Kandy Water Supply Project

Message of Hon Minister of Water Supply

"Water is life; there is no alternative for that. Conservation and saving of water for future generations is our responsibility"

National Water Supply and Drainage Board, under the guidance of Ministry of Water Supply & Drainage that follows the direction and guidance of HE President and Mahinda Chintana policy of development in is in the process of carrying out a pioneering service for provision of safe and reliable potable water for citizens of Sri Lanka.

NWSDB has been continuing to implement systematic programs to construct large and medium scale water supply schemes under the above direction and guidance. The customers who enjoy the benefits of such large investments are having a responsibility to save and use water with care and impunity.

We hope that this booklet will be important for the customers to understand the ways and means of economizing and using of potable water without wastage and manage waste water in proper manner.

Sri Lanka is ahead of many Asian countries with respect to water supply and sanitation. However, at a time the whole world is facing a crisis in clean water, our country will be unable to stay away from the problem. Therefore I would like to make a request to use water with care and save water at every opportunity to increase the water supply coverage and provide water to the people who are aspiring to have potable water**.**

Hon Minister of Water Supply and Drainage
Dinesh Gunawardene

Message from the Chief Representative of Japan International Cooperation Agency

It is a pleasure to give my massage at this important juncture of publishing the **Handbook for Water Consumers**. This technical communication document has included very useful knowledge areas that water consumers want to know. The handbook has targeted wide spectrum of people from school children to senior citizens.

The most of the consumers who receive a bill from the National Water Supply and Drainage Board (NWSDB) generally pay the bill without considering where the water comes from, or how it is treated and delivered to their homes. The water bill is typically far less than the actual cost which might not even cover the operational cost. Therefore conservation of water, protection of water sources, reduction of Non-Revenue Water, and improvement of collection ratio etc. are challenges that Sri Lanka is facing with now. It is indeed a great effort taken by the Greater Kandy Water Supply Project patronage of the NWSDB management to publish this Handbook for water Consumers that fill a gap in the knowledge, which has so far not been addressed.

JICA, being the financer, along with GOSL, for this valuable endeavor is happy to expresses our wishes for successful launching of the handbook.

Kiyashi Amada
Chief Representative – JICA

Message from Secretary of Ministry of Water Supply & Drainage

It is with great pleasure that I am issuing this message at the time of launching of the water consumers hand book that describes the importance of conservation of water resources and saving of potable water that resembles with the statement of great king Parakramabahu that “Not a single drop of water that touches soil shall be left to ocean unused”.

Availability of adequate water for all the living forms is becoming increasingly difficult throughout the globe. Though a considerable portion of the globe is covered in water, the quantity available for consumption is very limited. Wastage of water supplied by the NWSDB after spending a colossal amount of money by careless usage or without being used is fact to worry about.

The information provided through this booklet is of significance and it is my belief that you will use the information contained in the book for conservation and saving of water for provision of water supply to the masses that are waiting to receive water in many parts of the country.

Nihal Somaweera
Secretary – Ministry of Water Supply & Drainage

Message from Chairman of National Water Supply & Drainage Board

I am pleased to issue this brief massage on the occasion of publication of "***Hand Book for Water Consumers***" which is a long felt need for our valuable consumers and general public.

The NWSDB annually invest a colossal amount of funds to provide portable water to the consumers. Therefore, conserving water to meet the growing demand by other needy public is identified as a major requirement in the Water Industry.

In this context, this consumer manual would facilitate to take the massage of value to portable water and cost involved in the production process as well as to emphasize how the consumers would voluntarily contribute and participate in Water Conservation Process.

At this junction, I would like to appreciate Project Staff of GKWSP who voluntarily initiates this publication apart of having a heavy workload of Project on behalf of NWSDB.

Eng. R W R Premasiri
Chairman NWSDB

Message from General Manager – National Water Supply & Drainage Board

I'm extremely happy to issue this massage at the junction of publishing "***Hand Book for Water Consumers***" by NWSDB.

The NWSDB is making all efforts to provide efficient service for our valuable customer while conserving the water to meet future growing demands. For that purpose, it is required to have a participatory approach with stakeholders / water consumers in our day to day activities and interactions.

Therefore, the issuing of this booklet would facilitate to form a link between our customers & NWSDB while aware them about Cost of Water and their responsibilities towards conserving portable water.

I strongly believe that this work piece would fill some gaps between our institution and general public and create an enthusiasm among our valuable board staff on convincing them our duty to general public.

I appreciate the effort made undertaken by project staff of GKWSP and would like to invite other potential Engineers as well to come forward and contribute your knowledge and experience to build a healthy relationship with the general public while maintaining a quality culture in the water industry.

Eng. B W R Balasuriya
General Manager – NWSDB

Content

1. Introduction

No one can live without air, water or food. One may live for 3 minutes without air, 3 days without water and 3 weeks without food (www.livescience.com).

Air is ample so far, though water is already scarce. Food has many alternatives but for water there is no substitution. Water is most importantly used for consumption among other many other uses. Consumption of clean water is keeping our lives free of diseases and makes us live longer. Every country is facing many problems due to lack of clean or usable water and pollution of water. Polluted water is similar to having no water. Therefore every country is doing everything at their disposal for keeping water clean and converting raw water to potable water. Sri Lanka is not an exception and spends over Rupees 20,000 million a year for provision of potable water.

National Water Supply and Drainage Board (NWSDB) is the national institution for provision of potable water and the NWSDB has so far been able to provide 43.4% of population with pipe borne water. There are other forms of water supply through rural water schemes run by local governments as well as consumer societies and hand pumps etc that account for additional 25% of population. As such the total safe drinking water supply coverage in the country is closer to 65% of population.

Supply of potable water is an expensive affair and as such the capital investment required for provision of potable water exceeds Rs. 175,000 to 300,000 per family. Therefore the amount of money needed for water supply is huge and this has made the progress of supplying water slower. At the same time if the water produced is used for intended purposes, without wastage and improper usage, the coverage of population can be increased without going for further investments.

It is a fact that any type of water can be treated and made fit for consumption. Industrialized nations such as Japan and Singapore use effluent from sewerage treatment plants even and water is made suitable for drinking. However the fact that we should not forget is the treatment of polluted water is very costly and most

of the developing countries cannot afford to clean such dirty water for consumption. More is the level of pollution; more will be cost of purification. Keeping water from polluting can help keep our children and future generations safe and healthy.

Also we can preserve our environment and other living beings from extinction by keeping water free from pollution. Man is the only responsible person out of all the other living animals for pollution of water and that affects not only man but all the rest of the living beings.

Potable water produced by the NWSDB is conveyed to the households through pipe networks. Finally water ends up in the kitchens and bath rooms. The quality of water produced by the NWSDB meets Sri Lanka Standards (SLS) for drinking water. However the uses of water do not stop there in most of the time and clean water is used for the purposes that can easily be either avoided or satisfied by other water sources. Water produced by the NWSDB is transferred to households at a concessionary fee and the cost of water cannot be covered by the water bills paid by the customers. This has added weight to the government coffers and money for subsidized water is to be found from elsewhere. This will in other words be met by those who do not use pipe borne water, through indirect costs, which we as a nation, should try to avoid. In the business and economic world today the cost of products and services enjoyed are borne by the user.

Water shall be preserved and wastage shall be avoided by all possible means. Poorly fixed pipes, substandard or none standard fittings, faulty fixing of pipes by unqualified people, unawareness of cost and importance of water etc are the reasons that we can easily recognize and take precautionary measures to avoid many of the issues discussed above. Beneficiaries of such actions will be the water customers in the first place, general public at large and the NWSDB as the service provider who will be able to provide more people with water.

This book is called handbook of potable water supply as the book explains many dimensions to educate the consumers, help them understand piping installations standards, avoid water wastage due to unawareness, takes care of the environment more than before and most importantly provides a wide variety of information to be a good and responsible citizen.

1.1. National Water Supply and drainage Board

NWSDB is the shortened name of the National Water Supply and Drainage Board. Some times it is called Water Board as well.

However the NWSDB shall NOT be termed as Water Resources Board as it is another government institution looking after some other aspects related to water.

NWSDB is the semi government organization responsible for production, distribution and maintenance of public water supplies as enacted by the NWSDB act of 1974, amended subsequently in 1995. NWSDB with close to 10,000 staff and 312 water supply schemes throughout the country produces 1.5 million m^3 of potable water every day.

This is a huge water quantity and if 1% of water loss is saved it will be sufficient to provide water for 20,000 families. The related cost that the country could be saved will be approximately Rs. 3,000 million per year. This saving is sufficient to construct 1 km of highways per year. Therefore, if more percentage of water losses can be eliminated the benefits are not required to explain.

Having realized this national importance, NWSDB has made every effort to take every step to save water, construct more efficient water treatment facilities, and train the staff for systematic water management. The vision and mission of the NWSDB is set meeting the overall objectives.

Vision: To be most prestigious utility organization in Sri Lanka through technological and service excellence

Mission: Serve the nation by providing sustainable water and sanitation solutions ensuring total user satisfaction.

NWSDB has identified the customer as the most important element of the water supply, going with the global trend of treating the customers with highest priority and importance for business excellence and destined to deliver the products and services demanded by the customer to highest possible standards.

1.2. Consumer Charter

Following is the customer charter prepared by the NWSDB for keeping the customers more informed and comfortable.

PROVISION OF WATER SUPPLY AND SANITATION SERVICES

As the National Organization responsible for the provision of safe drinking water to the people in Sri Lanka the NWSDB is committed to ensure an efficient and reliable service to the beneficiaries by improving present condition of water supply schemes and in accordance with the guidelines mentioned in this customer charter.

1. Water quality standards - to comply with SLS standards
2. Level of service - to provide sufficient water to customers throughout the island

If further says that "We are always in courteous service to our customer's as we receive our salary through your payments; We are dedicated to serve you as follows."

Provision of a new connection	
Submitting an estimate after handover of duly completed Forms by the customers	1-7 days
Provision of connection after signing the agreement and making Total payment by the customer	1-4 days
Customer Complaints	
Reply to written complaints	Within 14 days
Water Bills	
To respond to complains on meter issues	Within 7 days
To respond to complains on meter readings	Within 14 days
Period between two meter readings (previous & current)	30 days
Re-connection	
Restoration of connection, if a payment is made before 12 noon on the same day of disconnection	Within 24 hrs.
First bill to customer after provision of the water a connection	30 days

Payments

Possibility of making all payments to NWSDB cashier points on week days from 8.00 a.m. to 03.30 p.m. and also possibility of making water bill payments to designated Banks, agency post offices, and approved agents and through the internet.

Reporting complains and other issues

Possibility in reporting complains and other issues through the phones or fax or to Regional Support Centers, Regional Managers officers, District officers, Area Engineers officers and OIC officers from 8.30 a.m. to 4.15 p.m. on all working days of the week. 24 hrs total free service facility for reporting of break downs or any other complain.

Prior notification

In case of essential repair work, the customers will be informed 24 hrs in advance regarding the reasons for the interruptions.

2. Call Centers & Contact Details Of NWSDB

NWSDB is maintaining call centers throughout the country and there is one toll free telephone number for informing about service interruption, illegal activity by someone, complains about the service or any other water supply related issue at any time of the day. The call centers are open for 24/7 basis.

Island wide toll free call number is 1939..... This number can be used from any mobile or land phone and no fee will be levied for using the toll free number.

In addition the Central Province Regional Supporting Center management is accessible through following numbers. Only key officers are listed in the table however, anyone who wishes to contact any section or officer of the NWSDB, SLT telephone directory can be used that gives the relevant telephone numbers.

REGIONAL SUPPORT CENTRE – CENTRAL

RSC Central - General No	081 238 8086 / Fax :081 238 8027
Free of Charge -(Call Centre) 24 hour Service	081 238 4400/Fax: 081 238 5300
SMS	077 396 2014
Manager (O&M) Kandy - South	Tel / Fax: 081 238 9077
Area Engineer (Kandy South) – Zonal 01	081 238 5726 /Fax: 081 238 5745
Area Engineer (Kandy South) – Zonal 02	081 238 5726 /Fax: 081 238 5745
Area Engineer (Gampola)	Tel/Fax:081 235 0497
O.I.C - Daulagala	081 238 5726
O.I.C - Gampola W.S.S	Tel/Fax:081 235 0497
O.I.C - Gampola Paradeka	081 380 4025 Tel/Fax: 081 235 0497
O.I.C - Nawalapitiya W.S.S	Tel/Fax: 054 222 4283
O.I.C -Nillambe W.S.S	081 380 1829
O.I.C - Weligalle - Elpitiya	081 380 1968 Tel/Fax: 081 235 0497
O.I.C - Megodakalugamuwa	081 238 5726
O.I.C - Edanduwawa	081 238 4230
O.I.C - Wellamboda	081 380 1968 Tel/Fax: 081 235 0497
O.I.C. - Gannoruwa zonal	081 238 6313
O.I.C. - Kadugannawa/Maligatenna	081 384 6120
O.I.C. - Egodakalugamuwa	081 238 5726 /Fax: 081 238 5745

Manager (O&M) - Kandy North	081 249 2302 / Fax: 081 242 2303/10
Area Engineer (Kandy - North)	081 249 2302/Fax: 081 242 2303
O.I.C. - Harispattuwa	081 249 9762
O.I.C. - Poojapitiya	081 230 0346
O.I.C. - Akurana	081 230 0205
O.I.C. - Galagedara	081 246 1395
O.I.C. - Pathadumbara	081 249 4351
O.I.C. - Kulugammana	081 249 9762
Manager (O & M) - Matale	Tel/Fax: 066 223 1905
District Engineer (Matale)	066 223 1112 /Tel/Fax: 066 223 1905
OI.C - Matale	066 222 2673
O.I.C - Dambulla	066 228 4612
O.I.C - Udatenna	066 224 4742
O.I.C - Naula	066 224 6201
O.I.C.- Pussella	066 300 4949
Manager (O&M) - Kandy East	081 242 2663 Tel / Fax: 081 242 0585
Area Engineer - Kandy East /Hatton	Tel/Fax:081 242 0585
O.I.C.- Kundasale - Zone 01 / 02 / 04	081 242 2663
O.I.C.- Kundasale - Zone 03	081 242 4663
O.I.C.- Madadumbara	081 237 4581
O.I.C - Marassana	081 236 9922
O.I.C - Haragama	081 240 4908
O.I.C - Manikhinna Consumer Service Office	081 237 6951
O.I.C - Hanthana	081 221 8810
O.I.C - Ampitiya	081 221 9733
O.I.C.- Rikillagaskada/Hanguranketha	081 380 2292
O.I.C.- Ragala	052 352 8271
O.I.C. - Hatton/Dikoya	051 222 3117
O.I.C. - Maskeliya	052 227 7200
O.I.C.- Sripada	052 350 1050
O.I.C.- Ginigathhena	051 224 2788
O.I.C.- Pundaluoya	081 375 3669
O.I.C.- Thalawakelle	052 225 8633

Customer in addition may face situations where they wish to contact the relevant officers of the NWSDB to collect first-hand information. Following table shows how this is made possible by the NWSDB.

To obtain a water connection	OIC
To complain about a quality issues of water (colour, smell etc) :	OIC/ Area Engineer
To complain about high or low pressure of the water connection	OIC/ Area Engineer

3. Alternatives To Pipe Borne Water

Do we have alternatives to the pipe born water? The answer is **yes**! This is a good area to investigate before going further in to the details.

There is only 65% of Sri Lankan population is served with some sort of safe drinking water with only 43.5% receiving pipe borne water. Remaining 35% of population is having alternative forms of water. These are either extremely costly to the people or unsafe for consumption (drinking).

If one tries to get water through a well using a water pump the minimum cost would be around Rs 100,000 and this can go even to half a million in worst case. If rain water is to be collected or bowser water supply is to be sought; the storage and piping etc can cost over 25,000 depending on the volume of water that is going to be stored.

Now let us see how other water related costs are associated with water supply.

Construction of Well with Water Pump: Rs. 100,000 - 250,000

Construction of Well : Rs. 100,000 – 200,000
Water Pump : Rs. 20,000 – 30,000
Pipe Line : Rs. 10,000

Construction of Rain-Water Harvesting System: Nearly Rs. 150,000 / family

(Needs 10 m^3 storage tank, pipe lines & pumps)

Purchase the 10 m^3 PVC Storage Tank : Rs. 100,000
Water Pump : Rs. 20,000 – 30,000
Pipe Line : Rs. 10,000

Bottle Water for Drinking & Cooking (20*l*/family/day): Rs. 7,500/family/month

A person needs 5 l of water for drinking and cooking per day
19 *l* bottle of water is nearly Rs. 250.00

Bowser Water Supply needs 5 m^3 Storage Tank & Pipe lines: Rs. 70,000/ family

Purchase the 5 m^3 Storage Tank: Rs. 60,000
Pipe Line : Rs. 10,000
Transport of Water (20 Km): Rs, 7,500 / month / family

For more details on alternative water sources please refer ***Appendix 01……***

4. Charges For Water Supply And Cost Of Water

The pipe borne water supplied by the NWSDB is highly subsidized. NWSDB charges Rs. 18,000 to 25,000 for provision of a connection. Subsequently the water bills are charged for the water consumed.

To provide Pipe Born Water Supply Facility

NWSDB Spends: Rs. 175,000 - 340,000/family

NWSDB Charge: Rs. 18,000 - 25,000 / family (Domestic)

NWSDB spends nearly Rs. 159 of Capital + O&M Cost to produce one cubic meter (1000 liters or 220 gallon or 1 ton) of treated water and distribute to the door step. However, the average Billing Rate of NWSDB is (as at 2013)

All Sectors : Rs. 47.30 / m^3

Domestic : Rs. 38.60 / m^3

Generation of water bill as per the current water tariff structure for ***Domestic None-Samurdi customers*** can be illustrated as shown in the below table. Please read annex for details as to how the calculation is done.

Domestic households bill formation (Non Samurdi customers)				**Bill Amount* (Rs.)**	**Average billing rate per unit (Rs.)**
Consumption range		**Usage charge per unit (Rs.)**	**Fixed charge (Rs.)**		
A	0-5	12	50	110	22.00
B	6-10	16	65	205	20.50
C	11-15	20	70	310	20.67
D	16-20	40	80	520	26.00
E	21-25	58	100	830	33.20
F	26-30	88	200	1,370	45.67
G	31-40	105	400	2,620	65.50
H	41-50	120	650	4,070	81.40
I	51-75	130	1000	7,670	102.27
J	76-100	140	1600	11,770	117.70

* This column shows the maximum bill value for the series in Class A above.

Example: |For class A above; the bill for 5m3 is (5 x 12 + 50 = 110)

The average water consumption per family is ***15 units per month***. As per the above table it is clear that the water bill is only Rs. 310 for 15 units. However

NWSDB spends Rs. 2,385.00 for production and distribution of 15 units. (Capital and operational expenses for 1 unit = Rs. 160)

As such, the NWSDB incurs 80% losses and recovers only 20% of cost through water bills as explained in the below given table.

Domestic households bill formation		**Domestic None-Samurdhi Consumers**		**Domestic Samurdhi Consumers**	
Consumption range (Monthly consumption m³)		Bill Amount (Rs.)	Subsidies given by Government to consumer(Rs.)	Bill Amount* (Rs.)	Subsidies given by Government to consumer (Rs.)
A	0-5	110	685	75	720
B	6-10	205	1,385	125	1,465
C	11-15	310	2,075	200	2,185
D	16-20	520	2,660	430	2,750
E	21-25	830	3,145	740	3,235
F	26-30	1,370	3,400	1,280	3,490
G	31-40	2,620	3,740	2,530	3,830
H	41-50	4,070	3,880	3,980	3,970
I	51-75	7,670	4,255	7,580	4,345
J	76-100	11,770	4,130	11,680	4,220

* This column shows the maximum bill value for the series in class A above.

Example: Cost for 10 units = 10 x 160 = 1,600.00
Charge for class B for 10 units = 205.00
Concession = 1,600 – 205 = 1,495.00
Concession for a month is Rs 1,495 for 20m3 of consumption.

This is a news story of a robbing of water in Harispattuwa, Kandy district and the Local Authority coming in to a stern action with respect to this robbery. Though we tend to ignore the fact that water is not free the reality is coming out at managerial and political level and this news is a testimony to that statement. If water is to be stolen it shall have a price.

Whether we like it or not now we all can see that water are expensive....

5. Cost of Water

Why is water so expensive? This can be the golden question every one may have, as the water bills are adding another cost item for already saddled family budget at every month.

Sri Lanka is in a transition stage where water and other utility services costing are to be fairly distributed among the masses in a reasonable manner creating fair play and justice to every citizen of the country. Water, in its historical perspective, is free for people of Sri Lanka being a blessed country with plenty of clean water and annual rainfall exceeding 1,500 mm per year in average. Water that we receive free from sky is freely used for centuries and pipe borne water is having only a short history.

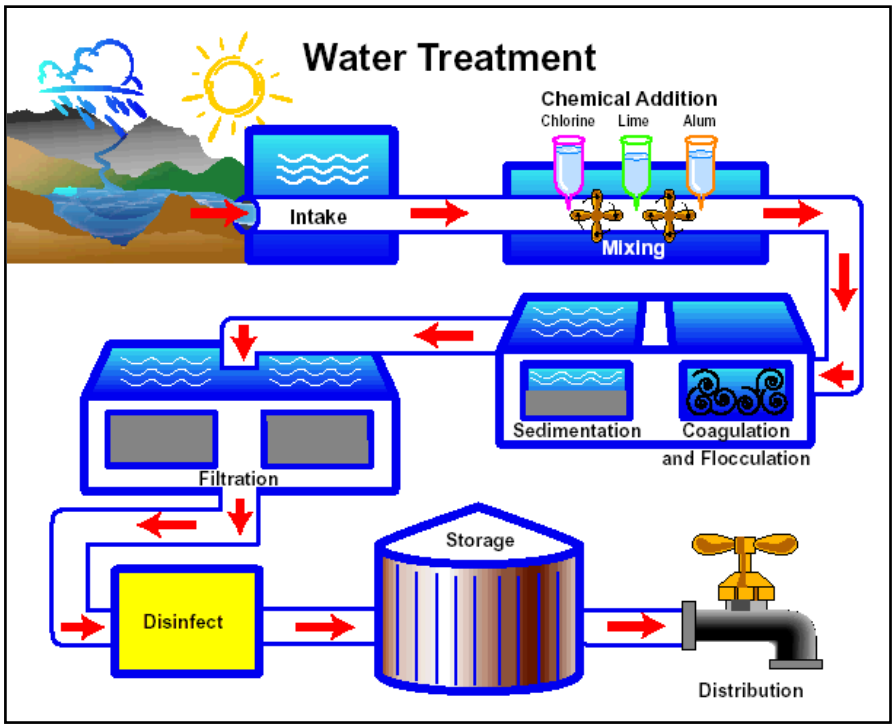
Colombo is having 100 year old pipe system and Kandy is having 60 year old pipes and most of the rest of the country is talking of pipe borne water only for past several decades. Industrialization, use of multitude of fertilizers, pesticides, herbicides, factory chemicals, disposal of solid wastes in to water bodies and having to live in smaller land parcels with poor sewerage management have added a heavy weight on clean water during the past few decades. While we are proud about our achievements, we shall admit that our work has not done fair enough for keeping our environment clean and safe. This has made us vulnerable to many water related issues that are directly related to drinking water of different forms over the past and it is continues to be so if not for getting worse.

Urbanization of earlier rural settings has left us with no option but to rely on safe drinking water coming, not from our own surrounding like before, but from elsewhere. These have made the production of water in mega plants at far places and transmit it to the city centers, distribute them to households and finally charge a fee through water bills. For example,

Water Supply to	Water Supply From	Distance
Batticaloa	Unichchi	23 Km
Colombo-South	Kandana (Kaluganga)	15 Km
Colombo	Kalatuwawa / Labugama	40 Km
Jaffna	Iranamaduwa	71 Km
Trincomalee	Kantale	40 Km

6. Production and Distribution Process

Following illustration shows the water purification process and this will help for us to understand how much money is needed for purification of water.



Intake

Intake can be a well, borehole, river, lake or even the ocean. Depending on the source the water, quality will be different and the treatment will be different.

Our wells may be polluted with coliforms, chemicals at times, algae or heavy metals. When the extraction rate is more there is a tendency that the contaminants in the neighboring soil are transported in to the well with water. Bore holes carry reasonably good water most of the time and however reliability of bore holes are questionable as the NWSDB has experienced depletion of the yields of many of them over the past several decades. Rivers carry many deleterious matters which they did not have some time ago in objectionable quantities.

Reservoirs or lakes are having their own contaminants. Rivers carry nutrients rich biological wastes releasing prosperous and nitrogen in excessive quantities inviting algal growths wherever stagnation of water is found. Mixing of chemicals add one of the most serious dangers due to presence of heavy metals in the water which cannot be removed easily.

In addition rains and droughts make the water completely different needing excessive interventions to clean them. Reservoirs are prone to algae growths with catastrophic consequences. Blue algae make water unsafe for consumption due to toxicity. This is the water that we all have to handle at the end of the day.

Intake has to extract water in and pump it to treatment plants needing power and high cost of construction.

Aeration

If the water do not carry enough oxygen then the treatment of water will be difficult through natural processes involvement. Most of the water sources are less oxygenated either due to stagnation or poor oxygen concentration due to bacterial pollution. Addition of oxygen is therefore done through aeration structures.

Flocculation and clarification

The unsuitable matters within water need to be removed and this will be facilitated by flocculation and clarification. These are huge structures that will be highly expensive for construction and additional costs are required for daily operation and maintenance of the structures.

Sedimentation tanks

Settleable substances, either naturally occurring or forced through the flocculation are removed by settlement at the settling tanks.

Filtration

Water needs filtration to remove the remainders and rapid sand filtration takes care of this work. Type of filters will depend on the rate of filtration, quality of raw water and availability of lands for construction.

Disinfection

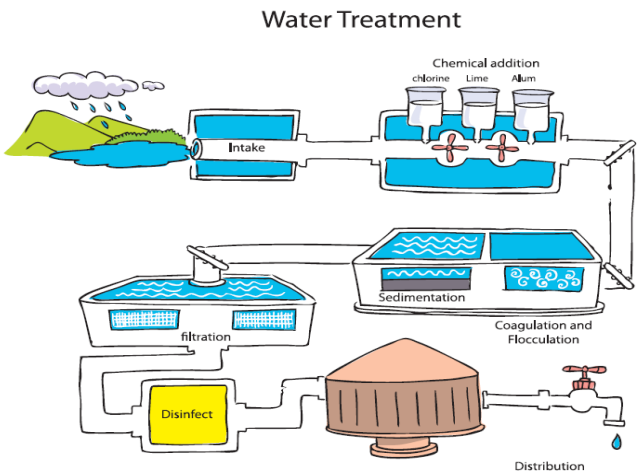
Any substance left or expected to be grown within water before consumption is to be treated with disinfection. There are many techniques for disinfection such as chlorination, ozonization, UV treatment etc which have their own merits and demerits.

Storage

Processed water finally stored for transfer to destinations. There are many forms of storages and all these add to the cost of water one way or another.

Distribution

This is the biggest cost element as the network is to be laid right throughout the service area. For example, Colombo Municipal Council area is having 927 km of distribution network to serve 700,000 customers, but Kandy Municipal Council area having 350 km to serve 40,000 customers. With all these steps in place there will be two basic components of costs of water namely the capital cost and recurrent cost. Capital cost is the initial construction cost and recurrent cost is that is required for production and distribution on daily basis. Capital cost alone will be between Rs 190,000 to 340,000 per family. Recurrent cost is in the range of Rs. 40 per one unit of water (1 m^3).



7. Water Quality and Its Standards

Water coming from the sky is clean in its original form. However this original form is now distorted beyond recognition due to manmade disasters. As such the water comes down contaminated due to emission of deleterious substances in to the air.

Still there is a reasonable possibility that the water coming from sky as rain can be collected and with little treatment can be used for may useful purposes. The water, upon falling on the ground reaches to situations where its use in its form or little intervention is not accepted due to excessive pollution. Water that comes down ends up in rivers, lakes, reservoirs or percolates in to the ground and comes as ground water. Water that the NWSDB extracts is from one of the above sources. Natural springs are supplying good quality water in small quantities and that is not sufficient to quench the thirst of mega cities.

Before discussing about how the water is treated it is better to understand what is wrong with water found in raw water sources. Pollution of water takes place knowingly and unknowingly.

Disposal of solid waste in environmentally harmful manner, discharge of untreated factory effluent to inland water bodies, excessive use of agro chemicals, pesticides, herbicides, vegetable preservatives, addition of construction debris to water, leachate generating from solid waste dumps, unprotected and unhygienic discharge of black and grey water in to the open water sources are polluting the water sources heavily.



8. Protection Of Water Resources

Water that is suitable for consumption shall have acceptable quality standards. The limits of standards will vary slightly from location to location of the globe and however there is a general rule that is highlighted by the World Health Organization (WHO).

Any water that exceeds the harmful levels of any listed substance is responsible for slow as well as immediate health issues of people. For example, the dogs and birds drink directly from the drain, and they eat the food fell on the contaminated floor. Dogs can eat stale food, rotten meat but still stay trouble free. Human body is susceptible to dirty water and therefore safety of water sources need to be paid serious attention. This is felt more than ever before due to persisting illnesses associated with kidney in many parts of the country at the moment. Even the unborn children will be affected and there are scores of child deaths as a result of kidney failures. It is proven that kidney failures are largely blamed for contaminated water.

Water is a very good carrier for soluble as well as insoluble substances. Water keeps them as either suspended matter or dissolves in it to release later under differing conditions. Some dissolved and suspended matters can be removed from water with little intervention. Some other stuff is difficult to remove and the removal techniques are so costly that ordinary people cannot afford.

Heavy metals are silent killers that dissolve in water in miniature amounts and goes through the metabolic system. These substances are not digested and instead add to blood stream and keeps hiding until a substantial amount is collected. The effects of accumulated substance are fatal and account for certain deaths due to poisoning, cancer etc. Among the heavy metals; mercury, lead, and arsenic are major substances that make people reach early end of their lives.

We will be compelled to live in places like this and this makes the pollution of water unless an effort is made to control it at every time and all time

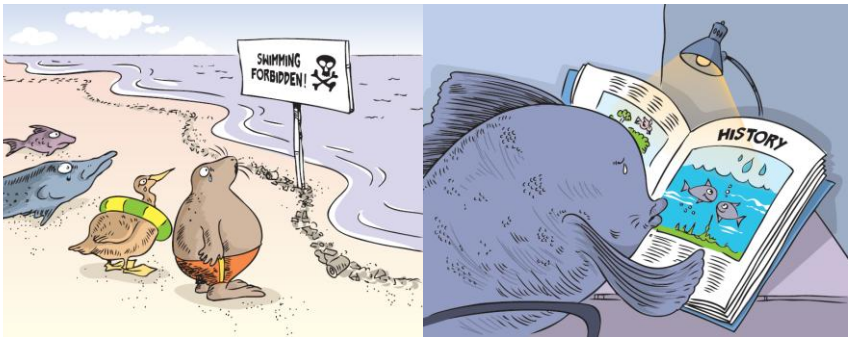
Heavy metals do not disintegrate in a shorter time. These substances reach plants as well as animals. Consumption of plant components or animal parts contaminated with heavy metals will ultimately transfer these substances to the people. The worst part of it is that the removal of these heavy metals from water is extremely costly and therefore only possible alternative will be to avoid consumption.

Poorly constructed toilets and pit latrines contribute heavily for pollution of ground and subsequently the water bodies. Therefore construction septic tanks with proper design and quality and avoid using pit latrines will help improve the situation.

Now it is better to understand how we could keep water without polluting. Most of responsible citizens do not violate the laws and would like to assume corporate responsibility.

Reaching this state is the first step and next is to know what is right and wrong.

Therefore following do's and don'ts will help us to understand how we could contribute to environmental safety. If we do not act fast enough there can be a day that followings can be in the news.



Do's

1. Report any water leakage from pipes irrespective of location of leakage.
2. Report any illegal water use or tampering with water pipes to the NWSDB
3. Use as minimum water as possible
4. Use only standard pipes and fittings for plumbing
5. Get the services of a qualified person for plumbing work even if it is of lesser magnitude.
6. Use water saving and habits for reduce consumption
7. Think about locating of pipes while the buildings are constructed to avoid poor quality work that can result in if pipes are located after the main structure is done.
8. Do keep access to pipes for maintenance when the pipes are installed.
9. Do educate people around you, including your children on water supply related matters that are discussed in this book

10. Separate your solid waste in to different categories and treat them separately.
11. Use chemicals as minimum as possible.

Don't s

1. Do not discharge mercury containing CFL bulbs, tube lights and electronic components in the open garbage disposal sites
2. Do not throw solid waste in places other than the places allocated for. Open water courses are taking the solid waste from place to place but never dispose it in environmental friendly manner.
3. Do not discharge waste water directly onto the environment
4. Do not dispose solid waste in the open or into the water
5. Do not leave even a tiny leakage in your house unattended
6. Do not leave PVC pipes open to sun as that will deteriorate the quality of pipes over the time.
7. Do not think that water is free or cheap any more

9. Steps For Obtaining A Water Service Connection

1. Applicant requests a new connection / connection enlargement from NWSDB

2. Issue applications and other necessary forms via relevant Area Engineer Office and Information Sheets (Forms such as : NC1aE, NC1aS, NC1aT or NC1bE, NC1bS, NC1bT and the information sheets such as NC2E, NC2S, NC2T)

3. Applicant submits the completed application to Area Engineer (AE) with

    a. Copy of deed

    b. Copy of tax notice

    c. Copy of applicant's national identity card

    d. If the applicant is not the owner of the premises he/she must submit the 'Gramasewa Niladari' certificate authorized by the relevant divisional Secretary and the affidavit from provided by the Board (NC3E, NC3S, NC3T)

    e. If applying for new connection for construction purpose approved house plan to be submitted

Area Engineer registers the application with new file number and sends it to the relevant OIC for clearance (NC4) and other field information. At the same time get the clearance from the commercial section

4. Field inspection is done by relevant OIC to investigate the issue regarding clearance, physical measurements required for estimate preparation (NC6). If everything is satisfactory the OIC issues the clearance with letter to CMC (NC7), RDA (NC8), Police (NC9) etc. whichever are necessary for getting approvals from other departments and send the file back to AE office.

5. AE prepares the estimate and issues the paying voucher (NC10) to the applicant

6. Applicant pays the estimate to the bank and also gets relevant approvals and submits them to the AE office

7. 'Paid New Connections' to be updated by Commercial Officer from the relevant bank statement to check the pending new connections

8. Agreement statement (NC11E, NC11S, NC11T) is signed by the applicant after fulfilling all the requirements, AE forwards the file to relevant OIC for physical work

9. OIC contacts the applicant again and arrange the new connection by relevant Zonal Officer, after completing the work OIC fills the Construction Completion Statement form (NC12) and forward this to the Independent Quality Assurance Officer nominated by AE

10. A IQAO performs and independent audit to ensure that all aspects of the new connection confirm to NWSDB regulations and certifies compliance to the AE

11. AE prepares the New Connection Completion Statement (NC13) and send it to the Commercial Section

12. Commercial Officer enters the data in to the billing database and deleted the relevant entry from the pending new connection list

13. First bill (Yellow Bill) is generated by the Commercial Officer and sends to the consumer by the relevant meter reader

14. With the first bill relevant Meter Reader also inspects the premises and fills a form (NC14) to inform the AE that it is readable to his satisfactory

Make sure that the connection falls within the service coverage area. Please inquire from the NWSDB regional office if the property is within the service area.

Obtain an application from the regional office closest to you. You may download the application from following web site. www.waterboard.lk/new water connection

Hand over the properly completed form to NWSDB office in your area. Following documents will be required with the application form. No fee will be charged for the application submission.

1. Address confirmation document. An electricity bill, telephone bill, bank statement etc will be okay for this work.

2. Ownership confirmation documents.

NWSDB will take field measurement and prepare estimates. Size of estimate will depend on the distance from water main to the location of the water meter, depth of the trench required as per the road authority requirements and special obstructions that will obstruct the laying of the line. This will in general be done within a week.

If the road on which the water main is located is a paved road the cost of repair of the road surface will be an addition to the estimate which shall be paid directly to the road authority. Estimate for road damages will be as per the estimation standards of the respective road authority. Once the payment for road repair is done the receipt of payment for road repair shall be submitted to the NWSDB office.

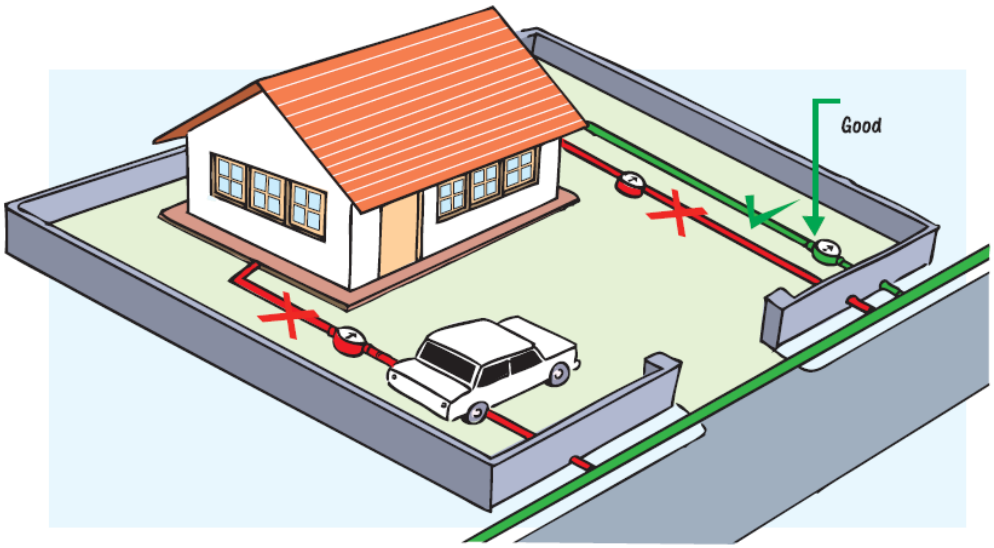
Pay the estimate of the NWSDB to the NWSDB office. This can be done in cash, through credit card or on line.

You will be required to enter into an agreement with the NWSDB for provision of water services. NWSDB will facilitate the preparation of the agreement and you will be required to incorporate relevant information to the agreement and sign it as appropriate.

Now what is left is the provision of the connection which will happen in less than a week from the date of payment.

10. Positioning Of Water Meter

Above illustration shows three typical locations for installation of water.



Following shall be taken in to account when assigning a location for water meter.

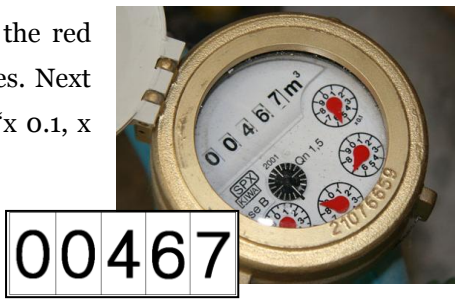
- ✓ Meter shall not be located too far from the property line and shall be as close as possible to the road.
- ✓ Water lines within the premises shall be shortest to ensure enough water flows in to the property.
- ✓ Meter shall not liable to loads from passing vehicles or parked vehicles.
- ✓ Location shall be accessible to the meter reader at all times.
- ✓ Location shall be free from falling objects such as coconut etc to ensure safety of the meter.
- ✓ Pipes shall not be laid across the areas where future developments are expected.
- ✓ As such illustration shows only one location suitable for the water meter.

11. How To Read Water Meters

There are two types of meter dials used in Sri Lanka.

Type 1 meter shows the direct reading. Dark colour shows the consumption in units and red wheels in decimal places. For example if the dark area shows 111 and red are show 234, then the meter reading is read as 111.234.

Type 2 meters as shown provides many dials with red indicators. When the meter is at work the red indicators will be busy in different intensities. Next to the red dials there are numbers such as “x 0.1, x 0.01 and x 0.001”.



If a meter reads 467.234, the dark and red dials will show as follows.

Dark reading = 467

Slowest moving red indicator (x 0.1) is at 2 showing 2 x 0.1 = 0.2 units (200 liters)

Next red indicator that moves faster than the above (x 0.01)is at 3 showing 3 x 0.01

= 0.03 units (30 liters)

Indicator faster than both above dials (x 0.001) is at 4 showing 4 x 0.001

= 0.004 units (4 liters)

Now add these 4 values together

This will give you the reading as 467 + 0.2 + 0.03 + 0.004 = 467.234.

12. How Do You Position Your Water Facilities Within Your Premises

It is extremely important to select right materials, right person and use the right methods to have a reliable water service within the premises. The quality of the service will be beneficial to you as well as NWSDB due to the fact that trouble free system will keep your quality of life high and at the same time NWSDB will benefit by having leak free system where water losses is prevented which will help the board to produce less water at a higher cost. There are three questions that you should find answers to accomplish the above.

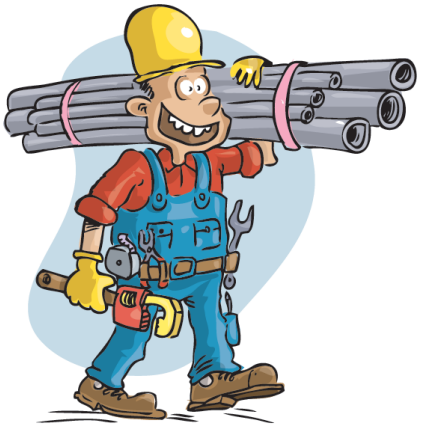
12.1. Right Materials

Right materials are that produced by recognized manufacturers. There are 5 SLS holders for production of PVC items in the country and the goods produced by them are accepted as right quality material. Even with this understanding please ensure that the materials from one and same manufacturer is used to have a more reliable system.

There are imported items which are not produced in the country. Since there is no quality control standards developed for such items, it is always advisable to go for branded imported materials. It is often seen that the some fittings are fabricated at the site by half-baked plumbers. Although this seems alright, the consequences are obvious. PVC cannot withstand heat beyond a certain limit and once it is heated beyond that point the properties will be changed and the expected performance will drop.

Irony is that the problems are surfaced some time later and it can be too late for rectification and even if it is done it will be at a greater cost. Therefore always go for high quality materials.

12.2. Right Person



It is definitely not the ordinary mason or carpenter we usually call as “Basunnehe”. It is the job of a Plumbing Technician. Plumbing Technicians are the people with theoretical knowledge, hands on experience at the training facilities, having knowledge of how water passes through different components of the system and assume responsibility for the work done. Contrary to this the basunnehe is having nothing as such but the statement that he has done may everywhere.

There are enough incidents they have messed up the whole system of pipe work. PVC is such a material that once fixed with solvent cement the two components are bonded rigidly. It is extremely easier to fix but very difficult to separate. PVC pipes are laid through gaps in most of the time and poorly fixed pipe cannot be redone in most of the time due to being not able to have even access to effect a correction.

For example, a repair socket pushed in to a pipe that just on the face of a wall leaks and the connection is totally inaccessible for removing the repair socket without cutting a sizable part of the wall and also digging deeper in to the wall to have more pipe faces exposed. Same with bath room fitting fixing. If done incorrect then it will be the time to break the tiled walls and do it all over with permanent damages or even leakages. Therefore always go for a qualified plumber.

12.3. Right Method

There are definite methods for fixing water pipes and fittings. This is required initially to invest less through reduced wastage, then select and install easy to operate fixtures and durability of the fixtures. Also most important of all is the ability to do a repair at a reduced cost and least inconvenience.

For example, a water pipes in a bath room can be laid not on the tiled inner side of the bath room walls and instead on the outer face of the bathroom walls. This will facilitate access to the pipes in future if there is a leakage in the system or accidentally breakdown. Leaking pipes behind bathroom tiling is a common feature in many newly built houses and no one can figure out where the leakage is originating but see that water is seeping through the wet walls with disastrous consequences.

Having taken these aspects in to account following sections will highlight the identification of pipe elements and installations guides to educate customers so that the plumber is supervised and correct materials are identified. Under this area different pipes and fittings used, method of fixing, different classes of materials and application of such fixtures are discussed.

13. Pipes and Fittings

13.1. Pipes

PVC pipes in the market are scientifically referred to as unplasticized Poly Vinyl Chloride (uPVC). Here "u" is referred to indicate that it resists sun light. However PVC pipes and fittings are having a shorter life span if they expose to prolong sunlight. PVC pipes are having different classes and diameters. Class 250 is referred to as T 250, indicating that it can resist an internal force of 250 kPa equivalent to 25m of hydrostatic pressure. Similarly there are T 400, T600 and T 1000 pipes.

Pipe sizes start from ½" and moves up as shown in the table below.

<table>
<tr><th rowspan="2">In inches</th><th rowspan="2">In mm</th><th colspan="4">Availability in the market</th></tr>
<tr><th>T 250</th><th>T 400</th><th>T 600</th><th>T 1000</th></tr>
<tr><td>½</td><td>20</td><td colspan="2" rowspan="7">Not Recommended For Drinking Water Supply Pipes</td><td>No</td><td>Yes</td></tr>
<tr><td>¾</td><td>25</td><td>No</td><td>Yes</td></tr>
<tr><td>1</td><td>32</td><td>Yes</td><td>Yes</td></tr>
<tr><td>1 1/4</td><td>40</td><td>Yes</td><td>Yes</td></tr>
<tr><td>1 ½</td><td>50</td><td>Yes</td><td>Yes</td></tr>
<tr><td>2</td><td>63</td><td>Yes</td><td>Yes</td></tr>
<tr><td>3</td><td>90</td><td>Yes</td><td>Yes</td></tr>
</table>

PVC pipes and fittings up to 2" are always of T 1000 and the fittings are all of T 1000. Pipes of T 600 and T 1000 are used for water supply and other lower classes are used for irrigation, rain water transfer, electrical conduits etc. Therefore never use pipes lower than T 600 for water supply. Length of pipes is 4 m up to and including 2" and larger pipes are manufactured in 6 m lengths. Cutting of pipes shall be perpendicular to the pipe and the edges shall be chamfered and cutter dust shall be removed prior to fixing. Pipe fixing is through glue application and the pipe labels shall be facing the plumber when the pipes are fixed in place. Flow direction and destination labels if pasted, will help the users to identify where water is flowing at later stages. This is primarily important as the installation of more and more pipes in stages will tend to lose the sight of flow direction and purpose as well.

13.2. Valves

There are many types of valves in the water supply system. However this handbook will be limited to the household application and therefore only the valves applicable for such uses are described.

13.2.1. Gate Valve/Stop Cock

This is used for closing a section of system for isolation for maintenance etc. it is always a good practice to install sufficient number of gate valves within the system for operation flexibility. This valve is usually opened through several rounds of handle and as such the line will be closing at a slower speed.

13.2.2. Ball Cock

This valve is doing the same purpose of gate valve however the opening mechanism is by turning 900. As such the system is isolated immediately and for larger diameter pipes surge can be causing excessive pressures.

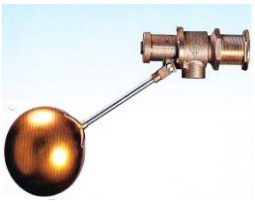
13.2.3. Non Return Valve

This is used for regulating flow in one direction and is extremely useful for household plumbing. There are many ways of using this for domestic plumbing for making water supply efficient, regularized, wastage minimized, accidental loss of water through overflows etc are prevented and accidental loss of water through draining back to the main road etc are prevented.

13.2.4. Pressure Reducing Valve

This is used when the pressure in the supply system is excessive making the domestic water fittings lose the water tightness and pipe bursts occur. However this valve is hard to maintain as the miniature leakage of the internal mechanism may lose the purpose of the valve. This can easily take place when there are solid particles in the water.

13.2.5. Ball Float Valve



This is always in the water tank controlling incoming water. It will open when the water levels are lower and shut down when the water level rises to the overflow limits in the tank. This is extremely important for domestic plumbing and many water losses at night etc are due to malfunctioning or leaky ball float valve. It shall be fixed with working space for the arm to move freely. Water flow in to the tank shall stop before the water level in the tank reaches overflow level. It is best if this is checked at night as the pressure in the pipe system increases at night.

13.2.6. Angle Valve

This is virtually a luxury fitting. We find this one mainly in wash rooms and there is ample number of different designs. The purpose is to connect or disconnect water supply to a fixture in the bathroom. It can be the water inlet to the water closet, bidet shower, telephone shower, wash basin or any other water related fixture. It can even be in the kitchen or external fixture. The valve can be fixed to a faucet socket without disturbing the piping system. This valve is important for shutting down water supply to the fixture at the time of a repair.

13.2.7. Concealed Valve

This valve can be either a gate valve or a ball cock fixed on to a body of a pipe line but buried beneath the surface. Often this valve is used for showers in the bath rooms where the shower is connected and disconnected with water while taking a bath. This is extremely important piece of fixture as once the fixture is buried behind wall tiles or any other valuable surfacing, the maintenance is extremely difficult. Therefore great care shall be taken when purchasing this item to make sure it is of highest quality. Good quality valves are having the capability of replacing the rubber rings that wears out inside over the time. But the irony is that the correct rubber ring is unavailable in the market mainly due to economic factor of not being able to charge high cost for a rubber ring of smaller size and also item is sought rarely by the customers.

13.3. Water Fittings

Water fittings are the items that are needed for managing water supply and are a part of the water supply system. Among them repair sockets (L) for joining two plain ends together, valve socket (or male socket) used for converting internally threaded end to a socketed end, faucet socket (or female socket) used for converting externally threaded end to a socketed end. Elbow (I) to turn the line at 90^{o} at the point itself, bends (A) to turn water line in angles, tees (E & F) for provision of branches from the main pipe, unions to install a collapsible joint, tapered core and tapered flange to convert a flanged end to a socketed end are the main fittings in use.

 **A - Bend**	 **B- Garden tap**	 **C- Bib Tap**	 **D- Ball cock**
 **E- Equal tee**	 **F- Reducing tee**	 **G- Faucet or male socket**	 **BH- lind cap or end cap**
 **I- Elbow**	 **J- Clamp saddle**	 **K- Mixer tap**	 **L- Repair socket/ connector**

14. Determination of Pipe Size

Generally the combination of fixtures that can release water simultaneously is considered for selection of pipe sizes.

For example;

The washing machine can collect water while the person inside the bathroom has just finished using toilet and ready to take a bath. This is a situation where there are three fixtures demanding water at the same time and the pipe sizes will be based on such combination. Generally having to consider three fixtures running together will give a reasonable pipe size. Once the fixtures that would go together in one branch of the pipe system is decided the values given in following table will guide the plumber to calculate the pipe sizes using pipe sizing tables.

This is not practiced in Sri Lanka most of the time and over sizing and under sizing are done by the person who fixes the pipe. Over sizing will result in additional cost and complication due to larger pipes being buried in the walls. Under sizing will affect the quality of service due to head losses.

	Rate of Flow	
Fixture	**(l/s)**	**l/min**
WC flushing cistern	0.1	6
Wash basin tap	0.15	9
Bidet	0.15	9
Shower head	0.2	12
Sink tap, 12 mm	0.15	9
Sink tap, 20 mm	0.2	12
Washing machine	0.1	6
Garden Tap	0.2	12

15. Operational Flexibility

There is a misconception in Sri Lankan community that fixing of water supply pipes is so easy and anyone can do it and no expertise is required. In fact the real situation is opposite and correct installation of the system will provide sustained long term benefits in the form of finance as well as psychological benefits.

Leaky pipe system is a trouble for everyone. Once a house is built and the piping is done, one assumes that the problem is over. However reliable plumbing system is essential for that perception to be a reality.

Following aspects will help one to have that reliable plumbing system,

- ✓ Use right quality materials
- ✓ Face the labels of the pipes to face the plumber so the pipe can be recognized
- ✓ Do not stress pipes and maintain alignment
- ✓ Use a qualified person to install the pipes
- ✓ Have a map of pipe system so that adjustments is facilitated later
- ✓ Start laying pipes after mapping them so that unnecessary damages to the walls and floors are prevented.
- ✓ Always leave provisions for adjustments of the system at a later stage
- ✓ Avoid direct exposure of PVC pipes to sunlight as the quality can deteriorate quickly
- ✓ Use appropriate fixtures such as non-return valves, isolation valves etc in a wise manner to ensure operational flexibility. For example,

    - If the kitchen sink is having a leakage the whole water supply system of the premises shall not be disconnected.
    - Once one tap at ground level is open it shall not affect the overhead shower at the upper floor or shall not affect the flushing of the toilet.

- ✓ Use correct diameters for supply and distribution lines. Over sizing will cost more and under sizing will cause head loss and poor water passage
- ✓ Solvent cement is used to glue two pieces together. Over usage of glue is counterproductive as excess glue can form a barrier for water flow when glue spills out in to the pipe faces
- ✓ Test the plumbing system before acceptance. This is hydrostatic test through a test pump that shall be done by an experienced person with right equipment.
- ✓ Do not leave even a tiny leakage within the building unattended as it will deteriorate your building.

16.Storage Tank

This is an essential item in most of the places as either the water pressure is not adequate for direct feeding or there is uninterrupted supply of water. Care must be taken when selecting the tank, positioning the tank, protection against environment, contamination of water inside the tank, pipes to and from the tank. Most of the tanks in Sri Lanka are wrongly positioned and the pipes are laid distorting the lush appearance of the house.

Take following facts in to account when planning the installation of tanks.

- ✓ Capacity of the tank shall be for at least one day usage. Generally, a family of 5 will be needing 500 liters of water per day. If 2 days are in mind 1000 liter is the suggestion.
- ✓ Do not expose the tank to direct sunlight as it will affect the durability of the tank and also water will be heated to high levels during the day which will make the water unfit for use, especially in warmer days.
- ✓ Maintain at least 15 feet of head over the highest point of water discharge, often the bath room of the highest level of the building. Without this pressure water is too slow in the pipe.
- ✓ Provide overflow and washout facilities and direct them to the surface drain without letting it free fall.
- ✓ Clean the tank at least once a year by opening the washout and removing the sediments accumulated.
- ✓ Do not position the tank just above the roof without planning the pipe routes as the pipes going in and coming out will not be able to reach neatly through the roofing. It will be extremely difficult to send a pipe through a roofing sheet and possibly through the ceiling as well. If done so leave purposely made openings in the roof and ceiling for passing pipes.

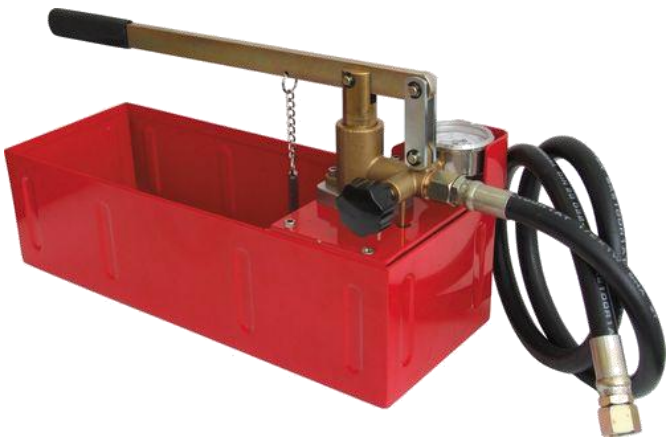
- ✓ In situations where the tanks are made of concrete or brick work, ensures that the tank is properly closed avoiding rodents and mice to contaminate water.
- ✓ Fix the ball float valve properly and test the functionality of the valve at every cleaning operation

17. Testing of Domestic Plumbing

It is extremely important to test the plumbing work before covering the pipes. If left without testing the leaks can appear some time later and it may be too late to rectify. Testing is done using test pumps and an experienced person shall do the testing to ensure that the system can withstand a pressure of the system.

Generally the water supplied by the NWSDB can have a pressure of 60 m or even more depending on the location of the house with respect to the elevation and time of the day. Pressures in the pipes are generally built highest around 2.00 am where most of the water outlets are closed. This is the time for the leakages to appear even if the leak is smaller in magnitude. The damage it can cause to a newly built building can be enormous.

Not much expensive test pump like what is shown below can do the testing but the quality control of testing is as important as the testing itself to ensure that the testing is done properly.



18. Leak Detection

This can be a new to the customers. There are frequent complaints from the customers about wastage of water and erroneous water meters. If there is an error in the meter, there is a way to rectify it. If the meter reading is high, that can be a leakage.

Minor leakage of water through smaller pipes for a too long period can be unbelievably high and enormous quantity of water can be lost through such minor leakages. There is a simple procedure to find out whether there is such a leakage in the system before making complaints to the NWSDB. Detection of leakages will be different depending on the following cases.

1. Direct Supply

- Close all the outlets within the premises and wait for few minutes until cisterns are filled up
- Read the meter and observe whether there is a movement
- If the meter still moving there can be leakage somewhere
- Get the leak repaired through a qualified plumber

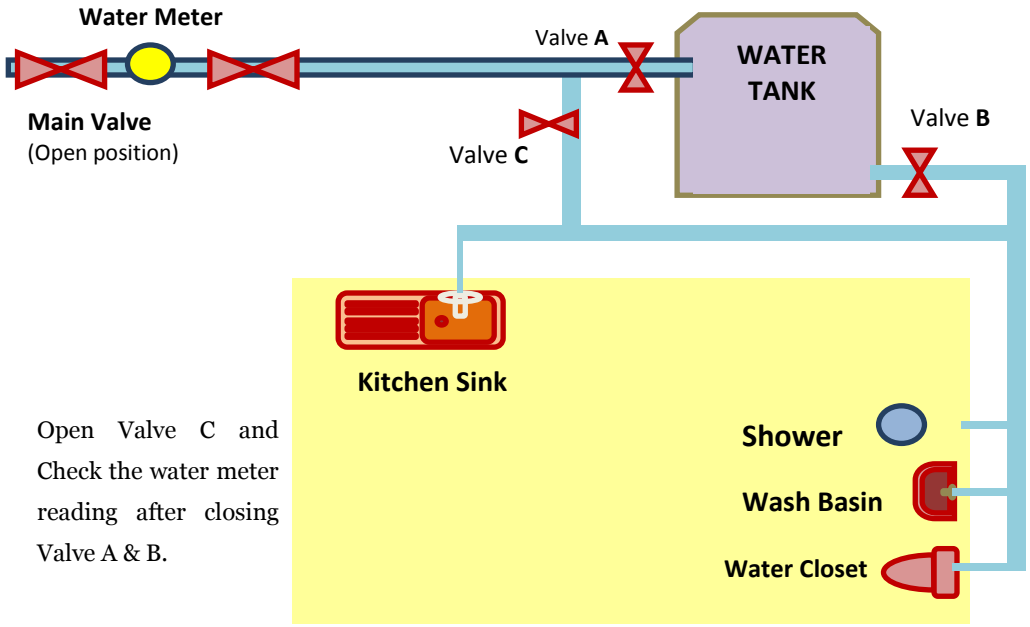
2. Water supply through a Storage Tank

- Water level in the tank can be monitored after closing down the main supply to the tank
- Close all the outlets and wait for a few minutes until cisterns are filled up
- Measure the water level in the tank
- Wait for ½ hour
- Measure the level again
- If the level has fallen there is a leakage in somewhere

3. When water is supply to the tank and the system directly

- Close all the outlet within the premises and wait for a few minutes until cisterns are filled up
- Close valve "A"
- Close valve "B"
- Open valve "C" and observe the meter
- If the meter is moving there must be leakage in somewhere

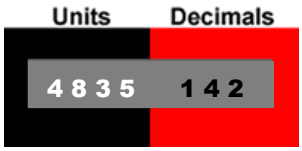
If the meter is dead silent, then the time is right for requesting a test of meter.



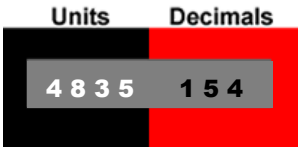
Open Valve C and Check the water meter reading after closing Valve A & B.

How to get the water meter reading

Meter reading at the Start



Meter reading after an hour



Water loss within an hour 0.012 m³ = 12 liters / hour

19. How Can We Report A Meter Error

This is a question many water users had or still having; knowing that the water meter reading is too high as they feel. This is provided by the NWSDB.

There is a request form available at the area office of the NWSDB. Ask for a form and fill it up and handover with the payment specified in the form (Usually Rs 250.00). NWSDB will send an investigation crew who will check the externality and assess the situation.

They may ask you to test internal leaks and if you have done it already then it is their turn to remove the meter and take it for testing. They will either test the meter and fix the same if the meter is not defective or fix a new meter if the existing one is found to be defective.

If the meter is found to be defective and the water bills for the past time has been high as a result, then there is a mechanism to waive off the extra payments made by the customer. NWSDB will readjust the water consumption based on the accurate readings and the additional money paid already will be credited to the water account. This will enable the customer to use that money for future water uses. No refund will however be made.

20. How We Can Report Mal Practice

There are many malpractices done by people. Water customers, being responsible citizens, will not ignore such unwarranted practices and are having a duty as responsible citizens to inform the relevant authorities for necessary action.

Below given are some common malpractices we could observe,

1. Water theft through illegal bypass connections
2. Illegal tapping on to water mains
3. Using water given for domestic consumption for business purposes

4. Unattended leakages within the premises
5. Handling of water installations such as washouts for releasing water for agriculture etc

Please dial toll free telephone number from any public, land or cell phone **1939** for reporting a malpractice. A reward mechanism is implemented for reporting such malpractices which will be available on request for interested customers.

21. Hot Water In A Flash

Sri Lankans particularly in the upcountry where the night temperatures fall low are beginning to use hot water extensively. While this is not affecting the water supplied by the NWSDB, it is an important area for the customers to know the basics in hot water supply for better maintain the systems.

Hot water needs a heat source. Solar heaters electrically operated geysers and on line water heaters are the heat sources that are in use. Whatever the source may be the piping system and fittings for hot water is different from cold water system.

Solar heating is done through a solar panel often installed on the roof. Heat is accumulated in a tank next to the solar panel and directed to the wash rooms. Geysers are the vessels installed filled with water and heated by electricity. On line heaters are the ones that heats water as it passes through a high powered water heating filament.

Water is blended with cold water to generate expected temperature and used through mixers. Pipes used for hot water shall either be copper or poly propylene. The fittings are of special types and are shown in pictures without going for details. Mixing is through mixer taps and mixer valves.

22. Waste Water Management

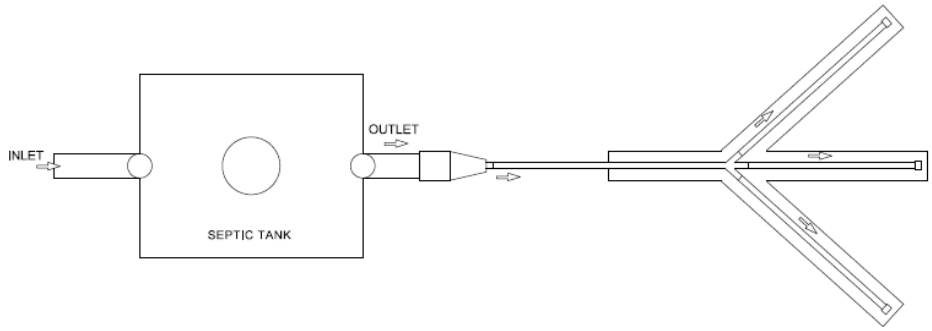
Why are we wasting water? What is this wastewater all about? One can have these questions, in the first place. In fact this wastewater is not the water intentionally wasted, but that is coming out of our operations involving clean water. Clean water, once used is considered as suitable for disposal and this is the water that is termed as wastewater.

Wastewater is primarily generated from;

a. Toilet bowl flushing (black water)
b. Bathing water (grey water)
c. Kitchen wash water from kitchen sink (grey water)

These three sources shall be treated separately although all of those fall under wastewater. Black water is the first and most important type due to presence of harmful bacteria in it in excessive amounts. Kitchen waste water is having nutrients rich oil that eliminate from food and food waste in the cooking procedure. Wash water from bathrooms etc contains detergents.

Black water shall be treated as the first priority and for residential premises the biological treatment is the most feasible option. This is achieved through introduction of septic tanks followed by soakage pits or soakage fields. It is important to know that waste water can be used as a valuable resource in our garden if managed properly. Soakage fields watered with effluent coming out of septic tanks can be used as effective source for water required for the plants community in the gardens.



SOAKAGE FIELD

However this needs to carefully manage to avoid possible nuisance especially during rainy weather.

22.1. Septic Tank

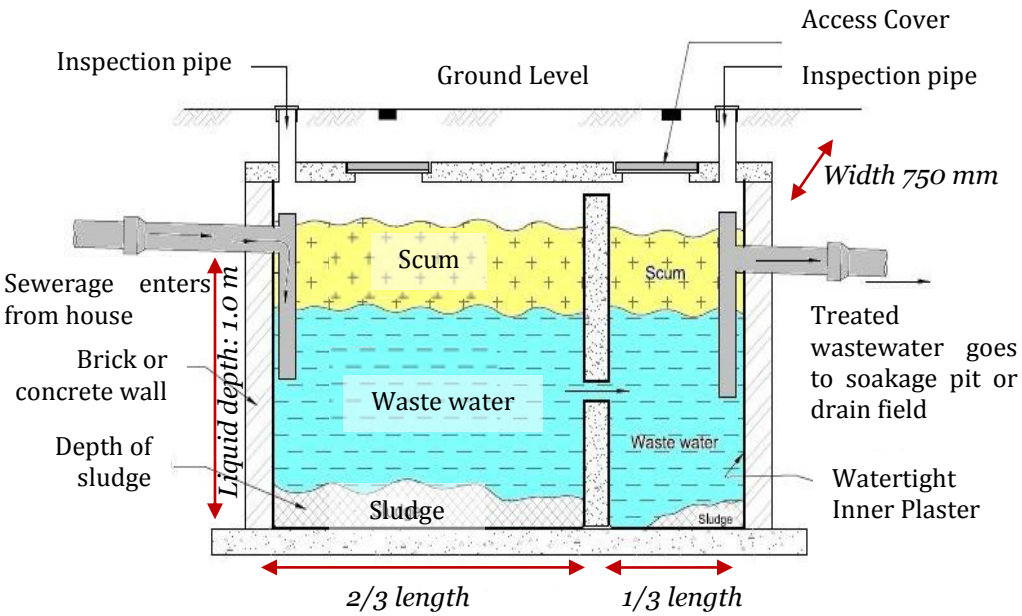
Septic tank is a mini treatment plant where bacteria is living on biological wastes consume the nutrients in the medium and convert it to biologically degradable and harmless residues while the water component is discharges out as less contaminated water. This water can be treated through a soakage in to the ground. When the ground conditions do not permit effective soakage, more advanced options such as soakage fields, elevated soakage systems, discharge in to purposely made biological lagoons etc will be enough for removal of harmful substances.

Having a properly designed water proof septic tank is essential for this function. There are enough instances where the pit latrine is wrongly interpreted as septic tank. Septic tank is a completely sealed unit with engineering design for effective removal of nutrients whereas the pit latrine discharges raw sewage into a pit where liquid and solid components are indirect contact with the neighboring soil. During dry periods the water component is quickly absorbed in to the ground leaving no water for the biological action to complete and during wet periods the too much ground water is making treatment efficiency very low. Apart from that wet weather makes them to overflow contaminating entire water body in the neighborhood. Therefore septic tanks shall be done with proper standards and a design.

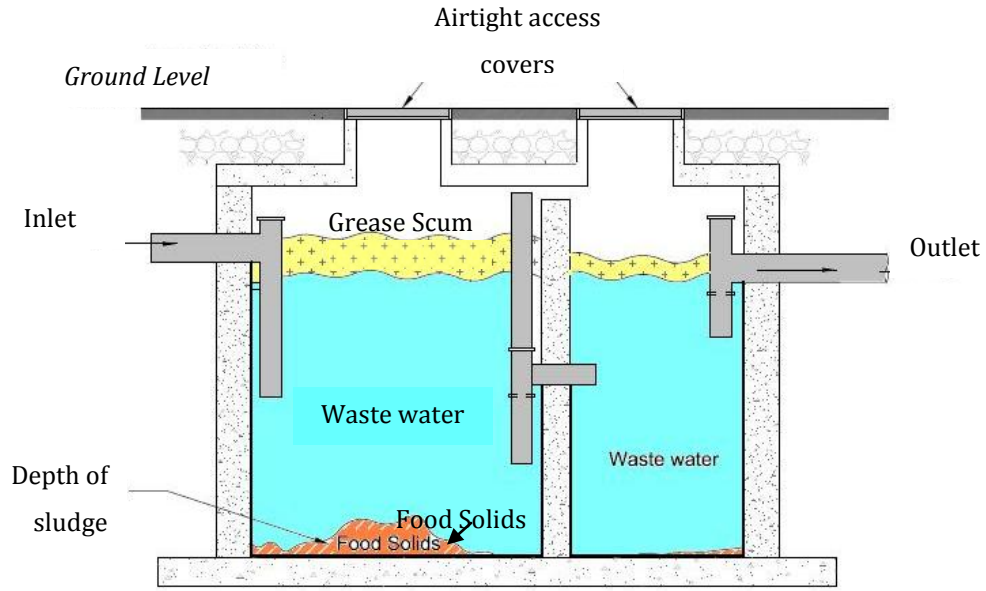
22.2. Soakage Pits

Soakage pits shall be located away from the dug wells for possible contamination. Though different local government institutions specify that the well and the toilet shall be some specific distance away, there is no such fixed formula and the contamination will purely depend on the type of soil around the pit. At the same time what is to be worried is not the location of the toilet but the soakage pit. Septic tank, if properly done, can stay next to the well, in general.

(Schematic Diagram of a Septic Tank)



(Grease/Oil Trap)



22.3. Grease / Oil Trap

Kitchen waste contains oil and fat which are rich in nutrients. If kitchen waste is discharged directly to the septic tank it will impart a too heavy biological load to the system where bacteria cannot cope with. This will make the oil to float on the water surface in the septic tank limiting the biological process. This will finally make the septic tank to function inefficiently and as a result bad odor can result in. In addition, the tank will bloat with sewage and floating scum in the septic tank can overflow in to the soakage pit which can convert it to a pit latrine.

Therefore kitchen waste shall be directed to the septic tank after trapping excess oil and fat in it. This is achieved by introducing a ***grease/oil trap***. Grease trap is a simple structure with floating oil and grease is removed while the heavier water based component is channeled to the septic tank. Therefore, the cover of the grease/oil trap should be prepared using a material that could easily open and close.

Wash water from bathing and washing clothes etc are a different category that shall be treated differently. It does not contain biological wastes in large quantities but instead detergents used for cleaning. Detergents are not in favor of bacteria and inhibit its growth and survival. Therefore this category shall not be directed to the septic tank.

It is most advisable to have a separate pit for discharging this category and if the land availability prohibits from building another pit in the land it is acceptable if it goes directly to the soakage pit.

22.4. Other Aspects to Be Considered

There are other areas that shall be carefully looked at in the disposal of waste water such as, size of pipes, type of pipes, locating pipes in the building as well as in the ground, water sealing arrangements, flexible connecting fittings, vent shafts, catch pits, use of bends in the system, maintenance possibility, leak proofing and water proofing.

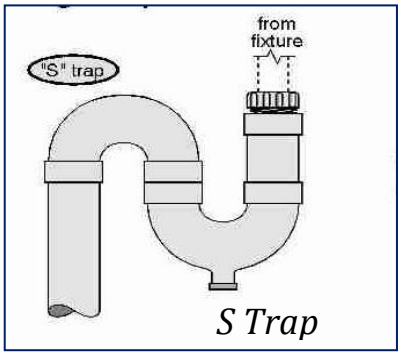
Pipes for waste water disposal shall be of type 600 PVC for ensuring durability. Most of the pipes in the market for this job are of type 400 and even type 250 PVC.

- ✓ Type 250 shall not be used for sewerage disposal.
- ✓ Type 400 is acceptable as far as they are not exposed to sun light and no loads are applied on to them by passing or parked vehicles etc.

Size of the pipes shall be 4" (110mm) minimum. Cover to the pipes shall be a minimum of 300mm and all the pipes on the walls shall be connected stress free with standard fittings keeping provisions for cleaning.

At the same time access to the pipe and fittings shall be ensured for easy maintenance and this is the fact that the Basunnehe doesn't care at all while the pipes are being installed.

Connection of toilet bowl to the pipe shall be through fittings generally called **"S" trap** and **"P" trap**. Selection of type of trap will depend on whether the exit pipe from the bowl goes in to the wall or goes downward to the floor. There are flexible connectors that can either be used as an S or P trap of which durability has not yet been established in the Sri Lankan market.



All the sewerage pipes are running under gravity, however leakages will definitely make problems that are far more serious than in clean water. Therefore even a milder leak shall not be kept in the construction stage and every care shall be taken to keep the system leak free in the first place.

Catch pits in the wash rooms is another item that shall be done carefully. If the edges of the catch pit is open to external surrounding it will invite creepy crawlies on the ground floor; and wet patches on the walls and slabs on upper floors. Seeing an earthworm in the sink or toilet floor is result of this short circuiting. Also the catch pit cover shall be of good and removal facilitated for cleaning and maintaining. PVC junction boxes in the market are not recommended without a solid concrete surrounding to it.

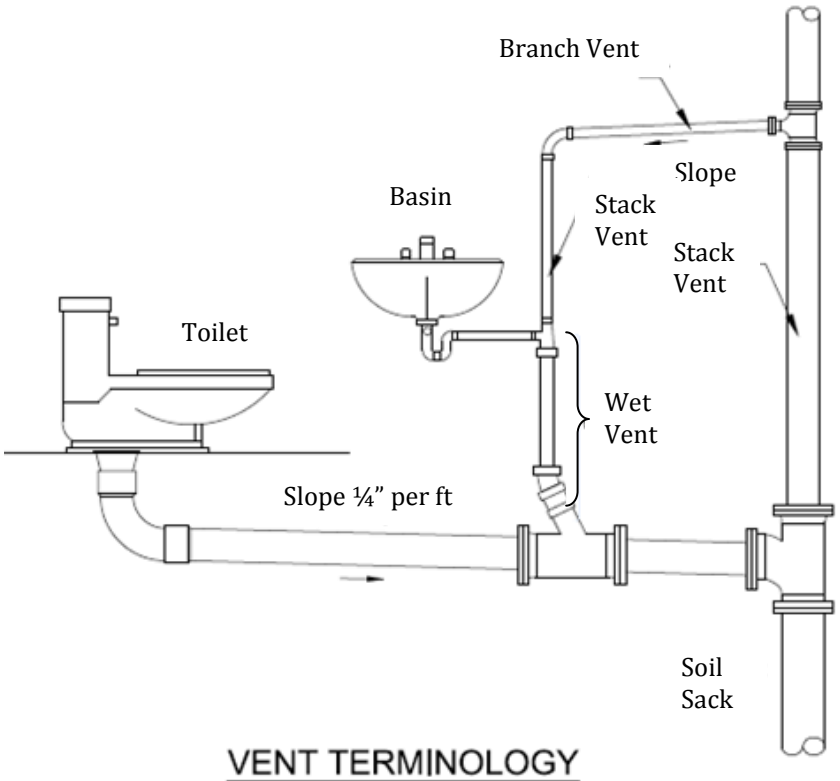
Apart from that the bath rooms shall be water proofed prior to tiling to avoid water seeping on to the walls and floors.

Substandard and none standard fittings shall not be used for sewerage disposal system.

Every section of the pipe shall be accessible for cleaning and this is facilitated by introducing cleaning eyes and manholes. There are various designs of cleaning eyes and care shall be taken in selecting proper items.

Manholes shall be constructed once the pipe lands on the ground and every turning point is to be provided with manholes. Size of manhole will depend on the depth of the line and generally shall not be smaller than 200 x 200 mm.

One of the most important but rarely practiced is installation of vents. Sewerage system need vent shafts for two purposes namely for breathing while flushing and releasing deleterious gases formed in the system. This shall be installed at the highest point of the disposal system so that the lighter gases accumulated at the far end of the lines will be released without breaking in to the wash rooms etc.



VENT TERMINOLOGY

Sewage so conveyed through the pipes finally and up in septic tanks. Piping within the septic tank also shall follow standard methods to make it function as expected. Wrongly installed pipes will make the system ineffective. Size of the septic tank will depend on the cleaning interval, number of users of the tank and the type of biological load coming in to the tank. This shall generally be calculated by an experienced professional. Effluent from the septic tank will then flown in to the soakage pit for percolation in to the neighboring soil.

Soakage pit can be made out of brick or concrete while leaving enough spaces for ground contact. Size of the tank will depend on the soakage characteristics of the soil around the tank. For this you may refer instructions given in the following SLS standards – SLS 745 and SLS 745: Part 2: 2009.

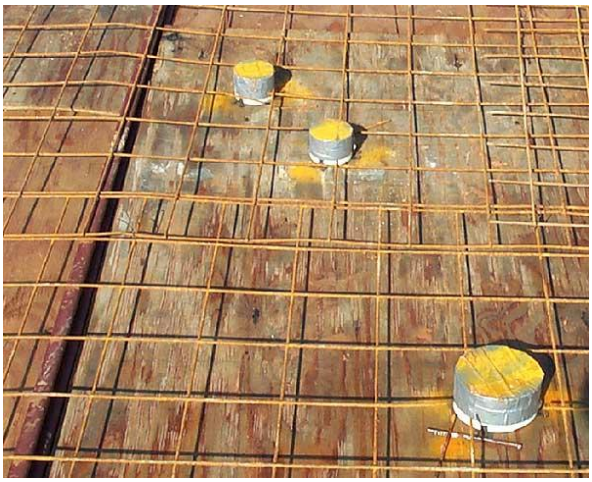
If the soil is poor in absorbing water the contact area shall be increased. If water level of the ground is shallow soakage fields with perforated pipes can be used to discharge effluent to top soil layer. If the water table is even closer to the surface, elevated systems can be built for soakage. In these situations you should try your best to avoid discharging of water to the ground.

23. Things to Be Considered When Installing a Pipe System

Spaces for installation of pipes are a part of planning in buildings. There are black water, grey water and rain water pipes that are originating from higher levels of the buildings that are forced to pass down from higher levels. Absence of such spaces will result in breaking of constructed parts, slabs in particular, for passing pipes. This is having financial, discomfort, time, and construction standards issues every time already constructed component of a building is to be broken to pass pipes.

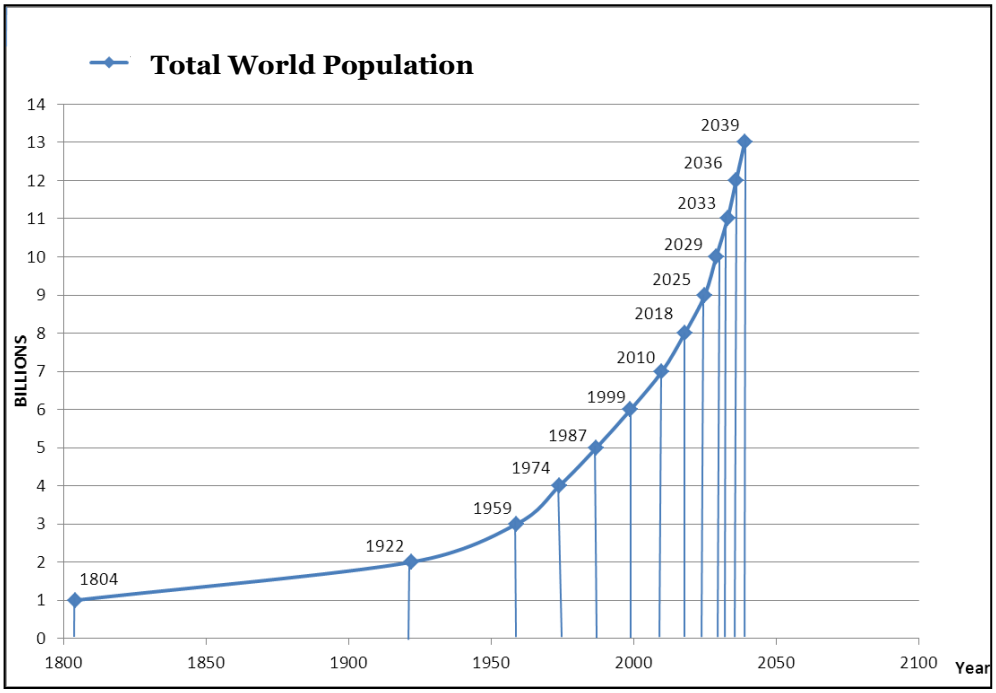
Breaking needs tools that are to be hired, breaking will destabilize already constructed parts of some important installation such as tiled floors, it will ask for extra time delaying the completion of buildings and most importantly the holes that are made may not be in right alignment forcing the installations to meet with poor installation standards.

The figure shows how openings shall be kept for passing some pipes from the floor slab to the level below.



24. Rain Water Harvesting

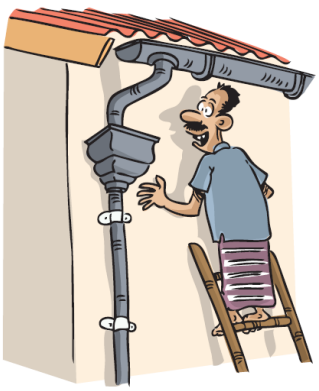
Rain water harvesting is not new to Sri Lanka. Our great kings like Parakramabahu's testament that "***Not a single drop of rain touching the soil shall be left to the sea without being used***" are known to all of us. We have been pioneers in conserving rain water for agricultural purposes for centuries and our amazingly efficient inland water tanks system that was in operation for centuries made our lands fertile and prosperous in agriculture. That is the time that passed and time has come that we have to think differently. Explosion of population at a rate faster than 200,000 more every day, pollution of fresh water bodies, change in rainfall patterns as a result for environmental changes and removal of forest cover to accommodate people are applying pressure on the available water



It is widely believed that the next world war will be on water and there will be increasing conflicts on water world over day by day. Already several international wars have been fought over water and this will escalate with time.

Inadequacy of water for multiple purposes is the cause for the conflicts. This will increase in many folds for drinking water as well. With the pollution of water bodies increasingly with toxic chemicals will render the cost of water go higher and higher and as such looking for alternative sources is inevitable.

Rain water harvesting is the ideal and reliable source for this problem. Much of the water we use doesn't need to be of drinking quality. At home and at work, we flush toilets, wash vehicles, launder clothes and water gardens with nothing less than drinking water! In fact, studies show that 55% of domestic treated water could be substituted for rainwater, while 85% of water used for commerce and industry does not need to be of drinking standard.



All rainwater harvesting systems operate using typical roof drainage layouts. This means rainwater runs down the roof and into the guttering and down pipes in the normal way before passing through a filter, which removes the leaves and debris. The rainwater is then can be stored in a tank. The tank can be built under ground or overhead. Rainwater harvesting can not only help conserve water supplies, it can also bring significant cost savings for properties on water meters. At the same time if rain water can be collected before touching the ground the water can be used for many purposes.

Method for construction of a rain water collection system is detailed in the ***Appendix 3***.

The information for this section is extracted from “rain water harvesting forum” which is an organization dealing with rain water since 1966. If further information is required with respect to this activity the rain water forum can contacted.

24.1. Benefits Of Rain Water Harvesting In Urban Setting

Rain water is an ideal substitute for many water uses at domestic level. In addition following benefits can be accrued through the action.

- Flash flood control in cities. - Cities are paved with non porous paving materials making the run off levels higher causing flash floods. Collection of sudden out pore is preventing the discharge of excessive rain water to the drains preventing flooding situations.
- Conservation of water resources – as per a study conducted as high as 35% of the urban water needs can be fulfilled through rain water collection.
- Power conservation – Water will be available at the point of use minimizing the need to use power for pumping water from lower levels.
- Reduction of water bills – Water bills can be reduced to the minimum level of 30%
- Enriching ground water – Slow release of rain water will support additional percolation of water to the ground that helps to recharge ground water.
- Since rain water is soft (P^H is less than 7.0) soap dissolution is slower.
- Cost of water treatment is reduced due to lesser water purification.

25. Latest Threats To Water Supplies

Water in the world is threatened beyond belief today. This includes fresh water as well as sea water. This will be something that the whole world has not taken seriously enough so far. Life began in water and life without water is not possible. Pollution of fresh water or sea water will have equally damaging consequences for the survival of the living beings, human in particular and the rest of the animals, fauna and flora.

The threats are coming from man and only from the man and therefore we can do many to avoid deterioration of the situation any further and bring the situation under control if an effort is made even at individual level. If the water is polluted and no water is available for drinking we do not die at once but one by one so saving of water also can be done us one by one and finally it will be all of us.

Following threats are already in the cards

Threat	**Reason**	**Consequences**
Saline intrusion in to inland fresh water bodies	• Sand mining. • Global warming.	• Fauna and Flora will be destroyed. • Water supply schemes will be made useless. • Damage to eco diversity of the system
Escaping sewage in to fresh water bodies	• Poor standards of sewage disposal at domestic and institutional level. • Malfunctioning sewerage systems.	• Many direct uses of water will be prevented and livelihood of many poor people will be lost. • Contaminated water will make treatment costlier. • Plant growth in water will be increased and water related livelihood will be affected.

Threat	Reason	Consequences
Discharge of factory effluent in to the water bodies	• Lack of proper monitoring mechanism. • Lawlessness. • Absence of a regulating authority.	• Toxic chemicals will end up in landing at the bodies of people making them permanently sick. • Eco diversity is lost due to death of vulnerable life forms
Removal of forest cover	• Population growth. Illegal deforestation. • Gem mining. • Illegal timber trade.	• Hydrology cycle is affected. • Floods and landslides. • Drying of fresh water sources. • Prolong droughts.
Excessive use of agrochemicals and fertilizer	• Lack of knowledge on consequences. • Over usage of materials.	• Inland water bodies contaminated with nutrients will make them unusable. • Water supply schemes generated from the water is becoming costlier. • Heavy metals will affect the farming population.

26. Sources Of Water Contamination And Its Effects

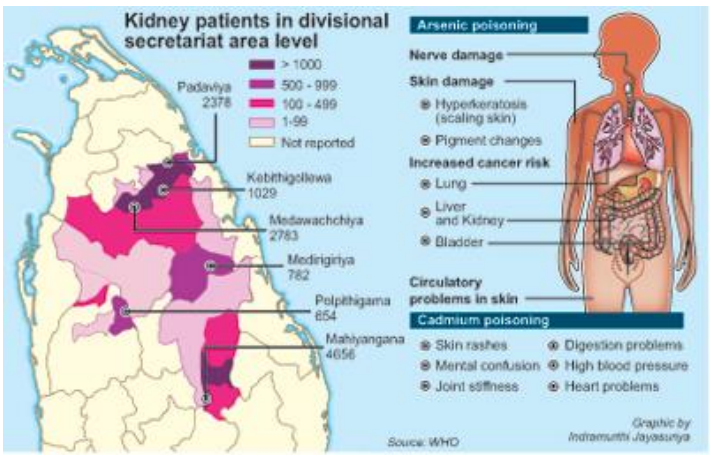
Sources of water contamination and its effects can be illustrated as follows;

Disposal of factory effluent without treatment causes water to lose its quality

Disposal of solid waste in disorderly manner causes the environment to pollute and leachate to generate

Our own actions are resulting in polluting water without our knowledge

Excessive agrochemicals will spill over to water bodies polluting them.

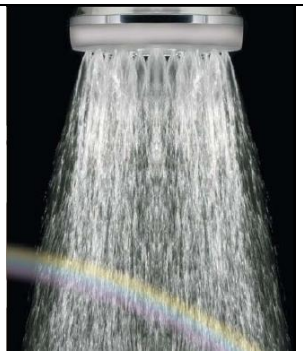


Kidney failure increased in the country is blamed for polluted water.

27. Water Saving Habits

 Turn off water whenever not in use	 Use a bucket and hose shutoff when washing your vehicle
 Turn off water while shampooing your hair	 Wash full loads of clothes only in the washing machine
 Turn off water while brushing	 Run your dishwasher with full load of dishes
 Water your lawn in the morning or late evening when there is less evaporation	 Never use toilet to dispose of trash

Use the Water Conserving Fittings and Equipment as much as Possible

 Flower watering cans saves water	 Garden sprinklers spreads water efficiently
 More water than actually runs is felt through shower heads	 Using kitchen taps with fine mesh is recommended as that gives the feeling that more water runs through than the actual flow. In addition to that as the kitchen taps are frequently used, it is recommended to use standardize, good quality tap, though it would be a little expensive to ensure the durability.

Appendix 01 – Alternative Water Sources

Consumers tend to use alternative water sources for their daily activities due to unavailability of Pipe Borne Water Supply to the households and/or due to the water sources being have been overexploited already.

With the concept of Water Conservation, these alternative sources could be considered as very useful for the nation. However, as mentioned in the above chapters, transformation of these water sources for consumption incurs different cost elements for the consumer. Having an alternative water source apart from regular water service is advisable for everyone specially to use in daily activities such as washing, watering the plants and other, except for drinking and cooking. Most common forms of alternative water sources are dug wells and rain water. Following sections describes how a well is transformed into a usable water source and how rain water harvesting is to be used as an alternative to regular water service. When the regular water service is unavailable these sources play more dominant role is such areas.

Construction of a dug well and water supply system from the well

Costs associated with construction of a 20 feet deep and 4 feet in diameter well are as shown below.

Excavation of the well (Rs 3,500 per foot)	Rs. 70,000
Purchasing and positioning of concrete rings 2 ft height	Rs.22,000
Hiring charges for lifting of rings by a JCB	Rs. 7,500
Miscellaneous expenses	Rs. 20,000
Service of a plumber for fixing pipes and installation of pump	Rs. 10,000
Cost of Water pump and electrical wiring etc	Rs. 20,000
Total cost	**Rs. 149,000**

Factors To Be Considered When Buying A Pump For A Well

1. Level difference between the water level of the well and the top water level of the water storage tank shall be known. Water level of the well shall be the lowest possible level after pumping or during dry season when the water levels are gone down. This level difference shall be made available to the seller.

2. The distance between the well and water tank shall be provided to the seller. This will provide an opportunity to calculate the diameter of the pipe required between the well and the tank and also the head loss through the pipe.

Once this information is provided to the seller he will be able to offer the right pump for the pumping system.

In selecting a pump the rate of pumping shall not be too low or too high. If rate of pumping is too low it will take a longer time for filling tank, consuming more power. Also the owner has to keep eye on the pump for long time. If the rate is too high the water level will drop too fast and the well may not be able to support enough water for pump take out of the well to withdraw. This can result in pump running dry and finally burning due to overheating.

As an example, if the level difference between the tank and the well water level is 40 feet and the distance between them is 100 feet then the cost of pump can be in the range of Rs. 17,000 to 20,000.

Rain Water Harvesting Unit

While being a tropical country, Sri Lanka normally has rain fall in many months of the year. Therefore, rain water could be considered as one of the major alternative water source. More information on rain water harvesting is provided in the ***Appendix 3***.

Appendix 2. Selection Of Pipe Size

Water for the households is stored at higher locations to have sufficient head for efficient water flow. The elevated tank at the higher location receives water by pumping from a well or from the main pipe line directly.

Figure shows how the water reaches a house.

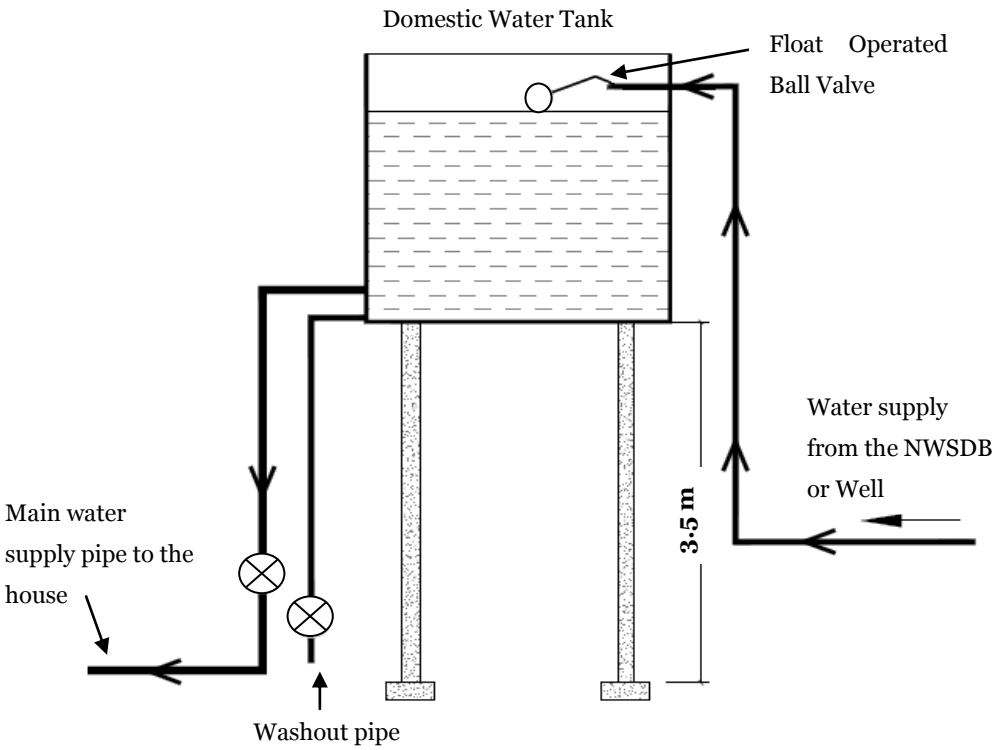


Figure shows the situation applicable for a single storied house. The water tank shall be installed at a minimum height of 3.5 m to have a sufficient water flows to the terminals.

The figure below illustrates how the installation of fixtures in a wash room.

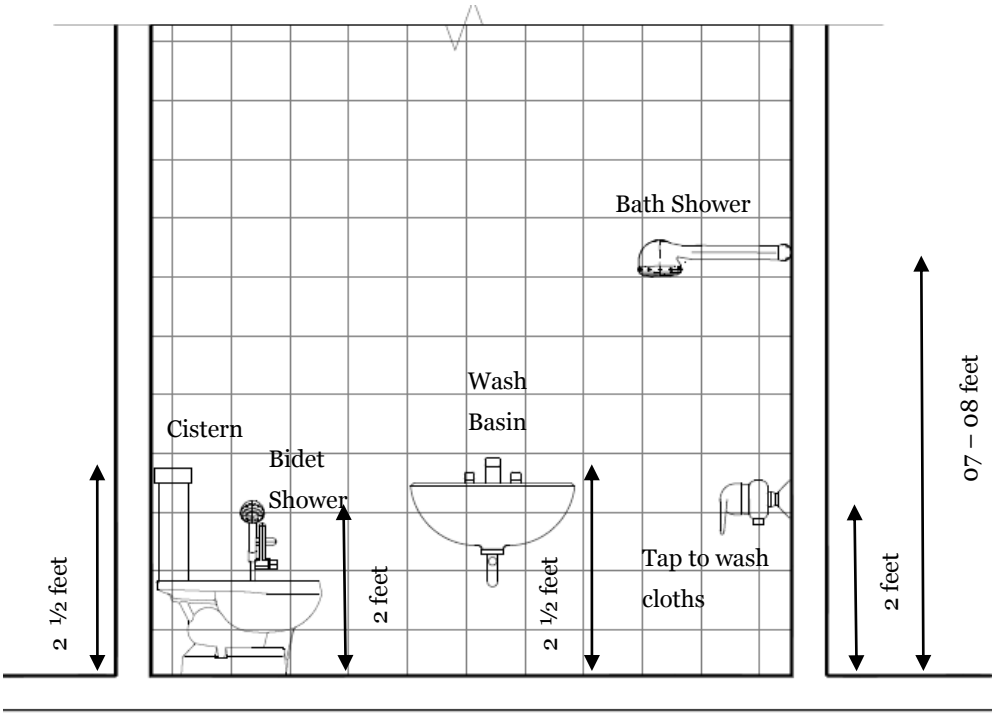


Fig 02

For example, the heights of fixtures in a wash room of one story house are shown in the following table,

Fixture	**Height above floor in feet Approximately**
Bath shower	6 feet
Wash basin	2 ½ feet
Cistern	2 ½ feet
Bidet shower	2 feet
Bib tap	2 feet

Further, even though a wash room is having many water outlets, the opening of all of them together is not practically required. Therefore the optimum combination of simultaneous opening of outlets shall be estimated for deciding the pipe sizes to feed a wash room.

Similarly, when the number of users in a household is in excess of 5 or 6, there can be a possibility of opening many outlets in more than one wash room at a time. For example operation of a washing machine, dish washer etc at the same time need to be considered in deciding pipe size from the storage tank to the last outlet.

Such situations can exist for a shorter time; however the water supply shall be capable of providing sufficient water even for a short time. Plumbing system shall be planned with this type of development in mind.

Use of water will depend also on the number of users at the house at a time. In a time like the morning rush, with a house having two wash rooms, the water requirement can be higher. Joining of washing machines, dishwashers etc at the same time will increase the demand for water in the pipe line. There can be as high as 8 outlets being open at a time as shown below and the pipe sizes shall be capable of supporting this water demand. This will however be present only for a short period of time.

Cistern	2
Washing and minor uses	2
Wash basins	2
Washing machine	1
Kitchen	1
Total	**8**

If the pipe sizes are planned after taking this type of developments in to account, the efficiency of water supply at times of additional water uses can be improved to the satisfaction of the users.

If the flow of water can be maintained as per the following illustration, the service can be considered as satisfactory.

No	Item	No of outlets	Flow rate		Total	
			Liter/ sec	Liter/ min	Liter/ sec	Liter/ min
1	Cistern	2	0.10	6.0	0.20	12.0
2	Miscellaneous and	2	0.15	9.0	0.30	18.0
3	Wash basins	2	0.15	9.0	0.30	18.0
4	Kitchen	1	0.15	9.0	0.15	9.0
5	Washing machine	1	0.10	6.0	0.10	6.0
	Total				**1.05**	**63.0**

Table 1

Following points will help to understand the flow rate calculation through pipes.

Fixture	**Capacity (liters)**	**Time taken to fill**
Cistern tank	06	1.0 minute
Plastic basket	60	3.5 minutes
Fill palmful of the hands	-	2 seconds
Kettle	1.0	7 seconds
Washing machine	40	7 minutes

Rate of flow through a terminal depend on the head of water in the pipe line at the point of the terminal. If the head of water at the location is high, adequate flow rate can be experienced.

Organization of pipes in and out of the storage tank is shown in the Fig 3. Pipe sizes of the respective pipes are shown in the boxes.

Calculation of head of water at the point of discharge is shown in the Table 2. Therefore if the water storage is located as shown and the pipes are laid in appropriate diameters as shown, an efficient and successful water service can be realized.

Please use following keys to refer the fig 3.

1- Wash basin

2- Bib tap for washing

3- Bath shower rose

4- Bidet spray

5-Water closet

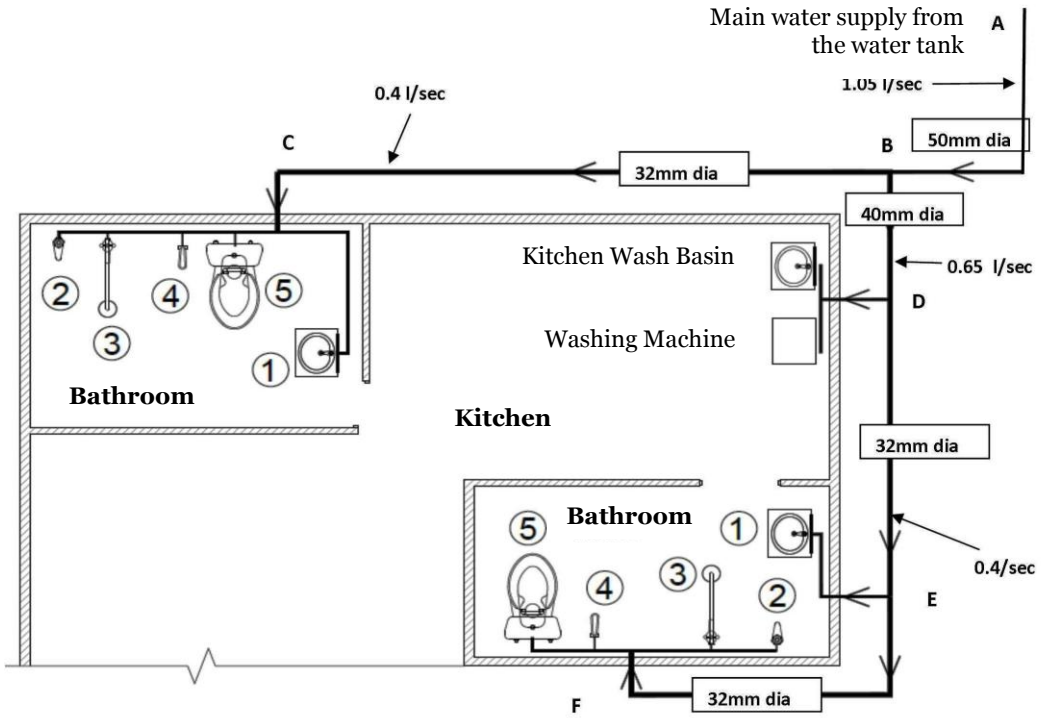


Fig. 03

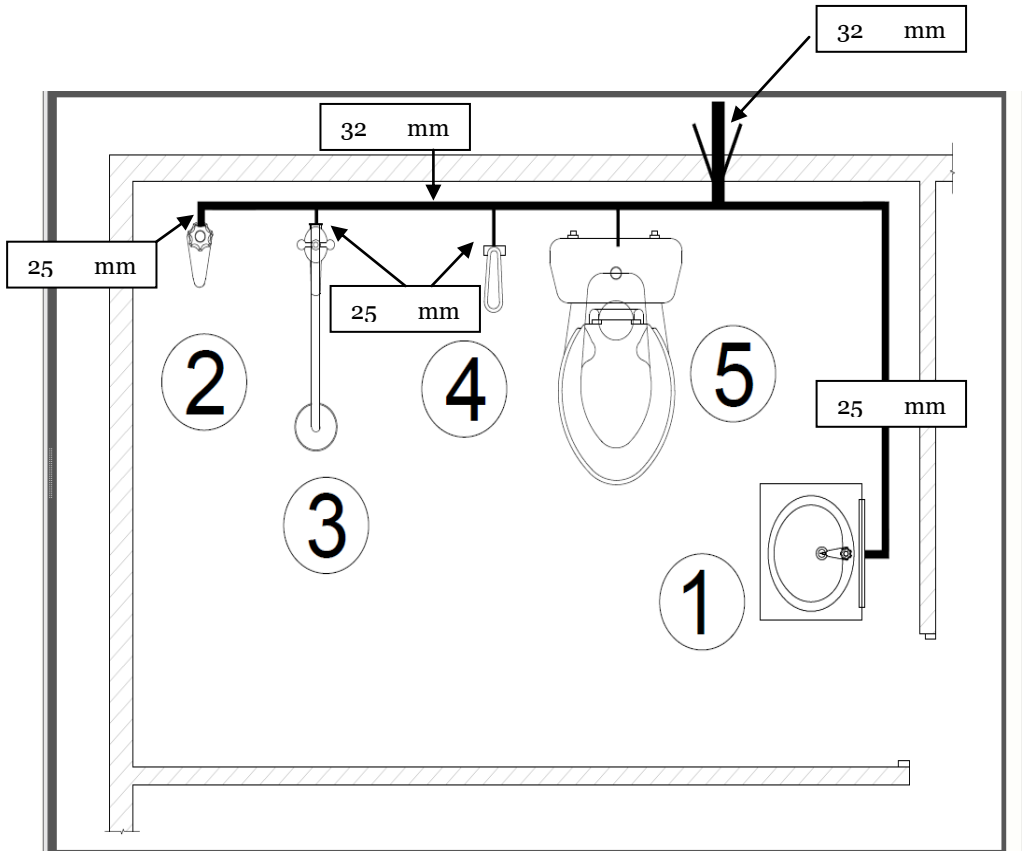
Table 2 shows the rate of flow, rate of loss of water head when the water runs through the pipe, total loss of head between different points, total head that can be expected with minor losses added and residual head at the terminals.

Point	Q (l/Sec)	Pipe Dia (mm)	Friction Loss Hf (mm/m)	Length (m)	Head Loss (mm)	Total Head loss with Fitting loss (10%)
AB	1.05	50	16.3	5	82	90
BD	0.65	40	20.5	6	123	135
DE	0.4	32	25	5	125	138
BC	0.4	32	25	12	300	330

Point	Residual Head (m)	Residual head (Ft)
B	3.91	12.83
D	3.77	12.39
E	3.63	11.93
C	3.58	11.75

Table 2

A – Pipe sizes in plumbing work in bath room is shown in the Fig 4



Fixture	Pipe sizes within the wall
Outlet # 3	32mm (1”)
Outlet # 2 or 1	25mm (3/4”)
Bath shower head	25mm (3/4”) Use a reducer (see note A)

Size of pipe carrying water for all the fixtures shall be a minimum of 25mm and a reducer shall be employed near the fixture.

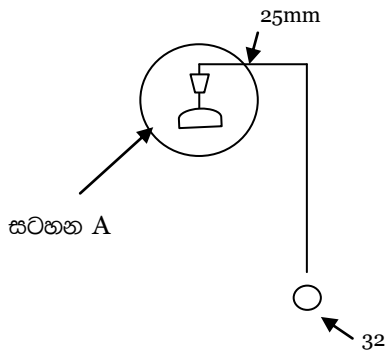


Fig – 04

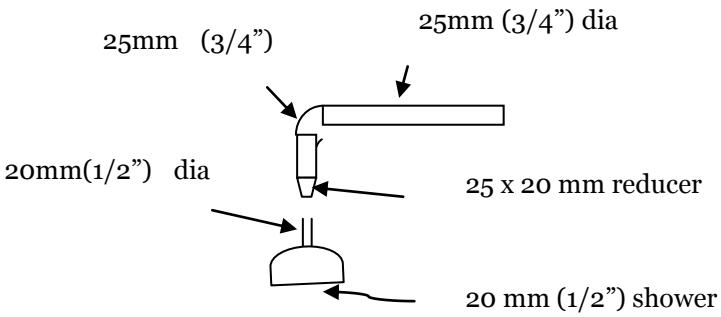


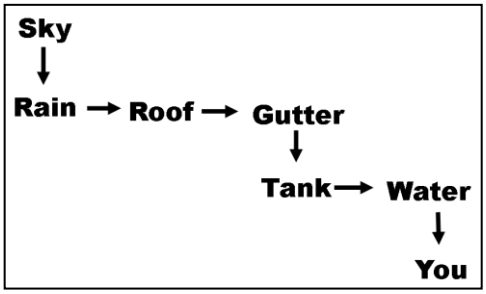
Fig – 05 (Note A Enlarged)

Flow rate through pipes and fixtures depend on the head of water at the terminal. Table 3 shows the rate of water flow through a selected set of fixtures. The head required for efficient operation of bidet shower, for instance, is 3.0m. The water storage tank shall be positioned 3.5m above the floor for meeting the above requirement. In addition, the internal design of a particular fixture will also have a significant effect on the rate of flow through the fixture.

	Rate of flow through the fixtures (l/s)				
Head (m)	**Tap -15mm**	**Hand shower**	**Wall shower**	**Ball float valve**	**Bidet spray**
1.0	0.136	0.065	0.118	0.130	0.044
1.5	0.159	0.095	0.139	0.185	0.055
2.0	0.192	0.097	0.158	0.189	0.064
2.5	0.215	0.119	0.176	0.195	0.072
2.8	0.227	0.120	0.190	0.196	0.075
3.2	0.245	0.131	0.196	0.198	0.077

Table 3

Appendix 3 – Rain Water Harvesting



We all live under the same roof called the sky. Water that comes through the sky is called rain. We shall not forget that the rain that gives life to all of us is falling on our roof. We shall not wait to understand this reality and the value of rain water that falls on our roof. We shall start collecting it in whatever quantity to use for all types of household chores including home garden agriculture, factories and many other uses at much ease.

Quantity Of Rainfall and the Roof

Rainfall for upcountry in Sri Lanka is in excess of 3,000 mm per year and this rises as high as 5,000mm for higher altitudes. Even the most arid areas of the country are blessed with more than 1,000mm a year. That rainfall is sufficient for collection of 5,000 liters of water if the roof area alone is used for fetching rainwater. This much of water is enough for over 2 months if 60 liters per day is used in most dry periods of the year.

Can We Drink Water Coming Through Roof?

This is a question most of us would like to ask. The answer is simple “YES”. The rain water that comes down after a long spell of dry period is flushing the roof during early hours of the rain. After some time the roof is clean for collection of water. Even if the bird drops etc are added subsequently, the sun light that is abundant in Sri Lankan tropics is a good sterilizer through ultra violet rays to kill the harmful bacteria contained on them. A roof covered with straw or Cajon can also be used to collect water through a strainer or by covering the roof during the rainy period with a sheet of polythene etc. Roof covered with asbestos, GI sheets or tiles are good for collection of water directly.

Collection of water from a roof covered with asbestos is accepted even by the world health organization. Asbestos is harmful if the substance enters lungs however the water collected from the roof is not harmful in that context as asbestos is a substance even found in ground water in marginal proportions.

Rain water can be used for drinking after boiling. However if the pipe borne water service is available it is safer that pipe borne water is sued for consumption while the rainwater is used for washing, gardening, agriculture etc.

Determination Of Size Of Storage Tank

Size of the tank for storage of rain water depends on rainfall, area of the roof, water use habits of the people and length of dry period. Tank can be 3,000 liter, 5,000 liter or even 10,000 liter. Tanks can be built above ground, on the ground or underground. A combination of above can also be done depending on the location and choice.

A tank of capacity 2,000 liter (450 gallon) is sufficient for a family of 4 for 2 months, if the water is used for drinking and cooking only since the water required for these two purposes is about 20 liters per day. However if the water is used for other purposes as well the capacity of the tank shall be larger and can be 5,000 to 10,000 liter. Since the rain fall in the dry zone is low, the careful usage of water stored can last longer than 2 months.

Water collected during dry period shall be used carefully particularly during the dry months beginning from March and April.

Building Of A Tank

Underground tanks can be built from brick masonry. Tanks on or above ground can be built in Ferro Cement technology in addition. Ferro cement technology is the use of a chicken mesh and cement mortar for construction of smaller scale water storage tanks that can be done by an experienced mason with little or no guidance, at remote places.

Outlet pipe for tanks built on ground can be through a pipe fixed at the bottom level of the tank. The tanks below ground can be used with a simple hand pump installed for taking water to the surface.

Cost Of Water Tanks

Cost of a 5000 liter tank can be Rs. 50,000 and every additional 1000 liter can cost around Rs. 10,000. This will make the cost of 10,000 liter tank around Rs. 100,000. If a tank of 5000 liter capacity is built on the ground, the cost can be in the range of 40,000 with the support in kind is given by the household residents. If the tank is built underground under the same supporting environment the cost can be as low as Rs. 30,000.

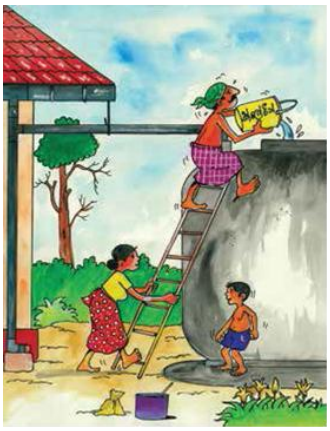
Taste Of Rainwater

Water is taste or colorless. However rainwater can have a taste as it comes down through the air. Water found in the ground is with dissolved minerals and these minerals are helpful and improve quality while adding taste to the water.

Taste is relative and once you get used to a taste it will become the taste that one wishes to have all the time. This is proved beyond doubt with food items and different people enjoy different food though the tastes differ vastly from each other and even from region to region. Similarly the water found in the ground can have negative elements such as fluorides, calcium salts that are not good for the consumption in the long run.

At the same time the heavy metals naturally occurring in the soil and found in certain parts of earth is not suitable for consumption at all. Rain water has no such limitation and is fit for consumption with a milder treatment such as boiling.

Before Drinking Rainwater



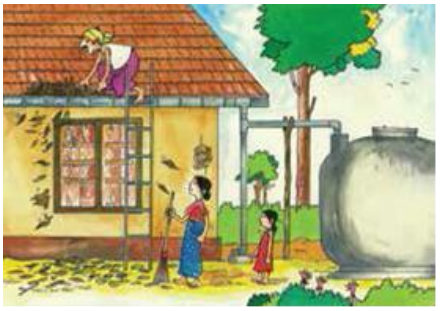
- Boil rain water and drink
- Keep water exposed to sun (SODISS) and ensure that the harmful substances are removed through UV.
- If disinfectant such as Chlorine is to be added it shall be done with bleaching powder calculated at 7 gram per 1000 liter of water.

How Rainwater Gets Polluted

Water found in rivers, lakes, reservoirs and ground water can be contaminated by human activity such as agrochemicals, herbicides, pesticides, faecal coliforms etc. However rainwater is highly reliable as it comes down and before touching ground. Therefore purification is much easier and cheaper.

Maintenance Of Roof, Gutters And Storage Tanks

Roof is a place where lot of dirt and debris can be collected over time. This can contaminate water fallen on it if not removed well in advance.



Therefore,

- It is required to clean the roof at least quarterly by removing dead leaves and other deleterious materials accumulated on it.
- Roof shall be specially cleaned close to a rainy season, in addition.

- Trees and creepers that shed leaves on to the roof shall be removed to keep the roof clean.

- First flush in early rain shall not be collected and by passed through a bypass mechanism.
- Leakages in the gutters and pipes shall be fixed.

When Water Is Collected From The Storage

- Collect water only through the dedicated outlet pipe
- Avoid putting basket etc in to the tank to collect water.

- Keep the lid firmly secured to avoid entry of insects etc.
- Keep some water in the tank all the time to avoid drying of the tank walls. Too dry walls tend to crack.
- Filter materials in the filter media such as charcoal, pebbles shall be replaced quarterly.

Stagnation Of Water In The Tank

Deterioration of quality of water stored in the tank can be reduced by following actions,

- Use a fine screen to filter water as it enters the tank. This will reduce unnecessary passage of floating matters in the receiving water. This will avoid the entry of sunlight in to the tank and as a result growth of bacteria and algae will be controlled.
- Use a filter cloth at the outlet. This will avoid the sediments interfering with water extracted from the tank.
- Clean the roof and the gutters whenever possible and prior to the monsoon in particular.
- Empty the tank twice a year, prior to the monsoon in particular to dispose of sediments. Washout pipe can be used for this purpose.

These actions will discourage the entry of mosquitoes, growth of algae in the tank, growth of bacteria in alarming proportions and avoids stagnation and generation of unpleasant tastes. If there is a doubt as to the quality of water, chlorine addition will nullify the effects of harmful activities if any.

Special Notes

- Always seek the services of a helper when working inside the tank to avoid accidents.
- Use only non-fuel type light sources for illumination inside the tank.
- Use nontoxic paint inside the tank walls.

Acid Rain, Red Rain, Thunder Water

There is no acid rain of significance reported so far in Sri Lanka, though this is prevalent in industrialized nations due to increased pollution of air with chemicals. The nitric acid formation in a thunder strike is also of little significance and limited to the path of the lightening spark. Therefore this is not affecting the rain water that we intend collecting.

There are sporadic reports of having red rains and authenticity of these rains have not been established to date.

Point Of Interest

If you are in an area where clean water is scarce, then the rain water is the savior of most of the difficulties that you face due to absence of water. Rain water is a gift of nature and reaping the benefits out of it is helpful as it is cheaper, reliable, abundant and safe

If the technical information or any other assistance is needed for rain water harvesting there is a responsible party to help you out.

Lanka Rainwater Harvesting Forum (LRWHF)

Lanka Rainwater harvesting forum is there for your assistance in all rain water harvesting related issues. LRWH has been in operation in the country since 1996 under the patronage of Ministry of Watr Supply and Drainage. Information of the forum is as follows;

Address:	
Lanka Rain Water Harvesting Forum Rain water Center 28/3 A Subadrarama Lane Nugegoda	
Telephone	: + 94 11 552 4612, +94 11 282 0851
Facsimile	:+ 94 11 276 8520
Electronic mail	: lrwhf@sltnet.lk, lrwhfcmb@gmail.com (Office) tanuja@sltnet.lk (executive Director)
URL	: www.rainwaterharvesting.com

Further information is available in the following documents published by the LRWHF

1. Ahas Diya Pipasayata (Rain water for thirst quenching) (Sinhala Language document)
2. If you want to take proper uses of rain water (Sinhala language document)
3. Rain water harvesting practitioners guide for Sri Lanka (English language document)